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Abundance and Run Timing of Adult Salmon in the Tozitna River, Alaska, 2007

Jason Post, Carl Kretsinger, and Bob Karlen

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Aerial view of the weir and fish trap on the Tozitna River. BLM photograph by Jason Post.

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ABSTRACT

The Tozitna River project is a multi-agency study to determine escapement, run timing, and age-sex-length composition of adult Chinook and summer chum salmon in a middle Yukon River Basin tributary. A resistance board weir was operated from 23 June 2007 to 6 August 2007. For Chinook salmon the escapement was 494 and the age composition was 29.3% age 4, 34.6% age 5, 35.8% age 6, and .4% age 7. The Chinook sex composition from strata-weighted sample data was 25.8% female. For summer chum salmon the escapement was 14,147 and the age composition was 1.6% age 3, 63.7% age 4, 32% age 5, and 2.6% age 6. The summer chum sex composition from strata-weighted sample data was 43.3% female.

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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). Management of Yukon River salmon escapement is mostly 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 1 October 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).

The Bureau of Land Management (BLM) received a Congressional appropriation for Yukon River salmon restoration in 2000. 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 the Alaska Department of Fish and Game (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
4) Estimate the weekly age and sex proportions of Chinook salmon so that the simultaneous estimates have a 95% probability of being within .05 of the population proportion, and so that estimates for chum salmon have an a = .10 and d = .10

Additional project tasks are:

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

In addition, the BLM seeks to provide ADF&G with 7 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 4215 km^2, 90% of which the BLM manages (Figure 1). The watershed originates in the southeastern Ray Mountains at 1676 m and flows southwesterly approximately 207 km to its confluence with the Yukon River (1096 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 located at lat 65°31.0980′ N, long 152°12.8622′ W, approximately 80 km upstream from the mouth of the Tozitna River and approximately 0.5 km upstream from the Tozitna River's confluence with Dagislakhna Creek. 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, 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 60 m wide and was operational on 23 June. The weir was cleaned and inspected on a daily basis to remove debris and ensure that the trap provided the only avenue for fish passage.

The Tozitna River weir has remained in the same location for the past 3 years (2005–2007). In 2005 the weir was relocated 200 m downstream of its original (2002–2004) location due to a change in channel morphology.

Escapement

All salmon passing through the weir and live trap were counted and identified to species.

Observers wore polarized sunglasses to facilitate in fish identification. Counting occurred 24 hours per day, 7 days per 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, peak, and median date of passage.

Data Analysis

Chinook Salmon

Temporally stratified random sampling design (Cochran 1977) was used to collect

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

and analyze age-sex-length (ASL) data, with statistical weeks defining strata. Strata began on Tuesday and ended the following Tuesday with a weekly sample size target of 112 Chinook salmon distributed uniformly throughout the week (16 fish per day). The weekly sample goal allowed up to 5% of the scales to be illegible. An overall sample goal of 448 fish was established to achieve 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. The first and last sampling strata were greater than a week because of low escapement for those periods.

Summer Chum Salmon

Sampling for chum salmon was done in much the same manner as the sampling for Chinook. The only difference was that the weekly sample goal for chum 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 per day). The first sampling stratum was greater than a week because of low escapement for that period, and the last sampling stratum was shortened due to flooding. The weekly sample goal allowed up to 15% of the scales to be illegible.

Statistical Method

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

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

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 3 scales for Chinook salmon were removed from the left side, 2 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 the

ADF&G Division of Commercial Fisheries 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 × 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.

Spawning Locations

Aerial surveys were conducted by helicopter on the entire length of the Tozitna River to document the abundance and location of Chinook and summer chum spawning areas (redds). Observers wore polarized sunglasses to facilitate locating and counting redds, which were then recorded with GPS equipment. Some reaches of the river contained high concentrations of redds; in these areas, observers estimated the number of redds. The survey was broken into 2 segments. The first segment started at the mouth of the Tozitna River and ended at the fish weir, and the second segment started at the fish weir and ended a few kilometers beyond the upper reaches of spawning.

Abiotic Measurements

Water temperature, turbidity, precipitation, and stream stage (water surface elevation) measurements were collected daily from 22 June to 11 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 2100P Portable Turbidimeter. Precipitation for the previous 24 hours was measured daily 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. Annual stream stage versus discharge ratings can be developed by combining the direct discharge measurements and computer-simulated peak flow using log-log regression (Rantz et al. 1982).

RESULTS

Weir and Trap

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 of increased discharge, weir panels can become submerged, allowing salmon to migrate over the weir undetected. In 2007 heavy rain in the upper Tozitna River watershed during the first week of August forced closure of the fish trap at 0500 on 6 August after the weir panels became submerged. This high-water event marked the end of escapement counts and sampling for the 2007 season. The weir and trap were completely removed on 12 August.

Escapement

Chinook Salmon

Chinook salmon (N = 494) passed through the weir from 3 July to 5 August (Table 1). Daily Chinook escapement during the last 3 days of counting was <1% of the cumulative escapement. The quartile dates (25%, 50%, and 75%) of cumulative passage for Chinook salmon were 13 July, 20 July, and 24 July, respectively (Table 1; Figure 2). The date of peak passage was 23 July (n = 51), and the 12-day period of 13 July to 24 July accounted for 50% of the escapement (Figure 2).

Summer Chum Salmon

Summer chum salmon (N = 14,147) migrated through the weir from 3 July to 6 August (Table 1). Daily chum escapement for the last three complete days of counting averaged 7.7% of the cumulative escapement. Escapement counts were incomplete due to missed counts from high water; quartiles dates are therefore approximate. The quartile dates (25%, 50%, and 75%) of cumulative passage for summer chum salmon were 25 July, 29 July, and 2 August, respectively (Table 1; Figure 3). The date of peak passage was 23 July (n = 2890), and the 9-day period of 25 July to 2 August accounted for 50% of the escapement (Figure 3).

Age-Sex-Length

Chinook Salmon

The sex composition of Chinook salmon was 25.7% female, ranging from 2.9% (3 July to 10 July) to 38.2% (25 July to 5 August) throughout weekly sampling strata (Table 2). Four age groups were identified from 217 readable scale samples. Overall, Chinook salmon were predominantly age 1.4 (35.4%) and age 1.3 (35%), followed by age 1.2 (29.2%) and age 1.5 (.4%) (Table 3). Females were generally older (77.8% age 1.4 and 19.9% age 1.3) than males (42.6% age 1.3 and 40.4% age 1.2). The structure of the run was influenced by sex and age, with the mean length of females age 1.3 and age 1.4 greater than that of same-age males. Females ranged from 700 mm to 910 mm, while the males ranged from 430 mm to 875 mm (Table 4).

Summer Chum Salmon

The sex composition of summer chum salmon was 43.3% female, ranging from 25.6% (12 July to 18 July) to 59.6% (2 August to 5 August) throughout weekly sampling stratum (Table 5). Four age groups were identified from 708 readable scale samples. Overall, chum salmon were predominantly age 0.3 (63.7%) and age 0.4 (32%), followed by age 0.5 (2.6%) and age 0.2 (1.6%) (Table 6). Females ranged from 420 to 630 mm, while males ranged from 500 to 695 mm (Table 7).

Spawning Ground Survey

An aerial survey was conducted by helicopter to document spawning areas on the Tozitna River on 26 July. The survey began at the mouth of the Tozitna River and ended approximately 35 km upstream of the fish weir (Figures 4, 5, 8, 9). The first segment started at the mouth of the Tozitna River and ended at the weir (Figures 4, 5), and the second segment began at the weir and ended a few kilometers beyond the last observed Chinook redd (Figures 8, 9). Low water levels in the Tozitna River at the time of the survey provided very good observation conditions.

Downstream of Weir

Observers recorded 22 Chinook redds and 1084 summer chum redds downstream of the Tozitna River fish weir (Figures 4–7). These figures represented 16% of the total Chinook redds and 53% of the total summer chum redds observed in the Tozitna River, respectively. The majority of the Chinook redds (73%), as well as 53% of the summer chum redds, were found between Reindeer Creek and the weir. The survey revealed the importance of the river between Reindeer Creek and the weir for the spawning of both species.

Upstream of Weir

Observers recorded 116 Chinook redds and 968 summer chum redds upstream of the weir (Figures 8–11). These figures represented 84% of the total Chinook redds and 47% of the total summer chum redds in the Tozitna River, respectively. The Chinook redd observed farthest upstream was approximately 32 km upstream of the weir and just below Fleshlanana Creek (Figure 8). Over half (55%) of these Chinook redds, as well as half (50%) of the summer chum redds, were observed within the 24 km stretch of river between Crooked Creek and McQuesten Creek. Similar results were found in 2005–2006 aerial surveys.

Abiotic Measurements

Hourly water temperatures ranged from 7 to 14.5 °C. The mean daily water temperature was 11.8 °C, slightly above the 7-year (2001–2007) average of 11.1 °C. During a majority (77%) of the monitoring period, water temperatures remained within those favorable for the migration (<15 °C) and the spawning and egg incubation (<13 °C) of salmon (Combs and Burrows 1957; Bell 1973; Hale 1981; McCullough 1999; Poole et al. 2001). However, water temperatures did at times exceed the State of Alaska standard for maximum water temperature during spawning and egg incubation (13 °C), as well as temperatures considered to cause elevated disease rates (14–17 °C) and reduced gamete viability (13–16 °C) in salmon (EPA 2001; Table 8).

Turbidity (NTU) ranged from 0.7 to 56.6 and averaged 4.28. Total precipitation for the period was 16.33 cm. Stream stage fluctuated from 155 to 34 cm and averaged 63 cm.

DISCUSSION

Chinook Salmon

The 2007 Yukon River Chinook run was expected to be average to below average and similar in abundance to the 2006 run, i.e., sufficient for escapements, a normal subsistence harvest, and a below-average commercial harvest (ADF&G 2007). All spawning escapement goals were met in Alaska, and in-season fishers' reports suggested that most mainstem Yukon Area subsistence fishing households met their subsistence needs for salmon (JTC 2008). The total commercial harvest of 33,634 Chinook salmon was 23% below the 10-year (1997–2006) average for the Alaska portion of the Yukon River drainage (JTC 2008).

The 2007 Chinook salmon escapement (494) on the Tozitna River was the lowest escapement count recorded since the project's inception in 2001. The 2007 Chinook escapement was only 33% of the 5-year average (2002–2005, 2007) of 1480. Escapement counts from 2001 and 2006 were not included in the average because there was no commercial fishing on the Yukon River in 2001 and the Tozitna counts were incomplete in 2006. Two factors suggest that the 2007 Chinook escapement counts on the Tozitna River are accurate: (1) the first Chinook passed 9 days after the weir was installed, and (2) Chinook escapement during the last 3 days of counting was <1% of the cumulative escapement. With 52% of the Chinook escapement sampled, the sex ratio of 25% female should likewise be considered accurate. This sex ratio is greater than the 5-year average of 21% female. Given an escapement of only 494 Chinook and a sex ratio of 25%, an estimated 127 females returned to spawn in 2007 (above the weir).

Chinook run-timing and quartile dates were slightly later than normal in 2007. The first Chinook passed the Tozitna River weir on 3 July, just 3 days later than the 5-year average of 30 June. Quartile dates were also 2 to 5 days later than the 5-year averages. The date of peak passage (51 Chinook) occurred on 23 July, which was 8 days later than average. However, 50 Chinook (only 1 less than peak passage) passed through the weir on 13 July, which was only 2 days later than average. Two noticeable pulses of Chinook occurred in 2007. The first pulse, which accounted for 27% of the escapement, occurred 10 July to 13 July. The second pulse, which accounted for 26% of the escapement, occurred 22 July to 24 July. In contrast, the 8-day period between pulses only accounted for 24% of the escapement. A comparative analysis of run timing will be performed on 2001–2009 Tozitna River escapement data after the final season and will be included in the final report. Run timing will then be compared to subsistence and commercial fishing seasons in the Yukon River to determine if run timing is influenced by, and/or correlates with, open fishing seasons on the Yukon River.

Summer Chum Salmon

The 2007 summer chum outlook was for an average to above average run. The run was expected to provide for escapement while supporting a normal subsistence harvest and a surplus of 500,000 to 900,000 fish for commercial harvest (ADF&G 2007). With a renewed market interest, numerous commercial seasons were directed at summer chum salmon in 2007 (ADF&G 2007). The total commercial harvest of 198,201 summer chum salmon was the tenth-lowest harvest for the Alaska portion of the Yukon River drainage since 1967 (ADF&G 2007) but 315% above the 1997–2006 average harvest (JTC 2008).

The 2007 summer chum salmon escapement count (14,147) for the Tozitna River was incomplete due to high water. The average daily escapement for the last 3 days of counting was 7% of the cumulative escapement. Given this average daily escapement count and run-timing dates from previous years, the 2007 total escapement was likely below the 4-year average (2001–2002, 2004, 2005) of 24,067.

The date of the first chum passing through the weir, quartile dates, and the date of peak passage were 2 to 7 days later than the 4-year average. The sex ratio (43% female) was only slightly below the 6-year average (44%).

Fall Chum and Coho Salmon

BLM employees observed fall chum spawning in the lower reaches of the Tozitna River and coho salmon spawning in front of the Tozitna River fish camp on 2 October 2007.

However, very little is known regarding the abundance and spawning locations of these fall-run salmon populations. During a helicopter survey on 29 September 2008, BLM employees counted 50 fall chum and 200 coho in the Tozitna River. These counts may have been reduced by the late timing of the survey and by limited visibility in some areas due to shading, dark (algae) substrate, and slush ice. Further research would provide baseline fisheries information on these Middle Yukon River Drainage salmon populations and help the BLM assess current and potential subsistence resources in this region.

Future Plans

The Office of Subsistence Management approved funding the Tozitna River project through 2009. The 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, the BLM would like to further monitor the ongoing low proportion of returning female Chinook to the Tozitna River as compared to the other 3 Yukon River Basin monitoring projects (Table 9; Figure 12).

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Table 1. Daily and cumulative counts for Chinook and summer chum salmon with the second quartile, median, and third quartile highlighted; Tozitna River, Alaska, 2007.

	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	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	1	1	0.00	1	1	0.00
7/4	1	2	0.00	5	6	0.00
7/5	0	2	0.00	0	6	0.00
7/6	1	3	0.01	6	12	0.00
7/7	1	4	0.01	32	44	0.00
7/8	5	9	0.02	62	106	0.01
7/9	9	18	0.04	31	137	0.01
7/10	26	44	0.09	79	216	0.02
7/11	47	91	0.18	148	364	0.03
7/12	8	99	0.20	105	469	0.03
7/13	50	149	0.30	135	604	0.04
7/14	17	166	0.34	26	630	0.04
7/15	0	166	0.34	31	661	0.05
7/16	-1	165	0.33	3	664	0.05
7/17	11	176	0.36	13	677	0.05
7/18	17	193	0.39	97	774	0.05
7/19	29	222	0.45	115	889	0.06
7/20	23	245	0.50	332	1221	0.09
7/21	23	268	0.54	408	1629	0.12
7/22	48	316	0.64	708	2337	0.17
7/23	51	367	0.74	553	2890	0.20

-Continued-

[a] Trap closed (not fish-tight) due to high water and turbidity.

Table 1 (cont.). Daily and cumulative counts for Chinook and summer chum salmon with the second quartile, median, and third quartile highlighted; Tozitna River, Alaska, 2007.

	Chinook			Summer chum		
	Daily	Cumulative		Daily	Cumulative	
Date	Count	Count	Proportion	Count	Count	Proportion
7/24	30	397	0.80	455	3345	0.24
7/25	16	413	0.84	718	4063	0.29
7/26	18	431	0.87	434	4497	0.32
7/27	8	439	0.89	1209	5706	0.40
7/28	6	445	0.90	874	6580	0.47
7/29	9	454	0.92	1264	7844	0.55
7/30	9	463	0.94	856	8700	0.61
7/31	8	471	0.95	777	9477	0.67
8/1	10	481	0.97	919	10396	0.73
8/2	13	494	1.00	767	11163	0.79
8/3	-1	493	1.00	1233	12396	0.88
8/4	0	493	1.00	627	13023	0.92
8/5	1	494	1.00	1119	14142	1.00
8/6[a]	0	494	1.00	5	14147	1.00

[a] Trap closed (not fish-tight) due to high water and turbidity.

Table 2. Female Chinook salmon composition for the Tozitna River, Alaska, 2007. SE = Standard Error.

	Sample			Escapement			
Stratum Dates	n	# Females	% Female	Weir Count	Estimated # Females	% Female (of total escapement)	SE
7/3–7/10	35	1	2.9	44	1	0.3	2.9
7/11–7/17	90	17	18.9	132	25	5	4.2
7/18–7/24	100	29	29	221	64	13	4.6
7/25–8/5	34	13	38.2	97	37	7.5	8.5
All Strata	259	60	–	494	127	25.8	2.9

Table 3. Age composition of Chinook salmon escapement by stratum and sex for the Tozitna River, Alaska, 2007. Standard error in parenthesis.

				Brood Year and Age										
				2004		2003		2002		2001		2000		
				1.1		1.2		1.3		1.4		1.5		
Stratum Dates	Weir Count	Sex	# Fish Sampled	%		%		%		%		%		% Escapement
7/3–7/10	44	M	32	0.0		4.8		5.2		1.8		0.0		8.9
		F	1	0.0		0.0		1.0		0.0		0.0		
		Subtotal	33											
7/11–7/17	132	M	54	0.0		12.2		10.5		7.2		0.0		26.7
		F	12	0.0		0.0		3.0		13.6		1.5		
		Subtotal	66											
7/18–7/24	221	M	61	0.0		13.2		21.5		7.6		0.0		44.7
		F	27	0.0		0.0		3.8		47.6		0.0		
		Subtotal	88											
7/25–8/5	97	M	18	0.0		9.8		5.4		0.9		0.0		19.6
		F	12	0.0		0.0		4.9		24.5		0.0		
		Subtotal	30											100
Combined Strata	362[a]	M	165	0.0	(0)	39.9	(7.9)	42.5	(7.9)	17.5	(5.5)	0	(0)	100
	132[a]	F	52	0.0	(0)	0	(0)	12.7	(8.4)	85.7	(9.1)	1.5	(4.3)	100
Total	494		217	–		–		–		–		–		–
Age Composition With Sexes Combined				0.0	(0)	29.3	(6.3)	34.6	(6.4)	35.8	(6.4)	.4	(0)	100

[a] Estimated number of male and female salmon derived from stratum-weighted ASL data.

Table 4. Chinook salmon mid-eye to fork length (mm) by age and sex for the Tozitna River, Alaska, 2007. SE = Standard Error.

Age	Sex	Sample	Mean	SE	Range
1.1	Male	0			
	Female	0			
1.2	Male	65	531	5.8	430–620
	Female	0			
1.3	Male	70	686	5.7	590–850
	Female	7	756	15	700–800
1.4	Male	30	761	7.8	650–875
	Female	44	820	6.8	730–910
1.5	Male	0			
	Female	1	900		900

Table 5. Female summer chum salmon composition for the Tozitna River, Alaska, 2007. SE = Standard Error.

	Sample			Escapement			
Stratum Dates	n	# Females	% Female	Weir Count	Estimated # Females	% Female (of total escapement)	SE
7/3–7/11	110	37	33.6	364	122	0.87	4.5
7/12–7/18	168	43	25.6	410	105	0.74	3.4
7/19–7/25	235	74	31.5	3289	1036	7.32	3.0
7/26–8/1	183	76	41.5	6333	2630	18.59	3.7
8/2–8/5	94	56	59.6	3751	2235	15.80	5.1
All Strata	790	286	–	14,147	6,128	43.3	2.2

Table 6. Age composition of summer chum salmon escapement by stratum and sex for the Tozitna River, Alaska, 2007. Standard error in parenthesis.

				Brood Year and Age								
				2004		2003		2002		2001		
				0.2		0.3		0.4		0.5		
Stratum Dates	Weir Count	Sex	# Fish Sampled	%		%		%		%		% Escapement
7/3–7/11	364	M	60	0.0		1.3		1.5		0.1		3.0
		F	31	0.1		1.0		0.7		0.2		
		Subtotal	91									
7/12–7/18	410	M	104	0.2		2.3		1.1		0.1		3.7
		F	38	0.2		0.9		0.5		0.1		
		Subtotal	142									
7/19–7/25	3,289	M	151	1.3		19.2		7.5		0.4		28.4
		F	66	0.2		12.2		4.0		0.0		
		Subtotal	217									
7/26–8/1	6,333	M	99	0.5		27.2		15.6		2.3		45.6
		F	72	0.6		31.0		11.5		0.6		
		Subtotal	171									
8/2–8/5	3,751	M	36	0.0		12.3		6.4		0.5		19.3
		F	51	0.0		20.5		14.8		0.7		
		Subtotal	87									
Combined Strata	362[a]	M	450	2.0	(1.1)	62.3	(5.8)	32.3	(5.6)	3.4	(2.2)	100.0
	132[a]	F	258	1.2	(1.6)	65.6	(6.1)	31.6	(5.9)	1.6	(1.7)	100.0
Total	494		708	-			-		-		-	-
Age Composition With Sexes Combined				1.6	(0.9)	63.7	(4.1)	32	(4.0)	2.6	(1.4)	100

[a] Estimated number of male and female salmon derived from stratum-weighted ASL data.

Table 7. Summer chum salmon mid-eye to fork length (mm) by age and sex for the Tozitna River, Alaska, 2007. SE = Standard Error.

Age	Sex	Sample	Mean	SE	Range
0.2	Male	13	560	1.1	520–605
	Female	9	517	1.6	420–585
0.3	Male	275	567	5.8	500–670
	Female	164	544	6.1	460–610
0.4	Male	149	583	5.6	520–695
	Female	78	550	5.9	480–620
0.5	Male	13	582	2.2	530–610
	Female	7	576	1.7	545–630

Table 8. Number of days, average hours per day, and percentage of the monitoring period (22 June to 11 August 2007) in which the water temperatures of the Tozitna River at the weir site exceeded water temperature threshold values considered to have an effect on salmon health and reproduction. The water quality standards and health and reproduction temperature threshold values are from 18 Alaska Administrative Code 70 and Poole et al. (2001).

	State Water Quality Standard for Max. Migration Temp. (>15 °C)	State Water Quality Standard for Max. Spawning and Egg Incubation Temp. (>13 °C)	Reduced Gamete Viability (13–16 °C)	Elevated Disease Rate (14–17 °C)	50% Pre-Hatch Mortality (≥16 °C)
No. days exceeding the parameter during the monitoring period	0	29	29	10	0
Avg. hours /day exceeding the parameter	0	9.8	9.8	3.8	0
% of monitoring period exceeding the parameter (hourly basis)	0	23.2	23.2	3.1	0

Table 9. Comparison of preliminary Chinook age composition by sex at the East Fork Andreafsky River, Gisasa River, Henshaw Creek, and the Tozitna River, Alaska for 2007.

				Brood year and Age							
				2004	2003	2002	2001	2001	2000	2000	Total
				1.1	1.2	1.3	1.4	2.3	1.5	2.4	
Location	River (km)[a]	Sample Size	Sex	%	%	%	%	%	%	%	%
EF Andreafsky Weir	167	631[b]	Males	0	25.5	18	11.5	0	0.4	0	55.3
			Females	0	16.2	7.7	20.6	0	0.3	0	44.7
			Subtotal	0	41.7	25.7	32	0	0.6	0	100
Gisasa Weir	908	336[b]	Males	0	26.1	17.9	16.7	0.2	0	0	61
			Females	0	4.2	2.8	31.7	0	0.2	0	39
			Subtotal	0	30.4	20.7	48.5	0.2	0.2	0	100
Henshaw Weir	1,539	258[b]	Males	0	46.6	15.9	12.6	0	0	0	75.1
			Females	0	0	4.5	20.5	0	0	0	24.9
			Subtotal	0	46.6	20.4	33	0	0	0	100
Tozitna Weir	1,096	217[b]	Males	0	30	32.2	13.8	0	0	0	76
			Females	0	0	3.2	20.3	0	0.5	0	24
			Subtotal	0	30	35.5	34.1	0	0.4	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 obtained from ADF&G, 2007.

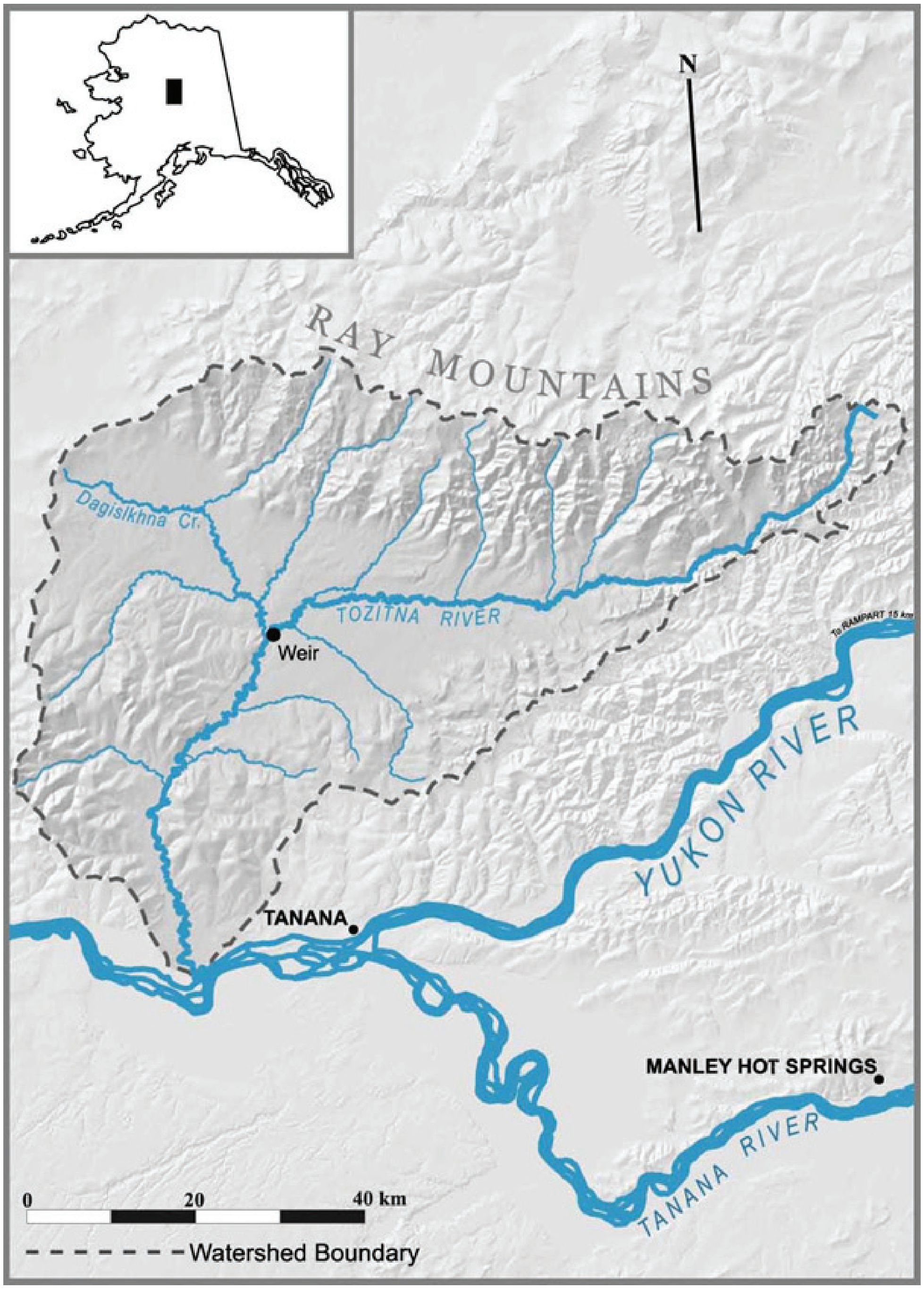

Figure 1. The 2007 location of the Tozitna River weir, Alaska.

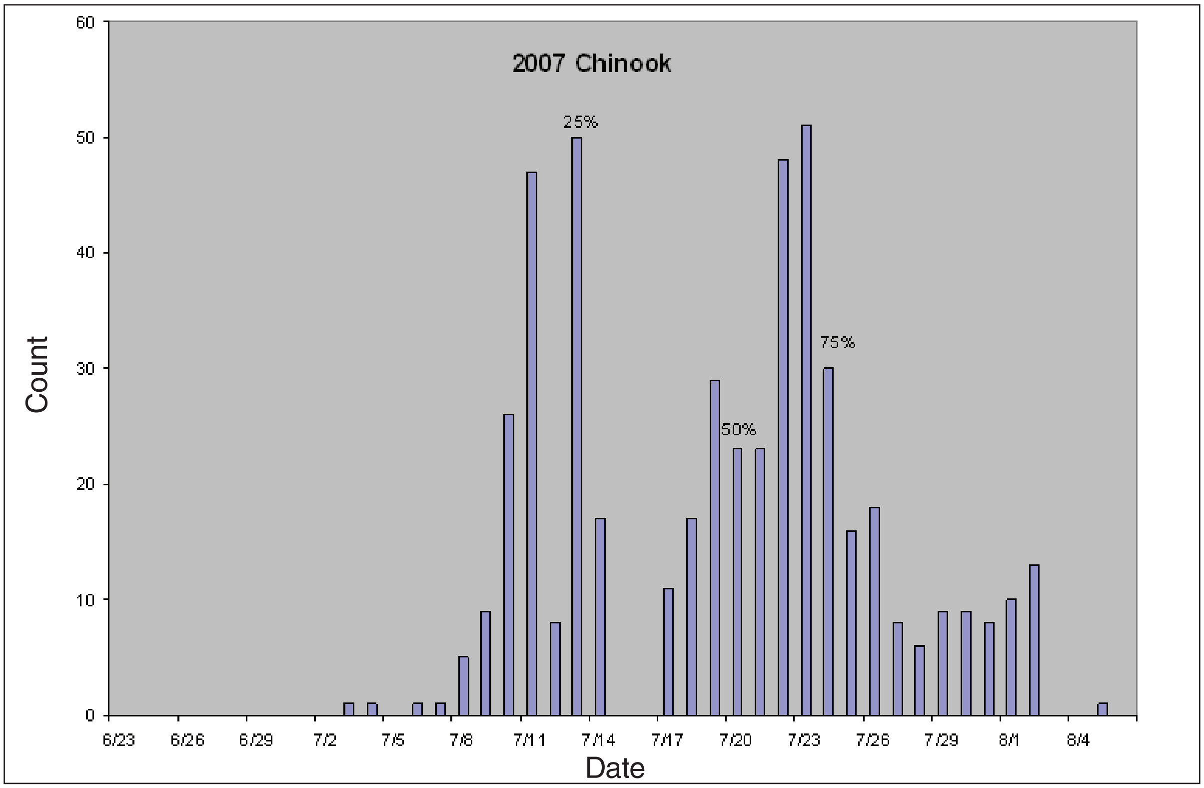

Figure 2. Chinook salmon daily counts with quartiles (25%, 50%, and 75%) of cumulative escapement for the period 23 June – 6 August, 2007, Tozitna River, Alaska.

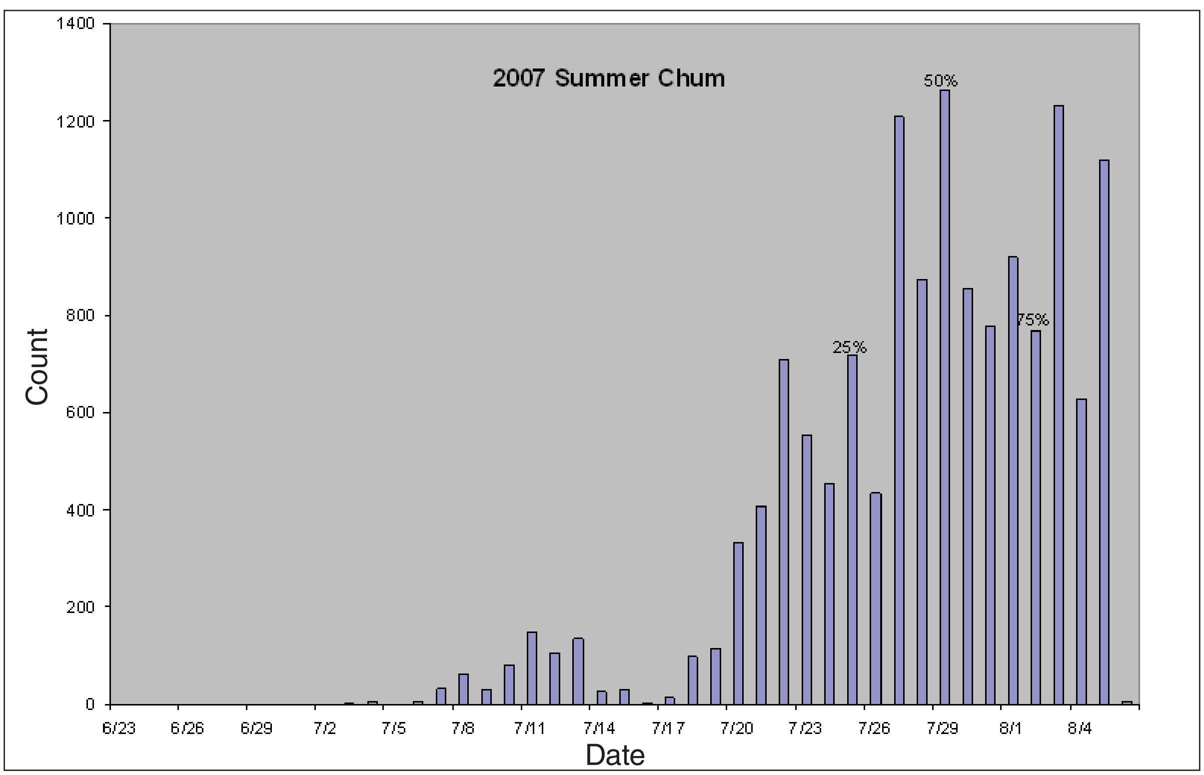

Figure 3. Summer chum salmon daily counts with quartiles (25%, 50%, and 75%) of cumulative escapement for the period 23 June – 6 August, 2007, Tozitna River, Alaska.

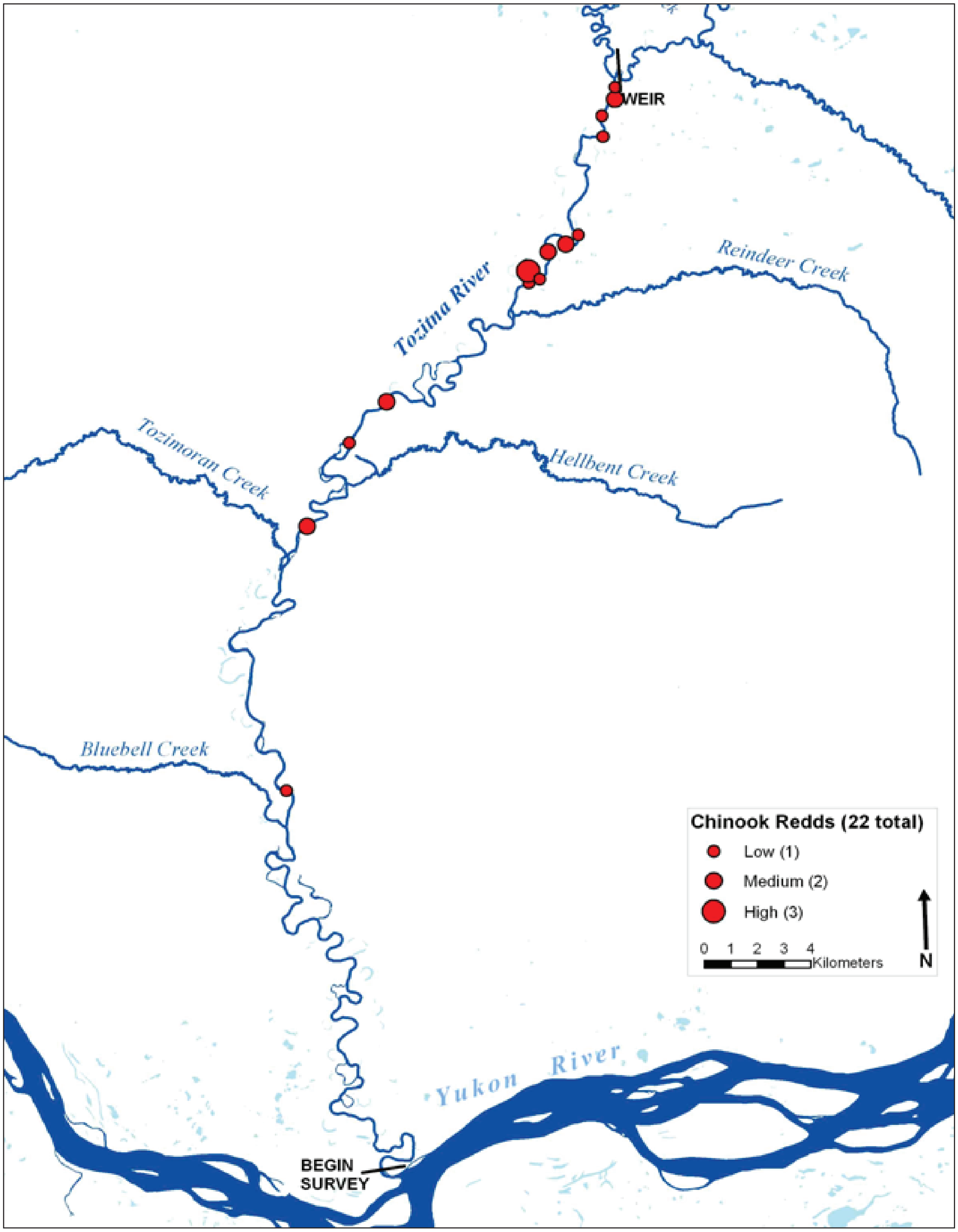

Figure 4. Number and distribution of Chinook redds downstream of the Tozitna River fish weir in 2007.

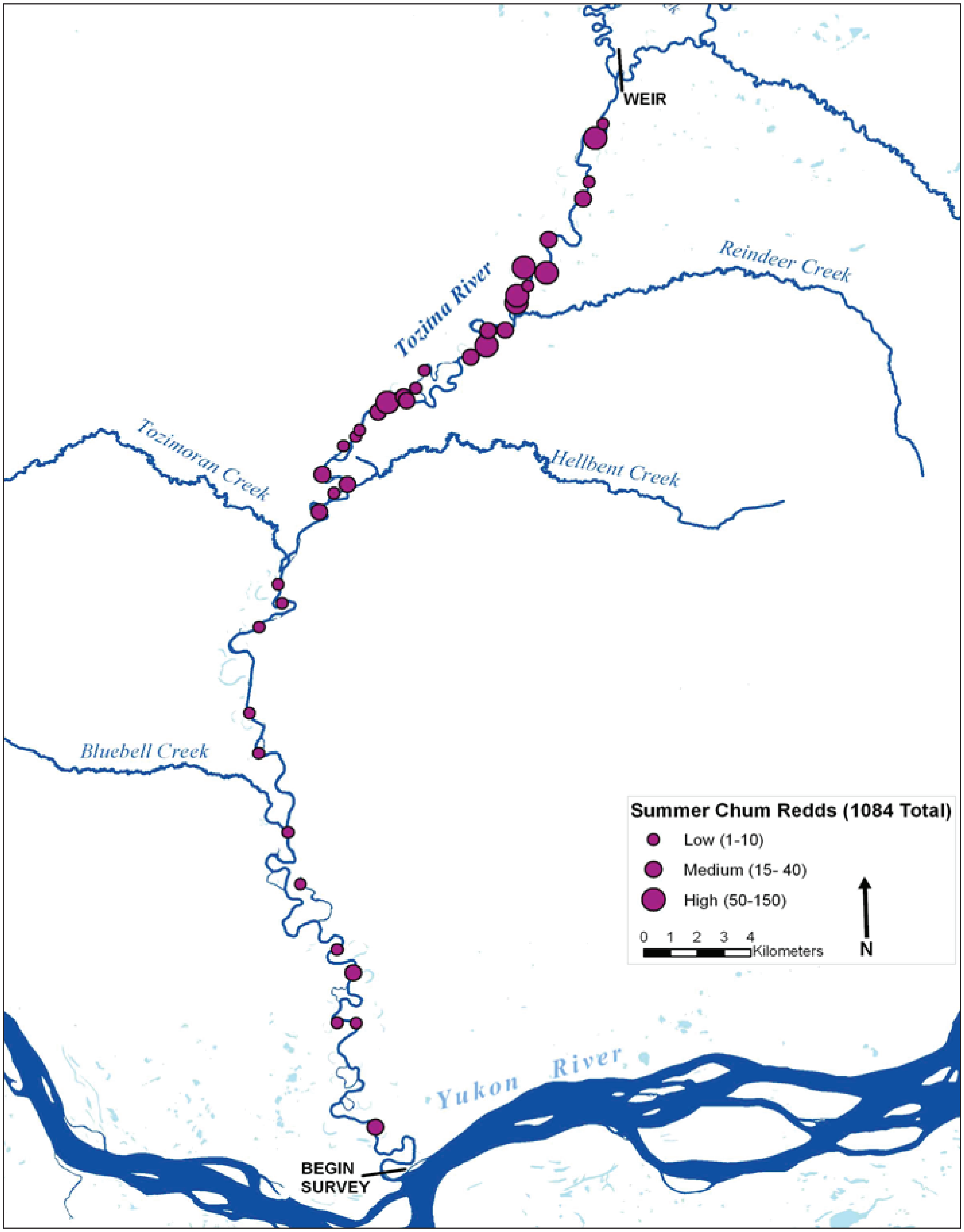

Figure 5. Number and distribution of summer chum redds downstream of the Tozitna River fish weir in 2007.

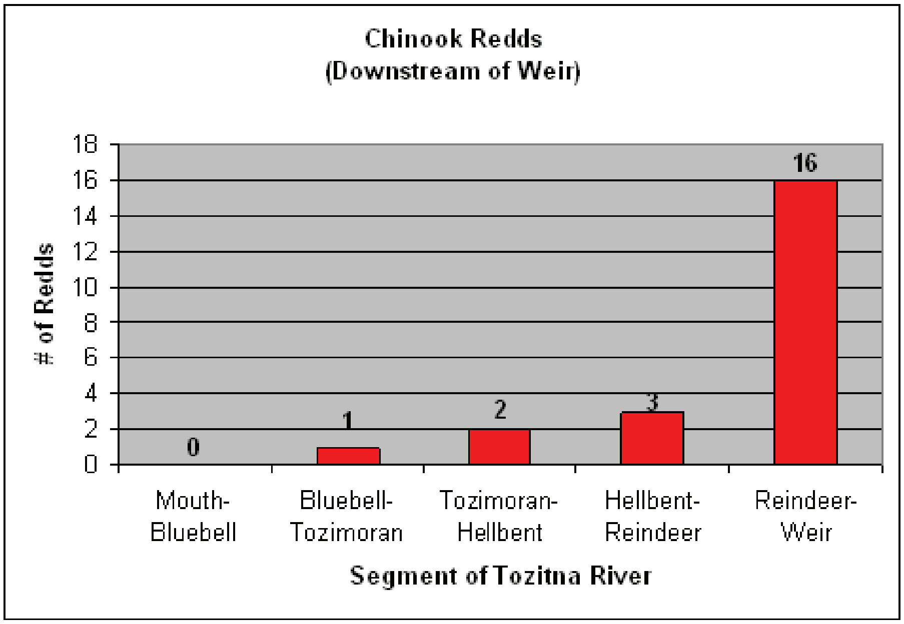

Figure 6. Distribution of Chinook redds downstream of the Tozitna River fish weir in 2007.

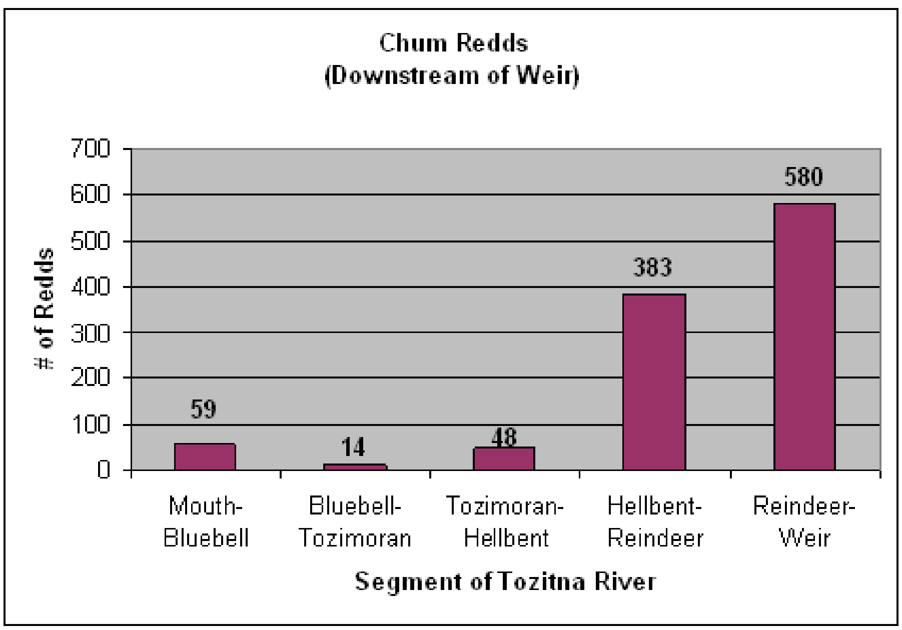

Figure 7. Distribution of summer chum redds downstream of the Tozitna River fish weir by river segment in 2007.

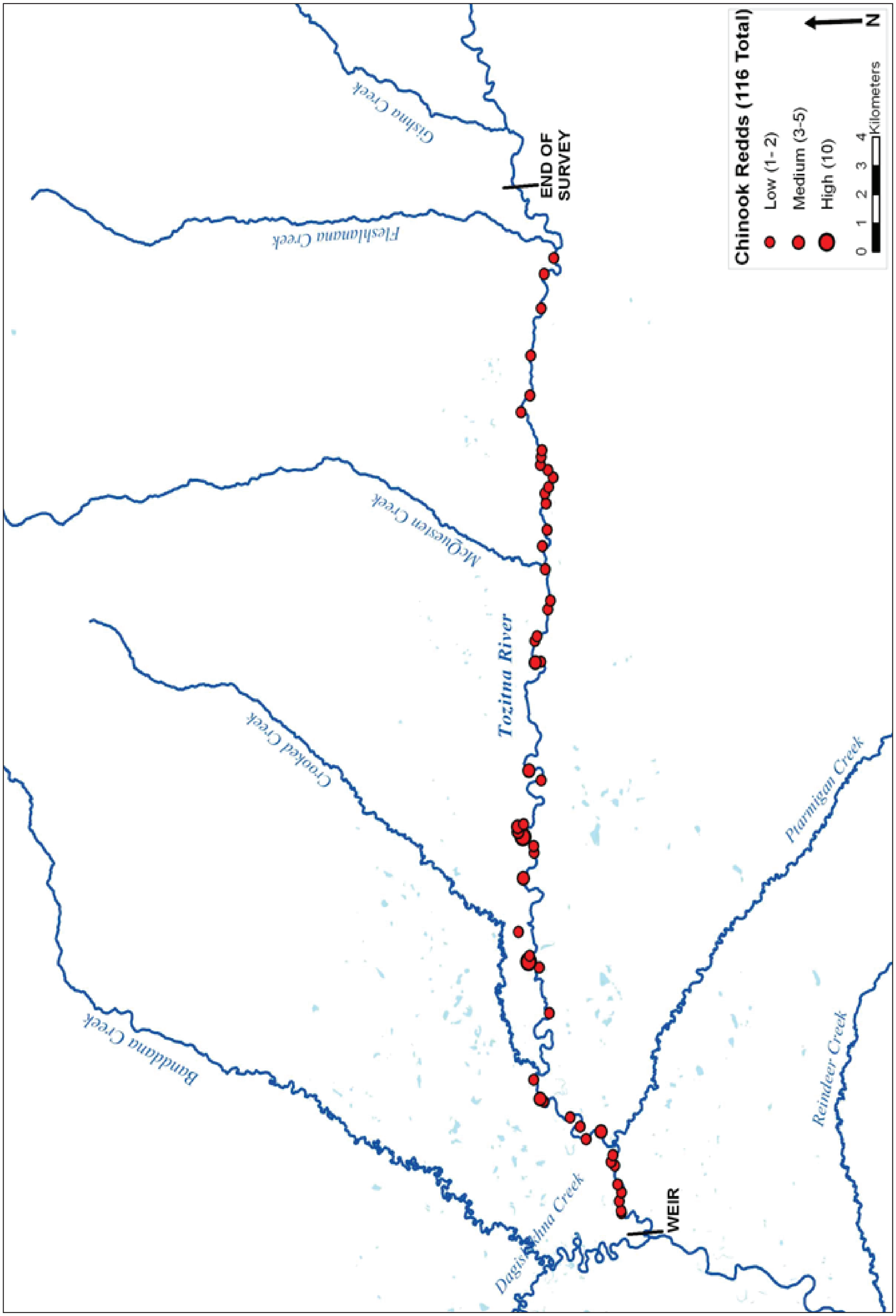

Figure 8. Number and distribution of Chinook redds upstream of the Tozitna River fish weir in 2007.

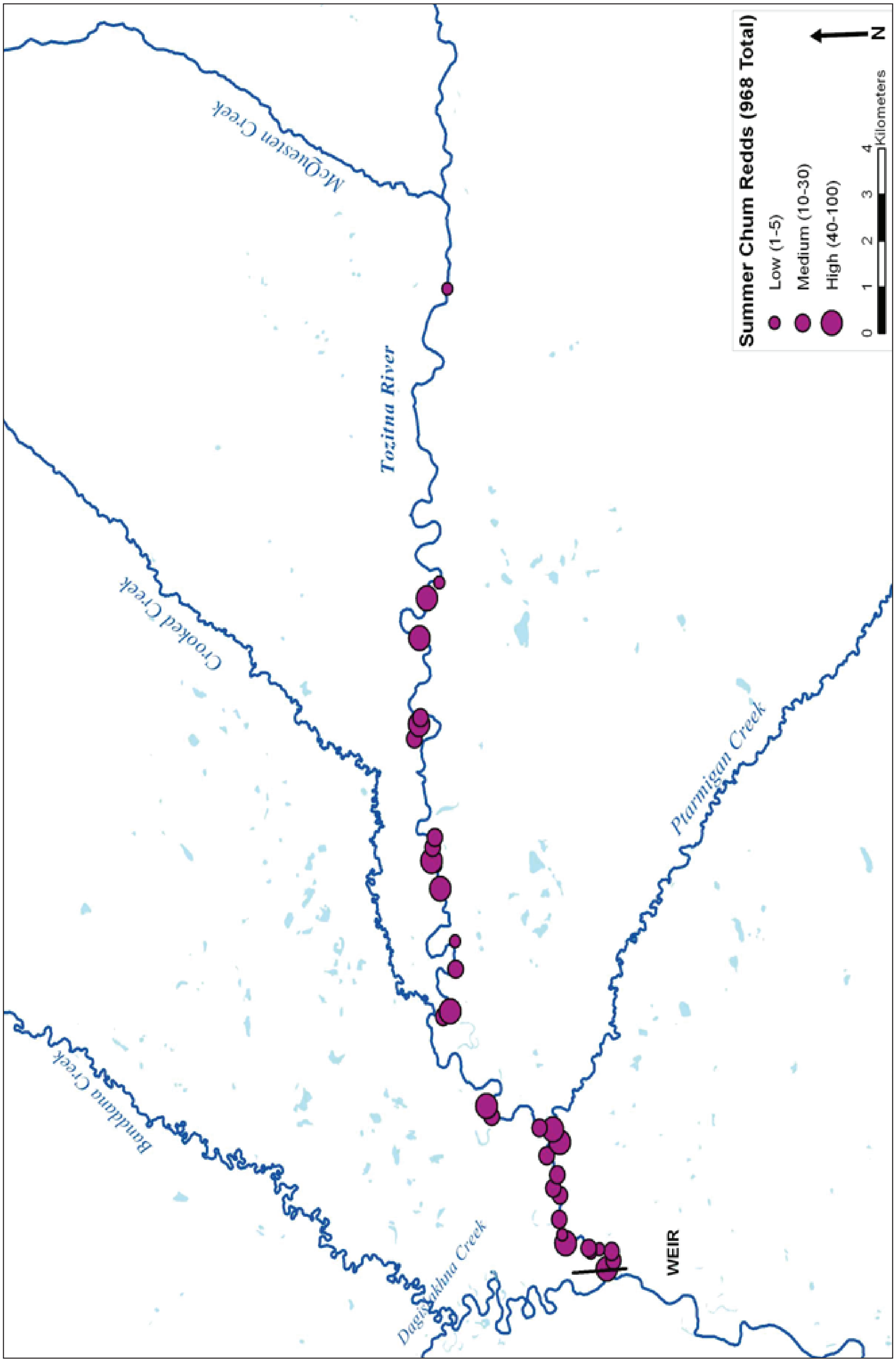

Figure 9. Number and distribution of summer chum redds upstream of the Tozitna River fish weir in 2007.

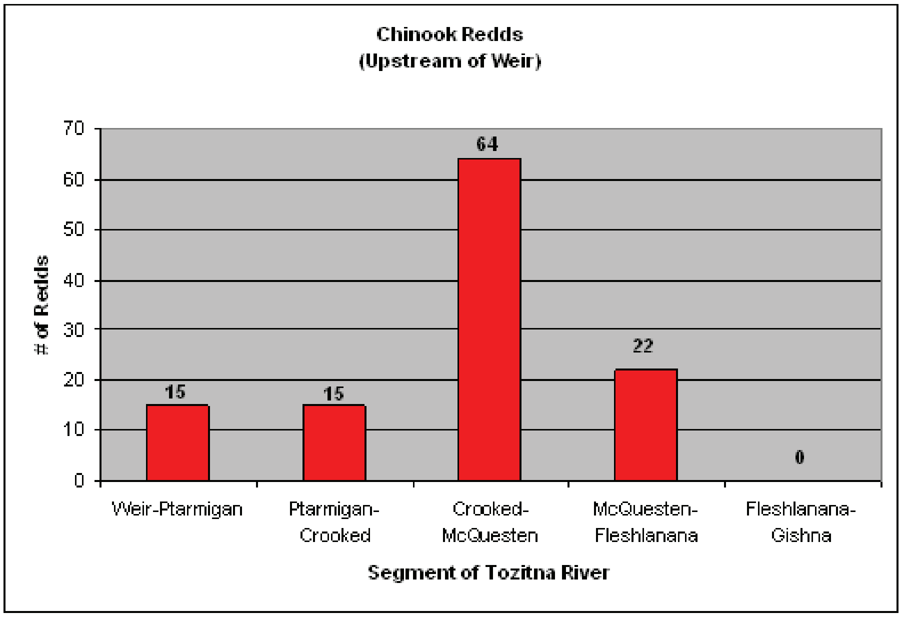

Figure 10. Distribution of Chinook redds upstream of the Tozitna River fish weir in 2007.

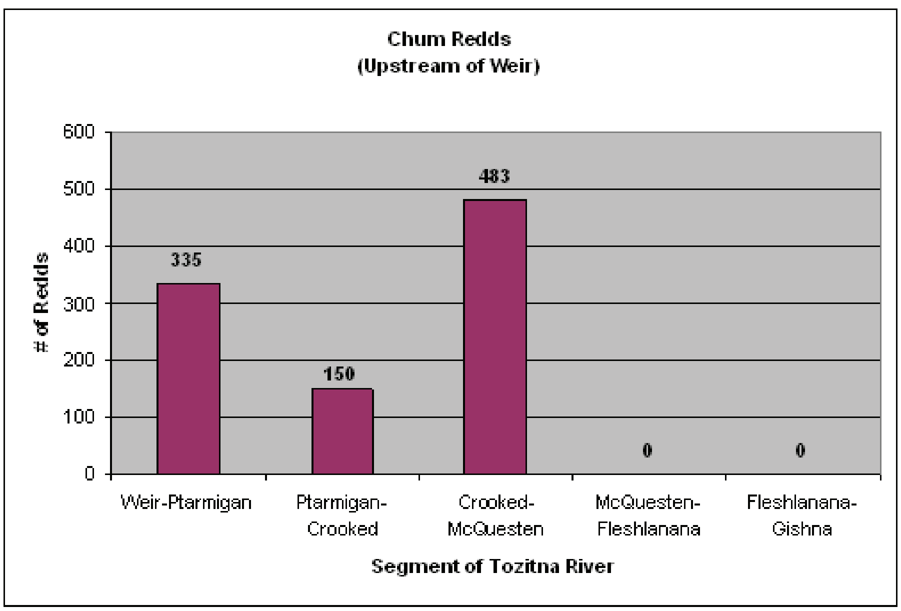

Figure 11. Distribution of summer chum redds upstream of the Tozitna River fish weir in 2007.

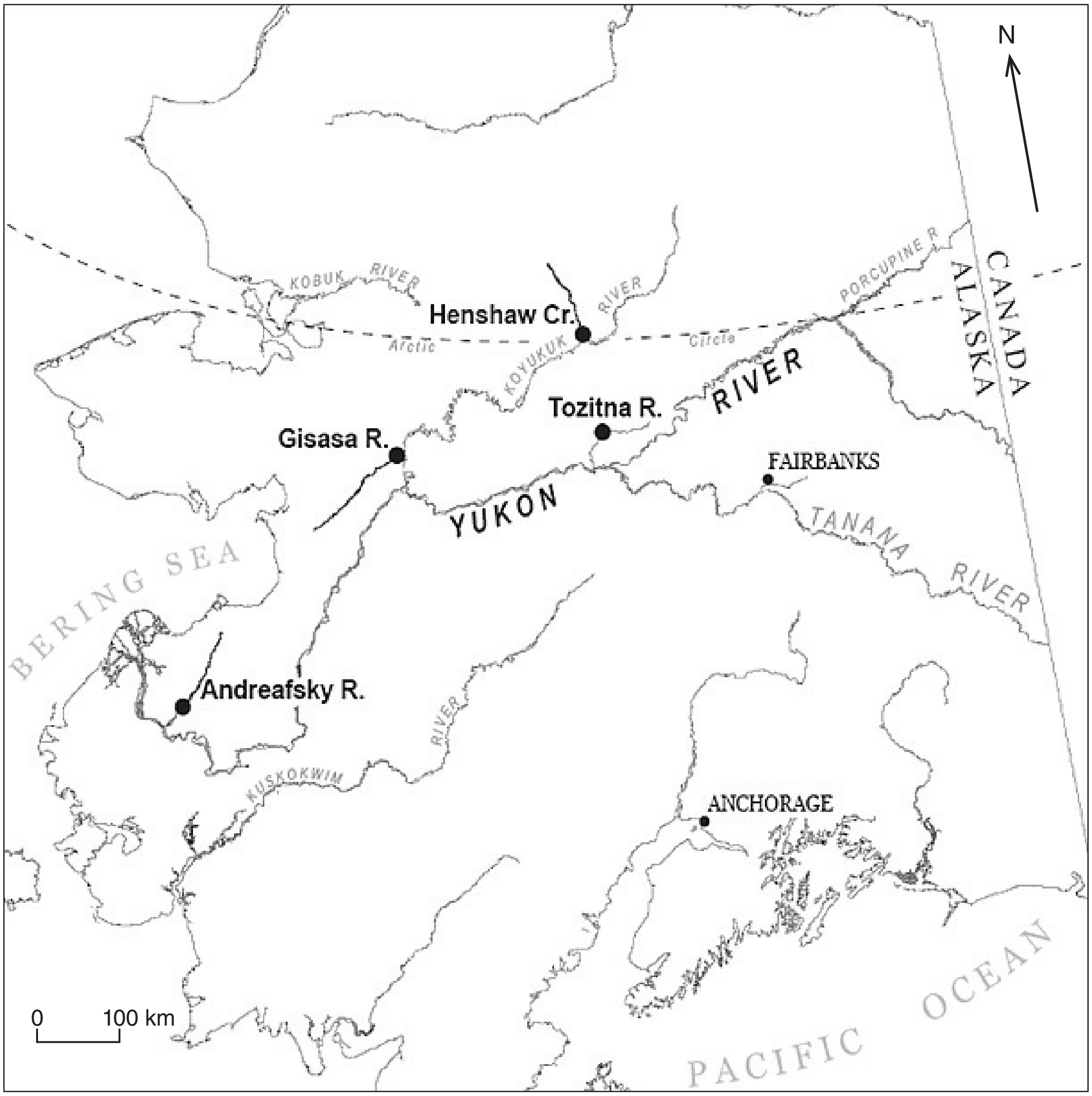

Figure 12. Location of the 4 weir projects monitoring Chinook salmon escapement in the Alaska portion of the Yukon River Basin in 2007. The projects were located on the East Fork Andreafsky River, Henshaw Creek, Gisasa River, and the Tozitna River.