DRAFT

2023 KUSKOKWIM RIVER SALMON MANAGEMENT STRATEGY

Draft of May 31, 2023

PURPOSE: This 2023 Kuskokwim River Salmon Management Strategy (Strategy) is intended to provide guidelines for a cooperative conservation management framework for the Kuskokwim River Inter-Tribal Fish Commission (Commission) and the U.S. Fish and Wildlife Service (USFWS) at the Yukon Delta National Wildlife Refuge (Refuge). As partners, the Commission and the Refuge are committed to collaboratively using this Strategy in the 2023 salmon season, and to further develop this Strategy into a longer-term salmon management plan as per the Memorandum of Understanding (MOU) signed by both entities in 2016.

Guiding Principles & Objectives

- **Avoid collective overharvest of salmon and rebuild Chinook, chum, and coho salmon populations** within the Kuskokwim River watershed through application of a precautionary approach to harvest management.
    - Prioritize meeting drainage-wide and tributary escapement targets over other objectives during the near-term Chinook salmon recovery and rebuilding phase. (Note that few escapement targets and no biological escapement goals currently exist for chum and coho salmon in the drainage.)

- Take a conservation-based approach to management by considering sources of uncertainty and external risk factors which are out of direct management control, including the cumulative effects of multiple risk factors.

- Implement Chinook, chum, and coho salmon conservation and management actions based on a mixed stock/multi-stock management approach that addresses the inherent differences in productivity among various stocks.

- Due to high uncertainty associated with recent prior-year forecasts, prioritize in-season indicators of run strength and run timing over the pre-season forecast.

- Take a holistic view of all pertinent sources of in-season information, including measures of abundance, run timing, and species composition provided by agencies as well as harvesters.

- **Sustainably manage other currently healthy salmon species within the Kuskokwim River watershed to avoid collective overharvest.**
- **Uphold fish conservation and diversity mandates within the Alaska National Interest Lands Conservation Act (ANILCA), National Wildlife Refuge System Administration Act, and within the Refuge's in-season management authority.**
- **Work to support and strengthen the relationship between the Commission and the Refuge established under the MOU.**
- **Integrate meaningful local and Indigenous Knowledge** into the fisheries management decision-making process.
    - Actively consider and use local and Indigenous Knowledge to help inform in-season fisheries management decisions.
    - Strive to consider local observations in the same context as standardized fishery abundance indices and statistical tools.

- **Strive to provide for continued customary and traditional subsistence harvests.**
    - Provide as much customary and traditional subsistence harvest of currently healthy salmon stocks by rural residents as possible, informed by sustainable salmon management practices that clearly address the mixed-stock challenge of these fisheries.
    - During the Chinook, chum, and coho salmon rebuilding phase, strive to provide maximum opportunity for customary and traditional harvest of salmon for Federally qualified subsistence users without jeopardizing drainage-wide and tributary escapements of Chinook, chum, and coho salmon essential for future salmon returns.
    - Provide equity of harvest opportunity across the entire watershed.

Salmon Declines and Unmet Subsistence Needs

Chinook Salmon Concerns

Since 2010, the Kuskokwim River Chinook (king) salmon run has shown low abundance and productivity in all years except 2019 (Figure 1).

Due to this prolonged decline and low productivity, Kuskokwim River Chinook salmon runs have not been abundant enough to meet defined subsistence needs without the risk of failing to meet escapement goals (Figure 2). Based on the 2022 season harvest and abundance information used in the Kuskokwim River Chinook salmon run reconstruction model, the preliminary 2022 estimate of total run for Kuskokwim River Chinook salmon is **142,495** (95% CI: 107,579–188,743) fish, with an estimated escapement of **107,980** (95% CI: 73,064–154,228) fish (Larson 2023).

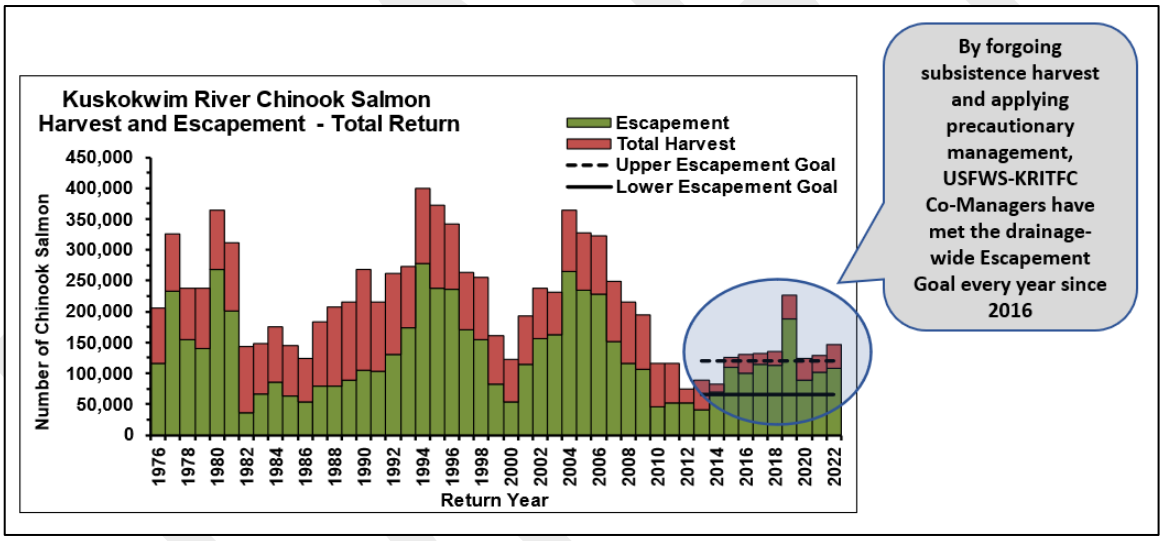

Figure 1: Kuskokwim River Chinook salmon escapement and total harvest by all user groups during 1976—2022. *Source: Larson 2023.*

Subsistence needs in Figure 2 are based on analysis of the long-term average harvests in the watershed, which are also reflected in an amount reasonably necessary for subsistence[1] (ANS) determination by the Alaska Board of Fish (BOF) in 2001 and updated in 2013. It is important to note that the size of Chinook salmon returning to the Kuskokwim has decreased in recent years, meaning

[1] In the absence of a formal Federal metric established by the Federal Subsistence Management Program to evaluate whether subsistence needs are being adequately provided, we reference the only available subsistence metric for Kuskokwim River salmon stocks, which is found in Alaska BOF regulations (5 AAC 01.286(b)). The Alaska BOF established the current ANS uses of Kuskokwim River salmon in 2013, based on the harvest history beginning in 1990. If the Federal Subsistence Board decides to establish a similar metric regarding Federal subsistence use amounts, it is likely to be based upon the same historical harvest data given that those data represent only the harvests by Federally qualified rural residents.

subsistence users are harvesting fewer pounds of meat per fish caught, intensifying unmet ANS and food security needs (Ohlberger et al. 2019)

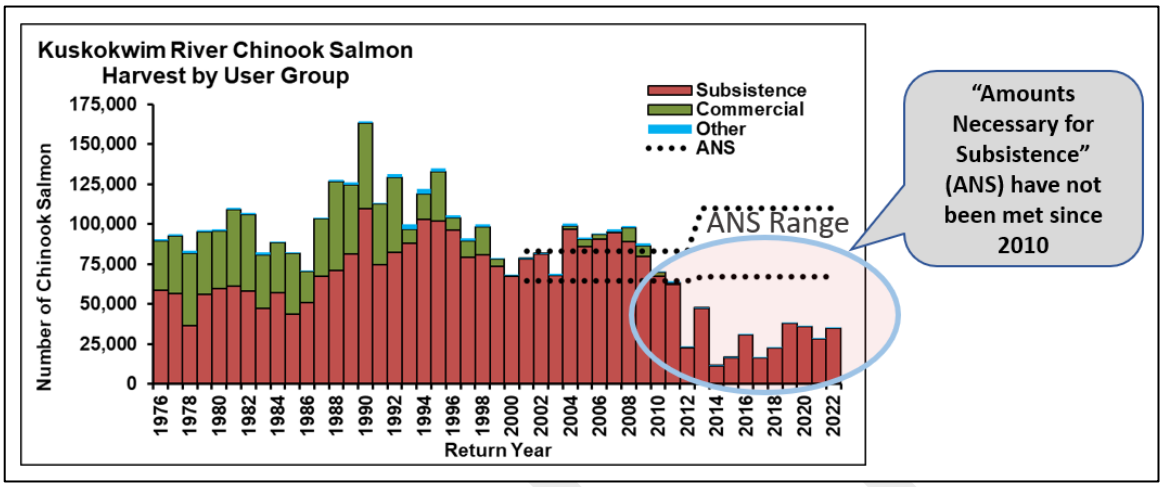

Figure 2. Kuskokwim River Chinook salmon harvest by user group during 1976—2022, showing that long-term subsistence harvest needs in the watershed have not been meet since 2011 (Subsistence harvest needs are based on Amounts Reasonably Necessary for Subsistence as determined by the Board of Fish). *Source: Smith et al. 2022.*

In addition to this decline in abundance, size, and adult productivity, the freshwater productivity of Kwethluk River Chinook salmon (surviving out-migrating juveniles produced per returning adult) declined about 50% each year from 2015 to 2018 (Boersma et al. 2019). The Kwethluk River is one of the two most productive tributaries currently monitored in the entire Kuskokwim River drainage.

Chum Salmon Concerns

Until 2019, chum salmon were the most abundant species in the river. However, chum salmon returns diminished after 2019, and returns in 2021 and 2022 were alarmingly low and among the lowest in the past two decades (Figure 3). No drainage wide estimates of total run or total escapement are available for Kuskokwim chum salmon.

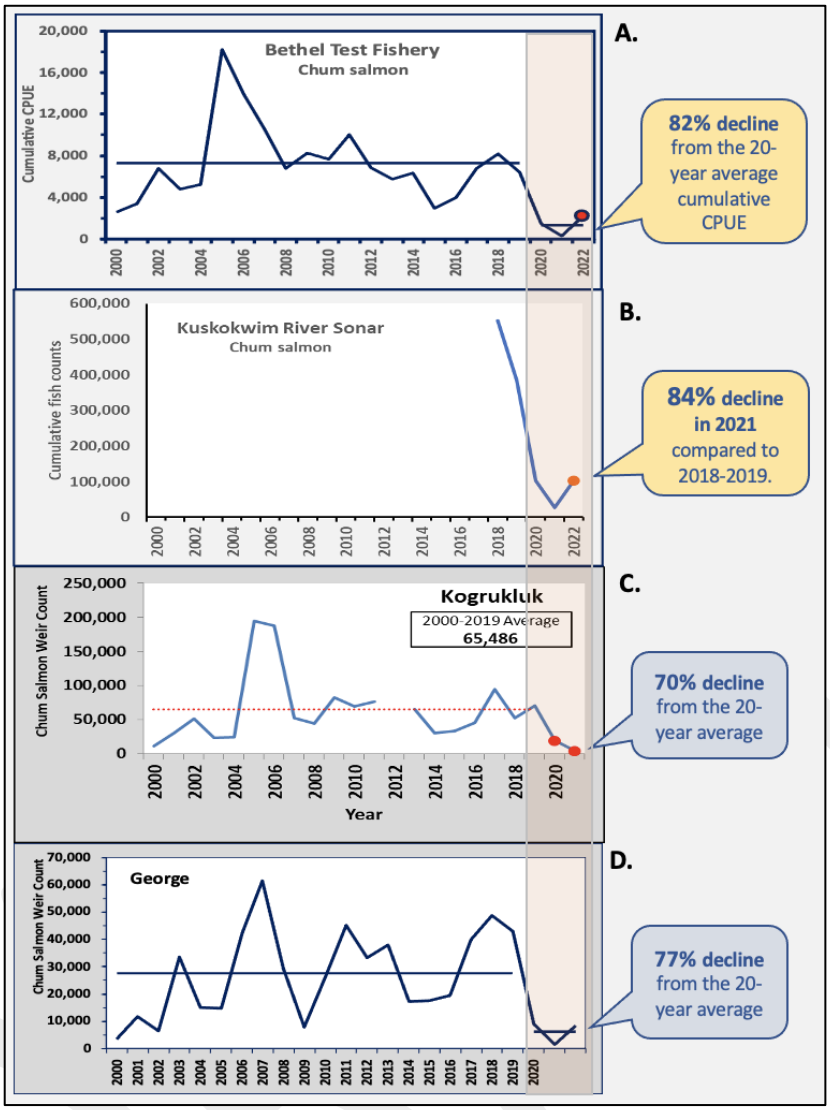

Figure 3: Evidence of continued severe decline of Kuskokwim River chum salmon populations and magnitude of decline in 2022. Annual chum salmon weir counts, and the long-term averages, for the **A.** George River 2000–2022. **B.** Kogrukluk river, 2000–2022. **C.** Cumulative end-of-season CPUE of chum salmon caught in the Bethel Test Fishery, 2000–2022. **D.** Cumulative annual counts of chum salmon from the Kuskokwim River sonar project, 2018–2022. ***Source**: Alaska Department of Fish and Game, AYK Database Management System.*

Figure 3 shows the evidence of this decline based on two in-season indicators (Bethel Test Fishery [BTF] cumulative catch-per-unit-effort [CPUE] and Bethel Sonar) and two tributary escapement projects (Kogrukluk River and George River weirs). The continued disastrously low chum abundance in 2022 was also confirmed by the direct observation by subsistence harvesters, as reported to the Commission in-season managers and via the Commission's Community Based Harvest Monitoring (CBHM) project. As an indicator of the poor 2022 chum run, the Bethel sonar project recorded the passage of more Chinook salmon than chum salmon – even though the 2022 Chinook run was relatively poor and has been a species of concern for over a decade.

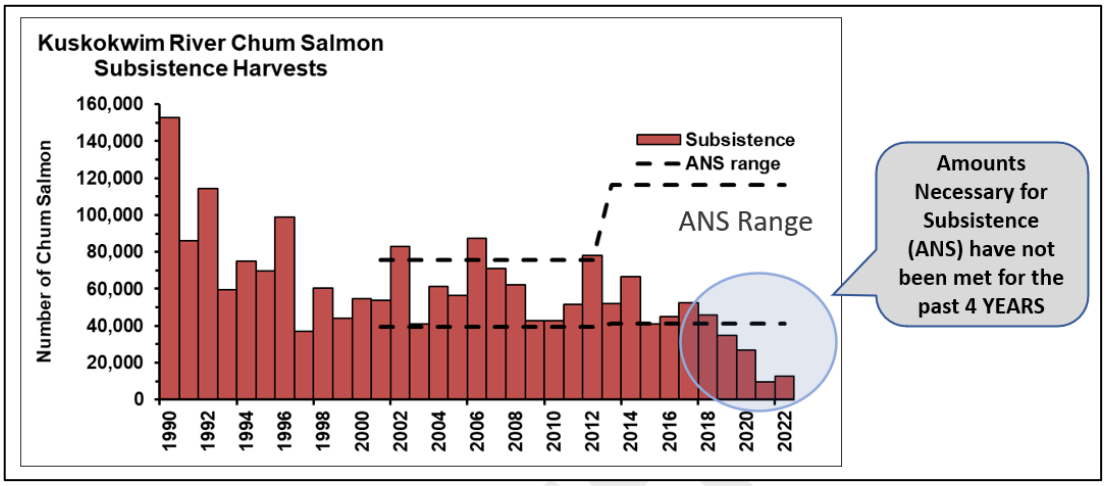

Figure 4. Kuskokwim River subsistence harvests of chum salmon relative to amounts reasonably necessary for subsistence uses, 1990-2022. *Source D. Koster,2022 ADF&G Subsistence Div., per. com.*

Figure 4 shows the estimated total subsistence harvests of Kuskokwim River chum salmon from 1990 to 2021. The ANS for Kuskokwim River chum salmon was determined by the Alaska Board of Fisheries in 2013 to be 41,200 – 116,400 chum salmon. Subsistence harvests of chum salmon were below the ANS range in 2015 and since 2019 (McDevitt and Koster 2022).

Sockeye Salmon Abundance

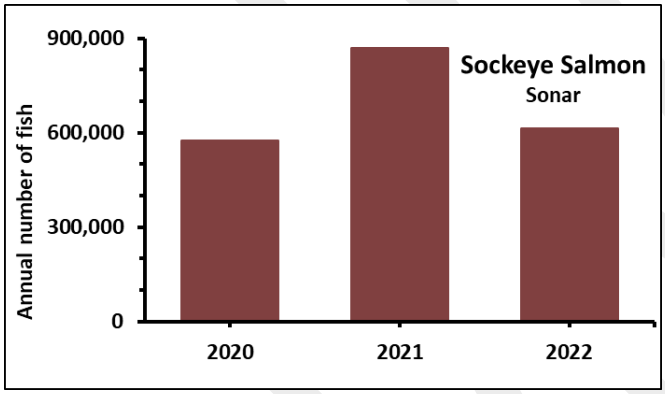

Figure 5: 2020–2022 Kuskokwim River sockeye salmon abundance assessed by the ADF&G Bethel Sonar.

With an average of 700,000 fish passing the Bethel sonar over the past three years, sockeye salmon have been the most abundant salmon species in the river (Figure 5). For comparison in 2022, red salmon were about six times more abundant than chum salmon and about five times more abundant than Chinook salmon.

Unfortunately, it is difficult for subsistence fishers to harvest significant numbers of sockeye salmon with drift nets without impacting currently severely declined Chinook and chum populations as the run timing of these three species overlaps (Figure 12). However, the widespread adoption of dipnet fishing could significantly expand the harvest of sockeye while providing for release of declined Chinook and chum salmon.

Coho Salmon Concerns

Until 2018, long-term coho salmon subsistence harvests averaged and remained relatively stable around 35,000 fish. With ongoing Chinook and chum salmon declines, river-wide dependence on coho salmon to meet subsistence needs increased.

Available long-term run assessment data from the Bethel Testy Fishery show that the Kuskokwim River coho salmon run has declined significantly since 2018 (Figure 6). BTF cumulative coho salmon catch-per-unit-effort (CPUE) has dropped 54% in the past four years.

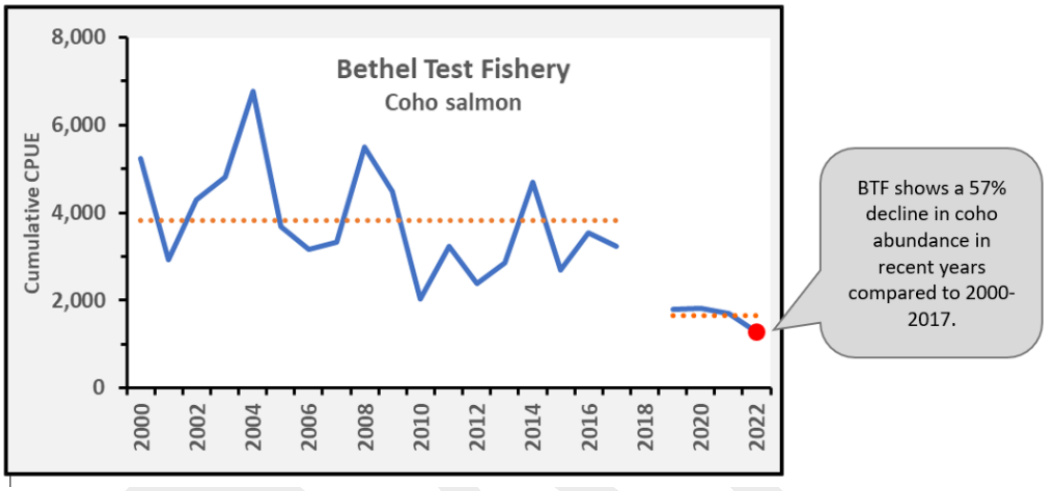

Figure 6: Cumulative end of season CPUE of coho salmon caught in the Bethel Test Fishery, 2000-2022, showing a steep decline in coho salmon runs for the past four years. The 2019–2022 average CPUE was 57% below the 2000–2017 average; 2018 data is not shown because the sampling season was incomplete. *Source: ADF&G AYK Database Management System.*

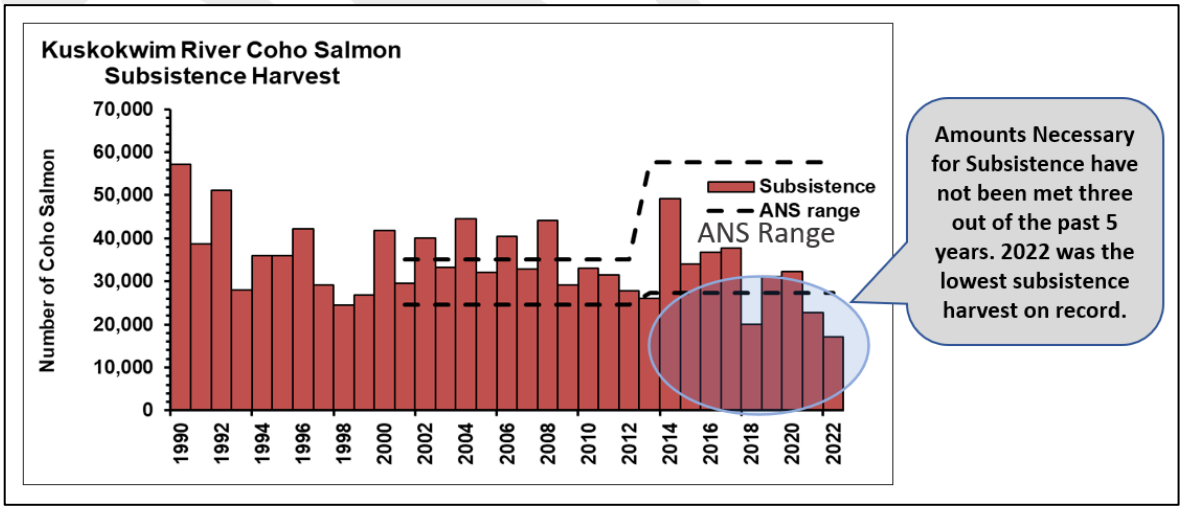

Figure 7: Kuskokwim River subsistence harvests of coho salmon relative to amounts reasonably necessary for subsistence uses, 1990–2022. *Source: McDevitt and Koster 2022.*

Figure 7 represents the estimated total subsistence harvests of Kuskokwim River coho salmon from 1990 to 2021. The amounts reasonably necessary for subsistence uses (ANS) of Kuskokwim River coho salmon were determined by the Alaska Board of Fisheries in 2001 to be 24,500–35,000, and revised in 2013 to be 27,400–57,600 coho salmon. Subsistence harvests of coho salmon fell below the ANS range in 2013, 2018, 2021, and 2022 (McDevitt and Koster 2022).

With three salmon species in apparent decline, it is critical that Kuskokwim River salmon managers, including the Refuge and the Commission, take a precautionary and balanced approach in their decisions to provide as much subsistence harvest as possible while aiming to achieve conservation objectives that promote stock sustainability. More information about the 2022 salmon season can be found in the Commission's 2022 Kuskokwim River Salmon Situation Report.

Risk Factors & Management Challenges Facing the 2023 Runs

In addition to uncertainties in forecasts and in-season data that make meeting our management objectives challenging, new research has documented several risk factors (Figure 8) most of which are not accounted for in the current salmon biological escapement goals.

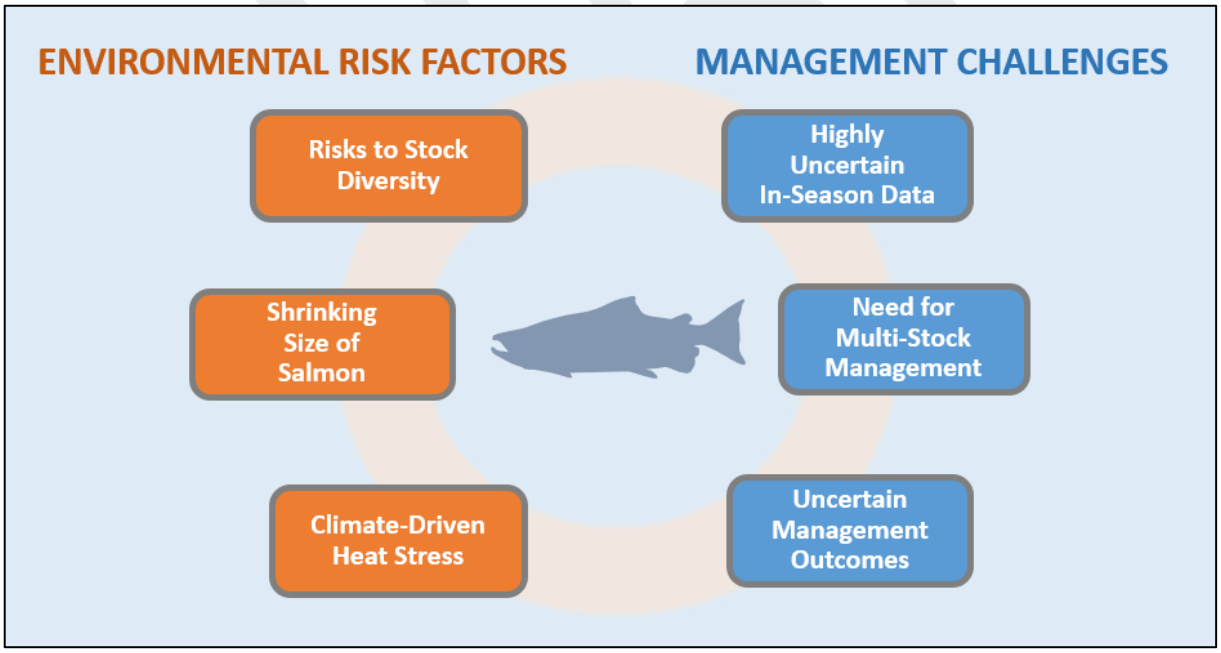

Figure 8: Overview of environmental risk factors and management challenges.

ENVIRONMENTAL RISK FACTORS

Risks to Stock Diversity

Stock Diversity in a Mixed Stock Fishery: Protecting diversity is hard when salmon of different species and from different tributaries are harvested in a **mixed-stock fishery** because not all salmon stocks can sustain the same level of harvest (as shown in Figure 9) (*Connors et al. 2020*).

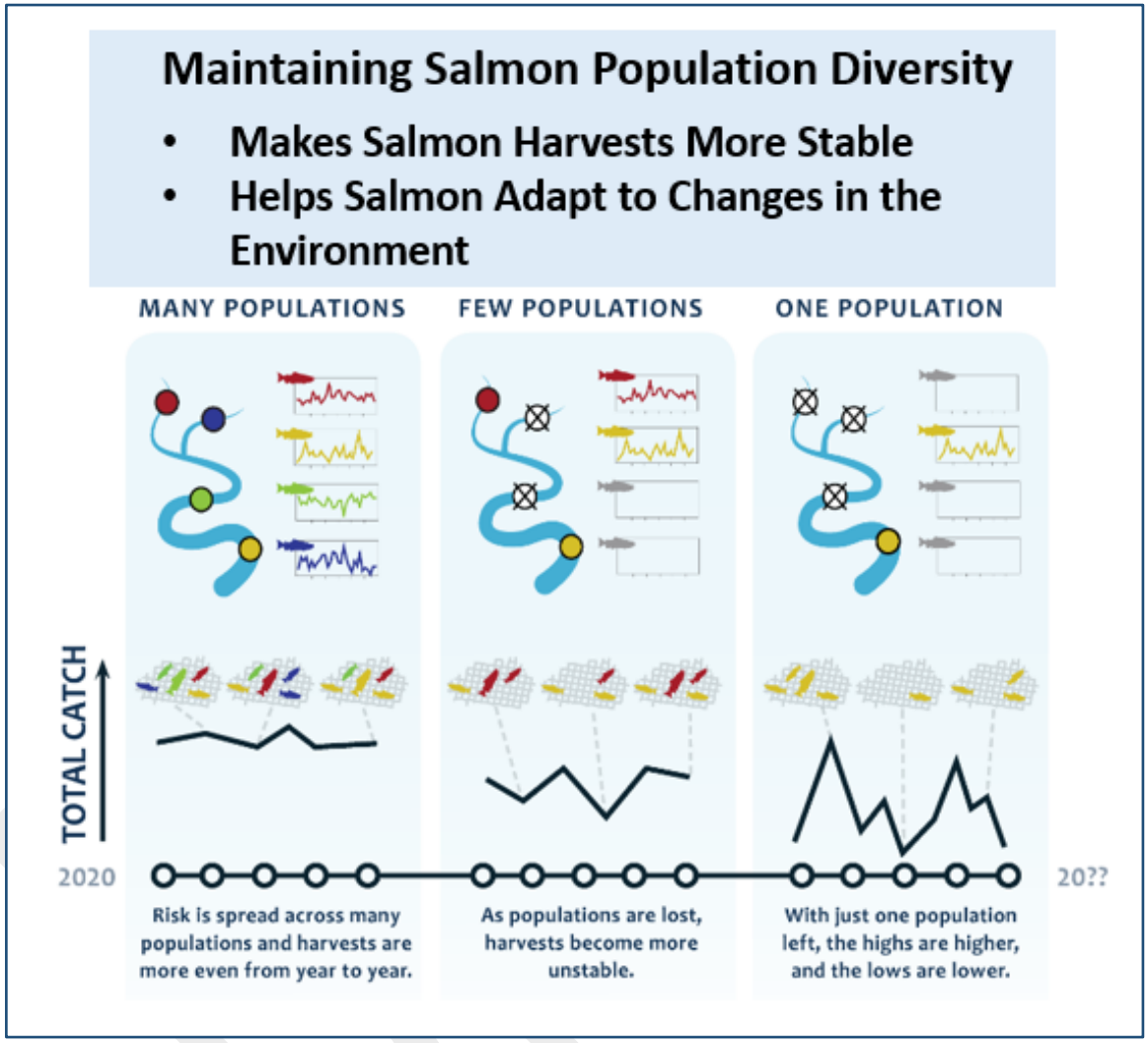

Figure 9: Overview of the benefits of maintaining salmon population diversity on the long-term stability of salmon runs.

Shrinking Size of Salmon

Significant Long-Term Decline in the Size of Returning Adult Chinook Salmon: Multiple studies have found long-term changes in the returns of older (larger) Chinook across Alaska and a decline in size-at-age for fish in the ocean. An independent expert panel that reviewed declines in the size and reproductive potential of Arctic-Yukon-Kuskokwim region Chinook salmon found a 40% decline in average total reproductive potential of Kuskokwim River Chinook salmon over the period 1976–2018 *(Ohlberger et al. 2019)* (Figure 10).

Decline in Caloric Value of Salmon: Due to this documented long-term decline in the size of returning adult Chinook salmon, we now know that 100 fish caught in the early 1970s provided on average the same amount of caloric energy—or food for subsistence fishing families—as approximately 138 fish caught in recent years in the Kuskokwim River.

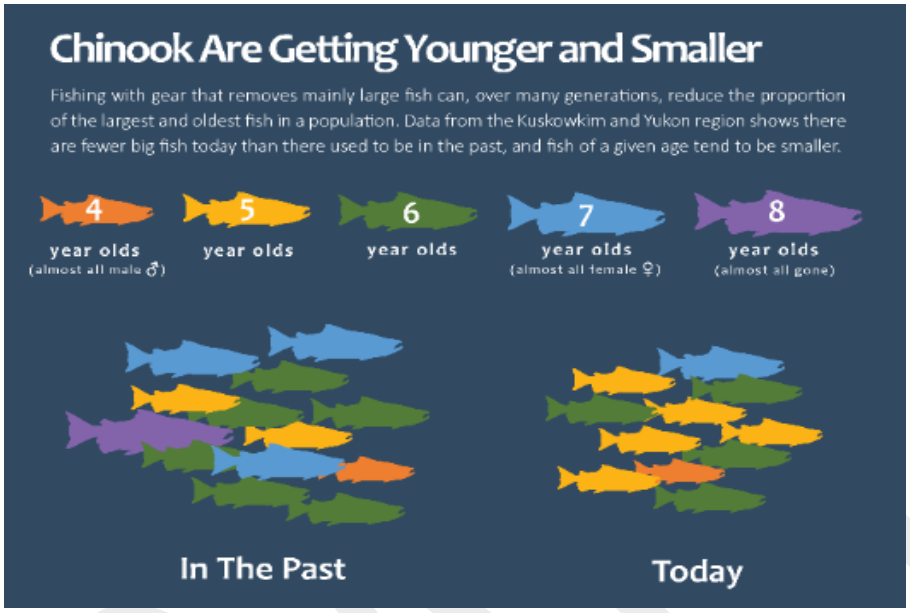

Figure 10: Data from the Kuskokwim and Yukon region shows that there are fewer big fish today than in the past, and fish of a given age class tend to be younger age and smaller (Ohlberger et al. 2019).

Climate-Driven Heat Stress

Heat Stress in Migrating Spawners: Heat events that result in water temperatures above 65°F, such as the one that occurred in 2019, pose risks to migrating adult salmon *(*von Biela et al. 2020*).* This poses risk to our sustainable salmon management if fish are counted at the Bethel sonar, but die before spawning or are unable to deposit all of their eggs in the gravel due to heat stress.

MANAGEMENT CHALLENGES

This section describes three factors that, taken together, explain the difficulties managers face to provide a safe amount of harvest of multiple salmon species without overharvesting individual stocks. Cumulatively, these factors explain why precautionary management is necessary.

Highly Uncertain In-Season Data

Sources of Uncertainty: Management decisions within Federal waters of the Kuskokwim River must be made using **limited in-season run abundance and run timing information:**

- **High Forecast Uncertainty**: On the Kuskokwim, there is currently no reliable method for forecasting this year's Chinook salmon return other than using the prior-year forecast method. The level of uncertainty associated this method is very high, making a practice of managing to the forecast risky.

- **Bethel Sonar Project:** This in-season indicator of run strength and run timing has operated for about five years and has proved to be an important source of run strength and run timing information in addition to Bethel Test Fishery. In the future, we hope that Bethel Sonar will be extended through the coho season.

- **Community-Based Harvest Data**: Subsistence harvest information from Bethel and a subset of lower river communities provides critical information about harvest during openings, including species ratios and catch per unit effort. This in turn provides immediate information about salmon abundance during a harvest opportunity. This community-based information is particularly valuable because it is provided by harvesters based on their direct experiences on the river and therefore has high credibility.

- **Bethel Test Fishery:** This long-term index of run strength and run timing serves as the main formal management tool. While it provides general categorical (e.g., high, medium, low) measure of abundance based on information from the past 25 years, BTF is a very imprecise in-season indicator of the total run size (which is only available post-season).

Even when these data sources are combined, it can be very difficult to accurately assess run timing and run strength. This uncertainty translates into risk of not meeting our management objectives. Therefore, we either need to know more, or take a precautionary approach to harvest management.

Need for Mixed-Stock Management

Importance of Multi-Stock Management for Salmon Conservation: From mid-June to mid-July the run timing of Chinook, chum, and sockeye salmon overlaps (Figure 12). Because salmon in this mixed stock fishery are harvested using non-selective 6" mesh gillnet gear, it is not possible to target abundant sockeye salmon without potentially impacting Chinook and chum salmon during their runs.

For the past eight years, Federal fisheries management actions aimed at Chinook salmon conservation effectively required YDNWR to manage all three species in Federal waters due to their overlapping run timing during the bulk of the Chinook salmon run. For example, numerous directed and limited Chinook salmon harvest opportunities for Federally qualified rural residents were intended to avoid overharvesting declined Chinook salmon. Due to the mixed stock nature of the fishery, these Chinook salmon conservation actions significantly limited the ability of subsistence users to harvest chum and sockeye salmon, even during years when chum and sockeye salmon were abundant. Additionally, with

our current chum conservation concerns, it is imperative to continue to uphold a precautionary management approach in this mixed stock fishery.

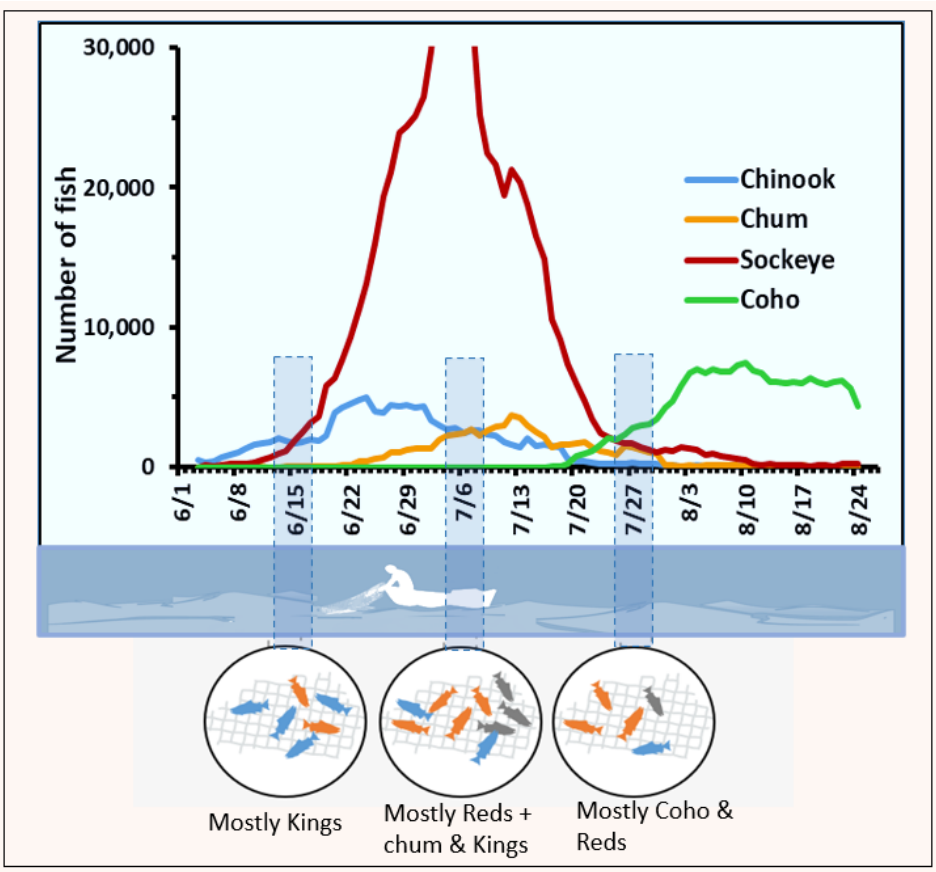

Figure 11: Average run timing from Bethel sonar data over the past four years shows the overlapping run timing of king, chum, red ,and coho salmon. As a result of this overlapping run timing, during most of the season harvesters using driftnets take a mixture of species, including currently declined populations of king, chum and coho.

In 2023, we intend to jointly monitor and collaboratively manage king, chum, and coho salmon within federal waters of the Kuskokwim River. Given the overlapping run timing and use of non-selective fishing gear to fish for salmon, it will be necessary to continue careful mixed-stock management this season.

Uncertain Management Outcomes

More Uncertainty Requires Being More Careful: Uncertainty of management outcomes is the final piece that makes management of decline stocks difficult. Even after reviewing all the available information and deciding to announce a subsistence fishing opening, managers do not know how many salmon of each species will be harvested in that fishing opportunity. The difference between the number of salmon we plan to harvest and the real number taken can have a big impact on meeting escapement goals and providing as much subsistence opportunity as hoped.

If we have comprehensive, real-time information and can predict “good” and “bad” environmental conditions, then we can adjust management actions to match and compensate in years of poor runs.

However, if we are not good at predicting environmental conditions and annual run sizes—as is the case on the Kuskokwim—then we must make careful and precautionary management decisions to make sure we do not unintentionally fish too hard on small runs and lose important populations or delay the time it takes to rebuild populations large enough to support river-wide subsistence needs. The degree of precaution we apply when making decisions should correspond to the level of uncertainty in our management and information.

OVERVIEW OF 2023 PRESEASON & IN-SEASON MANAGEMENT APPROACH: Ensuring Conservation-Based Salmon Harvest Management

To provide harvest opportunities while also (1) addressing the environmental and management risk factors listed above and (2) meeting essential conservation objectives, ***we support the following management approach:***

- **Due to ongoing conservation concerns, for the ninth year in a row, the 2023 salmon season will begin under the authority of the Federal in-season manager** with harvest limited to federally qualified subsistence users per the provisions of Title VIII of ANILCA.
- **We will work to support and strengthen the relationship between the Commission and the Refuge established under the Memorandum of Understanding (MOU).** The 2016 MOU between the Commission and YDNWR formalized the fishery management partnership between the parties. The MOU shall guide the relationship between the Commission and YDNWR, and both the Commission and YDNWR shall comply with its terms when collaboratively making fisheries management decisions and implementing fishery management projects.
- **We will review preseason forecast and forecast uncertainty.**
- **We will support a preseason salmon harvest closure from June 1 – June 11 to protect headwaters stocks.**
- **We will carefully evaluate in-season salmon population data and harvest assessment data between harvest opportunities.** The Commission and Refuge in-season managers will regularly examine a variety of in-season indices when making in-season management decisions.
- **We will review risk factors and sources of uncertainty impacting harvest management** (see Figure 8)**.**
- **We will use local and Indigenous Knowledge** from Commission In-Season Managers and other rural subsistence users to help inform assessment of run strength and run timing.
- **We will collect and use in-season subsistence harvest data.** The Community-Based Harvest Monitoring (CBHM) program and Bethel area harvest information collected by the Orutsararmiut Native Council, provides valuable real-time in-season harvest and CPUE data from subsistence harvester that will be integrated into the in-season management decision-making process.

- **We anticipate the need to extend our conservation-based management approach** to the 2023 chum and coho salmon seasons based on the disastrously low runs of chum and coho salmon in 2022.
- **We will communicate to Federally qualified subsistence users the need for a conservative management approach based on assessment between openings to avoid overharvest, which includes:**
    - Communicating the possibility that taking management action to avoid overharvest, as occurred in 2013, can result in some foregone harvest/underharvest.
    - Communicating that foregone/underharvest, if it occurs, can help provide equity of harvest across the watershed, rebuild salmon populations, and protect salmon population diversity.
- **We will continue to aim for Chinook salmon escapement at 110,000 with the understanding that in-season uncertainty will require a broader target of 100,000-120,000. This escapement focuses on the upper end of the current escapement goal range of 65,000 to 120,000.**
- Due to several sources of uncertainty and the imprecision of management actions, it will never be possible to precisely achieve any specific salmon escapement number. Therefore, it is appropriate to structure our escapement target as a range. Management uncertainties and challenges include:
    1. A high degree of uncertainty about in-season abundance and salmon run timing.
    2. Uncertainty about how many salmon will be harvested in any given harvest opportunity.
    3. A 6-to-8-week time lag between the time when harvest decisions are made (May through July) and when we can estimate the effect of those decisions on meeting our escapement target (end of September).

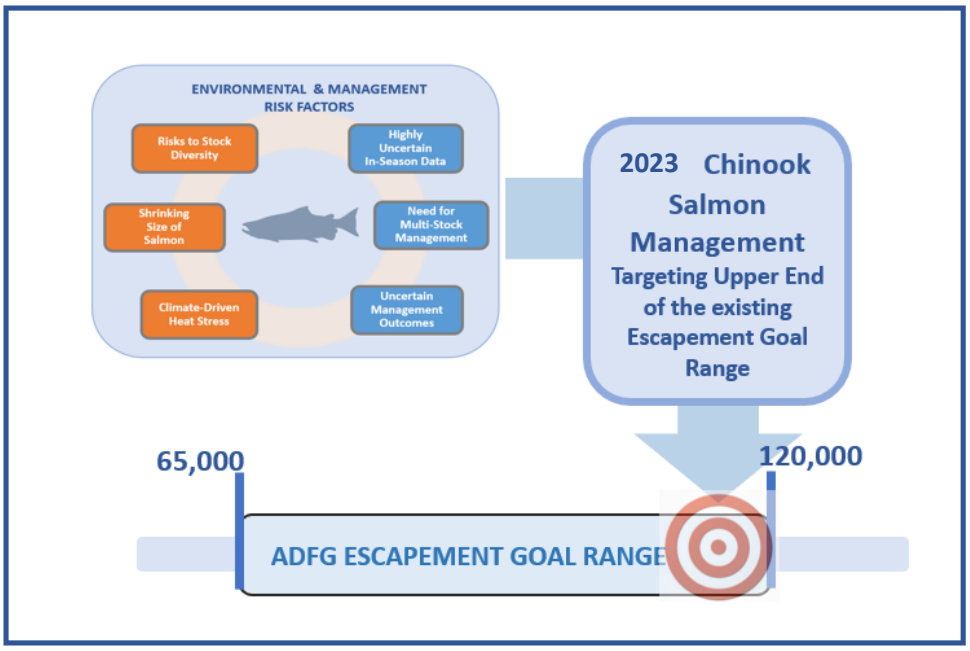

Figure 13: The 2023 precautionary escapement target aims at the upper end of the current escapement goal range (65,000-120,000 Chinook salmon) in response to cumulative effects among multiple risk factors and sources of uncertainty, and the need to conserve and rebuild the population.

Our Approach to Using Limited Information to Make Harvest Decisions:

- No single source of information about Kuskokwim salmon abundance or harvest levels provides a reliable in-season indicator of run abundance on its own. So, it is important to not focus on a single source of information, but to consider multiple sources of information that together point toward the same direction regarding run abundance and run timing.
- Due to very high uncertainty associated with recent prior-year Chinook salmon forecasts, **our approach will be to prioritize in-season indicators of run strength and run timing using information from a set of fisheries projects that operate during the Chinook salmon season over using the pre-season forecast**.
- Early in the season, we face the challenge of very minimal and often conflicting information from in-season data sources on the size and timing of the salmon runs. Therefore, we need to proceed with caution, especially during the first half of the run.
- It is important to remember that based on existing information sources it is not possible to put hard numbers on the size of run in-season. Rather the size of the run can only be assessed in rough categories such as: likely low abundance/poor run; likely a fair run; likely a strong run; likely a very abundant run. As the season progresses our confidence in our categorical assessment of the run abundance increases. Our managers intend to use a "salmon

management dashboard" approach to broadly categorize our perceptions of the strength of each salmon run, using the key sources of in-season information listen below.

Key Sources of In-Season Information

We draw on four key sources of in-season information, each of which is valuable and helps inform decisions:

- **Indigenous Knowledge and local observations** from Commission In-Season Managers and other rural subsistence users help inform assessment of run strength and run timing.
- **Bethel Sonar Project**
- **Community-Based Harvest Data**
- **Bethel Test Fishery & Aniak Test Fishery**

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