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Abundance and Run Timing of Adult Salmon in the Tozitna River, Alaska, 2006

Annual Report for Study 04-206

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REPORT SUMMARY

Title: Abundance and Run Timing of Adult Salmon in the Tozitna River, Alaska, 2006

Study Number: 04-206

Investigator(s): Jason Post, Carl Kretsinger, and Bob Karlen, U.S. Department of Interior, Bureau of Land Management, Fairbanks District Office.

Geographic Area: Middle Yukon River

Information Type: Stock Status and Trends

Issue(s) Addressed: Lack of escapement and run timing data in middle Yukon River Basin tributaries for Chinook *Oncorhynchus tshawytscha* and summer chum salmon *O. keta* to support Federal subsistence fishery management.

Study Cost: $144,000 ($66,000 contributed by the Office of Subsistence Management and $78,000 funded by the Bureau of Land Management).

Study Duration: 1 April 2006 to 1 May 2007

Abstract: The Tozitna River project is a multi-agency study to determine escapement, run timing, and age-sex-length (ASL) composition of adult Chinook and summer chum salmon in a middle Yukon River Basin tributary. A resistance board weir was operated from 24 June to 9 August 2006. Escapement, run timing, and ASL data for 2006 is considered incomplete due to a 6 day period of missing counts during high stream discharge. The escapement for Chinook salmon was 533. The age composition was 13 % age-4, 82.6 % age-5, and 4.4 % age-6. The sex composition from readable scales was 11.6 % female. The escapement for summer chum salmon was 22,629. The age composition was 0.3 % age-3, 30.2 % age-4, and 69.5 % age-5. The sex composition from readable scales was 55.9 % female.

Key Words: Chinook salmon, chum salmon, *Oncorhynchus tshawytscha, O. keta,* resistance board weir, sex ratio, spawning adults, stock status and trend, subsistence fishery, Tozitna River, Yukon River drainage.

Project Data: *Description* - Data for this study consist of escapement counts, age (scales), sex, and length information for Chinook and summer chum salmon. *Format* – Escapement, age, sex, length and genetic data are stored in Microsoft Access and Excel. Scale impressions were created on cellulose acetate cards. *Custodians* - Escapement, age, sex, and length data: Bureau of Land Management (BLM), Fairbanks District Office, 1150 University Avenue, Fairbanks, Alaska 99709 and the Alaska Department of Fish and Game (ADFG), Division of Commercial Fisheries (ADF&G-DCF), 333 Raspberry Road, Anchorage, Alaska 99518. *Availability* - Access to the data is available from the custodians upon request.

Report Availability: Please contact either the author(s) or Alaska Resources Library and Information Services to obtain a copy of this report.

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INTRODUCTION

Conservation of salmon in the Yukon River drainage is complex and challenging for fisheries managers because of several biological and social factors: mixed-stocks, large geographic spawning distribution, overlapping and compressed run timing, recent declines in escapement, multiple user groups, and multi-agency management. Several plans and policies have been created to manage the Yukon River salmon escapement (see Holder and Senecal-Albrecht 1998). Mostly, the Yukon River salmon escapement is managed based on sustained yield, defined as the average annual yield resulting from an escapement level that can be maintained on a continuing basis.

In 1998, the Yukon River Comprehensive Salmon Plan for Alaska (YRCSPA) was developed to improve salmon management in the Yukon Area. On October 1, 1999, the Federal government joined the State of Alaska in managing Yukon River fisheries, assuming responsibility for subsistence fisheries management in inland navigable waters on, and adjacent to, Federal conservation lands (Buklis 2002).

In 2000, BLM in Alaska received a Congressional appropriation for Yukon River salmon restoration. In response to this appropriation, the BLM convened interagency coordination meetings to determine the most beneficial use of the funding. Emphasis was placed on funding projects that would satisfy both the BLM and Yukon River fisheries management. Yukon River fisheries managers placed a priority on addressing escapement and run timing data gaps in the middle Yukon River Sub-Basin for Chinook *Oncorhynchus tshawytscha* and summer chum *O. keta* salmon, as identified in the YRCSPA (Holder and Senecal-Albrecht 1998). After interagency coordination meetings, the BLM chose the Tozitna River as the site for an escapement study. The BLM, had in 1986, designated the Tozitna River an Area of Critical Environmental Concern for the protection of salmon spawning habitat and had identified acquisition of baseline resource data as a management objective (BLM 1986; Knapman 1989). In addition to addressing data gaps identified in the YRCSPA, salmon escapement and run timing data collected on the Tozitna River would assist the BLM in fulfilling its management objectives.

Accurate escapement estimates from spawning tributaries are an important fisheries management tool used to assist in the determination of production, marine survival, harvest, and spawner recruit relationships (Neilson and Geen 1981; Labelle 1994). Although aerial escapement surveys on the Tozitna River have been conducted by ADF&G since 1959, results of aerial surveys are inherently variable (Schultz et al. 1993) and should only be used to examine trends in relative escapement abundance (Barton 1984). Samples taken at weirs are considered to be the least biased and most accurate data available for assessing escapement and age composition of a mixed stock fishery (Halupka et al. 2000).

To accurately assess escapement of Chinook and summer chum salmon in the Middle Yukon River Sub-Basin, the BLM has operated a resistance board weir on the Tozitna River since 2002. The objectives of the project are:

(1) Determine escapement of Chinook and summer chum salmon;
(2) Describe the run timing of Chinook and summer chum salmon;
(3) Estimate relative abundance of Chinook and summer chum salmon downstream of the weir and document spawning locations using aerial survey techniques; and
(4) Estimate the weekly age and sex proportions of Chinook salmon so that the simultaneous estimates have a probability of 95 % of being within .05 of the population proportion; and so that estimates for chum salmon have an $\alpha = .10$ and $d = .10$.

Additional project tasks are:

(1) Measure water temperature, turbidity, precipitation, stream stage, and determine daily stream discharge and;
(2) Provide ADF&G with scale samples from Chinook salmon to assist in their scale pattern analysis program.

In addition, BLM seeks to provide ADF&G with 6 to 10 years of accurate estimates of total abundance for adult Chinook and summer chum salmon in the Tozitna River so that escapement goals for this system can be addressed.

STUDY AREA

The Tozitna River is a large, clear-water, northern tributary to the middle Yukon River, with a watershed area of 4, 215 km^2, 90 % of which the BLM manages (Figure 1). The watershed originates in the southeastern Ray Mountains at 1,676 m and flows southwesterly approximately 207 km to its confluence with the Yukon River (1,096 river km), 16 km downstream of Tanana. The average yearly precipitation is 32 cm [(1)] with 62 % occurring between June and September. Average monthly ambient temperature ranges from -28 to 22 °C [(1)]. The river is usually ice-free in May, and freeze-up commonly occurs by November (J. Blume, Tozitna River homesteader, Fairbanks, personal communication). Peak discharge is correlated with spring snowmelt or high-intensity rainstorms during the summer. Water turbidity remains low for the period from late June through early August, except for periods of high-intensity precipitation. Fish species in the Tozitna River include Chinook salmon, summer and fall chum salmon (Barton, 1984), coho salmon *O. kisutch*, sockeye salmon *O. nerka*, Dolly Varden *Salvelinus malma*, Arctic grayling *Thymallus arcticus*, northern pike *Esox lucius*, burbot *Lota lota*, round whitefish *Prosopium cylindraceum*, slimy sculpin *Cottus cognatus*, and longnose sucker *Catostomus catostomus*.

The weir site is approximately 80 km upstream from the mouth of the Tozitna River. The weir is located between a downstream riffle and upstream deep meander pool. At this location the average wetted width at summer flows is 52 m with an average depth of 0.6 m. This site is

downstream of most Chinook salmon spawning (Kretsinger and Sundlov 2001, in preparation). The cross section is gradually sloping and the substrate consists of sand to cobble.

METHODS

Weir and Trap

Salmon escapement, run timing, and composition were assessed by counting and sampling fish as they passed through the resistance board weir fitted with a live trap. Construction and installation of the weir were as described by Tobin (1994). The trap (fabricated by Mackey Lake Co., Soldotna, AK) was incorporated into the weir on the upstream side. The weir was 57 m in width and was operational on 24 June. The weir was cleaned and inspected on a daily basis to remove debris and ensure the only avenue for fish passage was through the trap.

Escapement

All salmon passing through the weir and live trap were counted and identified to species except during the period from 1800 hour on 23 July through 1300 hour 6 August (14 days). During this 14 day period fish passage was estimated by counting for 30 minutes during the second ½ hour of every hour, i.e., from 1230-1300, 1330-1400, and so on. The counts were then doubled to account for the 30 minute period of unobserved passage. This method of estimating fish passage was used because our fish trap was destroyed by flooding whereupon we put together a makeshift fish trap and counting tower. High stream discharge also resulted in missed counts from 30 June to 3 July, however the weir remained "fish tight" during this period. Partial daily counts were made for the period of 7, 8, and 10 July and the daily estimate was made by averaging the counts for the corresponding hours from the first day before and after the missed periods and adding this number to the partial counts for the day. The missing day of 9 July was estimated by averaging the interpolated counts of 8 and 10 July. As a result of high stream discharge no counts were made during the 6 day period of 17 to 22 July during which time salmon could migrate around and over the weir undetected. No interpolation will be made for the 6 day period. Observers wore polarized sunglasses to facilitate in fish identification. The counting schedule prior to loosing the fish trap and the last 3 ½ days was 24 hours /day, 7 days / week and consisted of four 6 hour shifts. During daily sampling efforts the trap could be closed for up to 45 minutes. On average, salmon were able to pass through the trap within 15 minutes after entering. Hourly counts were summed to achieve a daily count (0000 – 2359 hours). Run timing was calculated by the proportion of daily to cumulative passage to determine quartile (25, 50, and 75 %) dates and peak and median date of passage.

Data Analysis

Chinook Salmon

Temporally stratified random sampling design (Cochran 1977) was used to collect and analyze ASL data, with statistical weeks defining strata. Strata began on Wednesday and ended the following Tuesday with a weekly sample size target of 112 Chinook salmon distributed uniformly throughout the week (16 fish/day). The weekly sample goal allowed up to 5 % of the scales to be illegible. An overall sample goal of 448 fish was established so that there was a probability of .95 that all of the estimates were simultaneously within .05 of the population proportions (Thompson 1987). All target species within the trap at the time of sampling were sampled to avoid bias. Due to the untimely flood event (near the peak of the run) which resulted in 6 days of missed counts, the loss of our fish trap, and because of the short time period during which 50 % of the Chinook return (7 day average, 2001-2005), we only collected 77 ASL samples from Chinook salmon. Because of this small sample size, strata were combined and analyzed for the entire sampling period. Total escapement, run timing, and ASL data for 2006 should be viewed as incomplete and interpreted accordingly.

Summer Chum Salmon

Sampling for summer chum salmon was done in much the same manner as Chinook. The only difference was the weekly sample goal was established using the method described by Bromaghin (1993) so that simultaneous interval estimates of sex and age proportions for each week had .90 probability of being within .10 of population proportions. Strata began on Thursday and ended the following Wednesday with a weekly sample size target of 175 chum salmon distributed uniformly throughout the week (25 fish/day). The first and third sampling strata are greater than one week because of low escapement and missed counts for those periods. The weekly sample goal allowed up to 15 % of the scales to be illegible.

Within a given stratum m, the proportion of species i passing the weir that are of sex j and age k (p_{ijkm}) is estimated as

$$P_{ijkm} = n_{ijkm} \ / \ n_{i++m}$$

where n_{ijkm} denotes the number of fish of species i, sex j, and age k sampled during stratum m and a subscript of "+" represents summation over all possible values of the corresponding variable, e.g., n_{i++m} denotes the total number of fish of species i sampled in stratum m. The variance of P_{ijkm} is estimated as

$$v(P_{ijkm}) = (1 - n_{i++m} \ / N_{i++m}) \ (P_{ijkm} (1 - P_{ijkm}) / n_{i++m} - 1),$$

where N_{i++m} denotes the total number of species i fish passing the weir in stratum m. The estimated number of fish of species i, sex j, age k passing the weir in stratum m (N_{ijkm}) is

$$N_{ijkm} = N_{i++m} P_{ijkm},$$

with estimated variance

$$v(N_{ijkm}) = N^2_{i++m} v(P_{ijkm})$$

Estimates of proportions for the entire period of weir operation are computed as weighted sums of the stratum estimates, i.e.,

$$P_{ijk} = \sum_m (N_{i++m} / N_{i+++}) P_{ijkm}$$

and

$$v(P_{ijk}) = \sum_m (N_{i++m} / N_{i+++})^2 v(P_{ijkm})$$

The total number of fish in a species, sex, and age category passing the weir during the entire period of operation is estimated as

$$N_{ijk} = \sum_m N_{ijkm},$$

with estimated variance

$$v(N_{ijk}) = \sum_m v(N_{ijkm})$$

Abundance Downstream of the Weir

An aerial survey (by helicopter) to document spawning areas on the Tozitna River was flown on 27 July beginning at the weir (~ 300 meters above Dagislakhna Creek) and ending approximately 38 kilometers upstream (Figures 2, 3, 4, and 5). Aerial surveys were attempted below the weir but were quickly aborted due to extremely poor visibility due to high turbidity from Dagislakhna Creek. Approximately 90 % of the Dagislakhna Creek watershed burned in 2004 during the North Dag Fire (BLM 2004) contributing to it's already tannin color. Low water levels in the Tozitna River at the time of the survey provided good observation conditions upstream of the weir. However, the substrate had been "washed clean" during recent flooding so that salmon redds, which normally stand out visibly as cleaned substrate, were not visible from the air. Therefore, live fish were counted instead of redds.

Results

An estimated 844 Chinook salmon were observed during the survey of which 68 % were between Crooked and McQuesten Creeks (Figure 2, 3). The last Chinook salmon observed was approximately 1.5 km downstream of Gishna Creek (Figure 2). An estimated 4,120 summer chum were observed of which 50 % were also found between Crooked and McQuesten Creeks

(Figure 4, 5). The last summer chum was observed approximately 2 km below McQuesten Creek (figure 4). The 25 km stretch of river between Crooked and McQuesten Creeks begins approximately 9 km above the Tozitna River weir (Figure 2, 4).

Age-Sex-Length

The live trap was used to capture salmon sampled for age, sex, and length. The upstream gate of the trap was closed for periods to obtain an adequate sample size. During sampling, a dip-net was used to capture salmon in the live trap. Salmon were then placed in a partially submerged, aluminum cradle for identifying species and sex, measuring, and removing scale(s). Lengths were measured to the nearest 5 mm from mid-eye to fork of the caudal fin. Morphological maturation characteristics were used to determine sex. One scale for chum and three scales for Chinook salmon were removed from the left side, two rows above the lateral line and on a diagonal line from the posterior end of the dorsal fin to the anterior end of the anal fin (Anas 1963; Mosher 1968). Scales were then placed on numbered gum cards and sent to ADF&G-DCF in Anchorage for aging. Aging was conducted by creating impressions on cellulose acetate cards with a heated hydraulic press (Clutter and Whitsel 1956) and then examining the scale annuli patterns (Gilbert 1922). European notation (Koo 1962) was used to record the ages. A holding pen (6 m x 2 m) was constructed adjacent to the trap, and after sampling, fish were transferred and held for 0.5 hours. The holding pen allowed sampled fish to recover in an area out of the main current.

Abiotic Measurements

Water temperature, turbidity, precipitation, and stream stage (water surface elevation) measurements were collected daily from the period 18 June to 9 August. Water temperature was monitored with an Onset® Tidbit temperature logger placed on the stream bottom in a shaded location within a deep (>1 m) meander pool upstream from the weir. Water temperature was recorded every hour. Turbidity was measured using a HACH model 2100P turbidimeter. Precipitation was measured daily for the previous 24 hours with a rain gauge. A staff gauge was used to record daily variation in stream stage.

To determine stream discharge, water velocity was measured over a range of stream stage elevations using a Price AA current meter. Stream stage was used as the independent variable to estimate stream discharge for days when discharge was not measured. An annual stream stage versus discharge rating was developed by combining the direct discharge measurements and computer-simulated peak flow using log-log regression (Rantz et al. 1982). In the fall of 2006, BLM installed a Sutron Satlink II system on the Tozitna River. The Sutron system will collect streamflow data for the purpose of establishing an instream flow reservation and ultimately protect the valuable Chinook and summer chum spawning and rearing habitat in the Tozitna River.

RESULTS

Weir and Trap

In 2006, the Tozitna River weir was located in the same location as the previous year which is approximately 200 meters downstream from its original (2002-2004) location. Weather systems in the summer often bring periods of rain to the interior of Alaska and result in elevated stream discharge in the Tozitna River. During these periods, turbidity, water depth, and velocity can increase to levels which prevent sampling and counting fish as they pass through the trap and can reach levels that submerge weir panels allowing salmon to migrate over the weir undetected. During the period of 30 June to 3 July, the trap was closed to fish passage due to high stream discharge but the weir remained "fish tight". Partial daily counts were made on 7, 8, and 10 July due to high stream discharge. No counts were made on 10 July and 17 to 22 July due to high stream discharge and submerged weir panels. On 9 August, less than 1 % of the cumulative escapement of Chinook and summer chum salmon migrated through the trap indicating the end of the run. The trap was closed at 2400 hours 9 August and weir removal was complete on 10 August.

Escapement

Chinook Salmon

Chinook salmon (N = 533) passed through the weir from 3 July to 9 August (Table 1). Daily Chinook escapement for the last four complete days of counting was < 1 % of the cumulative escapement. The quartile days (25, 50, and 75 %) of cumulative passage for Chinook salmon were 11, 16, and 25 July, respectively (Table 1; Figure 6). The date of peak passage was 11 July (n = 100), and the fifteen day period of 11-25 July accounted for 57 % of the escapement. Escapement data is considered incomplete due to 6 days of missing counts because of high stream discharge.

Summer Chum Salmon

Summer chum salmon (N = 22,629) migrated through the weir from 4 July to 9 August (Table 1). Daily chum escapement for the last two complete days of counting was < 1 % of the cumulative escapement. The quartile days (25, 50, and 75 %) of cumulative passage for summer chum salmon were 15, 25, and 29 July, respectively (Table 1; Figure 7). The date of peak passage was 24 July (n = 2894), and the fifteen day period of 15-29 July accounted for 54 % of

the escapement. Escapement data is considered incomplete due to 6 days of missing counts because of high stream discharge.

Sockeye Salmon

Sockeye salmon (N = 4) migrated through the weir from 24 July to 9 August. ASL data was not taken for sockeye salmon. Genetic samples were not taken because sockeye were not present during periods of sampling.

Age-Sex-Length

Chinook Salmon

The sex composition of Chinook salmon was 11.6 % female (Table 2). Three age groups were identified from 69 readable scale samples. Overall, Chinook salmon were predominantly age 1.3 (82.6 %) followed by age 1.2 (13%) and 1.4 (4.4 %) (Table 3). Female Chinook salmon ranged from 660 to 870 mm and male Chinook ranged from 475 to 840 mm (Table 4). Calculations were determined with partial escapement data because of high stream discharge.

Summer Chum Salmon

The sex composition of summer chum salmon was 55.9 % female, ranging from 19.7 % (13 July - 19 July) to 67 % (20 July - 2 August) throughout weekly sampling stratum (Table 5). Three age groups were identified from 543 readable scale samples. Overall, chum salmon were predominantly age 0.4 (69.5 %) followed by age 0.3 (30.2 %) and age 0.2 (0.3 %) (Table 6). Female chum salmon ranged from 460 to 620 mm and male chum salmon ranged from 495 to 660 mm (Table 7). Calculations were determined with partial escapement data because of high stream discharge.

Abiotic Measurements

Hourly water temperatures (°C) ranged from 6.0 – 13.1. The mean daily water temperature (°C) was 9.9, below the six year (2001-2006) average of 11.0. During 99.8 % of the monitoring period, water temperatures remained within those favorable for the migration, spawning, and incubation of salmon (Environmental Protection Agency 2001 and 1999, Hale 1981, Bell 1973,

Combs and Burrows 1957). Water temperatures exceeded the State standard for maximum water temperature during spawning and egg incubation (13 °C) for a total of 3 hours of the 1320 hours monitored. Turbidity (NTU) ranged from 0.9 to 96.5 and averaged 7.15. Total precipitation for the period was 11.5 cm. Stream stage (cm) fluctuated from 42.4 to 192 and averaged 74.7. Daily stream discharge (m^3/s) ranged from 10 to 60.6 and averaged 22.1.

DISCUSSION

The 2006 Yukon River Chinook salmon run was anticipated to be similar to the 2005 run, and below average (ADF&G 2006). Given the uncertainties associated with recent declines in productivity, it was anticipated the Chinook salmon run would provide for escapements, support a normal subsistence harvest, and a below average commercial harvest (ADF&G 2006). The Chinook salmon harvest (45,830) was the sixth lowest commercial harvest since statehood and 14% below the 1996-2005 average harvest of 53,183 fish (ADF&G 2006). Escapement goals (based on aerial surveys) were met or exceeded from select Yukon River tributaries in 2006.

Unfortunately, very little knowledge was gained this year regarding Chinook escapement, run timing, and ASL information on the Tozitna River. This was due to the limited number of samples taken, extended periods of high stream discharge (missed fish counts), and the subsequent loss of the fish trap near the historical peak of the run. Attempting to estimate the escapement (for the 6 days of missing counts) based on previous years run timing data and/or comparing run timing with neighboring fish weirs was determined risky at best. Run timing fluctuates from year to year, 50% of the escapement is compressed into an average of 6 days (2001-2005), and we often see fish move through the trap in large pulses. For these reasons, an interpolation for missed days or an overall escapement estimate was not considered.

The daily fish counts (Chinook and summer chum) we did collect were fitted to a run timing model in an attempt to estimate fish passage for the days of missed counts. The run timing model fit the data poorly because of large fluctuations, or “pulses”, in daily escapement counts. This method was discarded for estimating escapement.

Preliminary post-season analysis of escapement data indicates the 2006 summer chum salmon escapement was above average in most Yukon River tributaries and reached all time highs in others (ADF&G 2006). The summer chum salmon harvest (92,116) was the tenth lowest since 1967 and 22% below the 1996-2005 average harvest of 118,583 fish (ADF&G 2006).

The 2006 summer chum salmon escapement in the Tozitna River was also likely to be above average. We counted 22,629 summer chum and considering the 6 days of missed counts the total escapement would likely have exceeded the previous average of 24, 067.

The Office of Subsistence Management approved funding the Tozitna River project for three more years (2007-2009). BLM plans to use this funding to continue monitoring escapement, run timing, and age-sex-length composition of Chinook and summer chum on the Tozitna River.

Additionally, BLM would like to further explore the ongoing low proportion of returning female Chinook to the Tozitna River as compared to the 4 other Yukon River Basin monitoring projects (Table 8).

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FOOTNOTES

[1] 1949 - 2003 average monthly temperature and precipitation data for the Tanana FAA Airport, Alaska, supplied by Western Regional Climate Center, Reno, Nevada.

Table 1. Daily and cumulative counts for Chinook and summer chum salmon with the second quartile, median, and third quartile highlighted; Tozitna River, Alaska, 2006.

	Chinook			Summer chum		
	Daily	Cumulative		Daily	Cumulative	
Date	Count	Count	Proportion	Count	Count	Proportion
6/23	0	0	0.00	0	0	0.00
6/24	0	0	0.00	0	0	0.00
6/25	0	0	0.00	0	0	0.00
6/26	0	0	0.00	0	0	0.00
6/27	0	0	0.00	0	0	0.00
6/28	0	0	0.00	0	0	0.00
6/29	0	0	0.00	0	0	0.00
6/30[a]	0	0	0.00	0	0	0.00
7/1[a]	0	0	0.00	0	0	0.00
7/2[a]	0	0	0.00	0	0	0.00
7/3[b]	1	1	0.00	0	0	0.00
7/4	0	1	0.00	12	12	0.00
7/5	0	1	0.00	27	39	0.00
7/6	4	5	0.01	225	264	0.01
7/7[b]	11	16	0.03	400	664	0.03
7/8[b]	16	32	0.06	672	1336	0.06
7/9[c]	27	59	0.11	1015	2351	0.10
7/10[b]	37	96	0.18	1358	3709	0.16
7/11	100	196	0.37	1009	4718	0.21
7/12	9	205	0.38	207	4925	0.22
7/13	13	218	0.41	240	5165	0.23
7/14	15	233	0.44	277	5442	0.24
7/15	27	260	0.49	307	5749	0.25
7/16	10	270	0.51	253	6002	0.27
7/17[c]	0	270	0.51	0	6002	0.27
7/18[c]	0	270	0.51	0	6002	0.27
7/19[c]	0	270	0.51	0	6002	0.27
7/20c	0	270	0.51	0	6002	0.27
7/21[c]	0	270	0.51	0	6002	0.27
7/22[c]	0	270	0.51	0	6002	0.27
7/23	12	282	0.53	904	6906	0.31

-Continued-

Table 1. (Continued)

	Chinook			Summer chum		
	Daily	Cumulative		Daily	Cumulative	
Date	Count	Count	Proportion	Count	Count	Proportion
7/24	92	374	0.70	2894	9800	0.43
7/25	26	400	0.75	2286	12086	0.53
7/26	32	432	0.81	1840	13926	0.62
7/27	16	448	0.84	1540	15466	0.68
7/28	25	473	0.89	936	16402	0.72
7/29	6	479	0.90	1243	17645	0.78
7/30	1	480	0.90	760	18405	0.81
7/31	13	493	0.92	887	19292	0.85
8/1	17	510	0.96	599	19891	0.88
8/2	10	520	0.98	533	20424	0.90
8/3	9	529	0.99	622	21046	0.93
8/4	1	530	0.99	377	21423	0.95
8/5	6	536	1.01	245	21668	0.96
8/6	-2	534	1.00	240	21908	0.97
8/7	1	535	1.00	297	22205	0.98
8/8	-2	533	1.00	213	22418	0.99
8/9	0	533	1.00	211	22629	1.00

[a] Trap closed due to high water and turbidity but remained fish tight.
[b] Portion of daily count missed.
[C] Entire daily count missed.

Table 2. Female Chinook salmon composition for the Tozitna River, Alaska, 2006.
SE = Standard Error.

	Sample			Escapement			
Combined Strata	n	# Females	% Female	Weir Count	Estimated # Females	% Female (of total escapement)	SE
7/3-8/7	61	8	-	533	62[a]	11.6[a]	3.88

[a]Calculations were determined with partial escapement data because of high stream discharge.

Table 3. Age composition of the Tozitna River Chinook salmon escapement by stratum and sex; Alaska, 2006. Standard error in parenthesis.

				Brood Year and Age										
				2003		2002		2001		2000		1999		
				1.1		1.2		1.3		1.4		1.5		
Combined Strata	Weir Count	Sex	# Fish Sampled	%		%		%		%		%		% Escapement
		M	61	0.0		14.8		82.0		3.2		0.0		100
7/3 - 8/7	533	F	8	0.0		0.0		87.5		12.5		0.0		100
		Subtotal	69											
Combined Strata	471	M	61	0.0	(0)	14.8	(4.6)	82.0	(5)	3.2	(2.3)	0	(0)	100
	62	F	8	0.0	(0)	0	(0)	87.5	(12.5)	12.5	(12.5)	0	(0)	100
Total	533		69	-		-		-		-		-		-
Age Composition With Sexes Combined				0.0	0	13.0	(4.1)	82.6	(4.6)	4.4	(2.5)	0	0	100

[a] Estimated number of male and female salmon derived from strata weighted ASL data. Calculations were determined by using partial escapement data because of high stream discharge.

Table 4. Chinook salmon mid-eye to fork length (mm) by age and sex; Tozitna River, Alaska, 2006. SE = Standard Error.

Age	Sex	Sample	Mean	SE	Range
1.1	Male	0			
	Female	0			
1.2	Male	9	548	4.6	475-595
	Female	0			
1.3	Male	50	684	5	535-840
	Female	7	740	12.5	660-815
1.4	Male	2	750	2.3	720-780
	Female	1	870	12.5	870
1.5	Male	0			
	Female	0			

Table 5. Female summer chum salmon composition for the Tozitna River, Alaska, 2006 SE = Standard Error.

	Sample			**Escapement**			
Stratum Dates	n	# Females	% Female	Weir Count	Estimated # Females	% Female (of total escapement)	SE
7/3-7/12	136	46	33.8	4925	1666	7.4	4.1
7/13-7/19	76	15	19.7	1077	213	0.9	4.6
7/20-8/2	182	122	67	14422	9667	42.7	3.5
8/3-8/9	149	75	50.3	2205	1110	4.9	4.1
All Strata	543	258	-	22,629	12,656[a]	55.9[a]	2.4

[a]Calculations were determined with partial escapement data because of high stream discharge.

Table 6. Age composition of the Tozitna River summer chum salmon escapement by stratum and sex; Alaska, 2006 Standard error in parenthesis.

				Brood Year and Age								
				2003		2002		2001		2000		
				0.2		0.3		0.4		0.5		
Strata	Dates	Weir Count	Sex	# Fish Sampled	%		%		%		%		% Escapement
7/3-7/12		4,925	M	90	0.0		0.7		32.0		0.0		32.7
			F	46	0.0		0.3		12.9		0.0		
			Subtotal	136									
7/13-7/19		1,077	M	61	0.0		0.6		8.1		0.0		8.7
			F	15	0.0		0.4		1.2		0.0		
			Subtotal	76									
7/20-8/2		14,422	M	60	0.0		15.9		31.8		0.0		47.7
			F	122	0.0		33.2		43.2		0.0		
			Subtotal	182									
8/3-8/9		2,205	M	74	0.3		3.1		7.6		0.0		11.0
			F	75	0.4		4.0		4.4		0.0		
			Subtotal	149									
Combined Strata		9,973[a]	M	285	0.3	(0.6)	20.3	(5.5)	79.4	(5.6)	0.0	(0)	100.0
		12,656[a]	F	258	0.4	(0.8)	37.9	(5.1)	61.8	(5.1)	0.0	(0)	100.0
Total		22,629		543	-			-		-		-	-
Age Composition With Sexes Combined					0.3	(0.5)	30.2	(3.3)	69.5	(3.3)	0	(0)	100.0

[a] Estimated number of male and female salmon derived from strata weighted ASL data. Calculations were determined by using partial escapement data because of high stream discharge.

Table 7. Summer chum salmon mid-eye to fork length (mm) by age and sex; Tozitna River, Alaska, 2006. SE = Standard Error.

Age	Sex	Sample	Mean	SE	Range
0.2	Male	2	513	0.6	495-530
	Female	3	530	0.8	520-550
0.3	Male	47	548	5.5	495-635
	Female	92	523	5.1	460-610
0.4	Male	236	577	5.6	515-660
	Female	163	548	5.1	490-620
0.5	Male	0			
	Female	0			

Table 8. Comparison of preliminary Chinook salmon age composition by sex at the East Fork Andreafsky River, Gisasa River, Henshaw Creek, and the Tozitna River, Alaska, 2006.

				Brood year and Age							
				2003	2002	2001	2000	2000	1999	1999	Total
		Sample		1.1	1.2	1.3	1.4	2.3	1.5	2.4	
Location	River (km) [a]	Size	Sex	%	%	%	%	%	%	%	%
EF Andreafsky			Males	0	14.2	36.2	7	0	0	0	57.4
Weir	167	454 [b]	Females	0	2.8	18.7	21.1	0	0	0	42.6
			Subtotal	0	17	54.9	28.1	0	0	0	100
Gisasa			Males	0	13.5	54.3	3.5	0.4	0.1	0	71.8
Weir	908	530 [b]	Females	0.1	5.4	12.9	9.5	0.2	0	0.1	28.2
			Subtotal	0.1	18.9	67.2	13	0.6	0.1	0.1	100
Henshaw			Males								
Weir	1,539	0	Females								
			Subtotal								
Tozitna			Males	0	13	72.5	2.9	0	0	0	88.4
Weir [c]	1,096	69	Females	0	0	10.1	1.5	0	0	0	11.6
			Subtotal	0	13	82.6	4.4	0	0	0	100

[a]Kilometers from the Flat Island test fishing site near the south mouth of the Yukon River to the confluence of the listed tributary.
[b]Age data (preliminary) obtained from ADF&G, 2006.
[c]Tozitna Weir calculations were determined with partial escapement data because of high stream discharge.

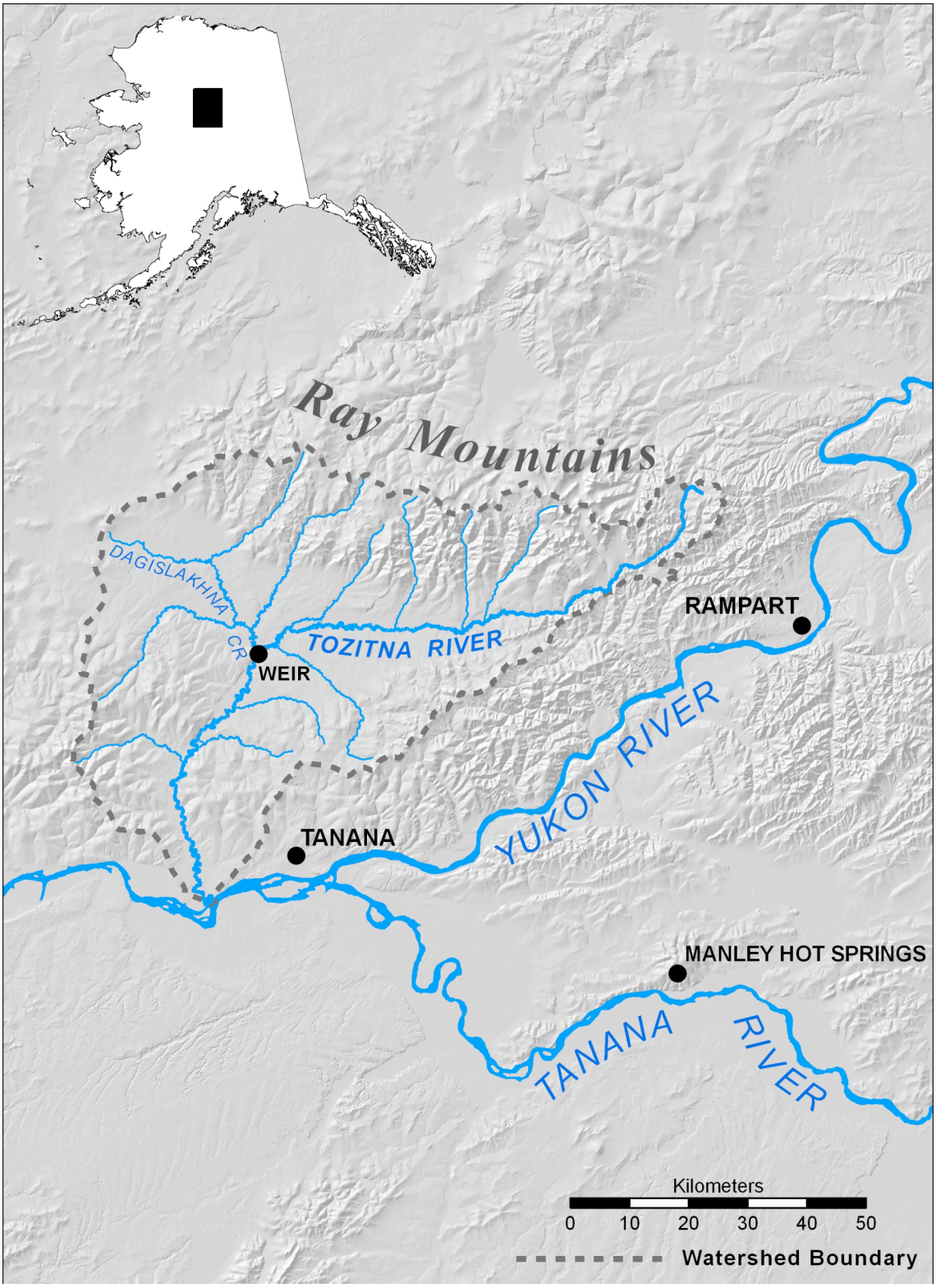

Figure 1. Location of the Tozitna River weir, Alaska 2006.

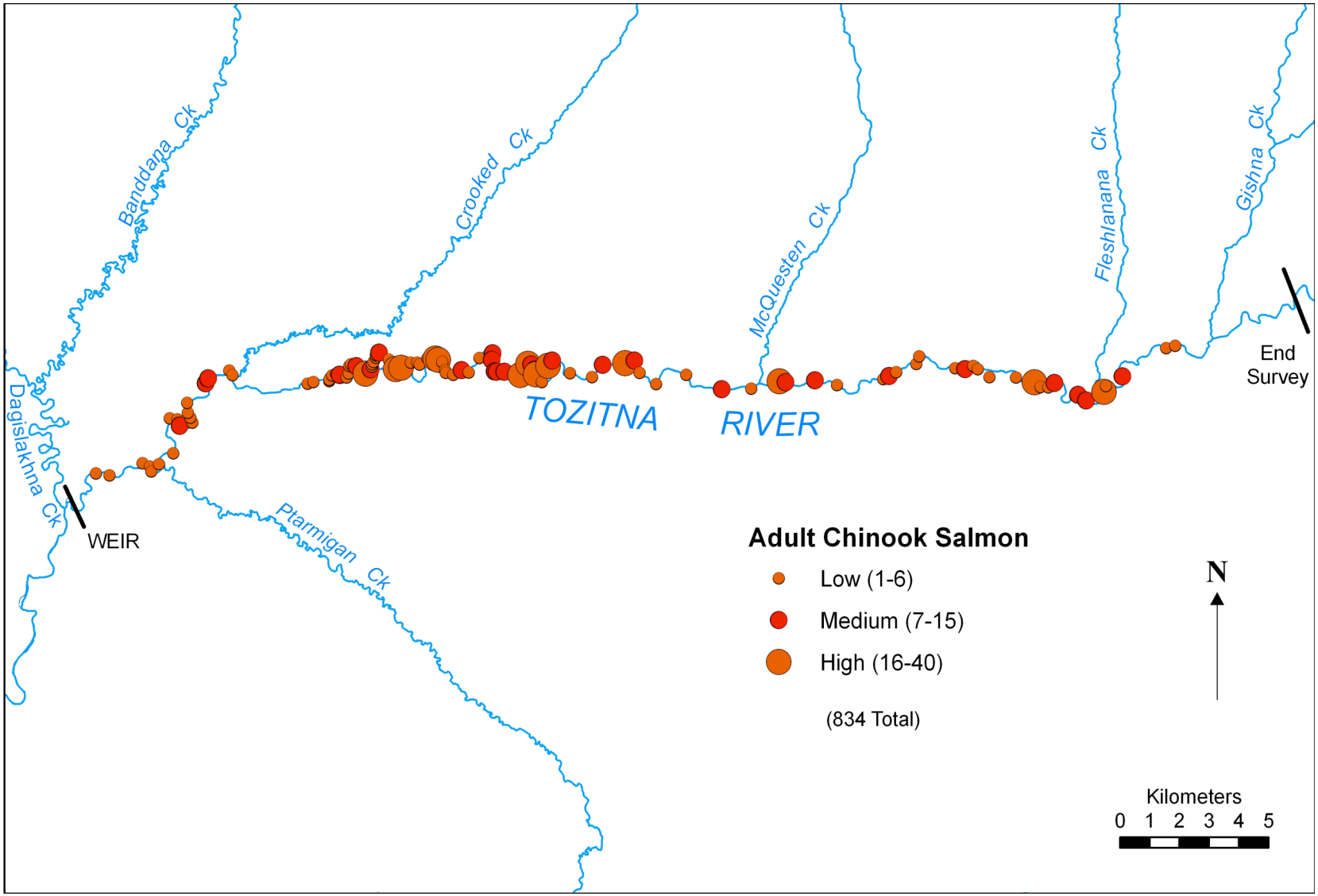

Figure 2. Frequency and distribution of Chinook salmon spawning areas found upstream of the Tozitna River weir, 2006.

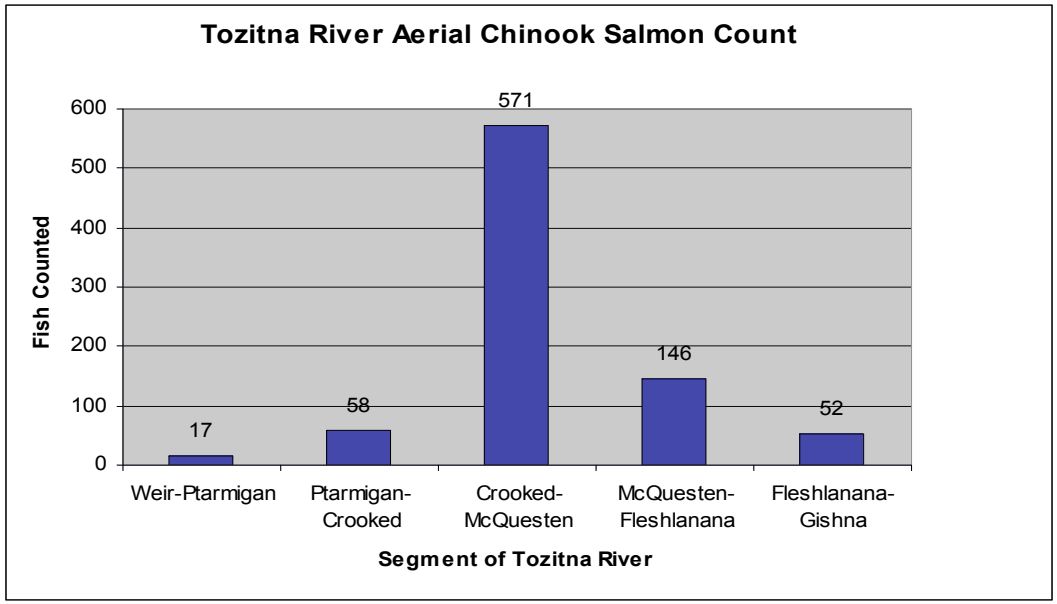

Figure 3. Location and distribution of Chinook salmon spawning areas found upstream of the Tozitna River weir, 2006.

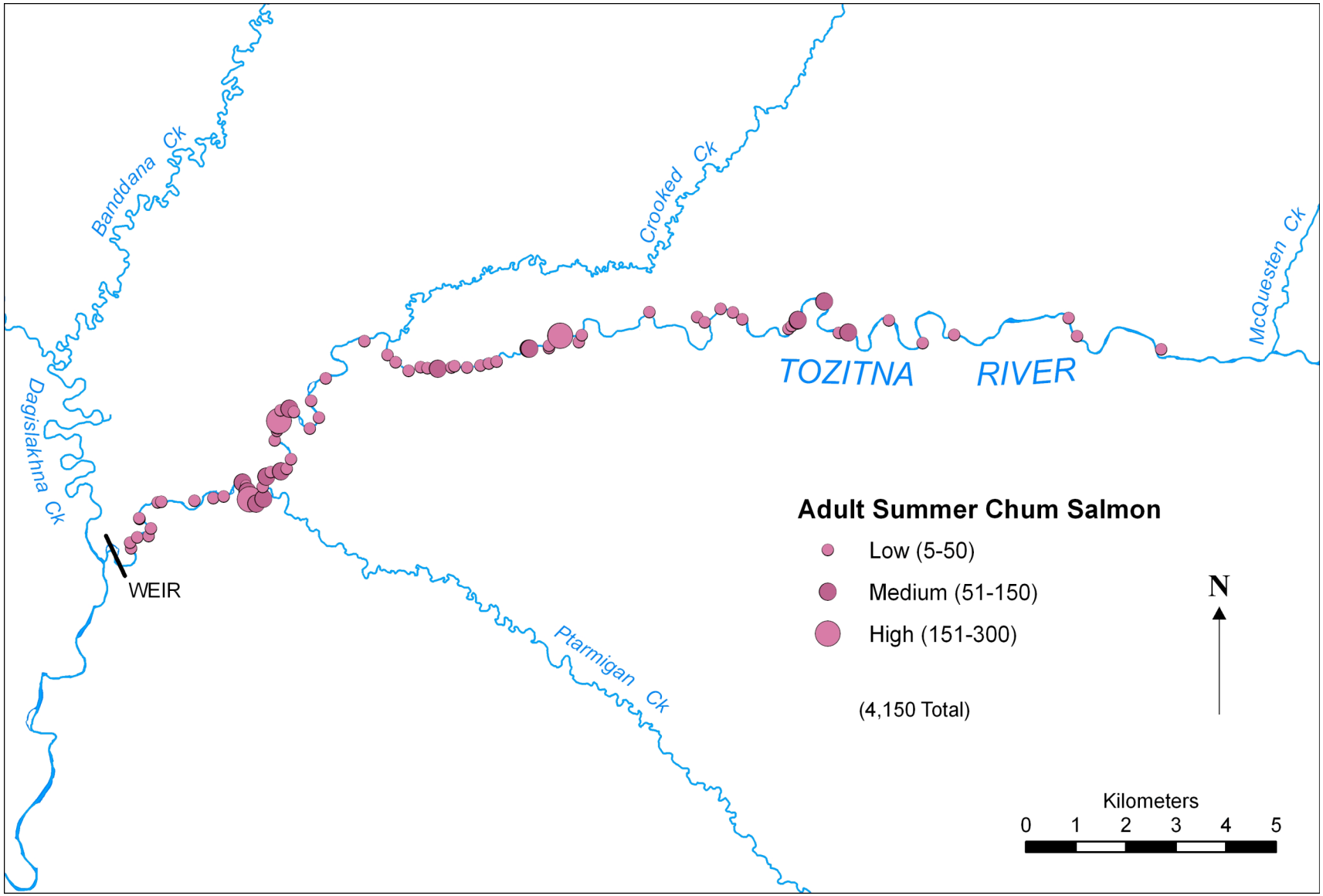

Figure 4. Frequency and distribution of summer chum salmon spawning areas found upstream of the Tozitna River weir, 2006.

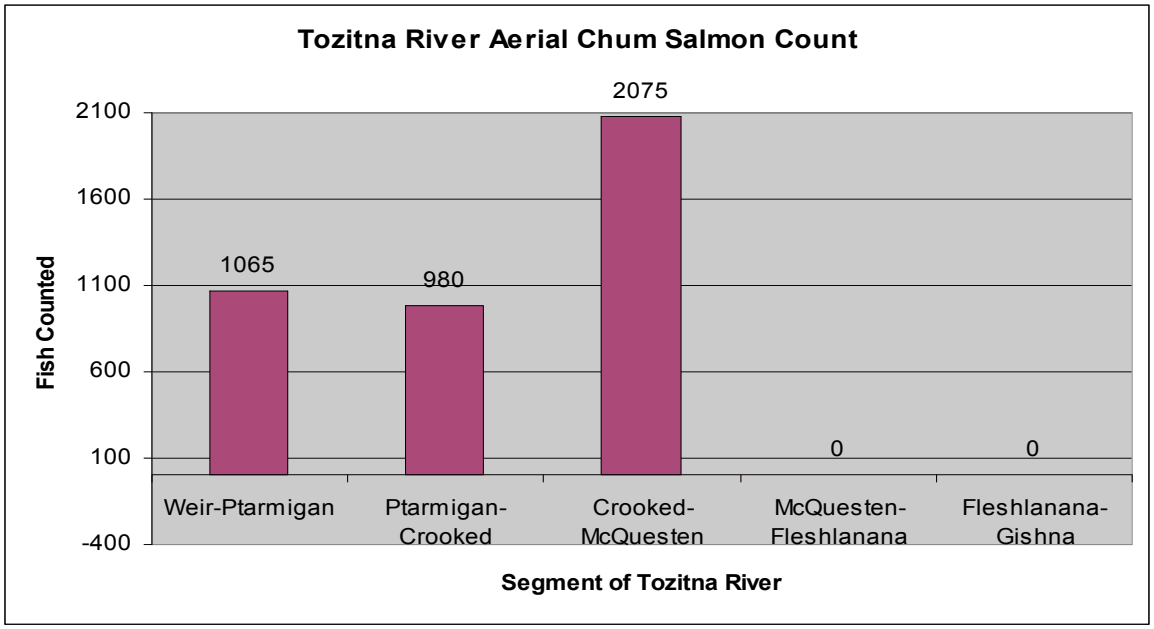

Figure 5. Location and distribution of summer chum salmon spawning areas found upstream of the Tozitna River weir, 2006.

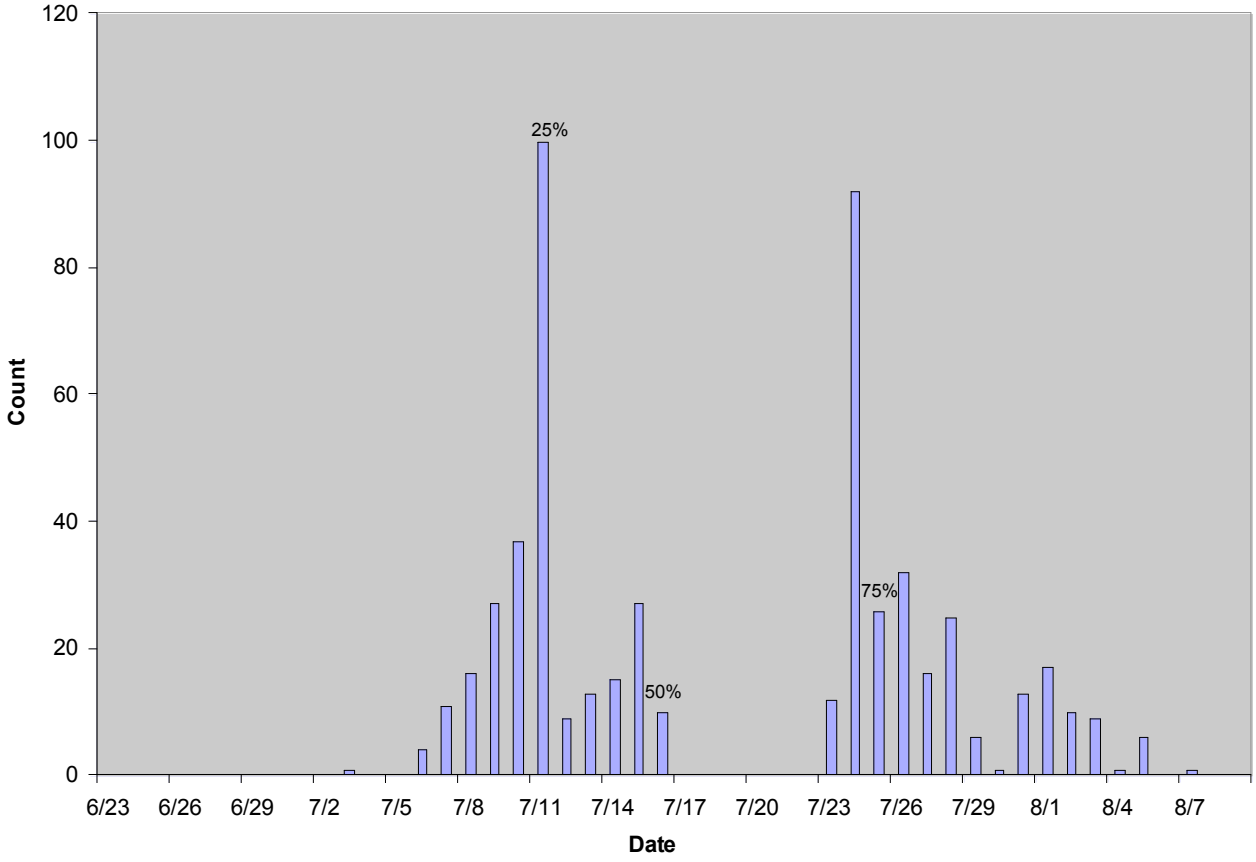

Figure 6. Chinook salmon daily counts with quartiles shown (25, 50, 75 %) of cumulative escapement for the period 24 June - 9 August, 2006, Tozitna River, Alaska.

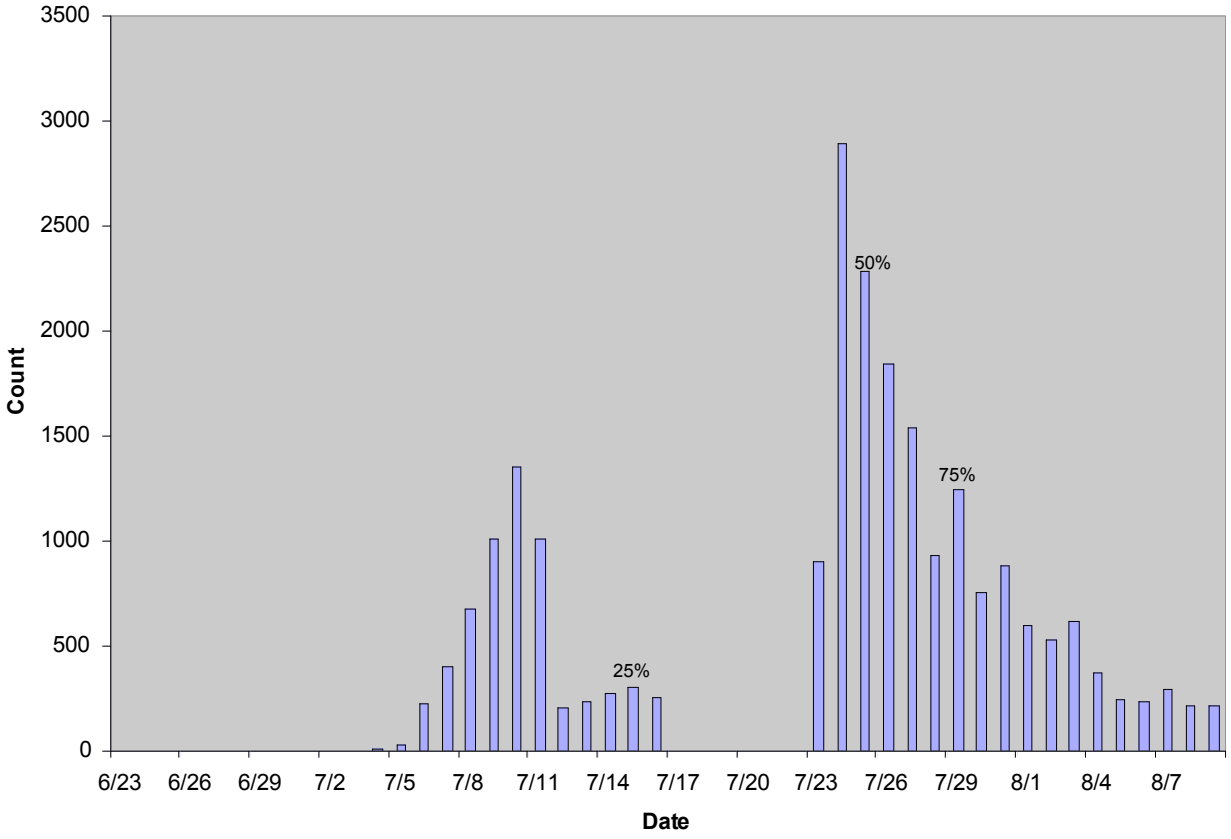

Figure 7. Summer chum salmon daily counts with quartiles shown (25, 50, 75 %) of cumulative escapement for the period 24 June - 9 August, 2006, Tozitna River, Alaska.

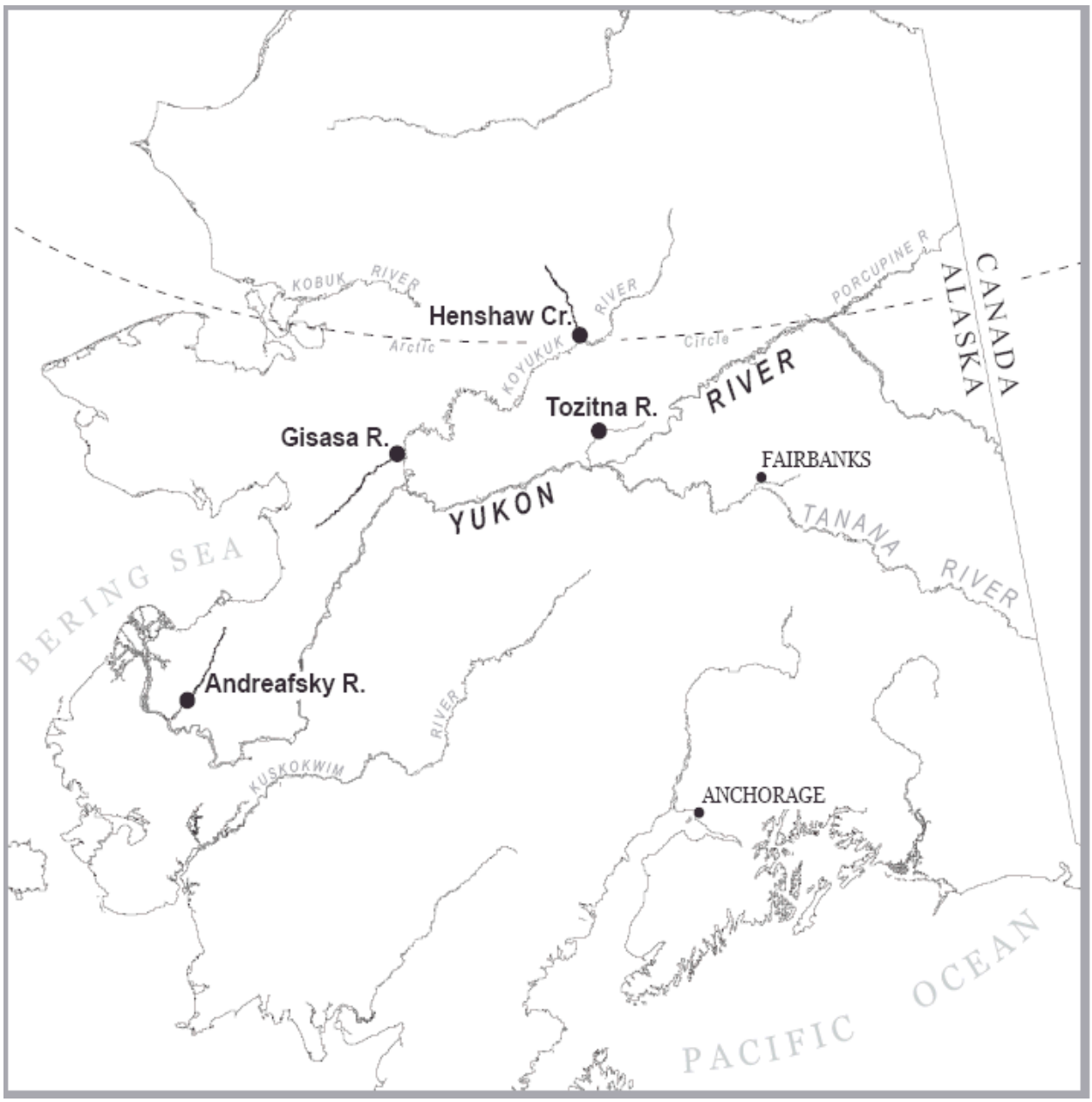

Figure 8. Location of the four weir projects monitoring Chinook salmon escapement in the Alaska portion of the Yukon River Basin in 2006. The projects were located on the East Fork Andreafsky River, Henshaw Creek, Gisasa River, and the Tozitna River.