KUSKOKWIM RIVER INTER-TRIBAL FISH COMMISSION

2020 Takotna River Salmon Run Timing and Abundance

by:

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II. ABSTRACT:

The Kuskokwim River Inter-Tribal Fish Commission, assisted by the Takotna Tribal Council and local fish technicians, monitored the escapement of Chinook salmon (*Oncorhynchus tshawytscha*) and chum salmon (*O. keta*), returning to the Takotna River. A resistance board weir was used from July 12 through August 10, 2020, to collect abundance and run timing of both Chinook and chum salmon, slightly shorter than the traditional target period of July 1 to August 10. Age, sex, and length data were collected from a sub-sample of the Chinook salmon. Data collected at the weir support management of the salmon fisheries that occur in the Kuskokwim River drainage. An estimated total escapement of 353 Chinook salmon and 1,000 chum salmon passed the weir during the target period of July 1 to August 10, 2020. The midpoint of cumulative passage for Chinook salmon occurred on July 19, and for chum salmon occurred on July 23. The predominant Chinook salmon ages were age 1.3 from the 2015 brood year for both males and females. Females comprised 42% of the estimated total 2020 return of Chinook salmon. Mean lengths were 750 mm for female Chinook salmon and 624 mm for males. Four of the Chinook salmon sampled for ASL were larger than 800 mm, but none were larger than 900 mm. All the age-6 Chinook salmon were females that ranged from 778 to 854 mm in length.

III. INTRODUCTION:

The Kuskokwim River historically supported the largest subsistence salmon (*Oncorhynchus* spp.*)* fishery in the state of Alaska, in both the number of residents who participate in the fishery and the number of salmon harvested (Fall et al. 2012). With some of the lowest per capita monetary incomes in the United States, subsistence use in this region is extremely valuable locally and is characterized by a high production of wild foods for local use (Wolfe and Walker 1987). In recent decades, residents of the Kuskokwim region have annually harvested over 360 pounds of wild foods per person for human consumption, with fish comprising up to 85% of the total poundage of subsistence harvests, and salmon contributing up to 53% of subsistence harvests (Simon et al. 2007; Wolfe et al. 2011). Residents harvest all five species of Pacific salmon: Chinook (*O. tshawytscha*), chum (*O. keta*), coho (*O. kisutch*), pink (*O. gorbuscha*), and sockeye (*O. nerka*). The importance of salmon, particularly Chinook salmon, to local residents extends well beyond nutrition and economic values and includes socio-cultural and personal identities (Ikuta et al. 2013). Kuskokwim River Chinook salmon stocks have been in a period of low productivity since 2007, requiring managers to enact significant subsistence fishing restrictions to meet established escapement goals. Since 2009, subsistence harvests of Chinook salmon in the Kuskokwim

River have been below the range of 67,200–109,800 designated in 2013 by the Alaska Board of Fisheries as Amounts Reasonably Necessary for Subsistence (ANS) for the Kuskokwim River (Lipka and Tiernan 2018; Tiernan et al. 2018; McDevitt et al. 2020). Subsistence harvests of chum salmon in the Kuskokwim River in recent years have been within the ANS range of 41,200–116,400 designated by the Alaska Board of Fisheries, but harvests have been below average owing to general fishery restrictions enacted to protect Chinook salmon (Tiernan et al. 2018).

A weir has been operated on the Takotna River for 18 years (2000–2013 and 2017–2020) as an upper Kuskokwim River index for salmon escapement (Figure 1). During 1995–1998, enumeration of the Takotna River salmon escapement was estimated using a counting tower. Tower operation employed students and staff of Takotna Charter School and Training Center with assistance from Alaska Department of Fish and Game (ADF&G). However, tower operations were only considered successful in 1996 and 1997 as water conditions impeded accurate counting of salmon passage in other years (Molyneaux et al. 2000). Beginning in 2000, a resistance board weir has been operated with a live trap, to allow enumeration and collection of biological data from passing fish, including during most high-water conditions with poor visibility (Williams and Blain 2013).

Following the lowest escapement of Chinook salmon to the Takotna River ever documented in 2013, combined with budget cuts and revised assessment priorities, ADF&G withdrew funding of this project beginning in 2014. Unfortunately, 2012–2014 also produced the lowest total Chinook salmon returns ever estimated for the Kuskokwim River drainage (Larson 2020). In response, regulatory changes adopted in 2016 closed salmon fishing during the early portion of the Chinook salmon spawning run, with the understanding that most of these early fish are upstream spawners (Clark and Smith 2019). However, there are very few upstream spawning tributaries with an extended history of weir operation to assess the effects of the early season closures and/or to assess the status of small stocks. The Takotna River weir is the only upriver tributary with a long-term data series suitable for evaluating the effects of the early season closure on headwater stocks.

Recognizing the importance of this project, the Takotna River weir was re-established in 2017 to measure Chinook salmon returns. The project historically operated as a community-based project with strong involvement from local villages to build local capacity and increase participation of upper Kuskokwim River stakeholders in the Chinook salmon management process. The weir project is designed to continue with this approach, under administrative support from the Takotna Tribal Council, with Bering Sea Fishermen's Association providing administrative and financial oversight and serving as the fiscal agent.

IV. OBJECTIVES:

The overarching project goal is to continue a long-term ground-based project that will adequately index salmon escapement to the headwater tributaries of the Kuskokwim River. By continuing the only long-term data set dedicated to evaluating salmon escapement to a Kuskokwim River headwater tributary, including continuing the time series of environmental data, this project provides local residents, researchers, and managers with useful data and insights to understanding the local impacts of climate change and fishery management practices. Specific project objectives include:

- Enumerate the daily passage and characterize the run timing of Chinook salmon through the resistance board weir from July 1 to August 10.

- Enumerate the daily passage and characterize the run timing of chum salmon and resident fish species through the resistance board weir from July 1 to August 10.
- Estimate the weekly sex and age composition of Chinook such that the simultaneous 95% confidence intervals have a maximum width of 0.20.
- Collection of environmental data (air/water temperature, flow volume, precipitation, etc.).
- Serve as a platform to develop local talent/capacity in a community-based stock assessment project and conduct community outreach.
- Serve as a platform for future research projects such as tagging studies, collection of genetics data, and monitoring of environmental data.

V. METHODS:

1. Project Area:

Originating in the central Kuskokwim Mountains of the upper Kuskokwim River, the Takotna River (Figure 1) is formed by the confluence of Moore Creek and Little Walden Fork. From this confluence, the Takotna River flows northeast, passing the community of Takotna at river kilometer (rkm) 80 (river mile [rm] 50), before turning southeast near the confluence with the Nikon Fork at rkm 24 (rm 15). The Tatalina River enters the Takotna at rkm 5 (rm 3), and then the Takotna River merges with the Kuskokwim River across from McGrath at rkm 752 (rm 467) from the mouth of the Kuskokwim River. The Takotna River is about 160 km (99 miles) long with a drainage of 5,646 square kilometers (2,180 square miles).

The Takotna River region has a sub-arctic climate characterized by extremes in temperature. Summer temperatures average 6 to 27 ˚C (42 to 80 ˚F), whereas winter temperatures average -18 to 6 ˚C (0 to 43 ˚F). Average yearly precipitation is approximately 30.5 cm (12 inches), with the majority falling between June and October. The rivers in this area generally become ice-free in the slow current sections by early May and freeze over during November.

During 2000–2013, and 2017–2020, the Takotna River weir was installed at 62°58.0' N. lat., 156°05.9' W. long., a site several hundred meters above the Takotna River bridge near the community of Takotna (Williams and Blain 2013) and about 17 air miles west of McGrath (Figure 1). The location provides for enumeration of most salmon spawning in the Takotna River drainage, excluding the Nixon Fork tributary returns. At the Takotna River weir site, the river channel is about 85 meters (279 feet) wide and less than 1 meter (3 feet) deep during normal summer flows, with a substrate of gravel mixed with some sand and cobble. Non-salmon species commonly found at this location include arctic grayling (*Thymallus arcticus*), whitefish (*Coregonus spp*.), northern pike (*Esox Lucius*), and longnose suckers (*Catostomus castostomus*).

2. Project Design:

All salmon passing upstream through the weir were counted to achieve a complete visual count of escapement during operations. Counts, by species as they passed, were made daily. The timing and number of counting sessions were adjusted in-season depending on the timing and abundance of fish passing through the weir (Molyneaux et al. 2010). The target operational period was July 1 through August 10.

A resistance board weir was installed across the entire 85-meter channel following the techniques described by Stewart (2003) and employed in prior years at this site. Weir installation is targeted for mid-June during a typical low water period. The weir has two sectional components: (1) a substrate rail and resistance board panels placed in the middle 75-meter portion of the channel; and (2) fixed weir materials (picket fence) installed from the stream bank to the floating panels. The floating and fixed weir lengths were adjusted as needed to accommodate river width and depth. Specific details of the design and materials for weir construction are provided by Tobin (1994), with panel modifications as presented by Stewart (2003). The Takotna River weir design applied a 4.29 cm (1 11/16 in) gap between pickets, which is enough to stop all adult salmon, except pink salmon, from upstream migration (Williams and Blain 2013). A live trap and skiff gate were incorporated into the weir structure at the deeper portion of the channel. The live trap was set to either allow fish to freely pass upstream while being counted, or to retain fish for collection of age, sex, and length (ASL) samples. The skiff gate allows boat operators to pass with little or no involvement of the weir crew, while minimizing or preventing passage of migrating salmon during boat passage.

During the period of weir operation, several non-salmon species (e.g., longnose suckers) migrate downstream. To provide for such migrations, "downstream passage chutes" were established by releasing the resistance boards on a pair of adjacent weir panels so that the downstream ends of the panel settles slightly below the water surface. The weir crew monitored these chutes and adjusted them as needed to ensure downstream migrant passage while preventing upstream migration of adult salmon.

The composition of spawning Chinook salmon (escapement quality) was estimated by sampling salmon passing retained by the live trap. Sampling techniques were consistent with standard methods described by Molyneaux et al. (2010), using a conventional fish trap design described by Linderman et al. (2002). Chinook salmon escapement was sampled daily, in proportion to observed passage abundance.

Climatological, stage height, and air and water temperature data were collected and recorded daily. Stream gage stage height was measured and recorded each morning at 0900 hours.

3. Data Collection and Reduction:

a. Escapement Monitoring

Similar to the past three years, the Takotna River weir objectives focused on enumeration of Chinook and chum salmon escapements. To achieve the objectives, July 1 to August 10 remained the target operational dates. These data continued the 20 plus years of Takotna River Chinook and chum salmon escapement estimates.

Historically, the weir was used to assess most Takotna River salmon runs, including coho salmon which have a later run timing than other species.

During the operational period, weir crews recorded daily and cumulative escapements by salmon species including estimated passage missed due to weir problems. The weir was inspected daily for holes and the potential for fish passage documented. Weir panels were cleaned daily, or as needed, of carcasses and debris. Carcasses were identified, and daily counts recorded by species and sex.

Counts of passing fish were made at a frequency of four to eight shifts per day between 0700

and 2400 hours. Counting effort increased during times of high fish passage, regardless of fish species, to reduce stress to fish being held in the weir live trap. During counting, a crew member opened the passage gate to allow fish to pass freely. The crew member then identified each fish being passed upstream by species, and the count recorded on a multiple tally counter. The crew ensured the passage gate was securely closed at the end of a counting shift.

b. Age, Sex, and, Length Composition

Collection of ASL data is crucial to evaluating the composition of salmon returning to any stream, and how management strategies and escapement composition may interact to affect long-term productivity within environmental constraints. Per Bromaghin (1993), ASL samples should be collected from a minimum of 190 Chinook salmon passing through the Takotna weir, assuming 10 age-sex categories, an unknown population size, and 95% confidence intervals for each age-sex bin. The Takotna River presently supports a relatively small population of Chinook salmon and weir counts ranged from 97 to 1,197 during 1996-2013, with an average escapement of 190 Chinook salmon during the 5-year period (2009–2013) of weir operation. The smallest observed escapement, 97 Chinook in 2013, corresponded to a range of years (2012–2014) representing the lowest drainage-wide returns of Chinook salmon to the Kuskokwim River on record (Larson 2020). While there are indications of improved returns in recent years, the rate of improvement has been slower than following historical declines. Therefore, it was anticipated that ASL samples should be collected from as many of the Chinook salmon being passed through the weir as was reasonable and prudent.

Chinook salmon used for ASL sample collections were captured from the weir live trap. During weir operation, salmon migrating upstream enter the entrance gate while the exit gate is closed. A V-shaped entrance gate prevents fish from easily returning downstream. The live trap was allowed to fill with fish until a reasonable number were inside. Weir crew members removed fish from the live trap using a short-handled dipnet. Fish were placed in a partially submerged fish "cradle." Scales were removed from the preferred area of the fish (INPFC 1963), and transferred to numbered gum cards as described in Molyneaux et al. (2010). Sex was determined through visual examination of the external morphology, focusing on the prominence of a kype, roundness of the belly, and the presence or absence of an ovipositor. Length (mid-eye to tail fork; nearest mm) was measured with a straight-edged meter stick. Sex and length data were recorded on standardized numbered data sheets that correspond to numbers on the gummed scale cards. Immediately after sampling, fish were released upstream of the weir and the process repeated until the live trap was empty. At the end of a sampling session, data on sampling date, sampling location, sex, length, and corresponding gum card numbers were transferred to an Excel spreadsheet. Salmon scales were cleaned and properly affixed to gummed scale cards and pressed on acetate to make an impression. Scale cards were completed according to ADF&G procedures for the Kuskokwim Area (Buklis 1985; Merritt 1987).

Scale analysis and reporting utilize methods described by Mosher (1969). Age determinations for Chinook salmon include the number of years spent in freshwater as a juvenile and the number of years spent in saltwater.

c. Environmental Monitoring

Water and air temperature data (°C) were recorded in a designated logbook at approximately 0900 and 1700 hours daily during weir operation. Additional information included wind direction, wind speed, cloud cover, precipitation, and river depth. Precipitation (in millimeters)

was recorded based on a rain gauge. River depth was determined using a standardized gauge consisting of a metal rod driven into the stream channel with a meter stick attached. The gauge was calibrated to a semi-permanent benchmark that corresponded to a stage measurement of 300 cm (Williams and Blain 2013).

4. Data Analysis:

Daily escapement counts and ASL data underwent a standardized post-season quality control review. Estimates of missed upstream passage of Chinook and chum salmon were made for all days in which the weir was inoperable because of delayed installation, flood events, or minor structural damage. Standardized Bayesian estimation methods were used by ADFG staff, consistent with other ADF&G escapement monitoring projects (Dickerson et al. 2019).

Project Monitoring and Evaluation:

The two primary objectives of this project are to operate a resistance board weir to count passage of Chinook and chum salmon during the period of July 1 to August 10. The project is deemed successful if the weir is operated by local hire technicians with a minimum of down time due to environmental conditions and counts of fish passage obtained by species. This information will be summarized for consideration during the inseason decision processes by fishery managers and advisory groups. A secondary objective of collection of Chinook salmon ASL will be deemed successful if up to 190 ASL samples are collected, pending the Chinook salmon escapement return. The ASL data will be used as input data into postseason stock assessment models. Collection of environmental data during the period of weir operation will provide a synopsis of conditions during the spawning season, but also serve as a basis for interannual comparisons to document effects of climate change.

VI. RESULTS:

Weir Operation:

In 2020, the Takotna River weir crew started preparing the weir and setting up camp on June 10. The crew consisted of six local hires from the community of Takotna. Due to high water, the weir was not fully installed until July 12. The weir was fish tight from July 12 through the entire monitoring season, except for July 19–23 and July 30 due to high-water flood events. The weir was dismantled on August 11.

Environmental Data:

The average water level recorded was 86 cm between July 1 and August 10. The highest water level was 102 cm on July 20 and 21. The lowest water level was 78.5 cm on July 17. The average water temperature recorded in the morning and evening was 13 ˚C (Figure 2). The highest water temperature recorded in the morning was 14 ˚C on July 19 and August 6, and in the evening was 15 ˚C on July 16 and 19 and August 5. The lowest water temperature in the morning was 11˚C on July 27, and in the evening was 11 ˚C on July 25 and 30. The average air temperature recorded in the morning and evening was 13 ˚C and 21 ˚C respectively. The highest air temperature recorded in the morning was 16.7 ˚C on July 23, and in the evening was 32.9 ˚C on July 8. The lowest air temperature in the morning was 8.1 ˚C on July 29, and in the evening was 13 ˚C on August 4.

Biological Data:

Chinook Salmon – An estimated total of 353 Chinook salmon passed the weir during July 1 through August 10, 2020 (Table 1). The first Chinook counted was on July 12, the first day of weir operation. The peak weekly passage (measured as Sunday to Saturday) of 106 Chinook salmon occurred July 19–25, and the midpoint of passage occurred on July 19. An estimated 164 Chinook salmon were missed during the high-water periods of July 1–11 (prior to weir installation) and July 19–23 and 30. An additional four Chinook salmon are estimated to have passed following the traditional weir coverage period.

Chum Salmon – An estimated total of 1,000 chum salmon passed the weir during July 1 to August 10, 2020 (Table 1). The first chum was counted on July 12, the first day the weir was fully operational. The peak weekly passage of 261 Chum salmon occurred July 26 to August 1, and the midpoint of passage occurred on July 23. An estimated 295 chum salmon were missed during the high water periods of July 1–11 (prior to weir installation) and July 19–23 and 30. An additional 34 chum salmon are estimates to have passed before and after the traditional weir coverage period.

Age, sex, and length data were collected from 76 Chinook salmon (no ASL data from Chum salmon). Of the 76 samples, 70 had a readable scale and sex was identified. Six age classes (0.2, 0.3, 0.4, 1.2, 1.3, and 1.4) were identified from scale samples (Table 2). The predominant age class was 1.3 for both males and females. After weighting the estimated passage by the ASL samples where age and sex were available, females comprised of 42% of Takotna River Chinook salmon return. The mean length was 750 mm for females and 624 mm for males. Five of the Chinook salmon sampled for ASL measured larger than 800 mm; all were female, and none were larger than 900 mm. All age-6 Chinook salmon were females that ranged from 778 to 854 mm in length.

Other Species – Other migrant and resident fish species counted during the weir operational period from July 12 through August 10, 2020, included 7 sockeye salmon, 11 coho salmon, 1 northern pike, 3 whitefish, and 2 suckers.

VII. DISCUSSION:

The Takotna River weir project was generally successful in meeting the goals and objectives within environmental complications. The Chinook and chum salmon resistance board weir was installed on July 12 (instead of July 1) due to high water, and operated through August 10, except for July 19–23 and July 30 when high water again prevented weir operation. Takotna River Chinook and chum salmon escapement and escapement quality data were collected and delivered to management agency and public, processed, archived, and distributed to interested parties. The 2020 escapement of 353 Chinook salmon during the standardized period of July 1 to August 10 was slightly less than the average escapement of 374 fish during 1996–2019 (Figure 3). The 2020 escapement of 1,000 chum salmon during the standardized period of July 1 to August 10 was 80% lower than the average escapement of 5,055 fish during 1996–2019 (Figure 3) and the lowest chum escapement on record for the Takotna. We note that because these annual escapement data (Figure 2) were standardized to the July 1 to August 10 period, and an ADF&G Bayesian statistical approach was used to fill in days missed due to high water conditions or other problems, the standardized annual estimates may differ from actual observed fish passages. However, a clear concern remains over chum salmon that have generally declined in the past decade, and uncertainty over Chinook salmon that show improvement over the past decade but remain highly variable.

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Table 1. Daily, cumulative (Cum), and cumulative percent (%) passage for Chinook, sockeye, chum, and coho salmon at the Takotna River weir, 2020.

	Chinook			Chum			Sockeye			Coho		
Date	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
6/24	0			0								
6/25	0			0								
6/26	0			0								
6/27	0			2								
6/28	0			1								
6.29	0			0								
6/30	0			1								
7/1	0	0	0	1	1	0						
7/2	0	0	0	0	1	0						
7/3	1	1	0	0	1	0						
7/4	1	2	1	1	2	0						
7/5	2	4	1	4	6	1						
7/6	4	8	2	15	21	2						
7/7	6	14	4	19	40	4						
7/8	8	22	6	30	70	7						
7/9	12	34	10	34	104	10						
7/10	14	48	14	47	151	15						
7/11	16	64	18	60	211	21						
7/12	9	73	21	43	254	25	0	0	0	0	0	
7/13	12	85	24	37	291	29	0	0	0	0	0	
7/14	5	90	25	17	308	31	0	0	0	0	0	
7/15	6	96	27	34	342	34	0	0	0	0	0	
7/16	19	115	33	20	362	36	0	0	0	0	0	
7/17	9	124	35	36	398	40	0	0	0	0	0	
7/18	23	147	42	56	454	45	0	0	0	0	0	
7/19	21	168	48	25	479	48	0	0	0	0	0	
7/20	19	187	53	0	479	48	0	0	0	0	0	
7/21	19	206	58	0	479	48	0	0	0	0	0	
7/22	17	223	63	0	479	48	0	0	0	0	0	
7/23	15	238	67	32	511	51	0	0	0	0	0	
7/24	8	246	70	30	541	54	0	0	0	0	0	
7/25	7	253	72	44	585	59	0	0	0	0	0	
7/26	12	265	75	48	633	63	0	0	0	0	0	
7/27	12	277	78	46	679	68	0	0	0	0	0	
7/28	11	288	82	28	707	71	1	1	14	0	0	
7/29	8	296	84	29	736	74	1	2	29	0	0	
7/30	9	305	86	27	763	76	1	3	43	0	0	
7/31	13	318	90	43	806	81	0	3	43	0	0	

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	Chinook			Chum			Sockeye			Coho		
Date	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
8/1	9	327	93	40	846	85	0	3	43	1	1	
8/2	8	335	95	35	881	88	0	3	43	0	1	
8/3	5	340	96	14	895	90	1	4	57	0	1	
8/4	8	348	99	26	921	92	1	5	71	0	1	
8/5	2	350	99	23	944	94	1	6	86	0	1	
8/6	0	350	99	14	958	96	0	6	86	0	1	
8/7	0	350	99	16	974	97	0	6	86	0	1	
8/8	2	352	100	15	989	99	0	6	86	1	2	
8/9	1	353	100	4	993	99	0	6	86	6	8	
8/10	0	353	100	7	1,000	100	1	7	100	3	11	
8/11	1			5								
8/12	1			4								
8/13	1			4								
8/14	1			3								
8/15	0			3								
8/16	0			2								
8/17	0			2								
8/18	0			1								
8/19	0			1								
8/20	0			1								
8/21	0			1								
8/22	0			1								
8/23	0			1								
8/24	0			1								
8/25	0			0								
8/26	0			0								
8/27	0			0								
8/28	0			0								
8/29	0			0								
8/30	0			0								
8/31	0			0								
Total	357	353		1,034	1,000			7	7		11	11

Notes:

Shaded dates represent days where the weir was not operational and passage was estimated through a Bayesian analysis (Dickerson et al. 2019). Missed days not estimated for sockeye and coho salmon.

Boxes for % show the cumulative 25%, 50%, and 75% passage during the traditional weir monitoring period of July 1 to August 19.

Table 2. Kuskokwim River Chinook salmon age, sex, and length (mm) composition after weighting ASL samples (n=70) to the total passage (N=357) from the Takotna River weir escapement project, 2020.

Brood year	2017		2016		2015		2016		2015		2014			
Age	0.2		0.3		0.4		1.2		1.3		1.4		Total	
	Age composition													
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	4	1.1	29	8.0	0	0.0	61	17.1	113	31.5	0	0.0	206	57.7
Female	0	0.0	16	4.4	6	1.5	17	4.8	83	23.1	80	8.4	151	42.3
Total	4		44		6		78		195		30		357	
%	1.1		12.5		1.5		21.8		54.6		8.4		100.0	
	Size Composition (length, mm)													
Male	484		631				546		669				624	
Female			741		801		523		730		817		750	
Total	484		670		801		541		695		817		668	

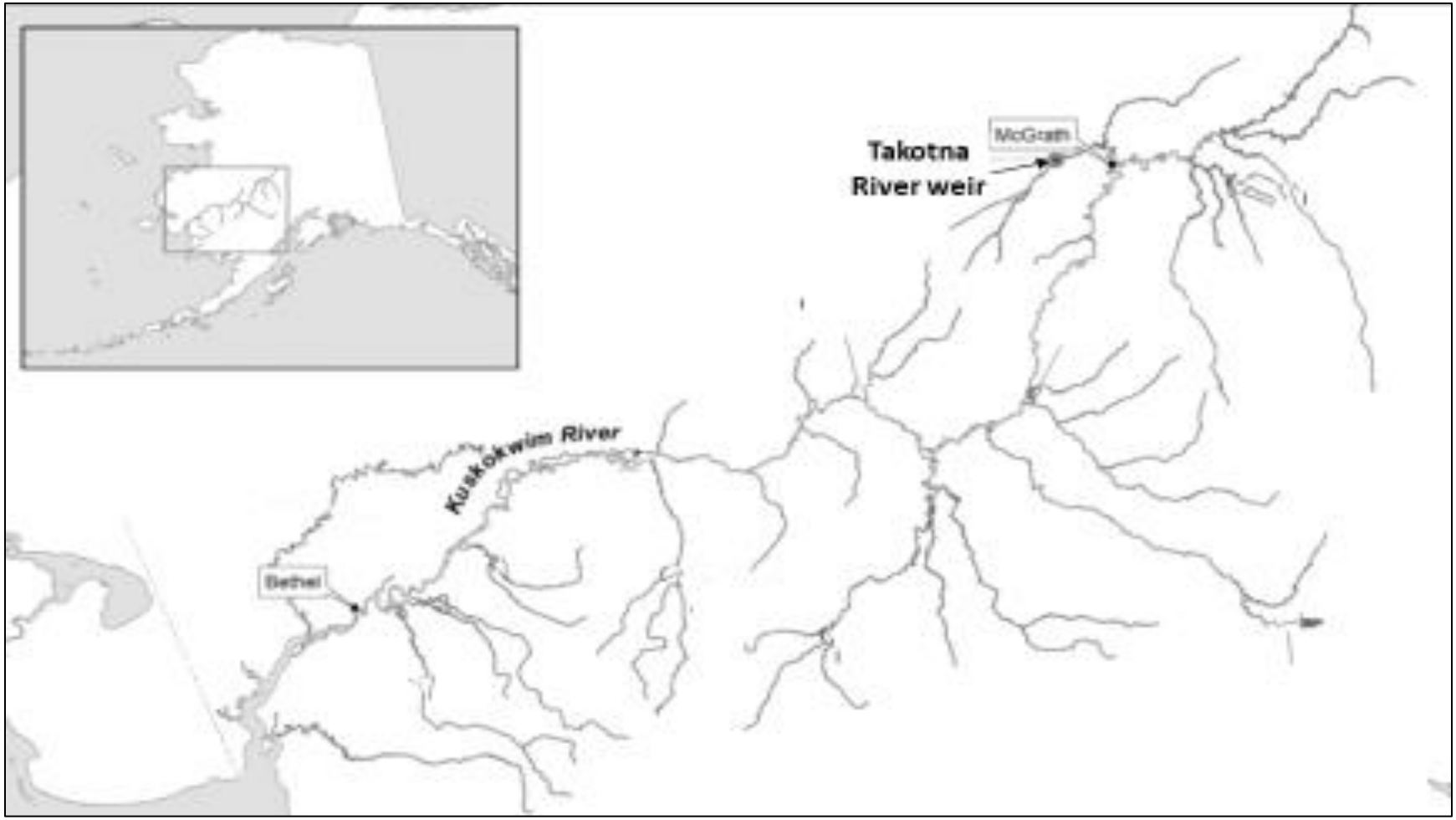

Figure 1. Takotna River weir project location on the Upper Kuskokwim River.

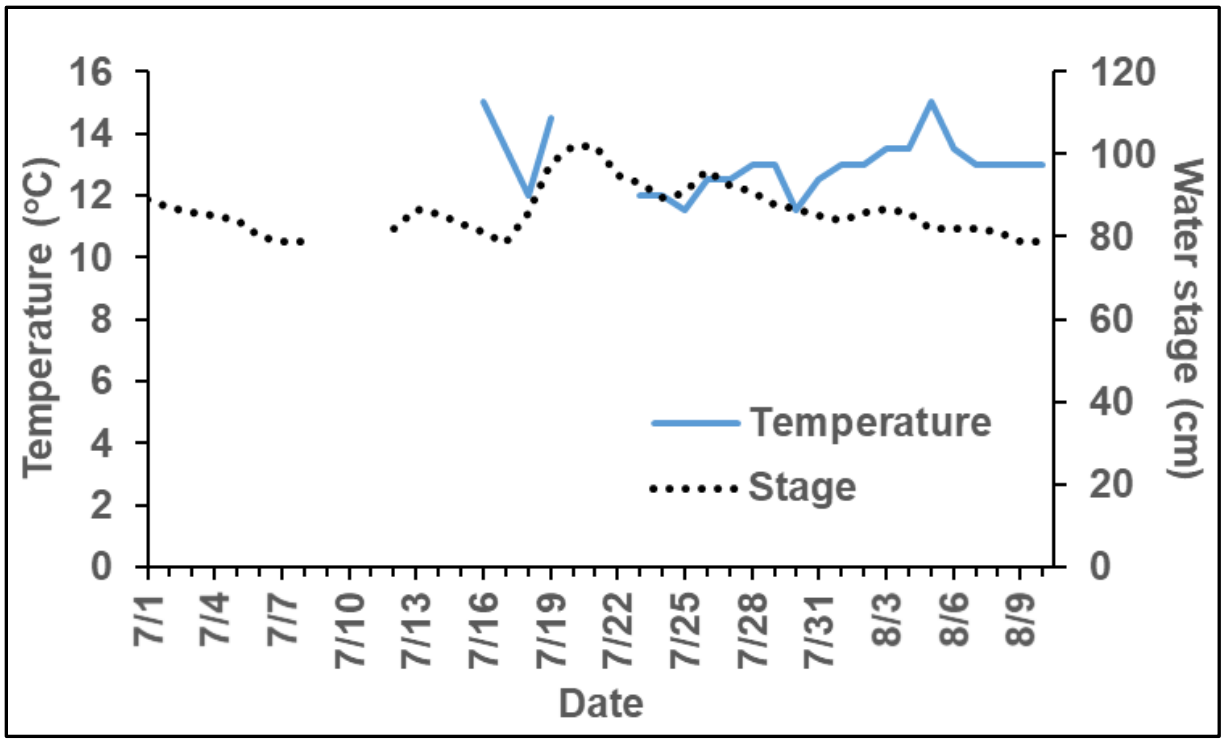

Figure 2. Average daily water temperature (solid line) and water stage (level; dotted line) recorded at the Takotna River weir, 2020.

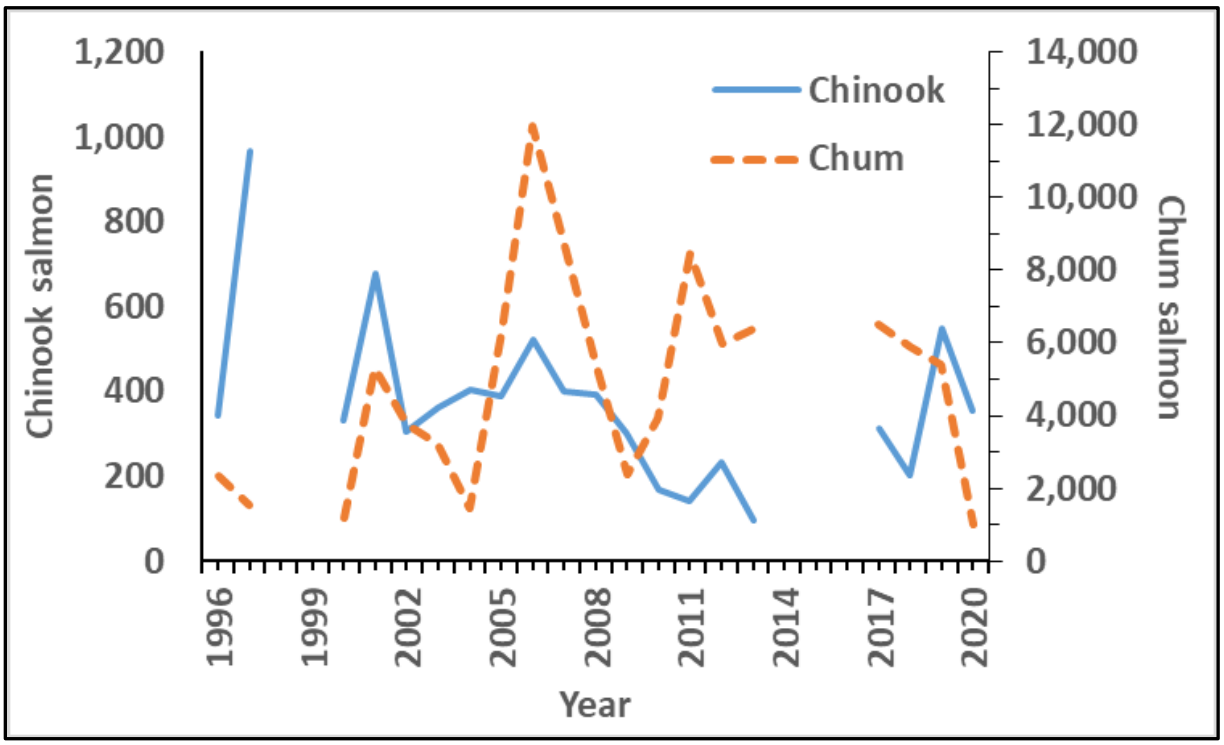

Figure 3. Annual July 1 to August 10 escapements of Chinook and chum salmon to the Takotna River, 1996–2020.