Takotna River Salmon Studies and Upper Kuskokwim River Aerial Surveys, 2000

by

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ABSTRACT

A resistance board weir was installed on the Takotna River in the summer of 2000 to enumerate adult salmon. The weir was designed to replace a counting tower project that operated with limited success from 1995-1999. Fish enumeration through the weir began on 23 June and ended on 20 September. A total of 345 chinook *Oncorhynchus tshawytscha*, 1,254 chum *O. keta*, 3,957 coho *O. kisutch* and 4 sockeye *O. nerka* passed through the weir. Scales were collected from a portion of the chinook, chum and coho passage in order to estimate the age composition of the run. Females comprised 24.5%, 57.7% and 51.9% of the total chinook, chum and coho passage. The samples also included length data for each fish.

Juvenile salmon were captured throughout the season to document their presence, or absence, in different parts of the Takotna drainage. The fish were caught with minnow traps and minnow seines deployed in the mainstem and tributary streams. Captures included 291 chinook, 23 coho and 1 chum fry. Densities appeared highest in the tributary streams of Fourth-of-July Creek and Big Creek (lower). Catch data suggest a drainage wide underutilization of the available fry habitat in the Takotna River.

Aerial surveys were flown twice throughout the Takotna drainage and selected upper Kuskokwim River streams in order to document the location and relative abundance of spawning salmon. The first set of surveys were flown in late June and focused on chinook and chum salmon. The second set of surveys were flown in late September and focused on coho and late spawning chum salmon. Within the Takotna River drainage, Fourth-of-July Creek appeared to be the primary spawning grounds for chinook, chum and coho salmon. No adult salmon were observed upstream of Fourth-of-July Creek.

INTRODUCTION

The Takotna River salmon escapement monitoring program is a cooperative project operated between Takotna Charter School and Training Center (TCSTC) and the Commercial Fisheries Division of the Alaska Department of Fish and Game (ADF&G). Since inception of the program in 1995, TCSTC has received operational funds through a grant from the Bering Sea Fishermen's Association (BSFA). Prior to 2000, ADF&G participation was mostly advisory; the limited ADF&G on-site involvement was supported by state general funds.

From 1995 to 1999 the escapement monitoring was done by means of a counting tower, but success was limited due to poor water clarity, periodic high water levels and organizational difficulties (Molyneaux et al. 2000). School representatives, community leaders and ADF&G took steps to improve the escapement monitoring program by transitioning the project in 2000 from a counting tower to a resistance board weir. The resistance board weir design is better able to handle periodic high water events than tower or fixed-panel weir designs as demonstrated in the Middle Fork Goodnews (Menard 1999), Tuluksak (Harper 1997), Kwethluk (Harper 1998; Chris and Cappiello 1999), Andreafsky (Tobin and Harper 1998), 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).

As with the tower project, the fabrication and operation of the weir was a cooperative venture. Weir materials and labor costs incurred by TCSCT were funded through the BSFA grant. Staff from ADF&G assisted in the development and operation of the weir through on-site involvement during weir fabrication, and by assigning a seasonal fishery biologist to work at the weir during installation and throughout project operations. ADF&G support was provided through a grant from the National Oceanic and Atmospheric Administration (NOAA) under the Western Alaska Salmon Fisheries Disaster Mitigation Research Plan. The NOAA grant includes ADF&G support costs for 2000, 2001 and 2002. The NOAA grant agreement includes ADF&G involvement in weir oversight, studies investigating juvenile salmon habitat utilization in the Takotna River basin, and aerial surveys in the upper Kuskokwim River drainage to document salmon spawning locations.

Background

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. 2000a). The ADF&G has lacked the necessary tools to adequately assess the distribution of escapement in the Kuskokwim River basin and the data necessary for the development of biological escapement goals (BEG). The area for which information is most lacking is the upper Kuskokwim River. Prior to 1995 the only thorough escapement monitoring project operated in the upper 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). From 1983-1994, escapement monitoring had 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 Salomone 1999). Part of the interest for developing an escapement monitoring project on the Takotna River 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 decisions. Through the cooperation of TCSTC, community leaders and various funding groups, the goal of developing this escapement monitoring project became a reality.

Another interest in monitoring salmon runs in 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; Molyneaux et al. 2000). 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 mouth of Fourth-of-July Creek (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 1900's (Stokes 1985).

Historically, weirs fitted with fish traps were a common method used by aboriginal groups for harvesting salmon. 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 confluence of 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 (lower), 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 epidemics, 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 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 1920's 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 likely due to a combination of over fishing and habitat alteration associated with mining development.

Area residents and local biologists described the Takotna River as being almost void of salmon during the 1960s and 70s (Molyneaux et al. 2000). However, by the 1980s, Takotna residents began to notice adult salmon in the river again. During an aerial 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, but few salmon were observed elsewhere in the Takotna drainage (Burkey and Salomone 1999). In recent years, sport fishers have also begun to catch coho salmon while pike fishing (D. Newton, local resident, Takotna, personal communication). The perceived increase in salmon abundance is what prompted the establishment of the escapement monitoring program on the Takotna River.

Monitoring salmon abundance is vital to sustainable salmon management; however, knowledge of the age, sex and length (ASL) compositions of salmon populations is also valuable. The ASL information can provide insights into understanding fluctuations in salmon abundance and is important for establishing escapement goals (DuBois and Molyneaux 2000). Consequently, salmon escapement projects typically include the collection of ASL data (e.g., Menard 1999).

Escapement projects also commonly serve as platforms for some level of habitat monitoring. Water temperature, chemistry and discharge rate are all fundamental variables of the stream environment that directly and indirectly influence salmon productivity (Hauer and Lambert 1996). These variables can change due to anthropogenic activities (mining, timber harvesting, man-made impoundments, etc.) or climatic changes (e.g., El Nino and La Nina events). Changes in these variables can affect stream productivity and the timing of events such as salmon migration and spawning. Such habitat monitoring will be incorporated into the Takotna River salmon escapement monitoring program.

The Takotna River weir project will also serve as a platform to investigate the distribution and habitat utilization of juvenile salmon and spawning adults. Given the mining and salmon abundance history of the Takotna River, such investigations may provide some insight as to whether the available habitat is being underutilized and why the salmon runs remain low. Aerial surveys will also be flown in other upper Kuskokwim River tributaries to document spawning grounds, estimate habitat utilization by spawners and to index run strength.

Objectives

1. Enumerate the daily and total annual chinook, chum and coho salmon escapements to the Takotna River, above the community of Takotna.
2. Estimate the ASL composition of the total chinook, chum and coho salmon escapements to the Takotna River, above the community of Takotna, from a minimum of three pulse samples, one collected from each third of the run, such that 95 percent

simultaneous confidence intervals for the age composition in each pulse are no wider than 0.20 (α 0.05 and d = 0.10).

3. Monitor the daily water temperature of the Takotna River.
4. Monitor water level and estimate daily discharge rates of the Takotna River.
5. Profile the water chemistry of the Takotna River (conductivity, pH, alkalinity, turbidity, color, calcium, magnesium and iron) at low, intermediate and high water levels.
6. Determine the distribution and habitat utilization of juvenile salmon upstream of the Takotna River weir.
7. Determine the distribution of spawning salmon upstream of the Takotna River weir.
8. Identify locations of spawning salmon aggregates in the upper Kuskokwim River drainage.

METHODS

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 passing 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 24.15; Brown 1983; Figure 1). Another tributary, the Tatalina River, joins at rm 3 (rkm 4.8), and then the Takotna River empties into the Kuskokwim River across from McGrath at rm 507 (rkm 815).

The Takotna River is about 100 mi (161 km) in length and 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 average 400 to 500 ft (122 to 152 m). The river slope as reported by Brown (1983) is about 4.7 feet per mile (0.89 meters 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 Rivers drain extensive bog flats and swampy lowlands, but the remainder of the basin is mostly upland spruce-hardwood forest (Brown 1983, Selkregg *undated*). White spruce with scattered birch and aspen is common on moderate south-facing slopes, while black spruce is more characteristic on northern exposures and poorly drained flat 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.

Weir Design and Operation

Site Selection

A weir site reconnaissance trip was conducted upstream of Takotna in 1999 (Molyneaux et al. 2000). A site was chosen directly upstream of a bridge located 2 rm (3.2 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. The bridge site allows for convenient road access and minimal boat traffic. A short access road leads from the road to the weir site. During the site survey on 7 July 1999, the river width was 237.5 ft (72.5 m), maximum depth was 2.3 ft (0.7 m) and maximum velocity was 5.0 ft/s (1.5 m/s). Discharge under these average summer flow conditions was estimated to be 1,232 ft^3/s (34.9 m^3/s).

Weir Fabrication

The weir materials were purchased in January and February 2000, and fabrication of the various components began in February 2000 at the ADF&G Sport Fish Division shop facilities in Palmer, Alaska. The weir components were shipped to Tatalina Air Force Station and transported to the weir site in May 2000.

Weir Design

The Takotna River weir spanned a 275-foot (83.3 m) channel with a maximum depth of 2-3/4 ft (0.84 m) at the time of installation. The weir consisted of 79 resistance board panels that covered the central 240 ft (73.2 m) of the channel, and eight sections of fixed weir. The resistance board portion of the weir was designed based on a style developed by the United States Fish and Wildlife Service (USFWS) (Tobin 1994). The fixed panel sections used along the river margins were based on a design described by Molyneaux et al. (1997).

Resistance Board Panels. The resistance board panels were designed similar to the style described by Tobin (1994). The primary exception was that each resistance board panel was narrower, 36 in (0.91 m), as opposed to 48 in (1.22 m). Another difference was that the edges of the plastic stringers were rounded to reduce the likelihood of abrading fish. The spacing between pickets was 1-1/4 in (40.6 mm). The pickets had some flexibility, but the narrow spacing allowed for a complete census of all but the smallest returning salmon. Small resident species were able to pass through the panels.

Rail and Cable. The resistance board panels were held in place by a rail and cable secured along the river bottom by stakes and duckbill anchors. Each rail consisted of a 10 ft (3 m) length of 3 in (7.6 cm) angle iron with three cross legs bolted to the base. Each end of the cross legs had a hole through which a stake was driven for securing the rail along the streambed. The stakes were made of 30 in (76 cm) lengths of ¾ in (1.9 cm) #6 rebar. To avoid downstream slippage, no. 1/38 duckbill anchors were driven into the substrate approximately 10 feet upstream of the rail and a cable extending from each anchor was secured to the rail. Adjacent rail sections were bolted together end-to-end forming one line of rail across the streambed.

Each rail section had two circular eyepieces through which a cable was threaded. After the rails were in place, one continuous piece of 3/8 in (9.5 mm) galvanized aircraft cable was threaded through all the rails. One end of the cable was anchored with 3 duckbills, the other end led to an anchored stanchion and winch that was used to tighten the cable. Resistance board panels were then hooked to the cable as described by Tobin (1994).

Fixed Weir. Sections of fixed weir were required along the flanks of the resistance board weir to accommodate the slope of the near shore area. The fixed weir sections consisted of aluminum panels and wooden tripods (Molyneaux et al. 1997). The tripods were composed of three wooden beams and a sandbag platform. The front leg of each tripod consisted of a 4 in X 6 in X 10 ft (10.3 cm X 15.4 cm X 3.0 m) beam. The two rear legs were consisted of 4 in X 6 in x 8 ft (10.3 cm X 15.4 cm X 2.4 m) beams. The aluminum panels were 2-3/4 ft (0.83 m) wide by 6-2/3 ft (2 m) high and had a 1-3/8 in (3.50 cm) gap between each 7/8 in (2.2 cm) diameter picket. The fixed weir was joined to the resistance board weir with floating bulkheads.

Passing Chute/Trap. A passing chute/live trap was positioned on the upstream side of the weir. Placement was based on the location where salmon tend to travel most. This was close to the deepest part of the channel. The trap frame was constructed from aluminum angle and channel stock and measured 5 ft X 8 ft X 5 ft (1.5 m X 2.4 m X 1.5 m). The trap floor was welded from a perforated aluminum sheet. The sides were constructed of vertically positioned 1 in (2.5 cm) IMC galvanized aluminum conduit. Spacing between the conduit pickets was 1/16 in (1.6 mm) wider than the spacing used in the weir panels, but the rigidity of the conduit and narrow spacing still allowed for a complete census of the salmon. The trap had a collapsible V-shaped entrance and a removable 16 in (40.6 cm) wide exit gate. In addition, a second exit gate was hinged near the base of the removable gate. When water clarity was diminished, the hinged gate, which was positioned on the outside of the trap, was partially raised to direct fish closer to the surface for better viewing. Side panels flanked the hinged gate in order to keep fish within the viewing area. The trap was joined to the weir by floating bulkheads constructed of the same material as the weir panels.

Two additional gates were installed to enhance fish passage through the weir. Each of these consisted of an aluminum fixed panel hinged to the upstream end of the resistance board panel. When fish needed to be passed, the hinged fixed panel would be lifted off of the resistance board panel exposing an open section in the resistance board panel that allowed fish to pass through. Fish were enumerated as they swam through the exposed hole in the weir.

Boat Passage. A section of the weir had modified weir panels that were designed to accommodate boat passage over the weir. This "boat gate" consisted of three modified resistance board panels that each had a 2 ft X 3 ft (61 cm by 91 cm) sheet of ½ in (1.3 cm) high-density polyvinyl plastic secured to the upper surface of the distal end of the panel. These acted as shock absorbers. This modification protected the panels from damage when boats would pass over them. The weight of passing boats would push the panel down allowing the boat to drive over the weir. Jet-driven engines could easily pass over the ramp, but operators of boats with prop driven engines had to pull themselves over the weir using a rope that was anchored immediately above the weir. When coming downriver, boats equipped with prop outboards needed to tilt the motor up before passing over the weir.

Weir Maintenance

Cleaning the weir was a daily operation. Cleaning consisted of walking across the weir to partially submerge each panel, thereby allowing the current to wash debris downstream. Algal growth was removed periodically by scrubbing the pickets with a long-handled push broom or by hand. Spent salmon and carcasses (hereafter referred to as carcasses) that washed up on the weir were counted by species and sex, and then passed downstream. The carcass count was recorded in the *"hourly carcass count"* portion of the logbook. Final carcass counts for the day were tallied, by species and sex, and entered on the "*daily carcass count*" section of the logbook.

In addition to the cleaning, a member of the crew would use snorkel gear to check the integrity of the weir and substrate rail. Any holes or scoured areas were repaired immediately then reported and described in the *"hourly fish passage"* section of the camp logbook. Snorkel gear inspections were done every few days depending on water conditions.

Biological Data

Fish Passage

All fish passing upstream through the passage gates were enumerated by species, with the exception of fish that were obviously small enough to pass freely through the panels. The counting schedule was variable, with adjustments being made depending on the migratory behavior of the fish. There were two to several counting episodes each day, and a single counting episode lasted from 20 minutes to a few hours depending upon fish passage. Passage numbers were entered in the logbook under "*hourly passage*" and "*daily passage*".

Estimating Age-Sex-Length Composition. Throughout the season scale samples, as well as sex and length information, were collected from chinook, chum and coho salmon following standard sampling procedures described by DuBois and Molyneaux (2000). The data were collected following a pulse sampling design whereby intensive sampling was done for a few days, followed by a few days without sampling. The goal of each pulse was to collect samples from 210 chinook, 200 chum or 170 coho salmon from a minimum of three pulses. These sample sizes were selected so that the simultaneous 95% confidence interval estimate of age composition proportions would be no wider than 0.20 (Bromaghin 1993). From three to six pulses were sampled from each species. Considering the dynamics of the ASL composition and fish abundance, the need for achieving the sample size goals had to be weighed against the need for collecting pulse samples over a brief period of time. For this reason, the sample size goals serve as general guidelines rather than rigid requirements.

Scales used in age determination were removed from the preferred area of the fish (INPFC 1963). Three scales were taken from each fish and mounted on gum cards. Sex was determined by visually examining external morphology, keying on the development of the kype, roundness of the belly and the presence, or absence, of an ovipositor. Length was measured to the nearest millimeter from mid-eye to the fork of the tail. Sex and length data were recorded along with other pertinent information on computer mark-sense forms. After sampling, each fish was released upstream of the weir. The gum cards and data forms were sent to the Bethel ADF&G office for processing following procedures described by DuBois and Molyneaux (2000).

The completed computer mark-sense forms were processed with an OPSCAN machine to produce ASCII computer files. The ASCII files were then processed to produce two summaries: one of the age and sex composition of each pulse sample, and another with length statistics.

These summaries were used to estimate the ASL composition of the entire chinook, chum and coho salmon escapement in the Takotna River. The season passage of each species was temporally stratified into several blocks of time (stratum). The ASL composition of each pulse sample was assumed to be representative of the fish passage during the stratum. The proportion of fish in each age and sex category, by species and stratum, was estimated as the number of fish determined to be in that category (after aging) divided by the total sample size. The number of fish in each age and sex category was then estimated as the product of the sample proportion and the sum of the species passage during the stratum. The number of fish in each category was summed over all strata to estimate total season passage by age and sex.

Length summary statistics (mean, SE, range) for each species were reported by stratum and age-sex category. The overall season mean length was estimated by weighting the stratum mean lengths by the total weir passage of each species during that stratum.

The original ASL gum cards, acetates and mark-sense forms were archived at the ADF&G office in Anchorage. The computer files, including ASCII and summary files, were archived by ADF&G in the Anchorage office.

Juvenile Salmon Investigations

Juvenile salmon were captured with beach seines and minnow traps to determine their distribution and habitat utilization of the middle and upper reaches of the Takotna River basin. Effort focused on 12 geographic zones that included the mainstem of the Takotna River and major tributaries (Figure 2). Seining took place throughout the field season as time allowed. The beach seines measured 30 ft X 4 ft (9.1 m X 1.2 m) and the mesh size was 3/16 in (5 mm). During a sampling event, several seine hauls were performed at each location and any juvenile salmon caught were identified and measured to the nearest millimeter (fork length). All other species were identified and their abundance was estimated. Records were kept of the number of fish by species, global positioning system (GPS) coordinates, bank designation and a brief habitat description. Catch per unit effort (CPUE) were tallied for each geographic area. Each CPUE unit is equivalent to one seine haul (i.e., number of fish per seine haul).

Minnow traps were used periodically throughout the season to capture juvenile salmon. The ¼ inch mesh traps were baited with salmon roe placed in small perforated plastic containers. Traps were fished for 24-hr periods. When checking traps, the number of fish by species, and fork length were recorded along with GPS coordinates and a brief habitat description. Catch per unit effort (CPUE) were tallied for each geographic area. Each CPUE unit is equivalent to one minnow trap baited for a 24-hr period (i.e., fish per day).

Aerial Surveys

The distribution of spawning adult salmon in the Takotna River was determined through aerial surveys conducted from a fixed-winged aircraft. Aerial surveys were also conducted over other upper Kuskokwim River tributaries in order to identify salmon spawning grounds. The aerial surveys were flown during two temporal blocks: late July when chinook and chum salmon were spawning, and late September when coho and late spawning chum salmon were spawning. The July surveys were conducted with a contracted pilot flying a PA-18 Super Cub. The September surveys were done with a pilot and PA-12 Super Cub chartered from McGrath, and with a pilot and Cessna 185 on floats provided by the United States Fish and Wildlife Service (USFWS).

Before each flight, a course was set with GPS coordinates to optimize time in the air. The GPS coordinates for the mouth of each river to be surveyed that day were entered into the pilots GPS based on the expected route to be flown that day. The pilot would follow the rivers to the best of his ability as the observer looked for fish. A tally counter was used to keep track of fish. Immediately after each river was surveyed, the observer would make notes about the survey such as time, wind, weather, water visibility, river substrate type, distance surveyed and an overall rating based on all of these factors. The notes were later transferred to an "*AYK Salmon Escapement Observations-Kuskokwim Area*" form, which was later entered into the Kuskokwim Area Salmon Escapement Observation Catalog.

Climatological and Hydrological Conditions

Water temperature, air temperature and water depth were monitored on a daily basis. Stream temperature is not uniform among all habitat types within a stream reach (Hauer and Hill 1996); therefore, temperature measurements were collected from a consistent, yet convenient, location. Measurements for the Takotna River were collected from a station downstream from the weir on the north shore. The temperature was taken once in the morning and once in the evening. They were then averaged for the day. A calibrated thermometer was submerged a few centimeters below the surface and allowed to stand undisturbed for a couple of minutes before being read. It was then placed back into the water for an additional 30 seconds and checked to see if the reading changed. If it was stable, the water temperature was recorded. If it changed, then the process was repeated until the temperature reading stabilized. The final reading was then entered in the "*climatology*" section of the logbook. Air temperature was measured at a shaded area near the weir site and recorded in the logbook. This was performed twice a day and then averaged.

Daily operations included monitoring stream flow with a standardized staff gage. The staff gage consisted of a metal rod with a meter stick attached to it. The rod was driven into the stream channel securing the meter stick in place. The height of the water surface as measured against the staff gage represented the "stage" or "gage height" above an established datum plane. The datum plane was selected for convenience, the number was arbitrary, but was intended to provide a stable and standardized reference point for the life of the project. The gage height was measured once in the morning and once in the evening, and then averaged for the day. The gage height was recorded in the "*climatology*" section of the camp logbook.

Standardized reference points for the datum plane were based on three benchmarks. These benchmarks can be used to reset the meter stick whenever it is dislodged, and at the start of each new field season. Each benchmark consists of a steel rod (1 in diameter X 6 ft) driven vertically into the ground so that only a few centimeters remained above the surface. The benchmarks are located approximately 25 meters downstream of the weir site. One is located near the waters edge, and the tip of the rod is equivalent to a water height of 58 cm. The other two poles were placed above a cut bank in the same general location and are equivalent to 144 cm and 179.5 cm.

Water Chemistry

Water samples were collected periodically in order to characterize the water chemistry of the Takotna River. Efforts were made to collect these samples at low, intermediate and high water levels. Samples were analyzed at the ADF&G limnology lab in Soldotna for conductivity, pH, alkalinity, turbidity, color, calcium, magnesium, total iron and reactive silicon. The water samples were collected upstream of the weir site and approximately three meters off shore. The 500-ml polyethylene bottle used for each sample was thoroughly pre-rinsed with water from the sample location. The bottle was then completely filled with river water so that no air space was visible. An external label was affixed to each bottle identifying the date and time the sample was collected, stream name, general location, collectors name, ADF&G contact name and phone number. The samples were then stored in a cool and dark location until transport could be arranged to the ADF&G limnology laboratory in Soldotna. Transport usually occurred within 24-hours and the laboratory was notified once the sample was in transit.

Conductivity (temperature compensated to 25° C) was measured in the laboratory using a YSI conductance meter equipped with a platinum electrode (cell constant = 1.0 cm^{-1}). The pH was measured with a Corning 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 an 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 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).

RESULTS

Weir Operations

The weir operated from 24 June through 20 September 2000 and was fully operational the entire period. The panels were cleaned every day and the weir was inspected for holes two to three times a week with snorkel gear. No holes were found that adult salmon could pass through undetected. A few small holes were detected and immediately repaired early in the season as the substrate adjusted to the weir.

Chinook Salmon

Passage and Run Timing. A total of 345 chinook salmon passed the weir (Table 1). The first chinook salmon was observed on 18 July, the second day of operation. Peak daily passage of 30 fish occurred on 22 July. The median passage date was 18 July, and the central fifty-percent of the run occurred between 7 and 26 July. The last chinook salmon was observed on 9 September.

ASL. Sex and length information, along with scale samples, were collected from 78 chinook salmon from 5 July to 29 August. The 78 chinook salmon successfully sampled comprised 23% of the total passage. The samples were collected from six pulses and sample sizes ranged from 14-25 fish per pulse. The chinook passage was partitioned into four temporal strata based on sample dates (Table 2). Females were less abundant than males during every pulse. The total chinook passage was estimated to be 24.5% female based on the stratified and weighted sampling. Age-1.4 chinook was the most abundant age class (35.6%), followed by age-1.3 (31.6%), age-1.2 (30.9%), age-1.1 (1.4%) and age-1.5 (0.6%). Average length by sex and age class is reported in Table 3.

Chum Salmon

Passage and Run Timing. A total of 1,254 chum salmon passed the weir (Table 4). One fish was seen on 24 June, the first full day of operation. Peak daily passage of 101 fish occurred on 8 July and the median passage date was 14 July. The central fifty-percent of the passage occurred between 8 and 22 July. The last chum salmon was observed on 29 August.

ASL. Sex and length information, along with scale samples, were collected from 365 chum salmon (Table 5 and 6). The 365 fish sampled comprised 29% of the total passage. The samples were collected from four pulses with sample sizes ranging from 23-140 fish. The chum passage was partitioned into four temporal strata based on the pulse sample dates. Based on the fish sampled, females comprised 57.7% of the total run passage. Females were more abundant than males during every pulse. As applied to total chum passage, age-0.3 fish were the most abundant age class (61.7%), followed by age-0.4 (35.2%), age-0.2 (2.7%) and age-0.5 (.4%) fish (Table 5). Average length by sex and age class is reported in Table 6.

Coho Salmon

Passage and Run Timing. A total of 3,957 coho salmon passed the weir during the operational period (Table 7). The first coho salmon was observed on 4 August and median passage occurred on 25 August. The central fifty-percent of the passage occurred between 20 and 29 August. A peak daily count of 490 coho salmon was observed on 28 August. Coho salmon were still passing the weir in small numbers when the weir was dismantled. The daily counts for the last five days of operation were 15, 5, 8, 10 and 11.

ASL. Sex and length information, along with scales. were collected from 395 coho salmon (Tables 8 and 9). The 395 fish sampled comprised 10.0% of the total passage. The samples were collected from four pulses with sample sizes ranging from 36 to 152 fish. The coho passage was partitioned into four temporal strata based on the pulse sample dates. The total coho passage was estimated to have been 51.9% females. Females were more abundant than males in all but the first stratum, where each sex comprised 50% of the passage. As applied to total coho passage, age-2.1 fish were the most abundant age class (97.7%), followed by age-3.1 (2.0%) and age-1.1 (0.3%) fish. Average length by sex and age class is reported in Table 9.

Sockeye Salmon

Four sockeye salmon passed through the weir. The first was on 5 August, two passed on 21 August and the last sockeye passed on 25 August.

Resident Species

Longnose suckers *Catostomus catostomus*, northern pike *Esox lucius*, Arctic grayling *Thymallus arcticus*, broad whitefish *Coregonus nasus*, humpback whitefish *Coregonus pidschian* and round whitefish *Prosopium cylindraceum* were observed passing the weir. Longnose suckers dominated the resident species counts with a total passage of 3,798 fish (Table 7). Of these, over 3,700 were observed during the first 23 days of operation. Five Arctic grayling, 11 pike and 11 whitefish were observed passing the weir. Of the 11 whitefish, 6 passed during ASL sampling and were identified to species. One was a humpback whitefish, two were broad whitefish and three were round whitefish.

Juvenile Investigations

During the course of the summer, 132 beach seine hauls were performed capturing 192 chinook salmon, 10 coho salmon and one chum salmon (Appendix A). Seining was attempted in 10 of the 12 designated sampling areas and juvenile chinook salmon were captured in four of the areas. There were 177 chinook captured in 94 seine hauls in the mainstem of the Takotna (CPUE of 1.9 fish per seine haul), while tributaries (including the outlets) accounted for 38 seine hauls that captured 15 chinook salmon (CPUE of 0.4 fish per seine haul) (Table 10). No coho salmon were captured in the mainstem with seines, while ten coho salmon were sampled using beach seines in the tributaries (CPUE 0.3 fish per seine haul), and they were all captured at the mouth of lower Big Creek. One juvenile chum salmon was captured in a seine on 3 July. Catches also included juvenile Arctic grayling, whitefish, longnose suckers, slimy sculpin *Cottus cagnatus*, northern pike and burbot *Lota lota* (Appendix A).

A total of 149 baited minnow traps were set for 24-hr periods in six of the designated sampling areas. Juvenile chinook salmon were captured in three of the sampling areas. Three of the 84 traps set in the mainstem yielded 15 juvenile chinook (CPUE of 0.2 fish per trap), while 65 traps set in tributary streams accounted for 84 chinook salmon (CPUE of 1.3 fish per trap) (Table 10). Thirteen coho salmon were captured in two of the designated areas using minnow traps, and all were caught in tributary streams (CPUE of 0.2 fish per trap). In addition to salmon, 25 slimy sculpin, 12 Arctic grayling, two burbot and one lamprey *Lamptera sp.* were captured with minnow traps (Appendix A).

The length of juvenile chinook ranged from 41 to 78 mm, and juvenile coho ranged from 28 to 100 mm. All chinook salmon sampled were age-0 fish, but coho juveniles included age-0 and age-1. Juvenile coho salmon over 80 mm in length were classified as age-1. Seven of the 23 coho salmon captured were classified as age-1.

Aerial Surveys

Aerial surveys were conducted in order to document salmon spawning areas in the Takotna River drainage and other upper Kuskokwim River tributaries. Approximately eight days were dedicated to flying surveys: six days at the end of July and two days in September (Appendix B.).

The July surveys, which focused on locating spawning chinook and chum salmon, included the Takotna River drainage and many other upper Kuskokwim River tributaries (Figure 3). Within the Takotna River drainage, 29 chinook and 12 chum salmon were observed in Fourth-of-July Creek, and one chum salmon was seen in the West Fork (Figures 4 and 5). No salmon were observed in Big Waldren, Little Waldren, Moore, Minnie or Bonnie Creeks, and no salmon were observed in the following Nixon Fork tributaries: John Reek, Broken Snowshoe or Cottonwood Creek. In the Pitka Fork drainage, 151 chinook were seen in the mainstem, plus 374 chinook were seen in the Salmon River (Figures 6 and 7). No salmon were observed in the Highpower Creek drainage, the Slow Fork tributaries, Jones River, Sheep Creek, or the Big Salmon Fork of the Little Tonzona River (Figure 8 and 9). Fourteen chinook were observed in a small-unnamed tributary of the Little Tonzona River (Figure 6).

Within the Stony River drainage, nine chinook and 307 chum salmon were seen in Can Creek, no salmon were found in Stink Creek, 10 chinook were seen in Telaquana River and 5,580 sockeye salmon were observed in Telaquana Lake and the lake outlet (Figures 10 and 11).

The September surveys focused on locating late spawning chum and coho salmon, which included the Takotna River basin and portions of the South Fork Kuskokwim River drainage. The Takotna River drainage was surveyed on 17 September; 272 coho salmon were observed in Fourth-of-July Creek and seven coho were found in lower Big Creek (Figure 4). In the Nixon Fork sub basin, 35 coho were seen in the West Fork, 53 in the upper Nixon Fork, and one coho was seen in Cottonwood Creek (Figure 5). No salmon were observed in Big Waldren, Little Waldren, Moore, Minnie, or Bonnie Creeks, and no salmon were seen in the John Reek or Ivy Creeks of the Nixon Fork. The South Fork Kuskokwim River was surveyed on 29 September; 502 coho salmon and 100 late spawning chum salmon were seen in small tributaries and side sloughs, 34 coho were seen in Jones Creek, and approximately 900 coho were observed in an unnamed tributary of the Little Tonzona River (Figures 5, 6, 7 and 12).

Climatological and Hydrological Conditions

The 2000 season was characterized by low to moderate water levels for much of the season and warm water temperatures during June and the first half of July. Daily average water levels ranged from 44.5 cm to 100 cm and the season average was 62.6 cm (Appendix C). Daily average water temperature ranged from 2.0°C to 18.5 °C and the season average was 10.6 °C. Daily average air temperature ranged from 1.5° C to 22 °C and averaged 11.6 °C for the season.

Water Chemistry

Water samples were collected from the Takotna River on 29 June, 24 July and 6 October under low, intermediate and high water conditions. Results of the water chemistry analysis are reported in Table 11.

DISCUSSION

Fish Passage

This was the first year of operation for the Takotna River weir. Water levels remained within a range that allowed for uninterrupted operations throughout the entire season, and water conditions did not affect species identification.

Chinook Salmon

Passage. The observed passage of 345 chinook salmon in 2000 likely represents nearly the entire chinook escapement upstream of the weir site. No chinook were observed on the first day of counts, and only seven were observed the first eight days of operation (Table 1). Furthermore, the weir operated without interruption until September 20, well beyond the date when the last chinook salmon passed the weir.

There was little evidence that water depth and temperature affected total daily passage of chinook salmon (Figures 13 and 14). The crew, however, did observe that when average daily water temperatures were relatively warm, chinook salmon tended to pass the weir more at night. This trend became less evident once the water-cooled in mid-July.

The 2000 weir escapement of 345 chinook salmon was low compared to past tower estimates (Molyneaux et al. 2000). Of the five years tower operations were attempted on the Takotna River, reliable estimates of chinook passage were available only in 1996 and 1997. The 2000 chinook escapement was 76% of the 1996 estimate (401) and 29% of the 1997 estimate (1,176) (Table 1; Figure 15).

The low chinook escapement observed in the Takotna River in 2000 was characteristic of the escapements observed elsewhere in the Kuskokwim River drainage. Aerial surveys flown in the Aniak, Kipchuk, Salmon (Aniak drainage), Holokuk, Oskawalik, Holitna and Salmon (Pitka Fork drainage) Rivers in 2000 were among to lowest ever observed, and in all cases the numbers observed in 2000 were well below the numbers of chinook observed in 1996 and 1997 (Burkey et al. 2000b). A similar pattern was also observed at the Kwethluk, George, Kogrukluk and Tatlawiksuk River weirs.

Run Timing. Run timing for the Takotna River chinook salmon was later in 2000 than in 1996 and 1997 (Figure 15). Median passage of the chinook salmon in 2000 occurred by 18 July, 12 days later than in 1996 and 10 days later than in 1997 (Table 1). It should be noted that in 1996 and 1997 enumeration ended early, probably before the end of the chinook run, so a small percentage of chinook salmon probably passed the tower site after the counts were discontinued. The shortened operational period would contribute a couple days toward making the run timing in 2000 appear later than in 1996 and 1997.

The run timing of Takotna River chinook salmon was later and more protracted than observed at other Kuskokwim River escapement projects in 2000 (Figure 16). The median passage date at the Kwethluk (rkm 298), George (rkm 507), Kogrukluk (rkm 725), and Tatlawiksuk (rkm 621) River weirs were on 13, 11, 14, and 8 July, compared to 18 July at Takotna River weir (rkm 926). Despite these weirs being separated by up to 450 river kilometers, the run timings were quite similar. One or more of three mechanisms could account for these similarities. First, populations that travel furthest to spawn may enter the Kuskokwim River at an earlier date than those that spawn in the lower tributaries. Second, all the fish may enter the river at the same time, but the fish that need to travel upstream further may just swim faster. A third mechanism may be that the milling time is inversely proportional to the distance fish need to travel to their spawning grounds. Marino and Otis (1989) concluded from their tagging study that chinook salmon entering the Kuskokwim River early in the season migrated greater distances to spawn, plus they traveled at faster rates, than fish that arrived to the Kuskokwim River later in the season.

ASL. The sample size of 78 chinook salmon is small, but accounts for 23% of the total passage. The samples are partitioned into four temporal strata with the sample sizes of 25, 23, 16 and 14 representing 21%, 51%, 18% and 16% of the passage during each respective stratum. Chinook ASL sample sizes were insufficient for the George and Tatlawiksuk Rivers to characterize the run composition in those streams, but sufficient samples were collected at the Kogrukluk and Kwethluk Rivers.

Age-1.2, -1.3 and -1.4 fish comprised 98.1% of the Takotna River chinook run in 2000 (Table 12). This is comparable to what was observed at the Kogrukluk (98.2%) and the Kwethluk River (92.9%) escapement monitoring projects. There were some disparities among the escapement projects in regard to the contribution of each of these three age classes. On the Takotna River, age-1.2, -1.3 and -1.4 fish comprised 30.9%, 31.6% and 35.6% of the entire run. On the Kogrukluk River, the respective composition was 9.9%, 49.2% and 39.1% and the Kwethluk had 30.0%, 35.3% and 27.6%. The Takotna and Kwethluk both had similar proportions of these age classes but for the Kogrukluk River age-1.3 fish dominated and age-1.2 were less frequent. Historically, this has not been the case for the Kogrukluk. Compared to historic data, the Kogrukluk typically has a lower percentage of age-1.2 fish and a higher percentage of age-1.3 fish than seen in 2000 (Salomone 2000). There is no historical data for the Takotna and only one year of data for the Kwethluk River. The proportion of age-1.5 fish was low in the Takotna (0.6%) and Kogrukluk (1.8%), but relatively higher in the Kwethluk River (7.1%). The proportion of age-1.5 chinook in the Kogrukluk was similar to the historical average (DuBois and Molyneaux 2000).

The age composition of the chinook passing the Takotna River weir changed little throughout the run (Table 2). This is not unusual among chinook salmon runs (DuBois and Molyneaux 2000). Results from Kogrukluk River also had no overt pattern of changing age composition; however, results did demonstrate age-1.3 fish becoming less prominent and age-1.4 fish became more prominent as the run progressed (P. Salomone, Alaska Department of Fish and Game, Bethel, personal communication).

The Takotna River chinook run was estimated to be 24.5% females (Table 12). For comparison, the Kwethluk River chinook run was estimated to be 22.9% females and the Kogrukluk River was estimated to be 41.2% females. Historically, the Kogrukluk River averages 34.1% females (DuBois and Molyneaux 2000). The proportion of female chinook salmon in the Takotna River generally increased as the run progressed. By strata, the percentage of females were 20.0%, 13.0%, 25.0% and 35.7% (Table 2). The Kogrukluk River had a similar pattern as the run progressed in 2000 and has a similar historical trend (P. Salomone, Alaska Department of Fish and Game, Bethel, personal communication; DuBois and Molyneaux 2000).

The percentage of female chinook in the Takotna River may actually be higher than the sampling results suggest. On a number of occasions the crew noticed that a higher proportion of females would pass the weir after an ASL sampling period. The larger female fish may have been less prone to enter the trap, although it is unclear if this observation was real or perceived. In the future, the sex should be recorded when passing fish when the water clarity is conducive to allowing observers to determine the sex of fish as they pass the weir. This would allow for some verification of the findings from the ASL sampling. Should a bias be detected, one possible solution would be to use a bigger trap with a larger gate opening.

The length frequency composition of the Takotna River chinook salmon was partitioned well by age class. For males ages-1.1, -1.2, -1.3, -1.4 and -1.5, the respective average lengths were 451 mm, 501 mm, 671 mm, 770 mm and 895 mm (Table 3). Females only occurred as age-1.3 and -1.4 fish, with respective average lengths of 774 mm and 818 mm. These average lengths are comparable to the 2000 chinook length data for the Kwethluk and Kogrukluk Rivers and for the historical Kogrukluk data (P. Salomone, Alaska Department of Fish and Game, Bethel, personal communication; Watry and Harper *in press*; DuBois and Molyneaux 2000).

Other Observations. The water was relatively warm and low throughout the chinook salmon run. The fish appeared timid around the weir and hesitant to pass upstream. At times the fish would slowly swim up to the weir, only to turn around and swim back downstream. While flying surveys on 26 July, the observer noticed about a dozen chinook within the 50 meters of river downstream of the weir. From the time that observation was made, it took two days before 12 chinook salmon passed the weir. This apparent hesitancy of chinook to progress upstream may be a result of the low salmon abundance. Salmon seem to demonstrate greater security in numbers and prefer to move in mass. When densities behind the weir remain low the salmon may tend to mill behind the weir longer than at times with higher abundance. Extra effort was made by the crew to pass fish upstream by leaving the passage gates open for long periods of time, both during the day and at night. Increasing the size of the fish passage gates may improve salmon passage rates.

There was little evidence of chinook spawning downstream of the weir. No fish were visually seen spawning downstream of the weir, although one spawned out female was captured in the trap late in the chinook run. All other female chinook examined during ASL sampling were in a pre-spawning condition.

A total of 14 chinook carcasses washed up on the weir, only one of which was a female. All of the carcasses appeared to be in a post-spawning condition. The first carcass was observed on 1 August and the last was seen on 18 August (Figure 17). Fifty-percent of the carcasses washed up on the weir by 9 August while fifty-percent of the upstream passage occurred on 18 July (Figure 18). This would suggest that it took in the vicinity of 22 days for chinook salmon to migrate from the weir to their spawning grounds, spawn, die and wash back downriver to the weir.

Chum Salmon

Passage. As with chinook salmon, the 2000 passage of 1,254 chum salmon at the Takotna River weir likely represents nearly the entire escapement upstream of the weir site. Some fish probably passed the site prior to weir installation, but the number is thought to be negligible. One chum passed the weir on the first day of operation and the daily average for the first week was 11 fish. The bulk of the chum passage occurred in July and the weir operated well past the date when the last chum salmon was observed on 29 August (Table 4).

The overall run of chum salmon in the Kuskokwim River was low in 2000 (Burkey et al. 2000b). The 1,254 chum salmon escapement on the Takotna River in 2000 was low compared to the reported passage in 1996 and 1997 (Table 4; Figure 19). The 2000 escapement was 45% of the 1996 passage estimate (2,794) and 70% of the 1997 estimate (1,794). Escapement at the George River was also low; the 2000 count of 3,498 was 20% of the 1996 passage (17,570), 59% of the 1997 passage (5,940) and 30% of the 1999 passage (11,682). The 2000 count of 11,489 at the Kogrukluk River weir was 38% of the escapement goal of 30,000 fish. Chum salmon passage at the Kogrukluk River weir in 2000 was the fourth lowest escapement reported since the project began in 1976. Historic escapement data on the Tatlawiksuk and Kwethluk Rivers is more limited, but chum escapement appeared lower in both of these streams in 2000 (DuBois and Molyneaux 2000).

Fluctuations in water depth and water temperature of the Takotna River in 2000 had no apparent influence on the daily chum salmon passage (Figures 13 and 14). Between 13 and 17 July the water level increased by about 15 cm and the water temperature cooled from 18 to 10°C, but there was no obvious change in the daily chum salmon passage. However, during the period of relatively warm water temperatures that existed prior to 15 July, fish tended to pass the weir more readily at night than during the day.

Run Timing. Run timing of chum salmon in the Takotna River appeared to be a little later in 2000 than in 1997 and 1996 (Figure 16; Table 4). The median passage date in each of these years was 14, 12 and 6 July respectively. As was described for chinook salmon, tower operations in 1997 and 1996 were truncated and probably resulted in estimated run timings that were slightly earlier than the actual run timing in those two years.

The run timings of chum salmon were similar at all the Kuskokwim River tributary streams where escapements were monitored in 2000. The daily percent passage at Kwethluk, Aniak, George, Kogrukluk and Tatlawiksuk rivers were nearly always within three days of the passage at Takotna River (Figure16). The similarity in run timing suggests that the fish that need to travel the greatest distance to their spawning grounds must either enter the Kuskokwim River earlier or swim at a faster rate than fish that need to travel a shorter distance to spawn. Results from a radio telemetry study conducted by the Bering Sea Fisherman's Association in 1995 suggest that chum salmon bound for upper Kuskokwim River tributaries such as the George (rkm 349), Holitna (rkm 393) and Stony Rivers (rkm 436) enter the Kuskokwim River early in the season, while fish bound for lower river tributaries such as the Kwethluk (rkm 31), Kisaralik (rkm 53), Kasiguk (rkm 53), Tuluksak (rkm 90), Aniak (rkm 213) and Holokuk (rkm 267) Rivers entered the river over a broader range of the season (Parker and Howard 1995). This investigation reported no evidence of fish milling between Bethel and the spawning grounds.

ASL. The 365 chum salmon with complete ASL data account for 29.1% of the total chum passage. The samples are partitioned into four temporal strata. The sample sizes by strata of 85, 117, 140 and 23 represent 20.5%, 41.6%, 40.5% and 10.9% of the passage during each respective stratum.

Older aged chum salmon tended to be more prominent early in the run and their proportion diminished as the season progressed. Age-0.5 chum salmon comprised only 0.4% of the total passage and were only represented in the first strata (Table 5). The proportion of age-0.4 fish, which comprised 35.2% of the total escapement, decreased from 49.4% to 17.4% as the season progressed. Age-0.3 chum salmon comprised 61.7% of the total escapement and the proportion of this age class increased from 49.4% to 73.9% as the season progressed. Age-0.2 chum salmon comprised 2.7% of the total escapement, and fish of this age class were only found in the second half of the run, increasing from 4.3% to 8.7% in the last two strata (Table 5). The progression of age classes observed in the Takotna River is typical of other Kuskokwim River chum salmon populations (DuBois and Molyneaux 2000). The relative proportion of each age class was also similar among projects, except at George River where age-0.4 chum salmon had a slight dominance over age-0.3 fish (Table 13).

Female chum salmon comprised 57.7% of the total escapement at Takotna River weir in 2000, which is comparable to what was seen at most other Kuskokwim River escapement projects (Table 13; DuBois and Molyneaux 2000). The percentage of female chum salmon reported at Tatlawiksuk, George, Aniak and Kwethluk Rivers all ranged between 43.5% and 54.9%; however, at Kogrukluk River females only comprised 13.4% of the total escapement. Historically, the Kogrukluk chum salmon escapements have had very low female composition averaging 29.2% from 1971-1999, and ranging from 4.1% to 15.4% the last five years (DuBois and Molyneaux 2000).

The percentage of females observed at the Takotna River did not steadily increase as the season progressed as has often been reported for other projects (Table 5; Figure 20; DuBois and Molyneaux 2000). Instead, the percentage of females in the four strata varied between 52.9% and 65.2% with no obvious pattern. Results from the Kogrukluk River also had no obvious pattern in the proportion of females as the run progressed, but results from the Tatlawiksuk, George, Aniak and Kwethluk Rivers did show the typical increase in the proportion of females as the run progressed (Figure 20).

The relatively small sample sizes collected at the Takotna River weir become problematic when analyzing ASL data because the samples from each stratum are partitioned into eight possible age-sex categories, which results in many of the categories having a very small number of fish. Still, like most other tributary escapement populations in the Kuskokwim River, one pattern that was clear is that the average length of female chum salmon was consistently less than males of the same age class (Table 6; DuBois and Molyneaux 2000). Seasonally, the average length by sex for age-0.3 and -0.4 chum salmon were generally smaller on the Takotna than at all the other escapement projects (Figure 21).

Other Observations. Chum salmon showed less hesitancy in passing the weir than chinook salmon. Their smaller body size and greater abundance may have contributed to this behavior. There was no evidence of chum salmon spawning downstream of the weir and all female chum salmon examined during sampling were in pre-spawn condition.

A total of 51 chum carcasses washed up on the weir, seven of which were females. The first carcass appeared on 13 July and the last on 20 September (Figure 17). Fifty-percent of the carcasses appeared by 2 August, while the mid-point of the upstream passage occurred on 14 July (Figure 18). This would indicate that it took in the vicinity of 19 days for chum salmon to migrate from the weir to the spawning grounds, spawn, die and wash back downriver to the weir.

Sockeye Salmon

Four sockeye salmon were observed passing through the weir. The crew physically handled three of these fish to confirm identification. Sockeye salmon have never been reported in the Takotna River and no large lakes are associated with the system (ADF&G 1998). Considering only four sockeye were observed in 2000, it is believed that these fish were strays.

Coho Salmon

Passage. Coho salmon abundance appeared to be average on the Kuskokwim River in 2000 (Burkey et al. 2000b). The poor chinook and chum runs resulted in a conservative effort to delay the onset of the commercial coho fishery. The delay intentionally allowed about the first third of the coho run to pass through the commercial fishing district of the lower Kuskokwim River in order to ensure that adequate numbers of coho would be available for subsistence fishers. If fish that need to travel farthest upriver to spawn enter the river earlier, as believed for salmon species, then a higher proportion of Takotna River coho salmon may have entered the river without being subjected to commercial fishing. If true, coho escapement to the Takotna River may have been above average.

The year 2000 was the first year for enumeration of coho salmon for the Takotna River. The weir passage of 3,957 coho is probably very near the entire escapement upstream of the weir site. Coho salmon were still passing the weir in small numbers up until the weir was dismantled; however, passage during the last five days of operation averaged less than 10 fish per day (Table 7; Figure 22). The number of fish not accounted for is unknown, but the number is assumed to be low relative to the total passage of 3,957.

Fluctuations in water depth and water temperature in the Takotna River in 2000 had no apparent influence on the daily coho salmon passage (Figures 13 and 14).

Run Timing. The coho salmon run timing on the Kuskokwim River was believed to be early (Burkey et al. 2000b). The relative run timing for coho salmon in the Takotna River and other Kuskokwim tributaries were similar (Figure 16). The median coho passage date on the Takotna

River was 25 August. In comparison, the median coho passage date on the Kwethluk, George and Kogrukluk Rivers were 21, 22 and 28 August.

ASL. The 395 coho salmon with complete ASL data account for 10.0% of the total coho passage on the Takotna River. The samples are partitioned into four temporal strata (Table 8). The sample size by stratum of 36, 152, 136 and 71 represent 4.0%, 7.0%, 21.6% and 56.4% of the passage during each respective stratum.

Approximately 97.7% of Takotna River coho salmon were age 2.1 (Table 8). The dominance of this age class is typical of the age composition found elsewhere in the Kuskokwim River (DuBois and Molyneaux 2000). Age-2.1 coho comprised 92.7% of the escapement on the Kwethluk River (Table 14). Kogrukluk data for 2000 had not been analyzed at the time of writing this report, but since 1989, age-2.1 fish have comprised 92.0% of the total coho escapement there (DuBois and Molyneaux 2000). ASL data was also not available for the George River during the writing of this report, and the Tatlawiksuk River weir ended operations early due to high water and no coho data was collected.

Female coho salmon comprised 51.9% of the total escapement at Takotna River weir in 2000 (Table 8). This is comparable to what was seen on the Kwethluk River where females comprised 47.1% of the escapement (Table 14). The data collected in 2000 was not available for the Kogrukluk River, but since 1989, the Kogrukluk River escapement has been 38.9% female composition. For reasons that are not well understood, Kogrukluk River periodically has a very low occurrence of female coho salmon (DuBois and Molyneaux 2000). A similar anomaly has been observed for Kogrukluk River chum salmon.

The percentage of females observed at the Takotna River weir increased as the season progressed as has often been reported for other projects, although the increase at the Takotna River was modest (DuBois and Molyneaux 2000). The percentage of females in the four strata increased from 50.0% and 50.7% in the first two strata to 56.6% and 57.7% in the third and fourth strata (Table 8). The Kwethluk River had similar increases in female composition as the run progressed (Watry and Harper *in press*). The 2000 Kogrukluk data had not yet been stratified at the writing of this report.

There was no indication that the average length of coho salmon changed as the run progressed on the Takotna River, and there was no obvious difference in the average length by sex (Table 9). Age-2.1 female and male coho salmon averaged 547 mm and 540 mm on the Takotna River in 2000. Both female and male age-2.1 coho averaged 559 mm on the Kwethluk River (Watry and Harper *in press*). The data was not available for the Kogrukluk at the time of writing this report, but since 1989, age-2.1 female coho salmon average 567 mm while males average 569 mm (DuBois and Molyneaux 2000).

Resident Species

Over 99 percent of the resident species passing the weir were longnose suckers. The bulk of these fish came early in the weir operation (Figure 23). A portion of the fish probably passed the site prior to the weir installation.

Juvenile Investigations

Chinook Salmon

Habitat Utilization. The rearing habitat available for juvenile chinook salmon in the Takotna River basin appears to be underutilized. Juvenile chinook were found in Fourth-of-July Creek, Big Creek (lower) and in the mainstem Takotna River downstream of Fourth-of-July Creek. Sampling upstream of Fourth-of-July Creek only produced one juvenile chinook and this fish was caught within one mile of the confluence (Appendix A). Sampling in the upper Takotna River, as throughout the study area, did reveal an abundance of grayling and whitefish, so water quality was likely not a factor in the absence of juvenile chinook in the upper basin (Appendix A).

The absence of juvenile salmon in the upper Takotna River basin is probably the result of the absence of spawners; however, studies described by Groot and Margolis (1991), suggest a possible alternative. Following emergence, juvenile chinook tend to drift downstream for a number of days before establishing a territory. This behavior could result in considerable downstream displacement before fish take up residency. The drifting behavior may be less pronounced in "stream-type" chinook as are found in the Takotna River.

Sampling effort for juvenile salmon upstream of Fourth-of-July Creek primarily occurred in September. Future sampling effort in the upper basin should be more temporally dispersed in order to address the potential that migratory behavior may account for the absence of juvenile chinook in that part of the drainage. Furthermore, sampling effort throughout the study area needs to encompass the entire array of potential rearing habitats. Smaller chinook juveniles tend to inhabit the margins of streams whereas larger fry tend to rear in swifter water farther offshore. The continued use of two gear types, seines and minnow traps, allowed for sampling in all types of habitat in the Takotna River.

Other Observations. Growth rates of the juvenile chinook were difficult to determine because of the small sample sizes. Samples were collected immediately upstream of the weir on four different occasions and in Big Creek (lower) on three different occasions (Appendix A). The average size of these fish is illustrated in Figure 24. The small sample sizes at the beginning of the Big Creek data, and at the end of the weir site data, make it difficult to come to any significant conclusions; however, this data suggests that the fish found in the mainstem by the weir may have emerged sooner and/or grew faster than the fish found in Big Creek.

Coho Salmon

Habitat Utilization. As with chinook salmon, there appears to be a drainage wide under utilization of rearing habitat by juvenile coho in the Takotna River. Juvenile coho salmon were captured in two locations in the Takotna River: Big Creek and Fourth-of-July Creek (Table 10; Appendix A). Rearing habitat appeared abundant throughout the river, but despite considerable effort, no coho salmon were sampled anywhere else in the Takotna drainage.

According to Lister and Genoe (1970) coho fry rear in the following preferred sites from most preferred to least preferred: back eddies, log jams, cut banks or open bank areas, and the least preferred habitat is fast water. Most of the sampling effort this past summer focused on these types of habitats.

Beaver ponds and oxbow ponds off the main channel can also be important rearing sites for coho salmon (AFS 2001), but these habits were not sampled in 2000. Future sampling effort should be broadened to include these habitats. The continued use of both minnow traps and beach seines should allow for all possible habitats to be sampled.

Other Observations. Takotna River coho salmon appear to emerge late in summer; consequently, they may not be available to the sampling gear during most of the field season. According to Groot and Margolis (1991) fry emerge from the gravel at about 30 mm in length. The 10 coho that were caught at the mouth of Big Creek on 3 August averaged 33.6 mm (Figure 25; Appendix A). These fish still had small transparent slits on their bellies where the egg sac had recently absorbed, indicating they had recently emerged. According to Susan Hayes (S. Hayes, Alaska Department of Fish and Game, Palmer, personal communication), fish smaller than 45 mm tend to escape through the sides of ¼ inch mesh trap. This would explain why only six age-0 coho were caught in minnow traps throughout the season. During most of the summer the young-of-the-year either had not yet emerged or were not large enough to be captured by the gear. In the future, smaller meshed minnow traps and seines should be used for sampling fry, and effort on coho should be focused on the later half of the summer and fall.

Aerial Surveys

Overview

Tributary streams of the upper Kuskokwim drainage were difficult to survey and it was often difficult to conclude if salmon were present or absent. Meandering channels, bank cover and watercolor all made it difficult to see salmon. In the upper portion of most streams, survey conditions generally improved to where salmon would be visible if present. Still, even when conditions allowed, salmon were often not observed in upper reaches of most drainages. It is unknown if salmon were present lower in the tributaries where conditions did not allow for adequate viewing. Overall, spawning and rearing habitat appeared to be good in the middle to upper ends of most tributaries and there seemed to be an under utilization of spawning habitat.

The aerial surveys in July in the Takotna River drainage and other upper Kuskokwim River tributaries generally had optimal survey conditions. High water proceeded and followed the survey dates in late July. Based on 2000 weir counts, the numbers of chinook and chum salmon on spawning grounds should have been adequate to determine spawning locations and relative abundance. The day the surveys started, the chinook percent-passage for the year was at 75% and chum were at 87% on the Takotna River. All the chum and chinook observed during the first set of surveys appeared to be actively spawning. The fish were spread out in small groups in the drainages they were observed in and redds were visible. The timing of the sockeye survey in Telaquana Lake may have been a little early. The majority of the sockeye salmon were still staging at the outlet of the lake at the time of the Telaquana survey.

Timing and survey conditions during the fall aerial surveys were generally good. The Takotna River was surveyed on 17 September and was well timed with 99.2% of the coho passage past the weir by that date (Table 7). In the Takotna River, when fish were present, they were spread throughout tributaries they were observed in and many redds were visible. The survey of the South Fork Kuskokwim River flown on 29 September may have been slightly early. Where coho were observed, they were distributed throughout the South Fork tributaries, but were in large schools. Furthermore, few redds were visible and no carcasses were observed. South Fork Kuskokwim coho may spawn later than the Takotna River coho salmon. Late spawning chum salmon observed in the South Fork were in small schools with some of the fish having substantial amounts of fungal growth on them. This would suggest they may have been past peak numbers.

In the future, an aerial survey index area should be determined in the Takotna River. The salmon counts from within this designated area could be correlated with the weir counts, and an expansion factor could be determined to estimate total abundance.

Comparison of Past Surveys

Historically, aerial survey coverage in the upper Kuskokwim drainage has been limited. Many of the tributaries flown in 2000 had never been surveyed before, and most tributaries flown in the past were flown again in 2000. The Big River was an exception. It was surveyed in 1996, but not in 2000 due unfavorable weather conditions.

Portions of the Takotna River were surveyed on three different occasions prior to 2000. The first two surveys were flown on 25 July 1987 and 27 July 1989, concentrating on the mainstem around the Waldren Forks (Burkey and Salomone 1999). No salmon were observed on these dates. The third survey was flown by helicopter on 30 July 1994, and an experienced biologist observed 5-8,000 chum and some chinook salmon in Fourth-of-July Creek, 30 chum in Moore

Creek and 20 chum and 2 chinook in the mainstem of the Takotna River (Molyneaux et al. 2000). The 2000 weir count of chum salmon was less than 20% of the 1994 aerial survey results. Furthermore, the aerial survey results on 25 July 2000 were far below the 2000 weir counts (Figure 4; Appendix B).

The Nixon Fork drainage also has a limited aerial survey history. On 24 July 1976 the portion of the Nixon Fork between Hosmer Creek and Washington Creek was surveyed and 186 chinook and 280 chum salmon were observed (Burkey and Salomone 1999). In 2000 the water in this stretch was too dark and deep to see fish. On 26 July 1987 the Nixon Fork was surveyed and no fish were seen. On 27 July 1989, 58 chinook salmon were observed in the middle stretches of the Nixon Fork mainstem (Burkey and Salomone 1999). On 20 June and 1 July 1994, a portion of John Reek, Ivy, Broken Snowshoe Creek and the West Fork were surveyed and no fish were observed. On 26 June 2000 only one chum salmon was observed in the West Fork (Figure 5; Appendix B).

The Salmon River of the Pitka Fork is the only stream in the upper Kuskokwim basin that is indexed and has an extensive aerial survey history. From 1975 to 1997 the Salmon River was surveyed 19 different years (Burkey and Salomone 1999). These surveys were timed to target chinook salmon and total chinook counts ranged from 272 in 1975 to 2,555 in 1992. The 2000 aerial survey count of 374 chinook was the second lowest ever reported for the Salmon River (Figure 6; Appendix B).

Telaquana Lake has been successfully surveyed on two previous occasions. On 25 July 1985, 15,426 sockeye salmon were observed and on 27 July 1995, 8,150 were observed (Burkey and Salomone 1999). By comparison, the 2000 count of 5,500 was relatively low (Figure 11; Appendix B). The lake was surveyed in several other years, but because of survey conditions or survey timing, no fish were observed.

The South Fork Kuskokwim River has only been surveyed once in the past with markedly different results from the 2000 survey. The portion from Farewell to the confluence with the Kuskokwim River was surveyed on 26 and 27 September 1996, and the findings were recorded in a detailed memo (Appendix D). During this survey 845 chum salmon and 90 coho salmon were observed. Global Positioning System (GPS) coordinates were recorded of all spawning areas. The results of the 2000 survey were markedly different with only 100 late spawning chum and 502 coho salmon being observed (Figure 12; Appendix B and D). Many of the late spawning chum observed in 1996 were in side channels of the South Fork Kuskokwim. These same channels were flown in 2000 and few chum salmon were observed. The scarcity of late spawning chum being observed in 2000 was due to fish either not being there or not being visible because of high water conditions.

Climatological and Hydrological Conditions

Local residents characterized the 2000 season stream flow and rainfall as being average and stream flow did not affect weir operations. Water levels were still dropping from spring melt-off when the weir was installed during the week of 20 June. Once installed, water levels were never detrimental to the operation of the weir. A peak water level of over 120 cm was recorded the day after counting operations ended for the season. At this water level the weir would have been inoperable and it appears maximum water level for weir operations is in the vicinity of 110 cm.

Water Chemistry

The results of the Takotna River water samples were compared to that of the Tatlawiksuk, George, Kasiguk, Kogrukluk and Kwethluk. The Takotna River had specific conductance, pH, alkalinity, color and magnesium measurements on the high end of the range among all sites. The turbidity of the Takotna River was on the low end of the range for all sites, and the calcium and reactive silicon concentrations were in the middle of the range among all sites. None of the concentrations for any of the sites were outside of normal parameters.

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Table 1. Historic daily and cumulative passage of chinook salmon past the Takotna River counting tower (1995-1998[a]) and weir (2000).

Date	Daily					Cumulative				Percent Passage		
	1995	1996	1997	1998	2000	1995	1996	1997	2000	1996	1997	2000
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	
21-Jun		0	0	0			0	0		0	0	
22-Jun		0	6	0			0	6		0	1	
23-Jun		0	0	0			0	6		0	1	
24-Jun		0	12	0	0		0	18	0	0	2	0
25-Jun		0	30	0	2		0	48	2	0	4	1
26-Jun		0	24		2		0	72	4	0	6	1
27-Jun		9	9	0	1		9	81	5	2	7	1
28-Jun		17	33	0	0		26	114	5	7	10	1
29-Jun		8	36	0	1		34	150	6	9	13	2
30-Jun		21	57	0	1		55	207	7	14	18	2
1-Jul		18	0	0	0		72	207	7	18	18	2
2-Jul		15	30	3	15		87	237	22	22	20	6
3-Jul		12	72	3	16		98	309	38	25	26	11
4-Jul		12	66	3	3		110	375	41	28	32	12
5-Jul		73	54	0	14		183	429	55	46	37	16
6-Jul		39	54	6	7	0	223	483	62	56	41	18
7-Jul	4	10	33		12	4	233	516	74	58	44	22
8-Jul	7	37	54		37	11	270	570	111	67	49	32
9-Jul	2	24	69		9	13	294	639	120	73	55	35
10-Jul	8	3	51		3	21	297	690	123	74	59	36
11-Jul	41	4	74		8	62	301	764	131	75	65	38
12-Jul	8	5	48		22	70	305	812	153	76	69	44
13-Jul	12	5	24		1	82	311	836	154	78	71	45
14-Jul	17	7	66		3	99	318	902	157	79	77	46
15-Jul	9	7	27		4	108	325	929	161	81	79	47
16-Jul	6	9	12		4	114	334	941	165	83	80	48
17-Jul	0	0	36		2	114	334	977	167	83	83	49
18-Jul	12	20	48		6	126	353	1,025	173	88	87	50
19-Jul	12	11	12		4	138	364	1,037	177	91	88	51
20-Jul	6	9	15		8	144	374	1,052	185	93	90	54
21-Jul	0	8	3		7	144	382	1,055	192	95	90	56
22-Jul	9	7	12		39	153	389	1,067	231	97	91	67
23-Jul	0	5	9		2	153	394	1,076	233	98	92	68
24-Jul	0	4	24		5	153	398	1,100	238	99	94	69
25-Jul	0	3	15		17	153	401	1,115	255	100	95	74
26-Jul	0	0	18		3	153	401	1,133	258	100	97	75
27-Jul	0		12		9	153		1,145	267		98	78
28-Jul	0		6		5	153		1,151	272		98	79
29-Jul	0		15		9	153		1,166	281		99	82
30-Jul	3		0		5	156		1,166	286		99	83
31-Jul	0		-6		2	156		1,160	288		99	84
1-Aug	0		3		1	156		1,163	289		99	84
2-Aug	0		9		1	156		1,172	290		100	84
3-Aug	0		5		5	156		1,176	295		100	86
4-Aug	0		0		8	156		1,176	303		100	88
5-Aug					7				310			90
6-Aug					4				314			91
7-Aug	0				1				315			92
8-Aug					7				322			94
9-Aug					7				329			96
10-Aug	0				0				329			96
11-Aug					3				332			97

Table 1. (page 2 of 2)

Date	Daily					Cumulative				Percent Passage		
	1995	1996	1997	1998	2000	1995	1996	1997	2000	1996	1997	2000
12-Aug	0				6				338			98
13-Aug					2				340			99
14-Aug					1				341			99
15-Aug	0				0				341			99
16-Aug					0				341			99
17-Aug					0				341			99
18-Aug					2				343			100
19-Aug					0				343			100
20-Aug					0				343			100
21-Aug	0				0				343			100
22-Aug					0				343			100
23-Aug	0				0				343			100
24-Aug					0				343			100
25-Aug	0				0				343			100
26-Aug					0				343			100
27-Aug					1				344			100
28-Aug	0				0				344			100
29-Aug	0				0				344			100
30-Aug	0				0				344			100
31-Aug	0				0				344			100
1-Sep	0				0				344			100
2-Sep					0				344			100
3-Sep					0				344			100
4-Sep					0				344			100
5-Sep					0				344			100
6-Sep					0				344			100
7-Sep					0				344			100
8-Sep					0				344			100
9-Sep					1				345			100
10-Sep					0				345			100
11-Sep					0				345			100
12-Sep					0				345			100
13-Sep					0				345			100
14-Sep					0				345			100
15-Sep					0				345			100
16-Sep					0				345			100
17-Sep					0				345			100
18-Sep					0				345			100
19-Sep					0				345			100
20-Sep					0				345			100

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

Table 2. Estimated age and sex composition for chinook salmon escapement at Takotna River weir, 2000.

Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 1.1 # fish	1.1 %	1.2 # fish	1.2 %	1.3 # fish	1.3 %	1.4 # fish	1.4 %	1.5 # fish	1.5 %	Total # fish	Total %
7/05- 7/07	25	M	5	4.0	38	32.0	38	32.0	15	12.0	0	0.0	96	80.0
(6/25-7/9)		F	0	0.0	0	0.0	5	4.0	19	16.0	0	0.0	24	20.0
		Subtotal	5	4.0	38	32.0	43	36.0	34	28.0	0	0.0	120	100.0
7/12- 7/14	23	M	0	0.0	8	17.4	18	39.1	12	26.1	2	4.3	39	87.0
(7/10- 7/16)		F	0	0.0	0	0.0	0	0.0	6	13.0	0	0.0	6	13.0
		Subtotal	0	0.0	8	17.4	18	39.1	18	39.1	2	4.3	45	100.0
7/19- 7/21	16	M	0	0.0	28	31.3	23	25.0	17	18.8	0	0.0	68	75.0
(7/17- 7-25)		F	0	0.0	0	0.0	0	0.0	22	25.0	0	0.0	22	25.0
		Subtotal	0	0.0	28	31.3	23	25.0	39	43.8	0	0.0	90	100.0
7/28- 7/30, 8/14, 8/2	14	M	0	0.0	32	35.7	19	21.4	6	7.1	0	0.0	58	64.3
(7/26-9/9)		F	0	0.0	0	0.0	7	7.2	26	28.6	0	0.0	32	35.7
		Subtotal	0	0.0	32	35.7	26	28.6	32	35.7	0	0.0	90	100.0
Seasonal	78	M	5	1.4	106	30.9	98	28.3	50	14.3	2	0.6	260	75.5
		F	0	0.0	0	0.0	11	3.3	73	21.3	0	0.0	85	24.5
		Total	5	1.4	106	30.9	109	31.6	123	35.6	2	0.6	345	100.0

Table 3. Estimated mean length (mm) of chinook salmon escapement at the Takotna River weir, 2000.

Year	Sample Dates (Stratum Dates)	Sex		Age Class 1.1	1.2	1.3	1.4	1.5
2000	7/5-7/7 (6/25-7/9)	M	Mean Length	451	515	674	743	
			Std. Error		23	19	8	
			Range	451- 451	418- 623	582- 754	728- 752	
			Sample Size	1	8	8	3	0
		F	Mean Length			722	844	
			Std. Error			0	16	
			Range			722- 722	805- 883	
			Sample Size	0	0	1	4	0
	7/12-7/14 (7/10-7/16)	M	Mean Length		519	646	802	895
			Std. Error		22	16	28	
			Range		476- 575	557- 706	728- 911	895- 895
			Sample Size	0	4	9	6	1
		F	Mean Length				873	
			Std. Error				50	
			Range				780- 950	
			Sample Size	0	0	0	3	0
	7/19-7/21 (7/17-7/25)	M	Mean Length		482	650	760	
			Std. Error		14	28	62	
			Range		453- 529	595- 719	673- 880	
			Sample Size	0	5	4	3	0
		F	Mean Length				781	
			Std. Error				37	
			Range				697- 860	
			Sample Size	0	0	0	4	0
	7/28-7/30, 8/14, 8/27 (7/26-9/9)	M	Mean Length		498	710	798	
			Std. Error		27	23		
			Range		430- 585	685- 755	798- 798	
			Sample Size	0	5	3	1	0
		F	Mean Length			812	821	
			Std. Error				39	
			Range			812- 812	714- 898	
			Sample Size	0	0	1	4	0
	Seasonal	M	Mean Length	451	501	671	770	895
			Std. Error		12	11	26	
			Range	451- 451	418- 623	557- 755	673- 911	895- 895
			Sample Size	1	22	24	13	1
		F	Mean Length			774	818	
			Std. Error				19	
			Range			722- 812	697- 950	
			Sample Size	0	0	2	15	0

Table 4. Historic daily and cumulative passage of chum salmon past the Takotna River counting tower (1995-1998[a]) and weir (2000).

Date	Daily					Cumulative				Percent Passage		
	1995	1996	1997	1998	2000	1995	1996	1997	2000	1996	1997	2000
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	
21-Jun		14	6	0			14	6		0	0	
22-Jun		0	0	0			14	6		0	0	
23-Jun		0	0	0			14	6		0	0	
24-Jun		102	12	0	1		115	18	1	4	1	0
25-Jun		0	27	0	24		115	45	25	4	3	2
26-Jun		0	12		23		115	57	48	4	3	4
27-Jun		137	51	0	11		252	108	59	9	6	5
28-Jun		68	45	0	9		320	153	68	11	9	5
29-Jun		127	84	0	6		448	237	74	16	13	6
30-Jun		117	48	9	6		565	285	80	20	16	6
1-Jul		101	18	0	10		666	303	90	24	17	7
2-Jul		85	33	15	18		752	336	108	27	19	9
3-Jul		69	33	6	17		821	369	125	29	21	10
4-Jul		123	69	3	39		944	438	164	34	24	13
5-Jul		264	72	12	12		1,207	510	176	43	28	14
6-Jul		295	87	6	45		1,502	597	221	54	33	18
7-Jul	0	242	33		44	0	1,744	630	265	62	35	21
8-Jul	53	209	42		101	53	1,953	672	366	70	37	29
9-Jul	82	172	57		49	135	2,126	729	415	76	41	33
10-Jul	222	105	63		27	357	2,231	792	442	80	44	35
11-Jul	63	86	65		58	420	2,317	857	500	83	48	40
12-Jul	42	78	33		29	462	2,395	890	529	86	50	42
13-Jul	98	70	36		49	560	2,464	926	578	88	52	46
14-Jul	117	11	117		50	677	2,475	1,043	628	89	58	50
15-Jul	82	26	36		35	759	2,502	1,079	663	90	60	53
16-Jul	126	37	54		33	885	2,539	1,133	696	91	63	56
17-Jul	11	56	78		51	896	2,595	1,211	747	93	67	60
18-Jul	150	53	57		34	1,046	2,648	1,268	781	95	71	62
19-Jul	129	35	18		59	1,175	2,682	1,286	840	96	72	67
20-Jul	42	29	30		50	1,217	2,712	1,316	890	97	73	71
21-Jul	129	26	72		43	1,346	2,737	1,388	933	98	77	74
22-Jul	72	21	24		53	1,418	2,758	1,412	986	99	79	79
23-Jul	79	16	66		33	1,497	2,774	1,478	1019	99	82	81
24-Jul	8	8	62		23	1,505	2,783	1,539	1042	100	86	83
25-Jul	18	11	24		25	1,523	2,794	1,563	1067	100	87	85
26-Jul	11	0	15		20	1,534	2,794	1,578	1087	100	88	87
27-Jul	33		72		14	1,567		1,650	1101		92	88
28-Jul	21		21		11	1,588		1,671	1112		93	89
29-Jul	29		57		18	1,617		1,728	1130		96	90
30-Jul	66		27		12	1,683		1,755	1142		98	91
31-Jul	6		21		10	1,689		1,776	1152		99	92
1-Aug	0		12		3	1,689		1,788	1155		100	92
2-Aug	0		6		12	1,689		1,794	1167		100	93
3-Aug	0		0		2	1,689		1,794	1169		100	93
4-Aug	0		0		22	1,689		1,794	1191		100	95
5-Aug					5	1,689			1196			95
6-Aug					11	1,689			1207			96
7-Aug	0				5	1,689			1212			97
8-Aug					11	1,689			1223			98
9-Aug					5	1,689			1228			98
10-Aug	0				10	1,689			1238			99
11-Aug					6	1,689			1244			99
12-Aug	0				6	1,689			1250			100
13-Aug					2	1,689			1252			100
14-Aug					0	1,689			1252			100
15-Aug	0				0	1,689			1252			100
16-Aug					0	1,689			1252			100

Table 4. (page 2 of 2)

Date	Daily					Cumulative				Percent Passage		
	1995	1996	1997	1998	2000	1995	1996	1997	2000	1996	1997	2000
17-Aug					0	1,689			1252			100
18-Aug					0	1,689			1252			100
19-Aug					0	1,689			1252			100
20-Aug					1	1,689			1253			100
21-Aug	0				0	1,689			1253			100
22-Aug					0	1,689			1253			100
23-Aug	0				0	1,689			1253			100
24-Aug					0	1,689			1253			100
25-Aug	0				0	1,689			1253			100
26-Aug					0	1,689			1253			100
27-Aug					0	1,689			1253			100
28-Aug	0				0	1,689			1253			100
29-Aug	0				1	1,689			1254			100
30-Aug	0				0	1,689			1254			100
31-Aug	0				0	1,689			1254			100
1-Sep	0				0	1,689			1254			100
2-Sep					0				1254			100
3-Sep					0				1254			100
4-Sep					0				1254			100
5-Sep					0				1254			100
6-Sep					0				1254			100
7-Sep					0				1254			100
8-Sep					0				1254			100
9-Sep					0				1254			100
10-Sep					0				1254			100
11-Sep					0				1254			100
12-Sep					0				1254			100
13-Sep					0				1254			100
14-Sep					0				1254			100
15-Sep					0				1254			100
16-Sep					0				1254			100
17-Sep					0				1254			100
18-Sep					0				1254			100
19-Sep					0				1254			100
20-Sep					0				1254			100

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

Table 5. Estimated age and sex composition for chum salmon escapement at Takotna River weir, 2000

Sample Dates (Stratum Dates)	Sample size	Sex	Age Class 0.2		0.3		0.4		0.5		Total	
			# fish	%	# fish	%	# fish	%	# fish	%	# fish	%
7/5-7/7	85	M	0	0.0	73	17.6	117	28.2	5	1.2	195	47.1
(6/24- 7/9)		F	0	0.0	132	31.8	88	21.2	0	0.0	220	52.9
		Subtotal	0	0.0	205	49.4	205	49.4	5	1.2	415	100.0
7/12-7/14	117	M	0	0.0	58	20.5	41	14.6	0	0.0	98	34.9
(7/10-7/16)		F	0	0.0	120	42.7	62	22.2	0	0.0	183	65.1
		Subtotal	0	0.0	178	63.2	103	36.8	0	0.0	281	100.0
7/19-7/21	140	M	8	2.2	104	30.0	52	15.0	0	0.0	163	47.1
(7/17-7/24)		F	7	2.1	131	37.9	44	12.9	0	0.0	183	52.9
		Subtotal	15	4.3	235	67.9	96	27.9	0	0.0	346	100.0
7/28-7/29	23	M	0	0.0	55	26.1	19	8.7	0	0.0	74	34.8
(7/25- 8/29)		F	18	8.7	102	47.8	18	8.7	0	0.0	138	65.2
		Subtotal	18	8.7	157	73.9	37	17.4	0	0.0	212	100.0
Seasonal	365	M	7	0.6	290	23.1	229	18.2	5	0.4	531	42.3
		F	26	2.1	484	38.6	213	17.0	0	0.0	723	57.7
		Total	33	2.7	774	61.7	442	35.2	5	0.4	1254	100.0

Table 6. Estimated mean length (mm) of chum salmon escapement at Takotna River weir, 2000.

Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
7/5-7/7	M	Mean Length		554	606	648
(6/24- 7/9)		Std. Error		6	7	
		Range		507-580	540-658	648
		Sample Size	0	15	24	1
	F	Mean Length		542	576	
		Std. Error		4	9	
		Range		490-583	514-667	
		Sample Size	0	27	18	0
7/12-7/14	M	Mean Length		561	577	
(7/10-7/16)		Std. Error		3	4	
		Range		537-587	548-602	
		Sample Size	0	24	17	0
	F	Mean Length		540	558	
		Std. Error		3	6	
		Range		500-583	485-614	
		Sample Size	0	50	26	0
07/19-7/20	M	Mean Length	547	562	590	
(7/17-7/24)		Std. Error	29	4	8	
		Range	496-596	502-610	530-698	
		Sample Size	3	42	21	0
	F	Mean Length	546	542	551	
		Std. Error	23	3	7	
		Range	516-591	407-591	515-618	
		Sample Size	3	53	18	0
07/28-7/29	M	Mean Length		564	620	
(7/25- 8/29)		Std. Error		6		
		Range		548-588	620	
		Sample Size	0	6	2	0
	F	Mean Length	525	542	519	
		Std. Error	15	10	5	
		Range	510-540	485-587	514-523	
		Sample Size	2	11	2	0
Seasonal	M	Mean Length	547	560	598	648
		Std. Error	29	2	4	
		Range	496-596	502-610	530-698	648
		Sample Size	3	87	64	1
	F	Mean Length	531	542	560	
		Std. Error	13	3	4	
		Range	510-591	477-591	485-667	
		Sample Size	5	141	64	0

Table 7. Daily and cumulative passage of coho salmon and longnose suckers past Takotna River weir, 2000.

	Longnose Sucker			Coho Salmon		
Date	Daily	Cumulative	Percent Passage	Daily	Cumulative	Percent Passage
24-Jun	2	2	0	0	0	0
25-Jun	67	69	2	0	0	0
26-Jun	82	151	4	0	0	0
27-Jun	63	214	6	0	0	0
28-Jun	101	315	8	0	0	0
29-Jun	100	415	11	0	0	0
30-Jun	220	635	17	0	0	0
1-Jul	406	1041	27	0	0	0
2-Jul	641	1682	44	0	0	0
3-Jul	489	2171	57	0	0	0
4-Jul	264	2435	64	0	0	0
5-Jul	134	2569	68	0	0	0
6-Jul	107	2676	70	0	0	0
7-Jul	158	2834	75	0	0	0
8-Jul	229	3063	81	0	0	0
9-Jul	118	3181	84	0	0	0
10-Jul	112	3293	87	0	0	0
11-Jul	94	3387	89	0	0	0
12-Jul	56	3443	91	0	0	0
13-Jul	112	3555	94	0	0	0
14-Jul	60	3615	95	0	0	0
15-Jul	63	3678	97	0	0	0
16-Jul	22	3700	97	0	0	0
17-Jul	9	3709	98	0	0	0
18-Jul	7	3716	98	0	0	0
19-Jul	0	3716	98	0	0	0
20-Jul	3	3719	98	0	0	0
21-Jul	9	3728	98	0	0	0
22-Jul	4	3732	98	0	0	0
23-Jul	0	3732	98	0	0	0
24-Jul	0	3732	98	0	0	0
25-Jul	1	3733	98	0	0	0
26-Jul	4	3737	98	0	0	0
27-Jul	4	3741	98	0	0	0
28-Jul	1	3742	99	0	0	0
29-Jul	7	3749	99	0	0	0
30-Jul	0	3749	99	0	0	0
31-Jul	2	3751	99	0	0	0
1-Aug	2	3753	99	0	0	0
2-Aug	7	3760	99	0	0	0
3-Aug	3	3763	99	0	0	0
4-Aug	1	3764	99	3	3	0
5-Aug	8	3772	99	11	14	0
6-Aug	4	3776	99	8	22	1

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	Longnose Sucker			Coho Salmon		
Date	Daily	Cumulative	Percent Passage	Daily	Cumulative	Percent Passage
7-Aug	3	3779	99	14	36	1
8-Aug	3	3782	100	19	55	[illegible]
9-Aug	0	3782	100	40	95	2
10-Aug	1	3783	100	31	126	3
11-Aug	0	3783	100	44	170	4
12-Aug	7	3790	100	80	250	6
13-Aug	0	3790	100	42	292	7
14-Aug	0	3790	100	51	343	9
15-Aug	0	3790	100	58	401	10
16-Aug	0	3790	100	54	455	11
17-Aug	0	3790	100	98	553	14
18-Aug	0	3790	100	146	699	18
19-Aug	0	3790	100	192	891	23
20-Aug	0	3790	100	80	971	25
21-Aug	0	3790	100	387	1358	34
22-Aug	2	3792	100	178	1536	39
23-Aug	4	3796	100	241	1777	45
24-Aug	1	3797	100	152	1929	49
25-Aug	0	3797	100	107	2036	51
26-Aug	1	3798	100	86	2122	54
27-Aug	0	3798	100	314	2436	62
28-Aug	0	3798	100	490	2926	74
29-Aug	0	3798	100	140	3066	77
30-Aug	0	3798	100	120	3186	81
31-Aug	0	3798	100	62	3248	82
1-Sep	0	3798	100	70	3318	84
2-Sep	0	3798	100	66	3384	86
3-Sep	0	3798	100	54	3438	87
4-Sep	0	3798	100	70	3508	89
5-Sep	0	3798	100	46	3554	90
6-Sep	0	3798	100	100	3654	92
7-Sep	0	3798	100	42	3696	93
8-Sep	0	3798	100	25	3721	94
9-Sep	0	3798	100	30	3751	95
10-Sep	0	3798	100	36	3787	96
11-Sep	0	3798	100	40	3827	97
12-Sep	0	3798	100	27	3854	97
13-Sep	0	3798	100	29	3883	98
14-Sep	0	3798	100	16	3899	99
15-Sep	0	3798	100	9	3908	99
16-Sep	0	3798	100	15	3923	99
17-Sep	0	3798	100	5	3928	99
18-Sep	0	3798	100	8	3936	99
19-Sep	0	3798	100	10	3946	100
20-Sep	0	3798	100	11	3957	100

Table 8. Estimated age and sex composition for coho salmon escapement at Takotna River weir, 2000.

Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 1.1		2.1		3.1		Total	
			# fish	%	# fish	%	# fish	%	# fish	%
8/14	36	M	0	0.0	421	47.2	25	2.8	446	50.0
(8/4-8/19)		F	0	0.0	445	50.0	0	0.0	445	50.0
		Subtotal	0	0.0	866	97.2	25	2.8	891	100.0
8/25-8/27	152	M	0	0.0	1059	48.7	15	0.7	1073	49.3
(8/20-8/29)		F	0	0.0	1087	50.0	14	0.6	1102	50.7
		Subtotal	0	0.0	2146	98.7	29	1.3	2175	100.0
9/01-9/03	136	M	0	0.0	273	43.4	0	0.0	273	43.4
(8/30-9/7)		F	0	0.0	334	52.9	23	3.7	357	56.6
		Subtotal	0	0.0	607	96.3	23	3.7	630	100.0
9/11-9/13	71	M	4	1.4	106	40.9	0	0.0	110	42.3
(9/8-9/20)		F	7	2.8	140	53.5	4	1.4	151	57.7
		Subtotal	11	4.2	246	94.4	4	1.4	261	100.0
Seasonal	395	M	4	0.1	1860	47.0	39	1.0	1902	48.1
		F	7	0.2	2006	50.7	41	1.0	2055	51.9
		Total	11	0.3	3866	97.7	80	2.0	3957	100.0

Table 9. Estimated mean length (mm) of coho salmon escapement at Takotna River weir, 2000

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	2.1	3.1
8/14	M	Mean Length		541	650
(8/4-8/19)		Std. Error		9	
		Range		476- 614	650- 650
		Sample Size	0	17	1
	F	Mean Length		535	
		Std. Error		11	
		Range		425- 610	
		Sample Size	0	18	0
8/25-8/27	M	Mean Length		537	506
(8/20-8/29)		Std. Error		5	
		Range		412- 611	506- 506
		Sample Size	0	74	1
	F	Mean Length		552	543
		Std. Error		3	
		Range		488- 600	543- 543
		Sample Size	0	76	1
9/01-9/03	M	Mean Length		547	
(8/30-9/7)		Std. Error		6	
		Range		420- 640	
		Sample Size	0	59	0
	F	Mean Length		544	563
		Std. Error		4	13
		Range		435- 594	523- 597
		Sample Size	0	72	5
9/11-9/13	M	Mean Length	573	551	
(9/8-9/20)		Std. Error		8	
		Range	573- 573	444- 611	
		Sample Size	1	29	0
	F	Mean Length	571	558	575
		Std. Error	21	5	
		Range	550- 591	477- 614	575- 575
		Sample Size	2	38	1
Seasonal	M	Mean Length	573	540	597
		Std. Error		4	
		Range	573- 573	412- 640	506- 650
		Sample Size	1	179	2
	F	Mean Length	571	547	557
		Std. Error	21	3	13
		Range	550- 591	425- 614	523- 597
		Sample Size	2	204	7

Table 10. Juvenile chinook and coho salmon data collected in the Takotna River in 2000.

	Chinook						Coho					
Area[a]	seined fish	# seine sets	CPUE	trapped fish	# trap sets	CPUE	seined fish	# seine sets	CPUE	trapped fish	# trap sets	CPUE
1	5	19	0.26	0	9	0.00	0	19	0.00	0	9	0.00
2	171	62	2.76	15	70	0.21	0	62	0.00	0	70	0.00
3	15	3	5.00	58	34	1.71	10	3	3.33	10	34	0.29
4	0	11	0.00	26	16	1.63	0	11	0.00	3	16	0.19
5	1	7	0.14	0	5	0.00	0	7	0.00	0	5	0.00
6	0	3	0.00	0	15	0.00	0	3	0.00	0	15	0.00
7	0	3	0.00	0	0	NA	0	3	0.00	0	0	NA
8	0	0	NA	0	0	NA	0	0	NA	0	0	NA
9	0	6	0.00	0	0	NA	0	6	0.00	0	0	NA
10	0	10	0.00	0	0	NA	0	10	0.00	0	0	NA
11	0	8	0.00	0	0	NA	0	8	0.00	0	0	NA
12	0	0	NA	0	0	NA	0	0	NA	0	0	NA
	192	132	1.45	99	149	0.66	10	132	0.08	13	149	0.09

[a] Area:

1 below weir
2 above weir to 4th of July Creek
3 Big Creek
4 4th of July Creek
5 Fourth of July Creek to Big Waldren Fork
6 Bonnie Creek
7 Minnie Creek
8 Big Waldren Fork
9 Big Waldren Fork to Moore Creek/Little Waldren Confluence
10 Little Waldren Fork
11 Moore Creek
12 Big Creek (upper)

Table 11. Chemical analysis of water samples collected from selected Kuskokwim River tributary streams in 2000.

River	Date	Sta[a]	Depth[b] (m)	Specific conductance (umhos/cm)	pH	Alkalinity (mg/L)	Turbidity (NTU)	Color (Pt units)	Calcium (mg/L)	Magnesium (mg/L)	Iron (ug/L)	Reactive silicon (ug/L Si)
Takotna R	6/29		S	114	7.2	53.0	3.4	32	14.2	3.8	1,071	3,450
Takotna R	7/24		S	105	7.1	50.3	2.6	41	12.6	5.2	1,138	3,097
Takotna R	10/8		S	115	7.2	52.0	2.4	na	12.8	5.8	937	4,967
Tatlawiksuk R	6/18	W	S	101	7.0	49.8	6.8	28	15.3	2.9	595	3,802
Tatlawiksuk R	8/5	W	S	62	6.7	27.6	6.0	53	8.9	2.4	940	3,937
Tatlawiksuk R	8/15	W	S	53	5.9	22.3	29.5	62	7.2	2.4	2,429	3,555
George R	6/12	W	S	133	7.1	59.6	10.0	21	17.3	5.7	716	3,689
Kasigluk R	8/9		S	104	6.8	40.9	25.0	12	11.5	5.1	2,035	4,838
Kogrukluk R	8/1		S	83	6.9	30.5	2.1	12	10.2	3.0	114	3,404
Kogrukluk R	8/15		S	97	7.1	35.8	1.0	8	12.4	4.2	98	3,099
Kwethluk R	7/6		S	96	6.8	31.7	2.0	5	11.8	2.2	102	4,345
Kwethluk R	8/13		S	93	6.9	32.6	5.9	11	11.3	2.7	475	4,108

[a] Stations : weir

[b] Depth : surface

Table 12. Age and sex composition of chinook salmon escapement for selected Kuskokwim River tributary streams in 2000.

Project	Age Class (%)					Female
	1.1	1.2	1.3	1.4	1.5	(%)
Takotna	1.4	30.9	31.6	35.6	0.6	24.7
Tatlawiksuk (insufficient samples)						
Kogrukluk	0.0	9.9	49.2	39.1	1.8	41.2
George (insufficient samples)						
Aniak (not collected)						
Kwethluk	0.0	30	35.3	27.6	7.1	22.9

Table 13. Age and sex composition of chum salmon escapement for selected Kuskokwim River tributary streams in 2000.

Project	Age Class (%)				Female
	0.2	0.3	0.4	0.5	(%)
Takotna	2.7	61.7	35.2	0.4	57.7
Tatlawiksuk	2.0	57.6	39.9	0.5	48.2
Kogrukluk	0.9	69.2	29.5	0.4	13.4
George	1.4	46.7	50.4	1.6	43.5
Aniak	1.8	73.8	23.9	0.5	54.9
Kwethluk	0.7	62.8	36.0	0.5	49.5

Table 14. Age and sex composition of coho salmon escapement for selected Kuskokwim River tributary streams in 2000.

Project	Age Class			Female
	1.1	2.1	3.1	(%)
Takotna	0.3	97.7	2.0	51.9
Tatlawiksuk (insufficient samples)				
Kogrukluk (not available)				
George (not available)				
Aniak (not collected)				
Kwethluk	6.7	92.7	0.6	47.1

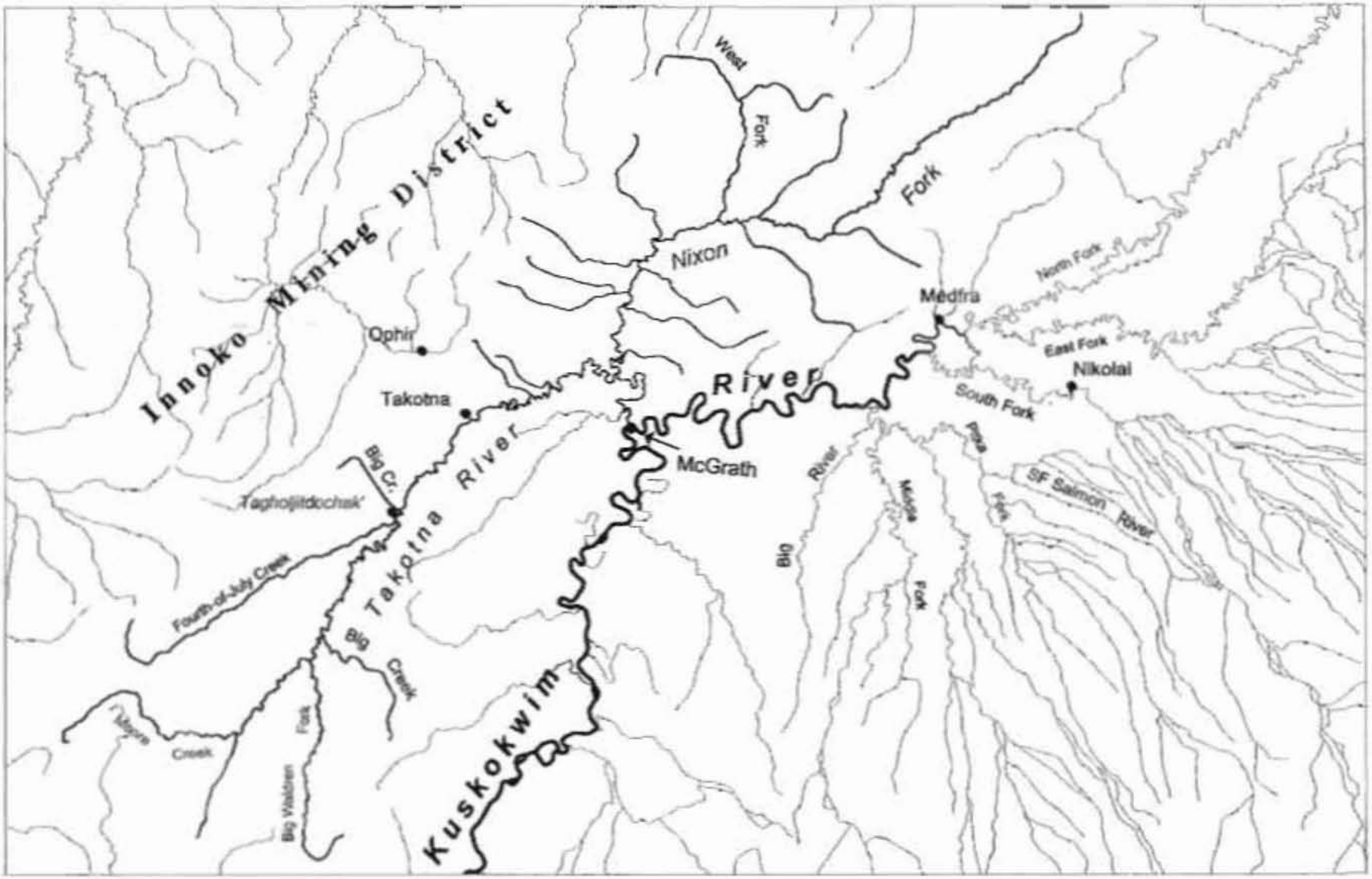


Figure 1. Takotna River drainage, upper Kuskokwim River basin.

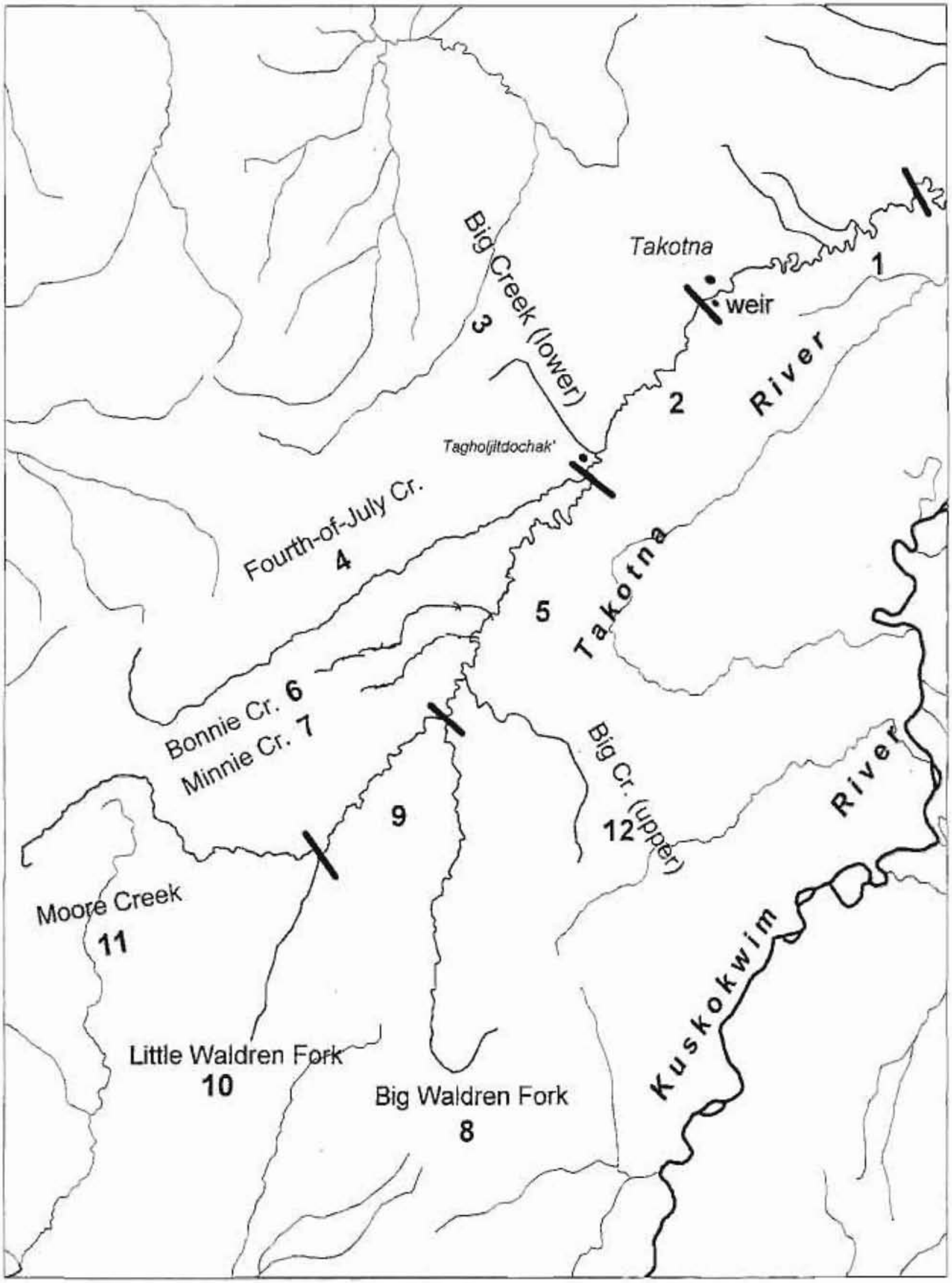


Figure 2. Juvenile salmon sampling areas in the Takotna River drainage.

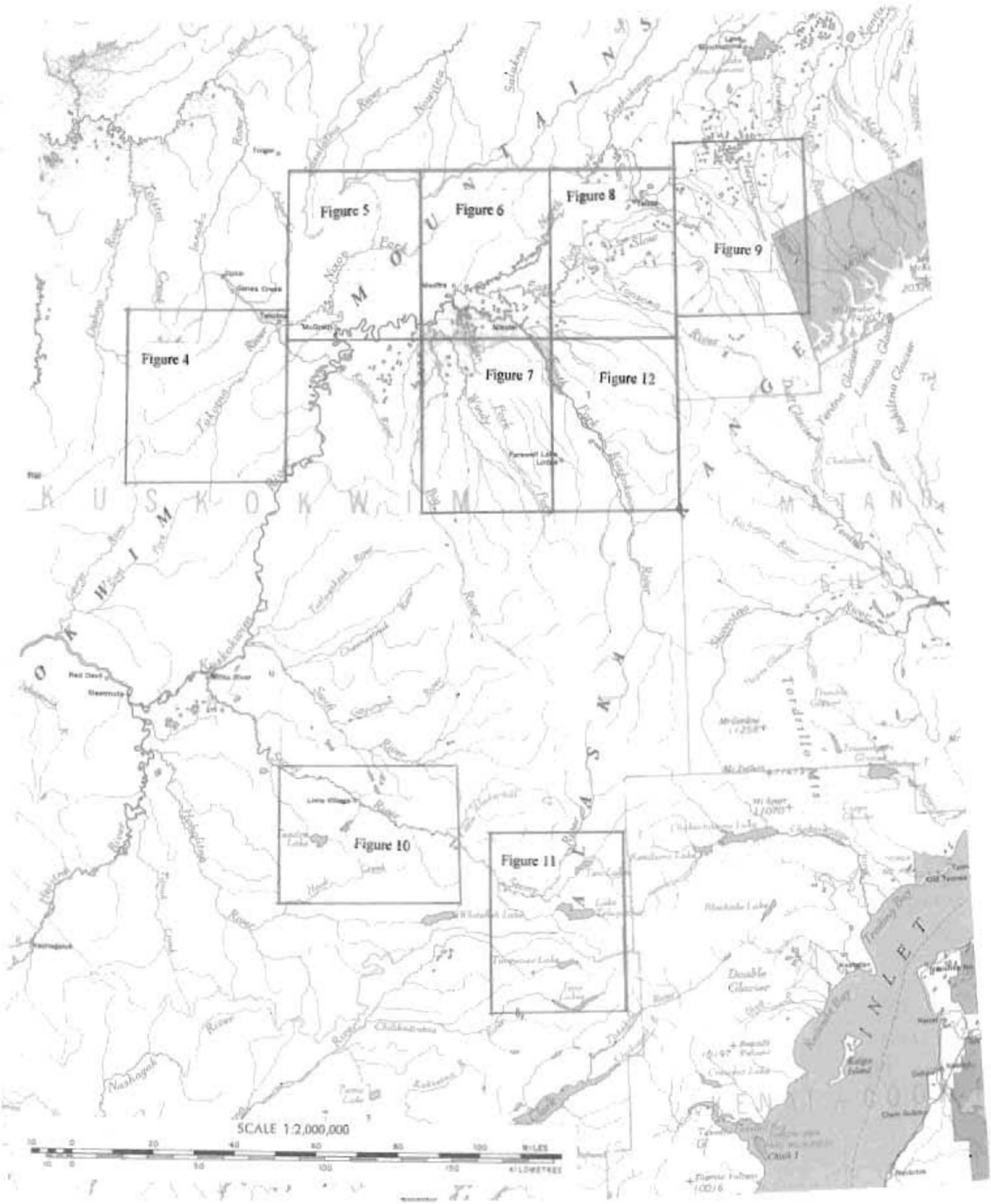


Figure 3. Reference map of upper Kuskokwim River for figures 4-12.

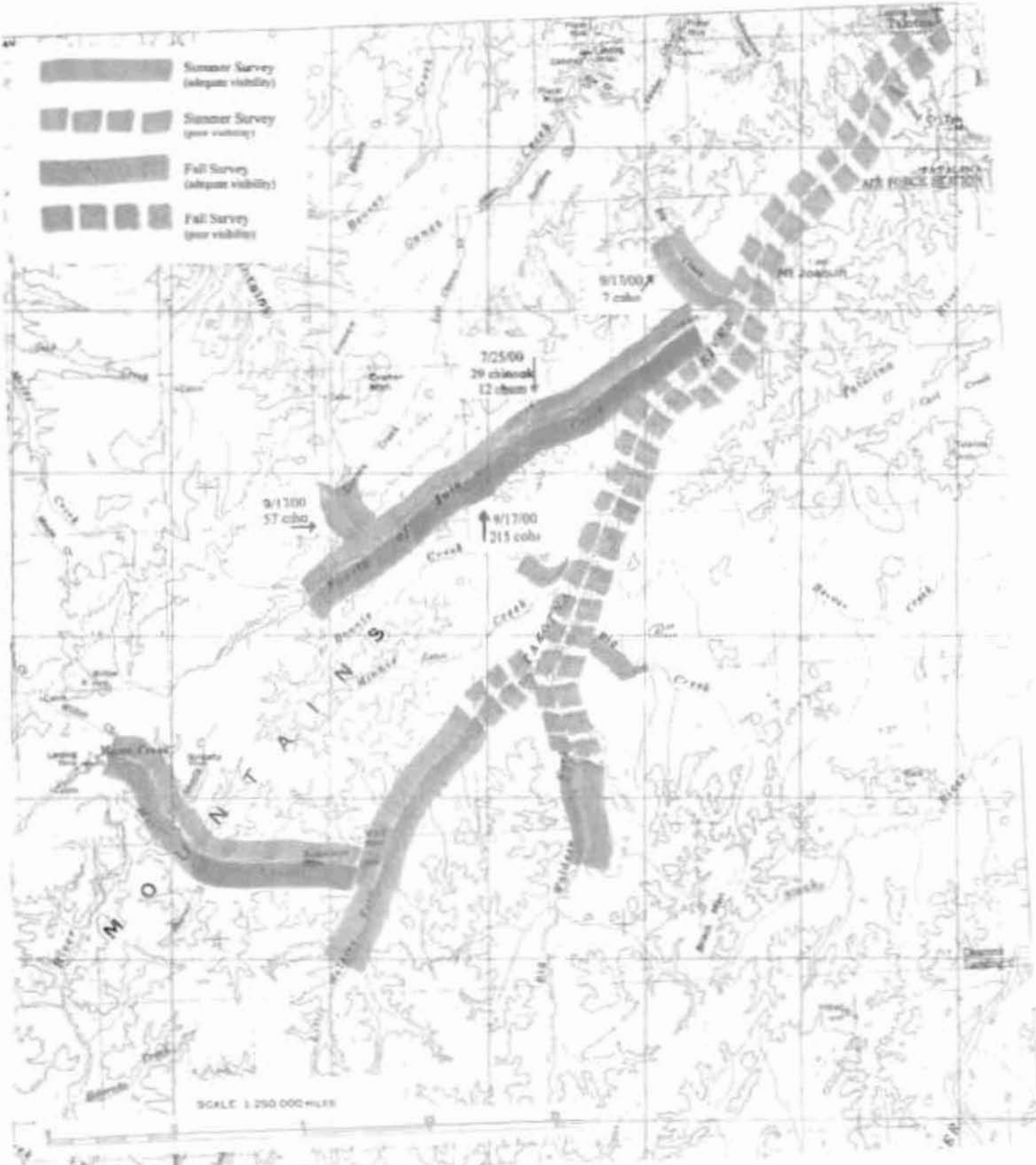


Figure 4. Aerial survey streams: Takotna River drainage.

Figure 5. Aerial survey streams: Nixon Fork drainage.

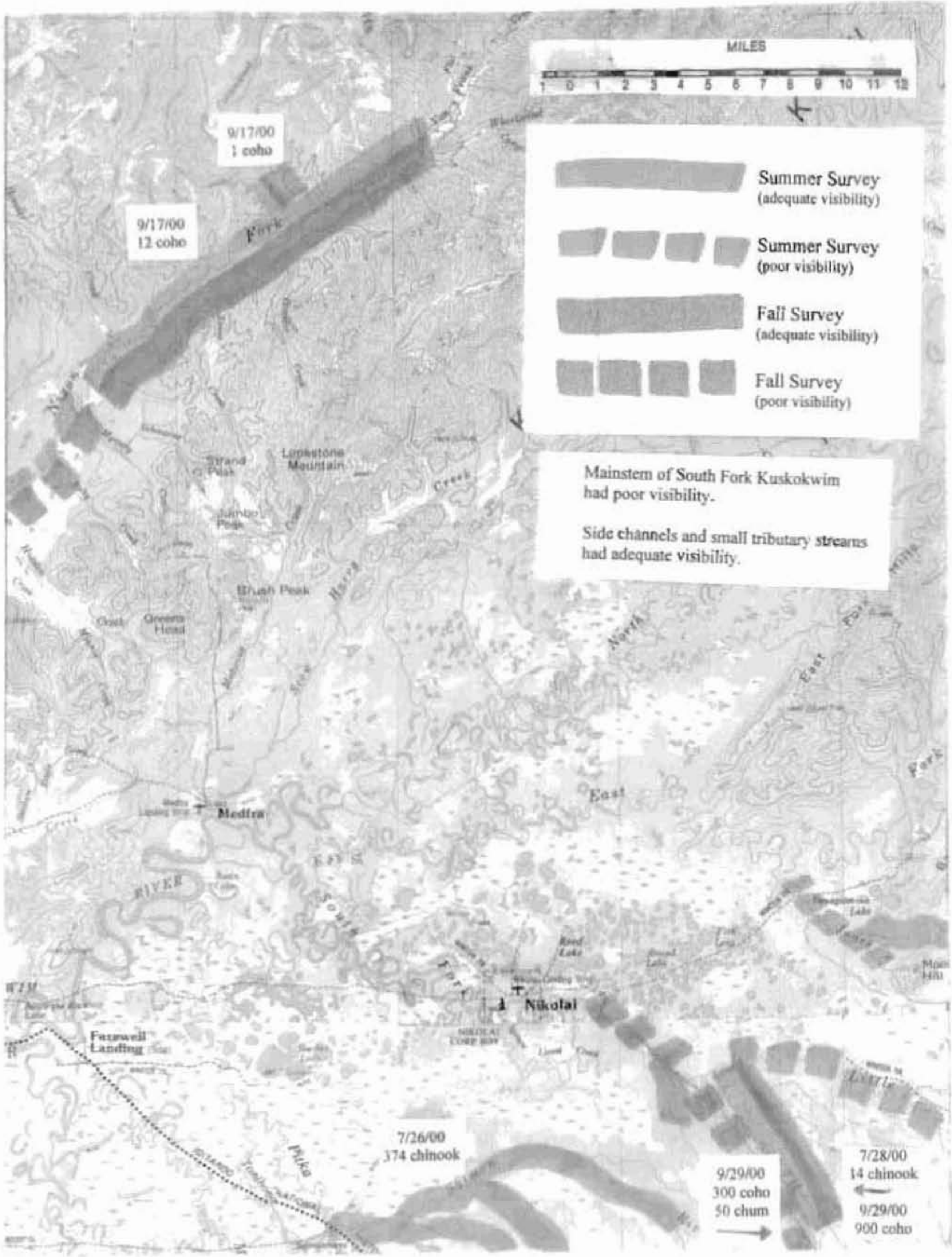


Figure 6. Aerial survey streams: upper Nixon Fork, lower South Fork, lower Pitka Fork and Jones Creek drainages.

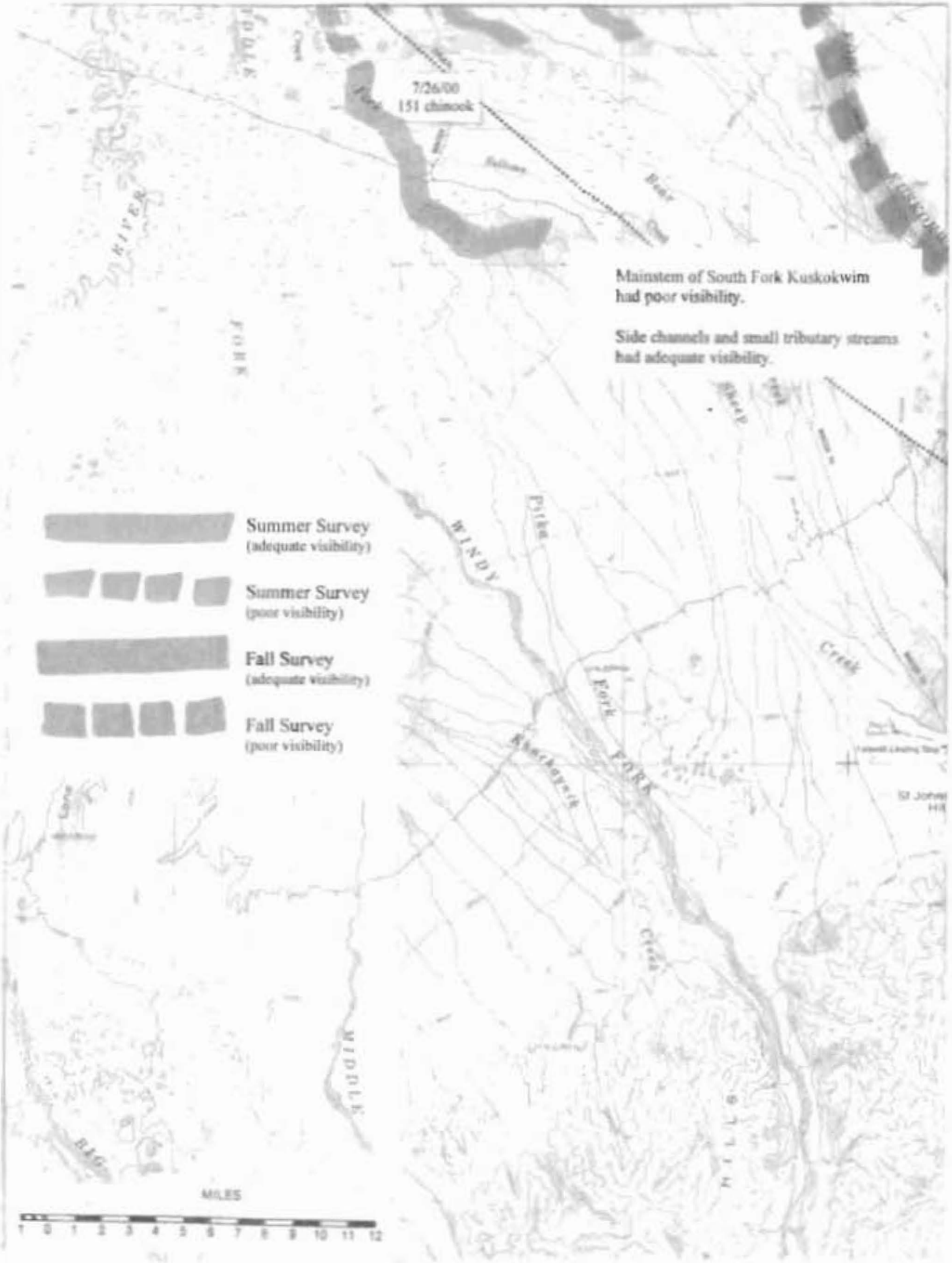


Figure 7. Aerial survey streams: upper Pitka Fork and South Fork drainages.

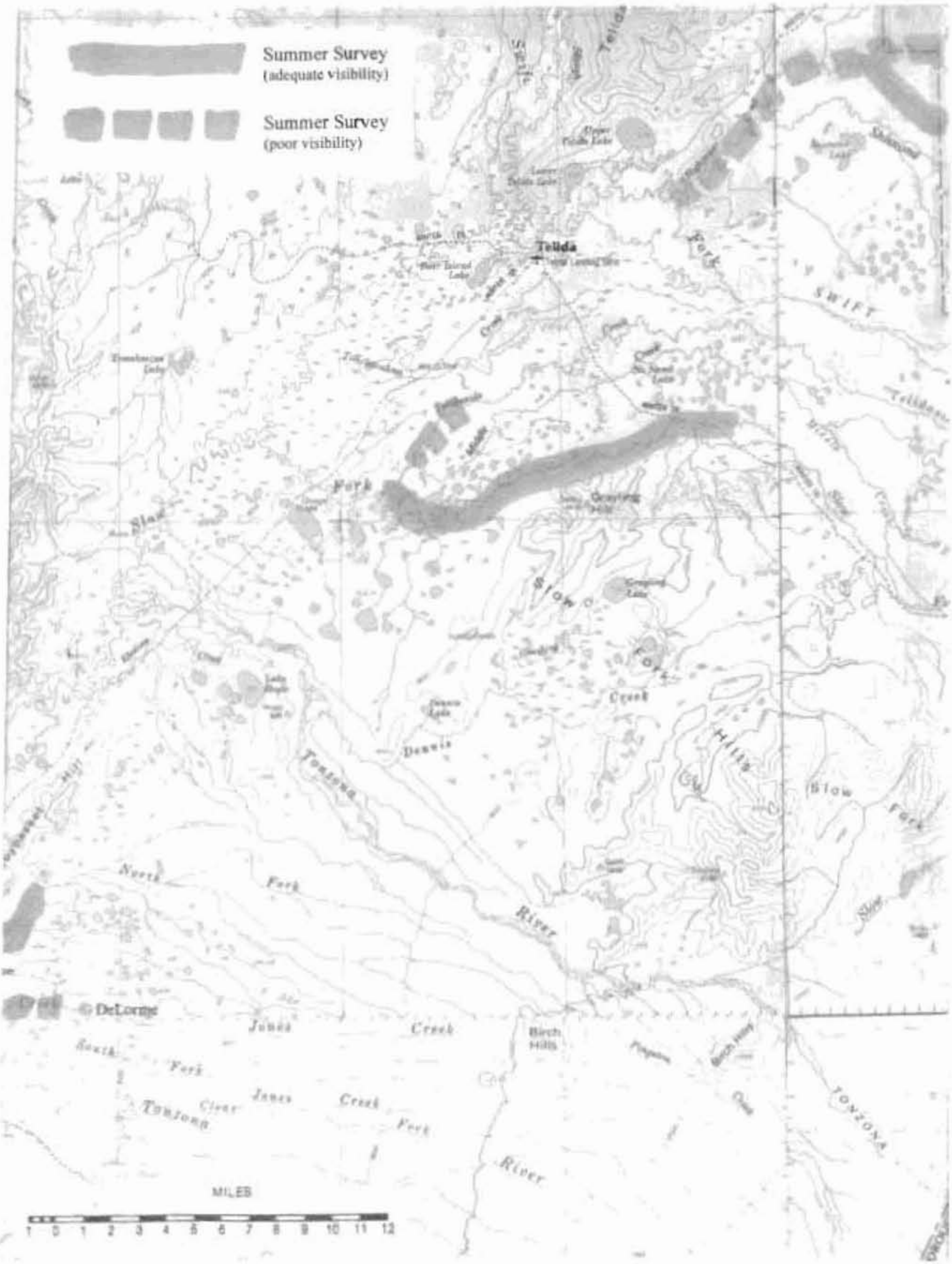


Figure 8. Aerial survey streams: upper Jones Creek, Slow Fork and Highpower Creek drainages.

Figure 9. Aerial survey streams: upper Highpower Creek drainage.

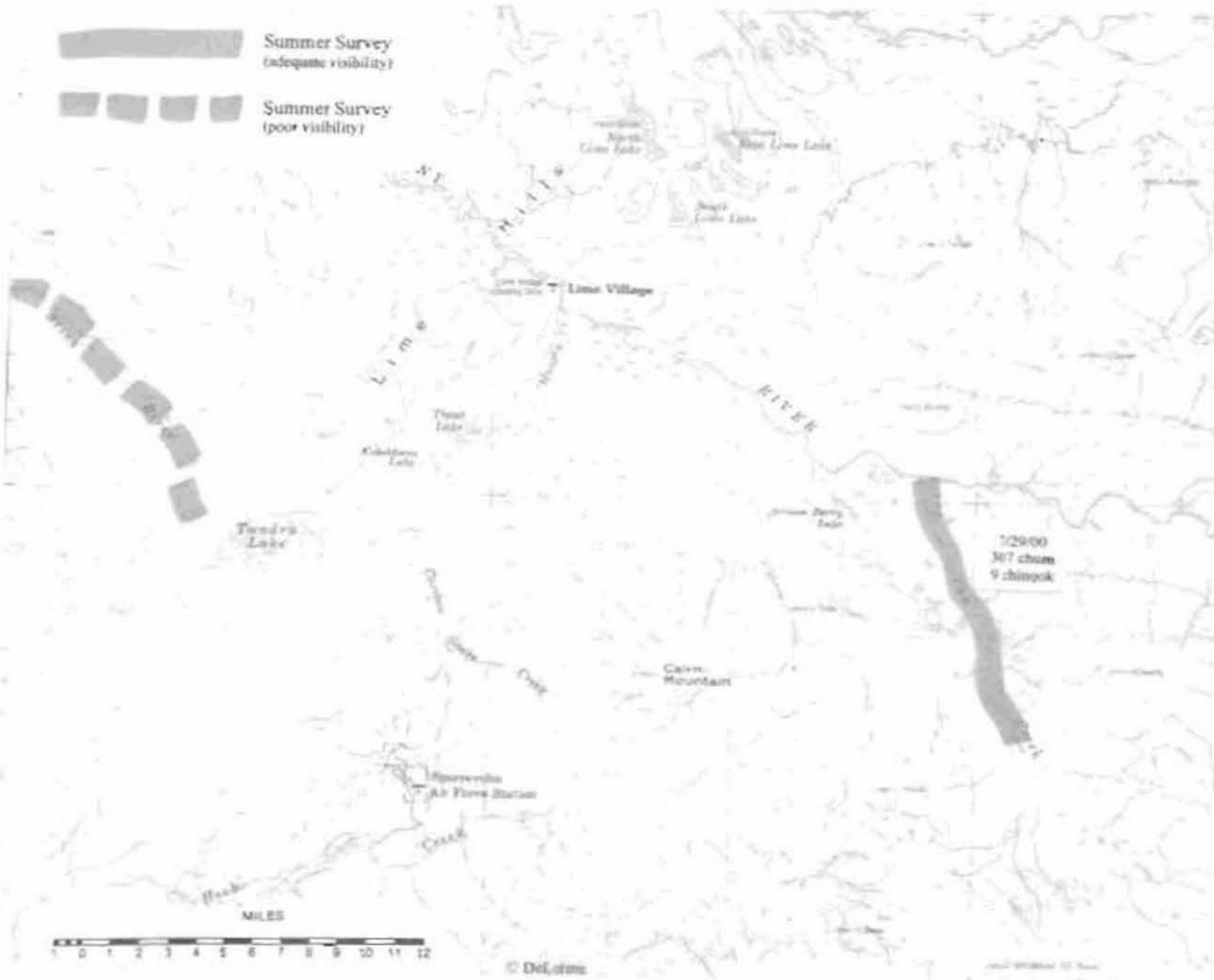


Figure 10. Aerial survey streams: Stink and Can Creek drainages.

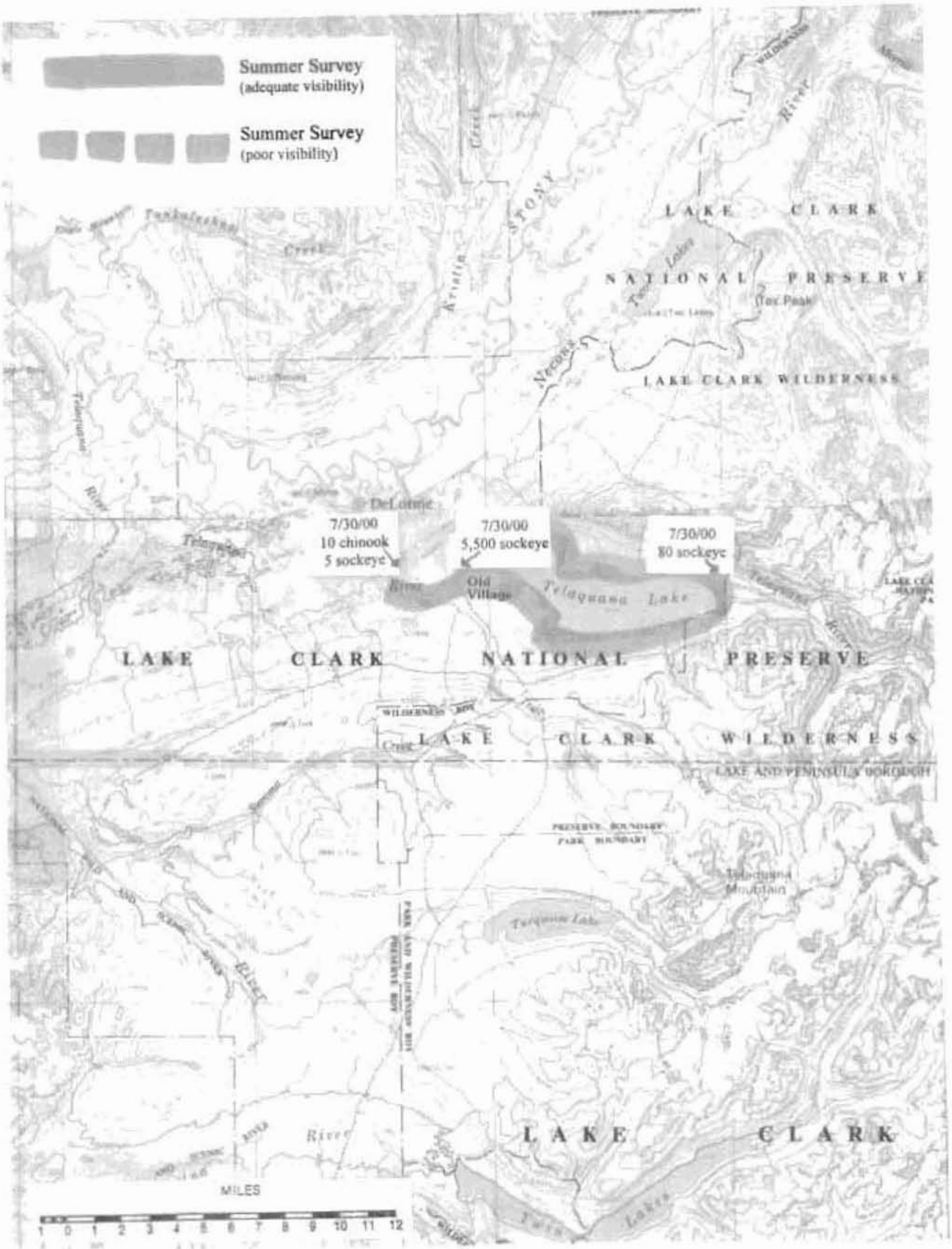


Figure 11. Aerial survey streams: Telaquana Lake and River drainage.

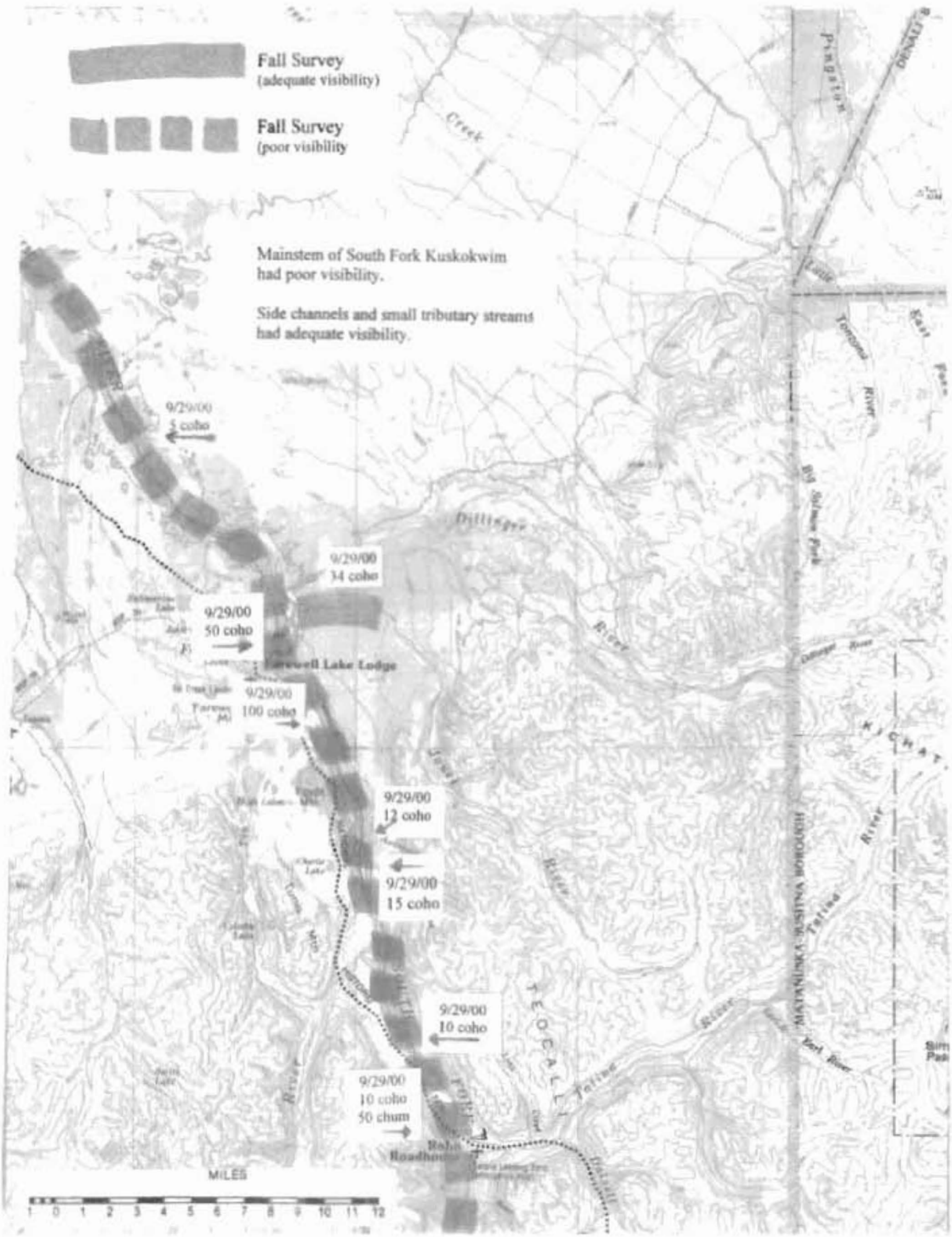


Figure 12. Aerial survey streams: South Fork drainage.

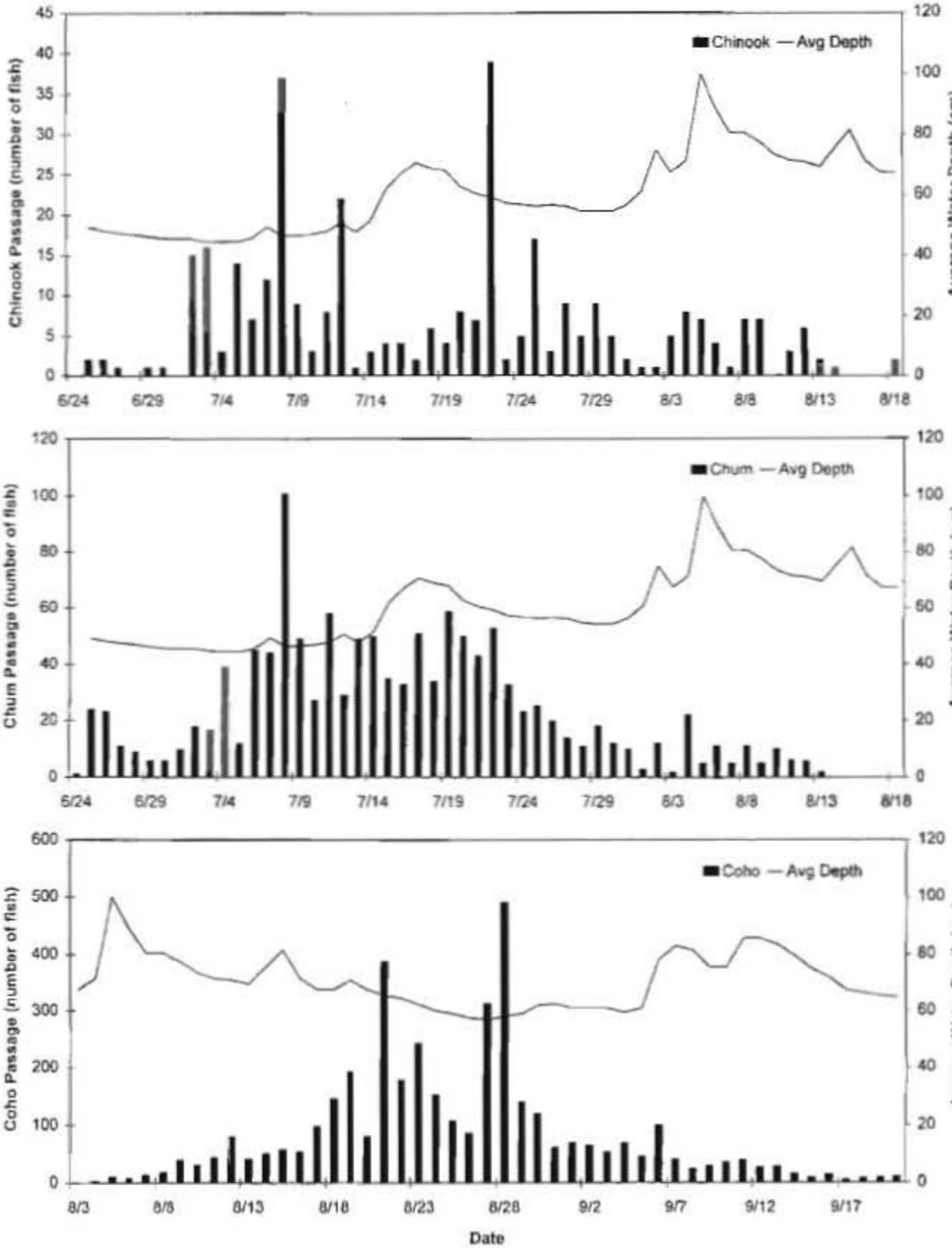


Figure 13. Daily chinook, chum and coho salmon passage at Takotna River weir relative to daily average water depth, 2000.

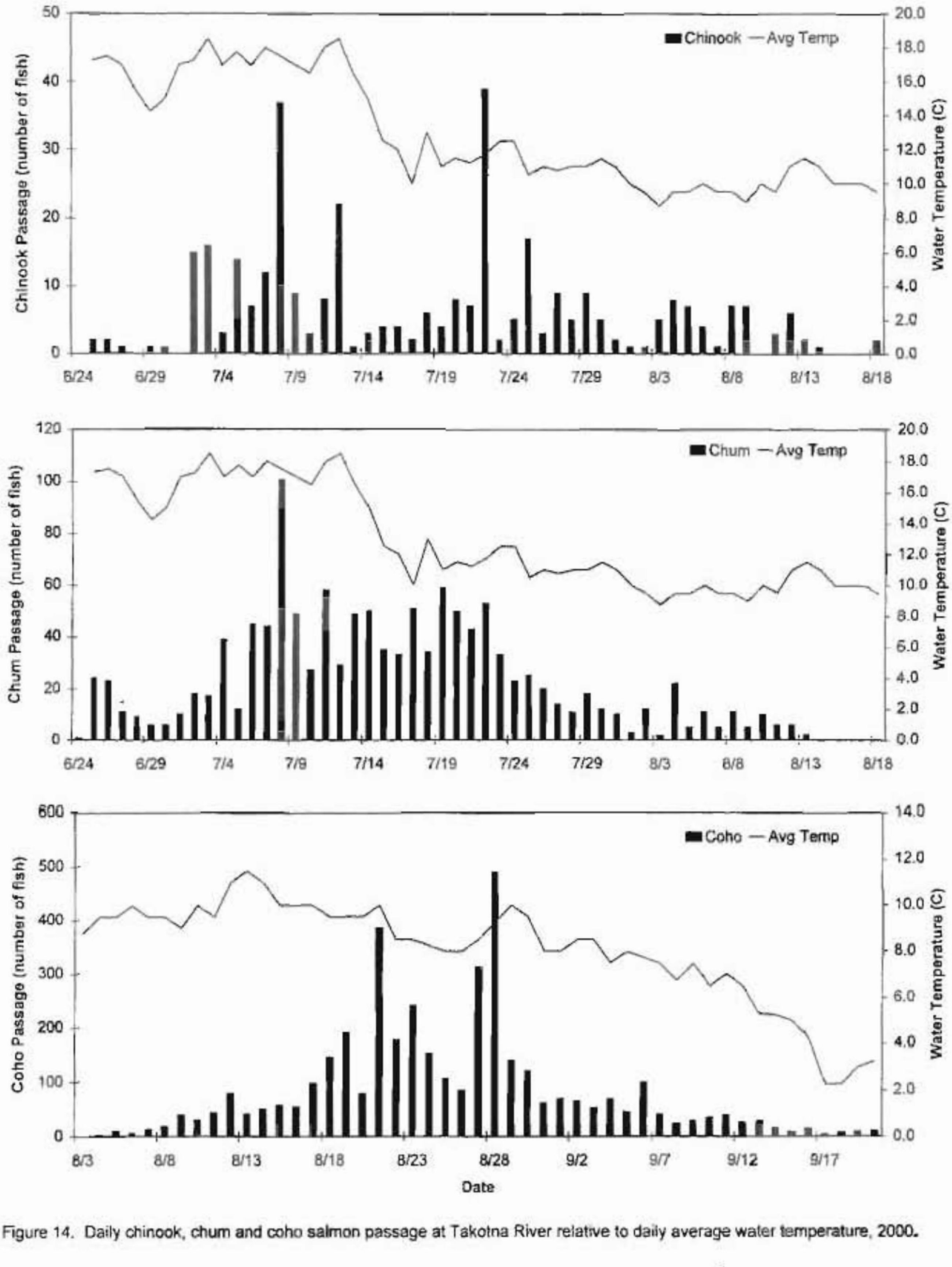


Figure 14. Daily chinook, chum and coho salmon passage at Takotna River relative to daily average water temperature, 2000.

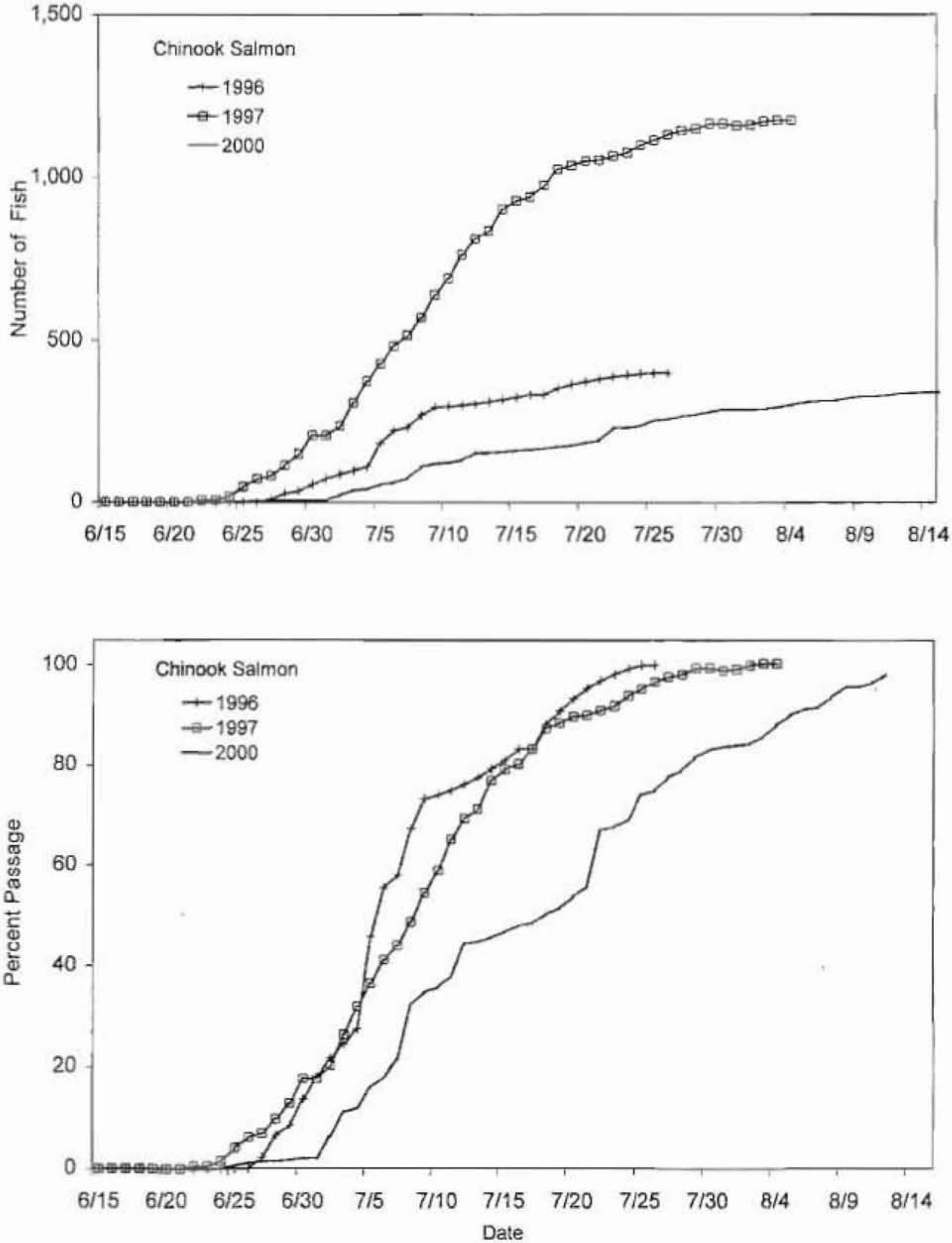


Figure 15. Cumulative and percent passage of chinook salmon migration past the Takotna River counting tower (1995-1997) and weir (2000).

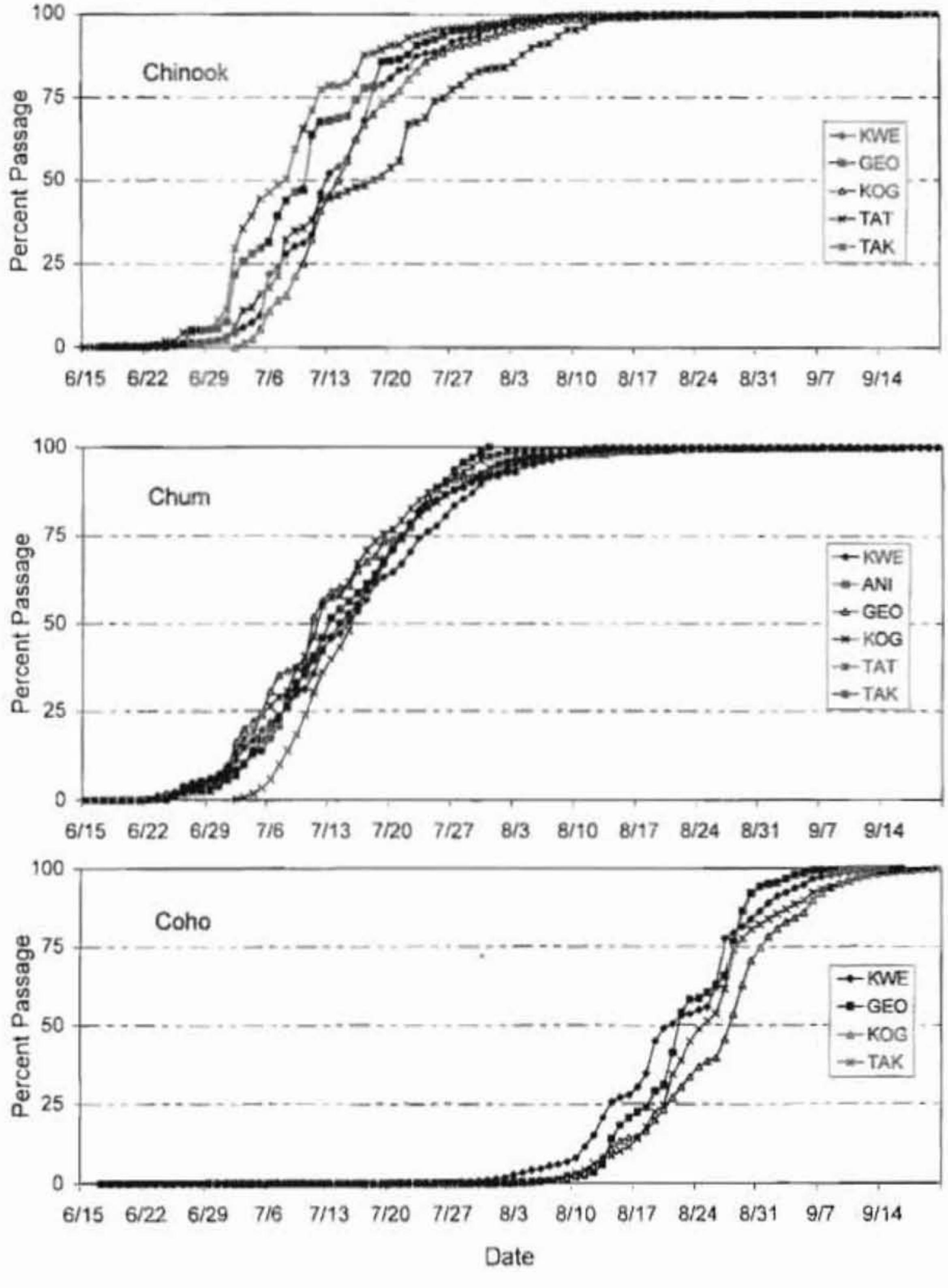


Figure 16. Run timing for chinook, chum and coho salmon based on percent passage for selected Kuskokwim River tributaries, 2000.

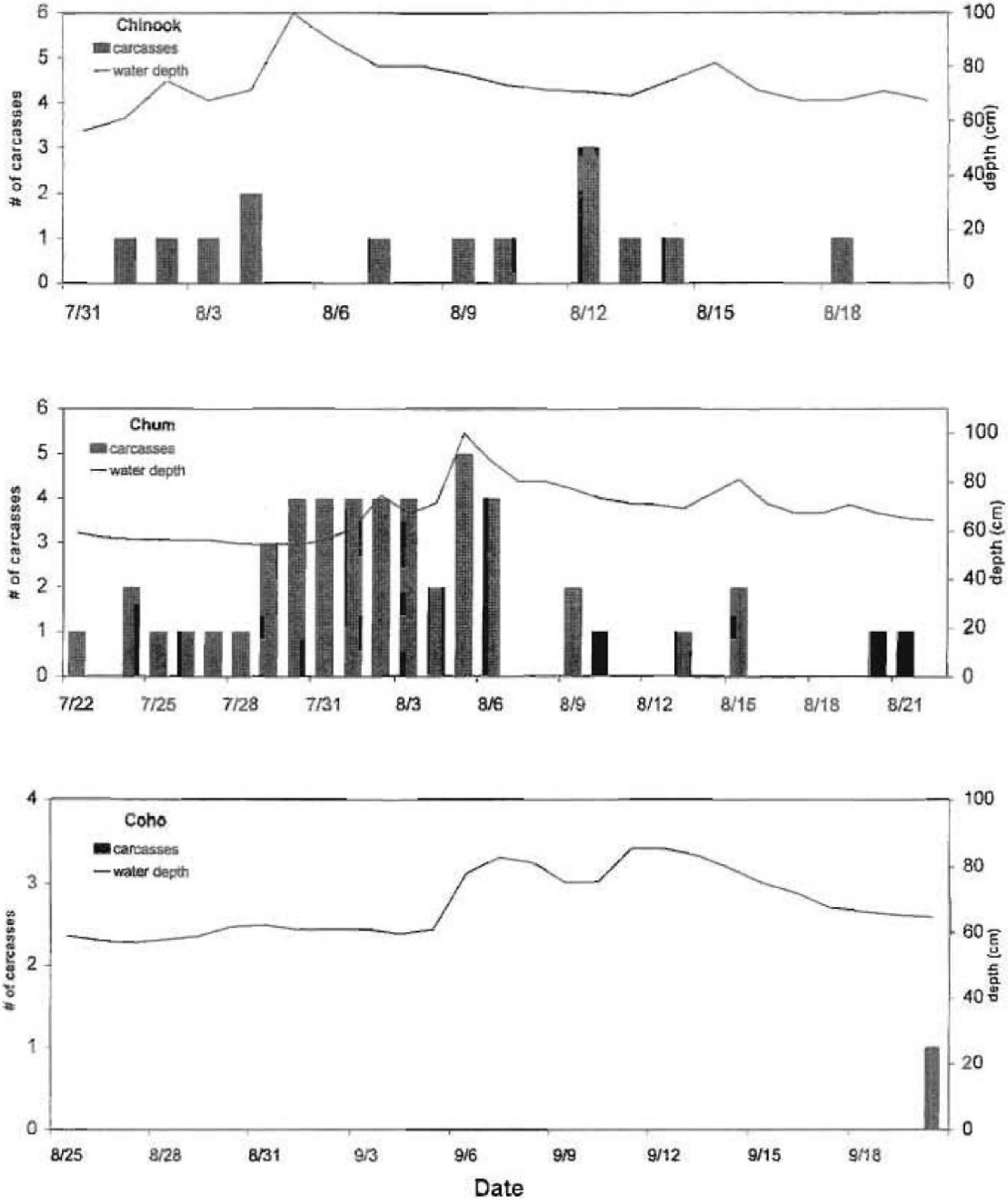


Figure 17. Daily salmon carcass counts at Takotna River weir relative to water depth, 2000.

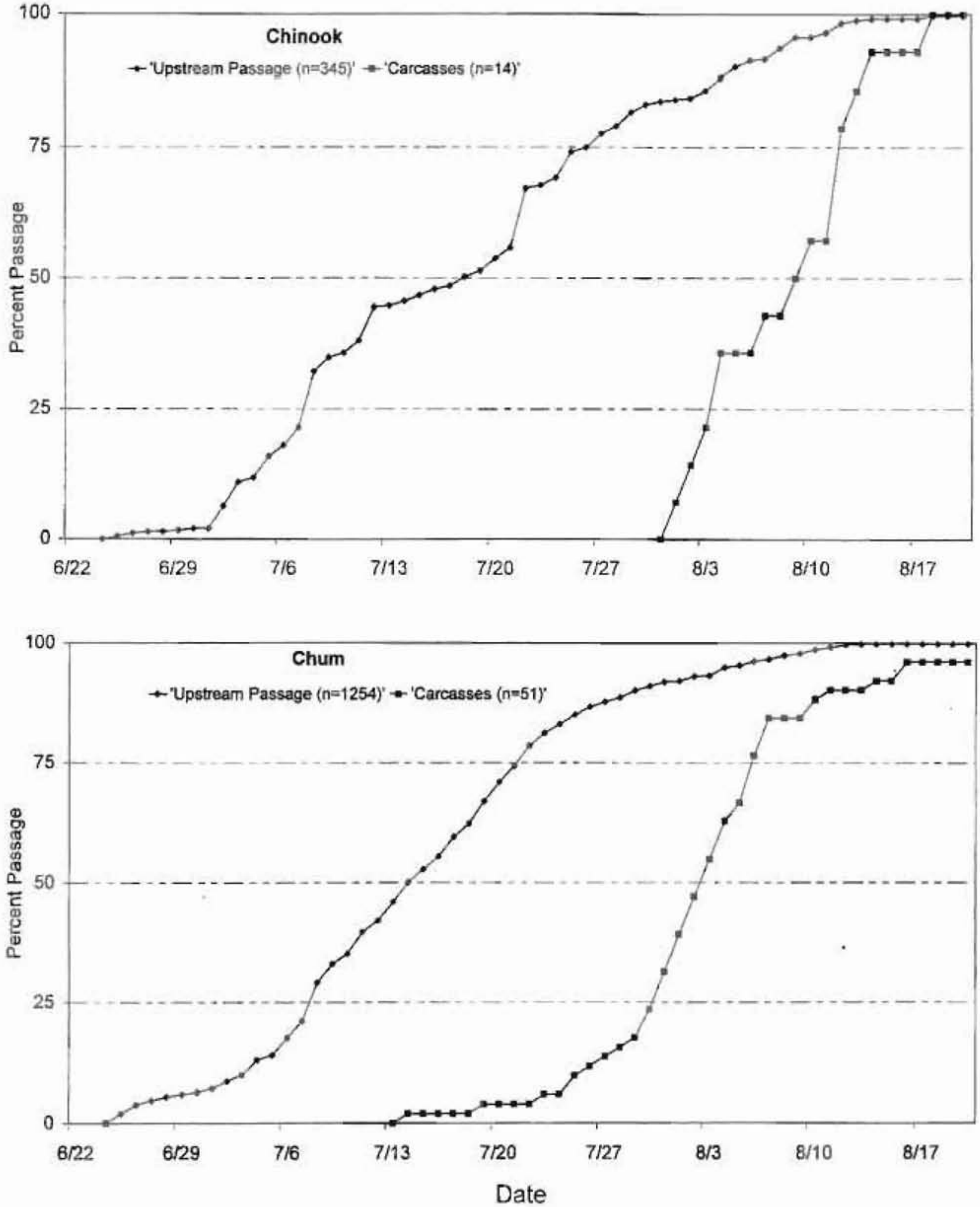
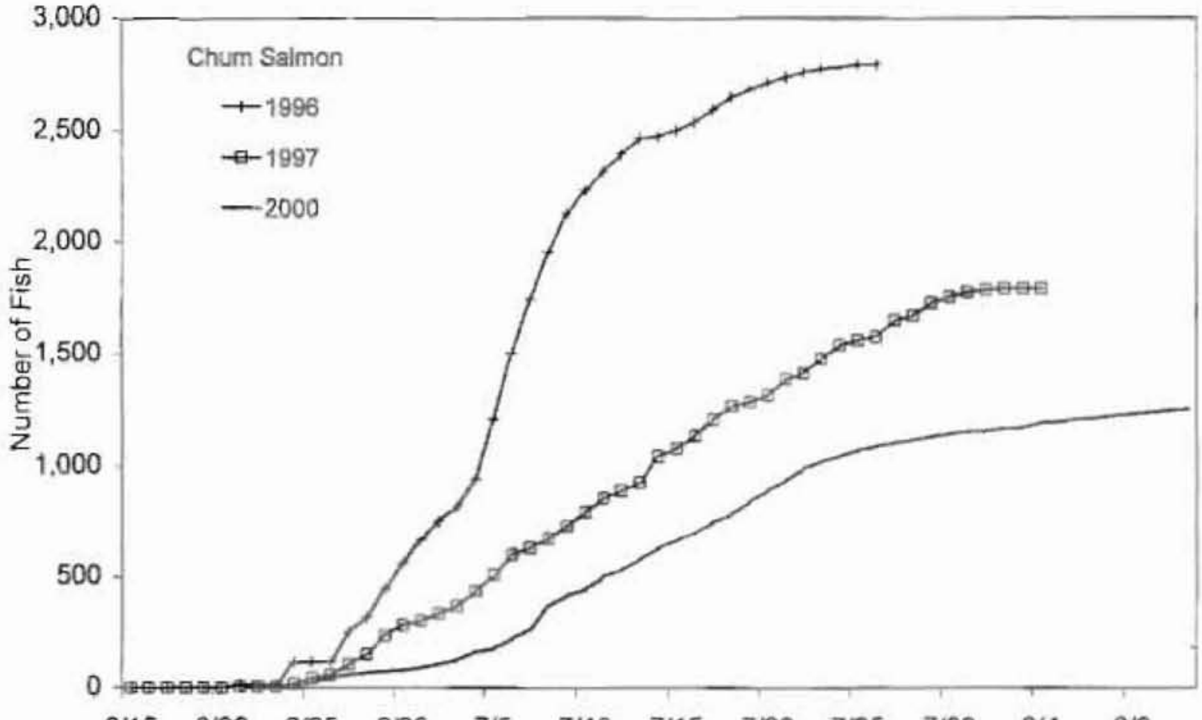


Figure 18. Cumulative percent upstream (live) and downstream (carcass) passage of chinook and chum salmon at Takotna River weir, 2000.



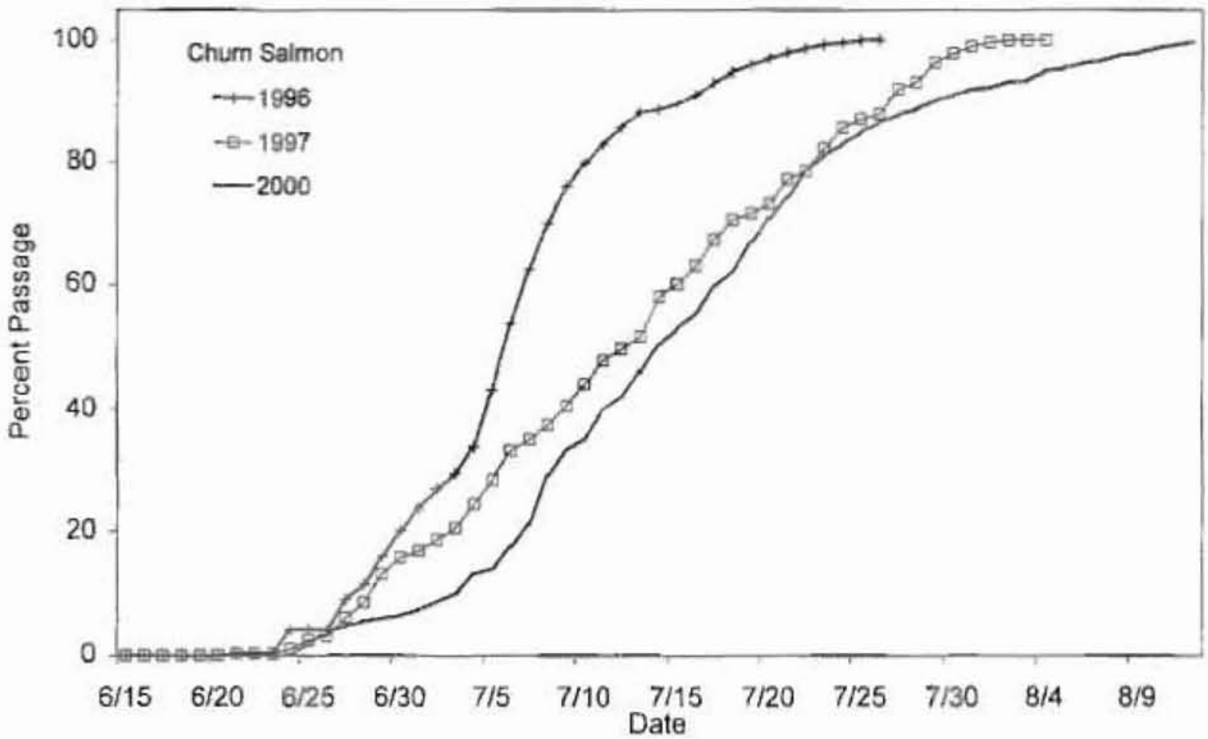


Figure 19. Cumulative and percent passage of chum salmon migration past the Takotna River counting tower (1995-1997) and weir (2000).

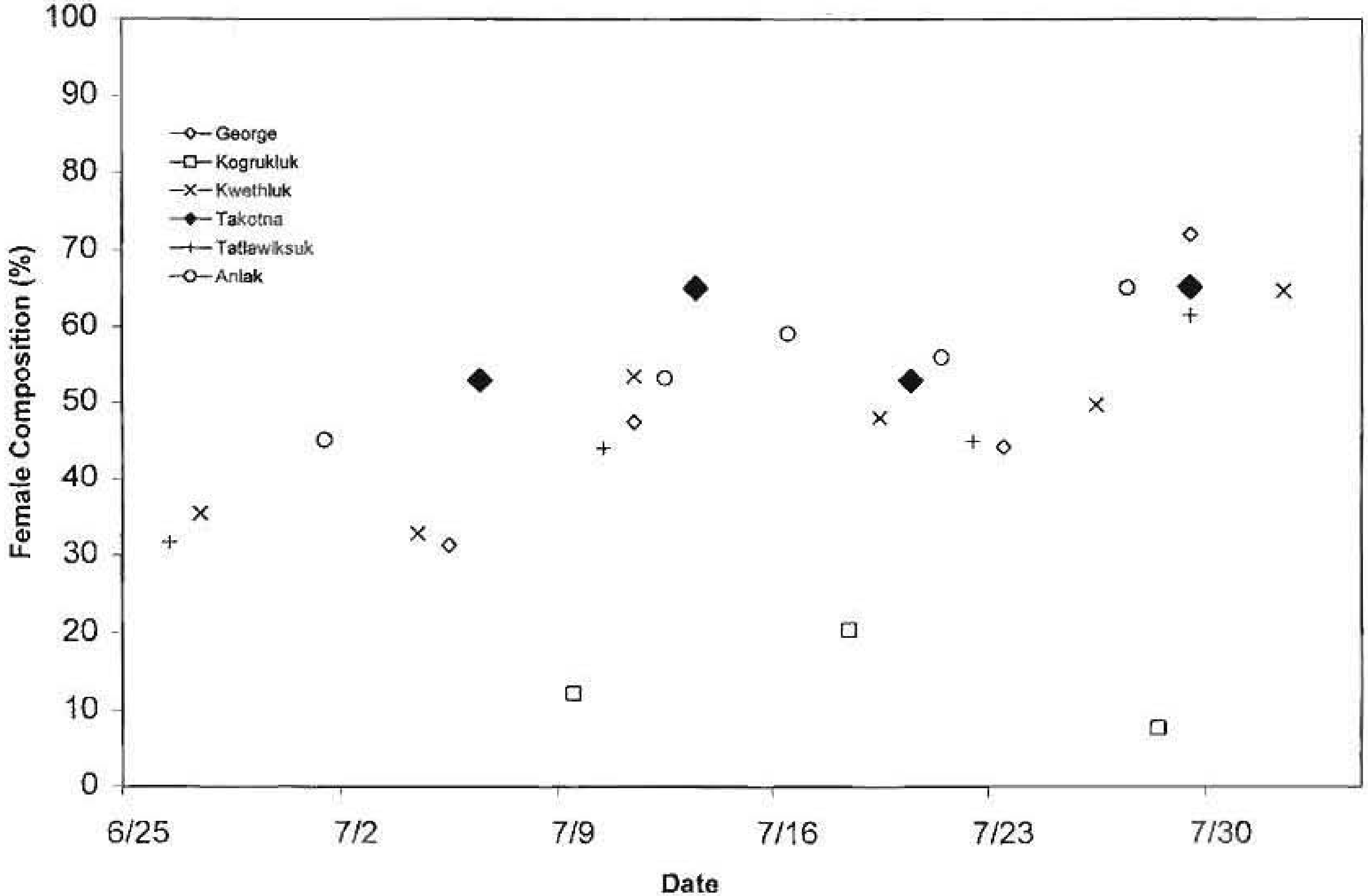


Figure 20. Proportion of female chum salmon, by sample dates, in selected Kuskokwim River tributaries, 2000.

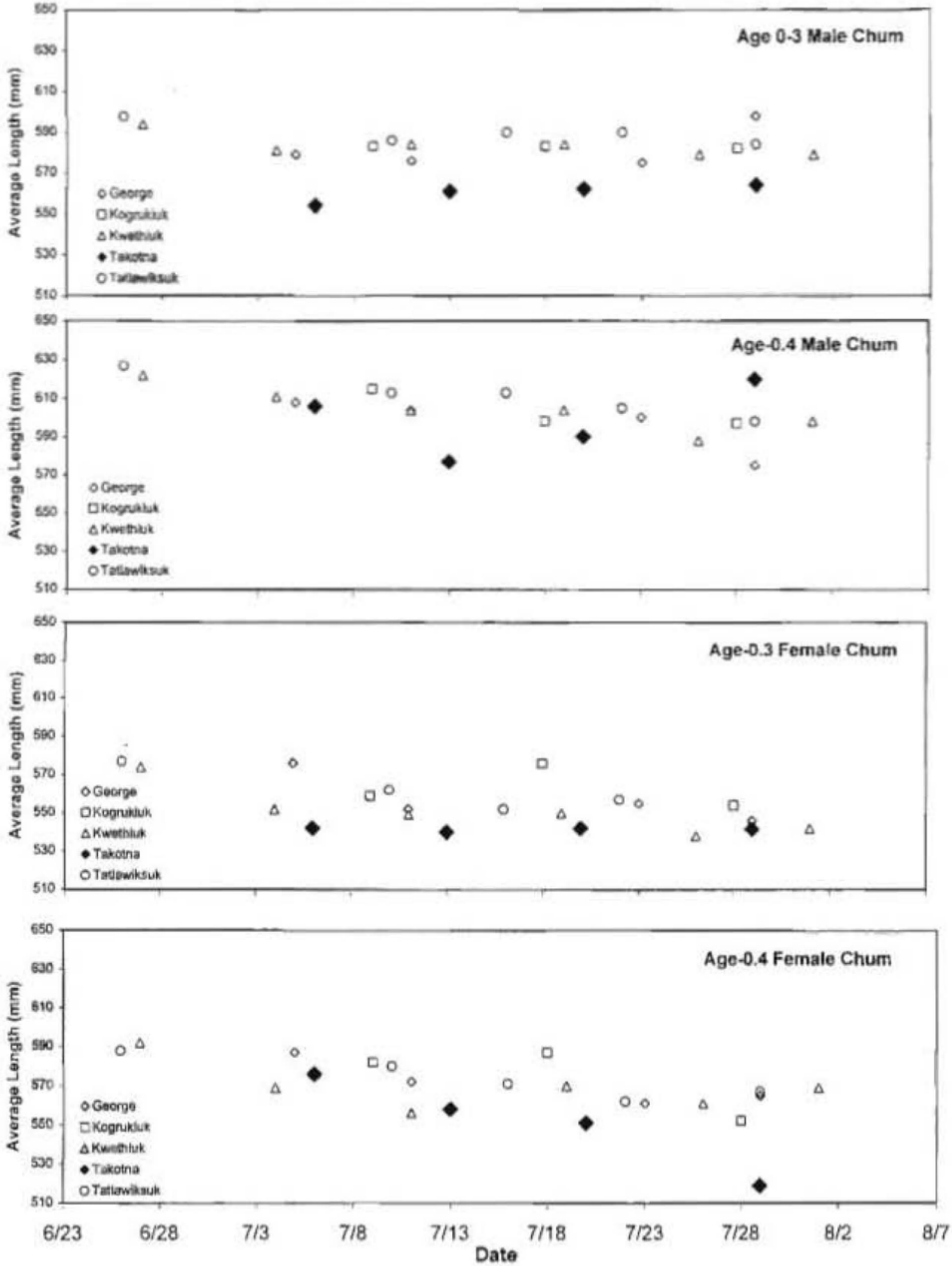


Figure 21. Average lengths of chum salmon, by sample date, in selected Kuskokwim River tributaries, 2000.

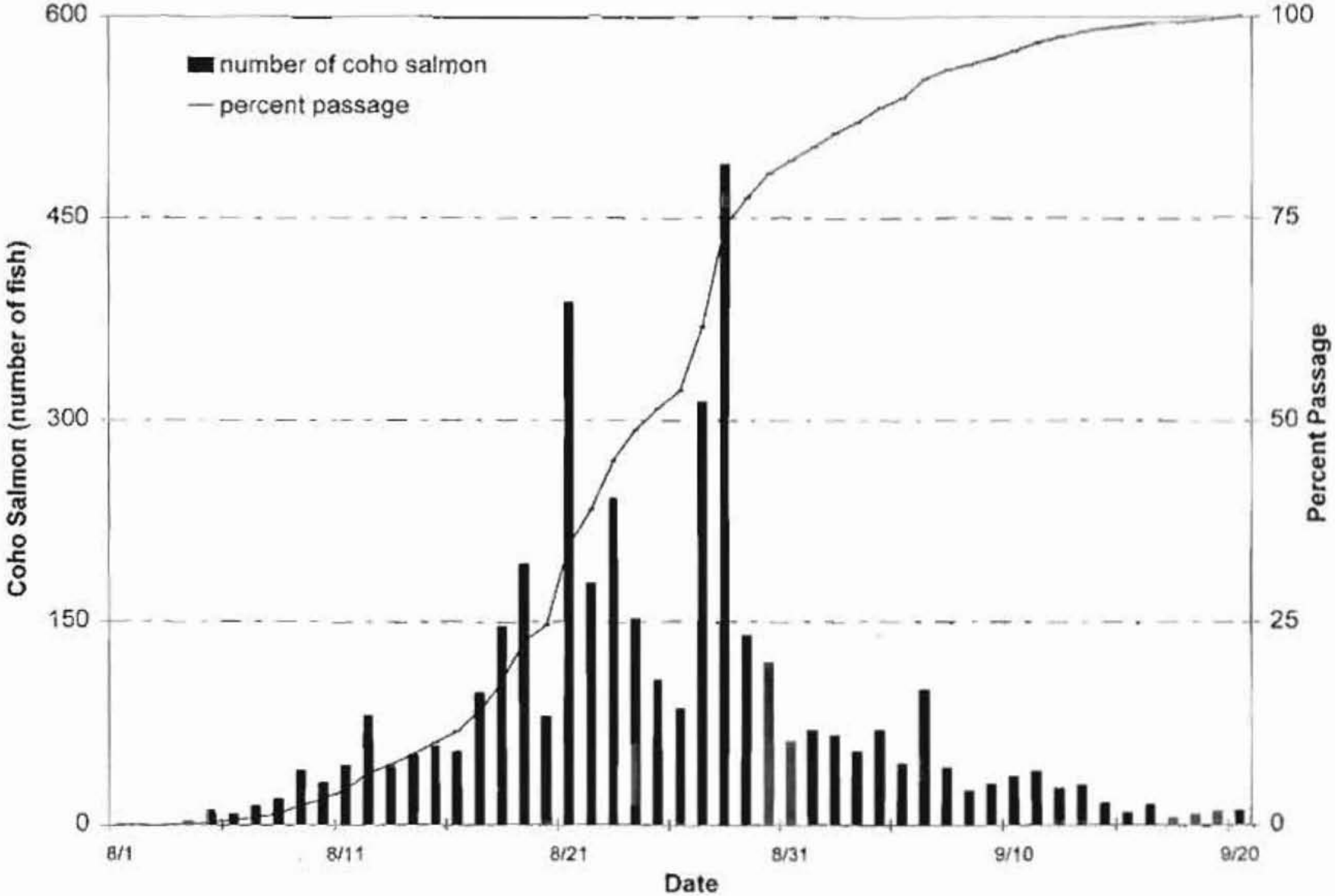


Figure 22. Daily and cumulative percent passage of coho salmon past the Takotna River weir, 2000.

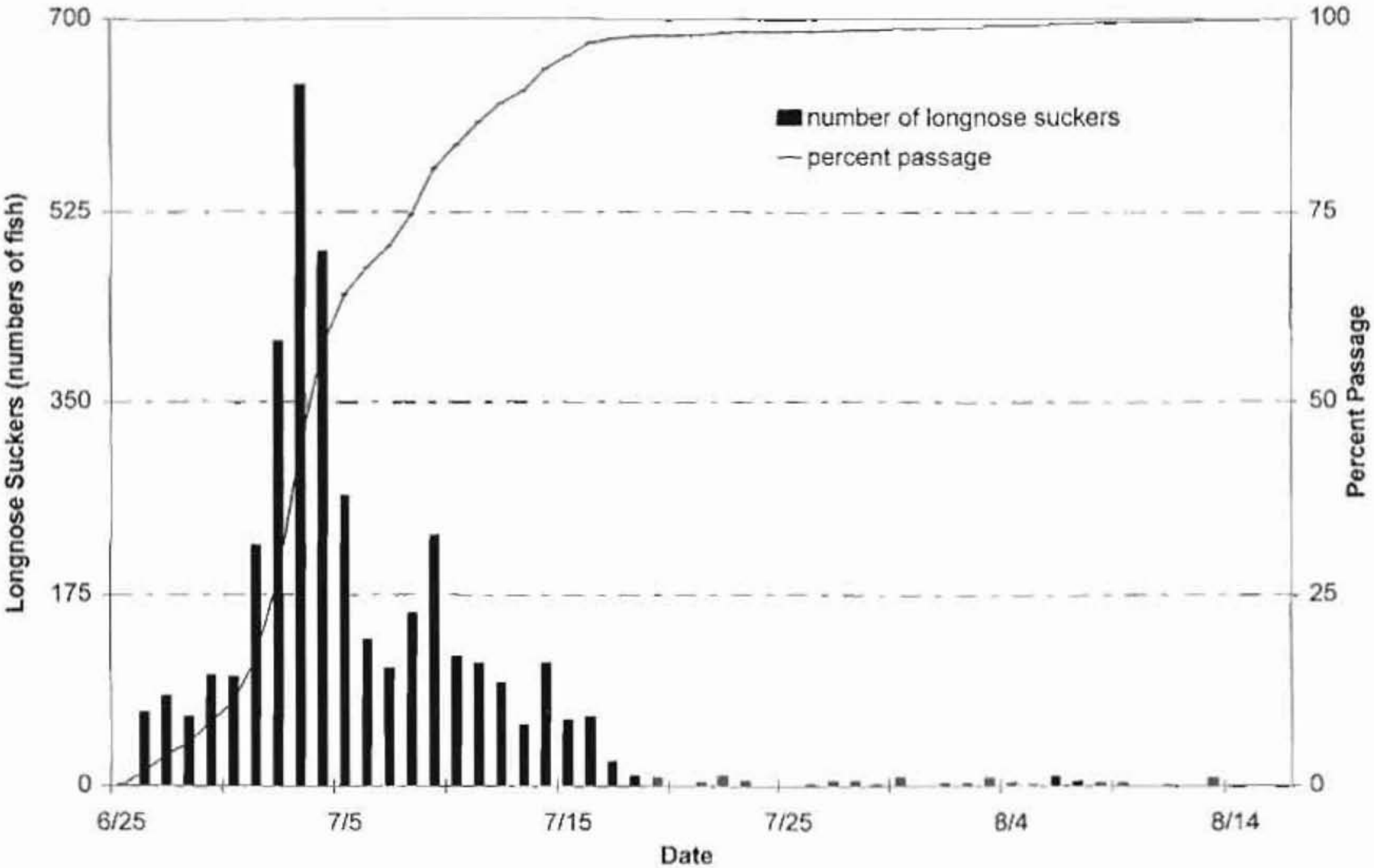


Figure 23. Daily and cumlative percent passage of longnose suckers past the Takotna River weir, 2000.

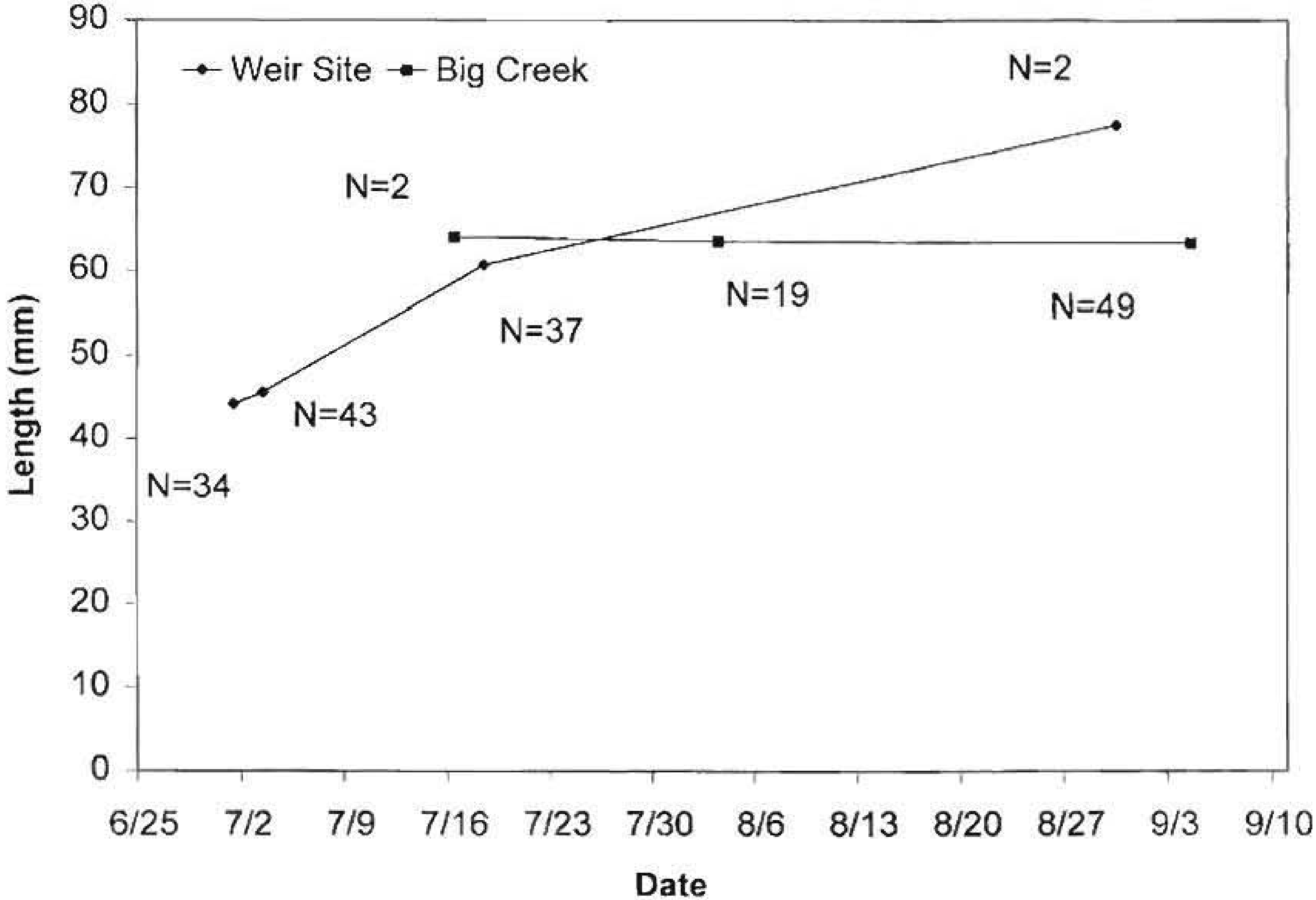


Figure 24. Average length measurements of juvenile chinook salmon from two sites on the Taktona River, 2000

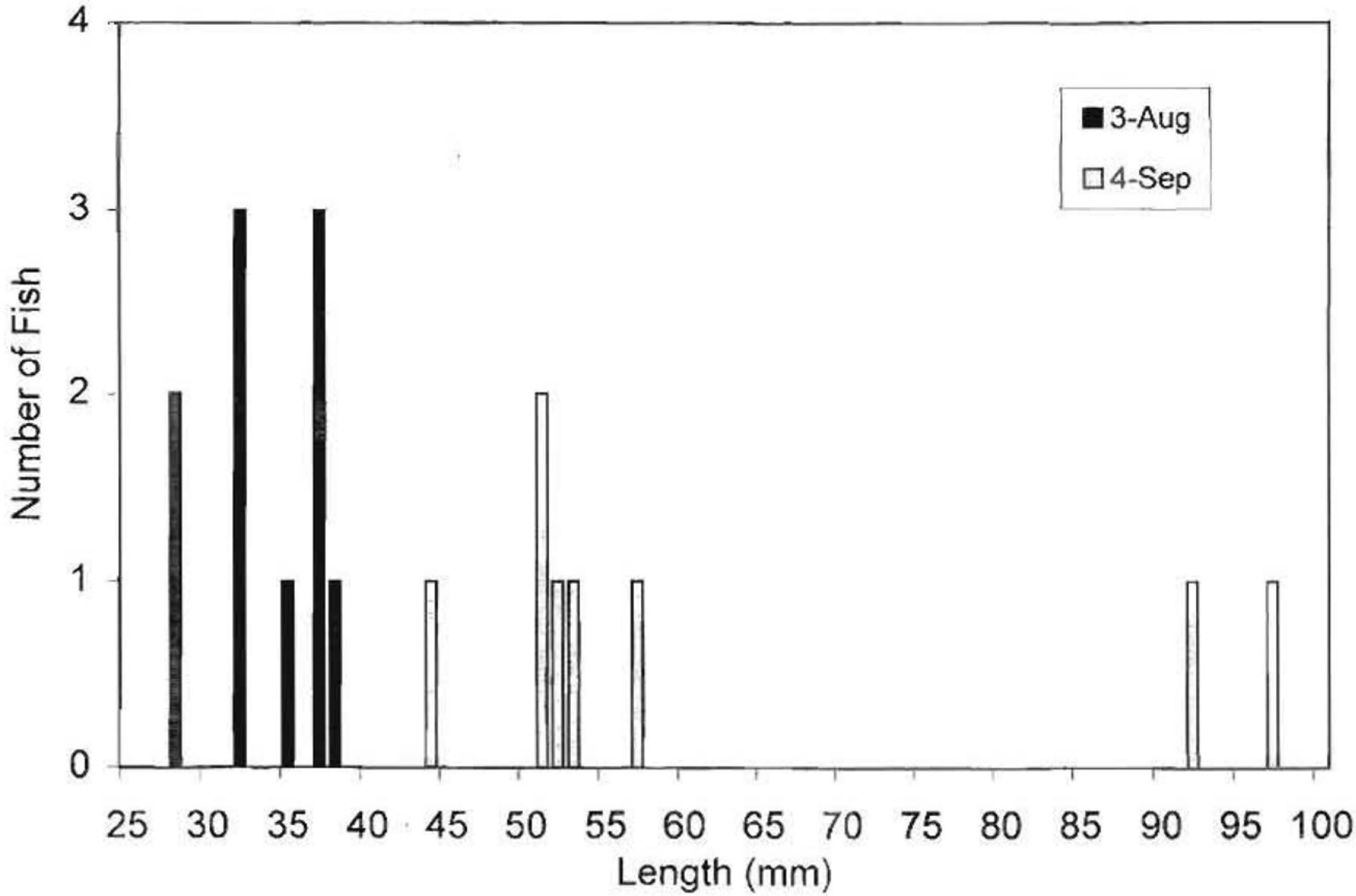


Figure 25. Juvenile coho lengths sampled from Big Creek, Takotna River, 2000.

Appendix A. Juvenile fish catch data from the Takotna River drainage, 2000.

AREA	DESCRIPTION
1	below weir
2	above weir to 4th of July Creek
3	Big Creek (lower)
4	4th of July Creek
5	Fourth of July Creek to Big Waldren Fork
6	Bonnie Creek
7	Minnie Creek
8	Big Waldren Fork
9	Big Waldren Fork to Moore Creek/Little Waldren Confluence
10	Little Waldren Fork
11	Moore Creek
12	Big Creek (upper)

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
1-Jul	Takotna	gravel/cutbank	seine-6	2	N	62 58.12	156 05.69	grayling	~70	
								sculpin	~10	
								chinook	34	49
										48
										46
										45
										41
										44
										43
										43
										42
										42
										45
										47
										44
										43
										46
										41
										42
										45
										41
										46
										44
										41
										45
										46
										47
										42
										45
										45
										44
										43
										47
										45
										41
										43
3-Jul	Takotna	gravel bar	seine-3	2	S	62 58.12	156 05.69	grayling	~50	
								sculpin	~6	
								chum	1	56
								chinook	43	47
										44
										49
										43
										50
										45
										45
										46
										48
										47

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
										41
										44
										43
										48
										47
										46
										42
										47
										45
										49
										47
										43
										45
										45
										43
										46
										48
										42
										48
										47
										49
										46
										46
										43
										45
										47
										43
										46
										47
										47
										43
										46
										41
15-Jul	Takotna	cut bank/gravel bar	seine-4	5	N	62 48.96	156 20.98	grayling	~250	
								sucker	~30	
15-Jul	Takotna	gravel bar	seine-3	5	S	62 49.67	156 19.53	grayling	~50	
								chinook	1	59
15-Jul	4th of July Cr	mud bar	seine-2	8	N	62 49.71	156 19.88	whitefish	~50	
15-Jul	Takotna	gravel bar/riffle	seine-3	2	S	62 49.99	156 20.46	chinook	9	69
										53
										66
										64
										61
										57
										68
										55
										59
15-Jul	Takotna (old Takotna)	gravel bar/riffle	seine-3	2	N	62 50.07	156 20.43	chinook	29	65
										57
										67
										55
										59
										66
										66
										68
										67
										68
										67
										64
										62
										64
										59
										62

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
										65
										56
										60
										60
										62
										62
										65
										62
										62
										63
										65
										65
										54
16-Jul	Big Creek	fallen tree	trap-24 hrs	3	N	62 50.23	156 19.67	chinook	1	65
								coho	2	93
										82
16-Jul	Big Creek	fallen tree	trap (2)-24 hrs	3	N	62 50.23	156 19.67	chinook	1	63
16-Jul	Takotna	grassy bank	trap-24 hrs	2	N	62 50.57	156 19.24			
16-Jul	Takotna	grassy bank	trap-24 hrs	2	S	62 50.57	156 19.24			
16-Jul	Takotna	log jam	trap-24 hrs	2	S	62 50.49	156 18.72			
16-Jul	Takotna	riffle	trap-24 hrs	2	N	62 50.44	156 19.58			
16-Jul	Takotna	eddy	trap-24 hrs	2	N	62 50.44	156 19.58			
16-Jul	Takotna	grassy bank	trap-24 hrs	2	S	62 50.40	156 19.86			
16-Jul	Takotna	feeder creek	trap-24 hrs	2	N	62 50.40	156 19.86			
16-Jul	Takotna	cut bank	trap-24 hrs	2	S	62 50.07	156 20.06			
16-Jul	Takotna	cut bank	trap-24 hrs	2	S	62 50.06	156 20.16			
16-Jul	Takotna	cut bank	trap-24 hrs	2	S	62 50.05	156 20.25			
16-Jul	Takotna	gravel bar	trap-24 hrs	2	N	62 50.10	156 20.30			
16-Jul	Takotna	gravel bar/riffle	trap-24 hrs	2	N	62 50.07	156 20.23	chinook	6	58
										58
										60
										60
										58
										59
16-Jul	Takotna	gravel bar/riffle	trap-24 hrs	2	N	62 50.09	156 20.09			
16-Jul	Takotna	gravel bar	trap-24 hrs	2	S	62 50.00	156 20.46			
16-Jul	Takotna	cut bank	trap-24 hrs	2	S	62 49.73	156 19.85			
16-Jul	Takotna	grassy bank	trap (2)-24 hrs	5	S	62 49.66	156 19.53			
16-Jul	Takotna	cut bank/log jam	trap-24 hrs	5	S	62 49.20	156 20.04	lamprey	1	
16-Jul	Takotna	cut bank	trap-24 hrs	5	N	62 49.07	156 20.22			
16-Jul	Takotna	grassy bank	trap-24 hrs	5	S	62 48.97	156 20.90			
16-Jul	Takotna	graval bar	seine-5	2	N	62 54.59	156 11.40	burbot	1	
16-Jul	Takotna	gravel bar	seine-3	2	S	62 55.10	156 11.32	chinook	3	72
										74
										58
16-Jul	Takotna	gravel bar	seine-3	2	N	62 54.63	156 11.27	grayling	~50	
	Takotna	gravel bar	seine-4	2	N	62 55.64	156 09.99	grayling	~75	
17-Jul	Takotna	beaver dam	trap (2)-24 hrs	2	N	62 55.62	156 10.04			
17-Jul	Takotna	cut bank	trap-24 hrs	2	S	62 55.43	156 09.61			
17-Jul	Takotna	side slough	trap-24 hrs	2	S	62 55.43	156 09.61			
17-Jul	Takotna	clear tributary	trap (2)-24 hrs	2	N	62 55.34	156 11.26			
17-Jul	Takotna	stained slough	trap (3)-24 hrs	2	N	62 55.07	156 11.40			
17-Jul	Takotna	log jam	trap (3)-24 hrs	2	S	62 54.80	156 11.38			
17-Jul	Takotna	cut bank	trap-24 hrs	2	S	62 54.74	156 11.23			
17-Jul	Takotna	cut bank/log jam	trap-24 hrs	2	S	62 54.76	156 11.22			
17-Jul	Takotna	slough/grassy	trap (2)-24 hrs	2	N	62 54.63	156 11.27			
17-Jul	Takotna	cut bank/log jam	trap-24 hrs	2	N	62 54.63	156 11.27			
17-Jul	Takotna	beaver dam	trap (3)-24 hrs	2	N	62 54.63	156 11.27			
17-Jul	Takotna	gravel bar	seine-4	2	N	62 55.47	156 09.52	grayling	~100	
								whitefish	~50	
								sucker	~20	
								sculpin	~50	

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
17-Jul	Takotna	gravel bar/riffle	seine-5	2	N	62 56.36	156 10.25	grayling	~100	
17-Jul	Takotna	gravel bar/riffle	seine-1	2	S	62 57.53	166 06.70	grayling	~40	
18-Jul	Takotna	gravel bar	seine-5	2	S	62 58.12	156 05.69	grayling	~300	
								sucker	~25	
								sculpin	~10	
								chinook	30	57
										64
										61
										62
										60
										59
										60
										59
										61
										62
										63
										64
										57
										61
										60
										58
										55
										62
										66
										61
										58
										63
										60
										60
										62
										62
										63
										59
										60
										59
18-Jul	Takotna	cut bank/gravel	seine-7	2	N	62 58.12	156 05.69	grayling	~100	
								sculpin	~10	
								sucker	~10	
								chinook	7	64
										61
										52
										64
										59
										60
										65
22-Jul	Takotna	gravel bar/riffle	seine-2	2	S	62 56.03	156 10.36	grayling	~50	
								whitefish	~15	
								sucker	~10	
								sculpin	~8	
22-Jul	Takotna	slow/muddy bottom	seine-1	2	S	62 56.43	156 10.76			
22-Jul	Takotna	gravel bar/riffle	seine-2	2	N	62 56.86	156 09.78	grayling	~30	
								whitefish	~10	
								sculpin	~5	
								chinook	1	75
22-Jul	Takotna	gravel bar/below riffle	seine-3	2	S	62 56.83	156 09.42	grayling	~80	
								whitefish	~40	
								sculpin	~20	
22-Jul	Takotna	gravel/slow water	trap-24 hrs	2	N	62 57.87	56 07.79	grayling	1	
								sculpin	1	
22-Jul	Takotna	grassy bank	trap-24 hrs	2	N	62 57.78	156 08.32			
22-Jul	Takotna	small slough	trap-24 hrs	2	S	62 57.67	156 08.41			
22-Jul	Takotna	eddy/muddy bottom	trap-24 hrs	2	N	62 57.52	156 08.89			

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
22-Jul	Takotna	eddy/muddy bottom	trap-24 hrs	2	S	62 57.16	156 09.11			
22-Jul	Takotna	log jam/cut bank	trap-24 hrs	2	S	62 57.16	156 09.11			
22-Jul	Takotna	cut bank	trap-24 hrs	2	N	62 57.06	156 09.26			
22-Jul	Takotna	grassy bank	trap-24 hrs	2	S	62 57.06	156 09.26	sculpin	1	
22-Jul	Takotna	beaver dam	trap-24 hrs	2	S	62 56.85	156 09.36	sculpin	1	
22-Jul	Takotna	gravel bar/above riffle	trap-24 hrs	2	N	62 56.75	156 09.59	grayling	1	
22-Jul	Takotna	beaver dam	trap-24 hrs	2	S	62 56.84	156 09.79			
22-Jul	Takotna	gravel bar/riffle	trap-24 hrs	2	N	62 56.84	156 09.79			
22-Jul	Takotna	gravel bar/riffle	seine-2	2	N	62 56.69	156 09.65	grayling	~130	
								whitefish	~30	
								chinook	3	68
										73
										67
22-Jul	Takotna	gravel bar/above riffle	trap (2)-24 hrs	2	N	62 56.50	156 10.11			
22-Jul	Takotna	eddy/muddy bottom	trap-24 hrs	2	N	62 56.42	156 10.41			
22-Jul	Takotna	slow/gravel bottom	trap (2)-24 hrs	2	N	62 56.42	156 10.41	grayling	1	
								sculpin	1	
22-Jul	Takotna	gravel bar/riffle	trap (2)-24 hrs	2	N	62 56.22	156 10.16	sculpin	1	
22-Jul	Takotna	cut bank/log jam	trap-24 hrs	2	N	62 56.00	156 10.32			
22-Jul	Takotna	gravel bar	seine-3	2	N	62 57.95	156 07.12	grayling	~20	
								whitefish	~30	
								sculpin	~10	
								chinook	10	67
										63
										59
										63
										66
										62
										63
										60
										57
										65
23-Jul	Takotna	gravel bar/riffle	trap-24 hrs	2	N	62 58.18	156 05.98			
23-Jul	Takotna	beaver dam	trap-24 hrs	2	N	62 58.22	156 06.10			
23-Jul	Takotna	grassy bank	trap-24 hrs	2	N	62 58.21	156 06.29			
23-Jul	Takotna	grassy bank	trap-24 hrs	2	S	62 58.13	156 06.10	sculpin	2	
23-Jul	Takotna	grassy bank	trap-24 hrs	2	S	62 58.15	156 06.15			
23-Jul	Takotna	log jam	trap-24 hrs	2	S	62 58.03	156 06.54			
23-Jul	Takotna	grassy bank	trap-24 hrs	2	N	62 58.06	156 06.71	grayling	1	
23-Jul	Takotna	grassy bank	trap-24 hrs	2	N	62 58.01	156 06.93	sculpin	1	
								chinook	1	60
23-Jul	Takotna	slough/grassy	trap-24 hrs	2	S	62 57.95	156 06.98			
23-Jul	Takotna	gravel bar/riffle	trap (3)-24 hrs	2	N	62 57.94	156 07.14	sculpin	4	
								chinook	8	63
										55
										59
										61
										65
										64
										57
										61
23-Jul	Takotna	log jam	trap-24 hrs	2	N	62 57.92	156 07.90			
23-Jul	Takotna	gravel bar/riffle	trap-24 hrs	2	N	62 57.90	156 07.17			
23-Jul	Takotna	gravel bar/riffle	trap-24 hrs	2	S	62 57.90	156 07.42	sculpin	2	
26-Jul	Takotna	gravel bar/riffle	seine-3	1	N	62 58.21	156 05.25	grayling	~100	
								whitefish	~80	
								sculpin	4	
								chinook	1	60
26-Jul	Takotna	gravel bar/riffle	seine-2	1	N	62 58.27	156 05.11	grayling	~150	
								whitefish	~100	
								sculpin	~10	
								sucker	4	

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
26-Jul	Gold Creek	gravel bar	seine-2	1	N	62 59.22	156 04.15	grayling	~500	
								whitefish	~300	
								sculpin	~30	
								sucker	~20	
								chinook	4	65
										74
										73
										69
26-Jul	Takotna	gravel bar	seine-2	1	S	62 59.20	156 03.91	grayling	~80	
								whitefish	~40	
								sculpin	8	
								sucker	4	
27-Jul	Gold Creek	riffle	trap (3)-24 hrs	1	N	62 59.22	156 04.15	sculpin	3	
27-Jul	Takotna	gravel bar	trap-24 hrs	1	S	62 59.17	156 03.87			
27-Jul	Takotna	beaver dam	trap-24 hrs	1	S	62 59.17	156 04.07			
27-Jul	Takotna	cut bank	trap-24 hrs	1	S	62 59.14	156 04.41			
27-Jul	Takotna	calm/gravel bottom	trap-24 hrs	1	S	62 58.96	156 04.74			
27-Jul	Takotna	Lake Creek mouth	trap-24 hrs	1	N	62 58.52	156 05.53			
27-Jul	Takotna	gravel bar	trap-24 hrs	1	N	62 58.19	156 05.29			
3-Aug	Big Creek	gravel bar/cut bank	seine-3	3	N	62 50.72	156 19.74	grayling	~300	
								whitefish	~100	
								sculpin	6	
								chinook	15	73
										78
										55
										46
										55
										54
										73
										67
										75
										66
										44
										67
										71
										64
										63
								coho	10	37
										32
										32
										32
										35
										28
										28
										37
										37
										38
3-Aug	Big Creek	over hangs/log jams	trap (6)-24 hrs	3	N	62 50.72	156 19.74	chinook	4	62
										64
										62
										67
4-Aug	4th July Creek (West Fork)	over hangs/log jams	trap (5)-24hrs	4	N	62 50.72	156 19.88	chinook	4	72
										67
										67
										70
								coho	1	80
4-Aug	4th July Creek (East Fork)	over hangs/log jams	trap (5)-24 hrs	4	N	62 50.72	156 19.88	chinook	22	71
										58
										68
										65
										60
										65

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
										56
										65
										62
										68
										64
										65
										64
										66
										59
										65
										65
										72
										74
										67
										72
										57
								coho	2	100
										95
4-Aug	4th July Creek (below forks)	over hangs/log jams	trap (6)-24 hrs	4	N	62 50.72	156 19.88			
4-Aug	4th July Creek (below forks)	gravel bar	seine-3	4	N	62 41.43	156 31.44	grayling	~200	
								whitefish	~200	
4-Aug	4th July Creek (below forks)	gravel bar/riffle	seine-3	4	S	62 41.88	156 31.65	grayling	~200	
								whitefish	~100	
								suckers	~20	
4-Aug	4th July Creek (below forks)	gravel bar	seine-2	4	N	62 41.97	156 31.06	grayling	~300	
								whitefish	~200	
4-Aug	4th July Creek (below forks)	gravel bar/riffle	seine-3	4	N	62 42.14	156 31.11	grayling	~100	
								whitefish	~50	
5-Aug	Big Creek (by mouth)	over hangs/log jams	trap (7)-24 hrs	3	N	62 50.72	156 19.74	chinook	3	68
										70
										64
30-Aug	Takotna	gravel bar/riffle	seine-3	1	S	62 59.28	156 00.84	grayling	~100	
								whitefish	~50	
								sucker	~50	
								sculpin	~30	
								pike	1	
30-Aug	Takotna	gravel bar	seine-2	1	S	62 59.32	156 00.93	grayling	~60	
								sculpin	~50	
								sucker	~10	
30-Aug	Takotna	gravel bar/riffle	seine-2	1	N	62 59.12	156 01.60	grayling	~75	
30-Aug	Takotna	gravel bar/riffle	seine-3	1	N	62 59.30	156 01.90	grayling	~100	
								sucker	~10	
30-Aug	Takotna	gravel bar	seine-3	2	S	62 58.12	156 05.69	grayling	~75	
								sucker	6	
								sculpin	3	
								pike	1	
								chinook	2	78
										77
4-Sep	Big Creek (mouth to 1/2 mile upriver)	over hangs/log jams	trap (18)-24 hrs	3	N	62 50.72	156 19.74	grayling	8	
								sculpin	3	
								burbot	1	
								chinook	49	61
										69
										65
										67
										56
										65
										65
										63
										62
										61

Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
										72
										72
										74
										73
										70
										74
										64
										61
										70
										68
										72
										70
										60
										61
										58
										59
										60
										68
										60
										61
										53
										60
										52
										55
										60
										62
										61
										62
										63
										61
										57
										65
										59
										68
										53
										58
										60
										68
										71
							coho	8	92
									97
									57
									51
									53
									51
									52
									44
5-Sep	Takotna	gravel bar/riffle	seine-1	9	S	62 35.42	156 43.27	whitefish	~20	
								grayling	~10	
6-Sep	Little Waldren	gravel bar/riffle	seine-2	10	N	62 32.17	156 49.00	whitefish	1	
6-Sep	Little Waldren	cut bank	seine-2	10	N	62 32.16	156 49 55	sculpin	2	
								whitefish	2	
								grayling	1	
6-Sep	Little Waldren	gravel bar/riffle	seine-6	10	S	62 32.45	156 48.65	whitefish	6	
								grayling	1	
								sculpin	2	
6-Sep	Takotna	gravel bar/riffle	seine-5	9	S	62 36.96	156 40.70	whitefish	~120	
								grayling	~100	
								sculpin	~80	
6-Sep	Moore Creek	gravel bar	seine-9	11	S	62 32.60	156 47.63	whitefish	1	
								grayling	1	
19-Sep	Bonnie Creek	over hangs/log jams	trap (15)-24 hrs	6	N	62 42.50	156 31.00	sculpin	5	

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Date	Sample Site	Habitat description	seine/trap	area	Bank	Latitude	Longitude	species	# caught	length
								burbot	1	
19-Sep	Bonnie Creek	gravel bar	seine-3	6	N	62 42.50	156 31.00	grayling	~50	
								whitefish	~50	
								sculpin	~10	
19-Sep	Minnie Creek	cut bank	seine-3	7	N	62 41.25	156 32.00	grayling	~30	
								whitefish	~20	
								sculpin	3	

~ = estimation

Appendix B. Aerial survey notes, Takotna River drainage and selected upper Kuskokwim River tributary streams, 2000.

Chum and Chinook

Corey Schwanke (ADF&G)-observer
Larry Nicholson (Gull Cape Air)-pilot
PA-18 Piper Super Cub

July 25. We left Takotna at 10:30 am with partly cloudy skies. We flew straight to the headwaters of Big Waldren Fork (62° 23 N, 156° 35 W) and flew down to the confluence with the Takotna River (63° 30 N, 156° 35 W). The water was brownish in color and difficult to see in. Spawning habitat was present throughout this section but little was concluded on the presence of salmon due to unfavorable water conditions. None were seen from the air.

Next we flew to the headwaters of Moore Creek, an upper tributary of the Takotna River. There was old mining activity in the headwaters of Moore Creek that changed the anatomy of the upper river (airstrip at mine-62° 36.21 N, 157° 08.35) (17 nautical miles from mouth). For about a two mile stretch the river was basically a series man made gravel pits. Immediately below the mining activity spawning habitat seemed abundant and looked good throughout the tributary. The water was clear and survey conditions were rated as good but no fish were observed. Flew all the way to the mouth (62° 32.30 N, 156° 47.50 W). It is our opinion that if fish were present, some would have been seen.

We then flew the Little Waldren Fork from its headwaters to its end at the confluence with Big Waldren Fork (62° 32.30 N, 156° 47.50 N). This fork also had good salmon spawning habitat in it. The water had a slight brown stain but the bottom was visible in most stretches. No fish were seen and it is our opinion that if they were present, a few would have been spotted.

We then continued on down the mainstem of the Takotna River to Minnie Creek. This stretch was marginal for spotting fish and none were seen, although there was plenty of spawning habitat. Minnie Creek was too small to survey (62° 41.25 N, 156° 32.00 W). It was not wide and had tall trees obscuring the bottom. We then flew to Bonnie Creek (62° 42.50 N, 156° 31.00 W). This creek was slightly larger but visibility was limited to glimpses. No fish were seen in it.

We then took a lunch break and flew to the mouth of Fourth-of-July Creek (62° 49.71 N, 156° 19.88 W). This river had clear water but had marginal visibility due to all the meanders and bank cover. From the mouth up to GPS coordinates 62° 43.81 N and 156° 44.97 W, 29 chinook salmon and 12 chum salmon were observed. It is believed this was only a small percentage of what was actually in the river, especially with chum salmon that were difficult to spot. Most of these fish appeared to be actively spawning. We did survey approximately five miles above where we saw the last fish and no more were observed. Most fish were seen in the middle stretch of the river. Lincoln Creek (62° 44.97 N, 156° 49.20W), a small tributary of Fourth-of-July Creek, was also surveyed but no fish were seen despite good visibility.

Last, we flew Big Creek (62° 50.72 N, 156° 19.74 W). This creek was small and difficult to see in. The water was clear but bank cover was unfavorable. No fish were seen. It is our opinion that if there were fish here in small numbers, we would not of been able to see them.

July 26. We departed Takotna at 11:20 am headed for the Nixon Fork drainage. The sky was cloudy and winds were calm. We flew straight to the mouth of the Nixon Fork (63° 02 N, 155° 40 W). The water was too dark and deep to see in so we flew a straight line upriver to the west bank tributary of John Reek Creek (63° 08 N, 155° 46 W). This river was about 10 miles long. The lower five miles had a muddy bottom with high banks and a lot of trees obscuring our view. About half way up the river conditions improved and a little gravel became visible. The upper third of the river had fair spawning habitat and was fair to survey. No fish were seen.

We then flew to the tributary Broken Snowshoe Creek next (63° 11.56 N, 155° 35.76 W). The anatomy of this creek was similar to that of John Reek Creek and once again, no fish were observed.

The mainstem of the Nixon Fork still had unfavorable survey conditions at this point so we headed for the West Fork (63° 15 N, 155° 22 W). We arrived at the West Fork at 12:00 pm. Conditions for surveying started out poor at the mouth but improved to good as the water cleared up. We surveyed nine nautical miles of river. Spawning habitat was abundant throughout the river. One chum salmon was observed about ¼ of the way up. The chum salmon was observed swimming near the surface. Chum salmon were virtually impossible to observe giving the water conditions. It is our opinion that if there were many chinook salmon in the fork, some would have been observed.

Wabash and Washington Creek were looked over next. Both of these were not surveyed due to a dark stain in the water. Beaver activity was present in both of these rivers.

Next we flew to the headwaters of the Nixon Fork. We started at GPS coordinates 63° 26 N and 154° 30 W. We flew from this point down 15 nautical miles till survey conditions deteriorated. This stretch of river was clear and had good to excellent survey conditions. Lots of gravel riffles were present and it looked like good spawning habitat. The tributary Cottonwood Creek (63° 23.24 N, 154° 37.22 W) also had good survey conditions and spawning habitat present. The observer believes if chinook and chum salmon were present in this stretch, they would have been observed. No salmon were observed.

We then flew to McGrath to refuel. We arrived there at 2:10 pm and departed at 3:10 pm headed for the Pitka Fork of the Middle Fork Kuskokwim River. The Salmon River of the Pitka Fork (62° 53.30 N, 154° 34.20 W) is the only river indexed in the Kuskokwim Aerial Stream Observation Catalog so it was flown concentrating on total escapement counts. River conditions were excellent for surveying. Most fish were on or around

redds but some were still schooled up. The biggest school had 35 chinook in it and the next largest was 26 fish. A total of 374 chinook salmon were observed.
After flying the Salmon River we decided to fly up the Pitka Fork. We flew a straight line to a point 12 nautical miles above the confluence. We then surveyed the river down to the confluence. Spawning habitat was abundant all the way down to a point three nautical miles from the mouth. We observed 151 chinook salmon in this stretch, some of which may have been in Sullivan Creek. The survey ended at 4:45 pm.

July 27. Today the skies were partly cloudy and the wind was from the east at 5 mph. We decided to fly to Telida and then survey Highpower Creek (63° 24 N, 153° 12W). We arrived in Telida around 11:30 am and were met by Steve Aluska. He and his parents were the only residents of Telida. We asked him for any information on salmon in the area. He pretty much said they do not fish up there because the fish were so few. We departed Telida with the intention of seeing if salmon were present in Highpower Creek and if the lower river was suitable for a weir. We flew straight to the mouth and surveyed it up. The water was muddy and so was the bottom. There was a giant logjam (63° 27 N, 153° 08 W) that was approximately 50 yards long and consisted of hundreds of trees. Water was being diverted around the jam through the trees. Under low water conditions this may be impassable by fish. We continued on up Highpower Creek and found two smaller logjams above the first. We continued on to the east bank tributary of Fish Creek (63° 55.00 N, 153° 40.25 W). We flew 12 nautical miles up this creek to its headwaters. Visibility was good and the water was clear in the headwaters. Conditions changed as we descended the river but remained good for the majority of the river. Gravel was abundant and spawning habitat looked good. No fish were seen.

We checked out Deep Creek (63° 28.90 N, 152° 50.25 W) next. It was not surveyed due to its small size and bank cover. Lonestar Creek (63° 29.50 N, 152° 47.25 W) had the same conditions and was not surveyed. Conditions in the mainstem improved as gravel started showing up about five miles above Lonestar Creek. There were three logjams within a five-mile stretch above Lonestar Creek. All may have impeded the travel of fish but no fish were observed behind them. From a point 7 to 17 miles above Lonestar Creek stream conditions became excellent to survey. Clear water with lots of light colored gravel made visibility good. Some stretches had discontinuous gravel and mud with fair survey conditions but most of it was excellent to see in. No fish were observed. We ended the survey at 1:40 pm. From our highest point on Highpower Creek we were 105 nautical miles from McGrath.

We flew back to Telida and put in the 10 extra gallons. We left Telida at 2:45 and headed for Telidaside Creek, a tributary of the Slow Fork (63° 16.80 N, 153° 25.70 W). This creek was small, had dark water and high trees obscuring the view, virtually impossible to survey.

We then flew over the Slow Fork by Grayling Hill. This creek had a brown stain to it but it was our opinion some fish would be visible (if any present) when we flew it. We flew it from Grayling Hill to a point 17 nautical miles above the mouth (63° 17.75 N, 153° 34.00 W). There was gravel present and the habitat for rearing and spawning looked good. The survey ended at 3:11 pm and no fish were seen. We started to smell exhaust in the fuselage so we decided to fly to Takotna and see what was wrong.

July 28. Had to have an exhaust leak welded on the plane's manifold. Left Takotna at 2:00 pm under a broken ceiling at 1,500 ft and a continuous ceiling at 4,000 feet. Today was primarily a clean up day with the plan of surveying a few creeks that were missed earlier in the week. We flew straight for Sheep Creek, a tributary of the Pitka Fork that was missed earlier in the week. The mouth coordinates were 62° 45.50 N and 154° 22.00 W. Nice little tributary with good visibility and habitat. No fish were observed.

We then flew to the Big Salmon Fork, a tributary of the Tonzona. This river was extremely turbid and was impossible to survey. While flying to this creek I noticed a nice clear little tributary that flows into the lower end of the Little Tonzona (62° 57.74 N and 154° 06.60) and parallels the South Fork. We flew this river about seven nautical miles and observed 14 spawning chinook salmon in it. It is the observer's belief that this is a fairly accurate count of the population since the creek was crystal clear and excellent to see in.

We then flew to Clear Creek (62° 57.10 N and 153° 58.10 W), a tributary of the Tonzona. This was just a small creek, too small to observe fish in and probably too small for salmon to spawn in.

We then flew over to the mouth of Jones Creek. Jones Creek flows into the East Fork Kuskokwim at 63° 04.25 N and 154° 03.50 W. This river had moderate spawning habitat and was marginal for surveying. The tributary forked by Moose Hill. We surveyed an eight nautical mile stretch of the northern fork. There were discontinuous gravel stretches separated by long stretches of muddy bottom. The water was stained brown which may have been from recent rains. No fish were observed and it is our opinion that if salmon were present, a proportion of them would have been observed. The southern fork was unsurveyable due to its small size and bank cover. We ended the survey at 4:00 pm. We landed in Nikolai to stretch and met Nick Alexia (advisory committee member) and Roger Jenkins (town Mayor). They were interested in our results. They told us that the clear water stream that flows into the Little Tonzona is simply called the Little Tonzona. They were of little help in pointing us towards fish. Left Nikolai at 5:25 pm headed for McGrath to buy fuel.

July 29. Overcast, ceiling at 4,000 ft, winds calm. Left Takotna at 10:22 am headed for Lime Village (100 nautical miles). We landed in Lime Village at 11:55 am and put in 10 gallons of gas and departed for the mouth of Stink Creek. We arrived at the mouth of Stink Creek around 12:30 pm (61° 30.30 N, 156° 07.50 W). The water was dark brown at the mouth so we decided to fly a straight line up it to see if the water cleared up. We flew all the way to a lake at the headwaters and it never cleared up well enough to see in. We ended survey at 12:55 pm.

We headed for Can Creek next. Arrived at the mouth (61° 16.00 N, 155° 01.00 W) and immediately saw some chum salmon. The water had a slight brownish stain to it. Bank cover was moderate. From the mouth to a point eight nautical miles up the creek, 307 chum salmon and nine chinook salmon were observed. It is our opinion that these counts were close to what was actually in the river. All fish were in the lower third of the river. Ended survey at 1:46 and headed for Telaquana Lake. Telaquana Lake was in a rainstorm so we decided to wait till tomorrow and hope for better conditions. Flew on to Port Alsworth to buy fuel.

July 30. We departed Lake Clark at 10:16 heading for Telaquana Lake. We had talked to a resident of Lake Clark who had flown the entire shore of Lake Telaquana five days earlier and seen no fish. We arrived at the lake at 10:45 pm and immediately saw a mass of sockeye salmon at the outlet. We bypassed these fish and started around the lake. Few fish had entered the lake. A total of 80 sockeye were seen in the lake (all by inlet and outlet). We estimated 5,500 to be in the river at the outlet. We flew a five nautical mile stretch of the river below the lake and counted 10 chinook salmon and a school of five sockeye salmon. We ended the survey around 12:30 pm and headed back to Takotna.

Notes: Larry Nicholson was an excellent aerial survey pilot. Larry had hundreds of hours of previous aerial survey time and his knowledge was very insightful. He helped out the observer in many ways beyond positioning the plane to view fish.

Coho and Late Spawning Chum

Corey Schwanke (ADF&G)-observer
Jim Ellis (Enterprise Flying)-pilot
PA-18 Piper Super Cub

September 17. Left Takotna at 10:25 am under clear skies with an east wind at 5 mph. Arrived at the confluence of Big Waldren Fork (on the Takotna River) at 10:50 am. We decided to fly a straight line to the headwaters and survey down. Water conditions were poor and no fish were seen. The water was just too dark to see in, especially in the middle to lower stretches. We ended survey at 11:05 am.

We then flew to the headwaters of Moore Creek. We landed at the airstrip for a short break and departed at 11:35 am. Conditions were good with lots of spawning and rearing habitat and water visibility was good. No fish were observed.

We surveyed the Little Waldren Fork next. With poor to good visibility no fish were observed. We then continued on down the mainstem to a point about five miles above Big Waldren Fork where visibility became poor. No fish were seen in this stretch. Ended this part of the survey at 12:30 pm and flew to Minnie Creek which was too small to survey.

We flew to Bonnie Creek next and decided to survey it. We flew about a six-mile stretch but could only see in about 10% of the river due to bank cover, water clarity and meanders. No fish were seen.

Headed for Fourth-of-July Creek next. Started survey at 12:53 pm with clear water conditions. The pilot had problems flying all the bends and circling back was too time consumptive so some of the river (<20%) was missed. In the mainstem, 215 coho salmon were observed and in the tributary Lincoln Creek another 57 were seen. Most of the fish seen in the mainstem were in a five-mile stretch below Lincoln Creek. Conditions were tough (meanders and bank cover) and these numbers are probably not representative of what was actually in the river. A couple large schools were seen (as big as 50) but most fish were seen in groups of less than ten. Ended survey at 2:00 pm.

We headed to Big Creek next. This river was even more difficult to fly and see in than Fourth-of July-Creek. Seven coho were spotted and many more were probably present. We then flew to Takotna for a lunch break.

We departed Takotna at 3:00 pm headed for the Nixon Fork of the Takotna River. We flew straight to John Reek Creek and arrived there at 3:15 pm. River conditions were the same as they were during the chinook survey and no fish were seen. The same held true for Ivy Creek, which we flew next.

We flew the West Fork Nixon Fork next. We flew this from the mouth up to the Sunshine Mountains where the creek originates. A total of 35 coho salmon were observed under fair to good survey conditions. Most were seen in the middle to upper third of the river. We ended this survey at 4:17 pm and headed for the headwaters of the Nixon Fork.

We surveyed the Nixon Fork from a point at its headwaters down to 63° 15.95 N and 154° 55.53 W (conditions deterioated). This stretch was about 10 nautical miles long and had good survey conditions. The water was clear, the gravel was light colored and bank cover was minimal. Twelve coho were observed in this stretch (middle) and one coho was observed in the tributary Cottonwood Creek. We ended the survey at 5:40 pm and headed back to McGrath and then to Takotna.

Notes: Jim Ellis had limited aerial survey experience and it showed. The plane had full fuel tanks that limited maneuverability for the first half of the day. His flying became better the second half of the day due to him becoming familiar with what it takes to survey a river and the fuel tanks becoming lighter.

Corey Schwanke (ADF&G)-observer
Paul Ladegard (United States Fish and Wildlife Service)-pilot
Cessna 185-floats

September 29. Took off from McGrath at 11:30 am headed for the South Fork Kuskokwim. Skies were overcast with winds from the east at 5 mph. We intersected the South Fork at Farewell and decided to fly the east bank up and come back down on the west bank. While flying up the east bank salmon were observed in several places. The first place was at 62° 27.55 N and 153° 28.44 W (12 coho). Upriver about a mile at 62°

26.70 N and 153° 29.08 another 15 coho were spotted. At 62° 20.58 N and 153° 25.69 W ten more coho were spotted. In another side slough at 62° 18.70 N and 153° 22.58 W, 50 chum and 10 coho were observed. All of these fish were observed in clear side sloughs of the South Fork of the Kuskokwim. We continued on to Rohn (in hindsight we should of went further upriver looking for more fish) and turned around to fly the west bank back. There was a nice long (couple of miles) clear side slough at 62° 30.43 N and 153° 31.93 W. We observed approximately 100 coho salmon in it. Also on the west bank at 62° 30.62 N and 153° 32.55 W we observed about 50 coho salmon.

We then flew up Jones Creek (62° 34.15 N/153° 33.30W). Survey conditions were good and 34 coho salmon were observed in it. The water had a greenish hue to it but the fish were easily seen. Only a four-mile stretch was surveyed because the river became steep and full of boulders (not good for salmon or surveying). Just below Jones Creek at 62° 37.32 N and 153° 41.17 W, five coho were spotted in a small east bank side slough. From this point on down we flew the center of the South Fork looking for clear adjacent sloughs/side channels to survey. At 62° 53 N and 154° 04 W about 300 coho and 50 chum were observed. These were in a three-mile long clear side slough on the west bank. We actually flew this twice double-checking the identification and it was accurate the first time.

We continued on down the South Fork till we hit the mouth of the Little Tonzona. From there we flew to the mouth of an unnamed tributary at the coordinates 62 58.01 N and 154 07.70 (same one surveyed for chinook salmon). We surveyed this up to 62° 53.75 N to 153° 56.54 W. This river was excellent to survey and 900 coho salmon were observed. Most fish were still aggregated in schools approaching 100 fish in the deeper pools. A few were actively spawning. We then flew to a smaller, similar in appearance, clear water tributary off of the mainstem of the South Fork located at 62° 57.83 N and 154° 11.95 W. No fish were observed in it.

We then flew on down the South Fork of the Kuskokwim till we hit Nikolai. We then ended the survey and headed back to McGrath.

Notes: The 185 is a marginal plane for flying surveys in the upper Kuskokwim. It was sufficient for flying the side sloughs of the South Fork. In the future, I would not recommend it for flying meandering tributaries.

Appendix C. Daily climate and water level data collected at the Takotna River weir site, 2000.

					Temperature				Depth in cm	
Date	Time	sky	Precip	wind	air	AVG air	water	AVG water	water level	AVG water level
25-Jun	600	3	0	W/10	15.0	18.8	16.0	17.3	49.5	49.3
25-Jun	1700	2	3 mm	W/5	22.5		18.5		49.0	
26-Jun	730	1	0	0	13.0	20.0	15.0	17.5	48.5	48.3
26-Jun	1900	1	0	W/5	27.0		20.0		48.0	
27-Jun	700	2	0	0	15.0	19.0	16.0	17.0	47.5	47.5
27-Jun	2000	1	0	W/5	23.0		18.0		47.5	
28-Jun	700	2	0	0	11.0	13.5	15.0	15.5	47.0	47.0
28-Jun	1900	4	0	NE/5	16.0		16.0		47.0	
29-Jun	700	4	0	NW/5	12.0	14.0	13.5	14.3	46.5	46.3
29-Jun	1900	3	2.5 mm	0	16.0		15.0		46.0	
30-Jun	700	2	0	0	10.0	12.5	15.0	15.0	46.0	45.8
30-Jun	1900	3	0	NW/10	15.0		15.0		45.5	
1-Jul	800	2	0	W/5	14.0	19.0	15.0	17.0	45.5	45.5
1-Jul	1700	1	0	W/10	24.0		19.0		45.5	
2-Jul	800	3	0	NW/5	13.0	17.0	16.0	17.3	45.5	45.5
2-Jul	1700	4	0	NW/15	21.0		18.5		45.5	
3-Jul	700	2	0	0	15.0	19.0	17.0	18.5	45.0	44.8
3-Jul	1700	2	1.5 mm	NW/10	23.0		20.0		44.5	
4-Jul	630	3	0	W/5	11.0	14.5	16.0	17.0	44.5	44.5
4-Jul	2000	3	.25 mm	W/5	18.0		18.0		44.5	
5-Jul	630	5	1 mm	W/5	13.0	16.5	16.5	17.8	44.5	44.5
5-Jul	1950	2	0	0	20.0		19.0		44.5	
6-Jul	730	1	0	0	12.0	17.5	16.0	17.0	45.0	45.8
6-Jul	1600	1	0	W/5	23.0		18.0		46.5	
7-Jul	700	3	0	0	13.0	16.5	17.0	18.0	50.0	49.5
7-Jul	1630	3	0	W/5	20.0		19.0		49.0	
8-Jul	800	4	1 mm	W/5	13.5	15.8	17.0	17.5	46.5	46.5
8-Jul	1800	3	0	W/5	18.0		18.0		46.5	
9-Jul	730	1	0	SW/5	13.0	16.0	16.0	17.0	46.5	46.5
9-Jul	1800	4	17 mm	0	19.0		18.0		46.5	
10-Jul	800	4	1 mm	0	14.0	16.0	16.0	16.5	47.0	47.0
10-Jul	1800	1	0	0	18.0		17.0		47.0	
11-Jul	800	1	0	NW/5	16.5	21.3	19.0	18.0	48.0	48.0
11-Jul	1630	1	0	NW/15	26.0		17.0		48.0	
12-Jul	800	1	0	0	17.0	22.0	17.0	18.5	50.5	50.8

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Date	Time	sky	Precip	wind	Temperature: air	Temperature: AVG air	Temperature: water	Temperature: AVG water	Depth in cm: water level	Depth in cm: AVG water level
12-Jul	1800	2	0	E/5	27.0		20.0		51.0	
13-Jul	800	4	0	NE/10	13.0	13.5	17.0	16.5	48.0	47.8
13-Jul	1900	4	12 mm	0	14.0		16.0		47.5	
14-Jul	800	4	0	SW/5	13.0	13.5	16.0	15.0	49.0	51.5
14-Jul	2300	4	0	0	14.0		15.0		54.0	
15-Jul	900	4	0	W/5	15.0	14.0	14.0	12.5	57.5	61.8
15-Jul	2300	4	5 mm	W/5	13.0		11.0		66.0	
16-Jul	800	4	0	W/5	11.5	12.3	12.0	12.0	66.0	67.0
16-Jul	2300	4	2 mm	0	13.0		12.0		68.0	
17-Jul	900	4	0	S/10	11.0	[illegible]	9.0	10.0	70.5	70.8
17-Jul	1700	4	6 mm	SW/5	11.0		11.0		71.0	
18-Jul	830	3	0	NE/10	10.0	13.0	10.0	13.0	69.0	69.0
18-Jul	1900	1	0	NE/5	16.0		16.0		69.0	
19-Jul	830	3	0	NE/5	12.5	13.3	10.0	11.0	68.5	68.0
19-Jul	1700	3	0	NE/5	14.0		12.0		67.5	
20-Jul	800	4	0	0	10.0	11.0	11.0	11.5	63.5	62.8
20-Jul	1900	4	~5 mm	NW/5	12.0		12.0		62.0	
21-Jul	800	2	0	0	10.5	13.5	10.0	11.3	61.0	60.5
21-Jul	1900	1	0	W/5	16.5		12.5		60.0	
22-Jul	800	1	0	0	13.0	15.5	11.0	11.8	59.5	59.3
22-Jul	1630	3	0	W/5	18.0		12.5		59.0	
23-Jul	900	4	0	S/10	15.5	14.3	12.0	12.5	57.5	57.3
23-Jul	1700	4	~3 mm	S/5	13.0		13.0		57.0	
24-Jul	800	4	0	0	11.5	12.3	13.0	12.5	56.5	56.8
24-Jul	1600	4	0	W/10	13.0		12.0		57.0	
25-Jul	800	1	0	SE/5	12.0	12.8	10.0	10.5	56.5	56.3
25-Jul	1600	3	~2 mm	W/10	13.5		11.0		56.0	
26-Jul	800	3	0	SW/5	10.0	11.5	11.0	11.0	57.0	56.5
26-Jul	1500	3	0	SW/10	13.0		11.0		56.0	
27-Jul	800	2	0	SW/20	7.0	8.5	10.0	10.8	57.0	56.3
27-Jul	1600	2	~1 mm	SW/15	10.0		11.5		55.5	
28-Jul	900	3	0	0	6.0	7.0	10.0	11.0	55.0	54.8
28-Jul	2100	2	0	W/5	8.0		12.0		54.5	
29-Jul	800	1	0	N/5	13.0	11.5	10.0	11.0	54.5	54.5
29-Jul	1700	3	0	SW/10	10.0		12.0		54.5	

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Date	Time	sky	Precip	wind	Temperature				Depth in cm	
					air	AVG air	water	AVG water	water level	AVG water level
30-Jul	900	4	0	0	13.0	14.0	10.0	11.5	54.5	54.5
30-Jul	1500	3	0	W/10	15.0		13.0		54.5	
31-Jul	900	4	0	0	10.0	11.0	11.0	11.0	56.0	56.5
31-Jul	2100	4	~15 mm	SW/5	12.0		11.0		57.0	
1-Aug	900	4	0	0	10.0	12.5	10.0	10.0	60.0	61.0
1-Aug	1500	4	0	0	15.0		10.0		62.0	
2-Aug	900	4	0	0	11.5	13.3	9.0	9.5	75.0	75.0
2-Aug	1600	4	0	0	15.0		10.0		75.0	
3-Aug	900	4	0	0	13.0	12.0	8.5	8.8	69.0	67.5
3-Aug	1500	4	11 mm	SW/5	11.0		9.0		66.0	
4-Aug	900	4	0	0	10.0	10.5	9.0	9.5	70.0	71.5
4-Aug	1600	4	9 mm	S/5	11.0		10.0		73.0	
5-Aug	900	4	0	SE/10	11.0	12.0	9.0	9.5	97.0	100.0
5-Aug	1500	4	3 mm	SE/15	13.0		10.0		103.0	
6-Aug	900	3	0	0	9.0	12.0	10.0	10.0	93.0	89.0
6-Aug	1500	3	0	0	15.0		10.0		85.0	
7-Aug	900	4	0	W/5	10.0	12.5	9.0	9.5	81.0	80.5
7-Aug	1500	3	1 mm	W/5	15.0		10.0		80.0	
8-Aug	900	4	0	W/5	10.0	12.0	9.0	9.5	80.0	80.5
8-Aug	1500	4	1.5 mm	W/5	14.0		10.0		81.0	
9-Aug	900	3	0	W/5	11.0	11.5	9.0	9.0	78.0	77.5
9-Aug	1500	4	0	W/5	12.0		9.0		77.0	
10-Aug	900	3	30 mm	SW/15	10.0	10.5	11.0	10.0	74.0	73.5
10-Aug	1500	3	2 mm	SW/15	11.0		9.0		73.0	
11-Aug	900	3	0	W/10	11.0	12.5	9.0	9.5	71.0	71.5
11-Aug	2000	3	0	W/5	14.0		10.0		72.0	
12-Aug	900	3	0	SW/10	14.0	16.5	11.0	11.0	71.0	71.0
12-Aug	1500	3	0	SW/10	19.0		11.0		71.0	
13-Aug	1000	3	51 mm	S/5	14.0	16.0	11.0	11.5	70.0	69.5
13-Aug	2000	2	0	S/5	18.0		12.0		69.0	
14-Aug	900	3	19 mm	S/10	11.0	11.0	11.0	11.0	71.0	75.5
14-Aug	2000	1	2 mm	0	11.0		11.0		80.0	
15-Aug	1000	1	0	NE/15	10.0	14.5	9.0	10.0	81.0	81.5
15-Aug	1900	1	0	NE/20	19.0		11.0		82.0	
16-Aug	1000	1	13 mm	W/10	15.0	13.5	10.0	10.0	73.0	71.5

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Date	Time	sky	Precip	wind	Temperature				Depth in cm	
					air	AVG air	water	AVG water	water level	AVG water level
16-Aug	2000	1	0	W/5	12.0		10.0		70.0	
17-Aug	1000	4	19 mm	SW/5	11.0	10.0	10.0	10.0	68.0	67.5
17-Aug	2000	4	13 mm	W/10	9.0		10.0		67.0	
18-Aug	900	3	42 mm	S/10	11.0	11.0	9.0	9.5	67.0	67.5
18-Aug	1900	3	0	SW/10	11.0		10.0		68.0	
19-Aug	1000	1	0	NW/5	7.0	8.5	9.0	9.5	71.0	71.0
19-Aug	2000	2	0	S/5	10.0		10.0		71.0	
20-Aug	1000	1	0	S/5	15.0	13.5	9.0	9.5	68.0	67.5
20-Aug	2000	2	0	0	12.0		10.0		67.0	
21-Aug	1000	3	88 mm	S/10	9.0	9.5	10.0	10.0	66.0	65.5
21-Aug	1700	3	0	S/10	10.0		10.0		65.0	
22-Aug	1000	3	0	SW/10	11.0	10.5	8.0	8.5	64.0	64.5
22-Aug	1700	1	0	SW/15	10.0		9.0		65.0	
23-Aug	1000	3	0	W/5	10.0	9.5	8.0	8.5	63.0	62.3
23-Aug	2000	3	0	0	9.0		9.0		61.5	
24-Aug	1000	3	0	W/5	9.0	11.0	8.0	8.3	60.0	60.0
24-Aug	2000	3	0	W/5	13.0		8.5		60.0	
25-Aug	1000	3	0	W/5	9.0	9.5	8.0	8.0	59.0	59.0
25-Aug	1500	3	0	W/5	10.0		8.0		59.0	
26-Aug	1000	2	0	0	6.0	9.5	7.0	8.0	58.0	57.5
26-Aug	1600	1	0	W/5	13.0		9.0		57.0	
27-Aug	1000	4	3 mm	0	9.0	10.5	8.0	8.5	57.0	57.0
27-Aug	1700	4	0	W/5	12.0		9.0		57.0	
28-Aug	1000	4	0	0	10.0	13.0	8.5	9.3	57.0	58.0
28-Aug	1600	2	0	W/5	16.0		10.0		59.0	
29-Aug	1000	4	6 mm	SW/20	10.0	11.0	10.0	10.0	59.0	59.0
29-Aug	1600	4	0	SW/15	12.0		10.0		59.0	
30-Aug	1000	4	0	SW/20	10.0	11.5	9.0	9.5	61.0	62.0
30-Aug	1600	4	.5 mm	SW/10	13.0		10.0		63.0	
31-Aug	1000	4	0	SW/10	7.0	9.5	8.0	8.0	63.0	62.5
31-Aug	1500	4	0	SW/5	12.0		8.0		62.0	
1-Sep	1000	4	0	SW/25	8.0	10.0	8.0	8.0	61.0	61.0
1-Sep	1500	4	2 mm	SW/10	12.0		8.0		61.0	
2-Sep	1000	3	0	0	9.0	11.0	8.0	8.5	61.0	61.0
2-Sep	1600	3	0	SW/5	13.0		9.0		61.0	
3-Sep	1000	4	0	0	7.0	9.0	8.0	8.5	61.0	61.0
3-Sep	1500	3	0	W/10	11.0		9.0		61.0	

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Date	Time	sky	Precip	wind	Temperature: air	Temperature: AVG air	Temperature: water	Temperature: AVG water	Depth in cm: water level	Depth in cm: AVG water level
4-Sep	1000	4	5.5 mm	0	9.0	10.0	7.0	7.5	60.0	59.5
4-Sep	1800	4	0	NW/15	11.0		6.0		59.0	
5-Sep	1000	4	0	W/10	6.0	7.0	8.0	8.0	60.0	61.0
5-Sep	1800	4	2 mm	W/5	8.0		8.0		62.0	
6-Sep	1000	4	12 mm	0	5.0	6.5	7.5	7.8	70.0	78.0
6-Sep	1800	4	0	W/10	8.0		8.0		86.0	
7-Sep	1000	2	0	S/10	5.0	6.0	7.0	7.5	82.0	83.0
7-Sep	1800	3	0	SW/15	7.0		8.0		84.0	
8-Sep	1000	3	0	N/5	3.0	6.0	6.5	6.8	83.0	81.5
8-Sep	1800	4	0	NW/5	9.0		7.0		80.0	
9-Sep	1000	4	0	E/5	5.0	6.5	7.0	7.5	76.0	75.5
9-Sep	1800	4	0	E/5	8.0		8.0		75.0	
10-Sep	1000	4	13 mm	W/10	3.0	5.0	6.0	6.5	75.0	75.5
10-Sep	1800	4	2 mm	0	7.0		7.0		76.0	
11-Sep	1000	4	2 mm	0	3.0	4.5	7.0	7.0	84.0	85.5
11-Sep	1800	4	1 mm	0	6.0		7.0		87.0	
12-Sep	1000	3	0	SW/5	6.0	7.0	6.5	6.5	86.0	85.5
12-Sep	1800	2	3 mm	SW/5	8.0		8.5		85.0	
13-Sep	1000	1	0	0	2.0	4.5	5.0	5.3	84.0	83.5
13-Sep	1800	4	0	0	7.0		5.5		83.0	
14-Sep	1000	1	0	E/10	6.0	5.5	5.0	5.3	80.0	79.5
14-Sep	1800	1	0	0	5.0		5.5		79.0	
15-Sep	1000	1	0	NE/5	5.0	8.5	4.5	5.0	76.0	75.0
15-Sep	1800	1	0	NE/5	12.0		5.5		74.0	
16-Sep	1000	1	0	E/5	3.0	4.5	4.0	4.3	73.0	72.0
16-Sep	1700	3	0	E/15	6.0		4.5		71.0	
17-Sep	1000	1	0	0	2.0	4.0	2.0	2.3	68.0	67.5
17-Sep	1800	1	0	0	6.0		2.5		67.0	
18-Sep	1000	1	0	N/5	-2.0	1.5	2.0	2.3	67.0	66.5
18-Sep	1800	2	0	0	5.0		2.5		66.0	
19-Sep	1000	3	0	N/5	5.0	5.5	3.0	3.0	66.0	65.5
19-Sep	1800	4	0	NE/5	6.0		3.0		65.0	
20-Sep	1000	4	0	0	7.0	8.5	3.0	3.3	65.0	65.0
20-Sep	1800	4	0	N/10	10.0		3.5		65.0	
Averages					11.6	11.6	10.6	10.6	62.5	62.5

~ = estimated precipitation

Appendix D. ADF&G 1996 trip report summarizing aerial survey results of upper Kuskokwim River.

MEMORANDUM	STATE OF ALASKA Department of Fish and Game

To: Charlie Burkey
Kuskokwim Area Manager
CFMD Division
AYK / Bethel

Date: October 16, 1996

File No: BURK0927.DOC

From: Russ Holder RX
Regional Resource Development Biologist
CFMD Division
AYK / Fairbanks

Telephone No: 459-7274

Subject: Late Spawning Chum Salmon Aerial Suveys

At the Kuskokwim Area staff meeting this past spring, staff had requested someone to fly aerial surveys in September to look for late-spawning fall chum salmon. I volunteered contingent upon receiving further information from Kuskokwim staff and availability of acceptable survey pilots. Both you and Larry DuBois provided background information prior to my departure. I left Fairbanks on September 23, 1996 at 12:15 p.m. with pilot Rick Swisher, of Quicksilver Air Service, in his Citabria Scout airplane. Attachments 1 and 2 should be joined at the match line for an approximate picture of the flight paths on September 23 and 24.

At 2:04 p.m. we intersected Highpower Creek at Global Positioning System (GPS) 63° 29.74/152° 46.67 and began surveying downstream. Stream appeared to be six to eight feet deep but colored and cloudy due to recent precipitation. I could only see in the shallower sections. Streamside vegetation was mixed spruce and birch trees. The sun was at a low angle in the sky and caused shadows, and we flew cutting the corners. I observed 15 coho salmon, and ended the survey at 2:24 p.m. at the confluence of another river (Fish River?) where there appeared to be a fishing or hunting cabin.

We continued to fly along Highpower Creek to Telida and then cut across country to intersect the Tonzona River. Started Tonzona River survey at 2:40 p.m. at GPS 63° 01.75/153° 14.71 flying downstream. Gravel braided river looked a lot like the upper end of the Toklat River. Did not see any fishm and ended the survey at 2:50 p.m.

See Attachments 3, 4 and 5 for South Fork Kuskokwim salmon locations. Flew and intersected the South Fork Kuskokwim at 3:00 p.m. We flew up the South Fork Kuskokwim and at GPS 62° 38.26/153° 43.65 we observed approximately 11 coho salmon in a stream that flows into the South Fork Kuskokwim. Four chum salmon were observed at GPS 62° 37.32/153° 41.17 right before the confluence of the Dillinger River on the east side of the South Fork Kuskokwim, and eight chum and 2 coho were observed at GPS 62° 35.95/153° 35.94. At 3:38 p.m. we began flying up the Dillinger River. The river was very swift with a bottom substrate of large gravel with and large boulders. The Dillinger River did not look like suitable chum salmon habitat. We ended the Dillinger River survey at approximately 3:40 p.m., flew across into the Jones River drainage at GPS 62° 36.46/153° 24.35 and flew it downstream. This Creek was shallower and smaller, but still swift, and did not contain as many boulders. Counted 247 coho salmon from start of survey to the mouth of Jones Creek, and ended the survey at 3:55 p.m.

We continued flying down the main South Fork Kuskokwim looking for likely, late-spawning fall chum salmon spots. At GPS 62° 34.30/153° 34.60 I observed approximately 100 chum and 50 coho salmon mixed together in a side channel of the main river and approximately 70 chum and 40 coho salmon at GPS 62° 33.74/153° 34.51. At GPS coordinates 62° 51.28/153° 59.93 we observed approximately 300 chum salmon in a side channel slough with one grizzly bear. At approximately 4:43 p.m. and between the GPS coordinates of 62° 54.37/154° 05.81 and 62° 55.86/154° 07.32 we observed approximately 375 chum salmon and two grizzly bears in this side channel slough on the west side of the flood plain. At 4:50 p.m. we broke off surveying and flew to McGrath where we overnighted.

The South Fork Kuskokwim fall chum salmon we observed blended very well with the slightly greenish glacial till color of the water. Most of the chum salmon had fungused white tails which helped in observing them. The spawning areas we observed were side channel sloughs of the main river system and not clear water tributaries. I would rate the overall observation conditions as fair. It appeared that the late spawning fall chum salmon were not that numerous in relation to the available spawning habitat. I would guess that the chum salmon are keying on upwelling and possibly warmer water habitat due to their late arrival on the spawning grounds. It would be extremely difficult to enumerate these fish if a high proportion of the late spawning chums are main channel spawners – you cannot see into the main channel. I am reasonably confident that these fish are relatively rare in relation to the river distances because it appeared a majority of the river's distance was devoid of predators or scavengers, and in the areas where we observed fish there were bears, ravens, and eagles.

On September 24, 1996, Rick Swisher and I continued our late spawning fall chum salmon explorations. We departed McGrath at 0927 and flew over to the Big River. We intersected the Big River at 1003 at GPS 62° 40.00/154° 59.39 and began flying upstream. At 1004 and GPS 62° 40.71/154° 57.69 we saw two grizzly bears and approximately 300 chum salmon in a side channel slough off the main river (see Attachments 6 & 7). The slough area was a semi V shape with timber all around the edges and the water color was a brighter green and clearer than the main channel. We also saw two chum salmon at GPS 62° 39.23/154° 58.86 and two chum salmon at GPS 62° 32.??/155° 02.85. We concluded the Big River survey at 1028 and GPS coordinates 62° 27.65/155° 03.25.

We crossed directly over the top of Lone Mountain enroute to the Middle Fork. The area where we intersected the Middle Fork was dry and frozen up so we continued over to the Windy Fork tributary. We intersected the Windy Fork at 1045 and GPS 62° 32.53/154° 20.52 and began flying it downstream. Windy Fork had clear water visibility with excellent spawning gravel. We observed a clear water tributary which we investigated and counted approximately 550 coho salmon,with the majority of spawners at GPS 62° 40.60/154° 35.47 (see Attachment 8). This tributary would be an excellent aerial survey index stream for coho salmon because it is very clear, sparsely treed, contains enough coho to be worthwhile, and appeared hydrologically stable. The mouth of this clear water stream has the coordinates 62° 41.99/154° 36.47. We counted approximately 350 chum salmon within the first 1/4 mile of the main river's side slough which the clearwater stream emptied into and another 50 chum salmon approximately 1/2 mile downstream at coordinates 62° 42.91/154° 36.47. We ended the survey at 1115 at coordinates 62° 43.87/154° 37.44.

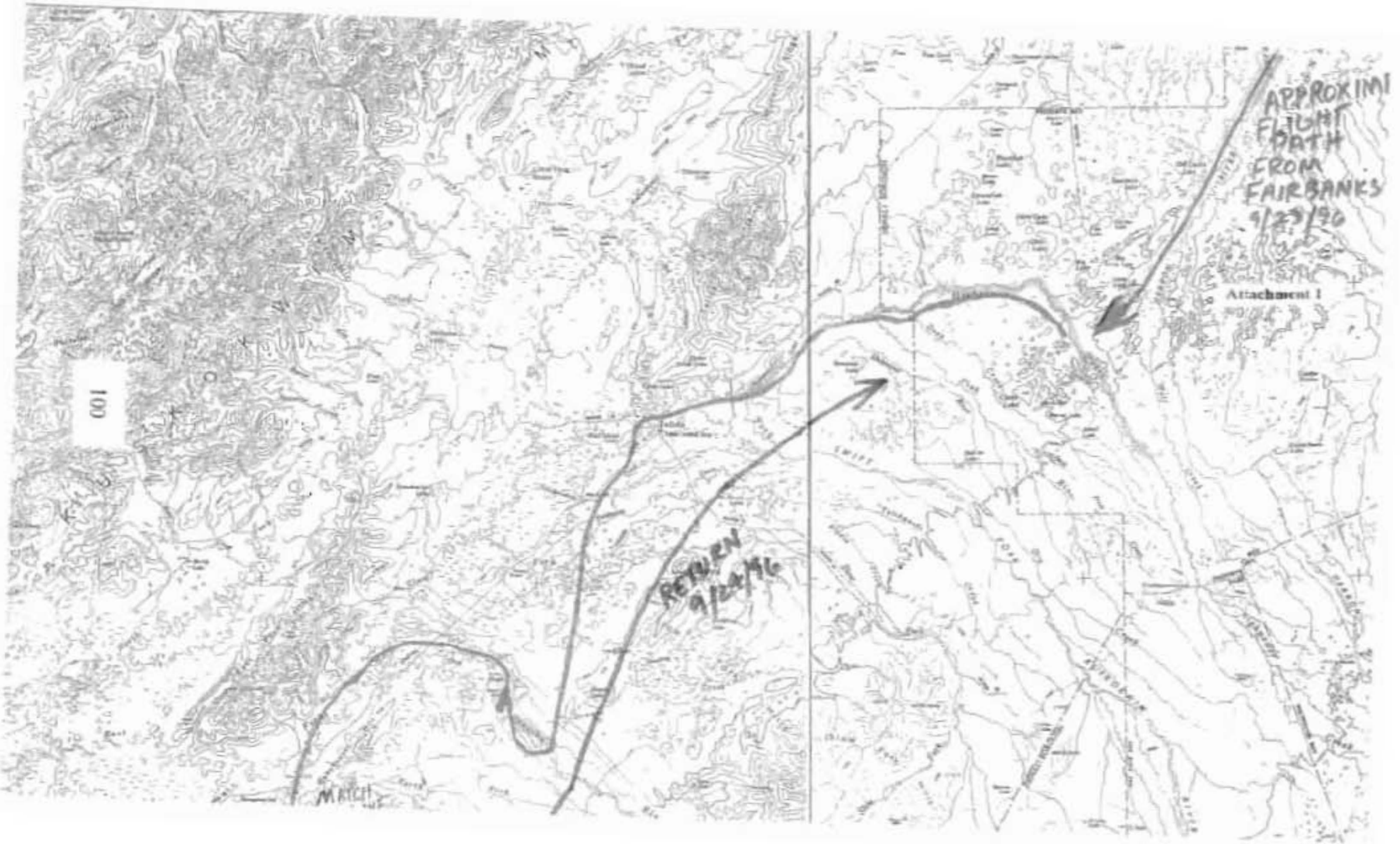
We flew and intersected the Pitka Fork at 1122 and coordinates 62° 50.23/154° 33.90. We flew upstream and then continued up Sullivan Creek. We flew a total survey time of 14 minutes in the Pitka Fork drainage and then broke off for Fairbanks not having seen any fish.

On the return trip we intersected a smaller clear water creek at 1209 coordinates 63° 22.91/152° 37.94 and counted 634 coho salmon into the upper end where it petered out at coordinates 63° 18.17/152° 36.45. This stream appeared to be a good coho salmon aerial survey index stream.

We landed back in Fairbanks at 1530 having accumulated approximately 11 hours of total flight time for two days.

Attachment 1 & 2, approximate flight path on 9/23 & 24.
Attachments 3-5 South Fork Kuskokwim map.
Attachment 6 map of Big River.
Attachment 7 two photographs of a chum salmon spawning location.
Attachment 8 map of Windy Fork.

cc: Anderson
Buklis
Cannon
DuBois
Kron
McGee
Molyneaux
File (3)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FROM
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9/23/96
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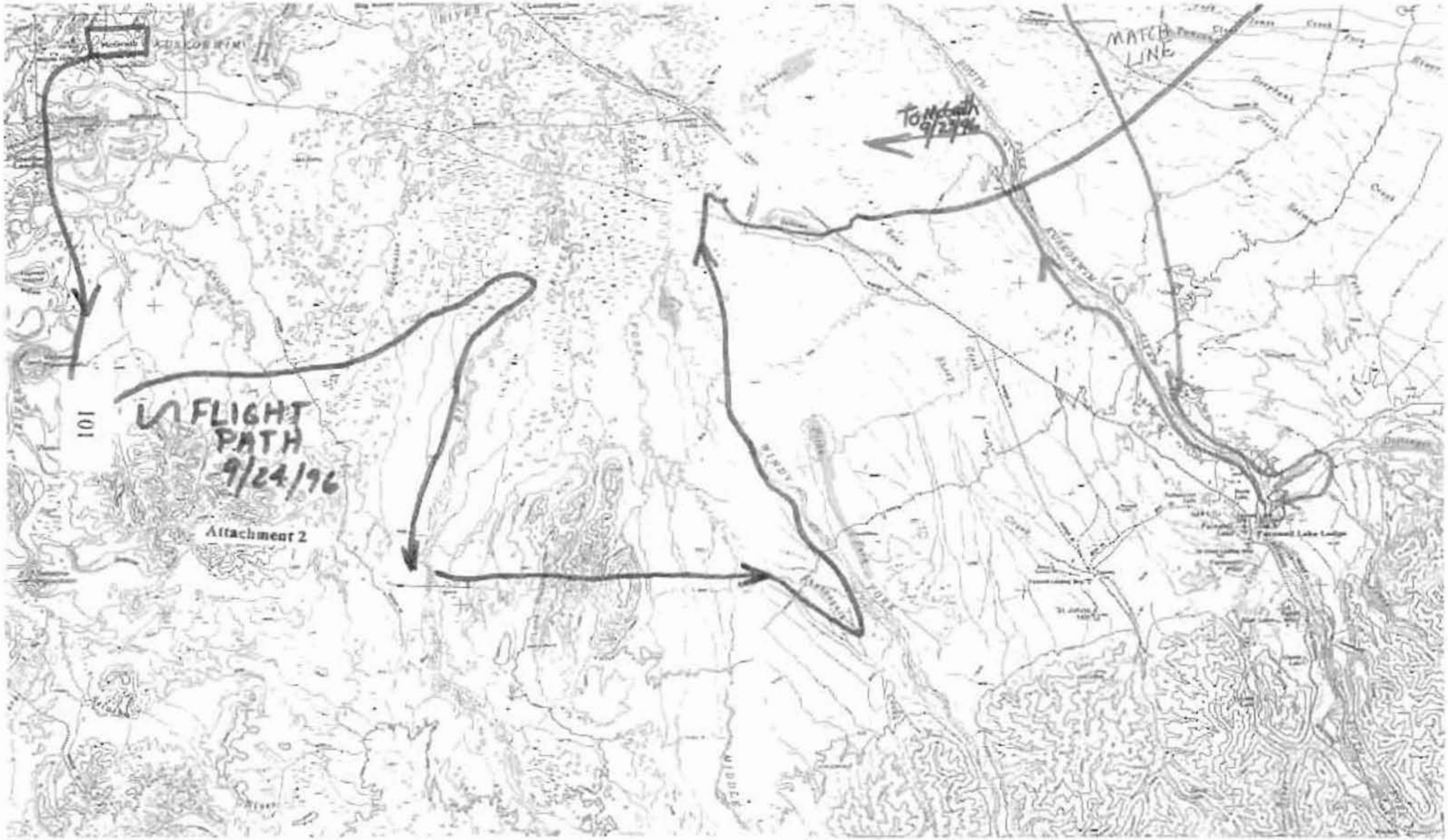
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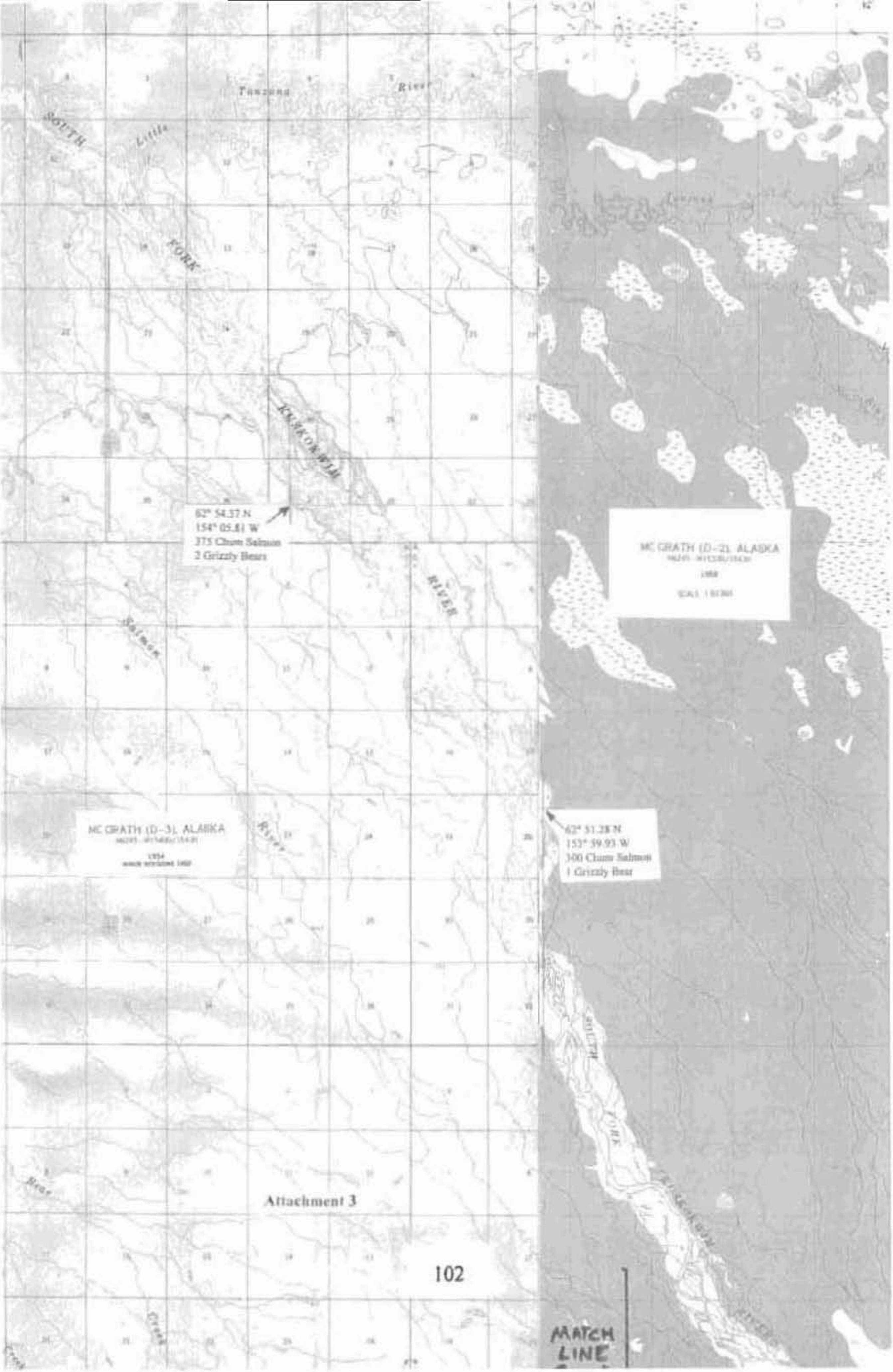
KUSKOKWIM



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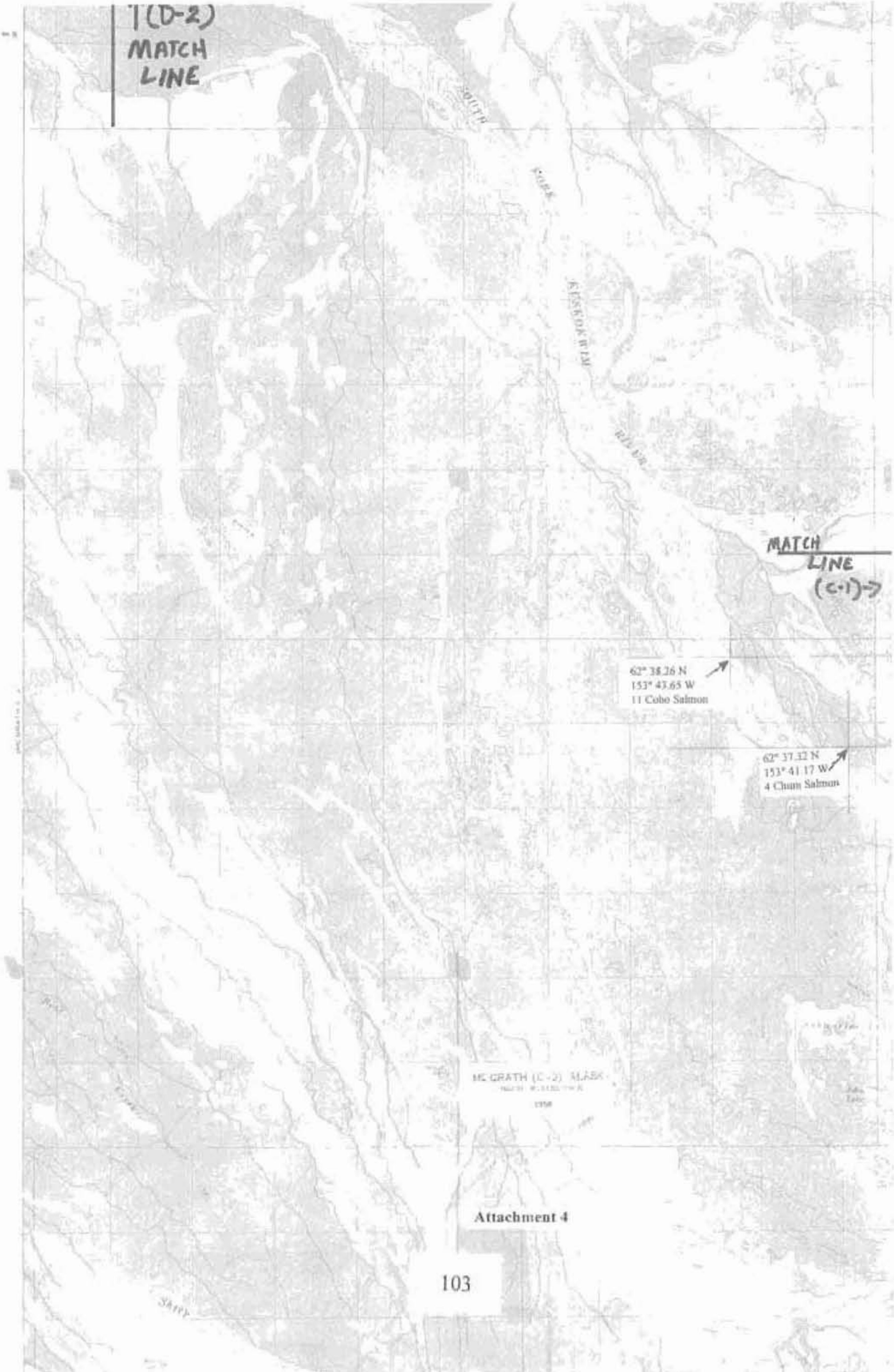

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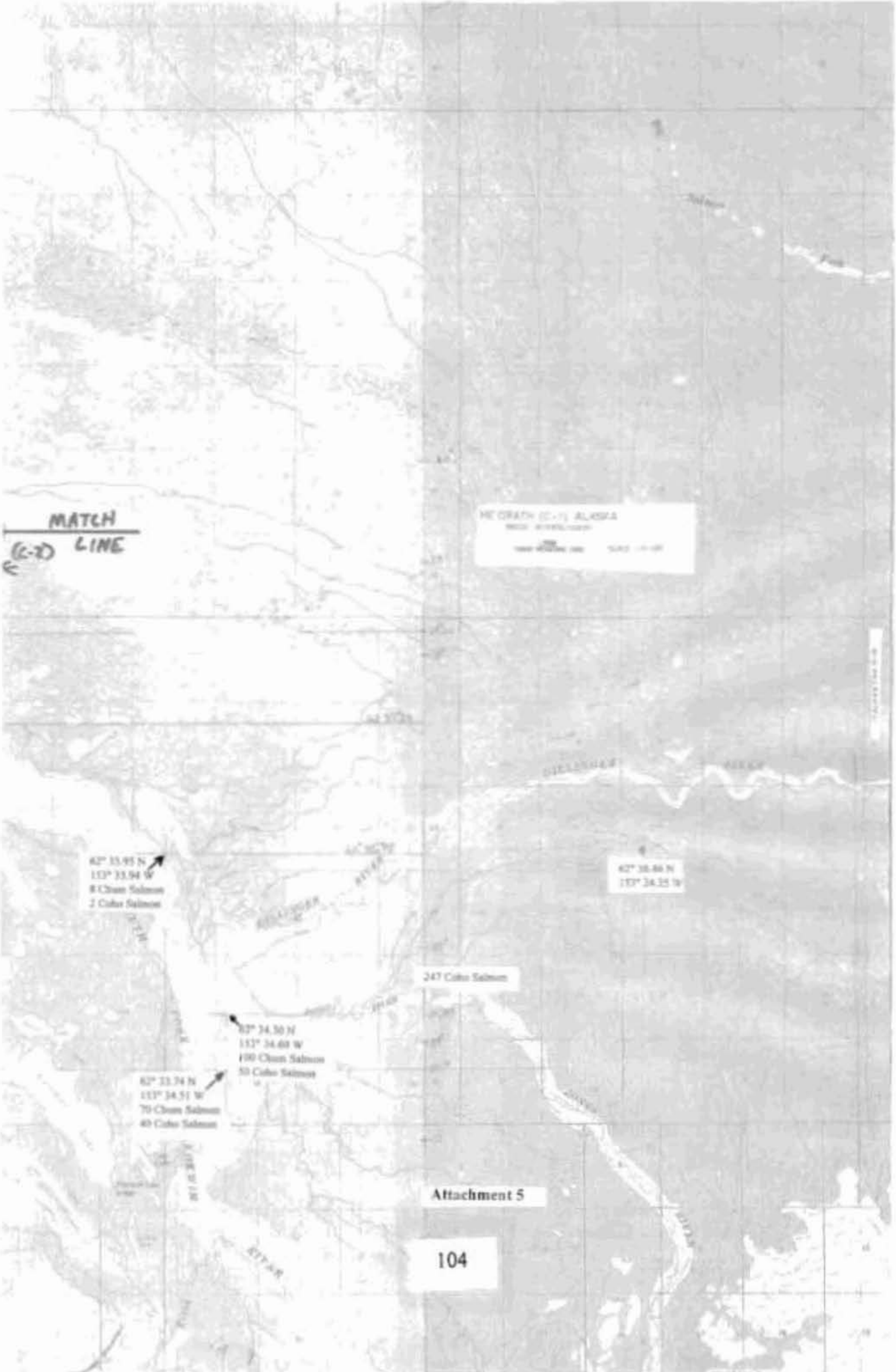

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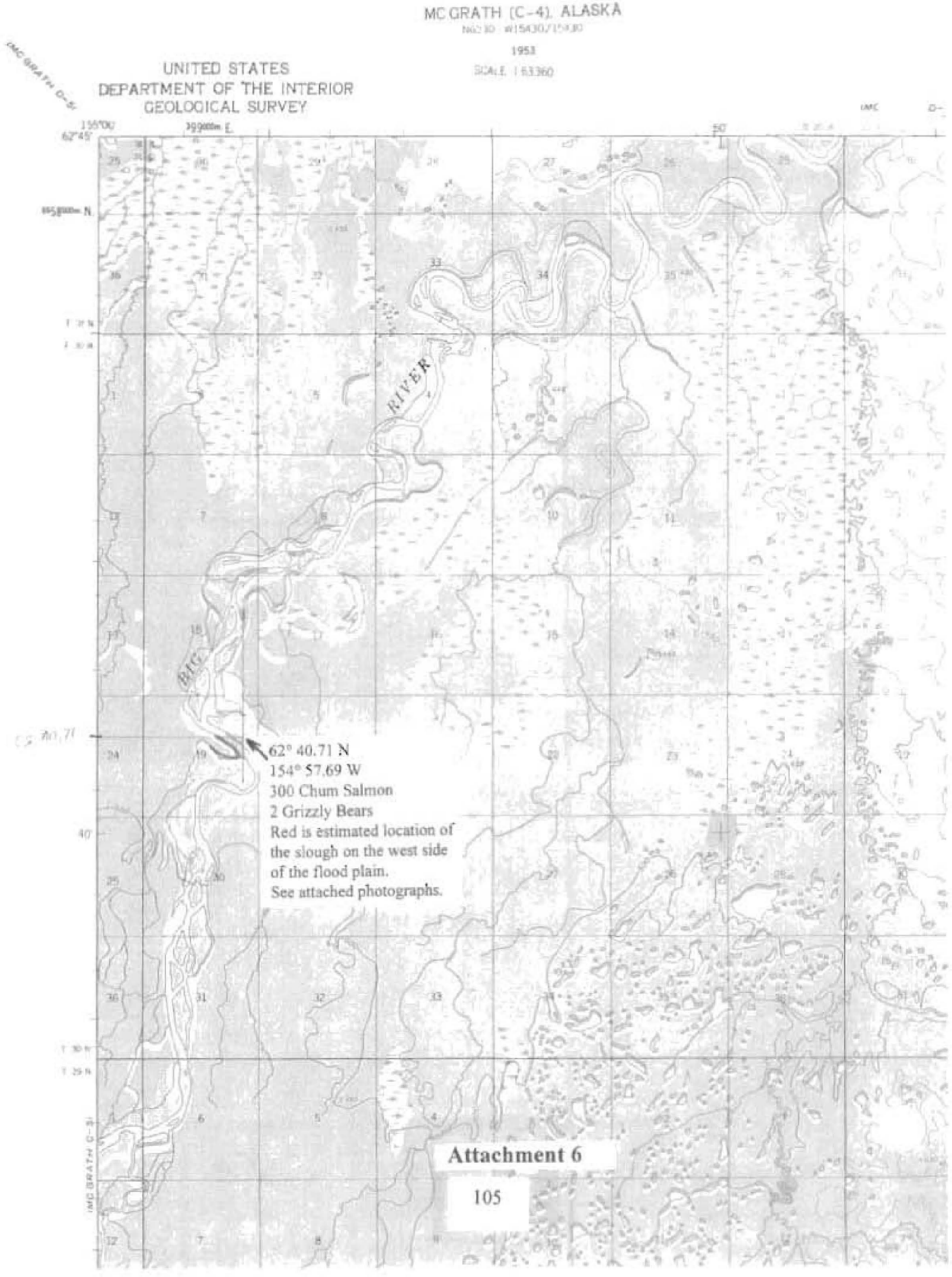
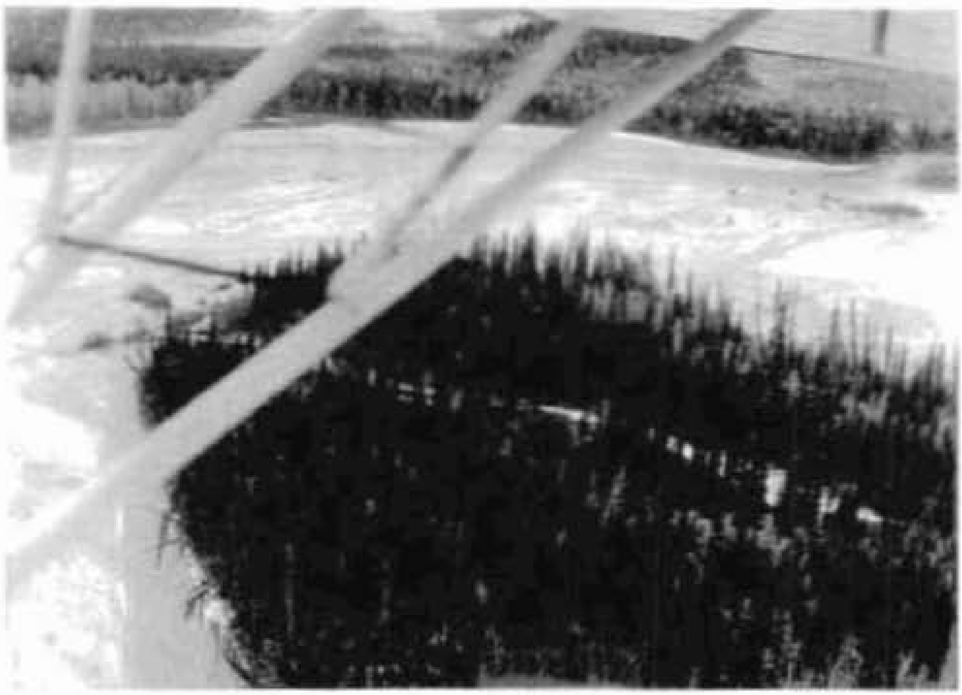


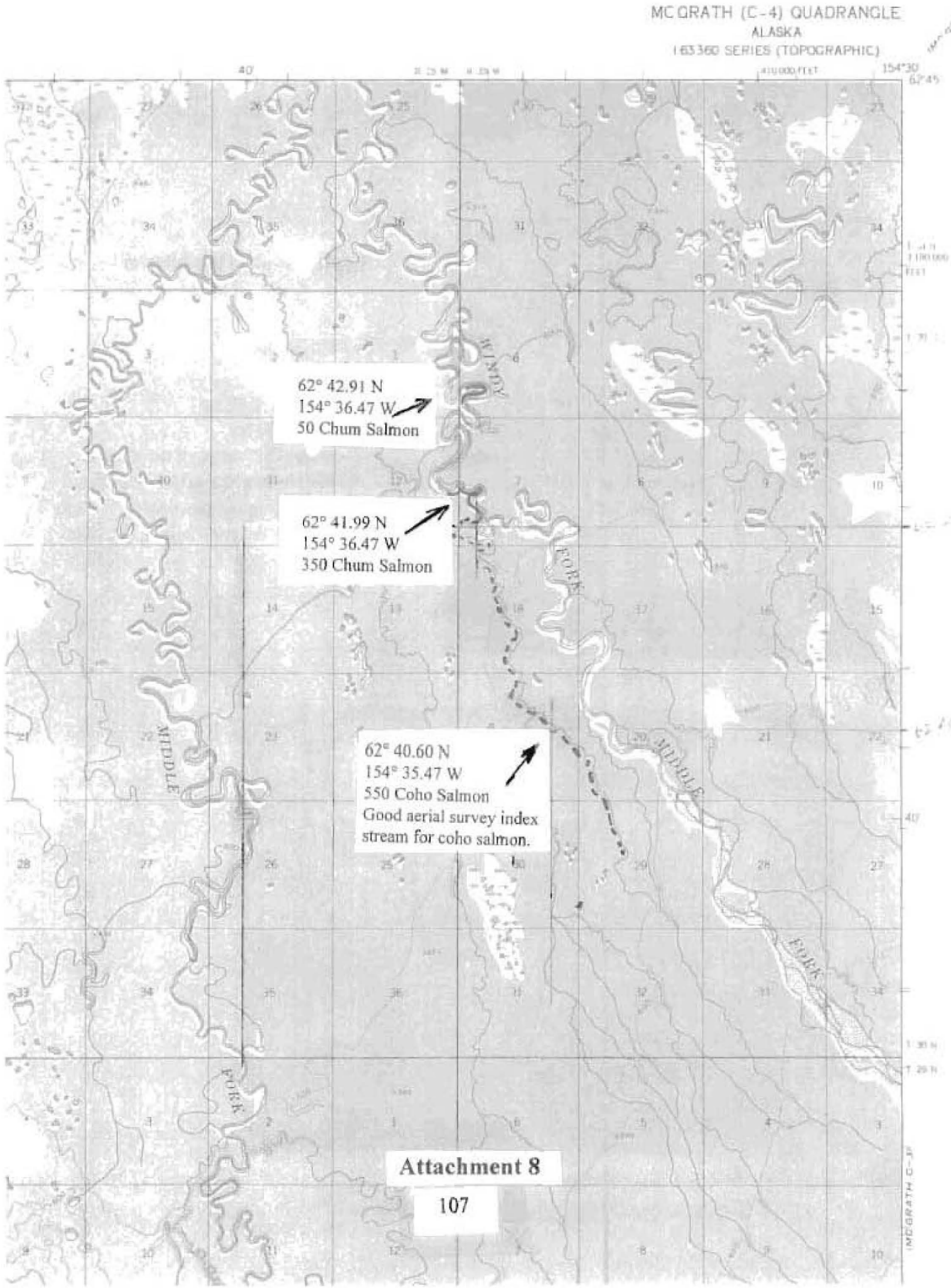
Attachment 6

Big River of the Kuskokwim

62° 40.71 N
154° 57.69 W
300 Chum Salmon
2 Grizzly Bears
Note the "V" shape of the slough which contained a majority of the fall spawning chum salmon. Slough located on the west side of the flood plain.



Attachment 7



Attachment 8