Fishery Data Series No. 18-11

Salmon Escapement Monitoring in the Kuskokwim Area, 2017

Annual Report for Project No. 14-303, 14-302, and 16-302

USFWS Office of Subsistence Management

Fisheries Resource Monitoring Program

by

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March 2018

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	\$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 18-11

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March 2018

This investigation was partially financed by USFWS Office of Subsistence Management (under Project Numbers 14-303, 14-302, 16-302), Fisheries Resource Monitoring Program under FWS Agreement Numbers F14AC00102, F14AC00109, and F16AC00279. Additional funds were provided by the State of Alaska.

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This document should be cited as follows:
Head, J. H., and N. J. Smith. 2018. Salmon escapement monitoring in the Kuskokwim Area, 2017. Alaska Department of Fish and Game, Fishery Data Series No. 18-11, Anchorage.

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G), in collaboration with other entities, conducted aerial surveys and operated ground-based weir projects to monitor Pacific salmon *Oncorhynchus* spp. escapement throughout the Kuskokwim Area in 2017. This report presents results of sampling activities and escapement monitoring from all aerial surveys and weir projects operated by ADF&G and partner agencies Native Village of Napaimute (NVN), MTNT, Ltd, and the National Park Service (NPS). Chinook salmon *Oncorhynchus tshawytscha* escapements were successfully enumerated on 10 tributaries by aerial survey and 7 tributaries with ground-based fish weirs. Overall, Chinook salmon escapement was near average in 2017. A total of 11 Chinook salmon tributary escapement goals were assessed; 1 goal was not met, 6 goals were met, and 4 goals were exceeded. Sockeye salmon *O. nerka* were successfully enumerated on 3 tributaries with weirs. Above average sockeye salmon escapement was observed throughout the Kuskokwim Area. Two sockeye salmon escapement goals were assessed in 2017 and both goals were exceeded. Chum salmon *O. keta* were successfully enumerated on 6 tributaries with weirs. Chum salmon escapement was near average at 2 locations, above average at 1 location, and well above average at 3 locations in 2017. One chum salmon tributary escapement goal was met and 1 was exceeded in 2017. Coho salmon *O. kisutch* escapements were incomplete at 2 of 3 monitoring locations due to high waters in 2017. Coho salmon escapement was above average at the George River weir, the only successful monitoring project in 2017. There was no effort to monitor coho salmon escapement in Kuskokwim Bay due to funding constraints in 2017.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *Oncorhynchus keta*, sockeye salmon, *Oncorhynchus nerka*, coho salmon, *Oncorhynchus kisutch*, aerial survey, resistance board weir, fixed picket weir, escapement, age, sex, and length (ASL), Kuskokwim River, North Fork Goodnews River, Middle Fork Goodnews River, Kanektok River, Kisaralik River, Aniak River, Salmon River (Aniak drainage), Kipchuk River, Holokuk River, Oskawalik River, George River, Holitna River, Kogrukluk River, Telaquana River, Cheeneetnuk River, Gagaryah River, Tatlawiksuk River, Salmon River (Pitka Fork drainage), Bear Creek, Kuskokwim Bay, Kuskokwim Area

INTRODUCTION

Pacific salmon *Oncorhynchus* spp. fisheries throughout the Kuskokwim Area are managed to provide for escapements within ranges that will provide for sustainable yield. The Kuskokwim Area comprises the Kuskokwim River and Kuskokwim Bay river systems (Figure 1). Long-term escapement monitoring projects are important tools for fishery management. Peak aerial surveys and ground-based weirs are used throughout the Kuskokwim Area to monitor annual escapement to key spawning systems (Figures 2 and 3) and track temporal and spatial patterns in abundance. Salmon spawn in many tributaries throughout the Kuskokwim River drainage and contribute to the subsistence, commercial, and sport fishery harvests. Because it is not feasible to monitor all tributaries of the Kuskokwim River, a subset of rivers distributed over a broad geographic area are monitored to provide an indicator of Kuskokwim River salmon escapement. The rivers monitored in Kuskokwim Bay are the primary spawning drainages and main producers of salmon harvested in Districts 4 and 5.

Formal abundance estimates do not exist for all salmon species returning to Kuskokwim Area systems. Available data indicate sockeye salmon *O. nerka* are the most abundant salmon species in Kuskokwim Bay river systems, followed by chum *O. keta*, coho *O. kisutch*, and Chinook *O. tshawytscha* salmon (Poetter et al. 2016). For the Kuskokwim River, data indicates that chum salmon are the most abundant salmon species in the drainage, followed by coho, sockeye, and Chinook salmon. Pink salmon *O. gorbuscha* abundance within the Kuskokwim Area has not been estimated.

Kuskokwim Area salmon support subsistence, commercial, and sport fisheries that contribute to an average annual harvest of approximately 734,000 fish (2005–2014: Poetter et al. 2016). The subsistence salmon fishery in the Kuskokwim Area is one of the largest and most important in the state and remains a fundamental component of local culture (Shelden et al. 2016). Although the subsistence salmon fishery occurs throughout the entire Kuskokwim Area, the majority of fishing effort occurs within the lower 320 km (200 mi) of the Kuskokwim River, Goodnews Bay, and the Kanektok River within Kuskokwim Bay (Shelden et al. 2016). Since 2001, the commercial salmon fishery has occurred in 3 districts within the Kuskokwim Area (Poetter et al. 2016). District 1 is located in the lower portion of the Kuskokwim River, and Districts 4 and 5 encompass areas in Kuskokwim Bay near the Kanektok and Goodnews rivers, respectively. The sport fishery is the smallest of the 3 fisheries and occurs throughout the Kuskokwim Area.

Peak aerial surveys have been conducted annually since 1959 in select salmon spawning rivers throughout the Kuskokwim Area to index salmon escapement abundance (Molyneaux and Brannian 2006). Aerial surveys flown on Kuskokwim Bay rivers index both Chinook and sockeye salmon escapement. Kuskokwim River aerial surveys index only Chinook salmon escapement. A total of 145 individual rivers and lakes throughout the Kuskokwim Area have been surveyed at least once (Brannian et al. 2006; AYKDBMS[1] [Arctic-Yukon-Kuskokwim Database Management System]). Although aerial surveys provide the most cost-effective means of monitoring salmon escapements, they are subject to limited reliability and high variability in precision depending on viewing conditions and the surveyor's experience (Burkey et al. 2001).

Weirs have been used annually since the late 1970s throughout the Kuskokwim Area to estimate total escapement to specific spawning tributaries and collect age, sex, and length (ASL) data from Chinook, chum, sockeye, and coho salmon (Molyneaux and Brannian 2006; Head and Liller 2017). Weir locations were chosen based on salmon abundance, ability to install and operate a weir, past monitoring history, availability of funding, and perceived local importance and interest. Pink salmon escapement data were also collected at the escapement projects; however, the smaller body size of pink salmon may have allowed some to pass through the weirs undetected, making complete counts impossible. In addition to Pacific salmon, many other resident fish species are commonly observed in the monitored streams. Ground-based weir projects provide a dependable and rigorous approach to escapement monitoring. However, the relatively high costs of weir projects and limitations of installing weirs in large or fast-flowing rivers limit the number of salmon producing tributaries that can be monitored using this method.

Formal escapement goals have been established for Chinook, chum, sockeye, and coho salmon in select monitored Kuskokwim Area tributaries (Conitz et al. 2015; Table 1). Within the Kuskokwim Area, Chinook salmon escapement goals have been established on 13 tributaries, with 4 weirs and 9 aerial surveys. There are 2 chum salmon escapement goals in the Kuskokwim Area, both established on tributary weirs. Sockeye salmon escapement goals have been established on 3 tributaries, with 1 weir and 2 aerial surveys. Finally, coho salmon escapement goals have been established on 3 tributary weirs in the Kuskokwim Area.

Kuskokwim River Chinook salmon is the only species with an established drainagewide escapement goal (Hamazaki et al. 2012; Conitz et al. 2015; Table 1). Estimates of total annual abundance are achieved using a maximum likelihood model that uses data collected from ground-based escapement monitoring projects and aerial surveys (Table 2; Bue et al. 2012). The model estimate is used to evaluate the drainagewide escapement goal for Chinook salmon (65,000–120,000 fish; e.g., Liller 2017).

[1] AYKDBMS [Arctic-Yukon-Kuskokwim Database Management System] Home Page. Hereafter cited as AYKDBMS. http://sf.adfg.state.ak.us/CommFishR3/WebSite/AYKDBMSWebsite/Default.aspx.

This report presents results of sampling activities and escapement monitoring from all aerial surveys and weir projects operated by ADF&G and partner organizations in 2017. ADF&G was the lead on all aspects of the Middle Fork Goodnews, George, Kogrukluk, Tatlawiksuk, and Salmon (Pitka Fork) river weirs. ADF&G provided funding to the National Park Service (NPS) to operate the Telequana River weir. Additionally, the Native Village of Napimute (NVN) and MTNT Ltd. were able to secure funding to independently operate the Salmon (Aniak) and Takotna river weirs. ADF&G helped facilitate these projects by providing infrastructure, sampling protocol, permitting, data analysis, and handling all reporting requirements. The projects discussed in this report provide information necessary for annual assessment of escapement goals in the Kuskokwim Area, including estimation of total run size of Kuskokwim River Chinook salmon. The U.S. Fish and Wildlife Service (USFWS) successfully operated salmon weirs on the Kwethluk and Tuluksak rivers in 2017, and the results from these projects are reported by USFWS. Data collected to determine ASL compositions are reported in the annual report *Salmon age, sex, and length catalog for the Kuskokwim Area* (e.g., Liller et al. 2016).

OBJECTIVES

1. Conduct aerial surveys of Chinook salmon or sockeye salmon abundance under good or fair survey conditions between 17 July and 5 August on the following Kuskokwim Area rivers in 2017:

   Kuskokwim Bay – Chinook and sockeye salmon

   - North Fork Goodnews River;
   - Middle Fork Goodnews River; and
   - Kanektok River;

   Kuskokwim River – Chinook salmon

   - Kisaralik River;
   - Aniak River;
   - Salmon River (Aniak drainage);
   - Kipchuk River;
   - Holokuk River;
   - Oskawalik River;
   - Holitna River;
   - Cheeneetnuk River;
   - Gagaryah River;
   - Salmon River (Pitka Fork drainage);
   - Pitka Fork; and
   - Bear Creek.

2. Estimate daily and annual escapements of Pacific salmon species at weirs operated on the following Kuskokwim Area rivers, during a standard estimation range in 2017:

   Kuskokwim Bay

   - Middle Fork Goodnews River – Chinook, chum, and sockeye salmon between 25 June and 18 September.

   Kuskokwim River

   - Salmon River (Aniak drainage) – Chinook, chum, and sockeye salmon between 15 June and 20 September;
   - George River – Chinook, chum, and coho salmon between 15 June and 20 September;
   - Kogrukluk River – Chinook, chum, sockeye, and coho salmon between 26 June and 25 September;
   - Telaquana River – sockeye salmon between 3 July and 20 September;
   - Tatlawiksuk River – Chinook, chum, and coho salmon between 15 June and 20 September;
   - Takotna River – Chinook and chum salmon between 24 June and 20 September; and
   - Salmon River (Pitka Fork drainage) – Chinook salmon between 20 June and 15 August.

3. Collect age, sex, and length data from adult salmon species using weir traps operated on Middle Fork Goodnews, Salmon (Aniak), George, Tatlawiksuk, Kogrukluk, Telaquana, Takotna, and Salmon (Pitka) rivers in 2017, such that minimum sample sizes meet or exceed the following:

   - Chinook salmon – 230;
   - Kuskokwim River sockeye salmon – 250 (Kogrukluk and Telaquana, sex and length data only);
   - Kuskokwim Bay sockeye salmon – 400;
   - Chum salmon – Kogrukluk – 600, all other projects - 400; and
   - Coho salmon – 400.

METHODS

STUDY AREA

The Kuskokwim Area is defined in regulation (5 AAC 07.100) as all waters of Alaska between the latitude of the westernmost point of the Naskonat Peninsula and the latitude of the southernmost tip of Cape Newenham, including the waters of Alaska surrounding Nunivak and St. Matthews Island and those waters draining into the Bering Sea (Figure 1). For the purposes of this report, the Kuskokwim Area was divided into the Kuskokwim Bay and the Kuskokwim River. Kuskokwim Bay includes mainland coastal streams (excluding the Kuskokwim River) and commercial fishing Districts 4 and 5. The Kuskokwim River includes the mainstem, all tributaries of the river, and commercial fishing District 1.

Escapement monitoring was conducted in select salmon spawning tributaries draining into the Kuskokwim Area. In 2017, ADF&G and its partners attempted to monitor escapement in 3 rivers draining into Kuskokwim Bay and 11 tributaries in the Kuskokwim River drainage (Figures 2 and 3). Chinook, chum, sockeye, and coho salmon are present at all monitoring locations; however, not all species are present in large numbers at all locations.

Kuskokwim Bay Assessment Locations

Goodnews River

Monitoring efforts within the north and middle forks of the Goodnews River provide an index of salmon escapement to the entire Goodnews River drainage and are used to inform sustainable management of the District 5 commercial fishery and local subsistence fisheries. The Goodnews River watershed drains an area approximately 2,636 km^2 (Brown 1983). Originating on the north side of the Aklun Mountains, the Goodnews River flows southwesterly a distance of 127 river kilometers (rkm) until emptying into Goodnews Bay, a small bay nested within Kuskokwim Bay. The mainstem Goodnews River is the northernmost branch of the Goodnews River system and is therefore referred to as the North Fork. Chinook and sockeye salmon escapement to the North Fork was monitored by aerial survey. The Middle Fork of the Goodnews River flows southwesterly a distance of approximately 97 rkm before joining the North Fork a few miles upriver from Goodnews Bay (Buzzell 2011). Chinook and sockeye salmon escapement to the Middle Fork was monitored by aerial survey. In addition, Chinook, sockeye, and chum, salmon escapement to the Middle Fork was monitored using a resistance board weir. The weir was located approximately 16 rkm upstream from the confluence with the North Fork at 59°9′36″N, 161°23′17″W. At the weir site, the river measured 61 m wide and 1 m deep during normal summer flow. Due to its proximity to the confluence, the weir accounted for the majority of salmon spawning within the Middle Fork.

Kanektok River

Monitoring efforts within the Kanektok River provides an index of salmon escapement returning to the entire Kanektok River and those data are used to inform sustainable management of the District 4 commercial fishery and local subsistence fisheries. The Kanektok River watershed drains an area approximately 2,261 km^2 (Walsh et al. 2006). The Kanektok River originates from Kagati and Pegati lakes, located between the Eek and Ahklun Mountains, and flows westerly for 147 rkm until emptying into Kuskokwim Bay near the village Quinhagak (Buzzell and Russell 2010). Chinook and sockeye salmon escapement to the Kanektok River was monitored by aerial survey.

Lower Kuskokwim River Assessment Locations

Kisaralik River

The Kisaralik River is located between the Kwethluk and Tuluksak rivers, which are both monitored by USFWS using weirs. Aerial surveys flown on the Kisaralik River are used to index Chinook salmon escapement to the Lower Kuskokwim River; a portion of the drainage where subsistence, commercial, and sport fishing is common. The Kisaralik River originates from Kisaralik Lake in the Kilbuck Mountains and flows northwesterly for approximately 187 rkm until reaching Kuskokuak Slough (at rkm 135; Buzzell 2010), which then flows into the Kuskokwim River (at rkm 131).

Middle Kuskokwim River Assessment Locations

Aniak River Drainage

The mainstem Aniak River is a large tributary that drains the southern portion of the middle Kuskokwim River. The Aniak River originates from the Aniak Lake basin in the Kuskokwim Mountains and flows northerly for approximately 151 rkm until entering the Kuskokwim River (at rkm 307) near the community of Aniak (Brown 1983). Chinook salmon escapement was monitored throughout the mainstem Aniak River by aerial survey.

The Salmon River is a tributary of the Aniak River and assessment provides an index of salmon abundance to the Aniak River. The Salmon River originates in the Kilbuck Mountains and flows northerly for approximately 71 rkm to its confluence with the Aniak River. Chinook salmon abundance was monitored using aerial surveys. In addition, Chinook, chum, sockeye and coho salmon escapement was monitored using a fixed picket weir. The weir was located approximately 1 km upstream of the confluence with the Aniak River at 61°03′46″N, 159°11′40″W. At the weir site, the river measured 35 m wide and 1.25 m deep during normal summer operations. Due to its proximity to the confluence, the weir accounted for nearly all salmon spawning within the Salmon River.

The Kipchuk River is a headwater tributary of the Aniak River and provides an index of salmon abundance to the Aniak River. The Kipchuk River originates in the Kuskokwim Mountains, several kilometers northwest of Aniak Lake. The Kipchuk River flows northerly for approximately 106 rkm until reaching the Aniak River. Chinook salmon escapement was monitored using aerial surveys.

Holokuk and Oskawalik Rivers

The Holokuk and Oskawalik rivers are relatively small tributaries that drain the southern portion of the middle Kuskokwim River. The Holokuk River flows northeasterly, approximately 72 rkm from its origins in the Buckstock Mountains, which separate the Holokuk River from the Aniak River. It joins the Kuskokwim River (at rkm 362) near the community of Napaimute (Brown 1983). The Oskawalik River originates from streams draining the Chuilnuk Mountains, which separate the Oskawalik River from the Holitna River basin. This river flows north-northwesterly for approximately 89 rkm until reaching the Kuskokwim River (at rkm 398; Brown 1983). Aerial surveys flown on each river were used to index Chinook salmon escapement to the middle portion of the Kuskokwim River drainage.

George River

The George River is the only monitored tributary that drains the northern portion of the middle Kuskokwim River. The George River originates in the northern Kuskokwim Mountains and flows southerly for approximately 120 rkm to its confluence with the Kuskokwim River (at rkm 446; Brown 1983). Chinook, chum, and coho salmon escapement was monitored using a resistance board weir. The weir was located approximately 7 rkm upstream of its confluence with the Kuskokwim River at 61°55′24″N, 157°41′53″W. At the weir site, the river channel measured about 110 m wide and had a depth of about 1 m during normal summer flow. Due to its proximity to the confluence, the weir accounted for nearly all salmon spawning within the George River.

Holitna River Drainage

The Holitna River watershed is one of the largest in the Kuskokwim basin, including the Kuskokwim, Kiokluk, and Chuilnuk mountains to the west, and the Shotgun and Nushagak hills to the south. The Holitna River is formed from the confluence of the Chukowan and Kogrukluk rivers and flows northerly for approximately 218 rkm until reaching the Kuskokwim River (at rkm 491) near the community of Sleetmute (Brown 1983; ADNR 1988). The Holitna River drainage is a highly productive system that supports a large number of spawning salmon (Molyneaux and Brannian 2006). Chinook salmon escapement was monitored throughout the mainstem of the Holitna River using aerial surveys. The Holitna River is also the single largest source of river-type sockeye salmon (Gilk et al. 2011).

The Kogrukluk River is a headwater tributary of the Holitna River and assessment provides an index of salmon abundance to the Holitna River. The Kogrukluk River forms in a low plateau that divides the Tikchik Lakes system and Nushagak River basin to the south from the Holitna River basin to the north. From its headwaters, the Kogrukluk River flows northerly for approximately 80 rkm to its confluence with the Chukowan River to form the Holitna River (Brown 1983). Chinook, chum, sockeye, and coho salmon escapement was monitored with a fixed picket weir. The weir was located approximately 1.5 rkm from the confluence with the Holitna River at 60°50′28″N, 157°50′44″W. At the weir site, the channel averaged 70 m wide and 1.25 m deep. Due to its proximity to the confluence, the weir accounted for nearly all salmon spawning within the Kogrukluk River.

Stony River Drainage

The Stony River joins the Kuskokwim River at rkm 536 and supports primarily sockeye salmon and a modest return of Chinook salmon. Telaquana Lake and Two Lakes form the headwaters of the Stony River and are the largest lake systems in the Kuskokwim River drainage. Both lakes provide requisite habitat for lake-spawning sockeye salmon, and are the primary producers of lake-type sockeye salmon in the Kuskokwim River drainage.

Escapement of sockeye salmon was assessed using a weir located on the Telaquana River near the outlet of Telaquana Lake. The Telaquana River originates in the mountains above Telaquana Lake, located in Lake Clark National Preserve. The Telaquana River watershed is bounded by the Neacola Mountains to the east and a low plateau to the south, separating it from the Bristol Bay watershed. From its headwaters, the Telaquana River flows westerly for approximately 30 rkm before entering Telaquana Lake. From the mouth of the lake, the Telaquana River flows 50 rkm to its confluence with the Stony River, which then joins the Kuskokwim River at rkm 536. The Telaquana River weir was located approximately 1 km downstream of Telaquana Lake outlet at 60°57′39″N, 154°02′40″W. The weir spanned a 70 m channel, and average channel depth was approximately 1.2 m with a maximum depth of 2.1 m. The weir accounted for all sockeye salmon spawning in Telaquana Lake, including those fish spawning in the lake outlet.

Swift River Drainage

The Swift River is a large tributary that flows northwesterly and joins the Kuskokwim River at rkm 560 (Brown 1983). The Cheeneetnuk and Gagaryah rivers are parallel tributaries of the Swift River, and aerial surveys are flown on these rivers to index Chinook salmon escapement to the Swift River. The Cheeneetnuk River originates in the foothills of the Alaska Range and flows southwesterly for approximately 113 rkm before reaching the Swift River (at rkm 27). The

Gagaryah River originates in the Lyman Hills and flows southwesterly for approximately 100 rkm before joining the Swift River (at rkm 61).

Tatlawiksuk River

The Tatlawiksuk River originates in the foothills of the Alaska Range and flows southwesterly for 113 rkm before joining the Kuskokwim River (at rkm 563; Brown 1983). Assessment provides an index of salmon abundance to the middle portion of the Kuskokwim River drainage. Chinook, chum, and coho salmon escapement was monitored with a resistance board weir. The weir was located approximately 4.5 rkm upstream from its confluence with the Kuskokwim River at 61°56′03″N, 156°11′33″W. At the weir site, the river measured 64 m wide and 1 m deep during normal summer operations. Due to its proximity to the confluence, the weir accounted for nearly all salmon spawning within the Tatlawiksuk River.

Upper Kuskokwim River Assessment Locations

Takotna River Drainage

The Takotna River originates in the central Kuskokwim Mountains of the upper Kuskokwim River basin. The Takotna River is approximately 160 rkm in length (Brown 1983). Formed by the confluence of Moore Creek and Little Waldren Fork, the Takotna River flows northeasterly and passes the community of Takotna (at rkm 80), before turning southeasterly near the confluence of the Nixon Fork (at rkm 24), and empties into the Kuskokwim River (at rkm 752) across the river from the community of McGrath. Chinook and chum salmon escapement is monitored with a resistance board weir installed at 62°58′06″N, 156°05′54″W, upstream of the Takotna River bridge near the community of Takotna. The river channel at this site is 85 m wide and less than 1 m deep during normal summer flow. This site allows for enumeration of spawning salmon in the Takotna River drainage, excluding those in the Nixon Fork tributary.

Pitka Fork Drainage

The Pitka Fork originates in a piedmont area north of the Alaska Range and flows northerly 106 rkm before joining the Middle Fork (Brown 1983). The Middle Fork then flows northwesterly until reaching the Big River, which finally joins the Kuskokwim River at rkm 827 (Brown 1983), upstream from the community of McGrath. Tributaries of the Pitka Fork are the northernmost monitored systems within the Kuskokwim River drainage and provided an index of Chinook salmon escapement in the headwaters of the Kuskokwim River. Chinook salmon escapement was monitored on the Pitka Fork by an aerial survey.

The Salmon River is a tributary of the Pitka Fork and flows northwesterly for approximately 47 rkm before joining the Pitka Fork 36 rkm upriver from its confluence with the Middle Fork. Chinook salmon escapement was monitored by aerial survey and a fixed picket weir. In 1981 and 1982, the weir was located on the South Fork of the Salmon River before being discontinued. In 2015, the weir was reestablished immediately downriver of the confluence of the north and south forks at 62°53′21″N, 154°30′35″W. The change in location allowed a more complete assessment of Chinook salmon escapement to the Salmon River. At the weir site, the river measured approximately 45 m wide and 1 m deep during normal summer operations. Due to its proximity to the confluence, the weir accounted for nearly all salmon spawning within the Salmon River.

Bear Creek is a relatively small northwest-flowing tributary that joins the Pitka Fork approximately 44.8 rkm upriver from its confluence with the Middle Fork. The confluence of

Bear Creek is located approximately 9.3 rkm southeast of the Salmon River with a nearly parallel flow direction. Chinook salmon escapement in Bear Creek was monitored by aerial survey.

ESCAPEMENT MONITORING

Aerial Surveys

Aerial surveys focused on Chinook salmon in Kuskokwim River tributaries, and both Chinook and sockeye salmon in Kuskokwim Bay rivers (Table 3). On occasion, other salmon species were counted opportunistically during aerial surveys; however, those counts are not representative of spawning escapement and are considered ancillary. Aerial survey counts of live fish, carcasses, spawning redds, survey ratings, and observer comments were archived in the AYKDBMS.

Aerial surveys were planned on 12 tributaries in the Kuskokwim River and on 3 rivers in Kuskokwim Bay in 2017 (Table 3; Figures 2 and 3). Standardized index areas were flown within each river to allow for interannual comparisons of aerial survey counts (Appendix A; Schneiderhan 1988). Index areas were defined by geographic coordinates and often coincided with landmarks that are easily recognized from the air. For each river, lists of survey areas (Appendix A) and corresponding maps were created that depict index areas and highlight those areas that must be surveyed (i.e., index objectives) in order to produce a comparable index of escapement. Details regarding survey locations were archived in the AYKDBMS.

One-time peak aerial surveys were conducted following standardized procedures. Aerial surveys were conducted with fixed-winged aircraft at an altitude between 150 feet and 500 feet, dependent on both surveyor and pilot preference and weather conditions. Aerial surveys operational standards required that all surveys were flown between the dates of 17 July and 5 August, which is believed to encompass peak spawning abundance for both Chinook and sockeye salmon across a range of locations and run timings. Observers rated survey conditions as good (rating = 1), fair (rating = 2), or poor (rating = 3) based on criteria related to survey method, weather and water conditions, time of survey, and spawning stage (Schneiderhan 1988). During the flight, the surveyor recorded counts of live salmon and carcasses for each index area on a tally counter. Survey counts from only the objective index areas were summed to determine the escapement index. The escapement index was reported only if survey conditions were rated as good or fair for the entire survey.

Weir Projects

Weir Design and Installation

A fixed picket or resistance board weir design with an integrated fish trap was used at all locations dependent on channel morphology and flow. A resistance board floating weir is designed to sink beneath flood waters, allowing debris to pass downstream with little obstruction. Resistance board weirs require a nearly level bottom profile and low enough water levels during the installation period to allow crew, working in snorkel gear, to attach weir components to the stream bed. In the Kuskokwim Area, where seasonal flooding occurs, resistance board weirs are preferred; however, not all rivers have conditions that allow for the installation and operation of resistance board weirs. In such cases, fixed picket weirs were employed. Fixed picket weirs have a rigid structure that requires disassembly for debris to pass freely downstream. These weirs are more prone to damage and often require disassembly during flood conditions. However, fixed picket weirs can be installed at higher flows and in more variable channel conditions. All weirs utilized a live fish trap design that was capable of freely passing fish or trapping fish for sampling purposes. The live fish trap design was the same at all projects (Linderman et al. 2002). Additional details on design and materials used for construction of resistance board weirs can be found in Tobin (1994) and Stewart (2002 and 2003) and for fixed picket weirs in Molyneaux et al. (1997), Baxter (1981), and Jasper and Molyneaux (2007).

Slight differences in picket spacing existed between projects. Weirs on the Goodnews, George, Tatlawiksuk, and Takotna rivers had a gap of 3.3 cm between each picket. Salmon (Aniak) and Salmon (Pitka Fork) river weirs had a gap of 3.6 cm, Kogrukluk River weir had a gap of 3.7 cm, and Telaquana River weir had a gap of 2.6 cm between each picket. Regardless of the spacing differences, all designs prevented most adult Pacific salmon from passing through the weirs undetected. However, pink salmon and other non-salmon species have been observed passing between pickets.

Weirs were installed across the entire river channel. On tributaries with resistance board weirs, the substrate rail and resistance board panels covered the middle 90% of each channel, and fixed weir materials extended the weirs to each bank. Floating and fixed weir lengths were adjusted inseason based upon minor changes in the width and depth of the river. A boat gate and a downstream fish passage chute were installed following techniques described by Linderman et al. (2002). Additional details on techniques for weir installation can be found in Stewart (2003).

Operations

Beginning in 2017, there was a minor change in operational terminology to help draw a clear distinction between the time period when the weir was planned to operate and the time period for which total escapement was estimated. Prior reports used the phrase “target operational period” to describe a standardized time period during which the weir was planned to operate. If possible, estimates were made for any days of missed passage within the target operation period in order to produce a standardized and comparable total annual escapement estimate. In recent years, funding limitation or direct efforts to increase efficiency resulted in a deliberate plan to reduce operational time to a portion of the historical target operational period. Moving forward, the phrase “planned operational period” will be used to describe the dates that the weir was scheduled to operate. The phrase “standard estimation range” will be used to describe the date range for which total escapement will be estimated. The standard estimation range for each project was consistent with the target operational period from prior years.

Each weir project has a yearly planned operational period based on historical run timing information and available funding (Table 4). Planned operational periods were intended to cover the majority of each target species’ escapement, which represented either a subset or the entire standard estimation range. The duration of the planned operational period ensured that high quality estimates of total escapement can be generated for the standard estimation range.

In 2017, ADF&G and its partners evaluated available funding and data needs to establish planned operational periods that would ensure estimates could be generated for target species at each site (Table 4). Projects that had available funding to operate for the entirety of the standard estimation range were the George, Kogrukluk, Telaquana, and Tatlawiksuk river weirs. The Middle Fork Goodnews River weir was operated for only the month of July due to limited funding, but historical run timings showed that this would be adequate to assess the Chinook, chum, and sockeye salmon runs. The Native Village of Napimute and MTNT Ltd. operated the

Salmon (Aniak) and Takotna river weirs for a subset of the standard estimation ranges, with a particular focus on assessing specific salmon species as defined in the project objectives.

DATA COLLECTION AND ANALYSIS

Escapement Counts

Daily escapement counts were conducted at all weirs. Crew members visually identified all species of fish observed passing upstream of the weir and recorded them on a tally counter. Fish were counted for approximately 1 hour, 4 to 8 times per day, between 0700 and 2400 hours. This schedule was adjusted as needed to accommodate variation in fish behavior and abundance or operational constraints, such as reduced visibility in evening hours late in the season. The live trap was used as the primary means of upstream fish passage. A clear plastic viewing window was placed on the stream surface to improve visual identification of fish entering the trap. Fish were only allowed to pass freely through the weir when an observer was present and opened the passage gate. Following each counting shift, passage numbers were recorded in a designated logbook, and the weir was inspected for holes and cleaned of carcasses and debris. If holes were found, a note was made regarding the size, location, and whether there was a potential for missed fish passage. Total daily and cumulative seasonal counts were reported along with operational details to ADF&G staff in Bethel or Anchorage by 9:00 AM the following morning and uploaded to the AYKDBMS that same day.

Missed Escapement Estimates

A variety of conditions can result in inoperable periods when fish cannot be counted through the weir. Conditions include, but are not limited to, 1) water levels preventing installation, requiring partial disassembly, or prompting removal of the weir; 2) water levels exceeding the top of the weir; 3) holes created from scouring, debris, or wildlife; 4) maintenance requiring partial disassembly of the weir; or 5) the counting gate being left open unattended. Duration of inoperable periods varied from a part of a single day to several days. Missed escapement of the target species was estimated for all inoperable days within the standard estimation range. No missed escapement estimates were created for nontarget species.

Missed escapement was estimated using a hierarchical Bayesian estimation technique (Adkison and Su 2001). All historical run timing was fitted to a log-normal distribution, in which each year's parameters were assumed to come from a common distribution (i.e., hierarchical parameters). Further, it was assumed that distribution of daily run timing followed a log-normal distribution (i.e., log plus 1 transformed count, or ln(daily count +1) was normally distributed).

Let y_{it} be the log plus 1 transformed count of year (i) and day (t) (y_{it} = ln(daily weir passage +1)); and assume that y_{it} is a random variable from a normal distribution of mean (θ_{it}) and standard deviation of day (t), σ_t. Then:

$$y_{it} \sim N(\theta_{it}, \sigma_t^2) \text{ and,} \qquad \theta_{it} = a_i \left(\frac{(\ln(t) - \ln(\mu_i))^2}{b_i^2} \right),$$

where:

σ_t^2 > 0, variance of daily passage of the day (t);

$a_i > 0$, the maximum daily passage of the year (i);

$t \geq 1$, passage date;

$\mu_i > 0$, mean passage date of the year (i); and

$b_i^2 > 0$, variance of run timing of the year (i).

The starting passage date and number and range of years with data vary between projects (Table 5). At the upper hierarchical level, annual maximum daily passage (a_i), mean passage date (μ_i), and spread (b_i) are assumed to be a random sample from a normal distribution:

$$ai \sim N(0,100000); \qquad \mu_i \sim N(\mu_0, \sigma_\mu^2); \qquad b_i \sim N(b_0, \sigma_b^2).$$

In most cases, prior distributions of the hyper-parameters for a_i, μ_i, and b_i were assumed to be non-informative as:

$$\mu_0 \sim N(50,1000)\ (\mu_0 > 0); \qquad b_0 \sim N(0.5,1000)\ (b_0 > 0);$$

$$\sigma_\mu \sim \text{uniform}(0, 10); \qquad \sigma_b \sim \text{uniform}(0, 100);$$

For George and Tatlawiksuk river Chinook salmon, the prior distribution of the spread parameter (b_i) was constrained to values >0.16, which is equal to the smallest (i.e., narrowest spread) parameter value observed for all prior years at both sites. This constraint was necessary to prevent an unrealistically narrow spread, and allowed for reasonable estimates of missed passage during the missed operational periods on the tails of the run.

Markov-chain Monte Carlo methods (WinBUGS v1.4; Spiegelhalter et al. 1999) were used to generate the joint posterior probability distribution of all unknowns in the model. Simulations were generated over 10,000 iterations with the first 5,000 iterations discarded (burn-in period), and samples were taken every 2 iterations. This resulted in 2,500 samples, and the median sample value was used to represent the point estimate of daily missed passage. From those, Bayesian credible intervals (95%) were obtained from the percentiles (2.5 and 97.5) of the marginal posterior distribution.

Available historical data limited estimation of missed passage to the dates of each project's standard estimation range. All missed escapement for Chinook, chum, and sockeye salmon that occurred on or after 1 September through the end of each project's standard estimation range were assumed 0 based on historical information. The Bayesian model provided accurate and precise estimates of total escapement as long as there was adequate count data to inform the timing and relative magnitude of the peak of annual spawning runs. Actual count data from a minimum of 60% of the run was expected to provide adequate information to inform annual estimates. Therefore, if more than 40% of the entire run was missed, based on historical run timing, estimates of missed passage were not created and total annual escapement was not imputed.

Total annual escapement was estimated as the sum of the daily observed escapement counts and the daily estimates of missed escapement within the standard estimation range. Estimates of daily escapement were used for each day the weir was inoperable unless the estimate was less than the actual number of fish observed during partial operations. In these scenarios, the estimate was disregarded and the observed escapement was considered a minimum daily escapement estimate.

WEATHER AND STREAM MEASUREMENTS

Weather and stream data was collected at all projects (Appendices B1–B7). Water and air temperatures were manually measured (°C) using handheld analog thermometers. Notations about cloud cover, precipitation, and river stage were also recorded. Daily precipitation was measured (mm) using a rain gauge, and water levels were measured (cm) using staff gauges installed approximately 150 meters from the weirs. The staff gauge was calibrated to a reliable benchmark using a sight or line level. All data were collected in the morning and evening at all projects except the Middle Fork Goodnews River weir, when data were only recorded in the morning. In addition, water clarity observations were recorded at the Kuskokwim River weir projects. Air and water temperature data are monitored year-round by Hobo[2] data loggers, as part of the Office of Subsistence Management Temperature Monitoring Project 14-701, conducted by the Aquatic Restoration and Research Institute.

AGE, SEX, AND LENGTH SAMPLING

A minimum sample size was determined for each species to achieve 95% confidence intervals of age-sex composition estimates no wider than ±10% (α = 0.05 and d = 0.10; Bromaghin 1993). Sample size goals (n) were estimated based on 10 age-sex categories for Chinook salmon (n = 190), 14 age-sex categories for sockeye salmon (n = 205), 8 age-sex categories for chum salmon (n = 180), and 6 age-sex categories for coho salmon (n = 168). Sample size goals were increased to account for unreadable scales, collection errors, and variation in run timing, and to allow for investigation of interannual changes in ASL composition. For most project locations, the collection goal is 230 Chinook, 400 chum, 250 sockeye, and 400 coho salmon. The Chinook salmon sampling goal was increased to 250 fish at the Salmon River (Pitka Fork) weir because the percentage of unreadable scales were expected to be larger than average because of scale reabsorption. At the Kogrukluk and Telaquana weirs, the sockeye salmon collection goal was 250 fish, but only sex and length measurements were collected. Sockeye salmon scales are not collected from Kuskokwim River escapement projects because previous reports indicated that saltwater age cannot be estimated from scales because of excessive deterioration of the scale margins (Liller et al. 2016). Sampling schedules were provided for each Kuskokwim Area weir project. Schedules attempted to guide the collection of samples throughout the season in proportion to historical run timing, and ensure an appropriate distribution of sampling effort across the run.

Age, sex, and length sample collection followed standardized procedures developed for the AYK Area (Eaton 2015). Salmon were captured for sampling using a trap integrated into the weir design. Following capture, crew members used safe handling techniques to place the fish into a partially submerged fish cradle. Scales were taken from the preferred area of the fish (INPFC 1963) and transferred to numbered gum cards. 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 from the middle of the eye to the fork of the tail was measured to the nearest millimeter using a straight-edged meter stick. Sex and length data were recorded on standardized numbered data sheets that corresponded with numbers on the gum cards used for scale preservation. After sampling, each fish was released upstream of the weir. The procedure was repeated until the trap was emptied. Sampling procedures are not

[2] Product names used in this report are included for scientific completeness but do not constitute a product endorsement.

biased for size or sex and are designed to reduced stress caused by holding and handling time. Further details regarding trapping methods or fish handling techniques can be found in Liller et al. (2016).

After sampling was completed, all ASL data and metadata were copied to Microsoft Excel spreadsheets that corresponded to numbered gum cards. Completed Excel spreadsheets were sent in digital format to the Anchorage ADF&G office for processing. The original ASL gum cards, acetates, and paper forms were archived at the ADF&G office in Anchorage. Data were also archived in the AYKDBMS.

RESULTS

OPERATIONS

Aerial Surveys

Aerial surveys were conducted on 11 rivers in 2017. All surveyed rivers were flown once between 20 July and 22 July (Table 6). Chinook salmon escapement indices were successfully determined for all surveyed rivers. The Kisaralik, North Fork Goodnews, Middle Fork Goodnews, and Kanektok rivers were not flown for Chinook or sockeye salmon in 2017 due to poor weather (Table 6).

Weir Projects

Middle Fork Goodnews River Weir

The Middle Fork Goodnews River weir was operated from 22 June through 31 July in 2017. During this period, the weir had 1 partial day of operation, which was on the first day of operations (Table 7). Middle Fork Goodnews River weir operations ended on 31 July. Data collected in 2017 was sufficient to generate total escapement estimates for Chinook, sockeye, and chum salmon. Insufficient data was collected to estimate total coho salmon escapement. Weather and stream observations were recorded between 23 June and 3 August (Appendix B1).

Salmon River (Aniak) Weir

The Salmon River (Aniak) weir was operated from 15 June to 2 August in 2017. The weir was out of operation 4 partial days during the 49 day period (Table 7). The operational period was shortened 13 days due to high water. As a result, insufficient data was collected to produce total escapement estimates for sockeye salmon in 2017. Data collected on Chinook and chum salmon in 2017 was sufficient to generate total escapement estimates for each species. Weather and stream observations were recorded between 28 June and 8 August (Appendix B2).

George River Weir

The George River weir was operated from 14 June through 13 September in 2017. The weir was inoperable for 4 partial days and 7 full days due to high water and holes in the weir (Table 7). The operational period was shortened by 7 days due to high water (Table 7). Data collected was sufficient to produce total escapement estimates for all target species in 2017. Weather and stream observations were recorded between 14 June and 20 September (Appendix B3).

Kogrukluk River Weir

The Kogrukluk River weir was installed early and operated from 23 June through 25 August in 2017. During this period, the weir was inoperable for 25 full day and 2 partial days due to high water at the weir (Table 7). In addition, the Kogrukluk River weir operations ended 31 days early due to high water levels. As a result, insufficient data was collected to produce total escapement estimates for coho salmon in 2017. Sufficient data were collected to produce total escapement estimates for Chinook, chum, and sockeye salmon. Weather and stream observations were recorded between 23 June and 12 September (Appendix B4).

Telaquana River Weir

The Telaquana River weir was operated from 6 July through 14 August in 2017. During this period, the weir was inoperable for 5 partial days due to holes found in the weir that allowed for unmonitored escapement of fish (Table 7). The operational period was shortened 17 days due to a decrease in daily passage signifying the end of the run. Data collected in 2017 was sufficient to produce total escapement estimates for sockeye salmon. Weather and stream observations were recorded between 6 July and 16 August (Appendix B5).

Tatlawiksuk River Weir

The Tatlawiksuk River weir was operated from 15 June through 13 September in 2017. During this period, the weir was inoperable for 24 full days due high water and the time it took to repair damage caused by large debris. In addition the weir was inoperable for 13 partial days due to high water and holes (Table 7). Tatlawiksuk River weir was removed 7 days early due to high water levels. Estimates were made for all days of missed passage. Sufficient data was collected to produce total escapement estimates for Chinook and chum salmon. Insufficient data was collected to produce total escapement estimates for coho salmon. Weather and stream observations were recorded between 16 June and 19 September (Appendix B6).

Takotna River Weir

The Takotna River weir was operated from 1 July through 3 August in 2017. During this period, the weir was inoperable for 5 partial days due to high water and holes observed in the weir (Table 7). The operational period was shortened 12 days due to high water. Additionally, irreconcilable data errors for 2 days resulted in culling those records and treating those days as inoperable for estimation purposes. Sufficient data was collected to produce total escapement estimates for Chinook and chum salmon. Weather and stream observations were not made available to ADF&G for the purpose of reporting.

Salmon River (Pitka Fork) Weir

The Salmon River (Pitka Fork) weir was operated from 20 June through 10 August in 2017. The weir was inoperable for 3 partial days due to holes in the weir (Table 7). The operational period was shortened 12 days due to a decrease in daily passage signifying the end of the run. No estimates are made for missed passage due to a lack of historical data. Weather and stream observations were recorded between 22 June and 10 August (Appendix B7).

ESCAPEMENT COUNTS

Chinook Salmon

Aerial Survey

Chinook salmon escapement goals were assessed for 6 of the 9 tributaries with established goals throughout Kuskokwim Bay and the Kuskokwim River (Table 8). Aerial survey counts were within historical ranges and sustainable escapement goals (SEG) were achieved on all but 1 of the surveyed rivers. The exception was the Holitna River, which fell below the established SEG range. However, during this survey, tannic water and an abundance of sockeye salmon in the lower reach made counting Chinook salmon difficult. Poor survey conditions prevented assessment of the established SEG on the North Fork Goodnews, Kanektok, and Kisaralik rivers (Table 6). An additional 5 surveys were flown on tributaries without an established SEG throughout the middle and upper portion of the Kuskokwim River. Surveys on the Kipchuck, Holokuk, and Oskawalik rivers had index counts below their historical averages, but larger than 40% of all historical observations for each site. This was the first time since 2011 that the Pitka Fork aerial survey had been conducted. The 2017 Pitka Fork survey was larger than 70% of all historical observations. The aerial survey conducted on Bear Creek, a headwaters tributary, was the third largest on record (492 fish) and was nearly double the historical average (n = 19 years) of 287 Chinook salmon (range: 36–1,381; Table 8).

Weir

Annual escapements were successfully estimated for Chinook salmon at the Middle Fork Goodnews (6,881 fish), Salmon (Aniak; 2,800 fish), George (3,685 fish), Kogrukluk (9,992 fish), Tatlawiksuk (2,156 fish), and Takotna (301 fish) river weirs (Table 9). Observed passage at the Salmon (Pitka Fork) weir was 8,003 fish (Table 9). No estimates were made for missed passage at the Salmon River (Pitka Fork) weir because this was the third year of operations and there was not enough historical run timing information to inform the Bayesian estimation methods. It is unlikely that much of the total escapement to the Salmon River (Pitka Fork) was missed because the weir experienced only 3 partially inoperable days during the entire season.

Chinook salmon arrival timing was average to late throughout the Kuskokwim area with the exception of the Middle Fork Goodnews (Figure 4). Early timing was observed at the Middle Fork Goodnews River in Kuskokwim Bay (Figure 4). Arrival timing at weirs did not affect assessment and the planned operational period was adequate to observe the entire escapement past each weir.

Overall, weir counts indicate that Chinook salmon escapement was near average. Chinook salmon escapement at the Middle Fork Goodnews River was nearly double the 2016 escapement, the largest run on record, and above the upper bound of the SEG (Table 10). The Tatlawiksuk River saw similar escapement compared to 2016, and was larger than 76% of historical observations. The Salmon River (Pitka Fork) had the highest escapement observed since the project began in 2015. The SEG on the Kogrukluk and George rivers were both exceeded. The Salmon River (Aniak) had its highest escapement since 2007, and was larger than 71% of all runs observed at that site.

Chum Salmon

Annual escapements were successfully estimated for chum salmon at the Middle Fork Goodnews (54,799 fish), Salmon (Aniak; 10,173 fish), George (40,028 fish), Kogrukluk (94,387 fish), Tatlawiksuk (29,875 fish), and Takotna (6,755 fish) river weirs (Table 11). Each weir operated throughout the majority of its planned operational period.

Chum salmon arrival timing was variable throughout the Kuskokwim Area in 2017 (Figure 5). The Tatlawiksuk River had early timing whereas the Kogrukluk and Takotna rivers had late chum salmon arrival timing. The Middle Fork Goodnews, Salmon (Aniak) and George rivers all had average arrival timing. Arrival timing at the weirs did not affect assessment and the planned operational period was adequate to observe the entire run past each weir.

Overall, weir counts indicate that chum salmon escapement was above average in 2017 (Table 12). Middle Fork Goodnews River chum salmon escapement was the largest on record and 4.5 times the SEG threshold (>12,000 fish) in 2017. Escapements on the Salmon (Aniak), George, and Kogrukluk rivers were the highest since the mid-2000s. The SEG on the Kogrukluk River was exceeded. The only tributary that had below average escapement in 2017 was the Tatlawiksuk River. However, chum salmon escapement to the Tatlawiksuk River was above the median and larger than 52% of all historical observations at that site.

Sockeye Salmon

Aerial Survey

Due to poor weather conditions during the target survey dates, no aerial surveys for sockeye salmon were flown in 2017. As a result, the 2 aerial survey sockeye salmon escapement goals in Kuskokwim Bay were not assessed.

Weir

Annual escapements were successfully estimated for sockeye salmon at the Middle Fork Goodnews (179,897 fish), Kogrukluk (27,315 fish), and Telaquana (145,287 fish) river weirs (Table 13). The Middle Fork Goodnews and Telaquana river weirs operated throughout the majority of the planned operational period and only minimal estimation was required. The Kogrukluk River weir had numerous out-of-operation periods, but adequate information was available to make an estimate of sockeye salmon escapement. The Salmon (Aniak) was compromised by high water and more than 60% of the sockeye salmon run was missed. As a result, estimates were not made in 2017

Sockeye salmon arrival timing was variable at Kuskokwim Area weirs. In 2017, average arrival times were observed at the Telequana and Middle Fork Goodnews river weirs, and late arrival timing at the Kogrukluk River weir (Figure 6). Arrival timing at the weirs did not affect assessment, and the planned operational period was adequate to observe the entire run past each weir.

Overall, sockeye salmon weir escapement was well above average at all projects (Table 14). The Middle Fork Goodnews River weir had the highest escapement on record and exceeded the upper bound of the biological escapement goal (BEG). Kogrukluk River escapement exceeded the upper bound of the SEG, and escapement past the Telaquana River weir was the largest on record at almost 3 times the long-term average. Additionally, observed passage of sockeye salmon past the Salmon (Aniak) weir was above the historic average despite less than 40% of the historic run timing being observed.

Coho Salmon

Annual escapement was successfully estimated for coho salmon at the George River weir (25,384 fish; Table 15). Coho escapement at the George River weir was above the long-term average of 18,076 fish and larger than 72% of all historical escapements (Table 16). Coho salmon arrival timing at the George River weir was the latest on record (Figure 7). Arrival timing at the weir did not affect assessment, and the planned operational period was adequate to observe nearly the entire run past the weir.

Coho salmon escapement could not be estimated for all other projects. The Tatlawiksuk and Kogrukluk river weirs were compromised by high water and more than 80% of the coho salmon run was missed. The Middle Fork Goodnews River weir ended operations prior to substantial arrival of coho salmon and as a result, the established SEGs at the Kogrukluk and Middle Fork Goodnews rivers were not assessed.

Nontarget species

Nontarget species were observed at all weir projects. In 2017, pink salmon, Arctic grayling *Thymallus arcticus*, and whitefish *Coregonus* spp. were observed at nearly all Kuskokwim Area projects. Coho salmon were observed at the Middle Fork Goodnews River weirs, sockeye salmon were observed at the George River weir, and chum salmon were observed at the Telaquana and Salmon (Pitka Fork) river weirs. Chinook salmon were observed at the Telaquana River weir. Longnose suckers *Catostomus catostomus*, Dolly Varden *Salvelinus malma*, Northern pike *Esox Lucius*, and rainbow trout *O. mykiss* were observed at multiple projects, and lake trout *Salvelinus namaycush* were observed at Telaquana River weir (Appendices C1–C7).

AGE, SEX, AND LENGTH COLLECTION

Chinook Salmon

Age, sex, and length samples were collected from Chinook salmon at the Middle Fork Goodnews (240 fish), Salmon (Aniak; 216 fish), George (233 fish), Kogrukluk (216 fish), Tatlawiksuk (139 fish), Takotna (147 fish), and Salmon (Pitka Fork; 172 fish) river weirs. Sample goals were not achieved at the Salmon (Aniak), Kogrukluk, Tatlawiksuk, and Salmon (Pitka Fork) river weirs, because of high water. Sample goals were achieved at the Middle Fork Goodnews and George river weirs (Table 17). At both locations, samples were collected on a near daily basis spanning approximately the central 90% of the run.

Chum Salmon

Age, sex, and length samples were collected from chum salmon at the Middle Fork Goodnews (608 fish), Salmon (Aniak; 345 fish), George (414 fish), Kogrukluk (387 fish), and Tatlawiksuk (400 fish) river weirs. Sample goals were not achieved at the Salmon (Aniak) or Kogrukluk river weirs, due to high water. Sample goals were achieved at the Middle Fork Goodnews, George, and Tatlawiksuk river weirs (Table 17). At these locations, samples were collected on a near daily basis spanning approximately the central 84% of the run.

Sockeye Salmon

Sex and length samples were collected from the Middle Fork Goodnews (614 fish), Kogrukluk (163 fish), and Telaquana (495 fish) river weirs. In addition, Middle Fork river weir collected paired scales for age data. The sample goal was not achieved at the Kogrukluk River weir, due to high water. Sample goals were achieved at the Middle Fork Goodnews and Telequana river weirs (Table 17). At these projects, samples were collected on a near daily basis spanning approximately the central 96% of the run.

Coho Salmon

Age, sex, and length samples were collected from coho salmon at the George (187 fish), Kogrukluk (40 fish), and Tatlawiksuk (5 fish) river weirs. The coho salmon sample size goal was not achieved at any project (Table 17).

DISCUSSION

The escapement data collected in 2017 are comparable to data collected in prior years at the individual monitoring locations and can be used to index variation in spawning abundance over time. However, aerial survey indices and weir counts should not be considered directly comparable. Air surveys provide only an index of peak spawning abundance to a broad geographic area, whereas weir counts are used to estimate the total number of salmon that escaped past a specific location over the entire season. In addition, aerial survey indices are not directly comparable among monitored locations within the same year, due to differences in observation error and differences in the size of the survey area. Air survey and weir data can be used to evaluate changes in relative abundance over time (e.g., years) for a single monitored location as long as standardized methodology are used. In addition, weir counts may be compared among the various monitoring locations within the same year, as long as total annual escapement was estimated.

KUSKOKWIM RIVER

High water levels throughout much of August and September caused operational challenges at some Kuskokwim River monitoring sites in 2017. The Kogrukluk River weir washed out on 26 July and was out of operation for almost an entire month. Continued high water throughout the remainder of the season limited the Kogrukluk River weir to only 5 days of operation in August and September. High water caused the Tatlawiksuk River weir to wash out on 15 August, and heavy debris loads caused extensive damage to the weir. Due to repair time and further high water events, the Tatlawiksuk River weir was only able to operate for another week before being removed for the season. High water impeded assessment of coho salmon escapement at the Kogrukluk and Tatlawiksuk rivers. High water did not prevent monitoring of Chinook, chum, or sockeye salmon at any weir location in 2017.

Surveyor comments indicated that the 2017 aerial surveys were flown before the peak arrival of the Chinook salmon run on the spawning grounds. The Bethel test fishery indicated late run timing through the lower river and most weirs also indicated late Chinook salmon arrival timing. In 2017, one-time aerial surveys were flown between 20 July and 22 July to take advantage of optimal weather conditions for surveys. The timing of the 2017 surveys was conducted towards the early end of the acceptable data range. The aerial surveyor noted that many fish were observed in the lower reaches of the survey areas and most were not actively spawning, which indicated that surveys were conducted prior to peak spawning. For example, the escapement objective that the SEG is based on for the Salmon (Pitka Fork) River includes index areas 102, 103, and 104. Index area 101 is not included in the escapement objective, because historically most fish have moved upstream from index area 101 prior to peak spawning. In 2017, there were 586 fish observed in index area 101, the largest on record for this index reach. The late arrival timing of Chinook salmon in 2017, in combination with early survey timing, may have affected the aerial surveyors' ability to accurately index the Chinook salmon run in 2017. As a result, aerial surveys probably undercounted escapement.

There are 15 existing escapement goals throughout the Kuskokwim River, 13 of which were assessed in 2017. The Chinook salmon goal on the Kisaralik River and the coho salmon goal on the Kogrukluk River were not assessed due to operational challenges. The upper bound of the goal was exceeded for chum salmon (Kogrukluk River), sockeye salmon (Kogrukluk River), and coho salmon (Kwethluk River). Of the 10 Chinook salmon escapement goals assessed, 1 was below the lower bound of the goal, 6 were within the goal range, and 2 exceeded the upper bound of the goal. The preliminary drainagewide abundance estimate indicates that the drainagewide Chinook salmon goal was exceeded.

KUSKOKWIM BAY

There have been many changes in both the Kuskokwim Bay fishery and monitoring program that affected fish escapement and the ability to assess escapement performance in recent years. There were no commercial fisheries in Kuskokwim Bay in 2016 or 2017 due to the lack of a buyer, and exploitation was limited to small localized subsistence fisheries. Funding for both Kuskokwim Bay weir projects are tied to the fishing industry. State of Alaska funding was not adequate to operate the Kanektok River weir, and the Middle Fork Goodnews River weir was only able to operate for the month of July. The majority of the Chinook, chum, and sockeye salmon escapement to the Middle Fork Goodnews River was monitored despite the abbreviated operational period. In addition, poor weather did not allow any of the Kuskokwim Bay aerial surveys to be conducted in 2017.

The Middle Fork Goodnews weir was the only project available to assess the size of the Chinook, chum, and sockeye salmon runs in 2017. Therefore, only 3 of the 8 escapement goals in Kuskokwim Bay were assessed. Chinook salmon escapement, which has been persistently low since 2010, exceeded the upper bound of the BEG for the second year in a row, and only the second time since 2007. Chum salmon escapement was 2 times the historical average, and almost 5 times the SEG threshold (>12,000 fish). Sockeye salmon escapement exceeded the upper end of the BEG range for the fourth year in a row, and was over 3 times larger than the historical average. The increased number of Chinook salmon returning to the Middle Fork Goodnews after consecutive years of low escapement is encouraging. The high numbers of chum salmon and sockeye salmon that escaped in 2017 are a result of no commercial harvest from local fisheries that have historically targeted these species.

ACKNOWLEDGEMENTS

The many Kuskokwim Area escapement monitoring projects are only successful due to the hard work and diligence of all the individuals that have contributed to the development and operations of each project.

The U.S. Fish and Wildlife Service, Office of Subsistence Management, provided funding support for George, Tatlawiksuk, and Salmon (Pitka Fork) river weirs under agreement numbers F14AC00102 (Project No. 14-303), F14AC00109 (Project No. 14-302), and F16AC00279 (Project No. 16-302) respectively, through the Fisheries Resource Monitoring Program.

We would like to thank all of our collaborators: United States Fish and Wildlife Service, National Park Service (NPS), Native Village of Napaimute (NVN), and MTNT, Ltd. Administrative and logistical support was provided by ADF&G staff: Aaron Poetter, Aaron Tiernan, Janet Bavilla, Josh Clark, and Katie Froning; and NPS staff: Dan Young. Thank you to ADF&G project crew leaders Rob Stewart, Amanda Hoeldt, Mike Oexner, Glen Lindsey, and Storm Phillips. A special thanks to all the technicians and interns from ADF&G, USFWS, NPS, and NVN. Zachary Liller provided regional report review, and Toshihide Hamazaki provided biometric review for ADF&G. OSM review was provided by Gary Decossas.

A special thanks goes out to the hard work put in by Dan Gillikin at NVN and Kevin Whitworth at MTNT, Ltd for their efforts to carry on the operation of the Salmon (Aniak) and Takotna river weirs in 2017.

This report was submitted as the technical project report to U.S. Fish and Wildlife Service, Office of Subsistence Management (OSM), Subsistence Fisheries Resource Monitoring Program for project numbers 14-302, 14-303, and 16-302.

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TABLES AND FIGURES

Table 1.–Escapement goals for Kuskokwim Management Area salmon stocks, 2017.

		Escapement goal		
Stock unit	Assessment method	Goal	Type	Year established
Chinook salmon (14 Goals)				
Kuskokwim Bay rivers				
Kanektok River	Aerial survey	3,900–12,000	SEG	2016
Middle Fork Goodnews River	Weir	1,500–2,900	BEG	2005
North Fork Goodnews River	Aerial survey	640–3,300	SEG	2005
Kuskokwim River / tributaries				
Kuskokwim River Drainage [a]	Run reconstruction	65,000–120,000	SEG	2013
Aniak River	Aerial survey	1,200–2,300	SEG	2005
Cheeneetnuk River	Aerial survey	340–1,300	SEG	2005
Gagarayah River	Aerial survey	300–830	SEG	2005
George River	Weir	1,800–3,300	SEG	2013
Holitna River	Aerial survey	970–2,100	SEG	2005
Kisaralik River	Aerial survey	400–1,200	SEG	2005
Kogrukluk River	Weir	4,800–8,800	SEG	2013
Kwethluk River	Weir	4,100–7,500	SEG	2013
Salmon River (Pitka Fork)	Aerial survey	470–1,600	SEG	2005
Salmon River (Aniak Drainage)	Aerial survey	330–1,200	SEG	2005
Chum salmon (2 Goals)				
Kuskokwim Bay rivers				
Middle Fork Goodnews River	Weir	>12,000	SEG	2005
Kuskokwim River tributaries				
Kogrukluk River	Weir	15,000–49,000	SEG	2005
Sockeye salmon (4 goals)				
Kuskokwim Bay rivers				
Kanektok River	Aerial survey	15,300–41,000	SEG	2016
Middle Fork Goodnews River	Weir	18,000–40,000	SEG	2007
North Fork Goodnews River	Aerial survey	9,600–18,000	SEG	2016
Kuskokwim River / tributaries				
Kogrukluk River	Weir	4,400–17,000	SEG	2010
Coho salmon (3 goals)				
Kuskokwim Bay rivers				
Middle Fork Goodnews River	Weir	>12,000	SEG	2005
Kuskokwim River / tributaries				
Kogrukluk River	Weir	13,000–28,000	SEG	2005
Kwethluk River	Weir	>19,000	SEG	2010

[a] Run reconstruction is conducted postseason using a model to estimate total run from harvest and escapement monitoring projects.

Table 2.–Projects used to inform the 2017 Chinook run reconstruction model.

Method	Location	Used in 2017
Weir	Kwethluk	x
	Tuluksak	x
	George	x
	Kogrukluk	x
	Tatlawiksuk	x
	Takotna	x
Aerial survey	Kwethluk	
	Kisaralik	
	Tuluksak	
	Salmon (Aniak)	x
	Kipchuk	x
	Aniak	x
	Holokuk	x
	Oskawalik	x
	Holitna	x
	Cheeneetnuk	x
	Gagaryah	x
	Pitka	x
	Bear	x
	Salmon (Pitka)	x
Harvest	Subsistence	x
	Commercial	x
	Test fisheries	x
	Sport	x

Note: Not all projects were operated in all years. No aerial surveys were flown on the Kwethluk, Kisaralik, and Tuluksak rivers in 2017.

Table 3.–Kuskokwim Area aerial survey locations, 2017.

Project	Species targeted	
Kuskokwim Bay rivers	Chinook salmon	Sockeye salmon
North Fork Goodnews R.	x	x
Middle Fork Goodnews R.	x	x
Kanektok R.	x	x
Kuskokwim River tributaries		
Kisaralik R.	x	
Aniak R.	x	
Salmon R. (Aniak)	x	
Kipchuk R.	x	
Holokuk R.	x	
Oskawalik R.	x	
Holitna R.	x	
Cheeneetnuk R.	x	
Gagaryah R.	x	
Salmon R. (Pitka Fork)	x	
Pitka Fork	x	
Bear Cr.	x	

Table 4.–Target operational period and species targeted at Kuskokwim Area weir projects, 2017.

Project			Species targeted			
Kuskokwim Bay rivers	Standard estimation range	2017 planned operational period	Chinook salmon	Chum salmon	Sockeye salmon	Coho salmon
Middle Fork Goodnews River weir	25 June–18 September	25 June–31 July[a]	x	x	x	
Kuskokwim River tributaries						
Kwethluk River[b]	[b]	[b]	x	x	x	x
Tuluksak River[b]	[b]	[b]	x	x	x	x
Salmon River (Aniak) weir[c]	15 June–20 September	15 June–15 August[a]	x	x	x	
George River weir	15 June–20 September	15 June–20 September	x	x	x	x
Kogrukluk River weir	26 June–25 September	26 June–25 September	x	x	x	x
Telaquana River weir	3 July–26 August	3 July–26 August			x	
Tatlawiksuk River weir	15 June–20 September	15 June–20 September	x	x		x
Takotna River weir[d]	24 June–20 September	1 July–15 August[a]	x	x		
Salmon River (Pitka Fork) weir	[e]	20 June–15 August	x			

Note: The "x" indicates that salmon species is monitored in notable numbers, and the planned operational period covers a majority of the run.

[a] The operational period was reduced compared to past years due to a lack of funding (Middle Fork Goodnews River, Salmon River Aniak, Takotna River).

[b] Kwethluk and Tuluksak river weirs are operated by the U.S. Fish and Wildlife Service and information is displayed to show all active salmon monitoring projects in the Kuskokwim River. For further information contact USFWS.

[c] Salmon River (Aniak) weir was operated by the Native Village of Napaimute. All data was transferred to and reported by ADF&G.

[d] Takotna River weir was operated by the MTNT. All data was transferred to and reported by ADF&G.

[e] The Salmon River (Pitka Fork) weir does not have a standard estimation range because the project has not operated for enough years to produce reliable estimates.

Table 5.–Starting passage dates and years used in the hierarchical Bayesian estimation technique to estimate missed escapement at Kuskokwim Area weir projects, 2017.

Project	Starting passage date	Weir passage years
Middle Fork Goodnews River weir	15 June [a]	2001–2016
Salmon (Aniak) River weir	15 June	2006–2009, 2012–2016
George River weir	15 June	1996–2016
Kogrukluk River weir	26 June	1976–2016[b]
Telaquana River weir	3-Jul	2010–2016
Tatlawiksuk River weir	15 June	1998–2016
Takotna River weir	24-Jun	1995–1997, 2000–2013

Note: Starting passage dates and weir passage years only apply to target species at each project.

[a] Starting passage date was for Chinook and sockeye salmon only. Chum salmon starting passage date was 20 June.

[b] Weir passage years are for Chinook, chum, and sockeye salmon only. Coho salmon passage years are 1981–2016.

Table 6.–Kuskokwim Area Chinook salmon aerial survey locations, survey dates, ratings, index objectives, and escapement indices, 2017.

River	Survey date	Overall survey rating	Index objective	Index area survey counts					Escapement index
				101	102	103	104	Supplemental	
Kuskokwim Bay Rivers									
North Fork Goodnews R.	–	–	101,102,103	–	–	–	–	[a]	–
Middle Fork Goodnews R.	–	–	101, 103, 104	–	–	–	–	[a]	–
Kanektok R.	–	–	101, 102, 103	–	–	–	–	–	–
Kuskokwim River Tributaries									
Kisaralik R.	–	–	102, 103	–	–	–	[a]	[a]	–
Aniak R.	22 July	Good (1)	102, 103, 104	–	908	815	58	[a]	1,781
Salmon R. (Aniak)	22 July	Fair (2)	101, 102, 103	279	119	25	[a]	[a]	423
Kipchuk R.	22 July	Good (1)	101, 102, 103	432	322	135	[a]	[a]	889
Holokuk R.	21 July	Good (1)	101, 102, 103, 104	27	31	59	23	[a]	140
Oskawalik R.	21 July	Fair (2)	101, 102, 103	36	38	62	[a]	[a]	136
Holitna R.	21 July	Fair (2)	102, 103	70	15	661	213	[a]	676
Cheeneetnuk R.	21 July	Fair (2)	101, 102	248	412	[a]	[a]	[a]	660
Gagaryah R.	20 July	Good (1)	101, 102	453[b]	[b]	[a]	[a]	[a]	453
Salmon R. (Pitka Fork)	20 July	Fair (2)	102, 103, 104	586	122	23	542	[a]	687
Pitka Fork	20 July	Fair (2)	101	234	[a]	[a]	[a]	[a]	234
Bear Cr.	20 July	Good (1)	101	492	[a]	[a]	[a]	[a]	492

Note: Survey ratings were based on criteria related to survey method, weather and water conditions, time of survey, and spawning stage (Schneiderhan 1988). The index objective defines the specific index areas that must be surveyed in order to produce a Chinook salmon escapement index count. Survey counts are not adjusted or expanded in any way. Escapement index is only reported when index objectives were achieved, survey conditions were rated good (1) or fair (2), and survey occurred between the target date range of 17 July and 5 August. Dashes (–) indicate no data.

[a] Index reaches do not exist for river.

[b] Index 101 is combination of both 101 and 102 index areas.

Table 7.–Target operational periods, actual operational periods, and missed passage days at Kuskokwim Area weir projects, 2017.

	Standard estimation range	2017 planned operational period[a]	Actual operational period	Partial missed passage days during actual operational period	Full missed passage days during actual operational period
Middle Fork Goodnews River weir	25 June–18 September	25 June–31 July	22 June–31 July	22 June	
Kwethluk River	[b]	[b]	3 June–10 September	12 July; 8 August	
Tuluksak River	[b]	[b]	9 June–9 September	3, 4, 5, 6, 26 August	
Salmon River (Aniak) weir	15 June–20 September	15 June–15 August	28 June–2 August	28 June; 9, 30, 31 July	
George River weir	15 June–20 September	15 June–20 September	14 June–13 September	17 June; 21 July; 3, 11 August	4–10 August;
Kogrukluk River weir	26 June–25 September	26 June–25 September	23 June–25 August	26 July; 25 August	27 July–20 August
Telaquana River weir	3 July–26 August	3 July–26 August	6 July–14 August	20, 21, 22, 31 July; 1 August	
Tatlawiksuk River weir	15 June–20 September	15 June–20 September	15 June–13 September	16, 20 June; 11, 19, 24–27 July; 3, 4, 8, 14 August; 6, 8, 10 September	5–7 August; 15 August–5 September
Takotna River weir	24 June–20 September	1 July–15 August	1 July–3 August	7, 8, 18, 22 July; 3 August	4, 5 July
Salmon River (Pitka Fork) weir	[c]	20 June–15 August	20 June–10 August	20 June; 22, 23 July	

[a] The operational period was reduced compared to past years due to a lack of funding (Middle Fork Goodnews River, Salmon River Aniak, Takotna River).

[b] Kwethluk and Tuluksak river weirs are operated by the U.S. Fish and Wildlife Service and information is displayed to show all active salmon monitoring projects in the Kuskokwim River. For further information contact USFWS.

[c] The Salmon River (Pitka Fork) weir does not have a standard estimation range because the project has not operated for enough years to produce reliable estimates.

Table 8.–Chinook salmon aerial survey escapement indices, Kuskokwim Area, 2000–2017.

	Kuskokwim Bay			Upper Kuskokwim River		
Year	North Fork Goodnews	Middle Fork Goodnews	Kanektok	Salmon (Pitka Fork)	Pitka Fork	Bear Creek
2000	–	–	–	362	151	–
2001	–	–	–	1,033	–	175
2002	1,470	1,195	–	–	165	211
2003	3,935	2,131	6,206	–	197	176
2004	7,482	2,617	28,375	1,138	290	206
2005	–	–	12,780	1,801	744	367
2006	–	–	–	862	170	347
2007	–	–	–	943	131	165
2008	2,155	2,190	–	1,033	242	245
2009	–	–	–	632	187	209
2010	–	–	1,208	135	67	75
2011	853	–	–	767	85	145
2012	378	355	–	670	–	–
2013	–	–	2,277	469	–	64
2014	630	612	1,840	1,865	–	–
2015	991	515	4,919	2,016	–	1,381
2016	1,120	1,301	5631	1,578	–	580
2017	–	–	–	687	234	492
Average	1,847	1,347	8,099	1,020	221	287
Median	1,174	1,222	6,172	903	170	206
Percentile rank	–	–	–	42%	72%	88%
Escapement goal	640–3,300	–	3,500–8,500	470–1,600	–	–

-continued-

Table 8.–Page 2 of 2.

	Lower / Middle Kuskokwim River								
Year	Kisaralik	Aniak	Salmon (Aniak)	Kipchuk	Holokuk	Oskawalik	Holitna	Cheeneetnuk	Gagaryah
2000	–	714	238	182	–	–	301	–	–
2001	–	–	598	–	52	–	4,156	–	143
2002	1,727	–	1,236	1,615	513	295	733	730	–
2003	654	3,514	1,242	1,493	1,096	844	–	810	1,093
2004	5,157	5,362	2,177	1,868	539	293	4,051	918	670
2005	2,206	–	4,097	1,679	510	582	1,760	–	–
2006	4,734	5,639	–	1,618	705	386	1,866	1,015	531
2007	692	3,984	1,458	2,147	–	–	–	–	1,035
2008	1,074	3,222	589	1,061	418	213	–	290	177
2009	–	–	–	–	565	379	–	323	303
2010	235	–	–	–	229	–	–	–	62
2011	–	–	79	116	61	26	–	249	96
2012	588	–	49	193	36	51	–	229	178
2013	599	754	154	261	–	38	532	138	74
2014	622	3,201	497	1,220	80	200	–	340	359
2015	709	–	810	917	77	–	662	–	19
2016	622	718	–	898	100	47	1,157	217	135
2017	–	1,781	423	889	140	136	676	660	453
Average	1,143	2,675	793	1,018	348	291	1,637	702	447
Median	643	2,186	589	989	233	197	1,573	512	359
Percentile rank	–	31%	35%	41%	40%	45%	26%	50%	61%
Escapement goal	400–1,200	1,200–2,300	330–1,200	–	–	–	970–2,100	340–1,300	300–830

Note: Average, median, and percentile rank was derived from all annual escapements on record at each project except 2017, and may include escapements prior to 2000. Escapement data for all projects' entirety are archived in the Arctic-Yukon-Kuskokwim salmon database management system (http://www.adfg.alaska.gov/CommFishR3/WebSite/AYKDBMSWebsite/Default.aspx).

Table 9.–Observed, estimated, and total passage of Chinook salmon at Kuskokwim Area weirs, 2017.

Project	Observed passage[a]	Estimated passage	Total passage	95% confidence interval	Percent of run missed
Kuskokwim Bay rivers					
Middle Fork Goodnews River weir	6,576	305	6,881	6,656–7,545	9.0%
Kuskokwim River tributaries					
Salmon River (Aniak) weir	2,432	368	2,800	2,588–3,233	13.6%
George River weir	3,539	146	3,685	3,617–3,795	2.3%
Kogrukluk River weir	6,088	3,904	9,992	8,360–12,083	21.5%
Tatlawiksuk River weir	2,006	150	2,156	2,141–2,175	6.0%
Takotna River weir	260	41	301	285–350	25.3%
Salmon River (Pitka Fork) weir	8,003	–	–	–	–

Note: Percent of run missed was determined by calculating the current years run timing, then using similar historical run timings to determine the percent of the run missed on each day of missed passage.

[a] Observed passage does not include partial day counts where estimates were made.

Table 10.–Annual escapement of Chinook salmon past Kuskokwim Area weir projects, 2000–2017.

	Kuskokwim Bay		Kuskokwim River					
Year	Middle Fork Goodnews River	Kanektok River	Salmon (Aniak) River	George River	Kogrukluk River	Tatlawiksuk River	Takotna River	Salmon (Pitka Fork) River
2000	2,670	[a]	[a]	2,959	3,242	807	345	[a]
2001	5,351	[b]	[a]	3,277	7,475	1,978	718	[a]
2002	3,025	5,304	[a]	2,443	10,025	2,237	316	[a]
2003	2,248	8,211	[a]	[b]	12,008	[b]	390	[a]
2004	4,438	19,569	[a]	5,488	19,819	2,833	461	[a]
2005	4,781	14,177	[a]	3,845	21,819	2,864	499	[a]
2006	4,572	[a]	7,075	4,355	20,205	1,700	541	[a]
2007	3,914	13,965	6,255	4,011	[b]	2,032	412	[a]
2008	2,223	[b]	2,376	2,563	9,750	1,075	413	[a]
2009	1,669	7,065	1,656	3,663	9,528	1,071	311	[a]
2010	2,176	6,537	[a]	1,498	5,812	546	181	[a]
2011	2,045	5,170	[a]	1,547	6,731	992	136	[a]
2012	524	1,561	[b]	2,201	[b]	1,116	228	[a]
2013	1,187	3,569	625	1,292	1,819	495	97	[a]
2014	750	3,594	1,757	2,993	3,732	1,904	[a]	[a]
2015	1,494	10,416	2,404	2,282	8,081	2,104	[a]	6,736
2016	3,767	[a]	[b]	1,633	7,056	2,494	[a]	6,326
2017	6,881	[a]	2,800	3,685	9,992	2,156	301	8,003
Average	2,815	8,262	3,164	3,426	10,139	1,631	417	6,531
Median	2,670	6,801	2,376	2,976	9,528	1,700	401	6,531
Percentile rank	100%	–	71%	66%	54%	76%	25%	100%
Escapement goal	BEG: 1,500–2,900	–	–	SEG: 1,800–3,300	SEG: 4,800–8,800	–	–	–

Note: Average, median, and percentile rank was derived from all annual escapements on record at each project except 2017, and may include escapements prior to 2000. Escapement data for all projects' entirety are archived in the Arctic-Yukon-Kuskokwim salmon database management system (http://www.adfg.alaska.gov/CommFishR3/WebSite/AYKDBMSWebsite/Default.aspx). Dashes (–) indicate no escapement goal exists

[a] Weir did not operate.

[b] Historical run timing indicates that more than 40% of the run was missed; annual escapement was not determined.

Table 11.–Observed, estimated, and total passage of chum salmon at Kuskokwim Area weirs, 2017.

Project	Observed passage[a]	Estimated passage	Total passage	95% confidence interval	Percent of run missed
Kuskokwim Bay rivers					
Middle Fork Goodnews River weir	41,729	13,070	54,799	51,979–54,792	15.8%
Kuskokwim River tributaries					
Salmon River (Aniak) weir	8,513	1,660	10,173	9,508–11,201	12.5%
George River weir	38,060	1,968	40,028	39,703–40,397	7.1%
Kogrukluk River weir	58,866	35,521	94,387	92,148–96,508	37.2%
Tatlawiksuk River weir	26,439	3,436	29,875	29,668–30,116	9.2%
Takotna River weir	5,639	1,116	6,755	6,520–7,101	18.0%

Note: Percent of run missed was determined by calculating the current years run timing, then using similar historical run timings to determine the percent of the run missed on each day of missed passage.

[a] Observed passage does not include partial day counts where estimates were made.

Table 12.–Annual escapement of chum salmon past Kuskokwim Area weir projects, 2000–2017.

	Kuskokwim Bay		Kuskokwim River				
Year	Middle Fork Goodnews River	Kanektok River	Salmon (Aniak) River	George River	Kogrukluk River	Tatlawiksuk River	Takotna River
2000	14,405	[a]	[a]	3,507	11,416	7,076	1,265
2001	26,820	[b]	[a]	11,287	31,587	23,863	5,408
2002	29,905	41,912	[a]	6,534	52,973	24,539	4,425
2003	21,778	40,086	[a]	33,648	23,779	[b]	3,430
2004	32,442	46,008	[a]	15,012	24,405	21,245	1,633
2005	26,501	55,340	[a]	14,834	194,887	55,599	6,488
2006	54,689	[a]	42,825	42,318	188,003	32,776	12,729
2007	50,232	131,000	25,340	61,531	52,961	83,484	8,950
2008	39,548	[b]	9,459	29,396	44,744	30,129	5,704
2009	19,236	55,846	9,392	7,944	82,483	19,975	2,528
2010	24,789	68,186	[a]	26,275	69,258	37,737	4,039
2011	19,974	53,050	[a]	46,650	76,823	88,202	8,822
2012	9,065	28,726	[b]	33,310	[b]	44,569	6,180
2013	27,682	43,040	7,723	37,879	65,644	32,249	6,465
2014	11,518	18,602	2,890	17,148	30,763	12,455	[a]
2015	11,517	15,048	5,657	17,551	33,201	10,379	[a]
2016	41,815	[a]	817	20,834	45,329	10,564	[a]
2017	54,799	[a]	10,173	40,028	94,387	29,875	6,755
Average	26,416	49,737	13,013	23,223	46,748	32,034	5,174
Median	26,501	44,524	8,558	19,193	33,201	24,539	4,917
Percentile Rank	100%	–	75%	85%	93%	52%	81%
Escapement goal	SEG: >12,000	–	–	–	SEG: 15,000–49,000	–	–

Note: Average, median, and percentile rank was derived from all annual escapements on record at each project except 2017, and may include escapements prior to 2000. Escapement data for all projects' entirety are archived in the Arctic-Yukon-Kuskokwim salmon database management system (http://www.adfg.alaska.gov/CommFishR3/WebSite/AYKDBMSWebsite/Default.aspx).

[a] Weir did not operate.

[b] Historical run timing indicates that more than 40% of the run was missed; annual escapement was not determined.

Table 13.–Observed, estimated, and total passage of sockeye salmon at Kuskokwim Area weirs, 2017.

Project	Observed passage	Estimated passage	Total passage	95% confidence interval	Percent of run missed
Kuskokwim Bay rivers					
Middle Fork Goodnews River weir	179,452	445	179,897	179,885–179,951	1.7%
Kuskokwim River tributaries					
Salmon River (Aniak) weir	1,440	–	–	–	62.0%
Kogrukluk River weir	16,332	11,004	27,315	24,288–31,149	32.5%
Telaquana Lake weir	138,400	23,576	145,287	145,119–145,445	10.8%

Note: Percent of run missed was determined by calculating the current years run timing, then using similar historical run timings to determine the percent of the run missed on each day of missed passage.

Table 14.–Annual escapement of sockeye salmon past Kuskokwim Area weir projects, 2000–2017.

	Kuskokwim Bay		Kuskokwim River		
Year	Middle Fork Goodnews River	Kanektok River	Salmon (Aniak) River	Kogrukluk River	Telaquana River
2000	40,828	[a]	[a]	2,895	[a]
2001	21,194	[b]	[a]	7,177	[a]
2002	21,329	60,228	[a]	4,084	[a]
2003	37,933	128,030	[a]	9,302	[a]
2004	54,035	105,135	[a]	6,895	[a]
2005	118,969	268,537	[a]	37,787	[a]
2006	127,245	[a]	7,086	61,382	[a]
2007	73,768	304,086	2,189	17,211	[a]
2008	43,879	[b]	1,181	19,675	[a]
2009	27,494	305,756	1,366	22,826	[a]
2010	36,574	204,954	[a]	17,139	71,932
2011	19,643	88,177	[a]	7,974	35,102
2012	29,531	115,021	924	[b]	23,005
2013	23,545	128,761	966	7,808	28,050
2014	41,473	259,406	894	6,413	24,293
2015	57,809	106,751	1,669	6,411	95,516
2016	170,574	[a]	254	20,087	82,706
2017	179,897	[a]	[b]	27,315	145,287
Average	51,202	172,904	1,837	12,687	51,515
Median	39,661	128,396	1,181	7,904	35,102
Percentile rank	100%	–	–	91%	100%
Escapement goal	BEG: 18,000–40,000	–	–	SEG: 4,400–17,000	–

Note: Average, median, and percentile rank was derived from all annual escapements on record at each project except 2017, and may include escapements prior to 2000. Escapement data for all projects' entirety are archived in the Arctic-Yukon-Kuskokwim salmon database management system (http://www.adfg.alaska.gov/CommFishR3/WebSite/AYKDBMSWebsite/Default.aspx).

[a] Weir did not operate.

[b] Historical run timing indicates that more than 40% of the run was missed; annual escapement was not determined.

Table 15.–Observed, estimated, and total passage of coho salmon at Kuskokwim Area weirs, 2017.

Project Kuskokwim River tributaries	Observed passage	Estimated passage	Total passage	95% confidence interval	Percent of run missed
George River weir	21,395	3,991	25,384	24,702–26,132	8%
Kogrukluk River weir	790	–	–	–	85.70%
Tatlawiksuk River weir	1,171	–	–	–	82.50%

Note: Percent of run missed was determined by calculating the current years run timing, then using similar historical run timings to determine the percent of the run missed on each day of missed passage.

Table 16.–Annual escapement of coho salmon past Kuskokwim Area weir projects, 2000–2017.

	Kuskokwim Bay	Kuskokwim River		
Year	Middle Fork Goodnews River	George River	Kogrukluk River	Tatlawiksuk River
2000	[a]	11,269	33,063	[a]
2001	18,300	16,724	19,983	[a]
2002	27,643	6,759	14,515	11,156
2003	52,504	32,873	74,915	[a]
2004	42,049	12,499	26,078	16,446
2005	20,168	8,294	25,407	7,076
2006	26,909	12,705	16,268	[a]
2007	19,442	28,398	26,423	8,500
2008	37,690	21,931	29,237	11,022
2009	19,123	12,490	22,289	10,148
2010	26,287	12,639	14,689	3,773
2011	24,668	29,120	21,800	14,184
2012	[a]	14,478	13,421	8,015
2013	[a]	15,308	21,207	12,764
2014	[a]	35,771	52,975	19,814
2015	[a]	35,812	32,457	17,701
2016	[a]	[a]	[a]	11,897
2017	[a]	25,348	[a]	[a]
Average	26,634	18,076	23,644	11,151
Median	25,478	13,592	21,800	11,089
Percentile rank	–	72%	–	–
Escapement goal	SEG: >12,000	–	SEG: 13,000–28,000	–

Note: Average, median, and percentile rank was derived from all annual escapements on record at each project except 2017, and may include escapements prior to 2000. Escapement data for all projects' entirety are archived in the Arctic-Yukon-Kuskokwim salmon database management system (http://www.adfg.alaska.gov/CommFishR3/WebSite/AYKDBMSWebsite/Default.aspx).

[a] Historical run timing indicates that more than 40% of the run was missed; annual escapement was not determined.

Table 17.–Age, sex, and length sample collection at Kuskokwim Area weir projects, 2017.

Species	Project	Season sample goal	Scales per fish sampled	Season total number of samples collected	Dates samples collected
Chinook	Middle Fork Goodnews	230	3	240	27 June–30 July
	Salmon (Aniak)	230	3	216	10 July–2 August
	George	230	3	233	2 July–14 August
	Kogrukluk	230	3	216	3 July–24 July
	Tatlawiksuk	230	3	139	30 June–24 July
	Takotna	230	3	147	3 July–1 August
	Salmon (Pitka Fork)	250	3	172	14 July–31 July
Chum	Middle Fork Goodnews	400	1	608	1 July–30 July
	Salmon (Aniak)	400	1	345	6 July–2 August
	George	400	1	414	2 July–14 August
	Kogrukluk	600	1	387	2 July–24 July
	Tatlawiksuk	400	1	400	29 June–3 August
Sockeye	Middle Fork Goodnews	400	3	614	27 June–29 July
	Kogrukluk [a]	250	0	163	4 July–24 July
	Telaquana [a]	250	0	495	13 July–10 August
Coho	George	400	3	187	14 August–6 September
	Kogrukluk	400	3	40	23 August–24 August
	Tatlawiksuk	400	3	5	11 August–12 August

[a] Only length and sex information was collected from sockeye salmon at Kogrukluk and Telaquana river weirs in 2017.

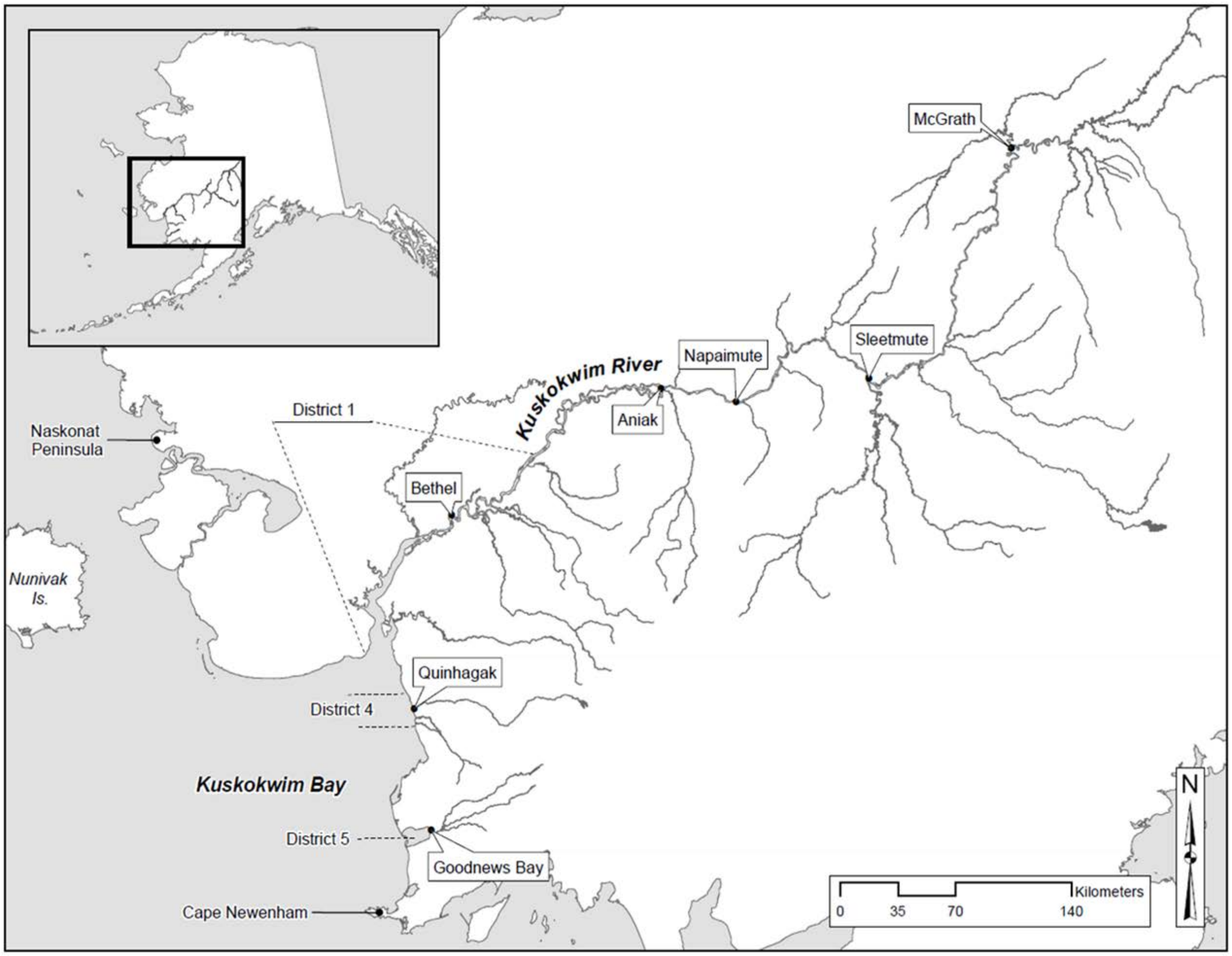

Figure 1.–The Kuskokwim Management Area, including Kuskokwim Bay, the Kuskokwim River, and select commercial fishing districts.

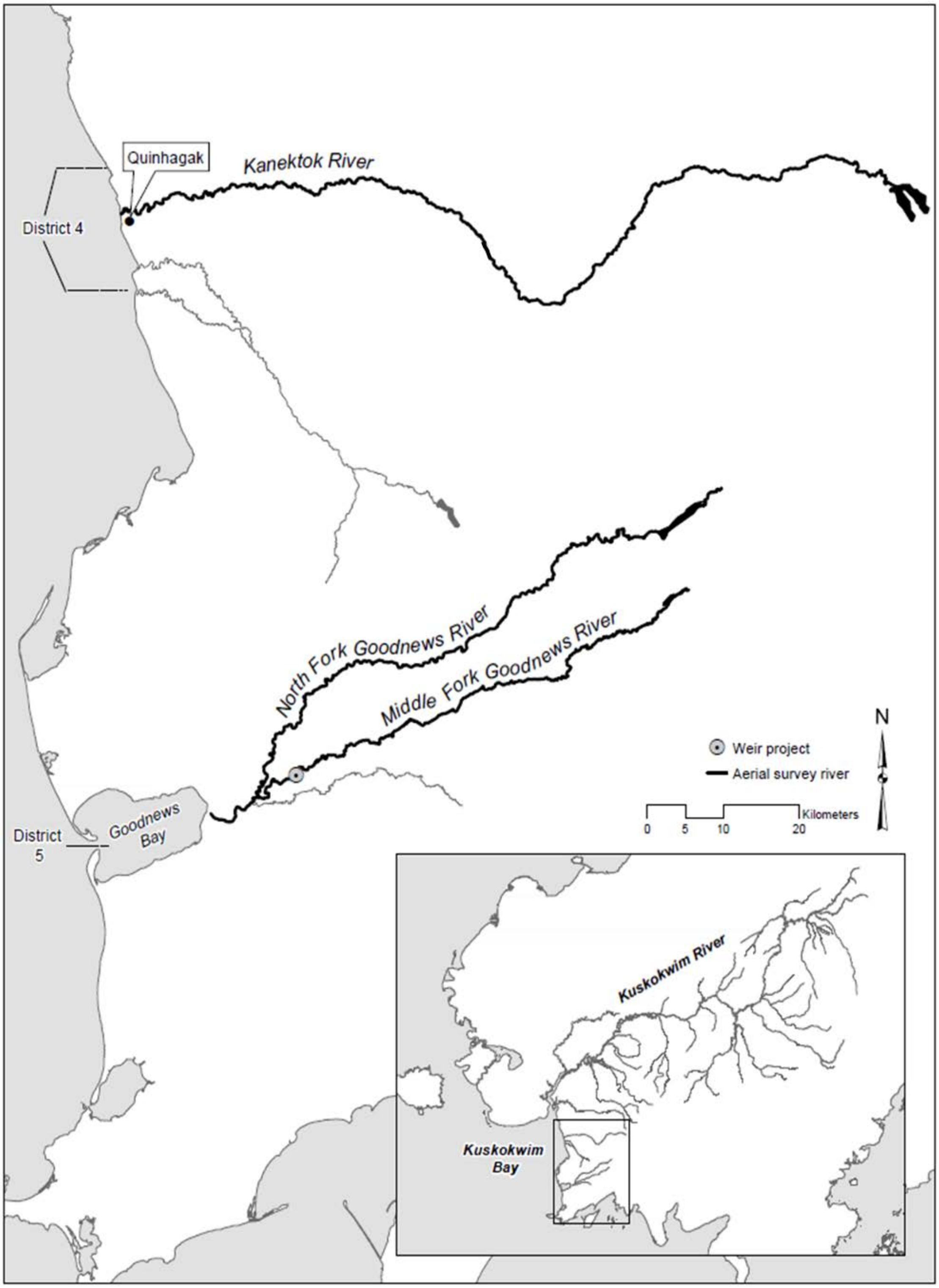

Figure 2.–Kuskokwim Bay rivers where salmon escapement monitoring was planned in 2017.

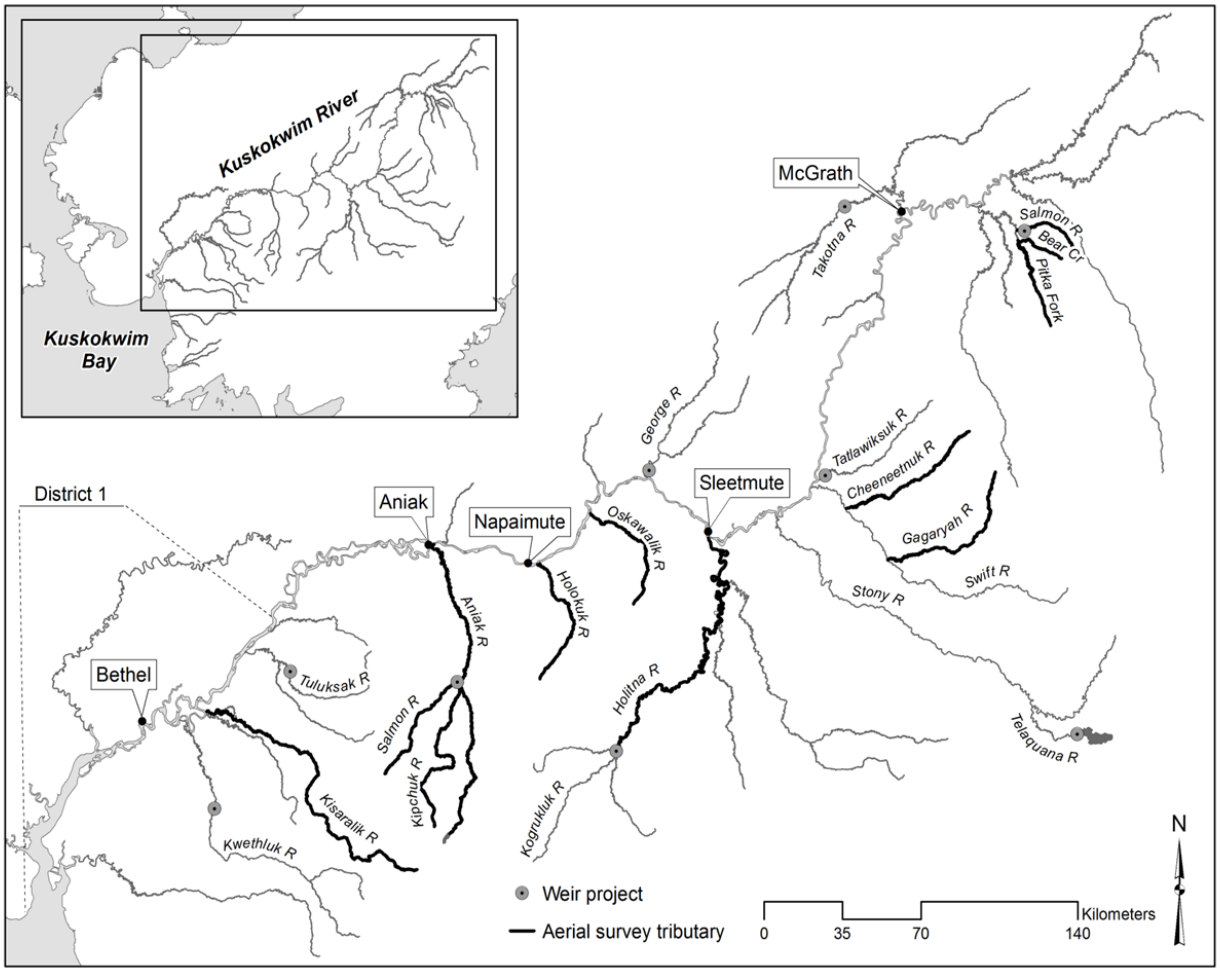

Figure 3.–Kuskokwim River tributaries where salmon escapement was monitored by ADF&G and partners, 2017.

Note: Kwethluk and Tuluksak river weirs are operated by the U.S. Fish and Wildlife Service and are displayed to show all active salmon monitoring projects in the Kuskokwim River.

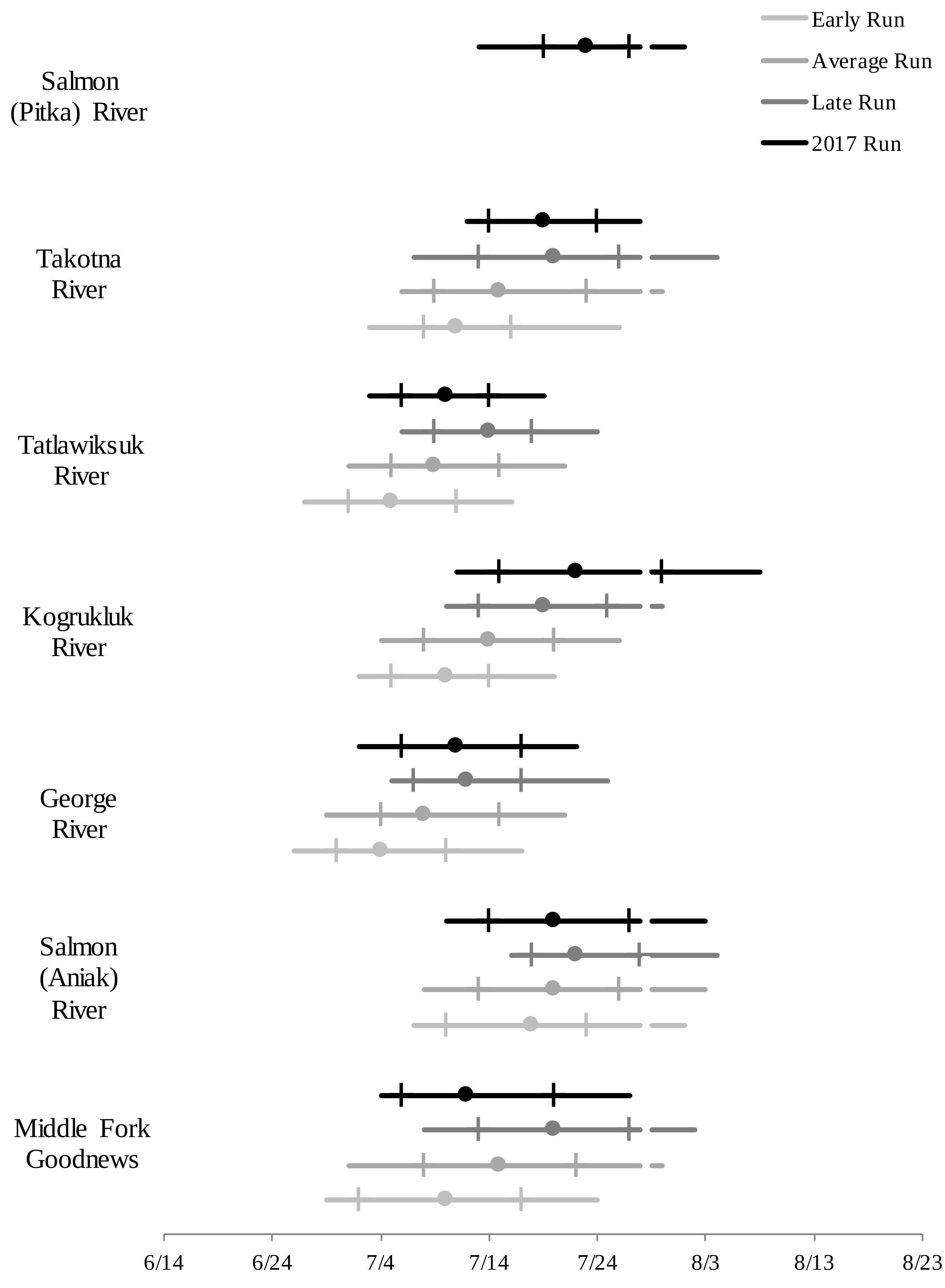

Figure 4.–Early, average, late, and 2017 run timings of Chinook salmon at Kuskokwim Area weirs.

Note: Lines represent the central 80% of the salmon run with the 25th and 75th percentile represented as vertical bars and the median with a solid circle. Salmon (Pitka) River only has 3 years of data, so early, average, and late runs were not calculated.

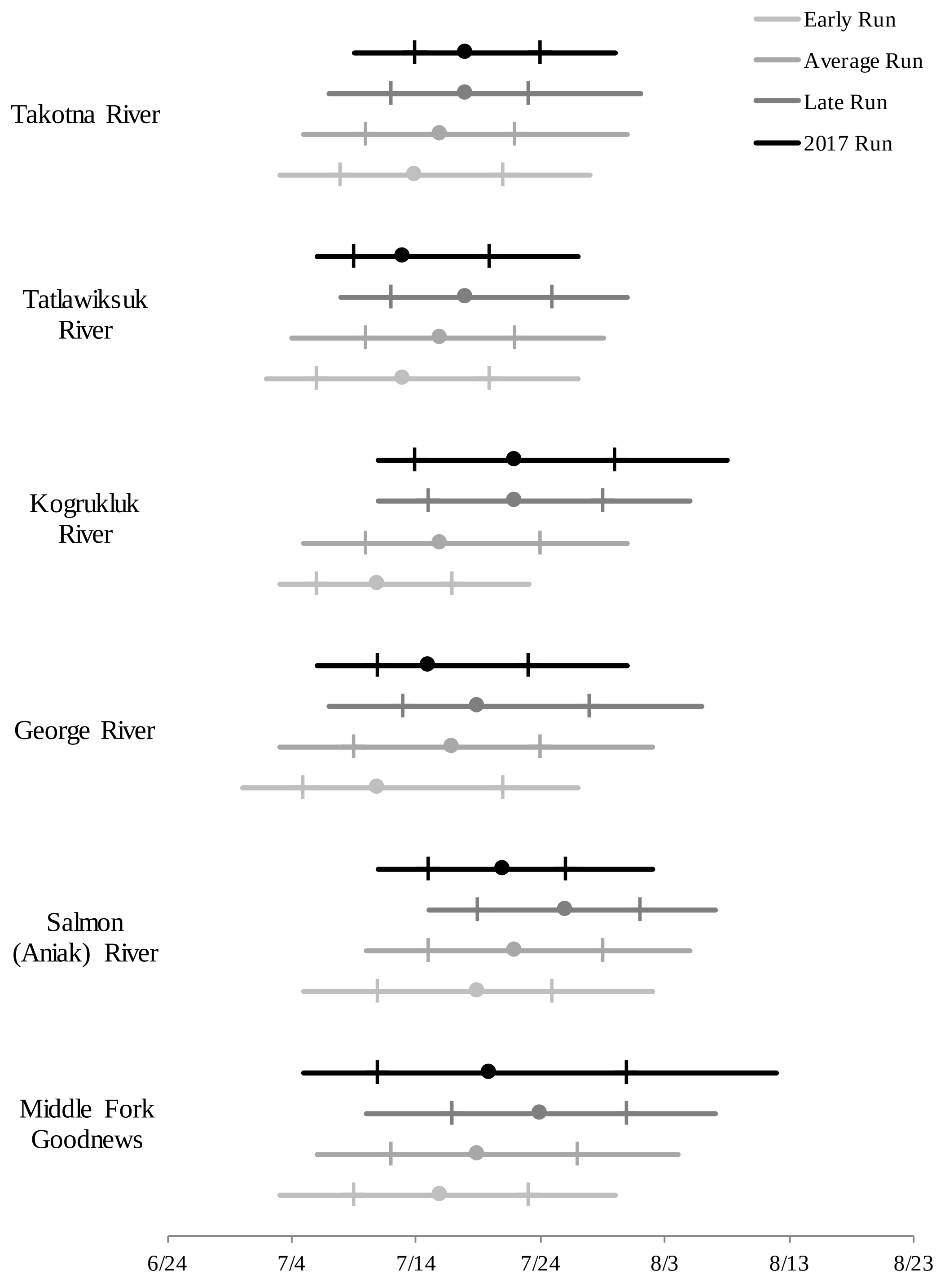

Figure 5.–Early, average, late, and 2017 run timings of chum salmon at Kuskokwim Area weirs.

Note: Lines represent the central 80% of the salmon run with the 25th and 75th percentile represented as vertical bars and the median with a solid circle.

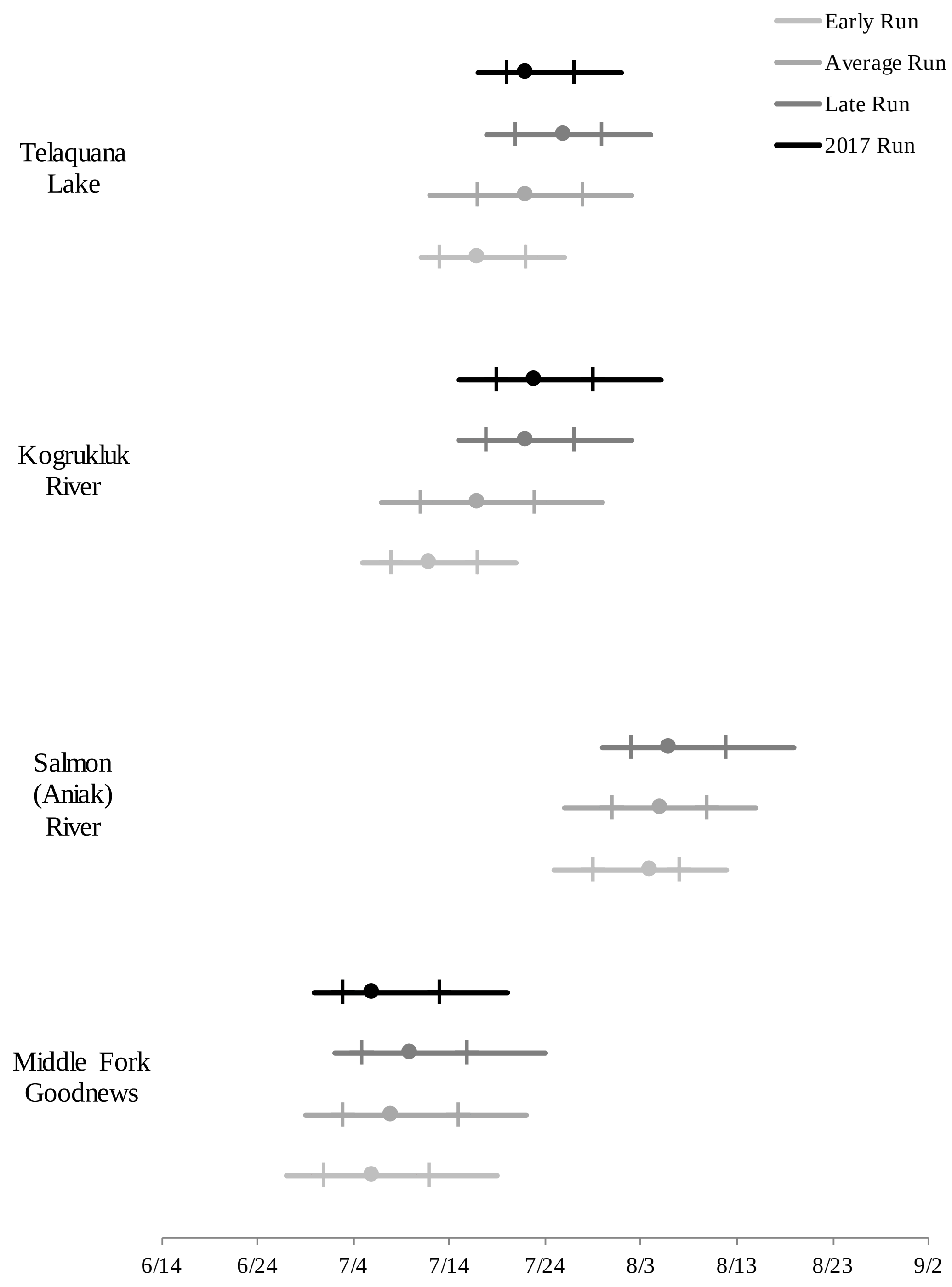

Figure 6.–Early, average, late, and 2017 run timings of sockeye salmon at Kuskokwim Area weirs.

Note: Lines represent the central 80% of the salmon run with the 25th and 75th percentile represented as vertical bars and the median with a solid circle. Salmon (Aniak) River run timing was unavailable for 2017 because too much of the run was missed.

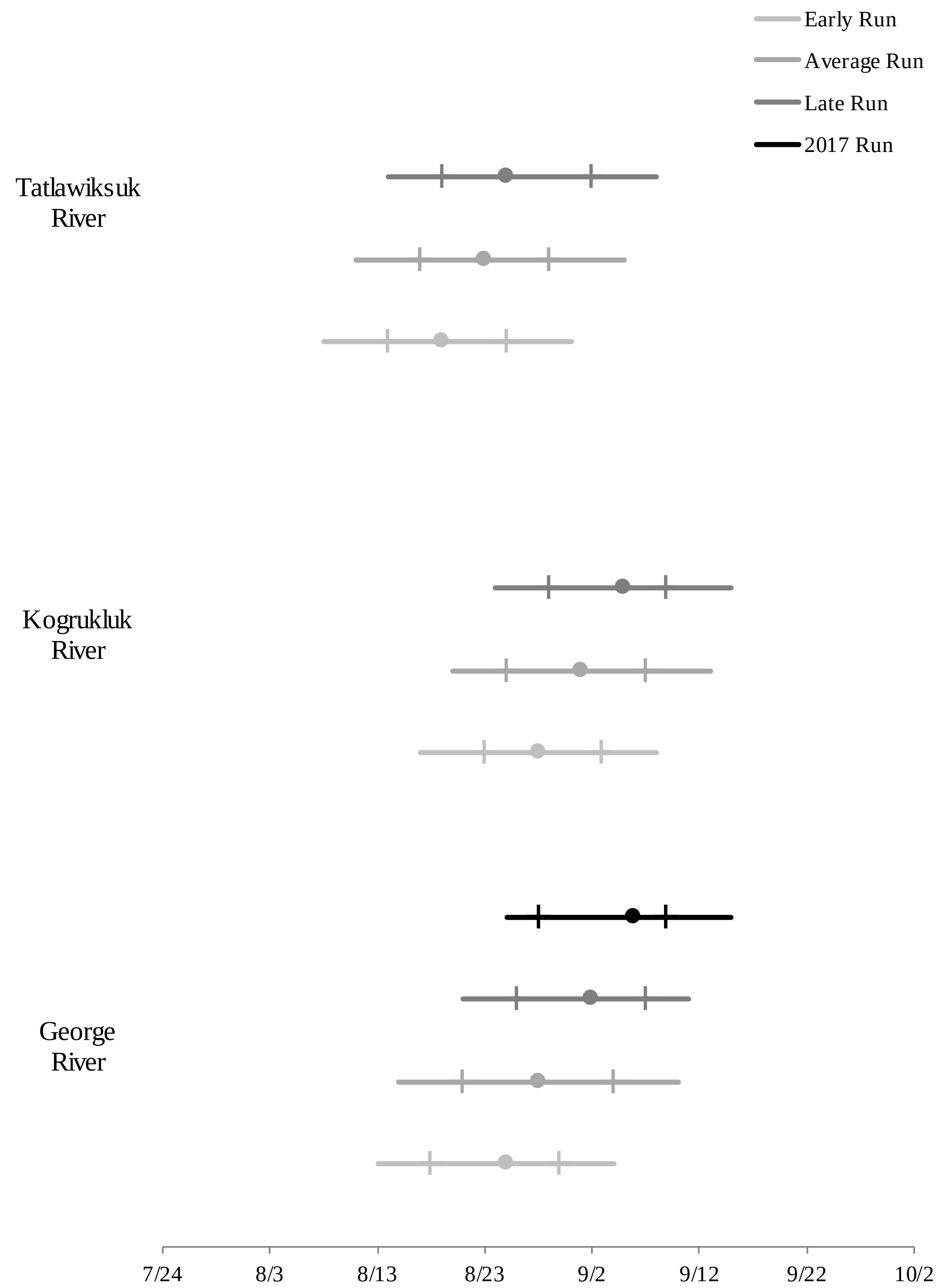

Figure 7.–Early, average, late, and 2017 run timings of coho salmon at Kuskokwim Area weirs.

Note: Lines represent the central 80% of the salmon run with the 25th and 75th percentile represented as vertical bars and the median with a solid circle. Kogrukluk and Tatlawiksuk rivers do not have 2017 run timing information because too much of the run was missed to determine run timing.

APPENDIX A

Appendix A1.–Index areas and objectives for survey rivers in the Kuskokwim Area.

River	Index areas[a]	Description/Landmark	Index objective[b]
North Fork Goodnews R.[c]	101 (59.17.55 N, 161.15.62 W)	Approx. 1 mi. upstream of confluence w/ Goodnews Bay	Chinook: 101, 102, 103 Sockeye: 101,102,103,104
	102 (59.27.00 N, 160.47.09 W)	Confluence w/ Slate Cr.	
	103 (59.28.57 N, 160.35.13 W)	Confluence w/ Nimgun Cr.	
	104 (59.28.56 N, 160.35.16 W)	Outlet of Goodnews Lake (survey lake and river at East end of Lakes	
	STOP (59.31.69 N, 160.28.23 W)	Approx. 3 mi. up river at East end of Goodnews Lake (Goodnews to Igmiumanik R)	
Middle Fork Goodnews R.[c]	101 (29.07.77 N, 161.28.00 W)	Confluence w/ Goodnews R.	Chinook: 101, 103, 104 Sockeye: 101,102,103,104
	102 (59.21.30 N, 160.41.11 W)	Confluence w/ North Lake Cr.	
	102 STOP (59.24.63 N, 160.35.74 W)	Outlet of North L. (Survey lake and creek at East end of lake)	
	103 (59.21.30 N, 160.41.11 W)	Confluence between North L., North Lake Cr., and M.F. Goodnews River	
	103 STOP (59.23.56 N, 160.34.25 W)	Outlet of M.F. Lake (Survey lake and creek at East end of lake)	
	104 (59.17.65 N, 160.51.15 W)	Confluence w/ Kukaktlik R.	
	104 STOP (59.20.17 N, 160.29.72 W)	Outlet of Kukatlim L. (Survey lake and all connected outlying lakes)	
Kanektok R.[c]	101 (59.44.90 N, 161.55.75 W)	Confluence w/ Kuskokwim Bay	Chinook: 101, 102, 103 Sockeye: 101, 102, 103, 104
	102 (59.42.54 N, 160.58.40 W)	Confluence w/ Nukluk Cr.	
	103 (59.52.28 N, 160.28.37 W)	Confluence w/ Kanuktik Cr.	
	104 (59.52.49 N, 160.07.35 W)	Outlet of Kagati/Pegati Lakes (survey lakes and creeks at South ends of lakes)	
	105 (59.53.50 N, 160.17.07 W)	Small chain of lakes west of Katati/Pegati L.	
	Supp. (59.44.28 N, 160.19.64 W)	Kanuktik Cr. and Kanuktik Lake	

-continued-

River	Index areas[a]	Description/Landmark	Index objective[b]
Kisaralik R.	101 (60.51.43 N, 161.14.31 W)	Confluence w/ Kuskokwim R.	102, 103
	102 (60.44.52 N, 160.22.75 W)	Confluence w/ Nukluk Cr.	
	103 (60.21.11 N, 159.56.63 W)	Upper falls	
	STOP (60.20.04 N, 159.24.40 W)	Outlet of Kisaralik Lake	
Aniak R.	101 (61.34.49 N, 159.29.35 W)	Confluence w/ Kuskokwim R.	102, 103, 104
	102 (61.20.33 N, 159.13.57 W)	Confluence w/ Buckstock R.	
	103 (61.03.88 N, 159.10.93 W)	Confluence w/ Salmon R. (to West)	
	104 (60.37.44 N, 159.05.20 W)	Start of island adj. to Gemuk Mountain	
	STOP (60.29.28 N, 159.09.28 W)	Outlet of Aniak Lake	
Salmon R. (Aniak)	101 (61.03.88 N, 159.10.93 W)	Confluence w/ Aniak R.	101, 102, 103
	102 (60.57.55 N, 159.23.68 W)	Confluence w/ Dominion Cr.	
	103 (60.52.91 N, 159.31.15 W)	Confluence w/ Eagle Cr.	
	STOP (60.47.11 N, 159.32.85 W)	Confluence w/ Cripple Cr. adj. to landing strip	
Kipchuk R.	101 (61.02.66 N, 159.10.50 W)	Confluence w/ Aniak R.	101, 102, 103
	102 (60.46.67 N, 159.19.14 W)	Confluence w/ small cr. from South at beginning of Horseshoe Canyon	
	103 (60.43.44 N, 159.20.53 W)	Confluence w/ trib. from South at East bend in R.	
	STOP (60.30.83 N, 159.14.37 W)	Lake outlet at end of East Fork in upper reach	
Holokuk R.	101 (61.32.15 N, 158.35.35 W)	Confluence w/ Kuskokwim R.	101, 102, 103, 104
	102 (61.26.00 N, 158.27.07 W)	Between Ski Cr. and Gold Run Cr.	
	103 (61.21.93 N, 158.17.54 W)	Confluence w/ Chineekluk Cr.	
	104 (61.16.06 N, 158.16.86 W)	Island at confluence w/ Egozuk Cr.	
	STOP (61.12.89 N, 158.18.45 W)	Confluence w/ Boss Cr.	
	2ND STOP (61.08.62 N, 158.27.39 W)	Upper reach Tri Fork	

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Appendix A1.–Page 3 of 3.

River	Index areas[a]	Description/Landmark	Index objective[b]
Oskawalik R.	101 (61.44.30 N, 158.11.30 W)	Confluence w/ Kuskokwim R.	101, 102, 103
	102 (61.41.40 N, 157.52.47 W)	Confluence w/ 1st large South tributary	
	103 (61.38.79 N, 157.42.71 W)	Confluence w/ 1st large North tributary	
	STOP (61.32.05 N, 157.40.43 W)	Fork adjacent to Henderson Mountain	
Holitna R.	101 (61.00.95 N, 157.41.37 W)	Nogamut	102, 103
	102 (60.58.24 N, 157.40.75 W)	1 mi. above Nogamut adj. to bluff	
	103 (60.57.52 N, 157.41.59 W)	Slough/confluence w/ Kiknik Cr.	
	104 (60.51.24 N, 157.50.22 W)	Kasheglok (downstream of Chukowan/Kogrukluk R. confluence)	
	STOP (60.50.32 N, 157.50.87 W)	Kogrukluk R. weir	
Cheeneetnuk R.	101 (61.48.62 N, 156.00.64 W)	Confluence w/ Swift R.	101, 102
	102 (61.51.57 N, 155.44.49 W)	Major South tributary below 1st major hills	
	STOP (61.57.28 N, 155.18.45 W)	Confluence w/ Shoeleather Cr.	
Gagaryah R.	101 (61.37.42 N, 155.38.61 W)	Confluence w/ Swift R.	101, 102
	102 (61.39.48 N, 155.21.07 W)	Head of island adj. to 1st hills	
	STOP (61.39.30 N, 155.03.41 W)	Major fork adj. to high hills	
Salmon R. (Pitka Fork)	101 (62.53.45 N, 154.34.86 W)	Salmon R. index area 101 start	102, 103, 104
	102 (62.53.37 N, 154.30.49 W)	Salmon R. index area 102/104 start	
	102 STOP (62.55.02 N, 154.17.08 W)	Salmon R. index area 102 stop	
	103 (62.53.11 N, 154.28.93 W)	Salmon R. index area 103 start	
	103 STOP (62.51.62 N, 154.19.82 W)	Salmon R. index area 103 end	
	104 (62.52.03 N, 154.30.27 W)	Salmon R. index area 103 start	
	104 STOP (62.51.00 N, 154.19.28 W)	Salmon R. index area 104 end	
Bear Cr.	101 (62.51.08N, 154.32.94 W)	Mouth of Bear Creek	101
	STOP (62.48.24 N, 154.13.66 W)	Headwaters of Bear Cr.	

[a] Parenthesis following the index areas contain the start point in latitude and longitude (degrees.minutes.seconds). Index area stop points coincide with the following sequential index area start point unless otherwise designated. For the last index area of a stream, the stop point is designated with STOP.

[b] The index objective defines the specific index area(s) that must be to surveyed in order to produce a comparable index of escapement. Index objectives are for all target species unless otherwise noted.

[c] Index areas may include lakes. Lakes are not surveyed for Chinook salmon even if the index area is required for the index objective.

APPENDIX B

Appendix B1.–Daily weather and stream observations at the Middle Fork Goodnews River weir, 2017.

		Sky	Precipitation	Temperature (°C)		River
Date	Time	conditions[a]	(mm)	Air	Water	stage (cm)
6/23	AM	4	0.0	10	10	–
6/24	AM	4	0.0	12	9	49
6/25	AM	4	0.0	9	9	48
6/26	AM	4	1.3	10	9	47
6/27	AM	4	3.8	10	8	49
6/28	AM	4	1.0	9	8	52
6/29	AM	4	1.3	12	8	52
6/30	AM	4	7.1	11	9	51
7/1	AM	4	3.0	13	9	50
7/2	AM	4	0.5	12	10	49
7/3	AM	4	4.3	10	8	50
7/4	AM	1	0.8	15	9	52
7/5	AM	3	0.0	15	11	49
7/6	AM	1	0.0	14	10	48
7/7	AM	1	0.0	12	11	46
7/8	AM	2	0.0	13	11	44
7/9	AM	4	0.0	14	11	43
7/10	AM	4	3.6	12	9	44
7/11	AM	2	0.8	12	10	46
7/12	AM	1	0.0	14	11	44
7/13	AM	1	0.0	11	9	42
7/14	AM	4	1.5	11	12	40
7/15	AM	4	0.8	12	10	42
7/16	AM	3	0.3	12	10	41
7/17	AM	4	2.5	13	12	40
7/18	AM	4	10.7	10	10	44
7/19	AM	4	5.1	10	9	47
7/20	AM	3	0.5	13	10	46
7/21	AM	3	0.0	19	13	43
7/22	AM	5	0.0	12	12	44
7/23	AM	4	0.0	11	12	43
7/24	AM	4	3.6	10	12	42
7/25	AM	4	10.2	13	10	49
7/26	AM	4	0.8	13	11	49
7/27	AM	2	0.0	16	11	46
7/28	AM	4	5.1	12	11	45
7/29	AM	4	3.8	11	11	48
7/30	AM	5	0.0	10	10	46
7/31	AM	4	0.0	12	12	44
8/1	AM	4	3.8	13	12	45
8/2	AM	4	12.7	12	12	45
8/3	AM	4	31.8	13	12	60
Average	–	–	2.9	12.0	10.3	46.3

[a] Sky condition codes:

1 = clear or mostly clear; <10% cloud cover

2 = partly cloudy; <50% cloud cover

3 = mostly cloudy; >50% cloud cover

4 = complete overcast

5 = thick fog

Appendix B2.–Daily weather and stream observations at the Salmon River (Aniak) weir, 2017.

		Sky	Precipitation	Temperature (°C)		River	Water
Date	Time	conditions[a]	(mm)	Air	Water	stage (cm)	clarity[b]
6/28	PM	4	0.0	–	–	16	1
6/29	AM	4	0.5	12	10	16	1
6/29	PM	4	0.1	15	11	16	1
6/30	AM	3	0.5	13	10	16	1
6/30	PM	4	0.1	15	12	16	1
7/1	AM	4	0.0	13	11	15	1
7/1	PM	4	0.5	17	13	15	1
7/2	AM	3	0.2	11	12	15	1
7/2	PM	2	0.0	20	15	14	1
7/3	AM	4	5.0	13	12	15	1
7/3	PM	4	1.8	14	12	16	1
7/4	AM	3	0.3	14	11	19	1
7/4	PM	3	0.0	19	14	19	1
7/5	AM	4	0.0	13	11	17	1
7/5	PM	3	0.0	22	14	16	1
7/6	AM	1	0.0	17	12	15	1
7/6	PM	1	0.0	23	16	15	1
7/7	AM	1	0.0	15	13	14	1
7/7	PM	4	0.0	19	14	14	1
7/8	AM	1	0.0	15	12	14	1
7/8	PM	3	0.0	20	15	14	1
7/9	AM	4	1.4	13	12	14	2
7/9	PM	4	16.5	12	12	15	2
7/10	AM	4	5.6	12	11	22	3
7/10	PM	2	0.3	16	13	22	3
7/11	AM	1	0.0	13	11	19	2
7/11	PM	2	0.0	21	15	18	1
7/12	AM	3	0.0	17	12	16	1
7/12	PM	3	0.0	22	15	16	1
7/13	AM	3	0.0	16	13	15	1
7/13	PM	3	0.0	22	15	15	1
7/14	AM	3	0.0	17	13	14	1
7/14	PM	3	2.4	20	15	15	1
7/15	AM	4	1.8	14	13	16	1
7/15	PM	4	0.7	14	13	16	1
7/16	AM	4	2.0	13	12	18	1

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Appendix B2.–Page 2 of 3.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River stage (cm)	Water clarity[b]
7/16	PM	3	0.0	17	13	18	1
7/17	AM	3	0.0	14	12	17	1
7/17	PM	3	0.0	18	13	16	1
7/18	AM	4	8.0	14	12	18	1
7/18	PM	4	7.0	13	12	19	1
7/19	AM	4	3.6	13	11	23	2
7/19	PM	2	0.6	18	14	23	2
7/20	AM	3	0.0	15	12	23	2
7/20	PM	4	0.0	27	15	22	1
7/21	AM	1	1.2	18	13	22	1
7/21	PM	1	0.0	23	15	22	1
7/22	AM	1	0.0	23	14	21	1
7/22	PM	1	0.0	26	18	21	1
7/23	AM	1	0.0	20	14	20	1
7/23	PM	3	0.0	24	17	19	1
7/24	AM	4	8.0	14	13	20	1
7/24	PM	4	1.2	17	14	21	1
7/25	AM	4	7.0	14	12	22	1
7/25	PM	4	1.6	15	14	22	1
7/26	AM	4	17.0	13	12	26	3
7/26	PM	3	0.6	17	14	26	3
7/27	AM	1	0.0	15	12	26	2
7/27	PM	3	0.0	19	14	26	2
7/28	AM	4	7.0	14	12	26	2
7/28	PM	4	0.0	15	12	27	2
7/29	AM	4	0.5	13	11	28	2
7/29	PM	4	0.0	17	12	28	2
7/30	AM	4	0.0	15	12	28	2
7/30	PM	2	0.0	21	14	28	2
7/31	AM	3	8.0	15	12	27	2
7/31	PM	4	0.7	16	12	27	2
8/1	AM	2	2.4	17	11	28	2
8/1	PM	4	0.5	16	12	28	2
8/2	AM	4	6.0	14	11	29	2
8/2	PM	4	4.0	15	12	29	2
8/3	AM	4	2.4	16	11	36	3

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Appendix B2.–Page 3 of 3.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C)		River stage (cm)	Water clarity[b]
				Air	Water		
8/3	PM	4	2.2	17	13	36	3
8/4	AM	2	3.6	15	13	36	3
8/4	PM	4	0.7	18	14	36	3
8/5	AM	1	0.0	18	13	35	3
8/5	PM	2	0.0	22	15	35	3
8/6	AM	1	0.0	14	13	35	3
8/6	PM	3	0.0	24	14	35	2
8/7	AM	2	0.0	15	12	34	2
8/7	PM	2	0.0	20	14	34	2
8/8	AM	2	0.0	14	13	33	2
Average	–	–	1.6	16.7	12.9	21.8	1.6

[a] Sky condition codes:
1 = clear or mostly clear; <10% cloud cover
2 = partly cloudy; <50% cloud cover
3 = mostly cloudy; >50% cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:
1 = visibility greater than 1 meter
2 = visibility between 0.5 and 1 meter
3 = visibility less than 0.5 meter

Appendix B3.–Daily weather and stream observations at the George River weir, 2017.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
6/14	AM	1	0.0	10	11	–	1
6/14	PM	1	0.0	14	13	45	1
6/15	AM	1	0.0	5	13	45	1
6/15	PM	1	0.0	17	15	44	1
6/16	AM	4	0.0	13	13	42	1
6/16	PM	4	2.1	14	15	42	1
6/17	AM	3	0.0	11	14	40	1
6/17	PM	4	2.6	15	14	42	1
6/18	AM	4	6.3	10	12	47	1
6/18	PM	1	12.5	9	12	50	2
6/19	AM	4	0.5	11	12	53	3
6/19	PM	1	0.0	15	14	56	3
6/20	AM	2	0.0	10	11	55	3
6/20	PM	1	0.0	15	14	52	2
6/21	AM	1	0.0	10	12	50	2
6/21	PM	1	0.0	17	15	46	1
6/22	AM	1	0.0	10	14	46	1
6/22	PM	4	0.0	14	16	45	1
6/23	AM	5	2.2	12	15	45	1
6/23	PM	1	0.0	16	15	44	1
6/24	AM	1	1.0	15	14	44	1
6/24	PM	3	0.0	15	15	45	1
6/25	AM	3	0.0	16	15	45	1
6/25	PM	1	0.0	19	16	43	1
6/26	AM	4	0.0	11	14	43	1
6/26	PM	4	0.0	13	15	43	1
6/27	AM	4	0.1	11	12	42	1
6/27	PM	4	0.1	14	13	42	1
6/28	AM	4	0.1	10	12	42	1
6/28	PM	4	0.0	13	12	42	1
6/29	AM	4	0.5	11	12	42	1
6/29	PM	4	1.2	15	13	42	1
6/30	AM	4	0.1	13	12	42	1
6/30	PM	4	0.0	14	13	42	1
7/1	AM	3	0.0	13	12	42	1
7/1	PM	3	0.0	19	13	41	1
7/2	AM	3	0.0	15	13	41	1
7/2	PM	3	0.0	20	16	40	1
7/3	AM	4	0.0	14	15	40	1

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Appendix B3.–Page 2 of 5.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
7/3	PM	4	0.0	15	15	39	1
7/4	AM	4	0.0	14	14	40	1
7/4	PM	4	0.0	14	15	40	1
7/5	AM	4	0.0	13	14	40	1
7/5	PM	4	0.0	22	17	41	1
7/6	AM	1	0.0	19	17	40	1
7/6	PM	1	0.0	23	17	40	1
7/7	AM	1	0.0	16	16	38	1
7/7	PM	3	0.0	16	16	38	1
7/8	AM	5	0.0	10	14	38	1
7/8	PM	2	0.0	15	16	37	1
7/9	AM	4	3.0	12	14	37	1
7/9	PM	4	36.0	16	17	48	3
7/10	AM	3	0.0	7	10	70	3
7/10	PM	3	0.2	17	11	81	3
7/11	AM	1	0.0	14	11	65	2
7/11	PM	4	0.0	16	11	61	2
7/12	AM	3	0.0	16	13	53	1
7/12	PM	3	0.0	25	15	51	2
7/13	AM	3	0.0	18	14	50	1
7/13	PM	1	0.0	21	17	48	1
7/14	AM	2	0.0	12	15	48	1
7/14	PM	1	30.0	22	17	48	1
7/15	AM	3	0.0	12	15	50	1
7/15	PM	3	0.0	16	15	50	1
7/16	AM	4	0.0	13	14	48	1
7/16	PM	4	0.0	19	15	48	1
7/17	AM	2	0.0	13	12	47	1
7/17	PM	4	0.0	16	14	46	1
7/18	AM	3	8.2	14	13	46	1
7/18	PM	4	1.4	18	18	47	1
7/19	AM	4	2.4	11	12	48	1
7/19	PM	3	0.0	19	14	50	1
7/20	AM	1	0.2	16	13	50	1
7/20	PM	4	20.0	18	16	48	1
7/21	AM	4	0.5	15	15	47	1
7/21	PM	1	0.0	24	17	47	1
7/22	AM	1	0.0	–	–	46	1
7/22	PM	1	0.0	–	–	46	1
7/23	AM	3	0.0	–	–	44	1

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Appendix B3.–Page 3 of 5.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
7/23	PM	3	0.0	22	17	43	1
7/24	AM	4	2.0	18	15	41	1
7/24	PM	4	0.0	14	15	41	1
7/25	AM	4	2.0	15	15	42	1
7/25	PM	4	0.6	15	14	43	1
7/26	AM	4	7.5	15	13	46	1
7/26	PM	3	0.2	15	12	46	1
7/27	AM	1	1.0	19	17	53	2
7/27	PM	3	0.0	21	15	53	2
7/28	AM	4	3.4	16	18	53	2
7/28	PM	4	0.6	14	12	54	2
7/29	AM	4	1.2	18	17	56	2
7/29	PM	3	0.2	15	12	54	2
7/30	AM	2	0.0	9	11	55	1
7/30	PM	3	0.0	18	14	51	1
7/31	AM	2	0.0	13	13	51	1
7/31	PM	4	0.0	14	13	50	1
8/1	AM	4	1.7	14	12	48	1
8/1	PM	4	15.0	18	17	50	1
8/2	AM	4	5.6	13	11	54	1
8/2	PM	4	9.5	19	17	74	3
8/3	AM	4	2.8	14	11	90	3
8/3	PM	4	6.5	19	11	102	3
8/4	AM	4	0.0	14	12	–	3
8/4	PM	4	0.3	13	11	–	3
8/5	AM	4	0.0	10	9	–	3
8/5	PM	1	0.0	16	12	–	3
8/6	AM	1	0.0	17	11	–	3
8/6	PM	4	0.0	24	11	–	3
8/7	AM	5	0.0	23	12	–	3
8/7	PM	3	0.0	16	11	–	3
8/8	AM	1	0.0	18	11	–	3
8/8	PM	3	1.2	13	11	–	3
8/9	AM	4	0.8	19	10	90	3
8/9	PM	4	0.0	17	11	88	3
8/10	AM	3	0.0	11	9	85	2
8/10	PM	2	2.5	18	10	84	2
8/11	AM	5	0.2	7	9	80	2
8/11	PM	4	0.0	12	10	80	2
8/12	AM	4	0.0	11	10	77	1

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
8/12	PM	4	3.0	10	9	74	1
8/13	AM	4	0.5	9	9	71	1
8/13	PM	4	0.0	12	10	71	1
8/14	AM	4	6.0	10	9	71	1
8/14	PM	4	1.0	11	9	90	2
8/15	AM	5	0.0	9	7	91	2
8/15	PM	4	4.1	13	9	89	2
8/16	AM	4	5.4	8	8	80	2
8/16	PM	4	8.0	9	9	80	2
8/17	AM	5	4.8	8	6	84	2
8/17	PM	4	0.6	8	6	86	2
8/18	AM	5	0.0	6	6	89	2
8/18	PM	4	0.0	8	8	89	2
8/19	AM	5	0.0	7	6	86	2
8/19	PM	3	0.0	12	9	82	2
8/20	AM	4	0.0	3	6	82	2
8/20	PM	1	1.2	11	7	81	2
8/21	AM	2	0.0	5	7	80	2
8/21	PM	1	0.0	10	8	78	2
8/22	AM	5	0.0	8	8	76	2
8/22	PM	4	1.0	11	8	74	2
8/23	AM	4	2.0	9	8	73	2
8/23	PM	4	8.2	10	8	75	2
8/24	AM	5	4.0	9	7	80	2
8/24	PM	4	5.0	10	6	86	2
8/25	AM	4	0.7	8	7	92	2
8/25	PM	4	3.9	12	8	90	3
8/26	AM	4	0.5	9	8	87	3
8/26	PM	2	0.6	13	8	91	3
8/27	AM	3	1.0	8	8	96	3
8/27	PM	2	0.3	14	9	101	3
8/28	AM	5	0.0	3	8	101	3
8/28	PM	1	0.0	17	9	96	3
8/29	AM	3	0.0	8	7	94	3
8/29	PM	4	7.8	7	6	93	3
8/30	AM	4	2.0	6	7	94	3
8/30	PM	4	6.2	5	6	98	3
8/31	AM	4	1.4	4	6	101	3
8/31	PM	4	4.0	7	5	101	3
9/1	AM	3	1.0	4	5	100	3

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Appendix B3.–Page 5 of 5.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River stage (cm)	Water clarity[b]
9/1	PM	3	0.0	9	5	100	3
9/2	AM	3	0.0	4	5	98	3
9/2	PM	4	3.0	7	5	98	3
9/3	AM	4	0.5	5	5	97	3
9/3	PM	3	0.0	8	5	97	3
9/4	AM	4	0.0	4	5	97	3
9/4	PM	4	0.2	10	5	97	3
9/5	AM	4	0.0	7	6	96	3
9/5	PM	4	0.0	14	7	96	2
9/6	AM	5	6.0	9	7	96	2
9/6	PM	4	3.0	11	7	97	2
9/7	AM	3	2.0	8	7	98	2
9/7	PM	4	0.7	10	7	100	3
9/8	AM	4	3.0	8	7	100	3
9/8	PM	2	0.4	9	7	100	3
9/9	AM	4	2.0	8	7	99	3
9/9	PM	2	0.5	8	7	98	3
9/10	AM	3	0.0	7	7	98	3
9/10	PM	3	0.0	7	7	98	3
9/11	AM	4	0.0	5	6	98	3
9/11	PM	4	0.2	11	6	97	3
9/12	AM	4	0.5	9	6	97	3
9/12	PM	4	3.4	10	6	97	3
9/13	AM	4	6.0	10	7	98	3
9/13	PM	4	7.5	10	7	102	3
9/14	AM	4	2.0	10	7	–	3
9/14	PM	3	0.7	11	7	–	3
9/15	AM	4	0.2	9	7	–	3
9/15	PM	4	0.2	10	7	–	3
9/16	AM	3	0.0	5	6	–	3
9/16	PM	–	–	–	–	–	
9/17	AM	2	0.0	3	6	–	3
9/17	PM	2	0.0	14	6	–	3
9/18	AM	4	3.0	9	6	–	3
9/18	PM	3	0.0	10	6	–	3
9/19	AM	3	0.0	5	7	–	3
9/19	PM	4	3.2	10	7	–	3
9/20	AM	4	11.0	–	–	105	3
9/20	PM	4	0.0	–	–	105	3
Average	–	–	1.7	12.4	10.8	65.9	1.9

[a] Sky condition codes:
1 = clear or mostly clear; <10% cloud cover
2 = partly cloudy; <50% cloud cover
3 = mostly cloudy; >50% cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:
1 = visibility greater than 1 meter
2 = visibility between 0.5 and 1 meter
3 = visibility less than 0.5 meter

Appendix B4.–Daily weather and stream observations at the Kogrukluk River weir, 2017.

		Sky	Precipitation	Temperature (°C)		River	Water
Date	Time	conditions[a]	(mm)	Air	Water	stage (cm)	clarity[b]
6/23	AM	4	0.0	14	–	252	1
6/23	PM	3	2.0	18	12	252	1
6/24	AM	1	0.2	10	9	252	1
6/24	PM	1	0.0	22	14	252	1
6/25	AM	1	0.0	11	11	252	1
6/25	PM	1	0.0	24	13	251	1
6/26	AM	4	2.2	9	10	251	1
6/26	PM	4	0.7	12	11	251	1
6/27	AM	4	1.0	11	10	250	1
6/27	PM	4	0.3	14	11	250	1
6/28	AM	4	1.0	10	9	256	1
6/28	PM	4	0.0	14	10	262	1
6/29	AM	4	1.4	11	10	271	1
6/29	PM	4	0.8	15	11	271	1
6/30	AM	4	15.0	9	8	269	1
6/30	PM	4	0.1	15	11	267	1
7/1	AM	4	0.3	12	9	265	1
7/1	PM	3	0.0	18	12	263	1
7/2	AM	3	0.0	14	0	261	1
7/2	PM	4	0.0	17	12	258	1
7/3	AM	4	7.4	13	10	261	1
7/3	PM	4	5.0	16	10	264	1
7/4	AM	3	0.6	13	9	283	1
7/4	PM	3	0.0	20	10	282	2
7/5	AM	4	0.0	11	8	276	2
7/5	PM	3	0.0	19	11	273	2
7/6	AM	1	0.0	9	7	269	1
7/6	PM	1	0.0	20	12	267	1
7/7	AM	1	0.0	9	7	265	1
7/7	PM	1	0.0	18	11	264	1
7/8	AM	1	0.0	9	8	262	1
7/8	PM	1	0.0	22	12	261	1
7/9	AM	4	0.0	10	7	260	1
7/9	PM	4	14.1	12	8	261	1

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
7/10	AM	4	6.4	10	7	266	1
7/10	PM	4	1.4	18	9	270	1
7/11	AM	2	0.0	8	8	276	1
7/11	PM	1	0.0	22	12	272	1
7/12	AM	3	0.0	15	10	277	1
7/12	PM	4	1.5	17	12	276	1
7/13	AM	3	0.0	16	9	262	1
7/13	PM	3	0.0	27	14	260	1
7/14	AM	2	0.0	18	12	259	1
7/14	PM	2	0.0	24	13	259	1
7/15	AM	2	0.0	17	12	259	1
7/15	PM	3	0.0	17	13	256	1
7/16	AM	3	0.0	12	11	256	1
7/16	PM	1	0.0	18	12	256	1
7/17	AM	2	0.0	12	10	255	1
7/17	PM	4	0.5	14	11	254	1
7/18	AM	3	3.0	13	10	255	1
7/18	PM	3	1.0	16	11	255	1
7/19	AM	4	15.0	10	9	268	1
7/19	PM	4	2.4	17	11	265	1
7/20	AM	4	2.6	12	11	275	2
7/20	PM	2	0.0	18	14	273	2
7/21	AM	1	0.0	10	8	274	2
7/21	PM	2	0.2	20	14	268	1
7/22	AM	2	0.0	11	11	268	1
7/22	PM	1	0.0	28	15	264	1
7/23	AM	–	0.0	10	8	266	1
7/23	PM	3	0.0	20	11	261	1
7/24	AM	4	0.1	11	13	267	1
7/24	PM	3	6.2	15	18	257	1
7/25	AM	4	3.2	11	11	263	1
7/25	PM	4	12.0	17	12	265	1
7/26	AM	4	12.2	11	9	306	3
7/26	PM	–	–	–	–	–	–

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
7/27	AM	1	0.0	16	13	296	3
7/27	PM	2	0.0	13	10	294	3
7/28	AM	3	2.5	11	8	289	3
7/28	PM	3	1.0	13	10	284	3
7/29	AM	3	1.5	13	12	283	3
7/29	PM	–	–	–	–	–	–
7/30	AM	–	–	–	–	–	–
7/30	PM	–	–	–	–	–	–
7/31	AM	–	–	–	–	–	–
7/31	PM	–	–	–	–	–	–
8/1	AM	–	–	–	–	–	–
8/1	PM	–	–	–	–	–	–
8/2	AM	–	–	–	–	–	–
8/2	PM	–	–	–	–	–	–
8/3	AM	–	–	–	–	–	–
8/3	PM	–	–	–	–	–	–
8/4	AM	–	–	–	–	–	–
8/4	PM	3	0.0	20	12	315	3
8/5	AM	–	–	–	–	–	–
8/5	PM	2	0.9	20	12	305	2
8/6	AM	2	0.0	14	11	300	2
8/6	PM	–	–	–	–	–	–
8/7	AM	2	0.0	13	10	295	2
8/7	PM	3	0.0	18	12	287	2
8/8	AM	3	0.0	12	10	284	1
8/8	PM	4	1.7	15	11	283	1
8/9	AM	4	4.5	13	10	284	1
8/9	PM	3	2.0	16	10	288	1
8/10	AM	3	0.0	12	10	294	1
8/10	PM	3	2.8	15	11	294	1
8/11	AM	4	0.0	10	9	292	1
8/11	PM	3	0.0	15	11	289	1
8/12	AM	4	0.0	10	11	287	1
8/12	PM	4	17.5	10	9	288	1

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Appendix B4.–Page 4 of 5.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
8/13	AM	3	2.0	7	8	297	2
8/13	PM	3	0.4	15	10	303	2
8/14	AM	4	0.0	8	8	297	2
8/14	PM	2	1.6	16	10	291	2
8/15	AM	3	0.0	10	9	287	1
8/15	PM	3	0.0	15	10	281	1
8/16	AM	4	4.8	10	9	280	1
8/16	PM	–	–	–	–	–	–
8/17	AM	3	5.5	9	8	288	2
8/17	PM	–	–	–	–	–	–
8/18	AM	3	0.0	10	8	290	2
8/18	PM	2	0.0	16	8	290	2
8/19	AM	2	0.0	11	7	284	1
8/19	PM	3	0.0	16	9	284	1
8/20	AM	4	4.2	10	8	281	1
8/20	PM	2	5.5	15	9	284	1
8/21	AM	1	0.0	7	7	289	1
8/21	PM	1	0.0	16	9	287	1
8/22	AM	3	0.0	10	7	283	2
8/22	PM	4	0.0	14	8	281	1
8/23	AM	4	4.2	10	6	279	1
8/23	PM	4	2.9	9	9	279	1
8/24	AM	4	5.8	10	8	279	1
8/24	PM	4	12.5	12	8	283	1
8/25	AM	4	4.5	10	9	294	2
8/25	PM	3	4.0	17	9	302	3
8/26	AM	3	2.0	10	9	306	3
8/26	PM	4	6.2	14	8	300	3
8/27	AM	3	7.0	9	9	298	3
8/27	PM	4	0.0	15	9	299	3
8/28	AM	3	6.0	7	8	294	2
8/28	PM	1	0.0	13	9	292	1
8/29	AM	4	1.0	5	8	290	1
8/29	PM	4	9.0	10	7	288	2

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Appendix B4.–Page 5 of 5.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
8/30	AM	4	8.0	7	7	284	1
8/30	PM	4	4.2	6	8	287	2
8/31	AM	4	6.0	6	6	290	2
8/31	PM	4	5.5	7	7	296	2
9/1	AM	1	0.5	3	6	301	2
9/1	PM	3	0.0	14	8	302	3
9/2	AM	4	10.0	7	6	296	2
9/2	PM	3	40.0	9	7	294	2
9/3	AM	4	4.0	7	7	297	2
9/3	PM	4	2.0	7	7	304	2
9/4	AM	3	41.0	8	7	301	2
9/4	PM	4	6.0	11	8	300	2
9/5	AM	5	2.0	8	7	300	2
9/5	PM	3	1.0	14	9	298	1
9/6	AM	4	85.0	10	8	298	2
9/6	PM	2	20.0	12	9	300	1
9/7	AM	4	3.0	7	7	300	1
9/7	PM	2	0.0	10	9	295	1
9/8	AM	4	5.0	7	8	292	2
9/8	PM	2	42.0	9	8	289	2
9/9	AM	4	4.0	8	7	288	2
9/9	PM	3	11.0	10	8	288	2
9/10	AM	3	0.0	8	7	287	2
9/10	PM	1	0.5	10	7	286	2
9/11	AM	4	0.5	4	6	283	2
9/11	PM	–	–	–	–	–	–
9/12	AM	4	2.0	9	7	280	2
Average	–	–	3.8	13	9	279	–

[a] Sky condition codes:
1 = clear or mostly clear; <10% cloud cover
2 = partly cloudy; <50% cloud cover
3 = mostly cloudy; >50% cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:
1 = visibility greater than 1 meter
2 = visibility between 0.5 and 1 meter
3 = visibility less than 0.5 meter

Appendix B5.–Daily weather and stream observations at the Telaquana River weir, 2017.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River stage (cm)	Water clarity[b]
7/6	AM	1	0.0	21	12	–	1
7/6	PM	3	0.0	16	15	–	1
7/7	AM	4	1.3	10	10	36	1
7/7	PM	3	4.8	17	12	37	1
7/8	AM	3	0.0	13	11	38	1
7/8	PM	4	0.3	18	12	38	1
7/9	AM	4	24.9	8	10	45	1
7/9	PM	3	1.8	13	11	45	1
7/10	AM	2	0.0	11	11	45	1
7/10	PM	2	0.0	15	12	45	1
7/11	AM	2	0.0	11	11	44	1
7/11	PM	2	0.0	19	14	44	1
7/12	AM	1	0.0	12	13	43	1
7/12	PM	1	0.0	24	15	43	1
7/13	AM	4	0.0	15	14	44	1
7/13	PM	1	0.0	25	17	44	1
7/14	AM	4	0.3	13	16	45	1
7/14	PM	4	5.8	16	16	47	1
7/15	AM	4	7.1	12	14	48	1
7/15	PM	4	1.3	13	12	49	1
7/16	AM	4	0.3	13	14	49	1
7/16	PM	4	0.0	16	15	49	1
7/17	AM	1	0.3	14	14	49	1
7/17	PM	4	0.0	15	15	50	1
7/18	AM	4	9.7	11	15	50	1
7/18	PM	4	3.3	13	15	52	1
7/19	AM	5	2.0	10	15	51	1
7/19	PM	3	0.0	15	15	51	1
7/20	AM	3	0.3	13	14	51	1
7/20	PM	2	0.0	16	16	50	1
7/21	AM	1	0.0	14	15	50	1
7/21	PM	2	0.0	19	15	49	1
7/22	AM	1	0.0	17	15	50	1
7/22	PM	1	0.0	23	16	50	1
7/23	AM	1	0.0	15	15	50	1
7/23	PM	1	0.0	23	16	49	1
7/24	AM	4	0.0	14	13	50	1
7/24	PM	4	1.8	13	13	50	1
7/25	AM	4	4.6	9	13	50	1
7/25	PM	5	1.5	12	13	50	1
7/26	AM	4	5.6	12	13	50	1
7/26	PM	4	0.5	13	14	50	1
7/27	AM	4	11.4	12	13	50	1
7/27	PM	4	15.2	13	15	51	1

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
7/28	AM	3	4.3	13	15	51	1
7/28	PM	4	11.9	13	15	50	1
7/29	AM	3	0.8	9	15	50	1
7/29	PM	3	0.0	17	15	49	1
7/30	AM	4	0.0	15	12	49	1
7/30	PM	2	0.0	21	14	48	1
7/31	AM	1	3.6	16	15	49	1
7/31	PM	4	0.0	14	16	49	1
8/1	AM	3	0.0	14	16	49	1
8/1	PM	3	0.0	14	16	48	1
8/2	AM	4	0.0	11	16	47	1
8/2	PM	5	17.8	13	16	50	1
8/3	AM	5	11.9	12	16	51	1
8/3	PM	4	7.4	14	16	52	1
8/4	AM	3	0.0	14	14	52	1
8/4	PM	3	0.0	19	16	52	1
8/5	AM	2	0.0	12	15	51	1
8/5	PM	2	0.0	24	16	51	1
8/6	AM	2	0.0	16	15	51	1
8/6	PM	2	0.0	26	17	51	1
8/7	AM	3	0.0	11	14	50	1
8/7	PM	3	0.0	17	15	50	1
8/8	AM	3	0.0	11	15	49	1
8/8	PM	4	0.5	15	15	49	1
8/9	AM	4	1.3	15	14	49	1
8/9	PM	4	0.8	16	14	49	1
8/10	AM	3	0.0	12	14	49	1
8/10	PM	3	0.0	16	14	49	1
8/11	AM	3	0.0	7	14	48	1
8/11	PM	3	0.3	17	15	46	1
8/12	AM	3	0.3	9	13	45	1
8/12	PM	4	1.8	15	13	45	1
8/13	AM	4	3.6	9	13	44	1
8/13	PM	4	2.3	10	13	45	1

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Appendix B5.–Page 3 of 3.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C)		River stage (cm)	Water clarity[b]
				Air	Water		
8/14	AM	4	3.8	9	13	45	1
8/14	PM	4	0.3	14	14	45	1
8/15	AM	4	3.6	10	13	45	1
8/15	PM	4	3.8	10	13	45	1
8/16	AM	4	8.4	8	12	45	1
8/16	PM	3	0.8	10	12	45	1
Average	–	–	2.3	14	14	48	–

[a] Sky condition codes:
1 = clear or mostly clear; <10% cloud cover
2 = partly cloudy; <50% cloud cover
3 = mostly cloudy; >50% cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:
1 = visibility greater than 1 meter
2 = visibility between 0.5 and 1 meter
3 = visibility less than 0.5 meter

Appendix B6.–Daily weather and stream observations at the Tatlawiksuk River weir, 2017.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River stage (cm)	Water clarity[b]
6/16	AM	–	–	–	–	–	–
6/16	PM	3	0.1	17	13	44	3
6/17	AM	3	0.0	11	12	43	3
6/17	PM	3	0.0	17	15	41	2
6/18	AM	2	0.0	13	12	41	2
6/18	PM	3	0.0	20	15	42	2
6/19	AM	1	2.8	12	12	44	2
6/19	PM	3	0.0	20	14	43	2
6/20	AM	1	0.3	14	12	42	2
6/20	PM	1	0.0	22	15	42	2
6/21	AM	1	0.0	15	13	40	1
6/21	PM	1	0.0	21	16	39	1
6/22	AM	1	0.0	14	13	37	1
6/22	PM	3	0.0	18	15	36	1
6/23	AM	4	2.4	11	15	36	1
6/23	PM	2	0.4	23	15	36	1
6/24	AM	1	0.0	14	13	35	1
6/24	PM	–	–	–	–	–	–
6/25	AM	2	0.0	14	14	34	1
6/25	PM	3	0.0	29	17	34	1
6/26	AM	3	0.0	12	14	34	1
6/26	PM	4	0.0	14	15	33	1
6/27	AM	4	0.0	14	13	33	2
6/27	PM	4	0.2	14	13	32	2
6/28	AM	4	4.0	11	12	32	2
6/28	PM	3	0.3	17	13	32	2
6/29	AM	4	0.0	12	12	32	2
6/29	PM	4	0.5	16	13	32	2
6/30	AM	4	0.3	12	12	32	2
6/30	PM	4	0.2	19	14	23	2
7/1	AM	4	0.0	13	12	32	2
7/1	PM	–	–	–	–	–	–
7/2	AM	3	7.4	14	13	32	1

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River stage (cm)	Water clarity[b]
7/2	PM	–	–	–	–	–	–
7/3	AM	4	0.1	14	13	34	2
7/3	PM	–	–	–	–	–	–
7/4	AM	4	0.1	14	13	34	1
7/4	PM	3	0.0	21	14	34	1
7/5	AM	4	0.0	16	13	34	1
7/5	PM	1	0.0	28	16	39	1
7/6	AM	3	0.0	17	14	38	1
7/6	PM	1	0.0	28	18	37	1
7/7	AM	3	0.0	14	15	35	1
7/7	PM	–	–	–	–	–	–
7/8	AM	3	0.0	12	14	34	1
7/8	PM	–	–	–	–	–	–
7/9	AM	4	16.0	11	14	33	1
7/9	PM	2	12.5	15	14	35	1
7/10	AM	3	0.3	12	12	36	2
7/10	PM	2	0.0	23	15	50	2
7/11	AM	2	0.2	15	13	52	3
7/11	PM	2	0.0	23	15	52	3
7/12	AM	4	0.0	18	14	50	2
7/12	PM	3	0.0	26	16	46	2
7/13	AM	3	0.0	21	15	42	2
7/13	PM	2	0.0	30	17	42	2
7/14	AM	3	0.0	17	16	40	2
7/14	PM	3	2.2	25	17	39	3
7/15	AM	3	0.2	16	15	38	1
7/15	PM	4	0.0	19	17	37	1
7/16	AM	4	0.0	14	14	37	1
7/16	PM	4	0.0	26	17	36	1
7/17	AM	1	0.0	14	14	36	1
7/17	PM	4	0.0	18	15	36	1
7/18	AM	4	9.0	13	14	35	1
7/18	PM	4	2.2	14	14	36	1
7/19	AM	4	6.0	13	13	38	2

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Appendix B6.–Page 3 of 6.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
7/19	PM	3	0.2	22	15	41	2
7/20	AM	4	0.0	14	13	45	2
7/20	PM	–	–	–	–	–	–
7/21	AM	3	0.0	16	15	45	2
7/21	PM	2	0.0	28	18	43	2
7/22	AM	1	0.0	14	15	41	1
7/22	PM	1	0.0	29	19	40	1
7/23	AM	1	0.0	16	16	38	1
7/23	PM	–	–	–	–	–	–
7/24	AM	4	5.5	13	16	36	1
7/24	PM	4	1.0	14	15	34	1
7/25	AM	4	0.0	13	14	34	2
7/25	PM	4	10.0	14	13	37	2
7/26	AM	4	8.5	13	12	40	2
7/26	PM	3	3.2	17	14	43	2
7/27	AM	3	0.3	14	13	50	3
7/27	PM	3	0.0	22	15	53	3
7/28	AM	4	1.8	14	13	54	3
7/28	PM	4	0.9	16	13	53	3
7/29	AM	4	1.0	12	12	50	2
7/29	PM	–	–	–	–	–	–
7/30	AM	3	0.0	11	12	47	2
7/30	PM	1	0.0	25	15	46	2
7/31	AM	3	0.0	15	13	44	2
7/31	PM	4	0.0	18	14	43	2
8/1	AM	4	1.0	12	12	46	2
8/1	PM	4	0.0	16	13	49	3
8/2	AM	4	12.5	12	11	48	3
8/2	PM	4	7.8	14	11	49	3
8/3	AM	4	17.0	13	11	58	3
8/3	PM	4	10.0	15	11	72	3
8/4	AM	2	4.8	13	10	91	3
8/4	PM	–	–	–	–	112	3
8/5	AM	2	0.0	13	11	112	3

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
8/5	PM	1	0.0	29	13	111	3
8/6	AM	1	0.0	19	12	105	3
8/6	PM	3	0.0	24	13	101	3
8/7	AM	2	0.0	14	11	96	3
8/7	PM	2	0.0	24	15	91	2
8/8	AM	2	0.0	10	11	89	2
8/8	PM	3	0.0	21	13	85	2
8/9	AM	4	1.5	15	11	81	2
8/9	PM	4	0.1	19	12	81	2
8/10	AM	4	3.0	9	10	76	2
8/10	PM	3	0.2	19	13	74	2
8/11	AM	5	1.8	2	9	74	1
8/11	PM	4	0.1	19	11	72	1
8/12	AM	3	0.0	7	10	71	1
8/12	PM	4	0.0	14	10	70	1
8/13	AM	4	0.0	9	9	68	1
8/13	PM	4	13.5	12	9	68	1
8/14	AM	4	11.0	11	8	79	2
8/14	PM	3	0.3	16	10	98	–
8/15	AM	–	–	–	–	–	–
8/15	PM	–	–	–	–	–	–
8/16	AM	4	0.0	9	8	–	3
8/16	PM	4	1.2	12	9	159	3
8/17	AM	4	0.1	8	8	–	3
8/17	PM	4	6.0	11	9	–	3
8/18	AM	4	3.6	8	8	–	3
8/18	PM	4	5.6	13	9	121	3
8/19	AM	3	0.3	4	7	123	2
8/19	PM	3	0.0	14	8	125	2
8/20	AM	3	0.0	8	7	122	2
8/20	PM	3	0.0	15	8	117	2
8/21	AM	2	0.0	8	7	109	2
8/21	PM	1	0.0	19	9	104	2
8/22	AM	4	0.1	7	7	97	2

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
8/22	PM	4	0.0	13	8	94	2
8/23	AM	4	5.0	10	6	90	2
8/23	PM	4	2.0	11	7	88	2
8/24	AM	4	12.5	10	7	90	2
8/24	PM	4	1.1	15	8	93	2
8/25	AM	4	0.1	8	7	97	3
8/25	PM	2	6.5	23	9	98	3
8/26	AM	4	8.0	10	8	97	3
8/26	PM	3	1.4	17	10	96	3
8/27	AM	3	3.0	9	8	94	2
8/27	PM	2	0.0	16	9	94	2
8/28	AM	5	0.0	5	8	92	2
8/28	PM	2	0.0	23	10	90	2
8/29	AM	3	0.2	8	8	88	2
8/29	PM	4	4.1	8	7	88	2
8/30	AM	4	3.1	7	6	87	2
8/30	PM	4	3.2	9	8	85	2
8/31	AM	4	0.4	6	5	86	2
8/31	PM	4	3.1	9	8	84	2
9/1	AM	4	1.0	7	7	84	2
9/1	PM	4	0.0	9	8	84	2
9/2	AM	4	9.0	8	7	88	2
9/2	PM	4	2.8	10	8	90	2
9/3	AM	4	0.5	8	6	96	2
9/3	PM	4	0.0	15	8	96	2
9/4	AM	3	0.7	7	7	98	2
9/4	PM	–	–	–	–	–	–
9/5	AM	1	1.1	6	7	92	2
9/5	PM	–	–	–	–	–	–
9/6	AM	4	2.7	12	7	88	2
9/6	PM	4	2.4	12	8	84	2
9/7	AM	3	0.2	7	7	83	2
9/7	PM	3	0.0	15	9	83	2
9/8	AM	4	1.0	8	8	86	2

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River stage (cm)	Water clarity[b]
9/8	PM	3	0.3	14	9	85	2
9/9	AM	4	0.0	7	6	82	1
9/9	PM	2	0.0	15	8	81	1
9/10	AM	4	2.2	7	6	80	1
9/10	PM	3	0.0	11	8	80	1
9/11	AM	4	0.0	0	6	85	2
9/11	PM	3	0.7	12	6	85	2
9/12	AM	4	1.2	7	6	85	2
9/12	PM	4	1.2	10	6	85	2
9/13	AM	4	10.3	10	6	86	2
9/13	PM	4	7.9	11	7	89	3
9/14	AM	4	3.0	7	6	102	3
9/14	PM	3	2.5	11	8	117	3
9/15	AM	4	0.2	8	7	120	3
9/15	PM	3	0.0	14	7	120	3
9/16	AM	4	0.0	6	6	119	3
9/16	PM	3	0.0	15	7	115	3
9/17	AM	2	0.0	0	6	111	3
9/17	PM	–	–	–	–	–	–
9/18	AM	4	0.2	7	6	101	–
9/18	PM	4	0.0	9	6	95	2
9/19	AM	1	0.0	-2	6	95	2
9/19	PM	4	0.8	-1	5	92	2
Average	–	–	1.7	14	11	67	–

[a] Sky condition codes:
1 = clear or mostly clear; <10% cloud cover
2 = partly cloudy; <50% cloud cover
3 = mostly cloudy; >50% cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:
1 = visibility greater than 1 meter
2 = visibility between 0.5 and 1 meter
3 = visibility less than 0.5 meter

Appendix B7.–Daily weather and stream observations at the Salmon River (Pitka Fork) weir, 2017.

Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River stage (cm)	Water clarity[b]
6/21	AM	–	–	–	–	–	–
6/22	PM	2	0.0	20	16	45	1
6/22	AM	1	0.0	16	16	45	1
6/22	PM	3	0.0	20	17	45	1
6/23	AM	4	0.0	16	17	44	1
6/23	PM	4	0.0	15	14	46	1
6/24	AM	1	0.0	12	11	47	1
6/24	PM	3	0.0	17	16	47	1
6/25	AM	1	0.0	13	13	47	1
6/25	PM	2	0.0	21	16	47	1
6/26	AM	2	0.0	13	14	48	1
6/26	PM	3	0.0	15	16	48	1
6/27	AM	3	0.3	13	14	48	1
6/27	PM	3	0.0	17	15	49	1
6/28	AM	4	0.0	12	12	48	1
6/28	PM	2	0.0	19	15	49	1
6/29	AM	4	0.0	11	12	49	1
6/29	PM	3	0.0	19	13	50	1
6/30	AM	4	0.0	13	11	50	1
6/30	PM	3	0.0	19	13	51	1
7/1	AM	1	0.0	14	12	51	1
7/1	PM	3	0.0	20	16	52	1
7/2	AM	4	0.0	14	14	52	1
7/2	PM	2	0.0	20	15	54	1
7/3	AM	4	0.0	14	13	54	1
7/3	PM	4	1.5	14	15	55	1
7/4	AM	3	0.8	14	13	66	2
7/4	PM	1	0.0	20	15	66	2
7/5	AM	3	0.0	14	14	64	1
7/5	PM	2	0.0	23	18	64	1
7/6	AM	3	0.5	16	16	62	1
7/6	PM	3	0.0	23	19	62	1

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C)		River stage (cm)	Water clarity[b]
				Air	Water		
7/7	AM	4	0.0	16	16	62	1
7/7	PM	3	12.7	19	15	63	1
7/8	AM	1	0.5	13	13	63	1
7/8	PM	4	0.0	21	16	63	1
7/9	AM	4	17.5	11	14	66	2
7/9	PM	3	6.0	15	15	84	2
7/10	AM	1	0.0	10	11	82	2
7/10	PM	3	0.0	19	15	79	1
7/11	AM	4	0.0	12	12	74	1
7/11	PM	4	0.0	11	13	73	1
7/12	AM	4	0.0	12	13	72	1
7/12	PM	3	0.0	25	15	71	1
7/13	AM	3	0.0	15	15	70	1
7/13	PM	3	0.0	26	15	71	1
7/14	AM	2	0.0	15	15	69	1
7/14	PM	3	0.0	24	18	70	1
7/15	AM	4	0.0	15	15	71	1
7/15	PM	3	0.0	21	11	73	1
7/16	AM	3	0.0	14	14	71	1
7/16	PM	3	0.0	20	16	72	1
7/17	AM	3	0.0	15	15	72	1
7/17	PM	3	0.0	20	16	72	1
7/18	AM	4	1.5	14	13	72	1
7/18	PM	4	5.0	14	13	75	1
7/19	AM	4	2.0	15	12	77	1
7/19	PM	3	0.0	20	15	78	1
7/20	AM	4	0.0	14	13	76	1
7/20	PM	4	0.0	20	16	75	1
7/21	AM	2	0.0	13	15	74	1
7/21	PM	1	0.0	22	17	75	1
7/22	AM	1	0.0	16	14	74	1
7/22	PM	1	0.0	25	17	74	1
7/23	AM	1	0.0	24	15	74	1
7/23	PM	3	0.0	25	17	74	1

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Date	Time	Sky conditions[a]	Precipitation (mm)	Temperature (°C)		River stage (cm)	Water clarity[b]
				Air	Water		
7/24	AM	4	8.2	14	13	75	1
7/24	PM	4	1.0	15	18	79	1
7/25	AM	3	0.0	12	12	78	1
7/25	PM	4	4.1	12	12	79	1
7/26	AM	4	3.9	11	12	84	2
7/26	PM	3	1.4	15	14	86	2
7/27	AM	3	1.3	19	13	84	2
7/27	PM	3	0.0	20	15	83	2
7/28	AM	3	1.4	15	15	81	1
7/28	PM	4	0.5	16	14	82	2
7/29	AM	4	2.0	13	12	89	2
7/29	PM	2	0.3	19	15	90	2
7/30	AM	3	0.0	12	12	88	2
7/30	PM	3	0.0	22	16	87	2
7/31	AM	4	0.0	13	14	86	2
7/31	PM	4	0.8	16	14	86	2
8/1	AM	4	0.2	13	14	85	2
8/1	PM	4	0.6	16	13	85	2
8/2	AM	4	12.5	12	12	89	2
8/2	PM	4	9.0	15	12	102	2
8/3	AM	4	6.0	14	12	110	2
8/3	PM	4	8.0	15	12	120	2
8/4	AM	4	2.5	14	12	118	2
8/4	PM	2	0.0	19	15	116	2
8/5	AM	1	0.0	13	14	110	2
8/5	PM	1	0.0	23	16	105	2
8/6	AM	1	0.0	14	14	100	2
8/6	PM	3	0.0	20	16	98	2
8/7	AM	3	0.0	14	14	96	2
8/7	PM	3	0.0	20	16	95	2
8/8	AM	3	1.0	14	14	94	1
8/8	PM	3	0.0	19	16	93	1
8/9	AM	4	0.2	14	13	92	1
8/9	PM	4	0.2	19	14	92	1
8/10	AM	4	7.0	14	13	92	1
8/10	PM	4	4.0	14	13	93	1
Average	–	–	1.2	16	14	73	–

[a] Sky condition codes:
1 = clear or mostly clear; <10% cloud cover
2 = partly cloudy; <50% cloud cover
3 = mostly cloudy; >50% cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:
1 = visibility greater than 1 meter
2 = visibility between 0.5 and 1 meter
3 = visibility less than 0.5 meter

APPENDIX C

Appendix C1.–Yearly observed passage of nontarget species at Middle Fork Goodnews River weir, 2012–2017.

Year	Pink salmon	Dolly Varden	Rainbow Trout	Whitefish
2012	6,316	798	104	138
2013	530	5,163	179	51
2014	9,287	6,369	12	289
2015	1,159	5,575	15	131
2016	11,267	9,732	13	200
2017	8,921	2,398	81	338
Average	6,247	5,006	67	191

Appendix C2.–Yearly observed passage of nontarget species at Salmon River (Aniak) weir, 2012–2017.

Year	Pink salmon	Longnose Sucker	Dolly Varden	Arctic Grayling	Rainbow Trout	Whitefish
2012	62	37	311	8	3	–
2013	17	50	86	11	22	2
2014	116	154	127	3	11	8
2015	126	288	491	13	22	9
2016	77	146	5	5	0	3
2017	525	74	100	57	8	10
Average	154	125	187	16	11	6

Appendix C3.–Yearly observed passage of nontarget species at George River weir, 2012–2017.

Year	Sockeye salmon	Pink salmon	Longnose Sucker	Dolly Varden	Arctic Grayling	Whitefish	Northern Pike
2012	79	6,271	2,900	2	–	1	1
2013	150	278	21,808	3	32	80	9
2014	156	906	2,294	4	45	49	–
2015	159	703	9,584	6	345	106	2
2016	2,807	1,708	4,941	9	172	34	0
2017	912	1,404	4,046	1	206	16	4
Average	711	1,878	7,596	4	160	48	3

Appendix C4.–Yearly observed passage of nontarget species at Kogrukluk River weir, 2012–2017.

Year	Pink salmon	Dolly Varden	Arctic Grayling	Whitefish	Northern Pike
2012	237	259	-	35	–
2013	13	84	-	13	–
2014	288	319	4	56	–
2015	88	381	2	117	1
2016	1,237	11	0	0	0
2017	299	38	1	17	0
Average	360	182	2	40	1

Appendix C5.–Yearly observed passage of nontarget species at Telaquana River weir, 2012–2017.

Year	Chinook salmon	Chum salmon	Pink salmon	Longnose Sucker	Arctic Grayling	Whitefish	Northern Pike	Lake Trout
2012	5	5	2	990	54	105	4	11
2013	17	83	0	348	72	17	10	5
2014	67	72	4	1,361	4	21	6	12
2015	101	92	4	115	34	1	0	1
2016	119	103	1	1,251	54	84	7	7
2017	202	157	7	1,590	85	40	5	8
Average	85	85	3	943	51	45	5	7

Appendix C6.–Yearly observed passage of nontarget species at Tatlawiksuk River weir, 2012–2017.

Year	Sockeye salmon	Pink salmon	Longnose Sucker	Arctic Grayling	Whitefish	Northern Pike	Dolly Varden
2012	9	27	640	14	3	6	0
2013	37	2	3,765	12	85	3	0
2014	9	5	770	2	1	1	1
2015	0	0	750	7	43	8	0
2016	240	111	433	36	18	5	0
2017	59	29	313	15	14	2	0
Average	59	29	1,112	14	27	4	0

Appendix C7.–Yearly observed passage of nontarget species at Salmon River (Pitka Fork) weir, 2015–2017.

Year	Sockeye salmon	Chum salmon	Longnose Sucker	Arctic Grayling	Whitefish	Northern Pike
2015	0	54	38	4	0	0
2016	0	55	324	2	36	3
2017	17	393	300	8	41	3
Average	6	167	221	5	26	2