Kuskokwim River Salmon Management Working Group

1 (800) 315-6338 (MEET) Code: 58756# (KUSKO)
ADF&G Bethel toll free: 1 (855) 933-2433

Meeting Agenda

Date: **06/14/2019** Time: **10:00 a.m.** Place: **Bethel**

Time Called to Order: Chair: Alissa N. Rogers

ROLL CALL TO ESTABLISH QUORUM:

Upriver Elder:
Downriver Elder:
Commercial Fisher:
Lower River Subsistence:
Middle River Subsistence:
Upper River Subsistence:
Headwaters Subsistence:

QUORUM MET? Yes / No

Processor:
Member at Large:
Sport Fisher:
Western Interior RAC:
Y-K Delta RAC:
KRITFC:
ADF&G:

INTRODUCTIONS:
INVOCATION:
APPROVAL OF AGENDA: *the agenda may be amended at this time.*
APPROVAL OF MINUTES: *Optional. ADF&G does not prepare official meeting minutes.*
USFWS/KRITFC UPDATE:
ADF&G MANAGEMENT ACTIONS UNDER CONSIDERATION:
PEOPLE TO BE HEARD: *Non-Working Group Members*
CONTINUING BUSINESS:

- Subsistence Reports: Lowest River, ONC Inseason Subsistence Report, Lower River, Middle River, Upper River, Headwaters
- Overview of Kuskokwim River salmon run assessment:
  a. Test Fisheries (Bethel and Aniak):
  b. Sonar/Weirs/Aerial Surveys/Other:
  c. Subsistence Division Project Update:
  d. NVN Report:
- Commercial Catch Report: N/A
- Processor Report: N/A
- Sport Fish Report:
- Intercept Fishery Report: *optional*
- Weather Forecast:
- Discussion of ADF&G Management considerations and discussion of possible alternatives (recommendations from the Working Group):
- Motion for Discussion and Action:

OLD BUSINESS:

- KRITFC escapement goal analysis: *Bill Bechtol/ Kevin Whitworth (KRITFC)*
- Update on procedure options for conducting off-season Working Group business: *ADF&G*
- Donlin Gold project impact on smelt: *Dave Cannon*

NEW BUSINESS:

COMMENTS FROM WORKING GROUP MEMBERS:

NEXT MEETING DATE:_____Time:_____Place:_____

Information Packets *ARE*:

- **Intended to help inform Working Group discussions.**
- **To be viewed and used in context with Working Group meetings only.**

Packets *ARE NOT*:

- **To be viewed as standalone documents.**
- **A final say on fisheries management decisions.**

Please use this information responsibly:
Packet information is an incomplete snapshot of an ongoing discussion and changing conditions. Packet information should not be reproduced for any purpose other than to describe Working Group meeting discussions.

Misuse of Packet information can contribute to misunderstandings that can **cause harm to salmon users** and potentially **damage salmon resources**.

Ask Questions: ADF&G staff will be happy to answer biology and management questions. Please call **1-855-933-2433** to reach ADF&G Kuskokwim Area staff.

Attend Meetings: Each Working Group meeting is announced at least 48 hours prior to time and date of meeting. In addition, each meeting is recorded. Recordings can be found here: **http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareakuskokwim.kswg**

Viewing the information packet while listening to meetings/recordings will provide a better understanding of the information presented in this packet.

Thank you.
Jennifer Peeks
Aaron Tiernan
Working Group Coordinators

Orutsararmiut Native Council (ONC) Inseason Harvest Monitoring Weekly Report

June 14, 2018

Summary of Interview Activities

On Saturday, June 8 and Wednesday, June 12, our fisheries team visited 30 total fish camps from Oscarville slough up to the bluffs and conducted surveys at the Bethel boat harbor with some surveys conducted in the Brown slough area.

Here is a summary of the comments from the June 8 opportunity:

- Requesting more openers to support large families
- Soak times are very long, but catches are low
- Wanted a drift-net opener
- Reported a state trooper throw a dead fish back into the water
- Wasting good drying weather waiting around for an opener

Here is a summary of the comments from the June 12 opportunity:

- Early in run because many of the Chinook salmon caught are small
- Patchy white coloration all over Chinook salmon flesh raised concerns
- Combat fishing

Table 1. Average number of salmon harvested by surveyed fish camps from June 8 fishing opportunity.

Data Source	Number of Surveys Conducted	Average Chinook Salmon Harvest	Average Chum Salmon Harvest	Average Sockeye Salmon Harvest	Average other harvest
Bethel Area Fish Camps	13	9	<1	<1	<1
Bethel Boat Harbor	27	3	<1	<1	<1

Table 2. Average number of salmon harvested by surveyed Bethel area fish camps and Bethel boat harbor from June 12 fishing opportunity.

Data Source	Number of Surveys Conducted	Average Chinook Salmon Harvest	Average Chum Salmon Harvest	Average Sockeye Salmon Harvest	Average other harvest
Bethel Area Fish Camps	17	10	1	1	1
Bethel Boat Harbor	85	6	<1	1	<1

Fishing Progress Information

This past survey period, we asked eight fish camps the following question: "How close are you to achieving your Chinook salmon harvest goals?"

Table 3. Fishing progress by surveyed fish camps for Chinook salmon from June 12 fishing opportunity.

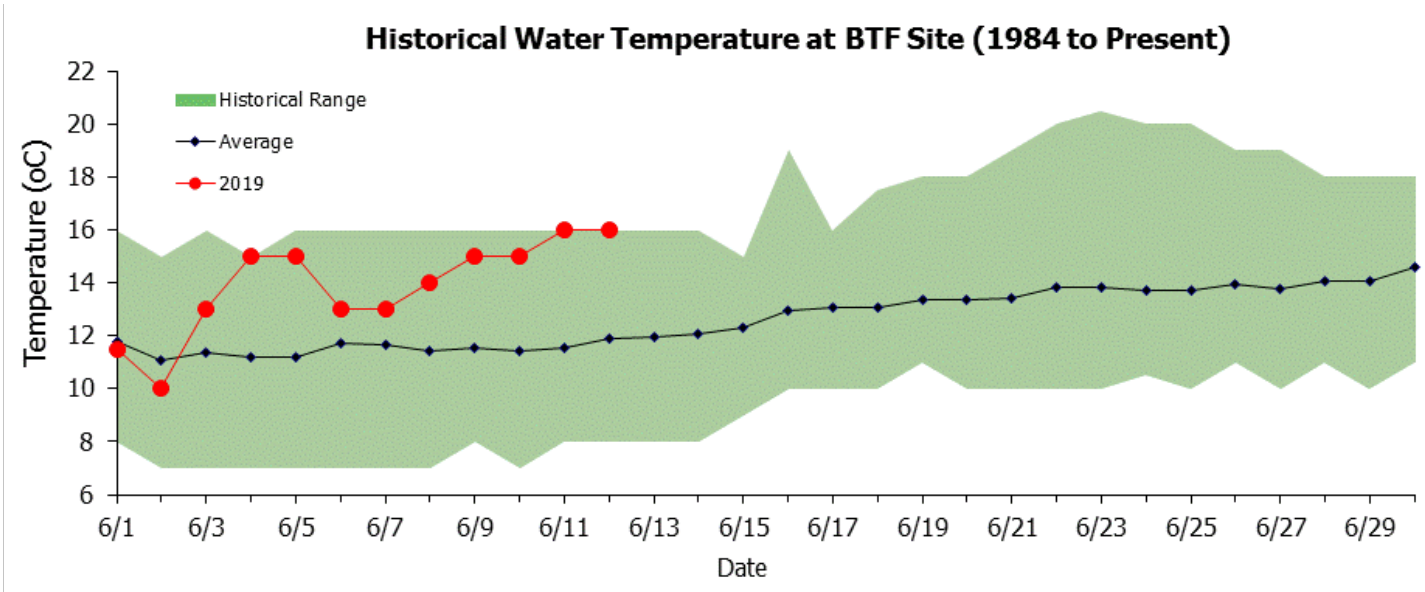
Salmon Species	Not at all	Under Half	Halfway	Over Half	Goal Met
Chinook salmon	25% (n=2)	25% (n=2)	38% (n=3)	12% (n=1)	0% (n=0)

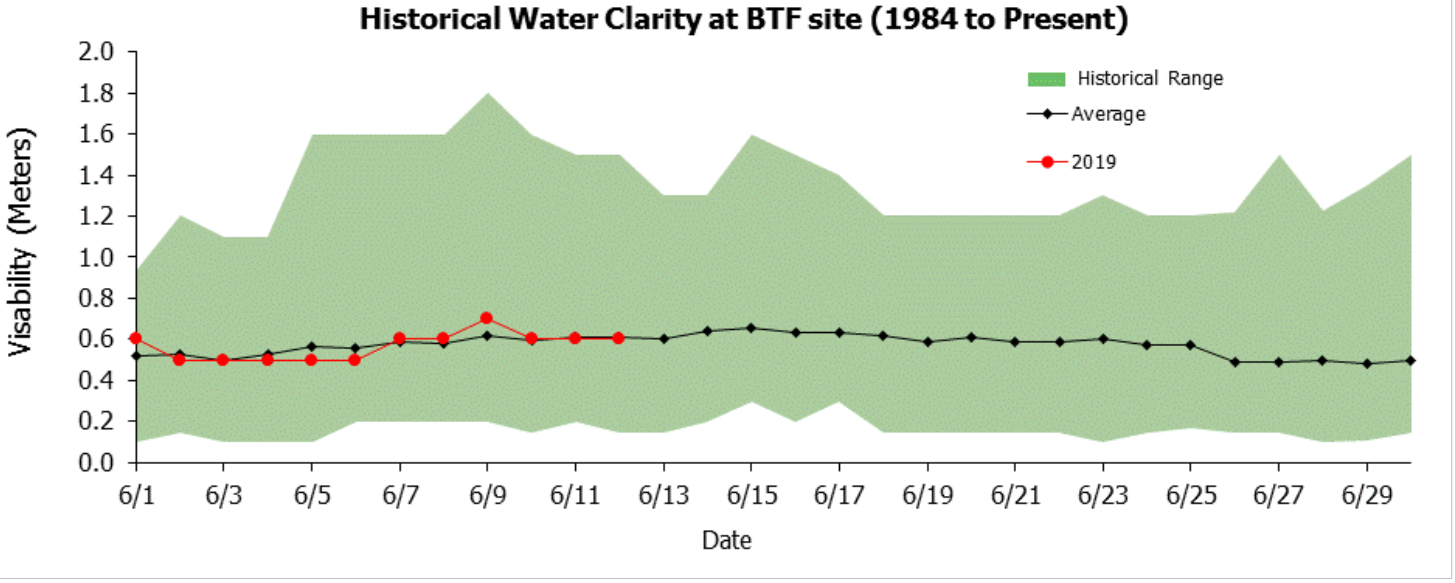
Chinook Salmon Age-Sex-Length (ASL) Sampling Program Recruitment

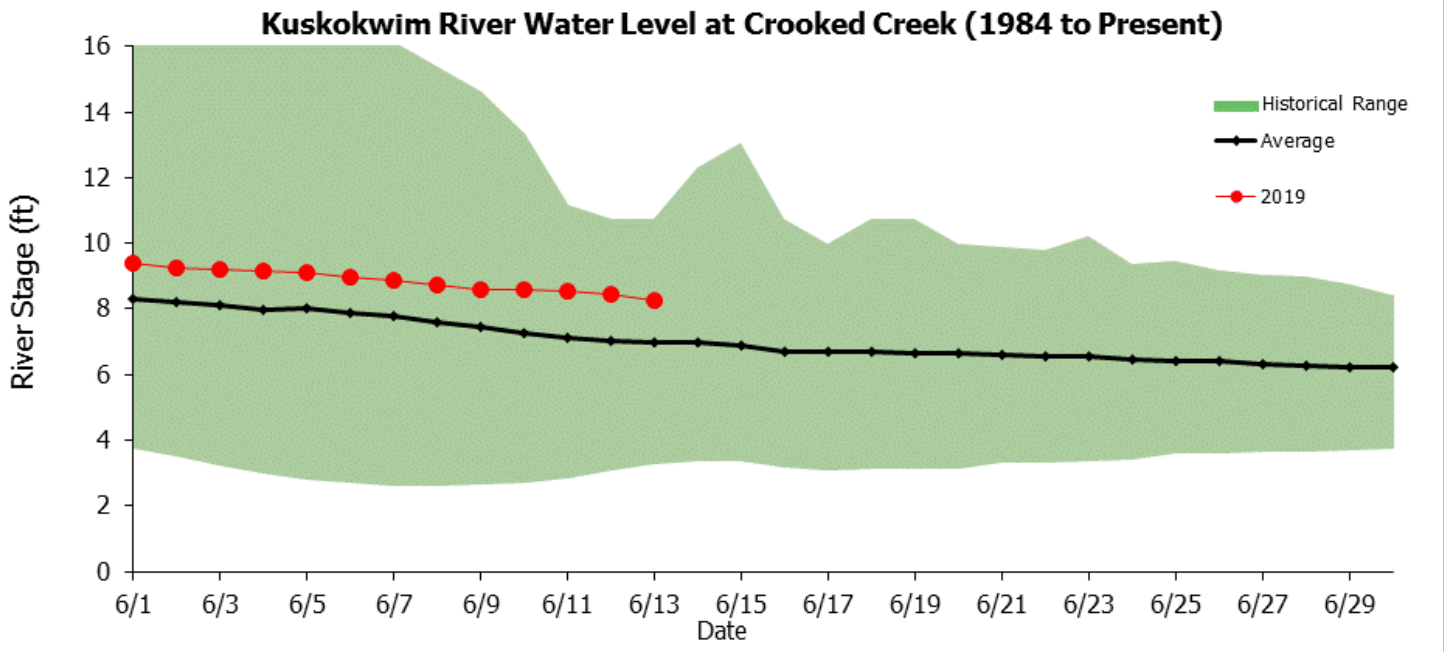
Thus far this season, there are 21 interested samplers from the Bethel community, and we've received samples from four of those individuals, all from the Bethel community.

Fish Distribution

From June 3-June 8, we've delivered 95 Chinook salmon, 7 sheefish and 4 chum salmon to Bethel area Elders, disabled and widows as well as ONC Senior Services department to provide salmon for the wheels on meals program. These fish served 90+ area Elders, disabled and widows in Bethel. These fish were caught by the Alaska Department of Fish & Game Bethel Test Fishery.


Historical Water Temperature at BTF Site (1984 to Present)
Historical Range
Average
2019
Temperature (oC)
22
20
18
16
14
12
10
8
6
6/1
6/3
6/5
6/7
6/9
6/11
6/13
6/15
6/17
6/19
6/21
6/23
6/25
6/27
6/29
Date


Historical Water Clarity at BTF site (1984 to Present)
Historical Range
Average
2019
Visability (Meters)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
6/1
6/3
6/5
6/7
6/9
6/11
6/13
6/15
6/17
6/19
6/21
6/23
6/25
6/27
6/29
Date


Kuskokwim River Water Level at Crooked Creek (1984 to Present)
Historical Range
Average
2019
River Stage (ft)
16
14
12
10
8
6
4
2
0
6/1
6/3
6/5
6/7
6/9
6/11
6/13
6/15
6/17
6/19
6/21
6/23
6/25
6/27
6/29
Date

Kuskokwim River Salmon Assessment Update
6/12/2019

This document presents the key assessment information considered by managers in-season. The production of this document is a collaborative effort between USFWS and ADF&G. **All data and analyses contained are preliminary and are subject to change, so please make interpretations carefully**.

If you have any questions about the content, please contact Gary Decossas (USFWS; gary_decossas@fws.gov) or Nick Smith (ADF&G; nick.smith@alaska.gov). Major credit for the development of this data packet belongs to Benjamin Staton.

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Abbreviations:

- BTF: Bethel Test Fishery
- ATF: Aniak Test Fishery
- CPUE: Catch-per-unit-effort
- EOS: End-of-Season

To view escapement information, please visit the ADF&G Kuskokwim River Fish Counts page:

- http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareakuskokwim.salmon#fishcounts

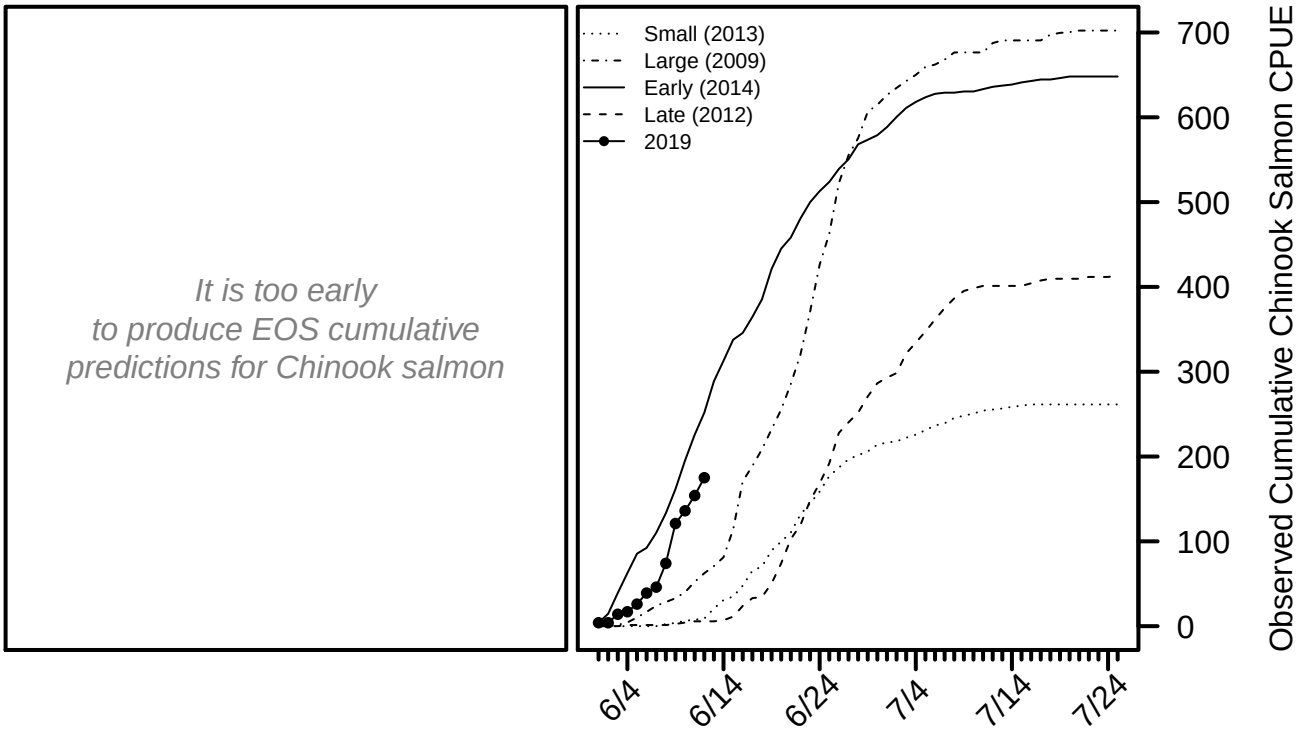
For the most up-to-date information regarding fishing opportunities please visit:

- **USFWS:** https://www.fws.gov/refuge/yukon_delta/wildlife_and_habitat/dailyupdate.html
- **ADF&G:** http://www.adfg.alaska.gov/index.cfm?adfg=cfnews.main

Chinook Salmon BTF Summary (6/12)

- The BTF daily CPUE was **21**.
- The BTF cumulative CPUE is now **175**.
- **91%** years since 2008 fell below this cumulative CPUE on this date.
- **12%** of the run is complete based on historical average run timing.
- **6% - 19%** of the run is complete based the central 50% of all historical run timing scenarios.
- **13% - 20%** of the run is expected to pass Bethel in the next 5 days.
- Over the last 3 days, Chinook salmon made up **83%** of the BTF catches, compared to **52%** on average.

Chinook Salmon Figure 1. *Left*: will show predicted cumulative EOS BTF CPUE according to various run timing scenarios when enough data have been collected. *Right*: The cumulative BTF CPUE from 2019 plotted along with four previous years intended to represent a range of early/late and small/large index values.



For more detailed information, see the ***Chinook salmon appendix*** *at the end of this document.*

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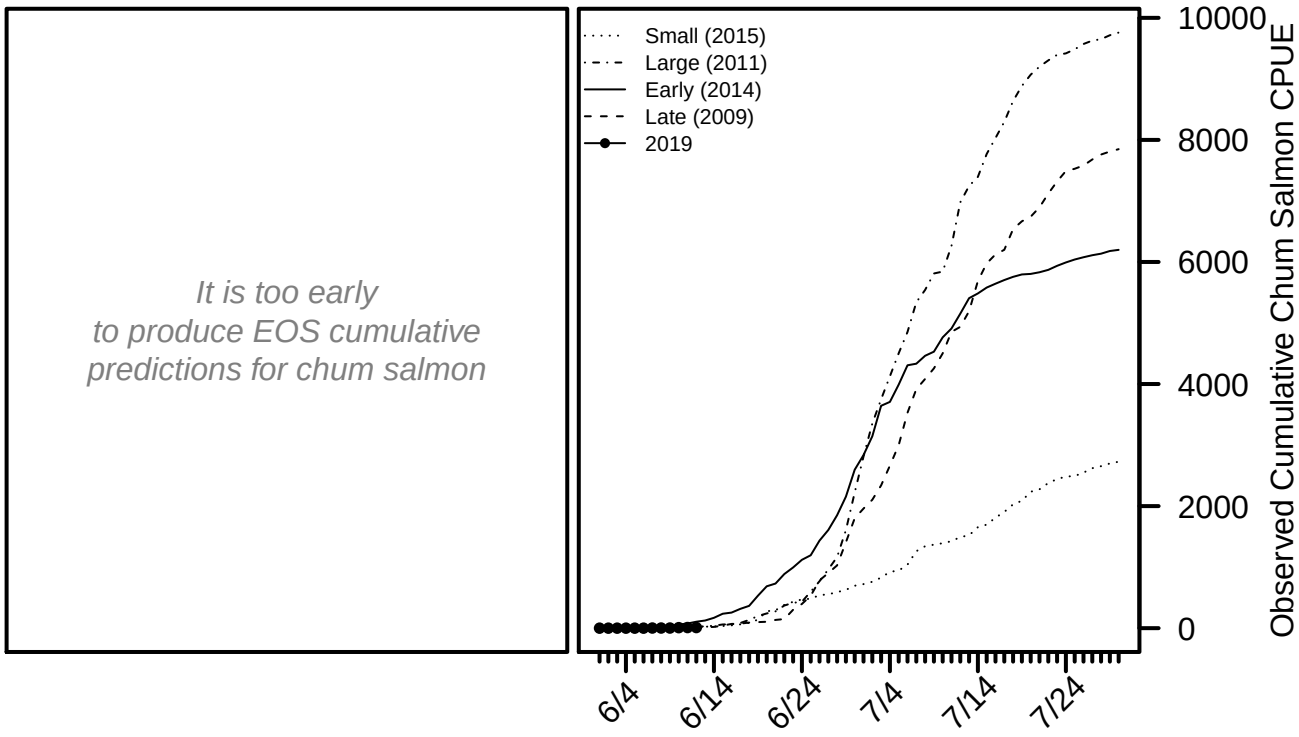
Chum Salmon BTF Summary (6/12)

- The BTF daily CPUE was **0**.
- The BTF cumulative CPUE is now **10**.
- **18%** years since 2008 fell below this cumulative CPUE on this date.
- **1%** of the run is complete based on historical average run timing.
- **<1% - 1%** of the run is complete based the central 50% of all historical run timing scenarios.
- **1% - 4%** of the run is expected to pass Bethel in the next 5 days.
- Over the last 3 days, chum salmon made up **12%** of the BTF catches, compared to **29%** on average.

Chum Salmon Figure 1. *Left*: will show predicted cumulative EOS BTF CPUE according to various run timing scenarios when enough data have been collected. *Right*: The cumulative BTF CPUE from 2019 plotted along with four previous years intended to represent a range of early/late and small/large index values.



For more detailed information, see the ***chum salmon appendix*** *at the end of this document.*

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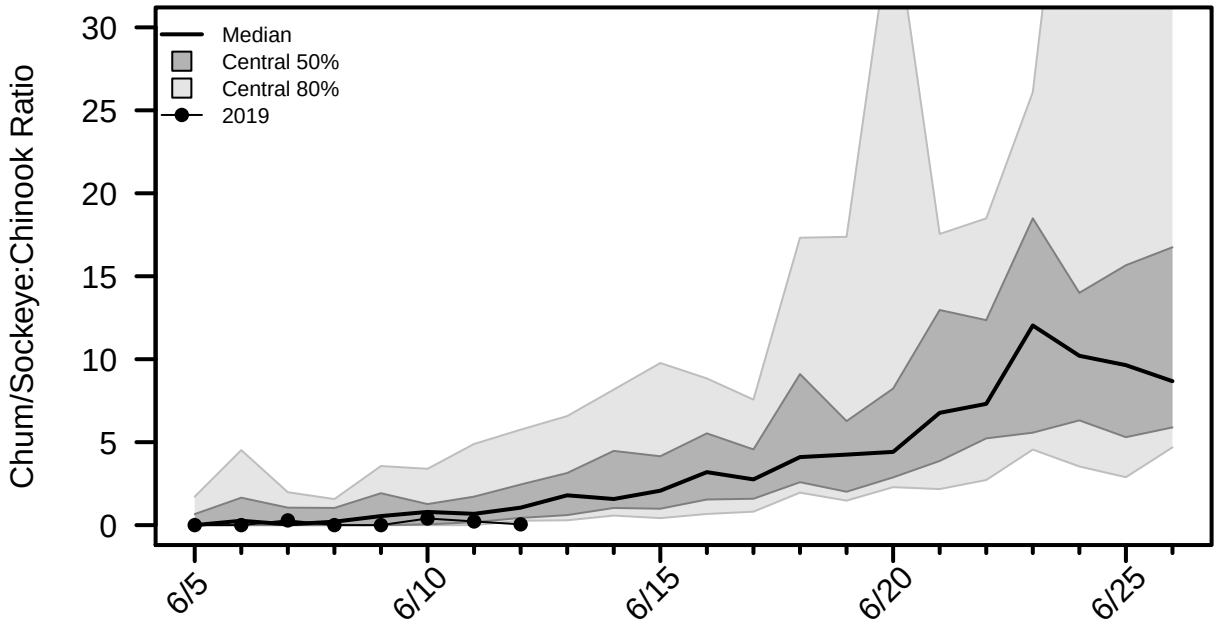
Chum/Sockeye:Chinook Salmon Ratio

This ratio is calculated by dividing the total number of chum and sockeye salmon counted by the number of Chinook salmon counted by a project each day. A value of zero indicates Chinook salmon were counted that day, but not chum or sockeye salmon. A missing value on a day the project operated indicates no Chinook salmon were counted that day.

Species Ratio Figure 1. Time series of the species ratio in the BTF with historical quantiles shown as grey regions and the ratio time series for 2019 shown with points connected by lines.



Ratio Table 1. A subset of the species ratios displayed in **Ratio Figure 1**, including the ratios from the ATF and from the sonar.

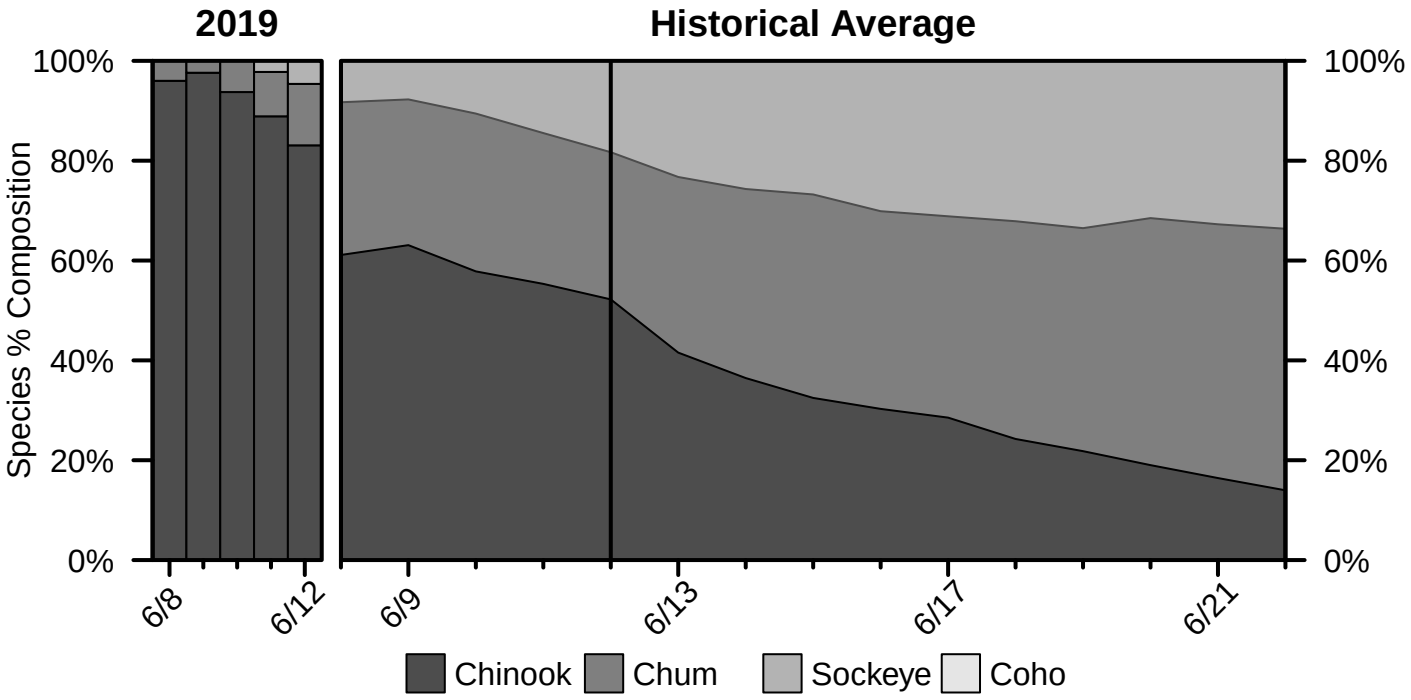
Date	2019 BTF	BTF Median	BTF Lower 10%	BTF Upper 10%	2019 Sonar	2019 ATF
6/9	0	0.54	0	3.56	0.06	–
6/10	0.4	0.8	0	3.4	0.11	0
6/11	0.22	0.68	0	4.89	0.18	0
6/12	**0.05**	**1.05**	**0.27**	**5.75**	**0.01**	**0**
6/13		1.8	0.29	6.57		
6/14		1.57	0.58	8.17		
6/15		2.08	0.42	9.77		

Ratio Table 2. The percent of previous years in which a given species ratio was exceeded at least once before a certain day in the BTF.

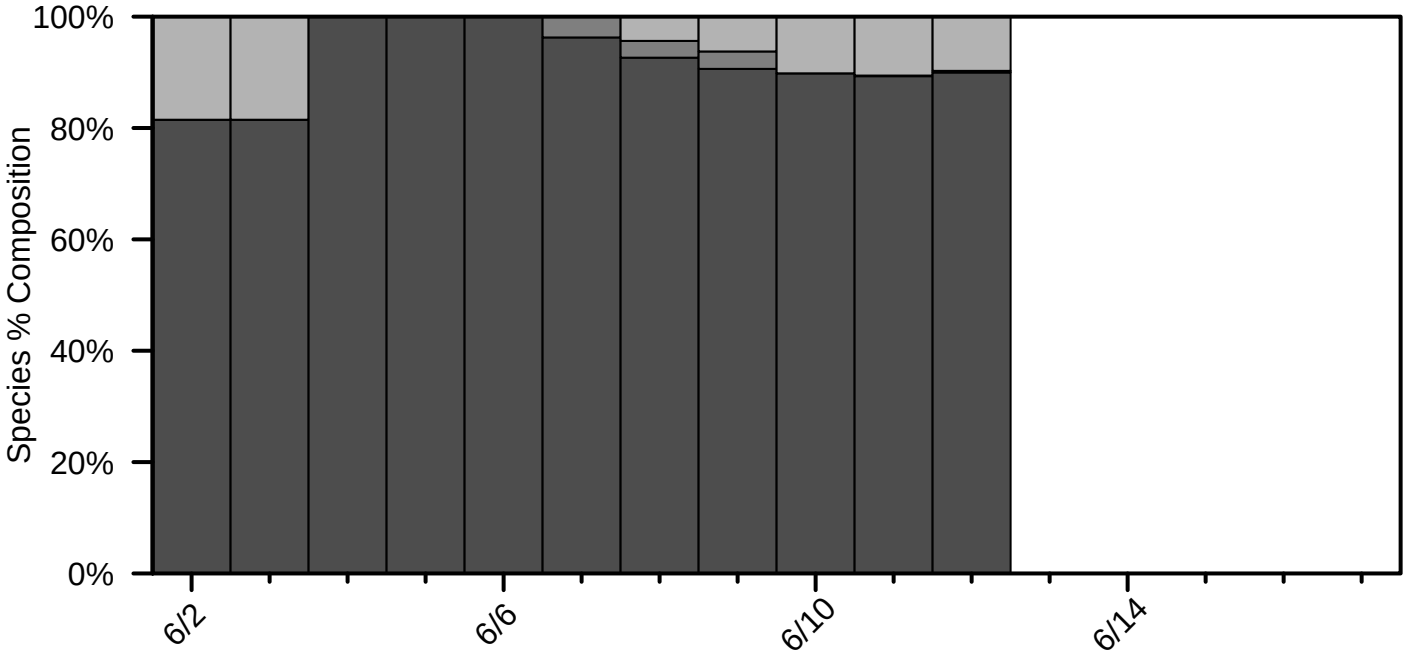
Date	Ratio > 1	Ratio > 3	Ratio > 5	Ratio > 10	Ratio > 20
6/9	71%	29%	9%	3%	3%
6/10	74%	37%	11%	3%	3%
6/11	80%	46%	17%	3%	3%
6/12	**83%**	**46%**	**26%**	**3%**	**3%**
6/13	89%	51%	34%	6%	3%
6/14	91%	66%	43%	9%	3%
6/15	94%	74%	49%	17%	3%

Percent Composition by Salmon Species

Percent Composition Figure 1. Species percent composition in the BTF from 2019 and based on the historical average. The composition presented on each day represents the average composition over the past 3 days.



Species Composition Figure 2. Species percent composition from the sonar estimates from 2019 (salmon species only, excluding pink salmon). The composition presented on each day represents the average composition over the past 3 days.



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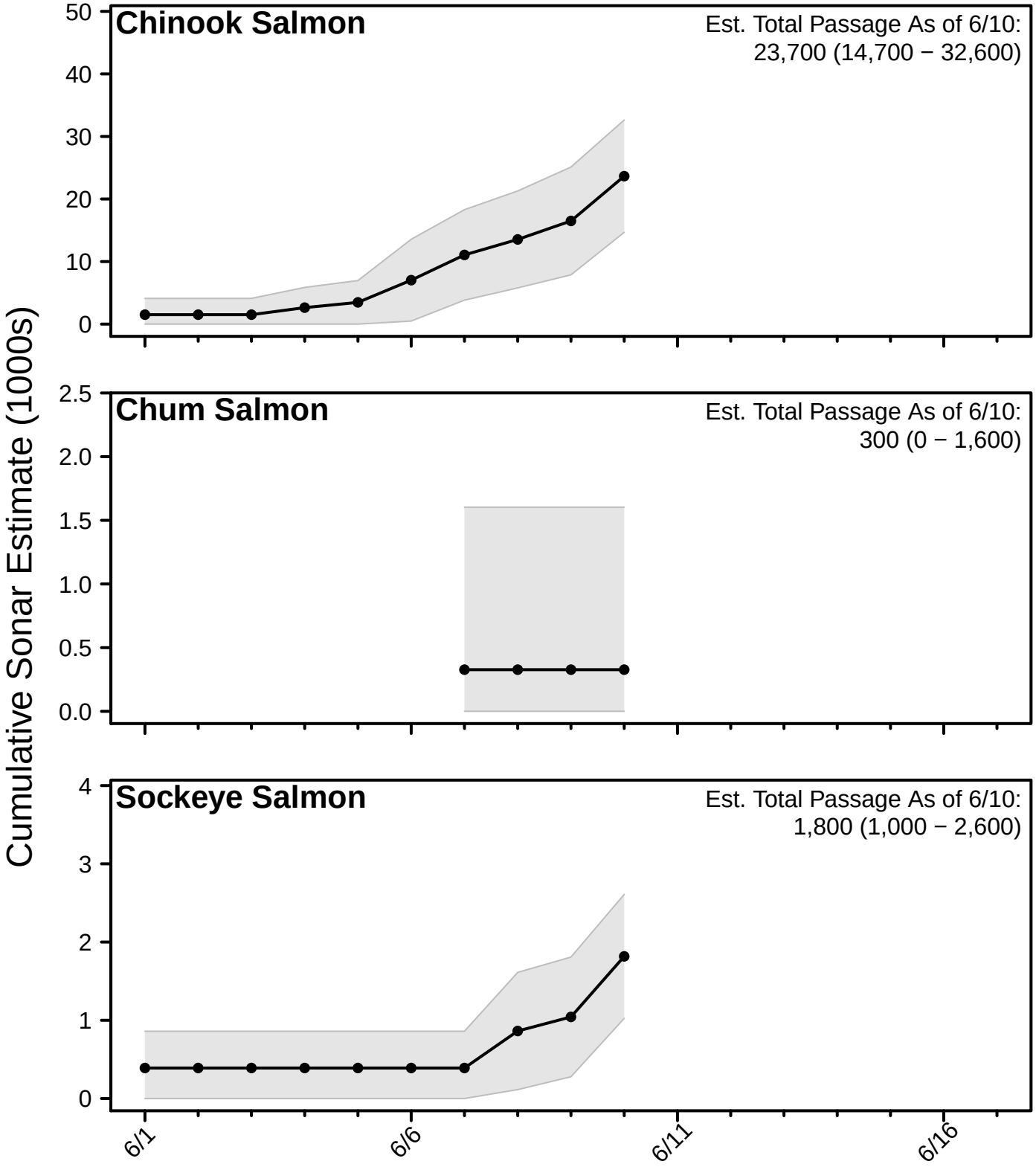
Sonar Passage Estimates

Sonar Figure 1. Cumulative estimates of salmon passage from the 2019 sonar operation through the last complete reporting day. Grey bands show the 95% confidence intervals on each complete reporting day.



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Chinook Salmon Appendix

Chinook Salmon Table A1. Cumulative CPUE from the BTF.

Date	2019	2018	2017	2016	2015	5-Yr Avg.	2008 - 2018 Avg.
6/9	121	29	9	114	76	78	48
6/10	136	38	12	126	89	92	57
6/11	154	49	18	144	104	108	67
6/12	**175**	**67**	**21**	**165**	**117**	**124**	**77**
6/13		91	23	175	132	142	90
6/14		112	27	196	144	158	102
6/15		145	36	218	164	180	122
EOS		667	374	687	625	601	550

Chinook Salmon Table A2. Cumulative CPUE from the ATF.

Date	2019	2018	2017	2016	2015
6/9	27	23	71	466	115
6/10	33	23	101	589	149
6/11	114	31	131	659	186
6/12	**218**	**64**	**186**	**724**	**256**
6/13		80	238	731	293
6/14		104	307	867	382
6/15		104	451	971	449
EOS		820	6,508	2,729	2,916

Chinook Salmon Table A3. Percent of run complete according to various historical run timing scenarios from the BTF.

Timing	Midpoint	6/12 Cumulative %
Earliest	6/14	38%
Early 10%	6/17	27%
Early 25%	6/21	19%
Median	6/22	12%
Late 25%	6/25	6%
Late 10%	6/27	3%
Latest	7/3	1%

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Chum Salmon Appendix

Chum Salmon Table A1. Cumulative CPUE from the BTF.

Date	2019	2018	2017	2016	2015	5-Yr Avg.	2008 - 2018 Avg.
6/9	2	20	11	16	18	21	13
6/10	8	22	24	18	18	29	18
6/11	10	37	27	21	18	36	22
6/12	**10**	**49**	**41**	**21**	**21**	**47**	**28**
6/13		74	59	24	24	61	38
6/14		106	65	35	27	80	49
6/15		188	92	42	35	119	75
EOS		8,212	6,785	3,894	2,943	5,636	6,678

Chum Salmon Table A2. Cumulative CPUE from the ATF.

Date	2019	2018	2017	2016	2015
6/9	0	8	24	19	17
6/10	0	8	31	19	25
6/11	0	8	61	19	40
6/12	**0**	**8**	**91**	**27**	**40**
6/13		8	98	27	49
6/14		8	106	49	66
6/15		8	145	72	66
EOS		10,277	11,588	5,304	5,669

Chum Salmon Table A3. Percent of run complete according to various historical run timing scenarios from the BTF.

Timing	Midpoint	6/12 Cumulative %
Earliest	6/23	4%
Early 10%	7/1	2%
Early 25%	7/3	1%
Median	7/6	1%
Late 25%	7/7	<1%
Late 10%	7/11	<1%
Latest	7/14	<1%

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Kuskokwim River Inter-Tribal Fish Commission
2019 Drainage-wide Escapement Target of 110,000 for Kuskokwim River Chinook Salmon

By Bill Bechtol and Kevin Whitworth

June 5, 2019

The drainage-wide escapement goal of 65,000–120,000 was first implemented by ADF&G in 2013 following development of drainagewide run-reconstruction model. A recent revision to the run-reconstruction model for 1976–2017 reduced estimates of total annual returns by an average of 11% and reduced estimated escapements by an average of 17%. Of note, while 2012 and 2013 are still estimated to be the lowest returns in over four decades, the model revision reduced total returns estimates for 2012–2017 by an average of 24%. In addition, the 2017 and 2018 drainagewide returns were still around 40% below the long-term average returns.

Targeting the upper portion of the drainage-wide escapement goal range for Kuskokwim River Chinook puts more "eggs in the gravel," maintains escapement within the established ADF&G escapement goal, and promotes a faster recovery by allowing the population to take advantage of rebuilding when ecological conditions improve.

2016:

On April 20, 2016, the Kuskokwim River Salmon Management Working Group (WG) unanimously adopted a motion that "Regardless of who manages what part of the river, managers should manage for the top 15% of the established Chinook salmon escapement goals in 2016." This would technically provide an escapement target of 111,750 Chinook.

USFWS-KRITFC adopted a similar approach. However, calculations made at the time were based on 85% of the upper bound of the escapement goal range, not 85% of the actual range, and the result of 102,000 Chinook salmon was rounded to 100,000 as an escapement target to guide management of fisheries in federal waters.

2017:

USFWS-KRITFC adopted an escapement target of 75% of the ADF&G escapement goal range (106,250 rounded up 110,000 Chinook) to promote stock rebuilding, with a subsistence harvest target of 40,000. This target decision was shared with the WG without objection.

2018:

On December 6, 2017, the USFWS-KRITFC adopted an escapement target of 75% of the ADF&G escapement goal range (106,250 rounded up 110,000 Chinook) to promote stock rebuilding; ADF&G didn't object because this is within the established range of 65,000–120,000. This target decision was shared with the WG without objection.

2019:

On March 15, 2019, KRITFC-USFWS adopted an escapement target of 110,000, or approximately 75% of the ADF&G escapement goal range, to promote stock rebuilding.

Precautionary Principle – The principle strategy for addressing risk resulting from data limitations and model misspecification, uncertainty in fisheries management decisions, and

> natural variability in productivity is precautionary management. Both state and federal policy, supported by contemporary fishery science and well established practice, mandate that precautionary approaches be applied to management of salmon and marine fisheries.

The NOAA report "Technical Guidance on the Use of Precautionary Approaches to Implementing National Standard 1" summarizes the precautionary approach to be applied to all marine fisheries as follows (Restrepo et al. 1993) (emphasis added):

> "The precautionary approach implements conservation measures even in the absence of scientific certainty that fish stocks are being overexploited. In a fisheries context, the precautionary approach is receiving considerable attention throughout the world primarily because the collapse of many fishery resources is perceived to be due to the inability to implement timely conservation measures without scientific proof of overfishing. Thus, the precautionary approach is essentially a reversal of the "burden of proof."

Precautionary Escapement Target – The core of sustainable management is to ensure that enough salmon reach the spawning grounds to maintain stock productivity, under a range of potential environmental factors. The current drainage-wide escapement goal established by ADF&G in 2013 for Kuskokwim River Chinook salmon is expressed as a range of 65,000–120,000 salmon. However, this stock has just undergone several years of some of the lowest returns in the past 40 years and recovery has been slower than in previous declines. Under the revised run-reconstruction model, drainagewide escapements during the years 2010–2013 were all below the 65,000 lower bound of the escapement goal range. Given the recent period of low productivity, stock recovery will benefit from having escapement on the upper end of the goal, i.e., putting more eggs in the gravel. Low escapements place Chinook salmon population at higher risk of loss of diversity; greater diversity helps promote resilience in the population. Having returns at the upper end of the escapement goal range supports greater diversity among subpopulations, increasing population resilience. During rebuilding of the run, the proposed management approach is to target the upper 75% level of the established escapement goal range in an effort to promote stock rebuilding.

Alaska Department of Fish and Game (ADF&G), Division of Commercial Fisheries

Position on the 2019 escapement and harvest objectives established by U.S. Fish and Wildlife Service and Kuskokwim River Intertribal Fish Commission for Kuskokwim River Chinook salmon

In consultation with the Kuskokwim River Inter-Tribal Fish Commission (KRITFC), the USFWS, Yukon Delta National Wildlife Refuge, Federal In-Season Manager has established a minimum escapement objective of 110,000 Kuskokwim River Chinook salmon and a harvest objective of 22,000 for the 2019 season.

A motion was made on May 17, 2019 for the Kuskokwim River Salmon Management Working Group (Working Group; a State of Alaska advisory body) by Co-Chair LaMont Albertson to support the escapement goal and harvest objective established by the Federal In-Season Manger and KRITFC. Working Group members deferred discussion of that motion until their June 5, 2019 meeting. They requested that USFWS and KRITFC explain how the escapement goal of 110,000 Kuskokwim River Chinook salmon was determined. In addition, ADF&G wanted to share its perspective on this motion.

Position of the Alaska Department of Fish and Game:

- ADF&G **Does Not Support** the fixed minimum escapement objective of 110,000 Kuskokwim River Chinook salmon.
- ADF&G **Does Not Support** the fixed harvest objective of 22,000 Kuskokwim River Chinook salmon.

Justification for the Alaska Department of Fish and Game's position:

Key points –

- ADF&G is required to manage Kuskokwim River salmon fisheries in accordance with escapement goals, management plans, regulations, and policies as established by the state through scientific and public processes.
- ADF&G has established an escapement goal range of 65,000–120,000 Kuskokwim River Chinook salmon based on the best available information, rigorous analyses, and though a formal public process.
- The ADF&G escapement goal incorporates principles of precautionary management, is designed to protect Kuskokwim River Chinook salmon, and is designed to protect and sustain subsistence harvest.
- ADF&G supports management of the fishery to achieve a drainagewide escapement within the range of 65,000–120,000 fish and maximize harvest opportunity for subsistence uses by incorporating uncertainty into the decision-making process.
- ADF&G supports providing preseason harvest outlooks for the purpose of management planning. Harvest outlooks should be presented as a range based on forecast uncertainty and consider the entire escapement goal range.
- ADF&G supports using a probability-based approach to inform inseason fishery management decisions.

- ADF&G supports using the analysis tool (p-star model) developed by USFWS analysts in consultation with ADF&G and others. This interactive model is a documented, scientifically defensible, and transparent method to estimate the probability of achieving the ADF&G escapement goal given alternative harvest scenarios.
- The scientific rationale and supporting analysis for the USFWS and KRITFC 2019 management objectives are lacking, and they do not fully address the concerns expressed by subsistence users to meet escapement goals while also maximizing harvest opportunity.
- Setting the escapement objective to a minimum of 110,000 fish unnecessarily restricts subsistence opportunity.
- Setting the escapement objective to a minimum of 110,000 fish does not guarantee larger runs or more harvest in the future.
- A harvest objective of 22,000 implies a guarantee of harvest by subsistence fisherman, which may not be appropriate under some possible run size scenarios.

Additional information related to ADF&G's position –

- **Escapement-based management**: ADF&G's policy is to manage salmon fisheries to achieve escapements within ranges that can sustain harvest. ADF&G escapement goals are based on the best available information and presented as a range. Escapement goal ranges are harvest management tools. All escapements within the range are expected to promote similar run sizes and harvest opportunities in the future. Within a specific year, however, there is a clear trade-off between escapement and harvest. ADF&G managers must attempt to achieve the escapement goal while at the same time providing subsistence users an opportunity to meet harvest needs. This balance is hardest when run sizes are low and fishing restrictions are needed to achieve escapement goals. Conservative management during years of low abundance is appropriate to ensure escapement goals are met. Conservative management may result in escapements near the upper end or in excess of a goal range, due to assessment and management uncertainty. However, ADF&G disagrees with management strategies that specifically target escapements near the upper end of the escapement goal range by reducing subsistence harvest opportunity when additional surplus is available for harvest. There is no scientific or social justification for such strategies.

  The precautionary approach is built into the ADF&G management process. Escapement is identified as the highest priority management objective. ADF&G escapement goals and management plans are used in combination to promote responsible and sustainable harvest opportunity. Methods used to establish ADF&G escapement goals are conservative by design. Managing for high escapements, even in years of low run abundance, are not needed to protect the population and unnecessarily restrict subsistence fishing opportunity.

- **Kuskokwim River Chinook salmon escapement goal**: ADF&G has established an escapement goal range of 65,000–120,000 Kuskokwim River Chinook salmon based on the best available information and though a formal public process. The ADF&G escapement goal range was established in 2013. It is the first drainagewide goal range established for this stock, and it is the only scientifically based escapement goal that has been proposed to date. The data and analyses

used to develop the ADF&G goal have been extensively reviewed and are consistent with best practices. The escapement goal was most recently reviewed, in some capacity, by ADF&G, USFWS, and an independent review panel funded by AYKSSI. USFWS concluded that the ADF&G escapement goal analysis was "among the most sophisticated approaches that can be used to determine an appropriate escapement goal….". During the run reconstruction model review process, the AYKSSI review panel developed escapement goals for the purpose of data exploration and not recommendation; however, their results were similar to ADF&G's and confirmed the spawner-recruit model selected by ADF&G is conservative. ADF&G concluded that the escapement goal range of 65,000–120,000 is appropriate but the stock was less productive than originally thought. This means that achieving escapements within the ADF&G goal range has the highest potential to promote large runs of Kuskokwim River Chinook salmon and provide for subsistence harvest in future years, but the fish available for harvest in the future may not be enough to support a full subsistence harvest and allow for other uses in all years. ADF&G and others analysis clearly indicates that maintaining escapements near the upper end of the escapement goal is expected to be detrimental to future harvest.

The precautionary approach was specifically incorporated into the Kuskokwim River Chinook salmon drainagewide escapement goal. ADF&G escapement goals for Kuskokwim River Chinook salmon are set at levels well above critical population abundance thresholds and properly incorporate data uncertainty. The Ricker spawner-recruit model used by ADF&G has been shown through independent review to result in a more conservative escapement goal compared to alternative models. In addition, the goal range was set higher than the range that would theoretically maximize future harvest and instead is more likely to maximize future run sizes. The lower bound of the goal was set at a level that was known (through prior observation) to be sustainable and return run sizes capable of supporting full unrestricted subsistence harvest. All escapements within the goal range have statistically similar expectations of producing future run sizes.

- **Kuskokwim River Chinook salmon conservation**: Kuskokwim River Chinook salmon runs have been below average since 2010, However, the run sizes in recent years (i.e., 2015–2018) are well above levels that would indicate the population is at risk. Furthermore, tributary escapement goals in recent years have generally been met, and the drainagewide goal has been met annually since 2014. Escapements in the lower half (65,000–92,5000 fish) of the goal range do not put the population at risk of extirpation. Stated another way, there is currently no conservation concern for the Kuskokwim River Chinook salmon population.

  We are concerned that fundamental misunderstandings of ADF&G's escapement goals and the history of escapement goal performance has led to an overly conservative management regime that unnecessarily restricts subsistence fishing opportunity. Currently, because there are enough fish to meet escapement goals, ADF&G's primary concern regarding Kuskokwim River Chinook salmon is to provide as much subsistence harvest opportunity as possible, while ensuring the escapement goals will be met. Management strategies that target the upper end of ADF&G escapement goal range (especially in years of low run abundance) are inconsistent with ADF&G policy, ignore repeated requests by subsistence fishers for more opportunity; and may be

detrimental to future harvest. Rigorous analysis conducted by ADF&G and others provide no support for the notion that targeting the upper end of the goal range will lead to faster stock rebuilding or that this tactic is better for some other biological reason. The most effective way to promote long-term healthy fisheries is to 1) consistently achieve varied escapements throughout the range of 65,000–120,000; 2) harvest fish of different ages, sizes, sexes, and genetics in proportion to their abundance; and 3) maximize annual harvest opportunity for subsistence uses.

Escapement goals are a spawning investment strategy for the future, and they take time. Recent year spawning investments will not be realized until years 2020–2022 when all major age classes (age 4, 5, and 6) will return from consecutive years when the drainagewide escapement goal was met. While there are no guarantees that recent spawning investments will return large runs, the expectations are high. For example, productivity (measured in recruits per spawner) from the 2011–2013 escapements are above average compared to the entire historical dataset and consistent with model projections. Given the uncertainty in survival of eggs in the gravel to adult fish, fishery managers should not ask subsistence users to unnecessarily sacrifice fishing opportunity to achieve high escapement levels in the hopes that environmental conditions change for the better.

- **USFWS and KRITFC escapement goal, 110,000 Kuskokwim River Chinook salmon**: ADF&G is unclear how the minimum escapement objective of 110,000 was determined, and the scientific justification provided by USFWS and KRITFC is unsubstantiated. Analysis by ADF&G and others demonstrate that consistent escapements near the upper end of the ADF&G escapement goal range could be detrimental to subsistence users over the long-term. In the short-term (2019), fishing opportunity will be unnecessarily reduced if escapements near the upper end of the goal range are specifically targeted. ADF&G does agree that tributary escapement goals are more likely to be achieved when drainagewide escapements are higher, but that tactic may not be optimal if more directed management actions can be taken to reduce harvest of less productive or less abundant stock components. To our knowledge, formal analyses that describe the influence of the Kuskokwim River drainagewide escapement goal on fish returning to individual tributaries are limited, currently unpublished, and have not been peer reviewed. ADF&G cautions using preliminary results of these studies to modify escapement goals. Nevertheless, escapements above the lower bound of the ADF&G escapement goal could help achieve some tributary escapement goals and provide protections to the less productive stock components. For those reasons, ADF&G supports a probability-based management approach that reasonably assures escapements will exceed 65,000 combined with time and area closures directed at protecting specific stock components as needed.

United States Fish and Wildlife Service (USFWS), Yukon Delta National Wildlife Manager

Position on the 2019 Escapement and Harvest Objectives

In consultation with the Kuskokwim River Inter-Tribal Fish Commission (KRITFC), the Federal In-Season Manager (Manager) as delegated authority by the Federal Subsistence Board has agreed to establish an 2019 escapement objective of 110,000 Kuskokwim River Chinook Salmon requested by the KRITFC, which implies a harvest target of 22,000 when compared to the mid-point (132,000) of the preseason forecast (115,000 – 150,000).

A motion was made on May 17, 2019 for the Kuskokwim River Salmon Management Working Group (KSMWG) to support the escapement goal and harvest objective established by the Manager and the KRITFC. Working Group members deferred discussion of that motion until their June 5, 2019 meeting. KSMWG members requested that the USFWS and the KRITFC explain how the escapement goal of 110,000 Kuskokwim River Chinook Salmon was determined. Following this meeting, the KRITFC and Alaska Department of Fish and Game (ADF&G) provided documents sharing their perspective about the escapement target of 110,000 , which was shared during the June 5, 2019 KSMWG meeting. The conversation on the escapement target was deferred by the KSMWG until the next meeting on June 14, 2019. After reviewing the ADF&G and KRITFC documents regarding identification of escapement goals, the YKD Manager provides the following Service perspective on the establishment of escapement goals for the 2019 Kuskokwim River Chinook Salmon season. To appropriately understand the Service's process to establish an escapement goal it is important to understand the science Service employees evaluated and the negotiation and consultation process utilized with the KRITFC to select the final 110,000 objective. The below management strategy is written to detail the Manager's perspective on management of the 2019 Chinook Salmon subsistence fishery.

2019 Kuskokwim River Chinook Salmon Federal In-Season Manager's Strategy

The overall adaptive management goal is to take what has been learned in recent years and implement a robust strategy that will reflect a balance of conservation and continuation of subsistence uses for Federally qualified subsistence users within the Kuskokwim River drainage.

To ensure we meet this adaptive management goal, managers, biologists, and partners involved with in-season management have gained a considerable amount of new knowledge pertaining to the dynamics of Chinook Salmon in the Kuskokwim River. Additionally, information gathered on harvest within the Refuge from monitoring the Kuskokwim River subsistence salmon fishery has provided useful harvest and effort estimates for use in fishery management decisions and have also helped everyone better understand fishery dynamics during short duration block openers (6 – 72 hours). With this new knowledge, modeling tools created for the Kuskokwim River have allowed managers to use the best available science to assist in establishing in-season escapement objectives that account for management and assessment uncertainty, while also allowing managers to recognize and communicate risk tolerances.

Objectives:

Conservation

1.) Ensure enough escapement to maintain stock productivity, under a range of potential environmental factors.
2.) Provide sufficient drainage-wide escapement to have a high likelihood of meeting tributary specific escapement goals
3.) Maintain protection for early running headwater stocks of Chinook Salmon

Harvest

1.) Provide reasonable harvest opportunities for Chinook Salmon to Federally qualified subsistence users in order to protect the continuation of subsistence uses.
2.) Equitably distribute harvest opportunities to Federally qualified subsistence users throughout the Kuskokwim River drainage.
3.) Schedule some of these harvest opportunities for Chinook Salmon in advance of the season, in order to assure Federally qualified subsistence users will have opportunities to fish during the season.

Review of Best Available Science

In developing this annual strategy we considered the best available science to include the *Spawner Recruit Analysis, Run-Reconstruction Analysis, and the Forecast Model.* A brief summary of critical data considered from the analysis and models follows. See **Attachment A** for the complete discussion.

Spawner Recruit Analysis: The drainage-wide sustainable escapement goal (SEG) established by ADF&G in 2013 (and reaffirmed in 2019) for Kuskokwim River Chinook Salmon is 65,000 – 120,000 fish. The updated spawner-recruit analysis performed in 2018 indicated that the current goal is sustainable, includes the range of escapements with the highest likelihood of maximizing future run-sizes, but does not ensure future yields large enough to support unrestricted subsistence fisheries (> 100,000 potential harvestable surplus).

Run-Reconstruction Analysis: The best available data is being used in the generation of drainage-wide abundances and escapements produced by the Chinook Salmon run-reconstruction model. The Manager believes every reasonable step possible has been taken to fully address the uncertainty in the data available to manage the stock and to obtain robust management targets, to include: (1) a full review of the run reconstruction model performance; (2) the determination of a biologically-defensible escapement goal range derived from a state-space model; and (3) the P-star mode now used for in-season assessment and management to set harvest targets.

*Forecast Model: P*re-season forecasted run-size ranges for Kuskokwim River Chinook Salmon are produced where the range is equal to the prior year run-size plus or minus the recent seven-year average percent deviation of subsequent year runs. This method has worked well in recent years (since 2014) because of the consistently lower than average run-sizes.

Last year's (2018) run-size published by ADF&G is 132,312 Chinook Salmon (95% CI: 104,858 – 166,954). The pre-season forecast for 2019 Chinook Salmon is for 115,000 – 150,000 fish (midpoint = 132,000 fish).

The Manager's position is the State pre-season forecast and the Pstar model provide the best available information for managers and stakeholders to provide estimates for the 2019 Chinook Salmon run. The Pstar model allows the Manager to assess risk tolerance levels in establishing and recommending pre-season escapement objectives and harvest targets.

Establishment of Escapement Objectives

Setting Escapement Objectives

The Manager, through the consultation process, accepted the escapement objective of 110,000 recommended by the KRITFC. However, based on the Service's scientific analysis an escapement objective of 95,000 Chinook Salmon could meet the Service conservation and subsistence objectives. The reasoning and science justifying the Manager's preferred 95,000 escapement objective include:

- First, the 95,000 objective provides a 30,000 fish buffer above the lower end of the ADF&G escapement goal, which prevents the eventual run-size from being close enough to escape the bare minimum number of Chinook Salmon (in relation to the SEG).
- Second, the 95,000 escapement target ensures a more than adequate probability (95% CL: 70 – 96%) of meeting tributary escapement goals on systems monitored by weirs and more than a 50% (95% CL: 60 – 80%) chance of meeting tributary escapement goals on systems monitored by aerial surveys (**Figure 1** and **2**).[1]
- Third, based on the Federal in-season manager's risk tolerance for the 95,000 escapement objective (50% chance of falling above or below), the Pstar model indicates there is only a 16% chance (~ < 1/5 chance) of going below the lower bound of the drainage-wide escapement goal of 65,000 Chinook Salmon. The expected escapement based on this level of risk tolerance and the preseason forecast is for 100,000 Chinook Salmon. For a table of results from the Pstar model for the recommended escapement objective please refer to **Table 1**.
- Fourth, the Manager's recommendation is also based on an examination of the recent actual run/escapement performance of the stock and how this performance can inform us on the cost and benefits of managing for the upper end of the escapement goal (like what has been done since 2016). This was done through an investigation of the spawner-recruit analysis for the stock and a simple management strategy evaluation (MSE), which allowed the Manager to measure management performance when targeting different targets within the escapement goal range. This analysis can be found in **Attachment B**. Because of this new information, the Manager is comfortable in providing more harvest than in recent years as the continued poor productivity of the stock and the management strategy evaluation indicate that the fishery is more likely to lose harvest opportunities without the additional benefit of guaranteeing future higher productivity.

[1] Analysis performed as logistic regression with drainage-wide escapement as independent variable and dependent variable as binary indicator for whether tributary above lower bound of the current goals in any given year. Analysis only performed on systems with tributary escapement goals (Kwethluk, George, Kogrukluk, Kisaralik, Salmon (Aniak), Aniak, Cheeneetnuk, Gagaryah, and Salmon Pitka. Results from analysis are ballpark numbers.

The Manager believes setting the escapement objective at 95,000, for the reasons above, provides a balance of conservation and subsistence needs.

Table 1. Quantities of interest obtained from Pstar model for the risk tolerance expressed by the Federal in-season manager. Pr(S < X) is mathematical way of stating the following: The probability of escapement falling below 65,000 (lower end of SEG) is around 16%

Quantity	Pr(S < 95,000) =0.5
Additional Harvest	**32,000**
Expected Escapement	**100,000**
Pr(S < 65,000)	16% (~ 1/5)
Pr(S > 120,000)	26% (~ 1/4)
Pr(65,000 < S < 120,000)	58% (~ 3/5)
Pr(S > 110,000)	34% (~ 1/3)
Pr(95,000 < S < 120,000)	24% (~ 1/4)

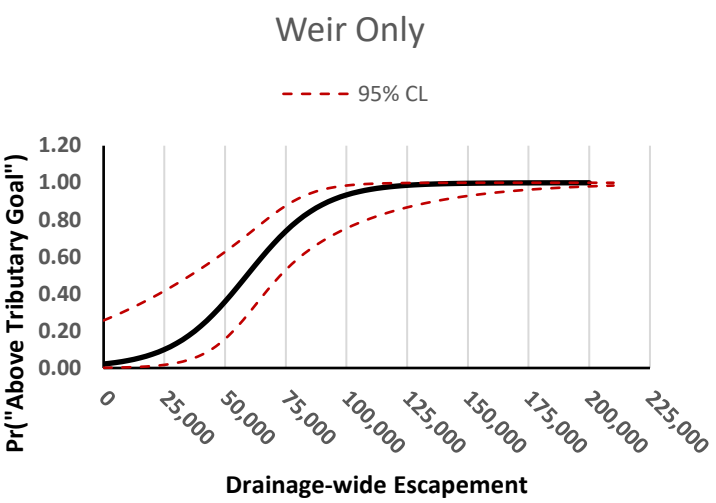


Figure 1. The probability of going above the lower bound of the tributary goal monitored by a weir in relation to drainage-wide escapement. Red dashed lines are 95% confidence intervals around the mean. Confidence intervals are wider than aerial because only three tributaries with escapement goals.

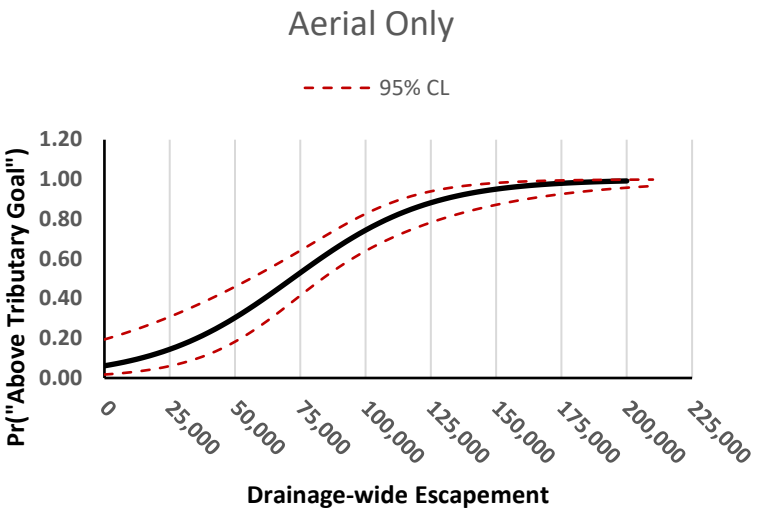


Figure 2. The probability of going above the lower bound of the tributary goal monitored by an aerial survey in relation to drainage-wide escapement. Red dashed lines are 95% confidence intervals around the mean.

Harvest Target and Strategy (**Attachment C**)

Based on the results of the Pstar model, the Manager is comfortable with an implied harvest target of 32,000 Chinook Salmon during the 2019 subsistence fishery. However, given that the KRITFC has a more conservative approach, the Manager has agreed to target an 110,000 escapement target and an implied harvest of 22,000 fish. The Manager's acceptable harvest limit is anything between 22,000 and 32,000 Chinook Salmon. The discussion below outlines the Manager's recommendation to the KRITFC as a part of the consultation process.

For the 2019 Chinook Salmon subsistence fishery season, the Manager recommends proceeding with a semi-scheduled fishery, in which initial opportunities during the fishing season are announced well in advance of the season and then additional opportunities are provided during the season as in-season data is collected and analyzed. This recommendation is essentially an extension of what was done during the 2018 season (i.e. announcing the June 12 and June 16 opportunities in advance). The advance notice of the opportunities provides certainty to the users of fishing opportunities.

Based on the in-harvest monitoring since 2016 the expectation is that any 12-hour harvest opportunity provided during the June 12 – June 30 time frame will result in a harvest of Chinook Salmon in between 3,000 – 7,000 fish per opportunity. With a harvest target of 22,000 Chinook Salmon, the Manager feels that anywhere from 3 to 5 12-hour subsistence harvest opportunities can be provided. With a harvest target of 32,000 Chinook Salmon, the Manager initially feels that anywhere from 5 to 8 12-hour subsistence opportunities can be provided in the June 12 – June 30 timeframe (**Table 2)**. With the 19 days in this time frame, we are confident that at least one 12-hour opportunity per week can be announced in advance of the season with no concerns of exceeding the harvest target if the pre-season estimated run materializes as predicted

Table 2. The approximate number of 12-hour opportunities that could be provided between June 12-June 30 timeframe based on a range of risk tolerances of falling below the Manager's recommended escapement objective of 95,000 Chinook Salmon. Red shaded cells: <1 opportunity per week, Yellow: at least one opportunity a week, Green at least two opportunities per week, Blue at least three opportunities per week, and Gray at least half the week per week.

Pr(S < 95,000)	Pr(S < 65,000)	Harvest	Harvest per 12-hour opportunity				
			3,000	4,000	5,000	6,000	7,000
0.01	0.01	0	0	0	0	0	0
0.05	0.01	0	0	0	0	0	0
0.10	0.01	0	0	0	0	0	0
0.20	0.02	6,000	2	2	1	1	1
0.25	0.03	11,000	4	3	2	2	2
0.33	0.06	18,000	6	5	4	3	3
0.50	0.16	32,000	11	8	6	5	5

Other Strategies and Perspectives

Front End Closure

The Manager's recommendation to ADF&G for the starting date of future front-end closures is June 1. This recommendation is based on the decision made by the Federal Subsistence Board (Board) during its April 2019 meeting, where the Board passed a fisheries regulation that prevents restrictions on six-inch or less gillnets before June 1 in the Kuskokwim River for Federally qualified users. Beginning the front-end closure on this date makes State and Federal regulations seamless and less confusing for subsistence users.

The Board's rationale for the June 1 decision, recognized the intent of the early season closures to protect the front-end of the Chinook Salmon run (known to return to the upper Kuskokwim River drainage) in order to distribute harvest to the middle and upper communities within the drainage. However, the Board also recognized that the historic timing of the closures (between May 20 and May 30 from 2016-2018) have severely limited gillnet opportunities for non-salmon species, such as white and Sheefish by Federally qualified subsistence users during a time when less than 1% of the Chinook Salmon run has entered the Kuskokwim River. Although four-inch set net opportunities have been provided, many subsistence users have preference for six-inch gear in order to harvest larger whitefish and sheefish species.

6" Set Gillnet Opportunities

During the front-end closure, the Federal in-season manager believes 6" set gillnet opportunities should be provided to provide qualified users with a "taste of salmon" opportunity during the early portion of the season. These opportunities coincided with the ADF&G announcements for 4" set gillnets for non-salmon species for State users.

Through consultation with the KRITFC and independent village visits by Refuge staff, all subsistence users have expressed their dislike for 4" mesh size set gillnets in the river when Chinook Salmon are present, as they are perceived as "salmon" killers. Based on the discussions with villages, the 4 inch mesh opportunities between June 1 and 11, result in lost salmon as they drop out from the net more than with 6 inch mesh gear. With this is mind, the Federal in-season Manager believes the action to use 6 inch mesh set gill nets will help alleviate these concerns heard from all of the villages during the pre-season as it will provide Federally qualified subsistence users with the option to use larger size gear. Larger mesh size will also provide qualified users a more efficient pathway to harvest small numbers of Chinook Salmon when present in the river. It is expected that qualified users will harvest few Chinook Salmon during these opportunities (~ 1,000 Chinook Salmon). Traditionally during this time period, many subsistence users will opportunistically harvest Chinook Salmon while fishing for other larger non-salmon species like Sheefish. Subsistence users typically are focusing their efforts getting a taste of fresh Chinook Salmon during this time period.

It is expected that Federally qualified subsistence users will not harvest enough Chinook Salmon during these opportunities to surpass our recommended harvest target. The data from last year's 12-hour 4" set gillnet opportunity on June 6, 2018 was estimated at 60 – 140 Chinook Salmon (compared to 200 – 400 non-salmon species harvested during that same time period)

(https://www.fws.gov/uploadedFiles/Harvest_Estimates_6_6_18.pdf). These harvest estimates were generated for a 4" set gillnet opportunity and the Federal in-season manager believes that the limited Chinook Salmon harvest during this time period was primarily due to net length and operational restrictions, rather than the mesh size restrictions. Restricting net length to 60 feet or less, 45 meshes or less, bank orientation, and cannot be operated more than 100 feet from the ordinary high water mark provides additional conservation measures for Chinook Salmon. These operation restrictions generally prevents Federally qualified subsistence users from fishing in the deeper channels of the river where Chinook Salmon typically swim.

Our assumptions about providing the 6-inch set gillnet opportunities were correct according to estimates calculated for June 1 and June 6 of this year. Total harvest during the two 6-inch set gillnet opportunities was 1,060 Chinook Salmon (Range: 820 – 1,340 fish).

Conclusion

The Manager believes 2019 Chinook Salmon strategy (using a 95,000 escapement goal) is robust and reflects a balance of conservation and the continuation of subsistence uses for Federally qualified users of the drainage. We are confident this strategy uses the best available science, recognizes the uncertainty in assessment tools, and provides a precautionary approach.

The establishment of an escapement objective of 95,000 Chinook Salmon for the 2019 Chinook Salmon subsistence fishery will conserve Chinook Salmon populations, maintain diversity of individual sub-stocks of Chinook Salmon (guard against population viability issues), and provide more than enough opportunities for subsistence users to harvest Chinook Salmon, depending on the pre-season forecast. However, through the consultation process with the KRITFC, the Manager is comfortable with targeting an escapement objective of 110,000 Chinook Salmon as it is within our limit (95,000 Chinook Salmon) and the primary user group is willing to accept a more conservative approach.

The combination of not restricting the use of gillnets for subsistence users before June 1 and allowing for 6" set gillnet opportunities that coincide with ADF&G 4" set gillnet opportunities provides for the continuation of subsistence uses for Sheefish and other larger whitefish species. Additionally, these additional opportunities provide a minimal risk to headwater Kuskokwim River Chinook Salmon stocks and allow for the continuation of subsistence uses for Chinook Salmon in the lower Kuskokwim River.

Finally, providing advance notice opportunities for subsistence users allow people to plan for fishing opportunities, which provides certainty to subsistence fishermen and reduces the complexity of in-season management. Given the conservative and science-led approach used to decide escapement and harvest objectives, the Manager believes announcing this many opportunities will not jeopardize the conservation of healthy Chinook Salmon populations within the Kuskokwim River.

ATTACHMENT A

Review of Best Available Science

Spawner Recruit Analysis

The drainage-wide sustainable escapement goal (SEG) established by ADF&G in 2013 (and reaffirmed in 2019) for Kuskokwim River Chinook Salmon is 65,000 – 120,000 fish. The updated spawner-recruit analysis performed in 2018 indicated that the current goal is sustainable, includes the range of escapements with the highest likelihood of maximizing future run-sizes, but does not ensure future yields large enough to support unrestricted subsistence fisheries (> 100,000 potential harvestable surplus).

Additionally, during escapement goal review stakeholder meetings in early 2018, there was considerable discussion about establishing a drainage-wide goal that would mitigate the risk of harvesting individual sub-stocks to ensure adequate escapement levels at individual tributaries. There was also a general support for basing the drainage-wide goal on the range of escapements that would maximize future run-sizes instead of future yield (i.e. maximizing yield may be a lower management priority compared to maintaining consistently large runs that would allow for subsistence users to meet harvest goals).

During the review of the Kuskokwim River Chinook Salmon SEG in 2018, Dr. Ben Staton and Gary Decossas, investigated how the revised run-reconstruction would influence the Kuskokwim River Chinook Salmon escapement goal. A letter by the Manager was sent to ADF&G during the escapement goal review process in 2018. Additionally, Refuge staff investigated the time series of productivity produced by the spawn-recruit analysis for the stock and a simple management strategy evaluation to measure management performance when targeting different objectives within the escapement goal range. A summary of the information is described below.

The results of these investigations show that recent poor runs are not due to overfishing, but because of a fairly prolonged period of poor productivity (this poor productivity period that the stock still seems to be in). This poor productivity regime has shown large variations in escapement that all seemingly lead to a capped low return, suggesting more escapement may not necessarily result in larger future run-sizes. In addition to these results, the management strategy evaluation suggested that measureable losses in management performance exist when targeting the upper end of the escapement goal range; measurable loses include: no guaranteed benefit to increase future run-sizes, less harvest with higher variability, and increased frequency of closures.

Run-Reconstruction Analysis

The Manager's positon is that the best available data is being used in the generation of drainage-wide abundances and escapements produced by the Chinook Salmon run-reconstruction model. The run-reconstruction model has undergone an incredibly thorough peer review and revision process (which included the incorporation of the most recent mark-recapture estimates). This collaborative review process included staff from ADF&G, USFWS, KRITFC, Auburn University, and Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYKSSI).

The Manager believes every reasonable step possible has been taken to fully address the uncertainty in the data available to manage the stock and to obtain robust management targets, to include: (1) a full review of the run reconstruction model performance; (2) the determination of a biologically-defensible

escapement goal range derived from a state-space model (the entire purpose of which is to properly deal with uncertainty in the data);and (3) the probabilistic approach now used for in-season assessment and management to set harvest targets (i.e., the P-star model).

Forecast Model

Pre-season forecasted run-size ranges for Kuskokwim River Chinook Salmon are produced by a method in which the range is equal to the prior year run-size plus or minus the recent seven-year average percent deviation of subsequent year runs. The average percent deviation is not a fixed value; rather, it varies as a function of similarity in run-sizes observed. This is a simple method that has worked in recent years (since 2014) because of the consistently lower than average run-sizes.

The 2018 run-size published by ADF&G is 132,312 Chinook Salmon (95% CI: 104,858 – 166,954). The pre-season forecast for 2019 Chinook Salmon would be approximately for 115,000 – 150,000 fish (midpoint = 132,000 fish). This forecast does not give the probability of any given run-size within the forecast, all run-sizes in the range are equally likely.

However, during the past year Refuge staff (in collaboration with others) have developed the Pstar tool which produces a run-size forecast that takes into account the full uncertainty in the pre-season forecast (i.e. considers variation in all years rather than just the previous seven years). The Pstar model and the preseason forecast are just only one part of the entire package. The preseason forecast for 2019 as generated from the PStar model can be found in **Table 1**.

The Manager's position is the State forecast and the Pstar model provide the best available information for managers and stakeholders to provide estimates for the 2019 Chinook Salmon run. The Pstar model allows the Manager to assess risk tolerances levels in establishing and recommending pre-season escapement objectives and harvest targets.

Table 1. Pre-season forecast table for 2019 produced from Pstar model.

Statistic	Forecast
Mean	132,000
SD	37,000
CV	0.28
2.50%	74,000
10%	89,000
25%	106,000
50%	127,000
75%	153,000
90%	181,000
97.50%	218,000

In-Season Utility of the Bethel Test Fishery

The Manager believes the utility of the Bethel Test Fishery (BTF) to accurately predict the in-season run abundance of Chinook Salmon is minimal and only generally informs managers on the composition (i.e. Chum/Sockeye: Chinook ratios) of run throughout the course of the season. The Manager accepts the uncertainty in run-size information from the BTF and therefore does not recommend using the test fishery to inform run-timing or run abundances until at least the latter part of June.

As stated many times over, the relationship between CPUE and true run abundances are confounded by run-timing variability and sampling variability. Efforts have been made to resolve our ability to predict run-timing; however, unfortunately, these efforts have not led to any improvements thus far.

In 2018, Ben Staton and others created a tool for managers that used information from the Bethel Test Fishery to update the pre-season forecast in a Bayesian format. Research demonstrates that the BTF data does not provide accurate or confident run-size estimates. The pre-season information should still have the most influence on the in-season perception of run-size and any resulting management decisions. However, later in the season, when BTF data provide a more accurate and confident run-size estimate, it can start to overwhelm the pre-season information by either reinforcing what was previously though or changing it.

Additionally, Ben Staton and Matt Catalano published a paper at the end of 2018 in the Canadian Journal of Fish and Aquaculture Sciences (https://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2018-0176). This paper formalized the ideas of the Bayesian tool mentioned in the previous paragraph (i.e. determine if updating provides better inference than using either the forecast or in-season estimates along), while also trying to answer if auxiliary run-timing information would assist in producing more accurate/precise inferences

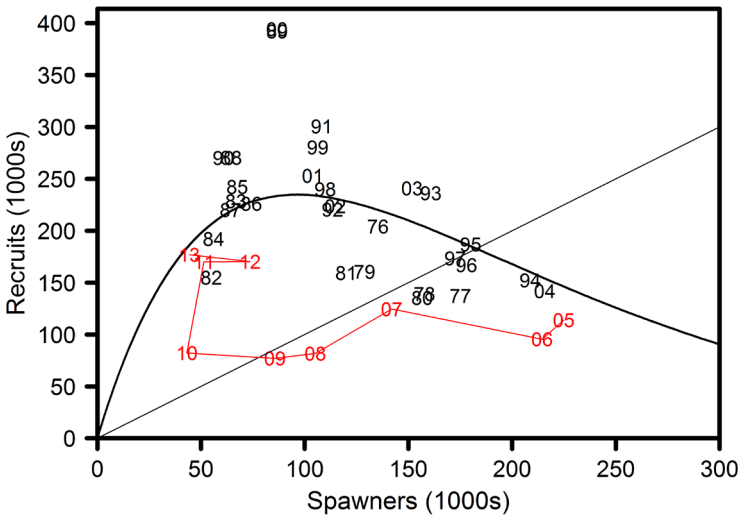
The results of the analysis in the paper suggest:

- Using the Bayesian in-season updating procedure would provide approximately the same (if not more accuracy) as either: utilizing only the pre-season forecast or only in-season estimates.
- Relatively predictable nature in recent years (i.e. preseason forecast is accurate)
- High degree of annual sampling variability led to uninformative in-season data.

ATTACHMENT B

ASSESSMENT ON PRODUCTIVITY OF THE STOCK

Figure 1. Spawner-recruitment plot.



We would like to illustrate "why" runs have been low in recent years (no mechanisms, just patterns). There are several ways to illustrate this, but we will begin with the standard spawner-recruit plot shown in **Figure 1**. Each year on the plot is the brood year pair of spawning escapement and returning recruits, and the red set shows the brood years that placed (and maintained) the stock in the current low run regime. For example, the 2007 brood year shows the escapement in 2007 on the x-axis and the number of fish that returned to spawn in the run years 2011 – 2014 as ages 4 – 7. **Figure 1** shows a trend of escapements becoming systematically smaller over time since 2005, but escapements between 2007 and 2010 had much lower recruitment than would be expected based on a stationary recruitment curve. **Table 1** shows the run years and ages these brood year recruits returned (grey are brood years with poor *expected* recruitment, red are brood years with poor *unexpected* recruitment, and blue is a brood year with good recruitment).

Table 1. Year and age of return for the recent brood years.

Run Year	Age 4	Age 5	Age 6	Age 7
2010	2006	2005	2004	2003
2011	2007	2006	2005	2004
2012	2008	2007	2006	2005
2013	2009	2008	2007	2006
2014	2010	2009	2008	2007
2015	2011	2010	2009	2008
2016	2012	2011	2010	2009
2017	2013	2012	2011	2010

Brood years 2004 – 2006 had low expected recruitment due primarily to overcompensation and resulted in low runs in starting in 2010 (whether one chooses to believe in over compensatory mechanisms or not, **Figure 2** clearly shows that high escapements are associated with low recruitments for this stock, therefore we use the term "overcompensation)". Brood years 2007 – 2010 had substantially worse-than-expected recruitment. This pattern has seemed to improve starting in 2011, though we caution in this interpretation as these recruitment events have not yet been completely observed (**Table 3**), but are instead estimated based on an assumed stationary maturity schedule and the estimated correlation in recruitment anomalies, thus they become shrunken toward the mean recruitment curve. This can be illustrated by looking at the recruitment anomaly time series, shown in **Figure 2**. The prolonged period of poor recruitment anomalies started in 2005 and began to show some improvement in 2010. The 2011 brood year has shown close-to-expected recruitment, though still poor: this brood year is only missing one age class (age 7 which will be observed in 2018, age 7 fish make up approximately 3% of all mature fish) so can be considered largely complete. The 2012 and 2013 recruitments only have 2 and 1 ages observed, respectively, thus are more susceptible to the shrinkage. 2007 was the last brood year included in the Hamazaki et al. (2012) analysis (Figure 7 therein shows the shrinkage for brood years 2005, 2006, and 2007, which we know now were poor recruitment anomalies - Figure 3, this document).

Figure 2. Time series of recruitment anomalies.

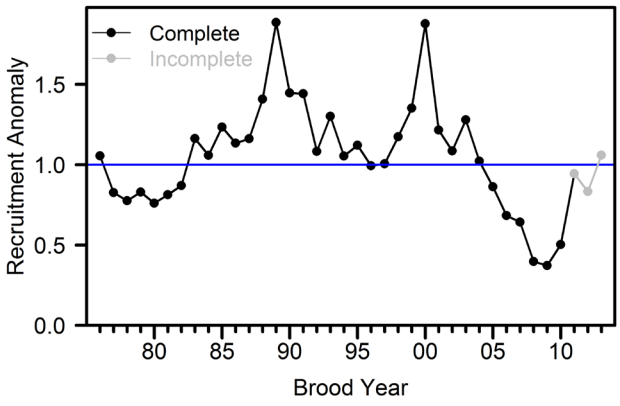
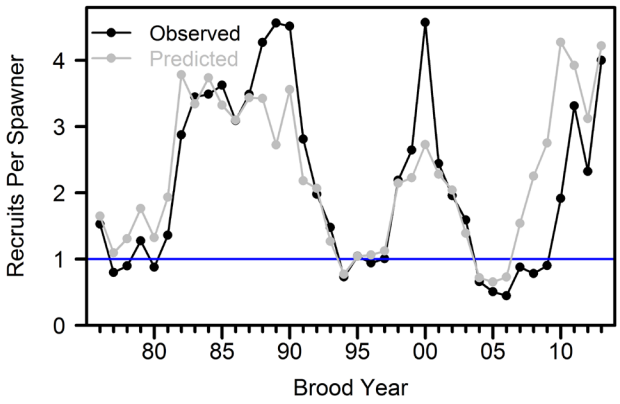


Figure 3. Time series of recruits-per-spawner



Another way to view this is in terms of the number of recruits produced by each spawner, or recruits per spawner, as shown in **Figure 3**. Really poor production began in brood year 2007 and continued through brood year 2010, as evidenced by the vertical difference between the grey and black lines.

While these figures do not shed any light on the mechanisms driving the observed poor productivity, they do illustrate when they must have occurred and attempt to drive the point home that recent poor runs are the result of events that happened in the past that were entirely outside of management control. This is an enormously important point to emphasize: the poor runs in recent years were not driven by poor escapement. The same levels of escapement observed between 2007 and 2012 have been observed many times before and produced more than adequate levels of recruitment to sustain subsistence fisheries (**Figure 1**). The poor runs were instead a result of poor productivity, presumably in the ocean-phase of the life cycle, and would almost certainly have been experienced even if no fish had been harvested in the brood years that produced them.

MANAGEMENT STRATEGY EVALUTATION COMPARING THE PERFORMANCE OF DIFFERENT LEVELS OF FIXED ESCAPEMENT

In recent years, it has been argued that aiming for the upper end of the escapement goal range is beneficial from a management perspective because it will lead to faster stock rebuilding. This has been justified based on the precautionary approach to fisheries management: when the data are uncertain regarding current stock status, it is better to be more conservative because the long-term losses for the biological and societal aspects of the resource of overfishing versus under fishing the stock are asymmetric. In general, lighter exploitation is the answer to faster stock rebuilding *when the cause of low stock abundance is overfishing*. However, as was shown in the first section of this memo, the stock has not been depressed because of overfishing but instead because of a fairly prolonged period of poor productivity.

A reasonable argument that there was management uncertainty due to inconsistent data existed in the years 2015 – 2017 when forecasts generated by the run reconstruction and mark-recapture estimates disagreed largely in the suggested amount of harvestable surplus (by approximately 30,000 – 40,000 fish). However, now that the run reconstruction model has undergone an incredibly thorough review and

revision process (which included the incorporation of the recent mark-recapture estimates), this argument should no longer be seen as valid. In fact, strong arguments exist to claim that every reasonable step possible has been taken to fully address the uncertainty in the data available to manage the stock and to obtain robust management targets, ranging from (1) a full review of the run reconstruction model performance to (2) the determination of a biologically-defensible escapement goal range derived from a state-space model (the entire purpose of which is to properly deal with uncertainty in the data) to (3) the probabilistic approach now used for in-season assessment and management to set harvest targets (i.e., the P-star model).

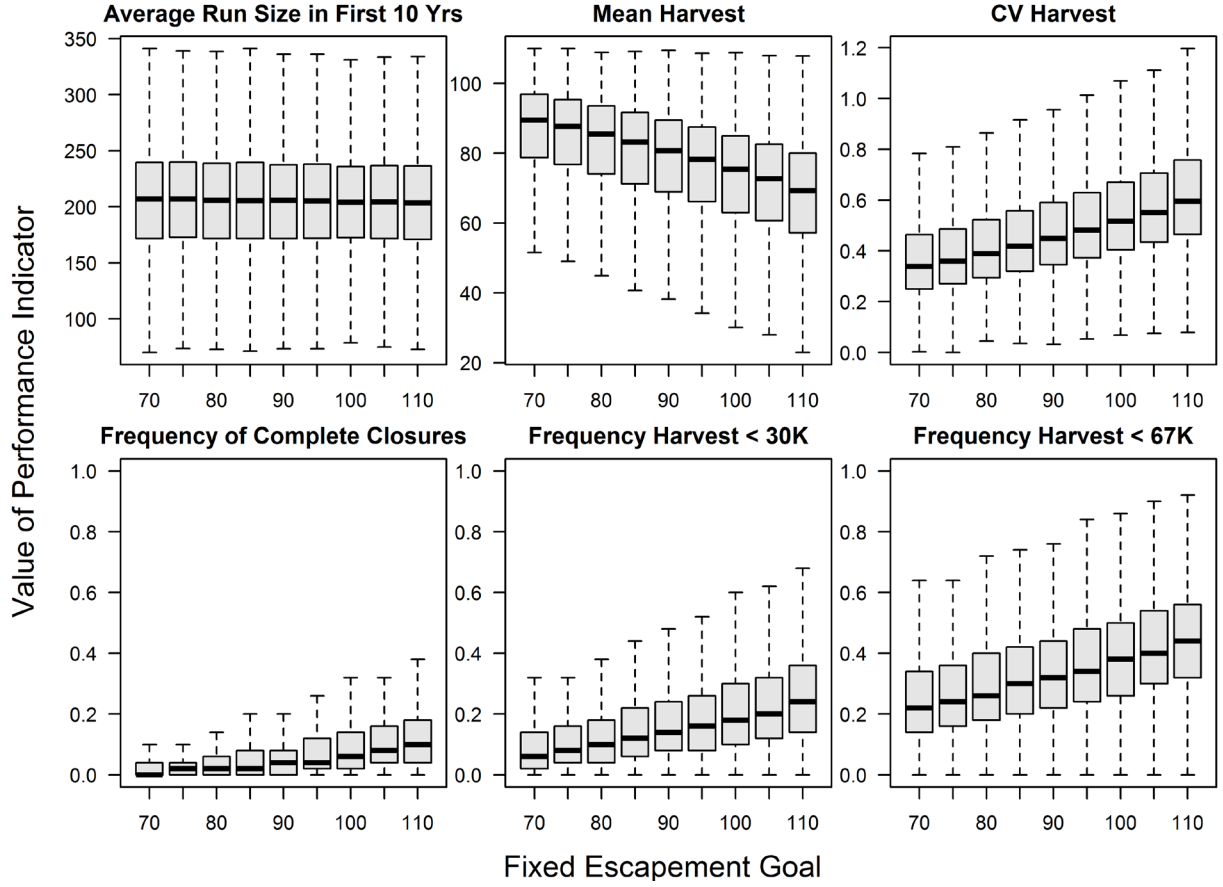
It can be shown, using the biological and statistical theory that govern the stock dynamics, that measureable losses in management performance exist when targeting the upper end of the escapement goal range. To illustrate this concept, we performed a management strategy evaluation. This approach simulates the stock dynamics as estimated from the state-space spawner-recruit analysis and implements different candidate management strategies (e.g., targeting 70,000 escapement versus 90,000 escapement year after year). The performance of each of these different strategies can then be summarized using a suite of management performance indicators. We selected the following six indicators:

(1) The average run abundance in the first 10 years,
(2) The average annual harvest,
(3) The CV (variability) of annual harvest,
(4) The frequency of complete fishery closures,
(5) The frequency that harvest was less than 67,000 fish (approximate smallest harvest in unrestricted years since 1990), and
(6) The frequency that harvest was less than 30,000 fish.

The analysis was performed using estimates from the state-space model fitted to the new run reconstruction estimates without doubling the CV of the observed abundance states. Approximately 10,000 posterior samples were drawn for all the necessary parameters needed to simulate the age-structured stock dynamics starting in 2018 and projected out for 50 years. Run size forecasts were made annually with an assumed CV of 0.27 (the current level of forecast error) and implementation error was made with a CV of 0.1 (i.e., the management system had error in perceiving the true run size as well as in harvesting the suggested harvestable surplus in any given year). Maximum annual harvest was capped at 110,000 fish (the approximate largest historically observed subsistence harvest of Chinook salmon).

The output of the analysis is displayed in **Figure 4**. The first thing to note is that it is clear that the expected average run size in the first 10 years is the same regardless of the escapement target used, which does not support the claim that higher escapements will lead to faster stock rebuilding. Next, is that average harvest is lower at higher escapements than at smaller escapements, and the variability of harvests (CV) increases with higher escapements. The frequency of complete fishery closures and of lower than needed harvests increase with higher escapements as well. *All of these patterns show no gain in performance for targeting higher levels of escapement.*

Figure 4. Boxplots showing the tendency and variability in the various performance indicators used in the analysis. The heavy black lines are the median values across simulations, the grey boxes are the interquartile range, and the dashed lines are 95% intervals.



The finding that the fixed escapement target had no effect on the average abundance in the first 10 years is driven by the fact that recruitment dynamics are governed by environmental effects as well as by stock size effects (Walters and Collie 1988). The presence of assessment and implementation errors also plays a role (though these effects are smaller than due to environmental effects). This environmental variability is present for all fish populations in the world and is the dominant reason why the spawner-recruitment relationship performs poorly at forecasting abundance: management can put as many fish as possible on the spawning grounds, but ultimately Nature decides how the juveniles survive and how many adults come back to spawn. The other patterns are driven by two considerations. First, the stock is fairly productive (expected maximum of 6 recruits per spawner) and is most productive at low stock sizes. This is due to the notion of compensation: per capita productivity is highest at low densities due to the dampening of density dependent mortality mechanisms (e.g., competition for prey resources resulting from high juvenile densities causes juveniles to grow more slowly resulting in higher mortality). The existence of compensation is true regardless of if you assume Ricker dynamics (low recruitment at high spawners, as used for the Kuskokwim Chinook stock) or Beverton-Holt dynamics (saturating recruitment at high spawners): in both cases, recruits per spawner is expected to be highest at low spawner densities. These density dependent mechanisms are absolutely necessary for the concept of sustainable fishery exploitation. If compensation did not exist, every fish population in the world would grow infinitely when

not fished (which is biologically impossible) and would eventually go extinct when fished however lightly for an extended period of time. That is, a quasi-stable population (as fish populations are) cannot bear the weight of additional mortality sources without the existence of faster replacement at lower densities. This notion is widely accepted among fishery scientists around the world, and simply must be recognized in order to believe that any reasonable level of harvest at all can be sustainable for an extended period of time. These concepts are excellently described in Rose et al. (2001). Compensation explains why more harvest is obtained at lower levels of escapement than at higher levels. Second, when the escapement target is higher, that means that more restrictions are necessary more often in order to ensure it is met. This leads to closing the fishery more often, resulting in lower and more variable in harvests and the increased frequency of failure to meet critical harvest thresholds more often.

While this is only a computer-based exercise, it does use the biological concepts on which fish populations are managed. The only other alternative to exploring these patterns is to conduct large-scale management experiments (Walters and Collie 1988). That is, harvest management would need to be conducted in a way that intentionally holds the stock at fixed levels (ranging from very low to very high) for extended periods of time, and the outcomes would need to be rigorously tracked. There are very few examples of this being done in reality (Hilborn 2016, Eggers and Rogers 1987, Walters et al. 1993), given that many factors exist preventing the success of such experiments (e.g., uncontrollable factors like random environmental variability and cyclic regime shifts as well as irreducible large degrees of assessment uncertainty). In addition, fishery managers would be forced to accept the biological and societal costs that would undoubtedly accompany such intentional manipulations.

ATTACHMENT C

Harvest Target and Strategy

Based on the results of the Pstar model, the Manager is comfortable with an implied harvest target for the 2019 Chinook Salmon subsistence fishery at 32,000 fish. However, given that the KRITFC has a more conservative approach, the Manager has agreed to target an 110,000 escapement target and an implied harvest of 22,000 fish. To summarize, the Manager's acceptable harvest limit is anything between 22,000 and 32,000 Chinook Salmon. The rest of the discussion below talks about the Manager's recommendation to the KRITFC as a part of the consultation process.

For the 2019 Chinook Salmon subsistence fishery season, the Manager recommends proceeding with a semi-scheduled fishery, in which initial opportunities during the fishing season are announced well in advance of the season and then additional opportunities are providing during the season as in-season data is collected and analyzed. This recommendation is essentially an extension of what was done during the 2018 season (i.e. announcing the June 12 and June 16 opportunities in advance).

Based on a recommended harvest target of 32,000 Chinook Salmon, the Manager initially feels that anywhere from 5 to 8 12-hour subsistence opportunities can be provided in the June 12 – June 30 timeframe (**Table 1)**. With the 19 days (see **Table 2** for calendar) in this time frame, we are confident that at least one 12-hour opportunity per week can be announced in advance of the season with no concerns of exceeding the harvest target.

Table 1. The approximate number of 12-hour opportunities that could be provided between June 12-June 30 timeframe based on a range of risk tolerances of falling below the Manager's recommended escapement objective of 95,000 Chinook Salmon. Red shaded cells: <1 opportunity per week, Yellow: at least one opportunity a week, Green at least two opportunities per week, Blue at least three opportunities per week, and Gray at least half the week per week.

Pr(S < 95,000)	Pr(S < 65,000)	Harvest	Harvest per 12-hour opportunity				
			3,000	4,000	5,000	6,000	7,000
0.01	0.01	0	0	0	0	0	0
0.05	0.01	0	0	0	0	0	0
0.10	0.01	0	0	0	0	0	0
0.20	0.02	6,000	2	2	1	1	1
0.25	0.03	11,000	4	3	2	2	2
0.33	0.06	18,000	6	5	4	3	3
0.50	0.16	32,000	11	8	6	5	5

Table 2. Calendar for 2019 summer timeframe.

Week 1 (6/12 – 6/16)		Week 2 (6/17 – 6/23)		Week 3 (6/24 – 6/30)	
Wednesday	6/12/2019	Monday	6/17/2019	Monday	6/24/2019
Thursday	6/13/2019	Tuesday	6/18/2019	Tuesday	6/25/2019
Friday	6/14/2019	Wednesday	6/19/2019	Wednesday	6/26/2019
Saturday	6/15/2019	Thursday	6/20/2019	Thursday	6/27/2019
Sunday	6/16/2019	Friday	6/21/2019	Friday	6/28/2019
		Saturday	6/22/2019	Saturday	6/29/2019
		Sunday	6/23/2019	Sunday	6/30/2019

This recommendation is based on our expectation that any 12-hour harvest opportunity provided during the June 12 – June 30 time frame will result in a harvest of Chinook Salmon in between 3,000 – 7,000 fish per opportunity. This range of potential harvest per 12-hour opportunity is a direct result of information that has been gathered through the in-season harvest monitoring program that has operated since 2016 (**Table 3**; **Figure 1**).

Additionally, based on the information collected from 2016 – 2018, it is possible to obtain predictions of harvest for salmon for each day of the season (**Figure 1**), by the product of fitted relationships for effort (Total Boat), catch per unit effort (Total Salmon Catch/Boat), and species availability (proportion of Chinook Salmon). The Manager believes these predictions and relationships can help guide in-season managers on when to provide scheduled opportunities in advance, but also in announcing opportunities during the season.

Providing advanced scheduling of opportunities allow subsistence users time to plan for fishing opportunities allowing for some comfort to subsistence users and reducing the complexity of in-season management. In the past, fishing opportunities were often made 24-48 hours in advance which did not allow much time for subsistence users to plan.

Table 3. Summary of harvest and effort estimates for 12-hour opportunities between June 12 and June 30 for 2016-2018.

Summary Stats	Drift Boat Trips	Chinook Harvest	Chum + Sockeye Harvest	Salmon Catch/Trip	% Chinook
Minimum	256	1,380	990	10	13
25%	429	3,045	2,285	12	24
50%	478	4,610	4,140	18	40
75%	613	6,755	13,295	44	67
Maximum	632	7,150	26,720	69	84

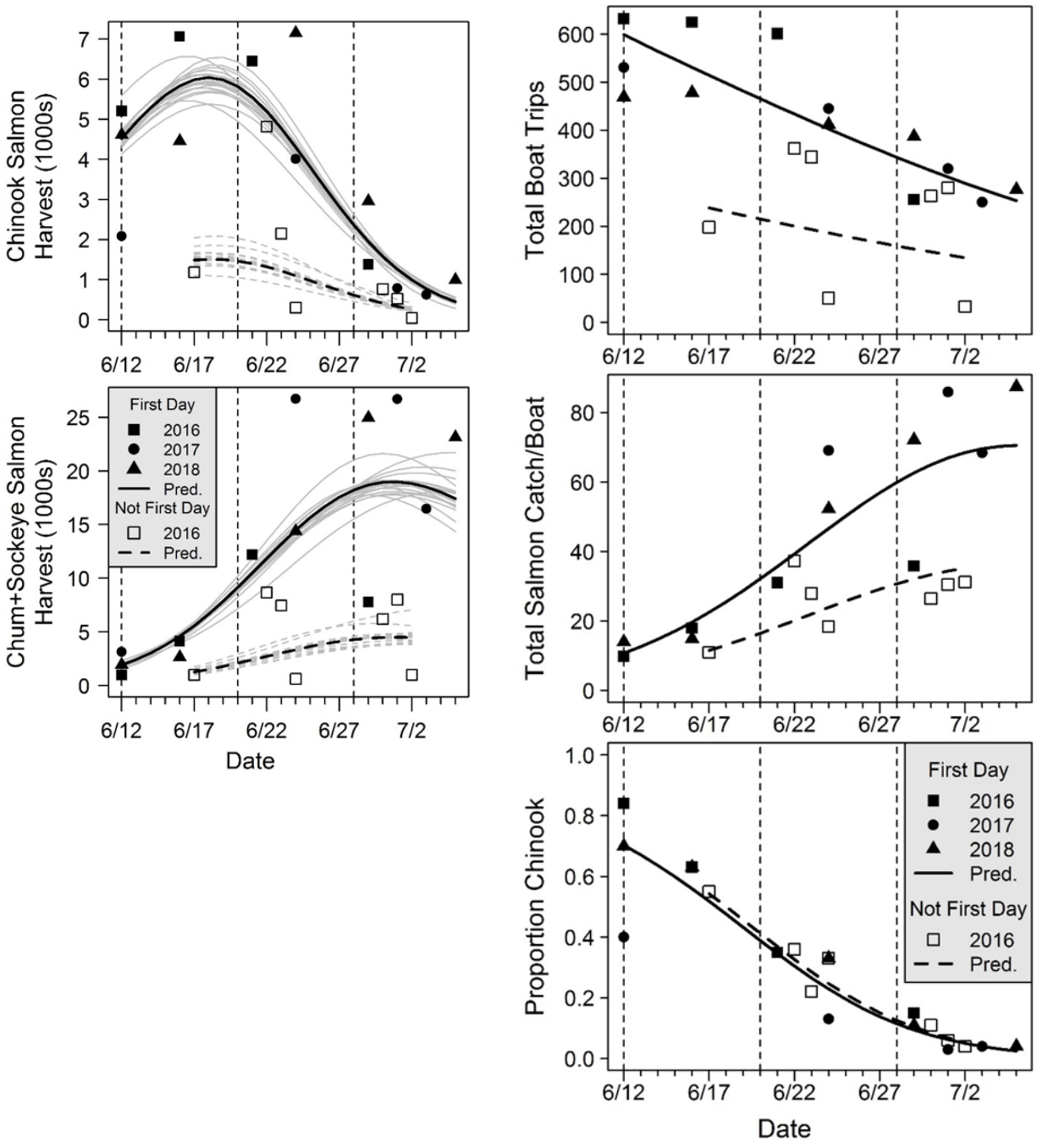


Figure 1. (Right plots) Relationships among the three quantities needed to predict harvest from an open fishing day and the day of the season according to equation (1). Solid points/lines represent fishing days that occurred on the first day of an opener; hollow points/dashed lines represent those that occurred on day there were more than 12 hour openers.