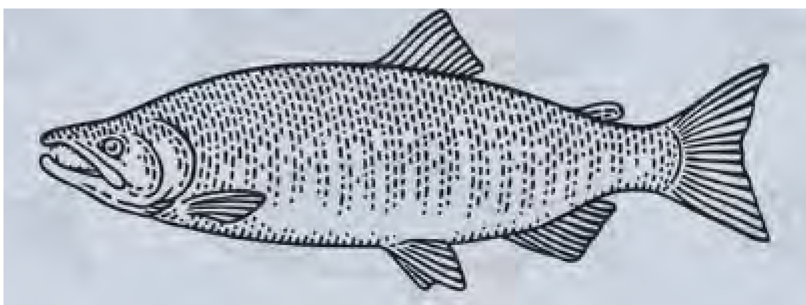
Bering Sea Chum Salmon Bycatch Management

Environmental Impact Statement

Scoping Report



United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service, Alaska Region

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Introduction

This report summarizes the public comments the National Marine Fisheries Service (NMFS) received during the July 11, 2023 through September 15, 2023 scoping period for the Environmental Impact Statement (EIS) that will analyze issues related to minimizing chum salmon bycatch in the Bering Sea pollock fishery in the Bering Sea subarea of the Bering Sea and Aleutian Islands (BSAI) Management Area[1]. That scoping period began the public process of developing the EIS in accordance with the National Environmental Policy Act (NEPA). The EIS is intended to evaluate the potential environmental, social, and economic effects of alternative management measures designed to achieve the North Pacific Fishery Management Council's (Council) Purpose and Need for this issue and inform the Council's recommendations to the NMFS on this proposed action. The EIS will also serve as NMFS's central informational document in the agency's decision-making on this proposed action and will help ensure that management of the Alaska groundfish fisheries complies with the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and other relevant statutes.

What is this Action?

This action would minimize the bycatch of Western Alaska origin chum salmon in the Bering Sea pollock fishery to the extent practicable (National Standard 9 and section 303(1)(11) of the Magnuson-Stevens Act) and consistent with the other National Standards. This action would create another layer in the Council's existing salmon bycatch management program. The current salmon bycatch management program is largely formed under Amendments 91 and 110 to the BSAI Groundfish FMP which have established a series of measures to minimize Chinook and chum salmon bycatch in the Bering Sea pollock fishery. In April 2023, the Council stated that its intent with this action is to minimize Western Alaska chum salmon bycatch while balancing the National Standards and maintaining the objectives of salmon bycatch management measures established within the existing program.

The Council has received scientific reports outlining the impact of warming ocean conditions on chum salmon mortality at sea, as well as substantial public comment and input from Western and Interior Alaska Tribes, Tribal Consortia, and subsistence salmon harvesters describing the importance of chum salmon for food security, wellbeing, the continuation of meaningful cultural practices and related Traditional Knowledge (TK) systems, as well as broader concerns of stewardship practices for salmon resources. The Council has also received public comments and annual presentations from pollock industry representatives on their efforts to minimize Chinook and chum salmon bycatch. Implementing additional chum salmon bycatch management measures could potentially have some positive benefit on the number of chum salmon that return to Western Alaska rivers. Any additional chum salmon returning to Alaska river systems improves the ability to meet the State of Alaska's spawning escapement goals which is necessary for the long-term sustainability of chum salmon fisheries.

[1] NMFS monitors salmon PSC as either "Chinook PSC" or "non-Chinook PSC." Sockeye (*Oncorhynchus nerka)*, coho (*O. kisutch)*, pink (*O. gorbuscha)*, and chum salmon (*O. keta)* are included in the non-Chinook PSC category, but over 99% of the salmon bycatch in the non-Chinook category are chum salmon.

Overview of the Preliminary Purpose and Need and Alternatives

Preliminary Purpose and Need

In April 2023, the Council adopted the following preliminary Purpose and Need Statement with additional language added by NMFS that addresses National Standard 9:

Salmon are an important fishery resource throughout Alaska, and chum salmon that rear in the Bering Sea support subsistence, commercial, sport, and recreational fisheries throughout Western and Interior Alaska. Western and Interior Alaska salmon stocks are undergoing extreme crises and collapses, with long-running stock problems and consecutive years' failures to achieve escapement goals, U.S.-Canada fish passage treaty requirements, and subsistence harvest needs in the Yukon, Kuskokwim, and Norton Sound regions. These multi-salmon species declines have created adverse impacts to culture and food security and have resulted in reduced access to traditional foods and commercial salmon fisheries.

The best available science suggests that ecosystem and climate changes are the leading causes of recent chum salmon run failures; however, non-Chinook (primarily chum) salmon are taken in the Bering Sea pollock trawl fishery, which reduces the amount of salmon that return to Western and Interior Alaska rivers and subsistence fisheries. It is important to acknowledge and understand all sources of chum mortality and the cumulative impact of various fishing activities. In light of the critical importance of chum salmon to Western Alaska communities and ecosystems, the Council is considering additional measures to further minimize Western Alaska chum bycatch in the pollock fishery.

The purpose of this proposed action is to develop actions to minimize bycatch of Western Alaska chum salmon in the pollock fishery consistent with the Magnuson-Stevens Act, National Standards, and other applicable law. In particular, National Standard 9 provides that conservation and management measures shall, to the extent practicable, (a) minimize bycatch and (b) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. Consistent, annual genetics stock composition information indicates that the majority of non-Chinook bycatch in the pollock fishery is of Russian/Asian hatchery origin; therefore, alternatives should structure non-Chinook bycatch management measures around improving performance in avoiding Western Alaska chum salmon specifically.

The Council intends to consider establishing additional regulatory non-Chinook bycatch management measures that reduce Western Alaska chum bycatch and meet the following objectives; (1) provide additional opportunities for the pollock trawl fleet to improve performance in avoiding non-Chinook salmon, while maintaining the priority of the objectives of the Amendment 91 and Amendment 110 Chinook salmon bycatch avoidance program; (2) meet and balance the requirements of the Magnuson-Stevens Act, particularly to minimize salmon bycatch to the extent practicable under National Standard 9; (3) include the best scientific information available, including Local Knowledge (LK) and TK, as required by National Standard 2; (4) take into account the importance of fishery resources to fishing communities including those that are dependent on Bering Sea pollock and subsistence salmon fisheries as required under National Standard 8; and (5) achieve optimum yield in the BSAI groundfish fisheries on a continuing basis, in the groundfish fisheries as required under National Standard 1.

Preliminary Alternatives

Alternative 1: Status Quo, no action

Alternative 1 is the current management of the Bering Sea pollock fishery with the measures to minimize non-Chinook salmon PSC under BSAI FMP Amendment 110, as described in the Purpose and Need statement and the associated monitoring and genetic data collection and analysis.

All action alternatives apply to the entire Bering Sea pollock B season, the season in which chum salmon are taken as bycatch.

Alternative 2: Overall PSC limit for chum salmon

Option 1: Chum salmon PSC limit (a range to be informed by PSC data).

PSC limits are apportioned among Community Development (CDQ), catcher/processor (CP), mothership, and inshore sectors based on historical total bycatch by sector. The inshore limit is further apportioned among the inshore cooperatives. The CDQ limit is further apportioned among the CDQ groups. Reaching a PSC limit closes the pollock fishery sector to which the PSC limit applies.

Option 2: Weighted, step-down PSC limit triggered by a three-river chum index (Kwiniuk (or index developed for Norton Sound area), Yukon, Kuskokwim) that is linked to prior years' chum abundance/amount necessary for subsistence (ANS)/escapement and weighted to account for variance in stock sizes across river systems.

PSC limits would be triggered and in effect when one or more Western Alaska chum index areas fails to meet index thresholds. As more areas fail to meet index thresholds, chum PSC limits would step-down and become more restrictive. PSC limits are apportioned among CDQ, CP, mothership and inshore sectors. The inshore limit is further apportioned among the inshore cooperatives. The CDQ limit is further apportioned among the CDQ groups. Reaching a PSC limit closes the pollock fishery sector to which the PSC limit applies.

Alternative 3: PSC limit for Western Alaska chum salmon

Option 1: Western Alaska chum salmon PSC limit (range to be informed by PSC data).

PSC limits are apportioned among CDQ, CP, mothership, and inshore sectors based on historical total bycatch by sector. The inshore limit is further apportioned among the inshore cooperatives. The CDQ limit is further apportioned among the CDQ groups. Reaching a PSC limit closes the pollock fishery sector to which the PSC limit applies.

Option 2: Weighted, step-down Western Alaska chum PSC limit triggered by a three-river chum index (Kwiniuk (or index developed for Norton Sound area), Yukon, Kuskokwim) that is linked to prior years' chum abundance/ANS/escapement and weighted to account for variance in stock sizes across river systems.

PSC limits would be triggered and in effect when one or more Western Alaska chum index areas fails to meet index thresholds. As more areas fail to meet index thresholds, chum PSC limits would step-down and become more restrictive. PSC limits are apportioned among CDQ, CP, mothership, and inshore sectors. The inshore limit is further apportioned among the inshore cooperatives. The CDQ limit is further apportioned among the CDQ groups. Reaching a PSC limit closes the pollock fishery sector to which the PSC limit applies.

Alternative 4: Additional regulatory requirements for Incentive Plan Agreements (IPA) to be managed by either NMFS or within the IPAs

Option 1: Require a chum salmon reduction plan agreement to prioritize avoidance in Genetic

Cluster Areas 1 and 2 for a specified amount of time based on two triggers: 1) exceeding an established chum salmon incidental catch rate; and 2) exceeding a historical genetic composition (proportion) of Western Alaska chum salmon to non-Western Alaska chum salmon.

Option 2: Additional regulatory provisions requiring IPAs to utilize the most refined genetic information available to further prioritize avoidance of areas and times with higher proportions of Western Alaska and Upper/Middle Yukon chum stocks.

Scoping and the Role of Public Comment Under NEPA

NEPA is a procedural law with an environmental emphasis intended to facilitate better government decisions concerning the management of our lands and oceans. Drafters of the law believed that by requiring a process designed to provide decision-makers with the best information available about a proposed action and its various alternatives, fewer adverse impacts would occur. NEPA does not dictate protection of the environment, but instead assumes that common sense and good judgment, based on a thorough analysis of impacts of a reasonable range of alternatives, will result in the development of the Nation's resources in a way that minimizes adverse impacts to our environment. This goal is facilitated by requiring a public process whereby the responsible government agency, together with the stakeholders associated with a particular natural resource and development project, present relevant information for use in making decisions.

The development of this EIS provides the opportunity for public participation. Scoping is the term used for involving the public in the NEPA process at its initial stages. In the initial stages of the NEPA process, federal agencies involve the public through the scoping process, which gives the public, other agencies, and interest groups a formal opportunity to comment on potential issues associated with the proposed action. Scoping helps to identify the environmental issues related to the proposed action and identify alternatives to be considered in the EIS. Scoping is accomplished through written communications and consultations with agency officials, interested members of the public and organizations, Alaska Native representatives, and State and local governments.

Where Are We in the NEPA Process Now?

In December 2022, the Council reviewed a discussion paper for this action. In April 2023, the Council reviewed recommendations for concepts for alternatives put forward by the Salmon Bycatch Committee. After review and discussion, NMFS determined that it would develop an EIS for the proposed action based on uncertainty or disagreement regarding the relevant science. The formal scoping period for this EIS began with the publication of a Notice of Intent in the Federal Register on July 11, 2023 (88 FR 44096) announcing NMFS's intention to develop an EIS and inviting public comment through September 15, 2023. In the Notice of Intent NMFS requested written comments from the public on the range of alternatives to be analyzed and on the environmental, social, and economic issues to be considered in the analysis. The NOI was also posted on NMFS website at:
https://www.fisheries.noaa.gov/resource/document/bering-sea-non-chinook-chum-salmon-bycatch-reduction-environmental-impact. The NOI was initiated and promulgated under the 2020 Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1503.4).

This Scoping Report summarizes the public comments received during the scoping period and informs NMFS, the Council, and the public of the issues that the public would like the Council to consider in developing the Purpose and Need, reasonable range of alternatives, and significant issues to consider in the analysis of the EIS. If the Council decides to proceed with this action at its October 2023 meeting as expected, a draft EIS will be prepared (DEIS). The DEIS will incorporate the Purpose and Need statement,

range of alternatives, and the significant issues to analyze as determined by the Council at the October 2023 meeting. A Notice of Availability for the DEIS would be expected to publish in the Federal Register mid-year 2024 in (Figure 2). Information on this action as it progresses through the NEPA process will be available on the NMFS Alaska Region website:
https://www.fisheries.noaa.gov/resource/document/bering-sea-non-chinook-chum-salmon-bycatch-reduction-environmental-impact.

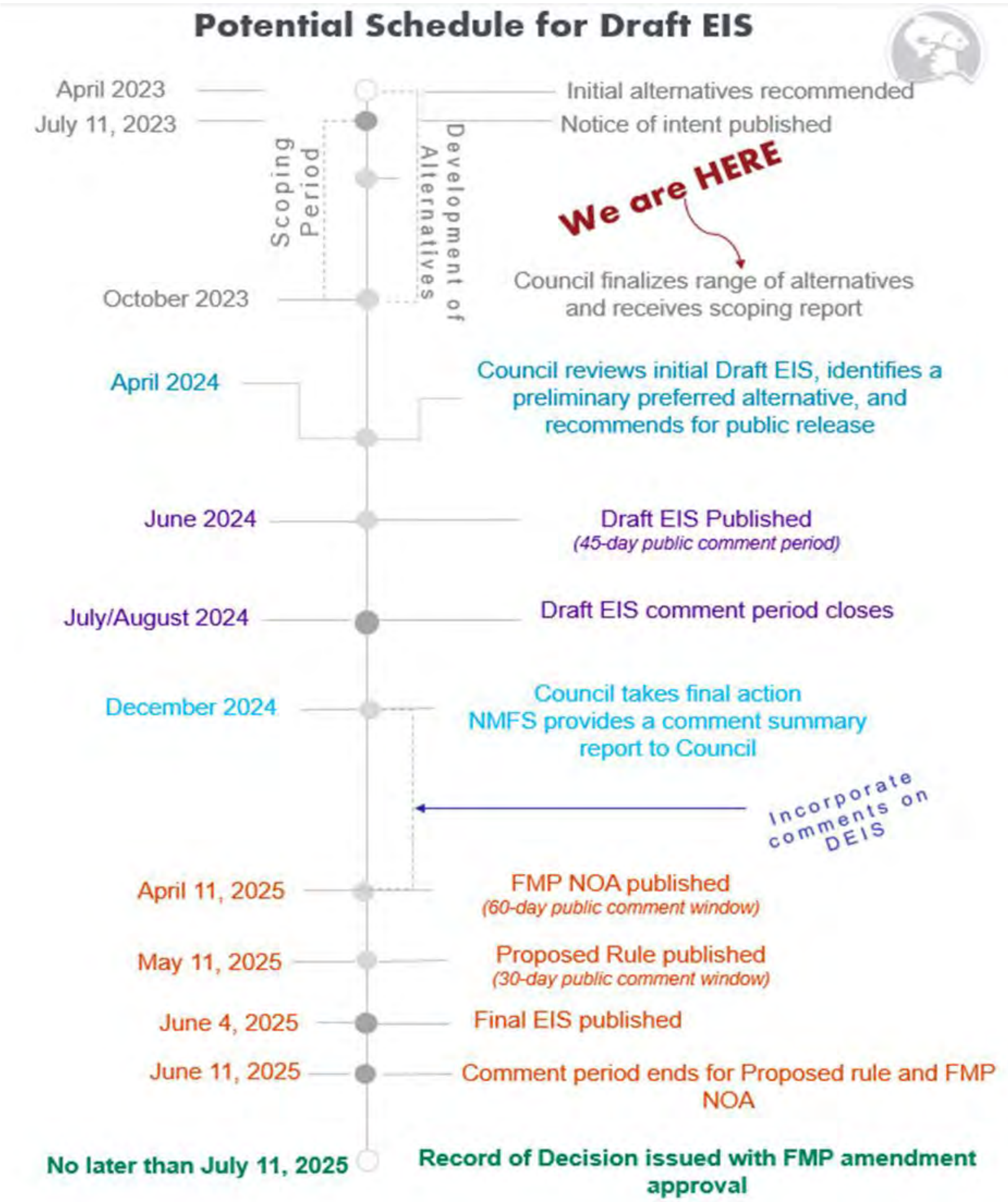

Figure 2. Anticipated schedule for the proposed action as it moves through the Council process.

Tribal Engagement

NMFS has engaged with Alaska Tribal governments and entities and Alaska Native Claims Settlement Act (ANCSA) Corporations regarding the development of the subject DEIS, inviting their comments on the NOI for this action and participation in the Council process. NMFS received public comments on the NOI from Alaska Tribal representatives that specifically addressed Tribal issues related to this action. NMFS has also accepted a request by the Kuskokwim River Inter-Tribal Fish Commission (KRITFC) to be a cooperating agency for this EIS as described in the next section.

NMFS has special obligations to consult and coordinate with Tribal governments and ANCSA corporations pursuant to Executive Order 13175 on “Consultation and Coordination with Indian Tribal Governments” and the Executive Memorandum of April 29, 1994, on “Government-to-Government Relations with Native American Tribal Governments.” Additionally, a recent Presidential memorandum affirms the Federal government’s commitment to including Tribal voices in policy deliberations that affect Tribal communities and recognizes that strong communication is fundamental to a constructive relationship.[2]

Tribal governments and ANCSA corporations have the opportunity to comment to NMFS at any time; however, comments submitted during the Council process of developing and analyzing alternatives for actions are very helpful and informative for the Council’s decision making process.

More information on the consultation process and contact information is provided at the following website: https://www.fisheries.noaa.gov/alaska/consultations/tribal-consultations-alaska.

Cooperating Agencies

The CEQ regulations for implementing the procedural provisions of the NEPA emphasize agency cooperation early in the NEPA process (40 CFR 1501.8). The implementing regulations provide for any federal, State, Tribal, or local agency to be a cooperating agency if it has special expertise with respect to any environmental issue to be addressed in an EIS. Cooperating agencies agree to participate in the early development of the EIS and assist in the writing and review of portions of the EIS that are within their expertise or management responsibility.

The KRITFC requested to be a cooperating agency for this EIS (see Appendix 1). The KRITFC has special expertise on issues related to subsistence use of chum salmon and collaborative management of Kuskokwim River salmon stocks. KRITFC is a Tribal consortium with authorizing resolutions from 27 federally recognized member Tribes throughout the Kuskokwim drainage to act on their behalf in fisheries management, research, and monitoring using the best available Indigenous Knowledge and science. Additionally, since 2016, via authorization of a formal Memorandum of Understanding and Section 804 of the Alaska National Interest Lands Conservation Act (ANILCA), KRITFC and U.S. Fish and Wildlife Service at Yukon Delta National Wildlife Refuge have collaboratively managed Kuskokwim salmon stocks. This includes Chinook, chum, and coho salmon runs for the protection of all three species and the prioritization of rural subsistence harvests as mandated by Title VIII of ANILCA. KRITFC staff have specific experience in the development of management plans based on precautionary, adaptive, and collaborative management. The KRITFC staff will assist NMFS in the development of this EIS to ensure a thorough analysis of issues outside the expertise of NMFS.

[2] More information can be found at the following website: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/26/memorandum-on-tribal-consultation-and-strengthening-nation-to-nation-relationships/.

Summary of Public Comments Received During Scoping Period

NMFS received 11 individual submissions of public comments. Comments were submitted by representatives of fishing industry, Alaska communities, tribal representatives, and individual fishery participants. NMFS Alaska Region staff compiled all incoming comment submissions to maintain a comprehensive list of all public comments. Additionally, staff assigned each submission a unique identification number. The submissions of comment and their attachments are available directly at https://www.regulations.gov under the docket number NOAA-NMFS-2023-0089.[3] NMFS reviewed all letters and attachments and summarized the comments received into 87 distinct comments.

This Scoping Report is intended to present a summary of comments for the Council to consider in its deliberation in finalizing its Purpose and Need, reasonable range of alternatives, and significant issues to analyze in the DEIS for this proposed action. Comment submissions with content pertinent to the NOI are included in this Scoping Report. Comment content includes assertions, suggested alternatives or actions, data, background information, or clarifications relating to the DEIS preparation. As the EIS is developed, each comment will be considered. Only those analytical issues that provide an understanding of the impacts of the proposed action and its alternatives on the human environment will be addressed in the EIS. The NEPA implementing regulations define the human environment as comprehensively the natural and physical environment and the relationship of present and future generations of Americans with that environment.

Comments are summarized by topic for this report. In many cases, comments from more than one commenter address the same concern. In those instances, NMFS Alaska Region staff have combined similar themes into a single, summarized comment that most fully represents and articulates the concern expressed by multiple commenters. Therefore, the number of unique comments under each section in this report does not reflect the number of individual comments on any particular topic or subtopic. Comments with a distinct perspective have generally been summarized in part or whole or are partially extracted from the full comment and may include specific details to convey the context of the point being made. Further, some individual comments address more than one interrelated topic in such a way that the comment is not easily separated into the topic framework of this report. Depending on the context of the comment, it could have been included in the section that covers any one of those categories in this report. However, such comments are generally included in only one topic section of the report. This approach is meant to reduce duplication within the report and is not intended to minimize the importance of the other topics within a particular comment. For the full text of individual comments, please reference the comments directly at https://www.regulations.gov under docket number NOAA-NMFS-2023-0089.

During the process of identifying substantive content for this report, all comments were treated equally. The emphasis is on the content of the comments. They are not weighted by organizational affiliation or other status of commenters. No effort has been made to tabulate the number of people for or against a specific aspect of a topic. In the interest of producing an EIS that both meets the mission of NMFS and best serves all stakeholders, all comments are considered equally on their merits.

[3] Visit www.regulations.gov and enter the docket number NOAA-NMFS-2023-0089 in the search bar.

Quality Control and Review

This Scoping Report was reviewed by the DEIS preparers. Additionally, various procedures were established in the summary process to prevent a submission or comment from being inadvertently omitted. Communication and cross-checking between the submissions and the comments have ensured that all submissions received during the comment period are included in the report. This process of quality control and review is ongoing through the development of the EIS.

List of Scoping Comment Topics

Topic 1: Purpose and Need Statement
- 1.a. Support Purpose and Need Statement
- 1.b. Oppose Purpose and Need Statement
- 1.c. Additional comments on Purpose and Need Statement

Topic 2: Alternatives/Options
- 2.a. Alternatives: support specific alternatives / options
- 2.b. Alternatives: oppose specific alternatives / options
- 2.c. Alternatives: additional comments / suggestions

Topic 3: Comments on significant issues to analyze or consider
- 3.a. Analytical methods and scientific, Local and Traditional Knowledge, and other information
- 3.b. Management, economic, social, and cultural considerations
  - i. Pollock trawl fishery
  - ii. Subsistence fisheries
  - iii. Alaska Natives / Tribes
- 3.c. MSA National Standards
- 3.d. Climate change / Greenhouse gas emissions

Topic 4: Out of the scope of the Purpose and Need for this action.

Scoping Comment Summaries by Topic

Topic 1: Purpose and Need Statement: Minimize non-Chinook (primarily chum) salmon bycatch in the Bering Sea pollock fishery

1.a. Support Purpose and Need Statement

1. The purpose and need adopted by the Council in April 2023 appears to comprehensively address the need for action. It appropriately highlights that the majority of chum salmon bycatch in the pollock fishery is of Russian/Asian hatchery origin. It therefore recognizes that alternatives should structure chum salmon bycatch management measures around improving performance in avoiding Western Alaska chum salmon specifically while at the same time maintaining the priority of the objectives of the Amendment 91 and Amendment 110 Chinook salmon bycatch avoidance program.
2. We maintain ongoing support for the priority stated in the Notice of Intent and Purpose and Need to focus this action on reducing bycatch of chum salmon of Western Alaska origin in the Bering Sea.

1.b. Oppose Purpose and Need Statement

NMFS received no comments that directly opposed the Purpose and Need Statement

1.c. Additional comments on Purpose and Need Statement

1. The implementation of the BSAI groundfish FMP must meet its own objectives, including the reduction of bycatch to biologically and socially acceptable levels.
2. The Purpose and Need statement for this EIS should be revised to set a chum salmon PSC cap on the Bering Sea pollock fishery that provides equity in the conservation measures ensuring the Western Alaska chum salmon stocks do not collapse.
3. The Purpose and Need statement for this EIS should be revised to include true Ecosystem- based Fishery Management that would allow for lower bycatch caps (limits) for all species seeing a decline in population and caps and conservation measures imposed on the trawl fleet; and management of the pollock fishery, including setting caps for bycatch with a comprehensive look at the fishery impacts to the whole ecosystem, including other fisheries, communities, and habitat. Such ecosystem management should also balance the economic benefits of the pollock fishery with the economic, cultural, and ecological devastation it causes and exacerbates, rather than giving the economic benefits an unbalanced weight.

Topic 2: Alternatives / Options

2.a. Alternatives: support specific alternatives / options

NMFS received no comments that directly supported any of the alternatives in their entirety as presented in the NOI.

2.b. Alternatives: oppose specific alternatives / options

1. We opposes Alternative 1 status quo in its entirety. The status quo involved the highest capture of prohibited chum species in a time where the run was so low that in-river subsistence harvest was prohibited. To continue this practice would have a devastating effect on these already threatened runs. Bycatch of chum salmon by the metric tons is unacceptable under any circumstance and especially now with remote Western Alaska seeing the decline and collapse closing fisheries.
2. None of the three action alternatives curb bycatch to an acceptable, equitable level. We request additional alternatives for effective and meaningful bycatch avoidance.
3. Alternative 3: The Western Alaska chum limit will not protect chum during this crisis.
4. Additional regulatory requirements to the pollock industry's IPAs are insufficient to ensure meaningful reduction of chum salmon bycatch now and in the future. The increase in overall chum salmon bycatch after the implementation of Amendment 110 and its reliance on IPA-level chum salmon avoidance demonstrates the inadequacy of the industry to reduce chum salmon bycatch without rigorous Tribal, agency, Council, and public oversight and pressure. We do not support Alternative 4 to insert regulatory requirements into the IPAs without also implementing provisions in Alternatives 2 and 3, including a PSC cap linked to Western Alaska chum salmon abundance and time and area closures.

5. The Western Alaska chum PSC limit presented in Alternative 3 is inadequate to protect threatened chum salmon runs in the Yukon and Kuskokwim Rivers. Chum salmon runs in the Yukon and Kuskokwim Rivers are at an all-time low. Runs are currently insufficient to maintain sustainability. In such desperate times, every salmon counts. While the PSC limit is roughly the average of the last decade bycatch, this period contains the steady decline and near total collapse of the salmon runs in Western Alaska. If anything, the PSC limit should be aligned with the limits prior to the salmon crash, meaning the limit should be cut in half at a bare minimum.
6. We oppose Alternative 4 as a standalone alternative, but we support Alternative 4 in conjunction with variable caps as described in Alternatives 2 and 3, with some modification[4]. The increase of chum bycatch after the implementation of Amendment 110 demonstrates the inability of the industry to reduce bycatch without rigorous oversight and public involvement. Without a variable cap any regulatory requirements are insufficient to ensure the bycatch reduction needed to preserve our salmon.
7. Multiple management measures, including IPAs, have failed to prevent Bering Sea Chinook and chum salmon bycatch from occurring at high levels in some years while multiple directed fisheries in Alaska are closed for conservation purposes. NMFS and the Council have used industry-run voluntary measures, which failed to prevent the 2005-2007 bycatch of over 292,000 Chinook that preceded stock collapses. Regulations implemented in 2016 incorporated chum salmon avoidance into the IPAs, which failed to prevent chum bycatch from increasing significantly over the past decade. For the most vulnerable stocks, in some years the only source of anthropogenic removals is trawl bycatch. The inability to constrain chum salmon bycatch with voluntary measures should inform the need to develop alternatives that can better meet the purpose and need to reduce chum salmon bycatch.

2.c. Alternatives: additional comments / suggestions

Public comments recommended the following types of additional alternatives:

- Alternatives should include PSC limits that extend well below average PSC levels.
- Chum PSC limits should be linked with chum abundance.
- Options for PSC limits should include incentive-based allocations and/or re-allocations reflecting good and poor performance.
- PSC limits should have meaningful short- and long-term impacts.
- Time and area closures should be considered.
- Consider additional tools relative to IPAs.
- Other suggestions for alternatives include 24/7 electronic monitoring, reducing the pollock TAC, and applying Alternatives 2, 3, and 4 to both the A and B seasons.

Chum salmon bycatch (PSC) limits

1. The range of alternatives must include PSC limits that are sufficiently low to restrict bycatch to protect Western Alaska chum salmon stocks. Evaluating "average" PSC levels 2011-2022 (as stated in the Council motion) inappropriately focuses the analysis on a 12-year time period when chum salmon bycatch was well- above (nearly double) the long-term average from 1991-2022. If historical averages are used to set PSC limits, they must reflect the full range of bycatch levels. A reasonable range of alternatives must include PSC limits that extend well below average PSC levels to meet the mandate of National Standard 9 to reduce bycatch.

[4] Described in other comments in this Scoping Report.

2. Analyze a reasonable range of alternatives that includes abundance-based limits. A Western Alaska chum salmon abundance index should consider both escapement and the subsistence needs of fishery-dependent communities. Chum salmon abundance has historically fluctuated, and there is sufficient data to effectively link PSC levels to Western Alaska chum abundance. This would provide the ability to have lower PSC limits in place to conserve the resource for dependent communities and the ecosystem more broadly when Western Alaska chum salmon runs are depressed.
3. A chum PSC limit should be linked with chum abundance to the extent possible. At times of very high abundance, it makes sense to ease PSC restrictions, and at times of low and very low chum abundance, PSC limits should be ratcheted down to better account for salmon sustainability as well as community and subsistence needs. Regardless of high or low abundance, PSC caps should still be meaningful to reduce overall chum salmon bycatch.
4. Link chum PSC limits to abundance, with meaningful reduction achieved at all levels. As with all responsible management, limits should fluctuate with abundance, rather than being set at a single static level. The EIS should consider abundance indices for Western Alaska chum as a trigger for setting annual limits. The conservation of both the chum resource and Bering Sea fishing opportunity will be collectively better served by considering a management framework that responds to abundance.
5. Set a PSC limit commensurate with chum abundance. In years where the runs are threatened, an inflexible chum cap doesn't protect the run. In years of plenty, the caps act as an arbitrary limit where none is needed. Instead, we recommend setting a variable cap based on the anticipated run size in Western Alaska, first ensuring that escapement and the subsistence needs of the fishery dependent communities in Western Alaska are met. Moreover, when escapement goals are consistently not met and the communities' subsistence needs are not met, the PSC cap for coming years should be reduced to permit recovery of the depleted salmon runs.
6. Chum bycatch should be reduced at all levels of salmon abundance. There may be value from a number of perspectives in exploring linkages to escapement and subsistence needs. These are extremely important considerations. However, in doing so, there needs to be appropriate awareness with regard to the potentially problematic nature of such issues, as well as the importance of reducing bycatch at any level of salmon abundance.
7. Alternatives must include variable caps that fluctuate depending on the abundance of the run size with close attention to escapement goals and the subsistence needs of Western Alaska over time while these populations regain abundance to stabilize for communities of Western Alaska.
8. Option 1 for both Alternative 2 and Alternative 3 (limiting the allocation of a potential PSC cap based on historical total bycatch) creates a perverse incentive, rewarding the vessels and sectors with the worst historical performance. The options being considered relative to PSC allocations of a PSC limit should be broadened to include incentive-based allocations and/or re-allocations, rewarding good bycatch performance and forcing poor performers to improve or face stricter PSC limits. Allocations strictly based on historical performance or pro-rata shares also ignores other spatial constraints of the inshore and offshore sectors and the disproportionate impacts each may have specifically on Western Alaska chum.
9. An overall or Western Alaska chum PSC limit, as presented in the Alternatives, must be low enough to have a meaningful impact short- and long-term. A high static cap will have no conservation outcome for communities that depend on salmon returns as a way of life. The values suggested in the 2023 April Council motion call out "average" bycatch levels to be analyzed from 2011-2022. However, during that 12-year time period, chum bycatch was well-above (nearly double) the long-term average from 1991-2022. This sets a dangerous precedent for selecting an "average" PSC limit based on historically high and unacceptable levels of bycatch.

10. The long overdue development of a chum PSC limit must include numbers and mechanisms that will result in effective changes to the pollock fleet's fishing behavior significant reductions. The short time period of 2011 through 2022 to analyze bycatch levels is far too narrow to capture the relevant history and current conservation needs around chum salmon and their interactions with off-shore industrial fisheries. It focuses attention on a time when chum PSC has been nearly double historic averages, and river returns at historic lows, indicating the potential or even intent to codify an unsustainable and unacceptably high level of PSC through an inflated limit.
11. Chum bycatch should be immediately reduced at least by half the recent bycatch levels to no more than 250,000. These reduced Chum salmon bycatch caps are reasonably attainable and should be implemented right away. Even lower salmon bycatch caps should be implemented for the longer term in order to support Western Alaska chum salmon recovery. Within a year that bycatch should be further reduced to a 150,000 chum salmon PSC limit. These lower limits should remain in place until such time that the Western Alaska salmon fishery rebounds enough to support a healthy salmon population that meets both the needs of subsistence users and escapement goals for future returns.
12. An overall or western Alaska-focused chum PSC limit, as presented in Alternatives 2 and 3 must be low enough to account for the long-term nature of the salmon crisis, and to have a meaningful and durable impact in both the short- and long- terms. A high PSC limit will not have a meaningful outcome for salmon or Tribal subsistence communities, nor will it address the long-standing nature of the problem. A cap must be significantly lower than the bycatch amounts extending back for decades, which is the duration of this problem.
13. PSC limit numbers must include a full range of numbers at the 'low' end of the spectrum. To do otherwise would not be respectful of the needs to consider all options, to consider the magnitude of the salmon crisis in subsistence communities (who have been expected to have little to no harvest, while anything approaching this has been considered unimaginable with regard to the pollock industry), and to produce an honest, transparent analysis and statement of values with regard to different fisheries, different fishing communities, different National Standards, different social and economic impacts and different bodies of knowledge.
14. Conservation measures for chum salmon should be shared. If fisheries in western Alaska are shut down, then the PSC limits should reflect the shutdown. It can no longer be ignored that what happens in the pollock fishery affects what's taking place in our rivers. Communities on the Yukon, Kuskokwim and numerous other rivers in western Alaska face the strictest of management measures - criminalization - for any harvest of chum or Chinook. If the strictest of measures are taken inriver, strict measures should be seen in federal ocean fisheries.
15. Set meaningful chum and Chinook salmon PSC caps for the Bering Sea pollock fishery, sharing the burden of conservation, preserving the sustainability of salmon, and pursuant to NOAA's Ecosystem-Based Fisheries Management policy. NMFS should revise the range of Alternatives for this EIS to set a chum salmon PSC cap on the Bering Sea pollock fishery that provides equity in the conservation measures ensuring the Western Alaska chum salmon stocks do not collapse. Since the mid- 1990s the Council has recognized the need to adopt meaningful measures to limit the impacts of the Bering Sea pollock fishery on chum salmon through bycatch limits. However, the Council has a long history of not enacting meaningful management measures to address concerns over the number of chum salmon taken as bycatch in the Bering Sea pollock fishery. In 2012, the Council did attempt to develop chum salmon bycatch management measures and was presented with alternatives that included area closures, seasonal caps, and temporal caps. However, the Council refused to select an alternative that would provide meaningful reductions in bycatch of both Chinook and chum salmon since it would result in reduction of the pollock harvest. Instead, under Amendment 110 in 2016, the Council integrated an avoidance program

for chum salmon within the trawl fleet's Incentive Plan Agreements. Since the integration of chum salmon avoidance incentives in the pollock fishery's IPAs in 2016, the number of chum salmon caught by the trawl fleet has been well over the ten-year average of 226,304 fish, and were in fact, the highest bycatch years since 2006.

16. An appropriate metric to trigger a lower bycatch limit in the following year in specific areas during the B-season could include any or all of a combination of failures to meet subsistence needs, escapement failures or other available data such as directed fishery CPUE or in-river fish counts. Over 27 percent of the 2022 western Alaska chum bycatch were age 4 and otherwise could have returned that year or the following year to contribute to escapements. The chum life cycle can be highly variable in terms of their spawning age. Chum typically return to spawn between three and five years old and most frequently at age 4. Historically, over two-thirds of the chum returning to the Yukon River were age four; five year old fish were the second most common returning age of spawners. Most of the chum taken as bycatch are adult fish age three and four. Each successfully spawning chum on average generates nearly two returning fish. In other words, a bycatch limit that responds to poor escapements or other abundance metrics could allow for more returning chum the next year and provide for better future returns. We request that NMFS develop this alternative as part of the agency's obligations under NEPA, regardless of the outcome of the Council's October meeting.
17. During recent periods when chum salmon population declines and direct target and subsistence fishers were severely limited or shut down, the pollock fishery annually caught greater than the ten-year average of chum bycatch. This represents many more fish caught by the pollock trawl fleet than Alaska direct target commercial fishers, subsistence harvesters, and sport fishing combined. The sharp decline in Alaska's chum salmon populations and the high bycatch of chum salmon necessitates NMFS provide a preferred alternative that sets a meaningful PSC limit on chum salmon for the Bering Sea pollock fishery, and not simply a continuation of the status quo or additional IPA measures.
18. Select a Preferred Alternative, based on an Ecosystem-based Fishery Management approach that provides meaningful reductions in bycatch of both Chinook and chum salmon even if it results in reduction of the pollock harvest. While we have grave concerns over the state of chum salmon returning to Western Alaska, and the impacts of bycatch of chum salmon by the pollock trawl fleet on Western Alaska populations, the focus of setting a chum salmon PSC limit without thorough discussion and analysis of the pollock fishery's impacts on other bycatch species and habitat, including Chinook salmon, squid, herring, crab, and halibut is disingenuous and counter to the purpose and intention of the Magnuson-Stevens Act. Pitting and prioritizing one bycaught species against and over others does not get to the root of the problem. Setting PSC limits with a single species focus allows the pollock fishery to continue to take bycatch of all species at an unsustainable level, while keeping a TAC that maximizes and prioritizes the pollock fleet's economic gains. Meanwhile, those fisheries targeting bycaught species continue to shoulder the burden of conservation measures for the recovery of their target species.
19. The Council has used bycatch limits for Bering Sea Chinook to varying degrees for several decades but has set those limits at such high levels that the pollock industry has not shared in conservation burden borne by Alaska fishermen. For example, one of the Council's proposed alternatives would set limits based on average recent bycatch which ranged between 315,000 to 377,000 chum depending on the selected time period. A limit developed under this range of could allow for the bycatch of over 60,000 western Alaska chum each year over time. Even ten to twenty percent reductions using this range may not meaningfully improve escapements or subsistence harvests, let alone provide sufficient salmon escapements to strengthen runs to the point of restoring an important commercial salmon fishery.

Time/area closures

1. Given the failure of previous management measures to constrain chum bycatch we request that NMFS and the Council consider developing an alternative that considers spatial and temporal management measures triggered by abundance-based metrics.
2. While proposed Alternative 4 considers spatial and temporal management measures by adding chum salmon bycatch reduction plan agreements to IPAs, it links those measures to pollock catch rates or the proportion of western Alaska stocks relative to other chum stocks, rather than to western Alaska chum salmon abundance. In other words, bycatch of western Alaska chum could remain high when there are high pollock catch rates or there is a large abundance of other chum stocks. Specifically, NMFS should develop an alternative with temporal bycatch limits and spatial closures that:

   (1) considers limits for specific areas during the portions of the B-Season when western Alaska chum bycatch is highest, and
   (2) utilizes abundance metrics such as escapements or amounts necessary for subsistence to trigger closures rather than industry catch rates or abundance of other stocks. Past, recent and ongoing chum genetic stock composition analyses can inform the development of an alternative that links bycatch limits with the spatial and temporal distribution of chum salmon bycatch. The largest numbers of bycaught chum that originate in the northeastern Pacific – whether from western Alaska or other parts of Alaska – occur in portions of the Bering Sea east of 170° longitude. Most of the bycatch of western Alaska or other Alaskan fish there occurs during the middle of the B-season, frequently in pulses such as in mid-July and mid-August.

   Representatives of western Alaska chum fishermen participating in the Council's Salmon Bycatch Committee recommended this alternative with two options that would set area-specific bycatch limits in Cluster 1 and close the area for either the early weeks of the B-Season or the entire B-Season. The Council refused to move this alternative forward for further analysis. The Council's September 2023 analysis indicates that agency staff consulted multiple representatives from the pollock industry in the development of alternatives, but did not consult with individuals who represent western Alaska chum fisheries.
3. Time and area closures should also be considered in addition to an overall PSC cap to target returning Western Alaska chum salmon migrating through the Bering Sea on their journey to natal rivers. Tribal representatives developed a comprehensive set of alternatives for the NPFMC's Salmon Bycatch Committee for their March 20 meeting (listed as Proposal 4). That set of alternatives represents a reasonable range and should be included in the analysis.
4. We recommend time and area closures. We applaud efforts to reduce bycatch of chum salmon in the Bering Sea pollock fleet, including but not limited to genetic sampling and identification of spatial, temporal, and thermal trends of chum salmon in the pollock fishery. W e encourage the continued use of said studies to further reduce the chum salmon bycatch in the pollock fishery and encourages further efforts to accomplish this priority. As the knowledge in these areas increases, we further support time and area closures to further decrease chum bycatch. Identifying times and areas of high bycatch will allow the fleet to avoid the valuable salmon runs of their further depletion.
5. Time and area closures must also be considered in addition to a PSC cap. The migratory behavior of chum salmon lends itself to an evaluation of time and area closures as part of the analysis. For

instance, there is indication that early B-season tends to see higher proportions of Western Alaska chum, especially in genetic sampling or Cluster Area 1. Focusing timed closures in areas with high Western Alaska chum salmon bycatch rates will ease choke points for returning chum salmon and will allow the most fit individuals to return to their natal rivers to spawn or provide for subsistence users. The available data from time and area closures provides valuable insight into linkages between amounts of bycatch, genetic composition of bycatch, temporal dimensions of bycatch, and spatial dimensions of bycatch.

6. Consider options for time and area closures that have the ability to conserve salmon at key migration times, respond to instances of high PSC rates with dynamic closure options, and focus areas that have Western Alaska chum savings potential specifically. While reducing overall chum PSC is critical, and responding to high PSC rates can help that, there is also benefit to distributing PSC take across time and area. PSC concentrated in singular spaces and times are more likely to remove genetically similar groups. Genetic diversity is a critical component of run plasticity, or, the ability to adapt to and survive ecosystem changes. The conservation of both the chum resource and Bering Sea fishing opportunity will be collectively better served by considering a management framework that responds to abundance as well as temporal and spatial dynamics.

Additional approaches to minimizing chum bycatch (PSC)

1. Other tools that could be explored relative to IPAs that have been part of previous chum salmon management regimes and inter-cooperative agreements, include a chum salmon weekly dirty 20 list (phased out during Amendment 110), inter coop incentives, and outlier provision regulations.
2. Apply Alternatives 2, 3, and 4 to both the A and B season. While the B season has historically seen the highest annual chum salmon bycatch, we request the A season be included as well. Ocean conditions in the Bering Sea are changing rapidly, as are the migration and feeding patterns of the many species that call it home. Salmon runs are currently in a crisis state, which mandates increased scrutiny and monitoring throughout the seasons.
3. Implement video monitoring on all trawl fishing vessels with 24/7 coverage to ensure salmon bycatch does not exceed these hard cap limits.
4. The pollock TAC must be ‘on the table’ as part of the solution. Part of the suite of behavioral or other changes must include the possibility that the pollock fleet may simply need to fish significantly differently and/or even simply fish less. The TAC must not be treated as sacred. It is just one factor among many, which must be considered; and it must be considered, including changing it, not just protecting it for its economic value.

Topic 3: Comments on significant issues to analyze or consider

3.a. Analytical methods and scientific, Local and Traditional Knowledge, and other information

Genetics Information

1. Genetic Diversity - From 2013-2023, over 3.1 million chum salmon have been taken as bycatch in Bering Sea groundfish fisheries. The cumulative impact of these removals on the genetic diversity and therefore the overall resilience of salmon populations in Western Alaska should be evaluated as part of the EIS. Genetic diversity in the fittest salmon returning to natal rivers is a key element of a populations’ resilience and ability to recover from a depressed state. In an increasingly unpredictable and warming climate, anthropogenic activities like bycatch that suppress life-history diversity could have serious consequences, particularly for depressed

populations persisting at ecological and physiological limits. The genetic diversity of each stock is the fail-safe that the population has to adapt and survive over time. If the same genetic portion of that run is removed, such as when bycatch events capture large groups of migrating fish that are likely to be genetically similar, it makes populations more vulnerable to extinction, with compounding effects for salmon-dependent ecosystems and communities.

2. The effectiveness of Western Alaska chum bycatch reduction measures must carefully consider the existing genetics data. Estimates of total Western Alaska chum salmon catch in the pollock fishery are available by Cluster (1-4) and Early/Late time periods (Early: Weeks 24-32, and Late: Weeks 33-43). Accurately predicting the spatio-temporal distribution of Western Alaska chum based on historical genetics information is the primary pathway for effectively reducing bycatch of Western Alaska chum salmon specifically. The EIS should carefully explore the patterns of historical Western Alaska chum salmon distributions to utilize for in-season management measures. If, hypothetically, a three-year time series most accurately reflects future year Western Alaska chum salmon distributions, then the following table would be most useful in determining areas and times that should be subject to increased bycatch avoidance. We envision these tables being updated with the latest genetics information on an annual basis, with trends being monitored continuously (as is currently done informally within the existing IPA management.). Thresholds may also be established such as cluster 4/Late (2% Western Alaska chum proportion), whereby all salmon bycatch avoidance measures are suspended so as not to force the fleet into areas of higher Western Alaska chum salmon. Only the IPAs can adapt to annual changes in genetics information to ensure ongoing prioritized avoidance of Western Alaska chum salmon specifically.
3. Advances in genetic sampling indicate there may be significant spatial trends in chum bycatch in the pollock fishery. For instance, Western Alaska chum is a greater proportion of overall chum bycatch in certain areas, especially in genetic sampling area Clusters 1 and 2. It follows that management measures to reduce chum bycatch should utilize spatial, temporal and thermal trends in extant data to identify ways to maximize reductions in Western Alaska chum bycatch specifically. We encourage NMFS and the Council to consider emerging technologies, such as genetic sampling, proactively in the EIS so that the document is forward-thinking and responsive to the development of more precise management tools longer-term.
4. Severe data limitations exist which could complicate effective development of a reliable index of Western Alaska chum abundance under Option 2 for both Alternative 2 and Alternative 3. Accurate chum salmon run reconstructions via weir projects, sonar counts, test fisheries, aerial surveys, etc. are highly dependent on funding availability, stream flows/flooding, turbidity, weather, and other extemporaneous factors. Reliable and consistent data streams are questionable, as is the arbitrary selection of highly diverse river systems (limited by available data of varying quality) to represent overall Western Alaska chum salmon abundance in the Bering Sea. At present there are three broad categories of data that could inform an index of Western Alaska chum abundance: (i) genetic analyses from pollock fishery bycatch; (ii) escapement/run reconstruction data; and (iii) commercial and subsistence harvest (ANS) data. To formalize a process whereby PSC limits are dependent on any of these three sources would be to assume both ecosystem stationarity and the future availability of those data from an external management body.
5. More research is needed on origin of chum caught in the Bering Sea pollock trawl fishery for meaningful western Alaska bycatch avoidance.

Local (LK) and Traditional/Indigenous Knowledge (TK)

1. TK should be a key component of an EIS and its analysis of social and environmental impacts of salmon bycatch in the pollock fishery, especially as they relate to Western and Interior Alaska communities. It would be impossible to accurately capture the impacts of salmon declines and conservation, or develop successful responses, without incorporating the LK and TK rooted in Western Alaska tribes and rural communities as a foundational source of information and rubric for assessment. Salmon loss to salmon-dependent cultures and communities results in impacts that include and far exceed the economic reliance more readily quantified in statistical analysis. The catastrophic effects of salmon declines, and the extraordinary benefits of conservation, have impacts on livelihood, nutrition, cultural identity, education, spiritual practice, rural economy practices, and many other aspects of community wellness that must carry fundamental weight in analysis, far beyond anecdotal narrative. LKTK as well as Tribal consultation can provide additional context and content necessary for properly assessing alternatives for action.
2. TK is part of the best information available, yet has not been treated as such despite National Standard 2. Fisheries science (and its particular model-, instrumentation-, and quantification-based approaches) has failed to steward the resource on its own. Millions of Chinook and chum salmon have been wasted as bycatch in the pollock fishery over the past several decades, many of which were bound for western and interior Alaska. Our Tribes do not believe this is insignificant at any level - not in terms of its species level effects, its effects on the ecosystem, and its effects on our communities and their *iluaġniq* (*well-being*, in Inupiaq).

Other analytical approaches and information issues to consider

1. The number of chum salmon that return to Western Alaska rivers given additional chum salmon bycatch measures must be analyzed quantitatively. Assessing numerical savings of Western Alaska chum salmon attributed to Incentive Plan Agreement salmon bycatch measures is difficult given the inability to predict fleet behavior and simulate hypothetical fishing effort. Council and Agency analysts have indicated any IPA options proposed under Alternative 4 will only be qualitatively evaluated, however, we believe this creates an unequal comparison between the existing alternatives.
2. We note that the Council's preliminary review analysis highlights that no low abundance threshold has been established by the Alaska Department of Fish and Game for chum salmon; and that a low abundance threshold would need to be determined by the Council, with perceptions of high vs. low abundance strongly influenced by the time series of data selected.
3. The Council analysis shows no direct correlation between whether the ANS are met and total run reconstruction estimate. We believe the absence of a direct correlation makes this metric a poor indicator of the stock status for Western Alaska chum salmon on a given drainage.
4. SeaState, Inc. developed a catch per unit effort simulation framework to analyze the effects of lowering the base rate (up to 50%) as well as increasing the size of closure areas. The results included five simulated scenarios with maximum estimates of total Western Alaska chum salmon savings of 3,522 (704 per annum average) fish over the recent five-year period (2018-2022). In two of the five years assessed, however, Western Alaska chum catch was estimated to increase relative to the status quo. Further, the proportion of estimated Western Alaska chum in the overall bycatch was calculated for each scenario. Across all scenarios in which chum salmon bycatch management measures were increased—expanding bycatch avoidance areas and decreasing by half the bycatch rate at which bycatch avoidance areas are identified—estimated reductions of the Western Alaska bycatch proportion decreased by a maximum of 1%. In fact, as the rolling hot spot program is enhanced to move the fleet more aggressively, there is increased variability in the predicted Western Alaska chum catch and diminished bycatch mitigation returns. The simulation highlights the difficulty in attempting to avoid 18% of a total population

of a given species, with a very limited understanding of the true spatio-temporal distribution of Western Alaska chum. Quantitative analyses of IPA bycatch mitigation measures are therefore essential to understand estimated impacts to the fleet as well as benefits to in-river salmon returns.

5. Performance metrics relative to bycatch tradeoffs should be extensively and quantitatively assessed for each of the chum salmon bycatch reduction measures considered within this EIS. It is critical to understand that increased avoidance of Western Alaska chum salmon may lead to bycatch tradeoffs. This was particularly evident in the chum salmon analysis completed in 2012, which showed that management actions to move the fleet away from the most productive fishing grounds to avoid chum salmon would extend the season and thus have adverse effects on Chinook salmon bycatch. SeaState, Inc. simulations resulted in marginal increases of Chinook salmon bycatch. However, Chinook bycatch is not the only tradeoff that must be considered. The 2023 B season has provided an example of additional regulatory constraints that must be considered in the context of this EIS. Catcher vessels operating within the Catcher Vessel Operational Area this B-season encountered large schools of herring at depths and in areas not traditionally encountered. Exceeding the pollock fishery's herring PSC limit was avoided by using the cooperative structure to implement voluntary closures to limit herring bycatch. However, catch of chum salmon of the inshore sector more than doubled within three days of implementing voluntary herring bycatch avoidance areas, clearly demonstrating the spatial mismatch of chum and herring distributions. Catcher/processor vessels were also forced to abandon pollock fishing in low chum bycatch areas within the Winter Herring Savings Area and move closer to the shelf break due to increasing herring catches. Chum salmon bycatch rates were significantly higher near the shelf break. These are examples of the daily decisions vessel captains face and the bycatch tradeoffs that must be considered.
6. A chum salmon abundance index should consider both escapement and the subsistence needs of fishery-dependent communities. To be more equitable, NMFS and the Council must concede that the unique life history of salmon and the ecosystems and people dependent upon them necessitates a comprehensive, gravel-to-gravel approach to management. When escapement goals are consistently not met and communities are significantly below their subsistence harvest goals (as measured by ANS), managers are not fully evaluating the systems impacted by their decisions. Bycatch is one of the few salmon life-stage specific mortalities that managers can control, and NMFS and the Council must do more to reduce Western Alaska chum salmon bycatch in a way that is responsive to community and ecosystem needs.
7. Analysis should never assess impact by describing total chum PSC as a percentage of target catch. The extraordinary size of the pollock harvest does not provide an appropriate context for the value and impact of salmon conservation. Incorporate meaningful biological analysis of salmon reproduction and recovery. In past analyses, we have observed a lack of robust salmon science as a cornerstone of impact assessment. Rather, analysis tends to focus on Western Alaska chum as a percentage of overall chum, and a percentage of a total annual escapement goal. This over simplifies the known dynamics of salmon resilience and reproduction, and the value of salmon conservation and biodiversity conservation over time. For example, a management mechanism resulting in an additional 500 chum salmon returning to a salmon system could be assessed as a small benefit, when compared strictly to the annual needs for escapement and subsistence. However, 500 salmon returning to a system in crisis can have a substantial impact on recovery for that system, based on reduced competition for habitat, feed availability, and other critical aspects of reproduction and juvenile survival. Another important component of salmon resilience is genetic diversity in returning salmon, and the long-term impacts of sustained genetic removals. An individual run is made up of a spectrum of genetically similar but not identical salmon; that

returning mixture results in a temporal, spatial and genetic spawning diversity critical to resilience within a dynamic and changing system. Salmon managers have recognized and responded to this within management schemes, including both the State of Alaska today and indigenous stewards throughout the history of these systems. When there are high salmon bycatch events that are likely to contain significant numbers of the same genetic group, or consistent significant removals during the same period of the run each year, the consequences of that genetic composition are as important as the number of fish. Analysis should incorporate the best available science around salmon recovery, including spawning brood tables accounting for reproduction and survival factors at different levels of abundance, and the impacts of genetic removals in the short term and compounded over time.

8. The scope of this EIS analysis must be broad enough to consider biological, ecosystem-wide, and human dimension issues.
9. We request an inquiry into the problem of *Ichthyophonus* found in the massive amounts of pollock processing waste thrown overboard as this diseased waste must be investigated as an additional factor, along with bycatch, of salmon decline. The salmon are known to key into this waste and eat it and *Ichthyophonus* has been detected in salmon on the spawning grounds.

3.b. Management, economic, social, and cultural considerations

3.b.i. Bering Sea pollock fishery Incentive Plan Agreements

1. The current IPAs are the most effective tool for managing Western Alaska chum salmon bycatch now and into an uncertain future. IPAs have two primary tools to further incentivize the fleet to avoid chum salmon generally and Western Alaska chum specifically. Those tools include reducing the bycatch rate threshold (base rate) at which bycatch avoidance areas are considered in areas and times when Western Alaska chum salmon are known to be in greatest abundance. It is important to recognize, however, that careful consideration and extensive analysis was conducted to establish the current base rate for chum salmon. It is predicated on a clear demonstration that lowering base rates below the 0.20 threshold diminishes returns on chum salmon savings; and while possibly reducing impacts on Western Alaska chum specifically, it would likely increase chum catch overall. Years of bycatch data were analyzed to show that closing areas at an extremely low bycatch rate threshold significantly decreases the likelihood that chum salmon abundance is lower outside of those areas. The second primary tool is to enlarge bycatch avoidance areas further, when and where Western Alaska chum salmon are known to be present. Again, chum salmon appear on the grounds in discrete areas and for very short time windows, suggesting that schools move rapidly and do not remain stationary occupying large areas. Accordingly, while Western Alaska chum salmon savings may be achieved, overall chum salmon bycatch reductions are in question.
2. Chum salmon move up onto the Bering Sea shelf and overlap with the pollock fishery in greater numbers as water temperatures increase. Additionally, chum salmon predation of Age 0 pollock increases when abundance is high, as was the case during the protracted warm phase of 2015-2021. Salmon productivity has also historically faltered during warm phases in which the primary productivity shifts from being an ice dominated ecosystem characterized by large lipid rich zooplankton abundance to warmer waters fueling multiple phytoplankton blooms and small copepod abundance and coccolithophore blooms. In short, we believe the current IPA system to be best suited to address the increasing variability in pollock and salmon abundance on the fishing grounds, as well as adapt to longer term changes in species distributions and

abundance due to climate change. Clear incentives are in place to reduce bycatch of chum salmon at all levels of pollock and salmon abundance.

3. IPA revisions can be made at any time and become effective upon Agency approval, providing an avenue for immediate action to address low Western Alaska chum salmon runs. In 2019 and 2020, the Western Alaska chum component of the overall chum bycatch was reduced from a historical annual average of approximately 18% to just 9%. The 50% decline of those stocks in the stock composition highlights the ability of the genetics data to provide limited information on stock status in the marine environment. In response to those declines, the IPA for the CP sector implemented three new measures to further prioritize and reduce chum salmon bycatch for the 2022 B season. Provisions were included to: (i) categorically close all areas with extremely high chum bycatch to all vessels regardless of performance; (ii) make the IPA more responsive to sudden spikes of chum bycatch by implementing bycatch avoidance areas bi-weekly instead of weekly; and (iii) implement a chum outlier provision. These changes have been successful at reducing chum salmon bycatch in the combined CP and CDQ sectors for 2022 and 2023, although it is unclear what additional external factors (including average bottom temperature) have contributed to the reductions.
4. As species distributions shift, the IPA can continue to be responsive to updated genetics information by adapting to inter-annual changes that may occur. Static regulations may direct the pollock fleet to prioritize areas and times where Asian origin hatchery fish are more prevalent, thereby increasing interactions with Western Alaska chum in the future. The greatest challenge of managing chum salmon bycatch in-season is the inability of current genetics to “independently assign” a river of origin either in real time or postseason for each genetic sample collected. In other words, in managing rolling hot spot closures, there is no way to determine whether specific hotspots of chum salmon abundance are predominantly aggregations of hatchery fish produced in Russia / Asia, or chum salmon bound for the Yukon River. In fact, it is impossible to determine post season if/whether a chum salmon caught during a specific haul was a chum salmon reared in the Kuskokwim River or originated from a hatchery in Japan. Only through Bayesian analyses is an estimate of the relative stock of origin proportion possible, albeit on a coarse spatial and temporal scale. We use the most current genetics data to inform when and where bycatch avoidance should be prioritized to minimize impacts on Western Alaska chum salmon.
5. Voluntary IPAs or similar approaches cannot be relied upon as the sole approach to this problem. It took public outcry to get the pollock fleet (and managers) to recently start seriously re-engaging the problem of chum bycatch. Even if the fleet can produce measurable and significant outcomes through these means and mechanisms, they cannot be left to their own devices to do so. Industry should be encouraged to work on such approaches, which may make a good component of a suite of solutions.
6. There has long been a sentiment that if chum are avoided the trawlers will catch more Chinook and vice versa. Industry can and should adopt measures that will allow for sustainable fisheries for all species. No longer pin Chinook and chum salmon bycatch against one another.
7. Amendment 110 clearly showed the trawling industry requires serious oversight to reduce bycatch; voluntary or regulatory requirements are not enough. Efforts such as the 1994 Chum Salmon Savings Area, the 2001 voluntary rolling hot spot closure system, the 2007 BSAI Amendment 84 allowing inter-cooperative Agreements, exemptions from Salmon saving Area Closures, 2010 BSAI FMP Amendment 91, IPAs, observer coverage in the GOA, the 2016 Amendment 110 to the BSAI FMP and GOA FMP were all enacted and bycatch continues and has actually increased. This industry can and must share the burden placed on other fisheries. The cost to them must be passed on to the consumer as a cost of doing business. The time of

"bycatch and bycatch mortality to the extent practicable where appropriate" has long been passed. Conservation measures shall minimize bycatch. Bycatch is wanton waste of communities' food security. This requires rigorous oversight for fairness and equity and promotion of conservation.

8. Alternatives must include measures beyond IPAs. Establishing a non-Chinook PSC limit and management framework is a critical and long-awaited step for our region, which has borne the entirety of regulatory conservation of Western Alaska salmon. We emphasize the importance of moving forward with an equitable standard for regulatory salmon conservation for the Bering Sea pollock fleet, recognizing that voluntary measures are a helpful but incomplete strategy for meaningful conservation-based management. Simply adding regulatory structure to the existing IPAs developed by the pollock industry would not achieve the standard of equitable or meaningful conservation needed in the North Pacific. While the factors contributing to salmon declines are complex, PSC is a known and significant contributor to mortality, and regulatory measures to limit and manage PSC provides a critical path to conserve salmon.

3.b.ii. Subsistence fisheries

General

1. The conservation of both the chum resource and Bering Sea fishing opportunity should be balanced with the subsistence needs of the Western Alaska region. For this reason, we note that recent catch years have resulted in chum PSC take that is beyond what would be sustainable or equitable at any level of Western Alaska chum abundance. The current authorized levels of salmon bycatch are not low enough to ensure there is enough salmon for subsistence users. Subsistence communities depend on these shared resources and have been adversely affected by in-river restrictions and complete closures to subsistence salmon harvest this past year.
2. It is imperative to the people of these regions that immediate action be taken to the reduce Bering Sea trawl fisheries the bycatch of Chinook and Chum salmon. Over many years, subsistence communities with extremely limited resources have been making many conservation efforts to protect the future viability of the fishery. Despite these efforts, access to this critical food source is now being severely restricted. S ubsistence salmon harvest in recent years is the lowest harvest levels recorded for Western Alaska communities. It is reasonable that the billion-dollar commercial trawl fisheries should take responsibility to further reduce salmon bycatch. Every salmon that makes it to the spawning grounds counts in this time of diminished returns, and every salmon is needed for there to be any chance of a subsistence harvest opportunity.
3. The importance of continually avoiding and reducing bycatch across all species must be prioritized. Subsistence communities are experiencing stressors across many species. Additionally, it is not acceptable to view the problem using an either/or perspective when it comes to subsistence resources (e.g. decreasing bycatch of one species but allowing it to increase for another to accommodate industry).

Environmental Justice and other cultural and social interests

1. The EIS must equitably address cultural, spiritual and social impacts to subsistence users associated with salmon declines. The closure of subsistence and direct target fisheries in Western Alaska have a devastating effect on communities along the Yukon and Kuskokwim Rivers that depend upon those fish for income, food security, and passing on traditions and cultural practices.
2. While there are economic impacts to communities associated with commercial and subsistence fishery closures, the catastrophic impacts of these closures extend well beyond economics.

Secretary of Commerce Raimondo recently announced Fisheries Disaster Declarations for the Yukon, Kuskokwim, and Norton Sound Fisheries. This acknowledgement is very important. However, even if subsistence communities were to receive some economic relief for the loss of food and livelihood we have suffered, no money can replace the millions of pounds of healthy subsistence salmon we rely on to survive. Nothing can replace the devastating loss of our salmon culture and way of life. All conservation measures are necessary to help rebuild and sustain the salmon population for future generations.

3. The fishing industry has been allowed to waste hundreds of thousands of fish subsistence users depend on. This waste occurs even while *piniaġniq* (*subsistence,* in Inupiaq) practitioners of Western and Interior Alaska go without and cannot conduct subsistence fishing. Foregoing this subsistence harvest is done to conserve the resource - the burden of which we, who have the least capacity to do so, bear disproportionately in comparison to the pollock industry. And foregoing this subsistence harvest - a harvest which has nothing to do with the problem - is done in large part per the mandates of the State of Alaska, which has refused to take any reasonable measures to stem the impacts of the directed commercial take of western Alaska salmon in Area M, the incidental take of salmon in the pollock fleet's bycatch, or the production, distribution and consumption of fossil fuels which drive the same climate change which fisheries managers are so fond of focusing on with regard to salmon declines. This has occurred as our salmon resources are depleted to almost nothing and our communities driven to the point of starvation.

3.b.iii. Alaska Natives / Tribes and Communities

General

1. The value of cultural survival and diversity must be considered for the net benefit of the nation and valued for its very character.
2. Providing an alternative that allows for meaningful and effective bycatch avoidance is a great opportunity for NMFS to change the legacy of federal fisheries management in Alaska, which is harming communities and threatening a way of life central to who we are as Native peoples. NOAA says that "Alaska's fisheries are among the best-managed, most sustainable in the world," while western Alaska salmon returns annually weaken. NOAA also states, "Alaska resources provide jobs and a stable food supply for the nation, while supporting a traditional way of life for Alaska Native and local fishing communities." We request that NOAA take meaningful action in regards to chum bycatch to live up to these statements.

Environmental Justice and other cultural and social interests

1. The scope of this EIS must be robust and diverse in its inclusion of Tribes and their knowledge and perspectives.
2. In developing the EIS, NMFS must engage with and consult with affected Tribes in a meaningful way. NMFS should engage with Alaska Native representatives through formal and informal Tribal consultation early on and continue throughout the development of this EIS. This EIS analysis should include early and ongoing Government to Government Consultation with Alaska Native Tribes, and consistent with the Presidential Memorandum on Uniform Standards for Tribal Consultation. All mandates of various kinds must be maximally attended to with regard to Tribal Consultation, Tribal sovereignty, the trust relationship, and human rights.
3. The EIS should include social and environmental impacts of salmon bycatch in the pollock fishery, especially as they relate to Western and Interior Alaska communities, utilizing TK as a key component.

4. The sovereignty of Tribes, their social, cultural and spiritual well-being, their subsistence rights, and the *ella* (environment, in Yup'ik) and resources on which they depend should all be taken into account. The EIS must equitably and robustly address social, cultural, psychological, nutritional, economic, and spiritual impacts to Tribes and subsistence users associated with salmon declines. These impacts have been massive and catastrophic. This includes, but is not limited to, negative impacts to physical, emotional, and mental health; loss of opportunities for intergenerational *apeghtuulluku* (*knowledge-sharing*, in St. Lawrence Island Yup'ik); cascading effects and pressures across multiple social and economic structures and subsistence practices; increased vulnerability to changing environmental and economic conditions; negative impacts to Tribal sovereignty.
5. All processes associated with this EIS must involve thorough, systematic, and meaningful two-way engagement and *qanertukut apyutkanek* (*Consultation*, in Yup'ik) with Tribes and Tribal organizations, and ensure equal or greater incorporation of TK in analyses and decision-making. Tribal expertise, social science, and best practices (such as the work products of the Council Local Knowledge, Traditional Knowledge, and Subsistence Taskforce) should be important.
6. The EIS must address how the alternatives would ensure that equity and environmental justice would be achieved.
7. We encourage the Council and NMFS to invite Tribal representatives and Indigenous peoples to be an integral part of development of this EIS analysis. The decision-making of the Council in managing the Bering Sea and Gulf of Alaska pollock fisheries impacts Alaska Native peoples and communities. Alaska Native coastal communities in Western Alaska are bearing the brunt of the burden of conservation measures due to low fish abundance in chum salmon that continue to be bycaught in the Bering Sea and Gulf of Alaska federally managed fisheries.
8. The interests and concerns of Alaska Native coastal communities have been underrepresented in previous NEPA analyses of federal fisheries management in the Bering Sea and Gulf of Alaska. NMFS should correct the historical imbalance and inequitable application of management decisions in the Bering Sea pollock fishery by setting a meaningful chum salmon PSC cap that protects subsistence and direct target chum users and communities.

3.c. Magnuson-Stevens Act National Standards

1. All of the National Standards must be addressed.
2. There are many factors, including the reductions from Maximum Sustainable Yield, which should be taken into account to formulate Optimum Yield and meeting all of the National Standards.

3.d. Climate change / greenhouse gas emissions

1. The EIS must consider managing fisheries in light of climate change and its impacts. Climate change should be considered as a major driver of the salmon decline. Alaska Native Tribes have been pioneers in documenting *silam innigua ałłaŋuqtuaq* (*climate change*, in Inupiaq) and its impacts on natural resources. But climate change as a driver of the salmon decline should not be used as an excuse to fail to appropriately and decisively act to reduce bycatch. Climate change must also be understood as a context within which fisheries managers are required to manage the fisheries.

Topic 4: Out of the scope of the Purpose and Need for this action

1. Significantly reduce salmon bycatch in the Bering Sea trawl fisheries to below the levels currently authorized by the Council in order to protect this important subsistence food that is critical for our survival and the continuation of our traditional lifestyle. Immediately reduce the Chinook salmon bycatch cap in the BSAI commercial fishery to at most 16,000 fish. These reduced Chinook salmon bycatch caps are reasonably attainable and should be implemented right away. Even lower salmon bycatch caps should be implemented for the longer term in order to support Western Alaska Chinook salmon recovery. The Councils believe that these reduced chum salmon bycatch caps are reasonably attainable and should be implemented right away. Even lower salmon bycatch caps should be implemented for the longer term in order to support Western Alaska Chinook and Chum salmon recovery. Within a year, further reduced to a 10,000 Chinook salmon hard cap limit. These lower limits should remain in place until such time that the Western Alaska salmon fishery rebounds enough to support a healthy salmon population that meets both the needs of subsistence users and escapement goals for future returns.
2. Explicitly considered subsistence needs in the management of Bering Sea commercial fisheries. Subsistence representation is critical to this objective and can be accomplished by adding at least two Alaska subsistence representative seats to the Council. Subsistence fishing communities are equal stakeholders in the management of this shared salmon resource and should have a seat at the decision- making Council table, whose decisions directly affects our lives. LKTK of subsistence fishers is critical to the success of salmon conservation management and will be an asset to the Council. We request two designated Alaska Subsistence or Tribal seats be added to the Council. There is precedence and a pathway for this process in place already for the western coast states; namely Federally Recognized Treaty Tribes hold a seat on the Pacific Fishery Management Council. While Alaska Tribes do not have the same fisheries treaty protections, all federally recognized Tribes have retained government to government authority. Rural subsistence communities do have subsistence priority on Federal lands and waters under Title VIII of ANILCA. That subsistence priority is effectively eliminated when salmon escapement is so low it causes severe restrictions or complete closure to any subsistence harvest. Therefore, we need Alaska Subsistence or Tribal representative seats on the Council to be able to vote on fisheries management actions and conservation measures that impact the continuation of subsistence uses. To maintain objectivity, these subsistence or Tribal representatives should not have any direct personal economic ties to the CDQ fisheries. Subsistence or Tribal representative seats must be included on the Council with amendment to the next reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act.
3. The 2004 Programmatic Supplemental Environmental Impact Statement (PSEIS) for the Bering Sea Aleutian Island and Gulf of Alaska Groundfish Fisheries, including the Bering Sea pollock fishery is outdated. The North Pacific is at the forefront of climate change. The 2004 PSEIS is focused on the economic gains of the trawl fleet, and not responsive to the impacts of the fishery on other fish, fisheries, communities, and the ecosystem, and is no longer reliable to inform the sustainability of the fisheries of the Bering Sea and Gulf of Alaska. Since the publication of the 2004 PSEIS, ocean conditions, habitat, and fish populations have changed dramatically. The Bering Sea and Gulf of Alaska have and are experiencing radical changes. Rising ocean temperatures are altering the marine ecosystem and changing fish species distribution and productivity, leading to a series of cascading impacts to the marine ecosystem and the people who depend on its resources. In the past several years, important fish to Alaska's economy and Alaskan's livelihoods, including halibut, crab, Chinook salmon, and chum salmon, are experiencing steep declines. The 2004 PSEIS and 2015 Supplemental Information Report are inadequate to adapt to current and future ocean conditions, and applies the National Standards in an unbalanced manner, and has aggravated the

severe burdens placed upon Alaska's most dependent fishing participants, Alaska Native people, and coastal communities. To better inform future federal fisheries management and correct the current management regime failings, NMFS undertake a comprehensive NEPA review of the Bering Sea and Gulf of Alaska ecosystems.

List of Preparers

Bridget Mansfield, NMFS

Persons Consulted:

Kate Haapala, NPFMC

Appendices

Appendix 1. Cooperating Agencies

Appendix 2. NEPA Implementing Regulations on Cooperating Agency requirements 40 CFR § 1501.8.

KUSKOKWIM RIVER
INTER-TRIBAL FISH COMMISSION
OUR RIVER, OUR PEOPLE, OUR FISH
P.O. Box 190 Bethel, AK 99559-0190 | (907) 545-7388 | info@kritfc.org | kuskosalmon.org

September 1, 2023

Mr. Jon Kurland Regional Administrator
Alaska Regional Office, National Marine Fisheries Service
PO Box 21668
709 West 9th Street
Juneau, Alaska 99802

Re: Cooperating Agency Request for EIS for Minimizing Non-Chinook Salmon Bycatch in the Bering Sea Pollock Fishery

Dear Administrator Kurland:

The Kuskokwim River Inter-Tribal Fish Commission (KRITFC) requests designation as a cooperating agency pursuant to the National Environmental Policy Act (NEPA) for the Minimization of Non-Chinook Salmon Bycatch in the Bering Sea Pollock Fishery.

KRITFC is making this request under the Council on Environmental Quality (CEQ)'s regulations implementing NEPA. The CEQ regulations define a cooperating agency as "any Federal agency (and a State, Tribal, or local agency with agreement of the lead agency) other than a lead agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action that may significantly affect the quality of the human environment."

KRITFC qualifies as a cooperating agency under this definition as a Tribal consortium with authorizing resolutions from 27 Federally recognized Member Tribes throughout the Kuskokwim drainage to act on their behalf in fisheries management, research, and monitoring using the best available Indigenous Knowledge and Western science. Additionally, since 2016, via authorization of a formal Memorandum of Understanding (MOU) and Section 804 of the Alaska National Interest Lands Conservation Act (ANILCA), KRITFC and U.S. Fish and Wildlife Service (FWS) at Yukon Delta National Wildlife Refuge (YDNWR) have collaboratively managed Kuskokwim salmon stocks. The 2023 season marks the eighth consecutive season of collaborative management, and the first that spanned the Chinook, chum, and coho salmon runs due to concerns for the protection of all three species and the prioritization of rural subsistence harvests as mandated by Title VIII of ANILCA.

KRITFC does not currently have a similar MOU or co-stewardship agreement with NOAA Fisheries, despite its government-to-government relationship with the agency. Nonetheless, KRITFC's role as a cooperative salmon management partner with FWS gives its Executive Council, In-Season Managers, Member Tribes, and staff specific experience in the development of management plans based on precautionary, adaptive, and collaborative management—principles KRITFC hopes to carry into a cooperative agency partnership with NOAA Fisheries.

Minimizing non-Chinook salmon bycatch, over 99% of which is chum salmon, is of utmost importance to KRITFC's Member Tribes. In the past four seasons, Kuskokwim chum salmon stocks have declined up to 97% in some tributaries with devastating effects to salmon-dependent Indigenous communities and ecosystems. While bycatch is one of many factors cumulatively contributing to Kuskokwim and Western Alaskan salmon declines, it is one over which our management bodies, including NOAA Fisheries and the North Pacific Fishery Management Council (Council), have control. Furthermore, the development of non-Chinook salmon bycatch management measures would benefit from the direct engagement, knowledge, expertise, and experience of salmon-dependent Indigenous communities whose well-being and way of life are at stake with proposed Federal action.

As a cooperating agency, KRITFC asks:

- For its appointed staff and/or Executive Council to be involved in all meetings (virtual and in-person), emails, and negotiations about the non-Chinook salmon EIS, including at the agency-level.
- To co-develop timelines and progress goals for the EIS and NEPA process, which should include sufficient time to review any documents developed with its Executive Council and legal team.
- To lead contributions on EIS sections about impacts to salmon-dependent subsistence communities, and to work with regional Tribal partners to develop these for the wider Western Alaska region.
- To coordinate with NOAA Fisheries and Council staff to organize in-region community meetings as a part of the formal scoping process.
- To have dedicated time to present on the Kuskokwim and Western Alaska salmon situation, and developments in this NEPA process, during NOAA Fisheries and Council staff presentations at Council meetings when non-Chinook salmon bycatch management or this EIS is on its agenda.

Thank you for considering this request. Please contact Kevin Whitworth, Executive Director, at 907-524-3088 or kevinwhitworth@kritfc.org if you have any questions. We look forward to your response.

Sincerely,

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668

September 20, 2023

Jonathan Samuelson
Kuskokwim River Inter-Tribal Fish Commission
P.O. Box 190
Bethel, Alaska 99559

Dear Mr. Samuelson,

The National Marine Fisheries Service and the North Pacific Fishery Management Council have recently begun preparing an Environmental Impact Statement (EIS), pursuant to the National Environmental Policy Act (NEPA) and implementing regulations (40 C.F.R. § 1501.8), for minimizing non-Chinook salmon bycatch in the Bering Sea/Aleutian Islands Fishery Management Plan area. For this project non-Chinook salmon is understood to be primarily chum salmon.

In response to your September 1, 2023 letter, we accept your request for the Kuskokwim River Inter-Tribal Fish Commission (KRITFC) to participate as a cooperating agency on this project due to KRITFC's special expertise with respect to chum salmon in Western Alaska. We understand that special expertise is related to the subsistence use of chum salmon by federally recognized member Tribes and their salmon-dependent communities throughout the Kuskokwim drainage on whose behalf you act for in-river fisheries management.

Congress has set a statutory timeline of two years for completion of EISs. The July 11, 2023 publication in the Federal Register of the Notice of Intent to develop this EIS began the two-year timeframe for this project, which will end with signing of the Record of Decision for this action. This will entail a tight schedule aligned with the Council's process and schedule.

We would like to meet with you to clarify additional details related to the schedule for the project and specific tasks you would agree to undertake as a cooperating agency. We will reach out to schedule a meeting, and we anticipate confirming an agreement with you regarding your role as a cooperating agency no later than the end of October 2023. We also encourage you to review the Council's preliminary review draft analysis on this topic, posted under Agenda Item C4 for their October 2023 meeting at https://meetings.npfmc.org/Meeting/Details/3003, and provide comments to the Council on that document.

Our lead contact for this process will be Bridget Mansfield. Please reach out to her at Bridget.Mansfield@noaa.gov if you have any questions or need additional information. We look forward to meeting with you.

ALASKA REGION – https://www.fisheries.noaa.gov/region/alaska

Sincerely,

HARRINGTON.GRETCHEN.ANNE.1365893833 Digitally signed by HARRINGTON.GRETCHEN.ANNE.1365893833 Date: 2023.09.20 13:31:18 -08'00'

Gretchen Harrington
Assistant Regional Administrator
for Sustainable Fisheries

Attachment: CEQ Regulations on Cooperating Agencies (40 C.F.R. § 1501.8)

Appendix 2. NEPA Implementing Regulations on Cooperating Agency requirements 40 CFR § 1501.8.

§ 1501.8 Cooperating agencies.

(a) The purpose of this section is to emphasize agency cooperation early in the NEPA process. Upon request of the lead agency, any Federal agency with jurisdiction by law shall be a cooperating agency. In addition, upon request of the lead agency, any other Federal agency with special expertise with respect to any environmental issue may be a cooperating agency. A State, Tribal, or local agency of similar qualifications may become a cooperating agency by agreement with the lead agency. An agency may request that the lead agency designate it a cooperating agency, and a Federal agency may appeal a denial of its request to the Council, in accordance with § 1501.7(e).

(b) Each cooperating agency shall:

(1) Participate in the NEPA process at the earliest practicable time.

(2) Participate in the scoping process (described in § 1501.9).

(3) On request of the lead agency, assume responsibility for developing information and preparing environmental analyses, including portions of the environmental impact statement or environmental assessment concerning which the cooperating agency has special expertise.

(4) On request of the lead agency, make available staff support to enhance the lead agency's interdisciplinary capability.

(5) Normally use its own funds. To the extent available funds permit, the lead agency shall fund those major activities or analyses it requests from cooperating agencies. Potential lead agencies shall include such funding requirements in their budget requests.

(6) Consult with the lead agency in developing the schedule (§ 1501.7(i)), meet the schedule, and elevate, as soon as practicable, to the senior agency official of the lead agency any issues relating to purpose and need, alternatives, or other issues that may affect any agencies' ability to meet the schedule.

(7) Meet the lead agency's schedule for providing comments and limit its comments to those matters for which it has jurisdiction by law or special expertise with respect to any environmental issue consistent with § 1503.2 of this chapter.

(8) To the maximum extent practicable, jointly issue environmental documents with the lead agency.

(c) In response to a lead agency's request for assistance in preparing the environmental documents (described in paragraph (b)(3), (4), or (5) of this section), a cooperating agency may reply that other program commitments preclude any involvement or the degree of involvement requested in the action that is the subject of the environmental impact statement or environmental assessment. The cooperating agency shall submit a copy of this reply to the Council and the senior agency official of the lead agency.

October 4, 2024

KAWERAK, INC.

YUKON RIVER INTER-TRIBAL FISH COMMISSION

NATIVE PEOPLES ACTION

Yukon River Drainage Fisheries Association

To: Kate Haapala
North Pacific Fishery Management Council
1007 West Third Ave., Suite 400
L92 Building, 4th floor
Anchorage, AK 99501-2252
Sent via email to: kate.haapala@noaa.gov

Doug Shaftel
National Marine Fisheries Service
PO Box 21668
Juneau, AK 99802-1668
Sent via email to: doug.shaftel@noaa.gov

Re: Chum Bycatch EIS Analyses

Dear Dr. Haapala and Mr. Shaftel,

We are writing to provide input on several key matters of concern regarding the Council and Agency's work on the revised analysis for the chum salmon bycatch preliminary Draft Environmental Impact Statement (DEIS).

Four Tribal organizations and two supporting organizations are signatories to this letter. Kawerak is the non-profit Tribal Consortium formed by and representing the 20 federally-recognized Tribes of the Bering Strait region. The Yukon River Inter-Tribal Fish Commission is a non-profit Tribal Consortium formed and representing, through resolution, 42 federally recognized Tribes on the Yukon River. The Association of Village Council Presidents is a regional non-profit and Tribal Consortium formed by and representing our 56 member federally-recognized Tribes across the Yukon-Kuskokwim Delta. The Tanana Chiefs

Conference is the regional non-profit Tribal Consortium formed by and representing the 37 federally-recognized Tribes of Interior Alaska. Native Peoples Action is a statewide non-partisan organization dedicated to protecting and restoring our people's inherent rights to hunt, fish, harvest, trap, and have ceremony as well as manage and steward our homelands for abundance. The Yukon River Drainage Fisheries Association works for the people and fish of the Yukon River, which is home to more than 50 sovereign Tribal Nations with a mission to protect and promote all healthy wild fisheries and cultures along the Yukon drainage.

Our letter is focused on three areas:

1. Considerations regarding the next analysis pertaining to bycatch impacts
2. Discussion of Alternatives and their analysis
3. Discussion of Tribal inputs into the process

1. Considerations for the next analysis pertaining to bycatch impacts

We would like to highlight an important issue for the work being prepared for the February 2025 meeting. Specifically, we want to note our concern about the request from the SSC for the production of an impact rate from bycatch on western Alaska chum. As analysts have made clear,[1] this cannot be defensibly produced at the current time. We hope that this line of inquiry is not advanced if it is not scientifically defensible. We also note that we are of the view that there are limitations to impact rate analyses in general, and that such considerations do not adequately take into account Traditional Knowledge (for example, about the impacts of waste on salmon, and about the value of a single salmon returning to an ecosystem or fish camp). We also question the effectiveness of impact rate analyses to fully consider the cumulative impacts of salmon bycatch. We hope that those and other considerations are taken into account in any analysis pertaining to bycatch impacts. For example, some of these considerations can be outlined as follows:

- Other perspectives than those which are baked into the assumptions are not considered. For example, what is the impact of the waste of a sentient species in reciprocal relationships with Indigenous communities on its long-term abundance and viability? This is known and accounted for in Traditional Knowledge but by and large not in the western science used in fishery management. To avoid collapse of resource availability in the future, humans must take only what is needed without resulting in waste; wasteful practices disrespect sentient salmon relatives such that their populations decline, and human-salmon relations are disrupted.
- An AEQ estimate approach (that informs an impact rate) is inconsistent with the concept of gravel-to-gravel management. The estimation of AEQ to a given salmon stock only covers the marine juvenile phase to returning spawning adults. The fittest returning chum salmon can release 2,400-3,100 eggs on average.[2] These returning adults could have generated thousands of eggs,

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[1] E.g. see pages 139-141 in NPFMC (2024) Draft for Initial Review: Preliminary Draft Environmental Impact Statement, Bering Sea Chum Salmon Bycatch Management. March 11, 2024. Available at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=7c6ea9b3-af3f-4ba9-b857-5f1434d22b12.pdf&fileName=C2%20Chum%20Salmon%20Bycatch%20Draft%20Environmental%20Impact%20Statement.pdf

[2] Alaska Department of Fish and Game (2024) "Chum Salmon: Wildlife Notebook Series." Available at https://www.adfg.alaska.gov/static/education/wns/chum_salmon.pdf.

fry and smolt that would contribute to a stock's long-term sustainability. Terminating an AEQ or impact rate estimate at returning adults limits the analysis scope and does not consider the entire salmon life history. Every egg is important when every salmon counts.

- An impact rate is a model, and as such cannot speak to definite effects on salmon populations. The impacts to discrete spawning populations (such as those in low abundance) cannot be precisely known.
- Cumulative impacts of bycatch on the marine ecosystem, including salmon populations, are not adequately understood, nor are impacts in the context of climate change. For example, what are the cumulative impacts on the stock of decades of millions of salmon wasted as bycatch? What are the impacts of bycatch on a species facing numerous and sometimes new stressors (e.g. in addition to other withdrawals, climate stressors, and changing stock characteristics)? These questions need to be better understood. Precautionary management requires action to further minimize salmon bycatch while such questions are further investigated.
- Impact rates are often mistakenly mapped onto notions of significance, which is not accurate or scientifically defensible. Tribes are in a crisis situation in western and interior Alaska, and even relatively low stock withdrawals from salmon bycatch are highly significant in terms of the state of the salmon stock and the communities who depend on it. For example, the 1990-2023 average number of summer chum salmon used for subsistence among Koyukuk River tribal communities was 8,040 fish, which provided for the highest rates of household and per capita uses of Yukon River summer chum salmon throughout the Yukon watershed in most years. Small numbers of fish can be substantial to Tribal food sovereignty and security.

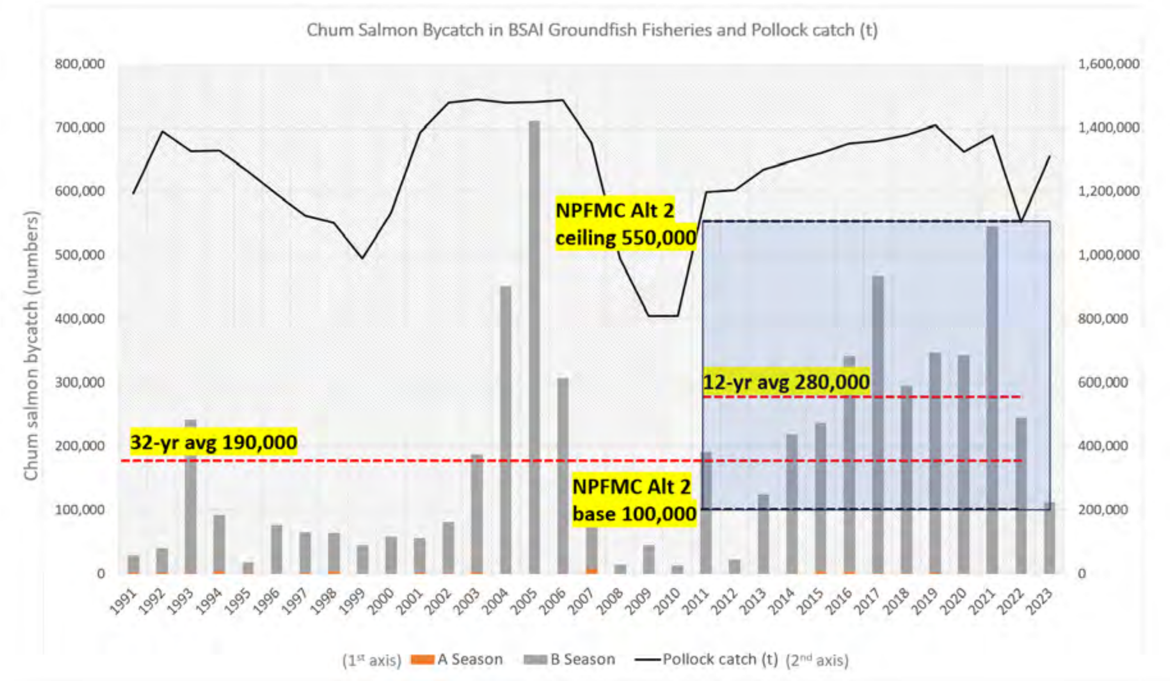
As such, we encourage both caution and awareness of complexity as regards the issue of bycatch impacts.

2. Discussion of Alternatives and their analysis

Here we would like to make a number of comments which we hope are addressed in upcoming analyses and discussions at the Council and Agency.

First, we would like to provide summary concerns about the limitations of some of the existing Alternatives under consideration for meeting the purpose and need for this action.

With regard to **Alternative 2,** we do not see how consideration of an overall bycatch cap which is anywhere near the average levels of bycatch (e.g. ~280,000 since 2011) is responsive to the need for this action to reduce bycatch. Accepting the 'average' is another way of maintaining the 'status quo.' Yet for some reason, the history of alternatives in this vein have been construed with a heavy slant away from minimization of bycatch, with the values in the proposed range extending far above the historical average yet not down to levels that have actually been achieved by the industry. The range of cap levels should be reduced so the higher end is closer to the average of the time series and thus more effective to reduce overall chum bycatch. Acknowledging NEPA requires the range to be meaningful; the Alternatives must meet the purpose of the action, which is reducing bycatch.



With regard to the options presented in **Alternative 3,** we also see significant deficiencies which hamstring the analysis. The overall numbers used for abundance are far too low (25th and 50th percentiles), defeating the purpose of achieving a conservation benefit in an action which would be responsive to both the short and long-term nature of this crisis. Using the 25th and 50th percentiles would situate triggers at and below an already-unacceptable level, effectively doing nothing for the stock, and failing to recognize the longer-term nature of the problem. The caps are also far too high, even extending to no cap, which does not meet a goal of minimizing bycatch at all levels of abundance. We also believe that a Yukon River-only index is not sufficient for this action.

The problems associated with the values selected for Alternatives 2 and 3 strongly suggest that for the NPFMC and NMFS, this issue has already been pre-decided, and that preserving the salmon stock is considered of secondary importance to the pollock fleet prosecuting its TAC.

We are concerned with the ways in which **Alternative 5** was constructed as well. First, we feel the existing bycatch allowances are too high in what is proposed. Second, we do not see how a suite of mutually exclusive spatial options regarding areas of concern related to chum bycatch presents a defensible and well-designed approach to best realizing a conservation corridor (the idea of which is worth analyzing). Third, there is a need for an overall chum bycatch backstop which is below the historical average. Without these considerations—lower bycatch allowances in whatever spatially-defined corridor area is created, a corridor that does not exclude highly-relevant areas from its spatial scope, and an overall backstop well below the historical average in the entire fishery—this Alternative could actually result in little more than a very high cap (which is not constraining and doesn't provide a conservation benefit) where fishing behavior with high bycatch is able to occur outside of areas that are not constrained.

Secondly, while we are not proposing a preliminary preferred alternative at this juncture, we want to note that we see promise in a combined approach to the ideas encapsulated in the Alternatives, and hope that this can be analyzed. These elements seem potentially promising when taken in conjunction, and we hope they can be analyzed together as a unified approach:

- **The development of a conservation corridor set in regulation (i.e. not existing solely in the IPAs) based on areas of highest western Alaska chum bycatch, as noted in Alternative 5.** However, such a cap can not be exclusive to only one of the relevant spatial areas, as it is currently stated (as all of these areas are of concern with regard to levels of chum bycatch), and must have a low cap number such that it effectuates a true conservation benefit. It also must be backstopped by an overall, fishery-wide bycatch limit which is well below the historical average such that appropriate conservation behavior also occurs outside the corridor area.
- The above could be implemented in conjunction with steps taken with regard to the IPAs outlined in Alternative 4 (some of this is already noted in Alternative 5 with regard to the language indicating that "Additional windows for salmon passage and other avoidance measures should be implemented in-season through the contracted Incentive Plan Agreements using in-season fishery data and best available genetic data."). **Additional work in the IPAs and scientific research and development aimed towards the implementation of real-time genetics is something which should be stressed.**
- **Mandatory review and revisiting of success.** Review could be mandated for the program after every certain number of years, as well as if particular metrics are not achieved (e.g. certain levels of WAK chum bycatch reductions). This could lead to reconsideration of the overall approach.
- **Investigation of the concept of frameworking** such that implementing real-time genetic analysis in the fleet could result in a more precise and effective implementation of these bycatch avoidance measures without necessitating a lengthy EIS process.

Such an approach could potentially effectuate a true conservation benefit that is responsive to the purpose and need and align with a needed broader ecosystem-based approach to the long-term sustainability of the salmon resource and communities dependent on it.

<u>3. Discussion of Tribal inputs</u>

We are concerned about issues related to the incorporation of Tribal inputs into this process. During the creation of the preliminary DEIS for its first initial review, capacity constraints at the Council level limited the opportunity for engagement with Tribal entities in a vein which would allow for achieving the engagement and informational goals developed through the work of the Community Engagement Committee and the LKTKS Taskforce.

Unfortunately, this situation has continued to date. We recognize that the Council is under significant capacity constraints, and appreciate the work of its analysts and the real limitations they are currently faced with. The impact of these constraints on the process need to be appreciated by whatever institutions have the ability to assist the Council in addressing this challenge such that it can fulfill its various goals and mandates.

We are also concerned about the issue of engagement and integration of Tribal information at the Agency level. The NMFS letter of July 11, 2024 sent to Tribal entities regarding inputs into the chum EIS process is particularly concerning in this regard. While at the most general level, we are appreciative of the

Agency reaching out to obtain information of this type, this is outweighed by significant concerns, perhaps the most important of which is this assertion in the letter: "We want to be clear about how any information and knowledge we receive would be used and careful not to misrepresent or misuse information that we receive from Tribes; thus, we will incorporate all written information and knowledge, as received in response to this request, into an appendix to the preliminary DEIS." This appears to send a signal to Tribal members and entities that their information will not be fully analyzed and incorporated into the analysis. That would not be in line with wise practices related to engagement with Tribal knowledge-holders and Tribal knowledge systems.[3] The mandate for incorporating Traditional Knowledge into federal fishery management - as exists in National Standard 2, and in other federal guidelines - cannot be achieved by not using it. It is also not a practice conducive to true engagement; why would Tribal entities engage a process when they are signaled at the outset that their information may be given lesser weight and inadequate treatment? We expect Traditional Knowledge provided to the Agency to be given equal weight to western scientific data in the chum DEIS, and not solely included in the appendix. NMFS Alaska Region may benefit from better-following the national NOAA Guidance and Best Practices for Engaging and Incorporating Indigenous Knowledge in Decision-Making. We also support expanding capacity of Council and Agency staff regarding, and addition of specialized trainings on, working with Tribal knowledge holders and Tribal knowledge systems, all of which may enhance Council- and Agency-Tribal relations.

Additionally, we note that the timeframe given to Tribes to provide contributions—between July 11 and October 4—is a key subsistence fishing, hunting, and gathering period for Tribal citizens in this region. While subsistence activities occur all year, this is a difficult season to request Tribal input with regard to this action, as many Tribal leaders have been away during large portions of this period engaging in salmon fishing and other subsistence activities (e.g. gathering berries and greens, moose hunting, and whitefish harvesting). True, effective engagement with Tribes occurs on and through a mutually-decided timeline and structure; does not interfere with traditional ways of life; and happens meaningfully in advance of document creation so that Tribal citizens' knowledge can be included in analyses informing decision-making.

There needs to be a stark recognition that this chum EIS process has not lived up to expectations to-date as regards engagement and incorporation of Tribal inputs. This is unfortunate not only in general, but also in context of the strides the Council and Agency have made at the level of guidance and policy in recent years, and in the context of the crisis which this action is supposed to address, given the severe impacts on Tribes and their resources. It is also unfortunately dovetailed with the development of Alternatives at the Council-level which to-date have not been responsive to the purpose and need for this action. There are clearly various issues underlying these issues, but the Council and Agency need to grapple with that and work to address it substantively moving forward.

Please reach out to the organizational contacts identified in the signature blocks below if you have questions regarding this letter.

Thank you for your consideration of these comments.

[3] See, e.g., North Pacific Fishery Management Council (2023) Protocol for Identifying, Analyzing, and Incorporating Local Knowledge, Traditional Knowledge, and Subsistence Information into the North Pacific Fishery Management Council's Decision-making Process. Available at: https://www.npfmc.org/wp-content/PDFdocuments/Publications/Misc/LKTKSprotocol.pdf

Sincerely,

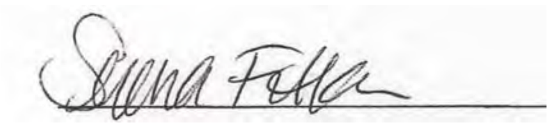
Melanie Bahnke, President
Kawerak, Inc.
Contact: Dr. Julie Raymond-Yakoubian: juliery@kawerak.org

Karma Ulvi, Chair
Yukon River Inter-Tribal Fish Commission
Contact: kulvi@eaglevillageak.com

Vivian Korthuis, Chief Executive Officer
Association of Village Council Presidents
Contact: vkorthuis@avcp.org

Brian Ridley, Chief and Chairman
Tanana Chiefs Conference
Contact: brian.ridley@tananachiefs.org

Craig Chythlook, Fisheries Policy Director
Native Peoples Action
Contact: craig@nativepeoplesaction.org



Serena Fitka, Executive Director
Yukon River Drainage Fisheries Association
Contact: serena@yukonsalmon.org

Cc:

- Angel Drobnica, Chair, North Pacific Fishery Management Council (adrobnica@apicda.com)
- Dave Witherell, Executive Director, North Pacific Fishery Management Council (david.witherell@noaa.gov)
- Jon Kurland, Regional Administrator, NOAA Fisheries Alaska Region (jon.kurland@noaa.gov)

YUKON RIVER
INTER-TRIBAL FISH COMMISSION

October 4, 2024

Attn: Gretchen Harrington
Assistant Regional Administrator for Sustainable Fisheries
United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
PO Box 21668
Juneau, AK 99802-1668
gretchen.harrington@noaa.gov

Dear Gretchen,

We are writing to clarify a few points about the chum salmon declines that are affecting the ecosystems and people of the Arctic Yukon Kuskokwim watersheds. While we focus on the Yukon River, there are similar trends in historical salmon abundance and the effects of commercial fisheries, both in river and offshore, within these collective watersheds. These declines are multidecadal in nature and have been documented with both western science and traditional and local knowledge. Since commercial fisheries began on the Yukon River around 1918, there have been numerous and continued complaints about their effect on stock abundance and subsistence fishing, with notable declines around 1919 and commercial fishing restrictions in 1936 and 1951. There were periods of low harvest of summer and fall chum in the late 1960s/early 1970s followed by a rapid increase in the amount of commercial fishing in the 1970s and 1980s followed by a decline that began in the 1990s, from which the Yukon River salmon have never fully recovered.

The advent of pollock fisheries in the Eastern Bering Sea in the 1960s and its peak in the 1970s further exacerbated the salmon declines, with catches of 1.3 to 1.9 million metric tons annually and unmanaged bycatch. The EBS pollock fishery catches have varied since 1977 but the average annual catch averages out to about 1.2 million metric tons. Even though bycatch has been better documented since 1991, the Yukon River salmon were already in decline and the impacts of bycatch up to that point will never be fully understood. While the management of the pollock fisheries and applicable bycatch measures have changed since then, it was not until the decline of western Alaska salmon stocks in the 1990s that led to stricter bycatch measures.

Every Salmon Counts

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More favorable environmental conditions and these more restrictive measures, along with other restrictions in the river and in the state managed Area M fishery, did help bring salmon abundance levels back up. The high bycatch rates that were seen 2006-2009 should have been attributed to increased salmon run sizes and resulted in an abundance-based cap, which was eventually established for Chinook salmon. It should be noted that the first self-imposed Chinook moratorium on the Yukon River was in 2015, just about one life cycle after a period with incredibly high bycatch rates. Additionally, it is not fully clear if the bycatch rates were also caused by the rolling hotspot system that was being tested during that same time. Some of the highest catch per unit efforts of EBS pollock occur where there are the highest amounts of salmon bycatch, since both Chinook and Chum salmon feed on young pollock.

Bycatch of Yukon salmon in the EBS pollock fishery has been an ongoing issue for over 60 years and needs even more attention in light of recent downtrends in salmon health and productivity. Current salmon research shows changing body conditions like decreased weight and length coupled with empty stomachs further challenges the ability of salmon to reach their natal spawning grounds. These changing conditions are not reflected in current Alaska Department of Fish and Game (ADFG) management escapement goals and harvest strategies. Escapement goals are set far too low with these changing conditions and need to be increased to account for current environmental conditions. Furthermore, ADFG has only managed to the drainagewide escapement goal and systematically fails to meet upriver escapement goals. Some of the richest chum salmon spawning tributaries like the Koyukuk and Anvik Rivers have not been meeting escapement goals in recent years and truly at this point, every salmon matters to the long term survival of these key discrete stocks. In 2023, the Anvik river only had about 60,500 summer chum in comparison to a historical average of about 450,000. Similarly, the Tanana River is a large contributor of fall chum and only had about 121,000 fall chum in 2023 compared to a historical average of about 212,000.

In a similar thread, the 3-river abundance index approach has some very inherent flaws when managing an area that is about half the size of Alaska. We are concerned that bycatch management strategies need to mirror what we want to see for in-river management, which means managing at the tributary level. With the amount of uncertainty and unknowns around discrete stocks, it is essential to be precautionary. Although Coastal Western Alaska chum genetics are difficult to break out by tributary, we know that some of the genetic data is lacking. For example, Tanana River is a major tributary to the Yukon River and fall chum genetics data consistently show that 30 percent or more of the entire fall chum run is destined for the Tanana River. Those finer genetic scales are not reflected in the Preliminary Draft Environmental Impact Statement.

While there are natural cycles of low and high abundance, notably about a 30-year cycle for salmon, which now appears to be changing to a 20-year cycle, the most recent decline in chum salmon is not rebounding as quickly as previous periods of low abundance (e.g. early 1970s, late 1990s/early 2000s). The Yukon River 2024 fall chum run size of 246,664 was the third lowest on

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record (1974-2024), and decreased significantly from 2022 and 2023, which had runs of 325,717 and 370,015, respectively. The 2024 summer chum run was also smaller than 2023, dropping from 845,988 to 757,817 but still within the drainage wide escapement goal. Meeting summer and fall chum escapement goals is more critical than ever as it is the only salmon our people may have a chance to harvest for the next seven years or longer. The recent Agreement of April 1, 2024 regarding Canadian-origin Yukon River Chinook Salmon for 2024 through 2030 restricts harvest of Chinook until a rebuilding target of 71,000 is achieved. The Chinook are far from recovery with the Eagle sonar only recording 14,752 and 24,112 Chinook in 2023 and 2024, respectively.

While there have been very small harvests of summer and fall chum in recent years, it is nowhere close to the amount necessary for subsistence. The salmon declines are affecting other species, which is vastly understudied and the effects of which are being felt by Yukon River communities. Moose numbers are down along the mid- and Upper Yukon River. Many hunters complain about not finding moose to harvest in their normal places or having to travel extremely long distances to find moose. Many of the caribou herds that Yukon River communities rely on are down too. For example, in ADFG Game Management Unit 20B, which includes Fairbanks, Nenana, Minto, Manley Hot Springs, and Rampart, the moose count is down 40 percent below management objectives. These are the communities that rely most heavily on fall chum with it making up a large part of their subsistence diet, about 50-60 percent. Similarly, the 40-mile caribou herd, which is heavily relied on by people in this area, is down to only 40,000 after once estimated at 600,000. The Western Arctic caribou are down to 164,000 from 500,000, the lowest population estimate in 40 years. The people of the Koyukuk River who rely heavily on summer chum will now be limited in their ability to harvest caribou as well. There are very limited options for food replacement with the lack of stores and limited air transportation. The Yukon River people are experiencing a devastating ecosystem crisis with cascading effects to their food supplies.

With increased frequency of periods with above average warm ocean and river temperatures, it is critical we plan accordingly and seriously consider solutions that focus on migration corridors for salmon that include chum bycatch caps, and time/area closure concepts. We need to work across jurisdictional boundaries and share the burden of conservation to help restore the health of salmon, people, and place. The Yukon River people have not fished in five years and are in desperate need of management objectives that help rebuild our salmon stocks.

We appreciate your inclusion of the historical and current perspectives outlined in this letter in the analysis for the Preliminary Draft Environmental Impact Statement for Chum Salmon Bycatch.

Respectfully,

Karma Ulvi, Chair

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668

Oct 18, 2024

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DELIVERED BY EMAIL ONLY

Re: October 4, 2024 letter to NMFS and North Pacific Fishery Management Council

Dear President Bahnke, Chair Ulvi, Chief Executive Officer Korthuis, Chief and Chairman Ridley, Mr. Chythlook, and Ms. Fitka:

Thank you for your letter dated October 4, 2024, regarding the ongoing development of the preliminary Draft Environmental Impact Statement (DEIS) for measures to reduce chum salmon bycatch in the Bering Sea pollock fishery. We are committed to continuing to improve our Tribal engagement, and appreciate your input and feedback as we learn.

I would like to address the concerns you raised about our July 11, 2024 letter informing Tribal representatives and leaders about an opportunity to contribute written knowledge and information to the forthcoming December 2024 version of the preliminary DEIS. That letter was a response to input from your organizations that we should make more efforts to reach Tribes that are not members of the Kuskokwim River Intertribal Fish Commission or Tanana Chiefs Conference, the cooperating agencies (as that term is used under the National Environmental Policy Act (NEPA)) who are collaborating with NMFS and North Pacific Fishery Management Council (Council) staff on the development of the EIS.

Our July letter continued our efforts to engage with affected Tribes on chum salmon bycatch management that we began prior to publishing the Notice of Intent, which began scoping for this EIS. In early 2023, we notified Tribes of this proposed project and conducted several consultations that were attended by many Tribal coalitions, including several of yours. NMFS offered to consult with Tribes again prior to the October 2023 Council meeting, at which the Council reviewed an analysis of the initial alternatives. In early 2024, NMFS staff conducted several Tribal engagement sessions with many of your organizations and others to discuss the scope of alternatives then under consideration. On March 19, 2024, NMFS held a Tribal engagement session specific to the initial review of the first preliminary DEIS at the April 2024 Council meeting. After the April meeting, we met with the cooperating agencies (including KRITFC and TCC) and identified the opportunity for additional input from Tribes that was the subject of the July letter.

The October 4 deadline in the letter for contributions that could be appended to the preliminary DEIS reflects a balance of the need to provide ample opportunity for Tribal engagement and input with the very real concerns we are hearing from Tribes and others that it is important that the Council and NMFS take timely action to minimize chum salmon bycatch.[1] I recognize that July 11 to October 4 was not ideal for people participating in summer subsistence activities. That window was driven by the work being done to prepare this version of the preliminary DEIS for the presentation to the Council in February 2025. In response to a request from Tribes and Tribal organizations to increase the usual 2-3 week timeframe that documents are available for review prior to the Council meeting, Council staff are aiming to post the document on the Council website by December 20, 2024. The time between early October and public posting is necessary for analysis, drafting, review, and editing prior to posting, which means that the analyses must be largely wrapped up in October. Therefore, we asked to receive all responsive information by October 4.

I understand your concern that some might view information in an appendix as being of lesser importance than information in the body of a document. As you note, it would be especially concerning if written information or knowledge shared by Tribes was being treated differently than that received from non-Tribal sources. However, that is not how appendices will be used in this document. NMFS and Council staff are working to stay within the 150-page limit for EISs that Congress imposed under the Fiscal Responsibility Act of 2023 (40 CFR 1502.7). Given the number, variations, and combinations of alternatives, as well as the amount of information needed to describe their environmental, social, and economic impacts, it will be necessary to direct the Council and public to appendices for much information that is critical to analyzing the alternatives. Those appendices will include substantial amounts of information from non-Tribal

[1] Extending the time period for receiving written materials would likely require delaying the release of the preliminary DEIS and considering it at a later Council meeting, rather than the February 2025 meeting.

sources. Further, by including contributions of Traditional or Indigenous knowledge exactly as submitted in an appendix, there is no risk that it is inaccurately summarized or inappropriately synthesized. The presence of documents in the appendix does not mean that information from those documents will not be considered in the body of the preliminary DEIS. NMFS and Council staff, along with cooperating agency analysts, are working to incorporate key information in the body of the preliminary DEIS and will be able to refer the reader to the source materials in the appendix. We welcome your review and feedback on how we did this in the preliminary DEIS, so that we can improve this process for the next version and in future NEPA documents.

Additionally, there will be many more opportunities to share information and knowledge with NMFS and the Council. At any time, Tribes or Tribal entities can submit information or knowledge directly to NMFS (Doug Shaftel, doug.shaftel@noaa.gov) or Council staff (Dr. Kate Haapala, kate.haapala@noaa.gov). Of course, the sooner it is received, the more time there is to incorporate it into the analysis.

Below are some additional dates and opportunities for providing input through the development of the EIS. NMFS will notify Tribes and Tribal organizations of the upcoming engagement opportunities and invite consultations prior to each Council meeting.

- December 20, 2024. This is the Council's target date to release the preliminary DEIS for review.

- Prior to the February Council meeting. We intend to host an engagement session prior to the February Council meeting and welcome ideas for collaboration and making it useful, inclusive, and accessible. As has become our practice preceding every Council meeting, NMFS will circulate an invitation to all Tribes to consult prior to the February 2025 special Council meeting.

- February 3-10, 2025; special Council meeting. At this meeting, the Council will decide whether to recommend that NMFS publish the DEIS. Written comments can be submitted directly to the Council on the preliminary DEIS. To allow the Council to review them prior to the meeting, written comments should be submitted to the Council website by noon on Friday, January 31, 2025 (www.npfmc.org/public-comment-policy/). Tribal members and organizations can also provide oral testimony to the Council at the Council meeting.

- DEIS public comment period (date tbd). If the Council decides the proposed action is ready to move to the next stage, all information and deliberations at the February Council meeting will be incorporated, as appropriate, into NMFS's DEIS, which we will publish for public comment. A public comment period of a minimum of 45 days will follow during which Tribes and Tribal organizations can provide information and knowledge to NMFS, including any information important to Tribes that is missing from the DEIS. NMFS always accompanies a DEIS with Tribal engagement and consultation opportunities.

- (if needed) Council meeting to review modified alternatives. If, at the February special Council meeting, the Council makes further substantive modifications to the alternatives that require staff analysis, a future Council meeting will be scheduled to review another (third) version of the preliminary DEIS. It is likely that the earliest that meeting could occur would be October 2025. Tribes and Tribal organizations could submit information and knowledge prior to that meeting on the Council webpage and orally at the Council meeting. (www.npfmc.org/public-comment-policy/)

- Council meeting for final action (tbd). If, at the February special Council meeting, the Council recommends to publish the DEIS, and NMFS agrees, a future Council meeting will be scheduled to review the public comments received on the DEIS. It is likely that the earliest that meeting could occur would be October 2025. Tribes and Tribal organizations can submit written information and knowledge prior to that meeting on the Council webpage and orally at the Council meeting.[2] (www.npfmc.org/public-comment-policy/)

- Final EIS, Record of Decision, Fishery Management Plan (FMP) amendment and rulemaking process. Once the Council takes final action, NMFS begins the process under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to review the Council recommendation and decide to approve, partially approve, or disapprove the FMP amendment and implement the action in Federal regulations. The Magnuson-Stevens Act and Administrative Procedures Act provide opportunities for comment during the FMP amendment decision and rulemaking process. NMFS will also complete the EIS process by issuing a Final EIS and a Record of Decision. NMFS accompanies the rulemaking process with Tribal engagement and consultation opportunities and will notify Tribes and Tribal organizations at each key step. This is a lengthy process that can take over a year.

We hear that there is a strong desire for NMFS representatives to meet in-person with representatives from Tribal communities. Suggestions offered at the October 2024 Council meeting included attending the Alaska Federal of Natives October 2024 meeting in Anchorage, participating in the Tanana Chiefs Conference biannual meeting in November 2024, and attending several Subsistence Regional Advisory Council meetings in February and March 2025. NMFS appreciates the importance of in-person time for relationship building and two-way dialogue and will try to attend these and other meetings we are invited to.

Additionally, thank you for sharing the information and concerns regarding bycatch impacts and the alternatives and their analysis. This input is useful for the Council to consider as it reviews the preliminary DEIS leading up to the February Council meeting. You mentioned a desire that the Council consider adopting both a version of Alternative 5 (the time/area closure, albeit with a lower limit than currently being analyzed) and, to address bycatch outside of the closure area, an overall bycatch limit under Alternatives 2 or 3. The Council can recommend a combination of alternatives as the preferred alternative.

[2] Substantive changes to the alternatives at this point in the process may require another publication of the DEIS and public comment period.

You also expressed that the Council's alternatives to date have not been responsive to the purpose and need for this action. We appreciate that the iterative process of developing a management alternative that both addresses the purpose and need and is consistent with the National Standards of the Magnuson-Stevens Act can sometimes be frustrating. Without discounting any other part of the purpose and need statement, it does include that "[t]he purpose of this action is to minimize the bycatch of chum salmon in the Bering Sea pollock fishery to the extent practicable (National Standard 9 and Section 303(a)(11) of the Magnuson-Stevens Act) while balancing the other National Standards." [3] For many reasons, achieving that purpose is no simple task. However, with input from Alaska Natives, industry, non-governmental organizations, the public, Tribes, and Tribal organizations, including yours, the iterative process required under the Magnuson-Stevens Act and NEPA has resulted in responsive refinements to Alternatives 2, 3, and 4, and the addition of Alternative 5. As noted, we are still in the alternatives development process and we are grateful for your willingness to continue to engage with the Council and NMFS to improve them.

Again, thank you for sharing your information and concerns. If you would like to discuss anything further about this management action, please contact the NMFS project lead, Doug Shaftel (doug.shaftel@noaa.gov; 907-308-3286). If you would like to request an engagement session or a formal government-to-government consultation at any time, you can do so by contacting NMFS Alaska Region Tribal Liaison, Amilee Wilson (Amilee.Wilson@noaa.gov; 907-723-7099).

Sincerely,

Jonathan M. Kurland
Regional Administrator

cc: Angel Drobnica, Chair, NPFMC
David Witherell, Executive Director, NPFMC
Dr. Kate Haapala, Fishery Analyst, NPFMC
Doug Shaftel, Fishery Analyst, NMFS

[3] The entire purpose and need statement is in Section 1.1 of the March 2024 preliminary Draft Environmental Impact Statement.

Appendix 2 Supplement to Chapter 2

This appendix provides additional and supplemental information to the proposed alternatives under consideration described in Chapter 2.

Alternative 1: No Action

Chum Salmon Savings Area

The Chum Salmon Savings Area would be retained under Alternative 1. It is a time and area closure in the southeastern Bering Sea. The area was identified as having high chum salmon bycatch rates in the early 1990s, established by Emergency Rule in 1994, and later incorporated into the BSAI Groundfish FMP under Amendment 35. Prior to 2007, this area would close to all trawl fisheries from August 1st-31st when chum salmon bycatch encounters were highest. In 2007, new regulations came into effect under Amendment 84 to the BSAI Groundfish FMP specified this area would only apply to vessels directed fishing for Bering Sea pollock using trawl gear (50 CFR 679.22(a)(10)). The area would remain closed if the bycatch limit of 42,000 non-Chinook was reached at any point from August 15 through October 14. The limit of 42,000 non-Chinook salmon was apportioned at the fishery level among CDQ and AFA pollock harvesters, and only those non-Chinook salmon encountered in the CVOA accrued to the limit (the CVOA is defined at 50 CFR 679.22(a)(5)).

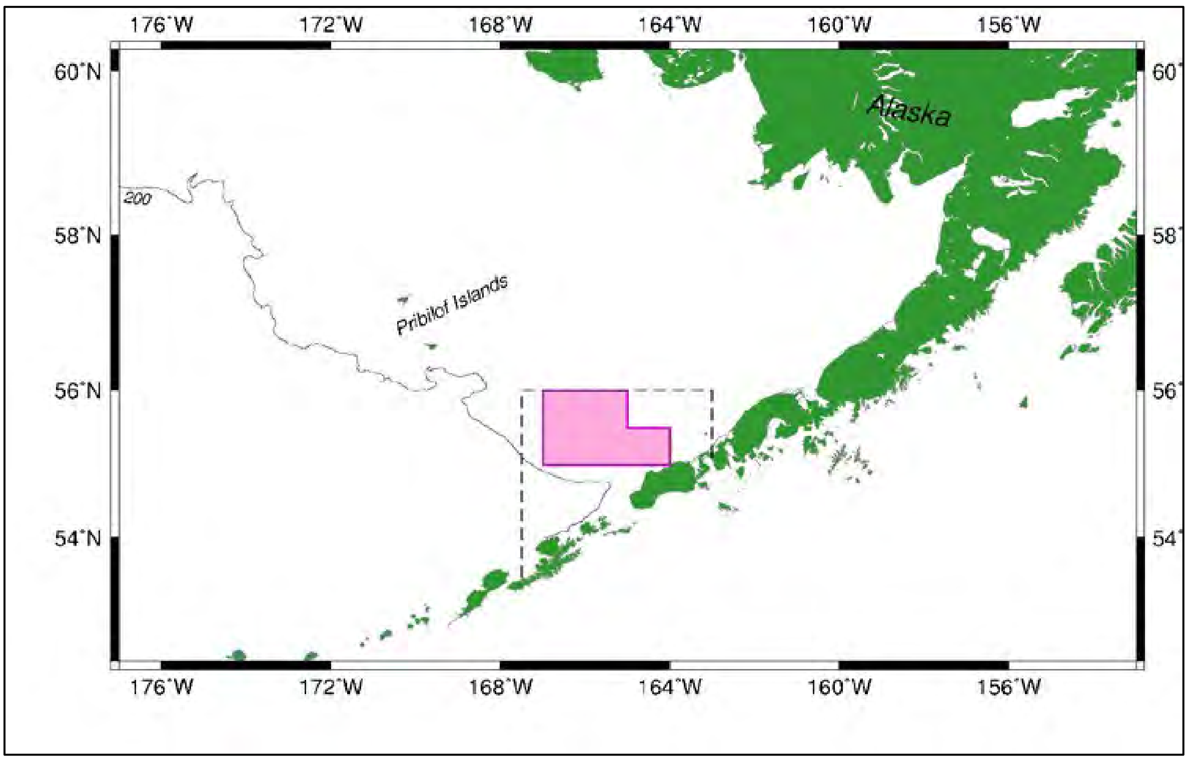

Figure A2 -1 Chum Salmon Savings Area is denoted in pink and encapsulated within the Catcher Vessel Operational Area is denoted with a dashed line

Chinook salmon PSC Management Under Amendment 91 and 110 to the BSAI Groundfish FMPs

Chinook Salmon PSC Limit

Amendment 91 came into effect in 2011 and established a Chinook salmon PSC limit (75 FR 5306). The

Chinook salmon PSC limit implemented under Amendment 91 is not connected to a spatial closure area but rather requires pollock fishing to cease when an entity reaches their portion of the limit. NMFS apportions an overall PSC limit of 60,000 Chinook among the Bering Sea pollock sectors and further divides the inshore sector's allocation among the cooperatives as well as the CDQ sector's allocation among the CDQ groups. The Chinook salmon PSC limit is apportioned among the A and B season pollock fishery (70% and 30%, respectively).

The PSC limit of 60,000 Chinook is applied if some or all of the pollock industry participates in IPAs that establish incentives for pollock fishermen to avoid Chinook on the pollock grounds at all levels of encounter rates. Participation in an IPA is voluntary. However, the pollock sectors will receive a portion of a lower PSC limit – 47,591 Chinook salmon –if no Chinook salmon bycatch IPA is approved by NMFS or if a sector exceeds its performance standard, the latter of which is discussed more below (50 CFR 679.21(f)(2)(i)).[1] The Council developed two Chinook salmon PSC limits to incentivize the industry to form IPAs to avoid the potential economic impacts of receiving an allocation under the lower limit.[2]

Amendment 110 modified Chinook salmon PSC limits established under Amendment 91 to fluctuate based on Chinook abundance (i.e., when WAK Chinook abundance is low, the Chinook salmon PSC limits are reduced) (see 81 FR 37534). NMFS publishes the applicable Chinook salmon PSC limit in the annual harvest specifications after determining if it is a low Chinook salmon abundance year based on information from the State of Alaska. The 3-River index used to determine WAK Chinook abundance is based on the sum of the run sizes of the Kuskokwim, Unalakleet, and Upper Yukon River systems. When this 3-River Index is less than or equal to 250,000 Chinook salmon, the Chinook salmon PSC limits drop to 45,000 Chinook salmon and 33,318 Chinook (50 CFR 679.21(f)(2)). NMFS issued allocations under the 60,000 PSC limit from 2011-2018 and again in 2020. In 2019, 2021, 2022, and 2023, NMFS issued sector and seasonal proportions of the 45,000 PSC limit as the 3-River Index determined WAK Chinook salmon abundance to be low.[3]

The pollock industry is also held to a **performance standard** (see 50 CFR 679.21(f)(6)). Prior to each fishing year, NMFS calculates each sector's **annual threshold amount** and publishes it on the NMFS Alaska Region web site (see 50 CFR 679.21(f)(6)(ii)). The annual threshold amount is the annual number of Chinook salmon that would be allocated to a fishing sector under either the 47,591 or 33,318 Chinook salmon PSC limit depending on a determination of abundance. At the end of each year, NMFS evaluates how many Chinook salmon were caught as bycatch compared to the sector's annual threshold amount. The performance standard requires each sector to not exceed its annual threshold amount in any three of seven years (i.e., no more than two years in a rolling seven-year period). If NMFS determines a sector has exceeded the performance standard, that sector will permanently receive an allocation of Chinook salmon PSC under the lower limit (either 47,591 or 33,318 Chinook salmon) in all future years.

The Chinook salmon PSC limit, performance standard, and annual threshold amount work together in the Chinook bycatch management program to keep the fishery below the overall cap. This management approach ensures the inshore CV, CP, mothership, and CDQ fishery sectors stay below their actual Chinook salmon PSC allocation because of the incentive to receive the highest PSC allocation available each year.

[1] [illegible]

[2] [illegible]

[3] [illegible]

As noted above, NMFS apportions the Chinook salmon PSC limit among the pollock sectors and further apportions the inshore sector's allocation among the cooperatives as well as the CDQ allocation among the CDQ groups. Each sector's allocation is based on an adjusted five-year (2002-2006) historical average proportion of the Chinook salmon PSC by sector and by season. As such, NMFS manages 15 different Chinook salmon PSC "accounts" each season (and 30 annually).

NMFS issues transferable Chinook salmon PSC limits to inshore cooperatives, the CDQ groups, and an entity representing the mothership and CP sectors (see 50 CFR 679.21(f)(8)). Chinook salmon PSC remaining in an entity's account (e.g., CP sector) can rollover from the A season to the B season, but the entity may only transfer a portion of its PSC allocation within the same season. Chinook salmon PSC may be transferred between sectors (i.e., inter-sector transfers), between inshore cooperatives (i.e., inter-cooperative transfers), between CDQ groups (i.e., inter-group transfers), and among vessels within a cooperative (i.e., intra-cooperative transfers). Intra-cooperative transfers of Chinook salmon PSC are completed by cooperative/IPA managers. Inter-cooperative, inter-group, and inter-sector transfers of Chinook salmon PSC require NMFS approval of the transfer. Requests for approvals are filed by the entity receiving the transfer (see 50 CFR 679.21(f)(8)(ii)).

Regulations at 50 CFR 679.21(f)(9)(ii) also allow for post-delivery transfers. If the amount of Chinook caught as bycatch exceeds an entity's seasonal allocation, the entity may receive transfers of Chinook salmon PSC to cover overages for that season. The Council included post-delivery transfers in its Preferred Alternative under Amendment 91 because, if an overage occurs, all vessels fishing on behalf of the entity are allowed to complete the pollock trip that they are on, but the vessels are not allowed to start another fishing trip for the remainder of the season. An entity is allowed to request a transfer to "cover" the overage and bring the allocation account balance to zero, but the entity is not allowed to transfer any more PSC than what is required to balance the account to zero.

Chinook Rolling Hotspot System

The RHS system for Chinook salmon avoidance is largely the same as that described for chum salmon. An important difference, however, is that the RHS system for Chinook salmon operates in the A and B pollock seasons. The Chinook Base Rate is calculated each week beginning on or near January 28th during the pollock A season and on or about July 1 during the B season. The Chinook Base Rate is determined to be the greater value of either 1) the average bycatch rate or 2) the rate of .035 Chinook salmon per mt of pollock. Preliminary data are used at the start of each fishing season (e.g., January 20 through January 29 in the A season) to determine the location and concentration of Chinook salmon, and to determine the initial Base Rate.

Hot spots are identified by evaluating the Chinook salmon bycatch rates for each ADF&G groundfish statistical area from which a Chinook salmon bycatch report is received, and when feasible, for each lateral half of the statistical area. This step helps to determine Chinook abundance on the pollock fishing grounds in a finer spatial and temporal scale. Area bycatch rates are calculated by dividing the number of Chinook salmon caught incidentally by the pollock fishery during the prior week within an individual ADF&G statistical area by the mt of pollock catch from the area during the prior week.

After identifying Chinook Bycatch Hotspots, RHS closure areas for Chinook established. On January 30 and on each Thursday thereafter for the duration of the A season, and on June 20 and on each Thursday thereafter for the duration of the B season, several criteria are used to provide notice to vessels of identified RHS closure areas for Chinook within which pollock fishing may be restricted.

Chinook Three-River Index Under Amendment 110

Following implementation of Amendment 91 in 2011, the Council began to receive annual updates on salmon bycatch numbers, IPA performance, and the genetic stock composition of both Chinook and chum salmon caught as bycatch. In response to continued concerns regarding chum salmon bycatch, widespread concerns over the stock status of WAK Chinook salmon, and indications that vessel-level incentives for Chinook bycatch avoidance could be strengthened (see Stram and Ianelli, 2015), the Council created a comprehensive salmon bycatch avoidance program. Amendment 110 regulations came into effect in 2016 and incorporated chum salmon avoidance measures into the IPAs, modified the requirements for the content of the IPAs to increase incentives for fishermen to avoid Chinook salmon, and provided additional flexibility in the seasonal apportionments of the Bering Sea pollock TAC to allow for more pollock to be harvested if desirable in the A season when Chinook salmon bycatch rates have historically been lower.

Additionally, Amendment 110 regulations reduced the Chinook salmon PSC limit in years when Chinook salmon abundance is determined to be low in WAK based on a Three-river index. The Three-river index used to determine WAK Chinook abundance is based on the sum of the run sizes of the Kuskokwim, Unalakleet, and Upper Yukon River systems. NMFS will determine that it is a low Chinook salmon abundance year when abundance of Chinook salmon in WAK is less than or equal to 250,000 Chinook salmon. By October 1 of each year, the State of Alaska provides to NMFS an estimate of Chinook salmon abundance using this index. In years when Chinook salmon abundance is determined to be low, the overall Chinook salmon PSC limit drops to 45,000 and the lower limit to 33,318 Chinook.

Alternative 2: Overall Chum Salmon PSC Limits

Table A2-1 compares existing salmon bycatch management tools, which were adopted under Amendments 91 and 110 to the Groundfish of the Bering Sea and Aleutian Islands Management Plan, to the tools proposed in this action.

<table>
<tr><th rowspan="2">Tool</th><th colspan="3">Current Salmon Bycatch Reduction Tools</th><th colspan="2">Proposed Bycatch Reduction Tools for Chum Salmon</th><th rowspan="2">Differences Between Current and Proposed Tools</th></tr>
<tr><th>Description</th><th>Chinook</th><th>Chum</th><th>Alt</th><th>Description</th></tr>
<tr><td>PSC limit</td><td>n/a</td><td>✕</td><td>✕</td><td>2</td><td>NMFS apportions to each sector a PSC limit of [100,000-550,000] chum salmon.</td><td>n/a</td></tr>
<tr><td>PSC limit, application depends on abundance
679.21(f)(2)
679.21(f)(6)</td><td>ADF&G provides Chinook salmon abundance estimates by October 1. Based on the index, NMFS publishes the applicable Chinook salmon PSC limit.

In years with no determination of low abundance, NMFS apportions PSC limits of 60,000 or 47,591 (if performance standard exceeded) Chinook salmon to each sector.

In low abundance years, NMFS apportions a PSC limit of 45,000 or 33,318 (if performance standard exceeded) Chinook salmon to each sector.</td><td>✓</td><td>✕</td><td>3</td><td>ADF&G provides chum salmon abundance estimates by October 1, and NMFS publishes the applicable PSC limit.

When estimates exceed all three river abundance thresholds under Option 1, or both thresholds under Option 2, there is no chum salmon PSC limit.

When estimates exceed two river abundance thresholds under Option 1, or one or zero thresholds under Option 2, NMFS apportions to each sector a PSC limit of [100,000-550,000] chum salmon.

When ADF&G estimates exceed zero or one thresholds under Option 1, NMFS apportions to each sector a PSC limit of [75,000-412,500] chum salmon.</td><td>Unlike for Chinook salmon, when estimates do not indicate low abundance, no chum salmon PSC limit would apply the following year.

Both caps count all salmon bycatch regardless of origin, though chum salmon bycatch may include a higher proportion of non-U.S. hatchery origin fish.</td></tr>
<tr><td>Multiple-stock abundance index
679.21(f)(2)</td><td>To determine abundance, ADF&G uses aggregate Chinook salmon data from the Kuskokwim, Unalakleet, and Upper Yukon.</td><td>✓</td><td>✕</td><td>3</td><td>Option 1. Three-river (Norton Sound, Yukon, and Kuskokwim) chum salmon abundance index.

Option 2. Yukon summer and fall chum salmon abundance index.</td><td>Similar to Chinook, Option 1 would use data from three river systems.
Unlike for Chinook, Option 2 would use data from a single river system.</td></tr>
</table>

PSC apportionment 679.21(f)(3)(iii) 679.21(f)(3)(v)	NMFS apportions the Chinook salmon PSC limit among sectors, and then further apportions it among cooperatives and CDQ groups in proportion to their pollock allocations. Cooperative managers monitor the Chinook salmon PSC limit and require their vessels to stop fishing once a PSC limit is hit.	✓	✕	2, 3 & 5	NMFS would use the same approach to apportion chum salmon PSC limits.	No differences in approach. However, there are four options for apportioning the PSC limit to each sector: 3-yr. avg; 5-yr. avg; pro rata; and AFA.
Opt-out apportionments 679.21(f)(5)	To vessels that opt-out of IPAs, NMFS apportions a lower Chinook PSC limit to this group than the PSC limit for which they would be eligible if they participated in IPAs. Opt-out apportionments are not transferrable.	✓	✕	n/a	n/a	Unlike for Chinook, NMFS would apportion the same chum salmon PSC limit to vessels that opt-out of and participate in IPAs.
Performance Standard 679.21(f)(6)	When a sector exceeds its annual threshold amount in three of seven consecutive years, NMFS apportions a lower PSC limit of 47,591 Chinook salmon or, during low abundance, 33,318 Chinook salmon, to that sector in all future years.	✓	✕	n/a	n/a	No alternative includes a chum salmon performance standard.
PSC transfers 679.21(f)(8)-(9)	Chinook salmon PSC may be transferred among sectors, among inshore cooperatives, among CDQ groups, and among vessels within a single cooperative. Intracooperative transfers of Chinook salmon PSC are completed by cooperative managers. Intercooperative, inter-CDQ group, and inter-sector transfers of Chinook salmon PSC require NMFS approval. Post-season transfers of Chinook salmon PSC are permitted with conditions.	✓	✕	2, 3 & 5	The same approach would apply to transfers of apportioned chum salmon PSC limits.	No differences.

Incentive Plan Agreements (IPA) 679.21(f)(12)(iii)(E)	IPAs are contracts that create incentives and penalties for member vessels to avoid both Chinook and chum salmon. Three IPAs have been in place since 2010: CP IPA; Inshore SSIP; and MSSIP. The thirteen provisions under 679.21(f)(12)(iii)(E) provide a framework for IPAs to reduce salmon bycatch. Some provisions require that the IPAs employ a specific tool, such as rolling hotspot closures or salmon excluder devices. Others require the IPAs to describe how they would achieve a specific management objective - for example, keeping each vessel's Chinook salmon bycatch below the performance standard. Some provisions are specific to Chinook salmon, some are specific to chum salmon, and some to both.	✓	✓	4	To the existing 13 tools and management measures under 679.21(f)(12)(iii)(E), the following tools would be required to be added to each IPA: • Require each IPA to describe how historical genetic stock composition data is included in chum avoidance measures; • Require provisions that address chum bycatch outlier vessels; • Describe how IPAs monitor for potential chum avoidance closures more than once per week; • Prohibit all vessels from fishing in chum avoidance areas when bycatch rates exceed 5 chum per ton of pollock (CP) and 3 times base rate (CV and MS); • Require all vessels to use salmon excluders in both A and B season; • Require IPAs to provide weekly salmon bycatch reports to Western and Interior Alaska salmon users.	With one exception, of the tools IPAs would be required to use for chum salmon avoidance, IPAs are required to use the same tools for Chinook salmon avoidance. The exception is that IPAs are not currently required to describe how they use historical genetic stock composition data for Chinook salmon avoidance.
Time/Area closure 679.21(f)(14) 679.22(a)(10)	*Applicable only to pollock vessels using trawl gear that are* ***<u>NOT</u>*** *operating under an approved IPA.* The Chum Salmon Savings Area (about 5000nm2) is closed for August. If 42,000 chum salmon are caught in the Catcher Vessel Operational Area from August 15 through October 14, the closure area remains closed for the remainder of the period of September 1 to October 14.	✕	✓	5	A time/area closure would be in place from June 10 to August 31. There are three mutually exclusive options for a closure area; Cluster 1, Cluster 2, and Unimak. NMFS would apportion to each sector a PSC limit of [50,000 to 200,000] chum salmon. Only chum salmon caught in the closure area would count against the limit. NMFS would close the area to any sector that exceeds its apportioned PSC limit until August 31.	Under Alternative 5, vessels operating under an IPA would <u>not</u> be exempt from area closures. No area would be automatically closed for a month-long period, however, the area-specific PSC limit would be larger and no area would be at risk of closure after August 31.

Comprehensive monitoring of salmon bycatch 679.21(f)(15) 679.51(a)(2)	Electronic monitoring or observers on every vessel. Every salmon is counted and biological and genetic samples are taken to understand stock origin.	✓	✓	All	No change	n/a

Alternative 3: Overall Chum salmon PSC Limit with Abundance Indices

The following section provides additional, supplemental information related to Alternative 3.

The preliminary review analysis presented to the Council in October 2023 included information in Section 3.2.2 that the Council used to support its recommendations for index data sources and threshold limits for the three-area chum salmon index. Based on new information from ADF&G that indicates funding to continue operating the Bethel Test Fishery is uncertain (see Section 2.4), the Council should consider other data sources for indexing adult chum salmon abundance to the Kuskokwim River if it intends to move forward with Alternative 3, Option 1.

Included directly below is Section 3.2.2 from the Preliminary Review of Bering Sea Chum Salmon Bycatch Management analysis (October 2023). The captions for the tables and figures are the same as what was used in the Preliminary Review analysis. ADF&G, with input from KRITFC, has updated the Kuskokwim River section to include other sources of information on adult chum salmon abundance for the Council's consideration. In reviewing this section is important to note that the concept of a three-area index was formerly contained in Alternative 2, Option 2 and in April 2024, the Council revised their motion such that the three-area index is now contained in Alternative 3, Option 1.

Section 3.2.2 Weighted, Step-down PSC Limit Triggered by a Three-area Chum Index

The range of values the Council selects to be analyzed as an overall chum salmon PSC limit would be the same under option 1 and 2 of Alternative 2. As noted above, under option 1 of Alternative 2, the chum PSC limit would be in place each B season. Under option 2 of Alternative 2, a chum PSC limit would only be in place, and potentially step-down (i.e., decrease), based on considerations of stock status for three Western Alaska chum salmon river systems. The three systems that correspond with ADF&G salmon management areas evaluated under this option are Norton Sound, Yukon, and Kuskokwim. For this reason, the analysis hereafter refers to the index as a "3-area index."

The Council indicated that an index would be weighted to account for variance in chum salmon stock sizes across these river systems, and that their performance (i.e., the stock status for chum salmon) would be linked to 1) overall abundance, 2) whether Amounts Reasonably Necessary for Subsistence (ANS) are met, and 3) whether escapement goals for chum salmon are met. The Council also requested that analytical staff work with ADF&G to determine the feasibility of this concept, and to provide suggestions for how best to weight or consider the three systems in conjunction with each other. The substance of those conversations and suggestions is captured below.

The following section of the analysis provides a consideration of the feasibility of option 2 Alternative 2, an overview of the information available that could be used to determine each river system's stock status (i.e., whether chum salmon returns are estimated to be a low or high abundance), and an estimate of when the data used to estimate WAK chum abundance in each area would be available because the Council would need to consider it in conjunction with its annual harvest specification process. An example of step-down PSC provisions based upon reaching identified thresholds by river system is also provided to illustrate how this index could be applied to a chum salmon PSC limit.

3.2.2.1 Feasibility of Concept and Data Availability

Use of a 3-area chum index appears to be feasible if the Council chooses to assess these areas independently. Each area would be treated as an individual "test" to determine whether chum salmon stock status is at low abundance. The corresponding management action in the pollock fishery's B season (i.e., the step-down provisions) would scale to the number of areas that meet a threshold for low abundance. The individual test approach is preferable to summing the areas together under one index (as was done for Chinook salmon under the Three-river index (see Section 2.6.4 of Amendment 110 to the BSAI Groundfish FMP, NMFS 2015) for two primary reasons. First, there are limited run reconstructions for chum salmon and the units of measurement for appropriate estimates of abundance differ between the areas (e.g., full run reconstruction, test fishery, weir count, and others). Second, treating each area as an independent test provides some proportionality among the river systems as their run sizes vary substantially. Each river system is described below with the relative information available for each system.

Yukon River: Reliable run abundance information is available for both Yukon River summer and fall chum salmon as both runs have full run reconstruction information available, meaning there is total accounting of catch and escapement within the drainage (Table A2-2 and Table A2-3; Figure A2-2). The Council would need to decide whether to include both summer and fall stocks in the Yukon area's portion of the 3-area index. Summer chum stocks contribute to the Coastal Western Alaska and Upper/Middle genetic reporting groups, while fall stocks contribute only to the Upper/Middle reporting group. A revised genetic baseline now enables all Yukon summer stocks to be included in the Coastal Western Alaska reporting group and a standalone Yukon River fall chum reporting group. This approach to genetic differentiation more closely aligns with how these stocks are assessed and the estimates of abundance that are available.

It is recommended that the full run reconstructions for both the Yukon summer and fall chum runs be used. Similar to the use of run reconstruction datasets for Chinook salmon under the three-river index under Amendment 110, preliminary estimates may be available in early fall following the salmon season. These preliminary estimates include best estimates of subsistence harvest before the final subsistence harvest analysis is completed in late winter/early spring of the following year.

Table A2-2 Yukon River chum salmon summer run reconstruction index and whether ANS and escapement goals were met,1992 through 2022

Year	Yukon Summer Index (run reconstruction)	Currently established ANS Met (83,500–142,192)	Met or Exceeded All Current EGs(Anvik, EF Andreafsky and Drainagewide; based on currently used EG range)
1992	2,707,800	YES	100%
1993	1,786,500	YES	100%
1994	3,670,100	YES	100%
1995	4,295,000	YES	100%
1996	4,219,600	YES	100%
1997	1,654,200	YES	100%
1998	1,012,700	YES	100%
1999	1,142,800	YES	67%
2000	552,470	NO	0%
2001	541,970	NO	0%
2002	1,273,400	YES	100%
2003	1,259,000	NO	33%
2004	1,462,500	NO	100%
2005	2,760,000	YES	67%
2006	4,012,700	YES	100%
2007	2,154,700	YES	100%
2008	2,065,100	YES	100%
2009	1,698,400	NO	33%
2010	1,664,800	YES	100%
2011	2,405,800	YES	100%
2012	2,478,400	YES	100%
2013	3,346,100	YES	100%
2014	2,463,900	YES	67%
2015	1,974,300	YES	100%
2016	2,578,100	YES	67%
2017	3,627,300	YES	100%
2018	2,070,000	NO	33%
2019	1,682,200	NO	67%
2020	762,520	NO	100%
2021	154,370	NO	0%
2022	478,130	NO	0%

Sources: https://www.adfg.alaska.gov/FedAidPDFs/SP22-20.pdf
https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareayukon.subsistence_salmon_harvest
https://www.adfg.alaska.gov/FedAidPDFs/SP22-20.pdf

Jallen, D. M., C. M. Gleason, B. M. Borba, F. W. West, S. K. S. Decker, and S. R. Ransbury. 2022. Yukon River salmon stock status and salmon fisheries, 2022: A report to the Alaska Board of Fisheries, January 2023. Alaska Department of Fish and Game, Special Publication No 22, Anchorage https://www.adfg.alaska.gov/FedAidPDFs/SP22-20.pdf

Table A2-3 Yukon River chum salmon fall run reconstruction index and whether ANS and escapement goals were met, 1992 through 2022

Yukon Fall Index (run reconstruction)	Currently established ANS Met (89,500–167,900)	Met or Exceeded All Current EGs(Drainagewide, Delta, Chandalar, Fishing Branch CA, Yukon Mainstem CA; based on currently used EG range)
568,652	YES	75%
473,535	NO	75%
1,109,572	YES	100%
1,611,534	YES	100%
1,141,115	YES	100%
707,279	YES	100%
351,957	NO	40%
419,480	YES	40%
252,942	NO	40%
374,885	NO	60%
427,969	NO	80%
792,025	NO	100%
653,216	NO	80%
2,180,488	YES	100%
1,211,273	NO	100%
1,160,101	YES	100%
857,269	NO	80%
598,277	NO	100%
587,091	NO	80%
1,238,091	NO	80%
1,085,700	YES	100%
1,211,909	YES	100%
954,769	YES	80%
823,653	NO	80%
1,389,062	NO	100%
2,288,383	NO	100%
1,112,834	NO	80%
801,614	NO	80%
184,233	NO	25%
95,249	NO	0%
242,480	NO	0%

Sources: https://www.adfg.alaska.gov/FedAidPDFs/SP22-20.pdf
https://www.adfg.alaska.gov/CF_R3/external/sites/aykdbms_website/DataSelection.aspx
https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareayukon.subsistence_salmon_harvest
https://www.adfg.alaska.gov/FedAidPDFs/SP22-20.pdf

Jallen, D. M., C. M. Gleason, B. M. Borba, F. W. West, S. K. S. Decker, and S. R. Ransbury. 2022. Yukon River salmon stock status and salmon fisheries, 2022: A report to the Alaska Board of Fisheries, January 2023. Alaska Department of Fish and Game, Special Publication No 22, Anchorage https://www.adfg.alaska.gov/FedAidPDFs/SP22-20.pdf

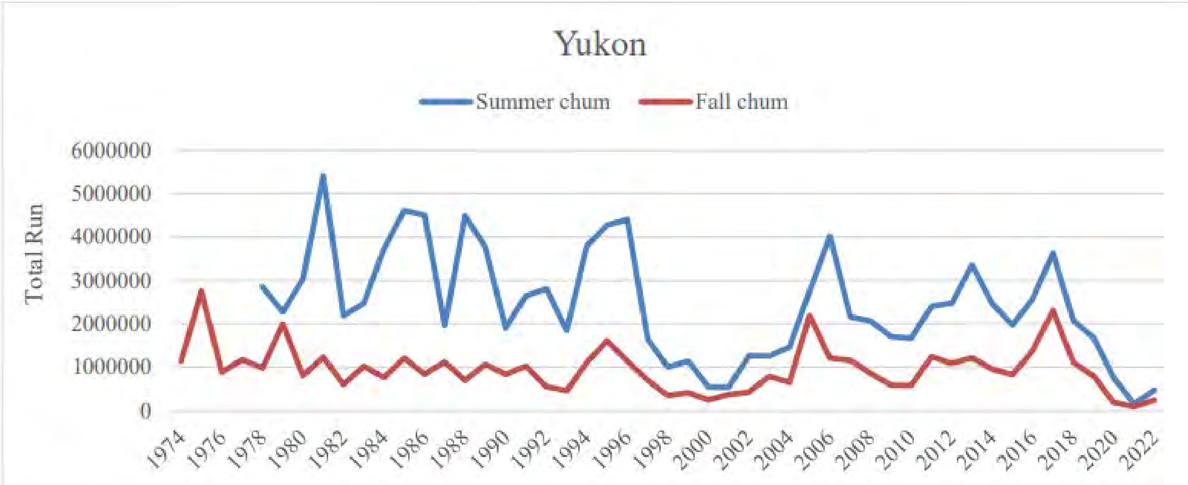

Figure A2-2 Yukon River summer and fall chum run reconstruction, 1974 through 2022

Kuskokwim River: It was previously recommended to use the annual cumulative CPUE data from the Bethel Test Fishery for the Kuskokwim portion of the 3-area index because these data provide a reliable estimate of run abundance (Table A2-4). However, new information from ADF&G indicates that funding to operate the Bethel Test Fishery is uncertain beginning in 2025 and these data may not be available for use in Alternative 3, Option 1, in the future. Therefore, the Council should consider other data sources for indexing adult chum salmon abundance to the Kuskokwim River.

Other sources of information on adult chum salmon abundance on the Kuskokwim River:

1. Kuskokwim River sonar
   Advantages:
   a. Reliable funding through the chum salmon run and plans to continue into the future; any excess BTF funding likely to support sonar operations.
   b. Project attempts to estimate total abundance past Bethel versus other projects that are designed to produce a catch-per-unit-effort index of abundance.
   c. Kuskokwim River Sonar Project employs the same standard methods ADF&G uses to estimate salmon abundance on the Yukon River, Kenai River and watersheds in the state.
   d. Correlates well with escapement and LKTK/community observations of salmon runs.
   e. Information is transparent and accessible to the public.
   f. Sonar data is expected to inform future run reconstruction models under development for Kuskokwim River chum salmon, similar to the Yukon River summer chum salmon model.
   Disadvantages:
   a. Short time-series (2018 – present).
   b. Has not operated during high run years, but has operated across a range of run sizes from record low (2021) to above average (e.g. 2018). Note: ADF&G and KRITFC staff can explore using BTF data to retro-cast likely abundances for sonar pre-2018.
   c. Sonar values likely to change based on further investigations of potential bias in species apportionment. While there is evidence that sonar estimates are biased low, the only other candidate mainstem data source is designed to provide only catch-per-unit-effort as an index of run strength.
   d. Drainagewide telemetry planned for 2026 and 2027, which is intended to assist with sonar bias investigation and potential correction.

2. Kogrukluk River weir

Advantages:
a. Long time-series (1976 – present).
b. Reliable funding and plans to continue into the future.
c. Annual escapements correlate well with drainagewide Kuskokwim River sonar index of abundance.
d. The Kogrukluk River has the only chum salmon escapement goal for the Kuskokwim River.
e. Information is transparent and accessible to the public.

Disadvantages:
a. A single river system serves as a partial index of abundance and is not representative of total drainagewide abundance.
b. If combined with a total drainagewide abundance index, potential for "double counting" fish.
c. Environmental conditions such as a flooding event may prevent weir from providing reliable estimate of abundance each year.

3. Other weirs: Kwethluk River, Salmon River (Aniak), George River, Takotna River

Advantages:
a. Long time-series for projects.
b. Various agencies plan to continue operations in the future.
    i. Kwethluk River weir operated by USFWS with local partnerships, including KRITFC and Organized Village of Kwethluk
    ii. Salmon River (Aniak) weir is operated by Native Village of Napaimute
    iii. George River weir is operated by ADF&G
    iv. Takotna River weir is operated by Kuskokwim River Inter-Tribal Fish Commission
c. Information is transparent and accessible to the public.

Disadvantages:
a. Projects are currently funded primarily using competitive grants.
b. Partial index of abundance and is not representative of total drainagewide abundance.
c. If combined with a total drainagewide abundance index, potential for "double counting" fish.
d. Environmental conditions such as a flooding event may prevent weir from providing reliable estimate of abundance each year.

4. Total harvest: commercial, subsistence, test fisheries, and recreational

Advantages:
a. Long time-series.
b. Collected annually and plans to continue into the future.
c. Information is transparent and accessible to the public.
d. In-season lower river subsistence harvest estimates produced by KRITFC are available post-season in early fall. The same methods are currently used to estimate subsistence harvest of Chinook salmon for the Three System Index.

Disadvantages:
a. Commercial harvest is influenced by factors other than abundance such as processor availability and both commercial and subsistence harvest are influenced by management measures to conserve Chinook salmon.
b. Partial index of abundance and is not representative of total drainagewide abundance.
c. If combined with a total drainagewide abundance index, potential for "double counting" fish.
d. Commercial harvest is confidential in years when participation is less than three permit holders.
e. River-wide subsistence/commercial harvest estimates produced by ADF&G are not available post-season in early fall.

5. Drainagewide run reconstruction, note this is not presently available:
   Advantages:
   a. Estimates total abundance.
   b. Potential for long time-series (1976 – present).
   c. The statistical model used for the run reconstruction has been published and can easily be reproduced.
   d. Uses multiple assessment projects and is consequently less vulnerable to unforeseen circumstances, e.g. flooding event, that may prevent an individual project from providing reliable estimate of abundance each year.
   e. Analogous to the run reconstruction currently used to inform the 3-area index for Chinook salmon which was determined to be best available information for Amendment 110.

   Disadvantages:
   a. Run reconstruction has not been peer reviewed or updated since 2008 and is currently not being used by ADF&G, KRITFC, or USFWS on an annual basis for management.
   b. Model result is biased low and can only be used as an index until bias is corrected.
   Ŧ Drainagewide telemetry planned for 2026 and 2027, which is intended to assist in correcting Kuskokwim River sonar bias and potential scaling of run reconstruction models.

Table A2-4 Kuskokwim River chum Bethel test fishery CPUE, commercial harvest, subsistence harvest, Kogrukluk escapement, and Kuskokwim sonar estimates and whether ANS and escapement goals were met, 1992 through 2024.

Year	Bethel Test Fishery CPUE	Commercial Harvest	Subsistence Harvest	Kogrukluk minimum escapement goal = 15,000	Kuskokwim sonar	Currently established ANS Met (41,200-116,400)	Met or Exceeded All Current EGs (Kogrukluk River; based on currently used EG range)
1992	3,057	344,603	114,164	36,085	n.a	YES	YES
1993	2,586	43,337	59,342	30,021	n.a	YES	YES
1994	4,801	271,115	75,174	n.a.	n.a	YES	
1995	3,986	605,918	69,877	32,466	n.a	YES	YES
1996	8,256	207,877	99,023	48,225	n.a	YES	YES
1997	1,965	17,026	37,017	7,957	n.a	NO	NO
1998	2,337	207,809	60,261	n.a.	n.a	YES	
1999	549	23,006	44,202	14,140	n.a	YES	NO
2000	2,599	11,570	54,641	11,426	n.a	YES	NO
2001	3,396	1,272	53,792	31,481	n.a	YES	YES
2002	6,798	1,900	82,916	52,912	n.a	YES	YES
2003	4,819	2,764	41,185	23,708	n.a	YES	YES
2004	5,248	20,150	61,182	24,429	n.a	YES	YES
2005	18,192	69,139	56,595	194,896	n.a	YES	YES
2006	13,927	44,152	87,254	183,743	n.a	YES	YES
2007	10,655	10,783	71,207	53,064	n.a	YES	YES
2008	6,749	30,798	62,034	44,717	n.a	YES	YES
2009	8,257	76,956	42,904	81,829	n.a	YES	YES
2010	7,655	93,917	42,567	63,612	n.a	YES	YES
2011	10,028	118,316	51,507	76,649	n.a	YES	YES
2012	6,894	65,195	77,994	n.a.	n.a	YES	
2013	5,739	52,236	52,230	65,648	n.a	YES	YES
2014	6,345	19,080	66,484	30,697	n.a	YES	YES
2015	2,945	507	40,872	33,091	n.a	NO	YES
2016	3,998	conf.	44,881	45,234	n.a	YES	YES
2017	6,785	conf.	52,589	85,793	n.a	YES	YES
2018	8,205	conf.	45,918	52,937	552,011	YES	YES
2019	6,429	conf.	34,568	71,006	385,409	NO	YES
2020	1,443	conf.	26,992	19,032	76,432	NO	YES
2021	327	conf.	9,759	4,153	26,973	NO	NO
2022	2,191	0	10,825	13,471	103,864	NO	NO
2023[a]	4,304	0	25,093	11,780	251,542	NO	
2024	5,981	0			253,825		

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

n.a. Not available

conf. Confidential due to fewer than 3 permit holders

Source: https://www.adfg.alaska.gov/FedAidPDFs/SP22-19.pdf
https://www.adfg.alaska.gov/FedAidPDFs/SP22-19.pdf

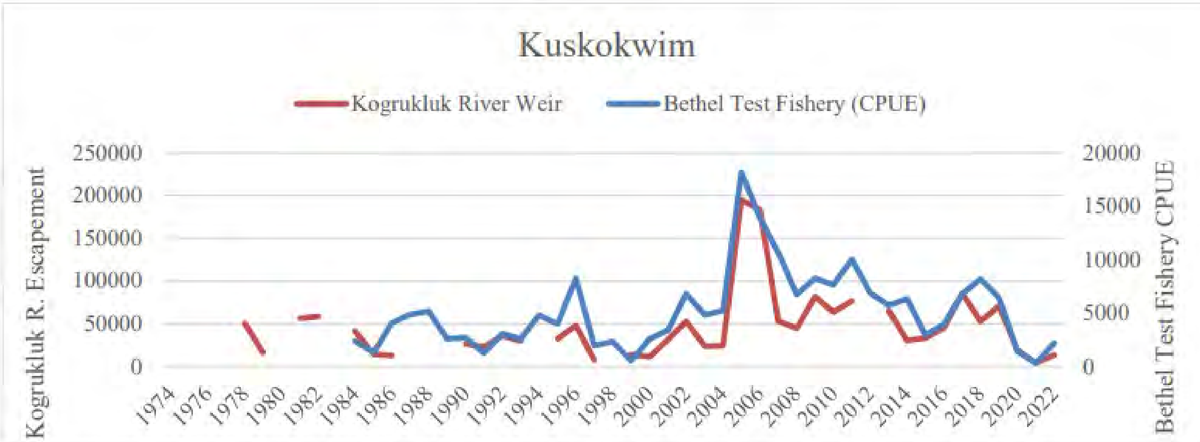

Figure A2-3 Kuskokwim River chum salmon: Bethel Test Fishery catch per unit effort (CPUE) and Kogrukluk River Weir

Norton Sound: The Council's April 2023 motion identified the Kwiniuk River as a candidate system to determine chum abundance for the Norton Sound region. Run reconstruction data are available for the Kwiniuk River through 2019 and could be used as an indicator of abundance for the Norton Sound region. However, the Kwiniuk River is only one of many Norton Sound rivers with a chum salmon run, and a run reconstruction from this single system may not be a consistently reliable indicator for the whole Norton Sound region. Additionally, the Kwiniuk River chum run reconstruction is not currently used by ADF&G for management, so ADF&G staff would have to conduct this analysis specifically to meet this request for the Council.

An alternative would be to use a standardized index constructed of escapements to five rivers in the area (Snake, Nome, Eldorado, Kwiniuk and North) that are consistently enumerated each year through weirs or counting towers as well as adding in the total Norton Sound harvest (commercial, sport and subsistence) (Table A2-5; Figure A2-3). Using a standardized index for the Norton Sound region based on these five rivers would be an approach that is more representative of the chum salmon returns across several management subdistricts within the Norton Sound region. Under this approach, the tributary escapements, commercial, sport, and subsistence harvest would be preliminary (not the final) estimates used to accommodate the Council's fall specification cycle. Preliminary escapement would be based on the total estimated chum salmon passage at each tributary assessment project, and the very small annual harvest that occurs upriver from the assessment locations would be ignored. Preliminary harvest would be informed by commercial fish tickets and ADF&G management staff expectation of subsistence and sport harvest based, in part, on historical trends, amounts of fishing opportunity provided, and observations of fishery participation. These preliminary data are available shortly after the salmon season, with final estimates for all components published in Annual Management Reports. Some consideration should be given to addressing missing data (such as recent 3 or 5-year average proportional contributions) should data to inform the index not be consistently available.

Table A2-5 Index of the sum of five Norton Sound Rivers Snake, Nome, Eldorado, Kwiniuk and North river weirs/towers escapement and total harvest) and whether ANS and escapement goals were met, 1997 through 2022 (data are incomplete for recent years)

Year	Minimum Standardized Index (Sum of Snake, Nome, Eldorado, Kwiniuk, North rivers weir/tower escapement and Total NS Harvest)	Kwiniuk River Run Reconstruction	Met or Exceeded Current EGs (Snake, Nome, Eldorado, Kwiniuk; based on currently used EG range - excludes Tubutulik because that system is rarely assessed)
1997	101,934	22,493	100%
1998	80,966	26,091	100%
1999	39,217	9,135	0%
2000	55,153	13,733	75%
2001	66,123	17,789	75%
2002	73,710	38,721	100%
2003	43,407	12,969	75%
2004	41,270	10,450	75%
2005	53,034	12,330	100%
2006	113,350	40,114	100%
2007	107,719	30,406	100%
2008	63,806	10,051	75%
2009	69,906	9,415	25%
2010	277,401	84,941	100%
2011	202,421	45,874	100%
2012	107,359	7,596	50%
2013	188,104	7,159	75%
2014	215,382	50,115	100%
2015	259,441	53,671	100%
2016	124,397	12,305	75%
2017	324,148	39,191	100%
2018	363,939	61,225	100%
2019	234,270	28,579	100%
2020	49,762	5,436	50%
2021	21,632	5,201	50%
2022	62,657	12,300	100%

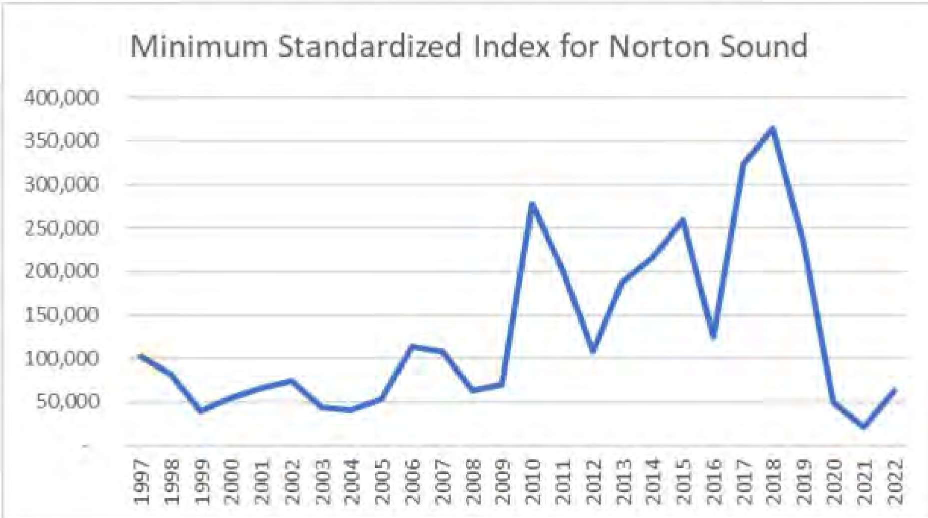

Figure A2-4 Minimum Standardized Index for the Norton Sound chum region (Sum of Snake, Nome, Eldorado, Kwiniuk, North rivers weir/tower counts and Total Norton Sound Harvest)

Other Western Alaska chum areas: ADF&G staff do not recommend the inclusion of additional stocks for consideration of western Alaskan chum indices for a variety of reasons. For example, Kotzebue chum salmon, while genetically distinguishable, lacks consistent escapement information; thus, the best indicator for these stocks is generally considered to be commercial harvest data. Bristol Bay chum salmon are primarily harvested incidental to the large sockeye fishery and as such escapements are not as diligently assessed across this broad system. Any index of Bristol Bay chum salmon would be largely based on commercial harvest data.

3.2.2.2 Criteria to Define Low Chum Abundance by Area

To move forward with option 2 of Alternative 2, the Council would need to provide input on several components related to establishing the 3-area index. **Specifically, the Council would need to establish the criteria that would be used to determine (or define) what constitutes low abundance in each area**. It is recommended that an overall determination for what constitutes low chum salmon abundance for each area be defined based on the available data for each area as indicated above. The Council has indicated it may be interested in considering additional criteria such as whether ANS or escapement goals are met. These additional criteria could provide additional context to help the Council determine the numerical thresholds they would like to use for each area, but it is not recommended the other criteria be used in isolation.

Historical abundance:

If the Council would like the 3-area index to be based on historical chum abundance in each management area, the Council would need to define a threshold – a number of chum salmon – for each area that defines low abundance. ADF&G does not have a specific number of chum salmon in each of the three management areas being considered that constitutes low abundance. As such, this is a determination for the Council. However, as noted above, it is recommended that a determination on historical chum abundance in each area be made using the sources of available data previously identified (e.g., full run reconstruction for Yukon River fall and summer chum, Bethel Test Fishery CPUE, and a standardized index of five rivers in the Norton Sound region).

To develop the criterion of low abundance, the Council would need to define the years from which average chum abundance would be estimated. The selection of the year set will greatly influence perceptions of what constitutes low and high chum abundance, and these perceptions of abundance may change into the future as more data are included in the time series. As the Council considers how to define the years to use for each area, it is important to note there may be different time series of information available by area. For example, the 15th percentile of one dataset may align well with how managers and stakeholders view a low abundance run in one area but may not align well with that perspective in another area - because the spread, historical patterns, and units of measure differ between the areas.

Amounts Reasonably Necessary for Subsistence:

ANS is a threshold for levels of harvest deemed reasonably necessary to support subsistence needs in a particular area (Table A2-6). The Board of Fisheries and Board of Game use Customary and Traditional Use Worksheets to determine whether a stock or population has been customarily and traditionally used in an area. If the Board gives a positive finding that a resource is customarily and traditionally used, an ANS amount is established, and management decisions as well as harvest opportunities are made with that range in mind. The ANS amount is set keeping in mind the sustained yield principle, and the amounts do not include salmon harvested from personal use permits or salmon retained from commercial fisheries for personal use. The Board of Fisheries has made positive ANS findings for chum salmon throughout the three areas being considered in this index (Table A2-7).

However, ANS is not a consistent metric across all areas. For example, the ANS determination for the Norton Sound region is based on all salmon and not chum salmon alone. Subsistence harvest data for some chum salmon stocks may be impacted by factors other than low run abundance in some years. For example, the Yukon River fall chum data shown in Table A2-3 demonstrate that there are years, such as 2017, with a relatively high level of chum returns (based on full reconstructions) for which ANS was not met. These patterns occur for a variety of reasons including ADFG’s historical management practices, nuances of the Pacific Salmon Treaty as it includes some negotiated escapement goals, changes in cultural and traditional use of salmon, among others.

Table A2-6 ANS for Arctic-Yukon-Kuskokwim areas by salmon species

Fisheries Management Area		Year of ANS Finding	Chinook Salmon	Chum Salmon	Summer Chum Salmon	Fall Chum Salmon	Sockeye	Coho	Pink	All Salmon
Kotzebue District		None								
Norton Sound-Port Clarence Area		1998								96,000-160,000
	Subdistrict 1 of Norton Sound District*	1999		3,430-5,716						
Yukon Area		2001	45,500-66,704		83,500-142,192	89,500-167,900		20,500-51,980	2,100-9,700	
Kuskokwim Area		2013								
	Kuskokwim River		67,200-109,800	41,200-116,400			32,200-58,700	27,400-57,600	500-2,000	
	Districts 4 and 5									6,900-17,000
	Remainder of Area									12,500-14,400
Bristol Bay		2001								157,000-172,171
	Kvichak River Drainage						55,000-65,000			
Alaska Peninsula		1998								34,000-56,000

Escapement goals:

Table A2-7 provides a summary of chum salmon escapement goals for river systems across the Arctic Yukon-Kuskokwim region. Achieving escapement goals for some chum stocks may be impacted by factors other than low abundance in some years. For example, again using the Yukon River fall chum data, two escapement goals on this system are associated with the Pacific Salmon Treaty and are therefore negotiated goals. These two goals are based on the best available data and consistent with sustained yield principles, but they do not necessarily conform to the same criteria that are used in establishing other escapement goals in this system. Escapements to the Fishing Branch on the Porcupine River (Canadian Yukon) have chronically been below what has been defined in treaty as an escapement objective, even when abundance for the rest of the fall chum salmon population is high. Additionally, some areas have more escapement goals than others – a criterion based only on escapement goals would lead to areas with fewer escapement goals to be more heavily influenced by one goal being met/not met. Generally, escapement goals across the AYK region are based on different criteria depending on data quality and type of goal (Sustainable Escapement Goal, Biological Escapement Goal, and Optimal Escapement Goals when established by the BOF).[4] As such, interpreting escapement goal performance requires context.

[4] More information on ADF&G's escapement goals can be found here: https://www.adfg.alaska.gov/index.cfm?adfg=sonar.escapementgoals#:%7E:text=Biological%20Escapement%20Goals%20(BEGs)%20and,sustained%20yields%20in%20the%20future

Table A2-7 Chum salmon escapement goals and escapements for Arctic-Yukon-Kuskokwim Region (where applicable), 2012 through 2021

	2021 Goal Range			Initial	Escapement								
System	Lower	Upper	Type	Year	2013	2014	2015	2016	2017	2018	2019	2020	2021
CHUM SALMON													
Kuskokwim Area													
Middle Fork Goodnews River	12,000		LB SEG	2005	27,692	11,518	11,475	33,671	44,876	NS	38,072	NS	NS
Kogrukluk River	15,000	49,000	SEG	2005	65,648	30,697	33,091	45,234	85,793	52,937	71,006	19,020	4,153
Yukon River Summer Chum													
Yukon River Drainage[a]	500,000	1,200,000	BEG	2016				1,866,200	2,997,200	1,432,100	1,398,400	705,880	153,120
East Fork Andreafsky River	40,000		LB SEG	2010	61,234	37,793	48,809	50,362	55,532	36,330	49,881	NS	2,531
Anvik River	350,000	700,000	BEG	2005	571,690	399,796	374,968	337,821	415,139	305,098	249,014	NS	18,819
Yukon River Fall Chum													
Yukon River Drainage[a]	300,000	600,000	SEG	2010	854,000	741,000	541,000	832,000	1,706,000	654,000	528,000	194,000	94,525
Delta River	7,000	20,000	SEG	2019	32,000	32,000	33,000	22,000	49,000	40,000	52,000	9,900	1,613
Teedriinjik (Chandalar) River	85,000	234,000	SEG	2019	253,000	221,000	164,000	295,000	509,000	170,000	116,000	NS	21,162
Fishing Branch River (Canada)[b]	22,000	49,000	agreement	2008[c]	25,000	7,000	8,000	29,000	48,000	10,151	18,000	5,000	2,413
Yukon R. Mainstem (Canada)	70,000	104,000	agreement	2010[d]	200,000	156,000	109,000	145,000	401,000	154,000	98,000	23,500	23,170
Norton Sound													
Subdistrict 1 Aggregate	eliminated			2019	108,120	97,234	92,030	60,749	123,794	85,390			
Nome River	1,600	5,300	SEG	2019	4,807	5,589	6,100	7,085	6,321	5,240	3,164	2,822	216
Snake River	2,000	4,200	SEG	2019	2,755	3,982	4,241	3,651	4,759	3,028	2,374	842	2,352
Eldorado River	4,400	14,200	SEG	2019	26,131	27,038	25,549	18,938	73,882	42,361	28,427	11,333	6,283
Kwiniuk River	9,100	32,600	SEG	2019	5,625	39,597	37,663	8,523	32,541	41,620	18,029	4,953	3,862
Tubutulik River	3,100	9,000	SEG	2019	4,532	NS	9,835	NS	NS	NS	NS	NS	NS
Kotzebue Sound													
Noatak and Eli Rivers	43,000	121,000	SEG	2019	NS	490,814	NS	NS	NS	NS	NS	NS	NS
Upper Kobuk w/ Selby River	12,000	32,100	SEG	2019	NS	65,653	NS	NS	NS	NS	NS	NS	NS

source: Munro and Brenner 2022, http://www.adfg.alaska.gov/FedAidPDFs/FMS22-02.pdf

Note : NA = data not available; NS = no survey; LB SEG = lower-bound SEG.

[a] A statistical model is used to estimate escapement. All historical escapement estimates are updated annually based on the most recent model run.

[b] Fishing Branch River fall chum salmon weir assessment project was not operated after 2012. Estimates are based on border sonar estimate minus community

[c] Fishing Branch River fall chum salmon IMEG of 22,000-49,000 was implemented for 2008-2021 by Yukon River Panel.

[d] Yukon River Mainstem fall chum salmon IMEG of 70,000-104,000 was implemented for 2010-2021 seasons by Yukon River Panel.

Table A2-8 provides an overall summary of the types of available information by river system that could be considered to determine whether each area in the 3-area index is at low abundance.

	Yukon	Kuskokwim	Norton Sound
River systems included by area	Yukon River	Kuskokwim River	Standardized index for Snake, Nome, Eldorado, Kwiniuk, and North Rivers + total Norton Sound harvest
Historical abundance indices	Run reconstruction for fall and summer chum – total accounting of catch and escapement in the drainage	Bethel Test Fishery annual CPUE	Sport, subsistence and commercial harvests; select weirs, and counting towers.
ANS	Subsistence harvest information based on ANS Summer chum: 83,500-142,192 Fall chum: 89,500-167,900	Subsistence harvest information based on ANS Chum: 41,20-116,400	Subsistence harvest information based on ANS All salmon: 96,000-160,000
Escapement Goals	Summer chum: 3 escapement goals Fall chum: 5 escapement goals, 2 based on Pacific Salmon Treaty	2 chum escapement goals	5 chum escapement goals (1 per river system)

3.2.2.3 Council Considerations for Refining Alternative 2, Option 2, 3-area Index:

If the Council would like to move forward with using the 3-area index, it would need to provide input on several components prior to staff being able to conduct additional analysis. Staff have summarized the decision points before the Council at this stage below.

The Council would need to define a threshold (i.e., number of chum salmon) for each area that defines low abundance. Using the available information sources identified above – full run reconstruction estimates for summer and fall chum on the Yukon River, Bethel Test Fishery CPUE, and a standardized index from five rivers in the Norton Sound Area—the Council could determine a numerical value for chum salmon abundance. The Council would need to select a range of years and percentiles of average historical abundance for consideration. Potential year sets are provided directly below, and they are based on the information provided in Table A2-2 for Yukon River summer chum, Table A2-3 for Yukon River fall chum, Table A2-4 for chum salmon estimates from the Bethel Test Fishery CPUE, and Table A2-5 for chum estimates based on a standardized index of five rivers in the Norton Sound region. It is recommended the Council consider using a longer year set to determine historical abundance of chum salmon than that used for chum salmon PSC because 2011 through 2022 would be a short period to consider chum life history (chum salmon typically have a 5-year lifespan).

- Yukon summer and fall: 1978-2022 (Note that fall summer chum data is available from 1974 on, but as these seasonal runs would be summed together and summer chum run data is only available from 1978 on.)
- Kuskokwim: 1984-2022 (Bethel test fishery CPUE only)
- Norton Sound: 1997-2022 (Minimum Standardized Index (Sum of Snake, Nome, Eldorado, Kwiniuk, North rivers weir/tower escapement and Total NS Harvest)

In addition to a numerical value for historical chum salmon abundance, the Council could consider whether ANS and escapement goals are met as additional criteria to define low abundance for each area (as mentioned above). If the Council would like to use ANS and escapement goals as additional criteria, these indices could provide additional context to help determine what constitutes low or high chum salmon abundance by area. However, using these criteria in isolation is not recommended. This is because ANS and escapement goals may sometimes be influenced by factors other than chum salmon abundance in a given year or area.

If the Council would like to use ANS and escapement goals as criteria to provide additional context, it is important to note that evaluating whether or not ANS and escapement goals have been met would be relatively straight forward. However, it is less clear how the Council would use these criteria in addition to historical abundance indices for each area as they do not track well together. In other words, historical abundance indices for an area may be low (e.g., below average) but ANS and escapement goals are met. Thus, using the combined approach that considers ANS and escapement goals as criteria may provide additional context for decision-making, but determining the numerical threshold for each area that constitutes low chum abundance would be a somewhat subjective decision for the Council.

Some methods could be used to consider these potentially differentially trending information sources, one would be to use a risk table similar to that which is used for groundfish stock assessments in which considerations are scored separately within each category (e.g., stock assessment, fishery performance, …) with an overall score reflecting the scores across all individual categories. The second is that the Council could establish explicit criteria by which the ANS and escapement goals are assessed annually (i.e. 'if ANS is not met, then…' or 'if all escapement goals are not met, then…') such that ADF&G would provide an annual letter determining if the criteria by region was met (similar to the determination of the three-river index number annually for Chinook in October). The use of these additional criteria would need to be explicitly defined by the Council in refining this alternative for further analysis.

As noted above, the Council could use a 3-area chum index if the areas are assessed independently such that each area would be treated as an individual test for low abundance. **The Council would need to consider whether each area would be treated equally (i.e., assessed independently but weighted equivalently) or if the Council would prefer to prioritize modifying management measures due to low abundance by area.** Under the first approach, if any one area is determined to be at low abundance, then a step-down provision(s) would be implemented. Under the second approach, the Council could determine an area of priority whereby step-down provisions would only start to be implemented if the priority area was determined to be at low abundance.

As noted above, the allocation and apportionment considerations described under option 1 of Alternative 2 would apply under option 2 of Alternative 2 and are not repeated here. The range of values for consideration and analysis as chum salmon PSC limits would also be the same as those specified under option 1 of Alternative 2. However, the Council has indicated that under option 2 of Alternative 2, the chum PSC limit would be triggered by, and linked with, step-down provisions when one or more of the three areas representative of WAK chum salmon abundance (i.e., Yukon, Kuskokwim, or Norton Sound) fail to meet the thresholds specified for the index. As more areas fail to meet index thresholds, the chum PSC limit would become more restrictive in the B season.

To move forward with option 2 of Alternative 2, the Council would also need to consider what the step-down provisions would be. An example of how the chum salmon PSC limit could be triggered, and the associated step-down provisions, could work is shown below. It is important to note this example assumes each of the three areas are weighted equally, but this is a policy consideration for the Council.

Asmore areas fail to meet their thresholds, the chum PSC limit would be progressively more restrictive, and the Council would need to determine what the appropriate PSC limit associated with each "step" would be.

a) if 3/3 areas are above index thresholds, no chum PSC limit implemented.
b) if 2/3 area are above index thresholds, the high point of the chum PSC limit values would be implemented.
c) if 1/3 areas are above index thresholds, the midpoint of the chum PSC limit values would be implemented.
d) if 0/3 areas are above index thresholds, the low point of the chum PSC limit would be implemented.

Again, this example assumes that each area is equally weighted in terms of whether they meet their respective thresholds. If the Council would like to weight river systems differentially then the criteria associated with the step-down provisions would need to be explicit by river system (i.e., 'if the Kuskokwim and the Yukon systems are above their thresholds but the Norton Sound does not, then…'). The Council must also determine the value of the PSC limit associated with each step of the step-down provision.

The table below was not included in the Preliminary Review analysis but summarizes the historical abundance based on the available data currently selected to inform Alternative 3, including the 25th and 50th percentile values for each area, for the relevant years of available data in each area.

Table A2-9 Historical chum salmon abundance based on index data source from 1992 to 2022, as well as the 25th and 50th percentile used for index thresholds

Year	*Yukon Summer Chum Salmon*	*Yukon Fall Chum Salmon*	*Kuskokwim Bethel Test Fishery CPUE*	*Norton Sound Minimum Standardized Index (Sum of Snake, Nome, Eldorado, Kwiniuk, North rivers weir/tower escapement and Total NS Harvest)*
1992	2,833,600	556,852	3,057	
1993	1,891,700	462,735	2,586	
1994	3,871,700	1,114,772	4,801	
1995	4,300,100	1,614,534	3,986	
1996	4,401,300	1,140,415	8,256	
1997	1,654,300	705,179	1,965	101,934
1998	1,012,700	350,457	2,337	80,966
1999	1,146,500	416,480	549	39,217
2000	552,820	250,242	2,599	55,153
2001	542,190	372,385	3,396	66,123
2002	1,275,200	426,469	6,798	73,710
2003	1,262,200	792,375	4,819	43,407
2004	1,463,000	652,616	5,248	41,270
2005	2,761,400	2,188,488	18,192	53,034
2006	4,019,500	1,213,273	13,927	113,350
2007	2,157,800	1,161,101	10,655	107,719
2008	2,067,500	857,819	6,749	63,806
2009	1,703,700	591,077	8,257	69,906
2010	1,668,300	585,791	7,655	277,401
2011	2,406,000	1,244,141	10,028	202,421
2012	2,479,900	1,089,200	6,894	107,359
2013	3,349,600	1,215,809	5,739	188,104
2014	2,467,600	956,669	6,345	215,382
2015	1,978,400	828,453	2,945	259,441
2016	2,581,500	1,390,329	3,998	124,397
2017	3,635,100	2,315,883	6,785	324,148
2018	2,074,700	1,114,684	8,205	363,939
2019	1,689,400	802,964	6,429	234,270
2020	763,200	184,233	1,443	49,762
2021	156,130	95,249	327	21,735
2022	478,690	242,465	2,191	70,702
25th Percentile	1,268,700	444,602	2,772	57,316
50th Percentile	1,978,400	802,964	5,248	91,450

Notes: The year set used in this table for each area aligns with the information the Council considered in October 2023 when Amounts Reasonably Necessary for Subsistence and escapement goals were considered alongside historical abundance information for context.

Alternative 5: Inseason Corridors

Table A2-10 Comparison of Options 1 through 3 under Alternative 5

Option	Area	PSC Limit Range	ADF&G groundfish statistical areas
1	Cluster Area 1	50,000 – 200,000	625504, 625531, 625600, 625630, 625700, 625730, 635501, 635504, 635530, 635600, 635630, 635700, 635730, 645434, 645501, 645502, 645530, 645600, 645630, 645700, 645730, 655407, 655409, 655410, 655430, 655500, 655530, 655600, 655630, 655700, 655730, 665335, 665336, 665401, 665403, 665404, 665430, 665500, 665530, 665600, 665630, 665700, 665730
2	Unimak	50,000 – 200,000	625331, 635501, 635504, 635530, 645434, 645501, 645502, 645530, 655409, 655410, 655430, 655500, 655530, 665335, 665337, 665401, 665403, 665404
3	Cluster Area 2	50,000 or 100,000	675430, 675500, 675530, 675600, 675630, 675700, 675730, 685500, 685530, 685600, 685630, 685700, 685730,685430

Notes: The ADF&G groundfish statistical areas included under Option 2, Unimak fishing grounds, are different than those specified in the Council's April 2024 motion. The Council's intent was to mirror the areas used in the genetic analyses by Auke Bay Labs and Sea State, which is reflected in the revised list of statistical areas below.

Table A2-11 CDQ group apportionments of the area-specific PSC limit under Option 1 (Cluster 1) of Alternative 5

PSC limit	*Apportionment*	*CDQ*	*14% APICDA*	*21% BBEDC*	*5% CBSFA*	*24% CVRF*	*22% NSEDC*	*14% YDFDA*
50,000	3-Yr Avg.	6,450	903	1,355	323	1,548	1,419	903
	5-Yr Avg.	5,150	721	1,082	258	1,236	1,133	721
	Pro Rata	6,088	852	1,278	304	1,461	1,339	852
	AFA	5,000	700	1,050	250	1,200	1,100	700
100,000	3-Yr Avg.	12,900	1,806	2,709	645	3,096	2,838	1,806
	5-Yr Avg.	10,300	1,442	2,163	515	2,472	2,266	1,442
	Pro Rata	12,175	1,705	2,557	609	2,922	2,679	1,705
	AFA	10,000	1,400	2,100	500	2,400	2,200	1,400
150,000	3-Yr Avg.	19,350	2,709	4,064	968	4,644	4,257	2,709
	5-Yr Avg.	15,450	2,163	3,245	773	3,708	3,399	2,163
	Pro Rata	18,263	2,557	3,835	913	4,383	4,018	2,557
	AFA	15,000	2,100	3,150	750	3,600	3,300	2,100
200,000	3-Yr Avg.	25,800	3,612	5,418	1,290	6,192	5,676	3,612
	5-Yr Avg.	20,600	2,884	4,326	1,030	4,944	4,532	2,884
	Pro Rata	24,350	3,409	5,114	1,218	5,844	5,357	3,409
	AFA	20,000	2,800	4,200	1,000	4,800	4,400	2,800

Table A2-12 Inshore cooperative apportionments of the area-specific limits under Option 1 (Cluster 1) of Alternative 5

PSC limit	Apportionment	Inshore	33.788% Akutan	0.00% Arctic Enterprise	10.773% Northern Victor	2.512% Peter Pan	11.454% Unalaska	22.093% Unisea	19.380% Westward	0.00% Open Access
50,000	3-Yr Avg.	38,150	12,890	0	4,110	958	4,370	8,428	7,393	0
	5-Yr Avg.	40,000	13,515	0	4,309	1,005	4,582	8,837	7,752	0
	Pro Rata	34,238	11,568	0	3,688	860	3,922	7,564	6,635	0
	AFA	22,500	7,602	0	2,424	565	2,577	4,971	4,361	0
100,000	3-Yr Avg.	76,300	25,780	0	8,220	1,917	8,739	16,857	14,787	0
	5-Yr Avg.	80,000	27,030	0	8,618	2,010	9,163	17,674	15,504	0
	Pro Rata	68,475	23,136	0	7,377	1,720	7,843	15,128	13,270	0
	AFA	45,000	15,201	0	4,848	1,130	5,154	9,942	8,721	0
150,000	3-Yr Avg.	114,450	38,670	0	12,330	2,875	13,109	25,285	22,180	0
	5-Yr Avg.	120,000	40,536	0	12,928	3,014	13,745	26,512	23,256	0
	Pro Rata	102,713	34,704	0	11,065	2,580	11,765	22,692	19,906	0
	AFA	67,500	22,807	0	7,272	1,696	7,731	14,913	13,082	0
200,000	3-Yr Avg.	152,600	51,560	0	16,440	3,833	17,479	33,714	29,574	0
	5-Yr Avg.	160,000	54,061	0	17,237	4,019	18,326	35,349	31,008	0
	Pro Rata	136,950	46,273	0	14,754	3,440	15,686	30,256	26,541	0
	AFA	90000	30,409	0	9695.7	2260.8	10308.6	19883.7	17442	0

Table A2-13 CDQ group apportionments under all area-specific limits under Option 2 (Unimak Area) of Alternative

PSC limit	Apportionment	CDQ	14% APICDA	21% BBEDC	5% CBSFA	24% CVRF	22% NSEDC	14% YDFDA
50,000	3-Yr Avg.	38,450	5,383	8,075	1,923	9,228	8,459	5,383
	5-Yr Avg.	40,900	5,726	8,589	2,045	9,816	8,998	5,726
	Pro Rata	34,463	4,825	7,237	1,723	8,271	7,582	4,825
	AFA	22,500	3,150	4,725	1,125	5,400	4,950	3,150
100,000	3-Yr Avg.	76,900	10,766	16,149	3,845	18,456	16,918	10,766
	5-Yr Avg.	81,800	11,452	17,178	4,090	19,632	17,996	11,452
	Pro Rata	68,925	9,650	14,474	3,446	16,542	15,164	9,650
	AFA	45,000	6,300	9,450	2,250	10,800	9,900	6,300
150,000	3-Yr Avg.	115,350	16,149	24,224	5,768	27,684	25,377	16,149
	5-Yr Avg.	122,700	17,178	25,767	6,135	29,448	26,994	17,178
	Pro Rata	103,388	14,474	21,711	5,169	24,813	22,745	14,474
	AFA	67,500	9,450	14,175	3,375	16,200	14,850	9,450
200,000	3-Yr Avg.	153,800	21,532	32,298	7,690	36,912	33,836	21,532
	5-Yr Avg.	163,600	22,904	34,356	8,180	39,264	35,992	22,904
	Pro Rata	137,850	19,299	28,949	6,893	33,084	30,327	19,299
	AFA	90,000	12,600	18,900	4,500	21,600	19,800	12,600

Table A2-14 Inshore cooperative apportionments of the area-specific PSC limit under Option 2 (Unimak Area) of Alternative 5

PSC limit	Apportionment	Inshore Sector	33.788% Akutan	0.00% Arctic Enterprise	10.773% Northern Victor	2.512% Peter Pan	11.454% Unalaska	22.093% Unisea	19.380% Westward	0.00% Open Access
50,000	3-Yr Avg.	38,450	12,991	0	4,142	966	4,404	8,495	7,452	0
	5-Yr Avg.	40,900	13,819	0	4,406	1,027	4,685	9,036	7,926	0
	Pro Rata	34,463	11,644	0	3,713	866	3,947	7,614	6,679	0
	AFA	22,500	7,602	0	2,424	565	2,577	4,971	4,361	0
100,000	3-Yr Avg.	76,900	25,983	0	8,284	1,932	8,808	16,990	14,903	0
	5-Yr Avg.	81,800	27,639	0	8,812	2,055	9,369	18,072	15,853	0
	Pro Rata	68,925	23,288	0	7,425	1,731	7,895	15,228	13,358	0
	AFA	45,000	15,205	0	4,848	1,130	5,154	9,942	8,721	0
150,000	3-Yr Avg.	115,350	38,974	0	12,427	2,898	13,212	25,484	22,355	0
	5-Yr Avg.	122,700	41,458	0	13,218	3,082	14,054	27,108	23,779	0
	Pro Rata	103,388	34,933	0	11,138	2,597	11,842	22,841	20,036	0
	AFA	67,500	22,807	0	7,272	1,696	7,731	14,913	13,082	0
200,000	3-Yr Avg.	153,800	51,966	0	16,569	3,863	17,616	33,979	29,806	0
	5-Yr Avg.	163,600	55,277	0	17,625	4,110	18,739	36,144	31,706	0
	Pro Rata	137,850	46,577	0	14,851	3,463	15,789	30,455	26,715	0
	AFA	90,000	30,409	0	9,696	2,261	10,309	19,884	17,442	0

Table A2-15 CDQ group apportionments of the area specific PSC limits under Option 3 (Cluster Area 2) of Alternative 5

PSC limit	*Apportionment*	*CDQ*	*14% APICDA*	*21% BBEDC*	*5% CBSFA*	*24% CVRF*	*22% NSEDC*	*14% YDFDA*
50,000	3-Yr Avg.	300	42	63	15	72	66	42
	5-Yr Avg.	850	119	179	43	204	187	119
	Pro Rata	1,475	207	310	74	354	325	207
	AFA	5,000	700	1,050	250	1,200	1,100	700
100,000	3-Yr Avg.	600	84	126	30	144	132	84
	5-Yr Avg.	1,700	238	357	85	408	374	238
	Pro Rata	2,950	413	620	148	708	649	413
	AFA	10,000	1,400	2,100	500	2,400	2,200	1,400

Table A2-16 Inshore cooperative apportionments of the area-specific PSC limits under Option 3 (Cluster Area 2) of Alternative 5

PSC limit	**Apportionment**	**Inshore**	**33.788% Akutan CV Assoc**	**0.00% Arctic Enterprise**	**10.773% Northern Victor Fleet Coop**	**2.512% Peter Pan Fleet Coop**	**11.454% Unalaska Fleet Coop**	**22.093% Unisea Fleet Coop**	**19.380% Westward Fleet Coop**	**0.00% Inshore Open Access**
50,000	3-Yr Avg.	32,400	10,947	0	3,490	814	3,711	7,158	6,279	0
	5-Yr Avg.	30,250	10,218	0	3,259	760	3,465	6,683	5,862	0
	Pro Rata	29,925	10,109	0	3,224	752	3,428	6,611	5,799	0
	AFA	45,000	15,201	0	4,848	1,130	5,154	9,942	8,721	0
,000	3-Yr Avg.	64,800	21,895	0	6,981	1,628	7,422	14,316	12,558	0
	5-Yr Avg.	60,500	20,442	0	6,518	1,520	6,930	13,366	11,725	0
	Pro Rata	59,850	20,222	0	6,448	1,503	6,855	13,223	11,599	0
	AFA	45,000	15,205	0	4,848	1,130	5,154	9,942	8,721	0

Appendix 3 Supplement to Chapter 3

This appendix contains additional information related to the resource categories analyzed in Chapter 3. The order of content follows the main document structure.

BSAI Groundfish Stock Status and Eastern Bering Sea Pollock

Table A3-1 2024 to 2026 OFL, ABC, and TAC

		2024			Catch as of	2025			2026		
Species	**Area**	**OFL**	**ABC**	**TAC**	**11/23/2024**	**OFL**	**ABC**	**TAC**	**OFL**	**ABC**	**TAC**
Pollock	BS	3,162,000	2,313,000	1,300,000	1,309,114	2,957,000	2,417,000	1,375,000	2,496,000	2,036,000	1,375,000
	AI	51,516	42,654	19,000	4,981	55,728	46,051	19,000	56,231	46,437	19,000
	Bogoslof	115,146	86,360	250	23	77,354	58,015	250	77,354	58,015	250
Pacific cod	BS	200,995	167,952	147,753	120,040	183,509	153,617	133,602	169,243	141,520	123,077
	AI	18,416	12,431	8,080	3,853	16,782	13,376	8,694	16,273	12,973	8,432
	BSAI/GOA	55,084	47,146	n/a		58,532	47,605	n/a	57,797	47,008	n/a
Sablefish	BS	n/a	11,450	7,996	4,720	n/a	13,203	8,496	n/a	13,037	8,996
	AI	n/a	13,100	8,440	1,414	n/a	11,566	7,940	n/a	11,421	7,440
Yellowfin sole	BSAI	305,298	265,913	195,000	85,373	299,247	262,557	135,000	305,039	267,639	145,000
Greenland turbot	BSAI	3,705	3,188	3,188	769	2,598	**1,678**	**1,678**	2,059	**1,328**	**1,328**
	BS	n/a	2,687	2,687	464	n/a	**1,415**	**1,415**	n/a	**1,120**	**1,120**
	AI	n/a	501	501	305	n/a	**263**	**263**	n/a	**208**	**208**
Arrowtooth flounder	BSAI	103,280	87,690	14,000	10,215	104,428	88,683	14,000	102,472	87,035	14,000
Kamchatka flounder	BSAI	8,850	7,498	7,498	5,115	8,019	6,800	6,800	7,790	6,606	6,606
Northern rock sole	BSAI	197,828	122,091	66,000	29,359	165,444	157,487	75,000	166,220	158,225	75,000
Flathead sole	BSAI	81,605	67,289	35,500	12,707	101,621	83,807	36,000	106,283	87,700	36,000
Alaska plaice	BSAI	42,695	35,494	21,752	10,241	34,576	28,745	**15,903**	33,965	28,230	**16,200**
Other flatfish	BSAI	22,919	17,189	4,500	3,093	26,083	19,562	4,500	26,083	19,562	4,500
Pacific Ocean perch	BSAI	49,010	41,096	37,626	36,040	44,594	37,375	33,458	43,084	36,578	33,490
	BS	n/a	11,636	11,636	10,702	n/a	10,121	10,121	n/a	9,905	9,905
	EAI	n/a	7,969	7,969	7,780	n/a	6,278	6,278	n/a	6,144	6,144
	CAI	n/a	5,521	5,521	5,250	n/a	5,559	5,559	n/a	5,441	5,441
	WAI	n/a	15,970	12,500	12,308	n/a	15,417	11,500	n/a	16,058	12,000
Northern rockfish	BSAI	23,556	19,274	16,752	8,785	22,848	18,694	12,000	22,284	18,232	12,000
Blackspotted/Rougheye Rockfish	BSAI	761	569	569	618	838	706	706	902	766	766
	BS/EAI	n/a	388	388	179	n/a	408	408	n/a	441	441
	CAI/WAI	n/a	181	181	439	n/a	298	298	n/a	325	325
Shortraker rockfish	BSAI	706	530	530	151	631	473	473	631	473	473
Other rockfish	BSAI	1,680	1,260	1,260	1,351	1,406	1,054	1,054	1,406	1,054	1,054
	BS	n/a	880	880	783	n/a	639	639	n/a	639	639
	AI	n/a	380	380	568	n/a	415	415	n/a	415	415
Atka mackerel	BSAI	111,684	95,358	72,987	72,176	122,622	103,247	82,000	107,889	92,361	82,941
	BS/EAI	n/a	41,723	32,260	31,769	n/a	46,650	39,000	n/a	41,731	41,731
	CAI	n/a	16,754	16,754	16,654	n/a	26,511	24,443	n/a	23,716	23,716
	WAI	n/a	36,882	23,973	23,753	n/a	30,087	18,557	n/a	26,914	17,494
Skates	BSAI	45,574	37,808	30,519	25,900	44,086	36,523	27,646	43,285	35,833	27,646
Sharks	BSAI	689	450	400	174	689	450	400	689	450	400
Octopuses	BSAI	6,080	4,560	400	240	6,080	4,560	400	6,080	4,560	400
Total	BSAI	4,609,077	3,476,801	2,000,000	1,746,452	4,334,715	3,588,066	2,000,000	3,849,059	3,189,555	2,000,000

Table A3-2 Time series of OFL, ABC, TAC, and catch (mt) for eastern Bering Sea pollock, 2011-2024

Year	OFL	ABC	TAC	Catch
2011	2,450,000	1,270,000	1,252,000	1,199,041
2012	2,474,000	1,220,000	1,200,000	1,205,293
2013	2,550,000	1,375,000	1,247,000	1,270,827
2014	2,795,000	1,369,000	1,267,000	1,297,849
2015	3,330,000	1,637,000	1,310,000	1,322,317
2016	3,910,000	2,090,000	1,340,000	1,353,686
2017	3,640,000	2,800,000	1,345,000	1,359,367
2018	4,797,000	2,592,000	1,364,000	1,379,301
2019	3,914,000	2,163,000	1,397,000	1,409,235
2020	4,085,000	2,043,000	1,425,000	1,325,000
2021	2,594,000	1,626,000	1,375,000	1,339,000
2022	1,469,000	1,111,000	1,111,000	1,105,677
2023	3,381,000	1,910,000	1,300,000	1,310,716
2024	3,162,000	2,313,000	1,300,000	1,300,000

Source: Modified year set from Table 2, Ianelli et al., 2024.
Notes: 2024 value is based on catch reported to October 25th and includes an added component of due to pollock bycatch in other fisheries.

Chum Salmon Biology, Distribution, and Status Changes

Below provides a summary of chum salmon abundance trends. Abundance includes catch, escapement and returns, depending on the country, species, and available data. Red arrows indicate a decreasing trend; green arrows indicate increasing trends; yellow arrow indicate stable trends. NW = Northwest, W = Western, NW = Northeast, EBS = Eastern Bering Sea, GOA = Gulf of Alaska, SE = Southeast.

	Past 11 years (2010–2020)	Last 3 years (2018–2020)	Preliminary 2021
NW Pacific			
Russia			
W Bering Sea & NW Pacific	↔	↓	↑
Sea of Okhotsk	↑	↓	↓
Primor'e & SW Sakhalin	↓	↓	↓
Japan			
Hokkaido Pacific side	↓	↓	↓
Hokkaido W & Okhotsk sides	↔	↓	↔
Honshu Pacific side	↓	↓	↓
Honshu western side	↔	↔	↓
Korea	↓	↓	↓
NE Pacific			
USA (Alaska)			
Northern EBS	↔	↓	↓
Southern EBS	↔	↓	↓
Western GOA	↔	↓	↓
Northern GOA	↔	↓	↓
Eastern GOA/SE Alaska	↔	↓	↓
Canada			
Northern B.C./Yukon	↔	↓	↓
Southern B.C.	↔	↓	↓
USA (Washington)			
Puget Sound (not ESA listed)	↓	↓	↓
Hood Canal (ESAt listed)	↔	↓	↑
Coast	↑	↑	↑
Lower Columbia River	↑	↑	↑

Figure A3-1 Summary of chum salmon abundance trends
Source: NPAFC 2023, Technical Report 19, Appendix B.

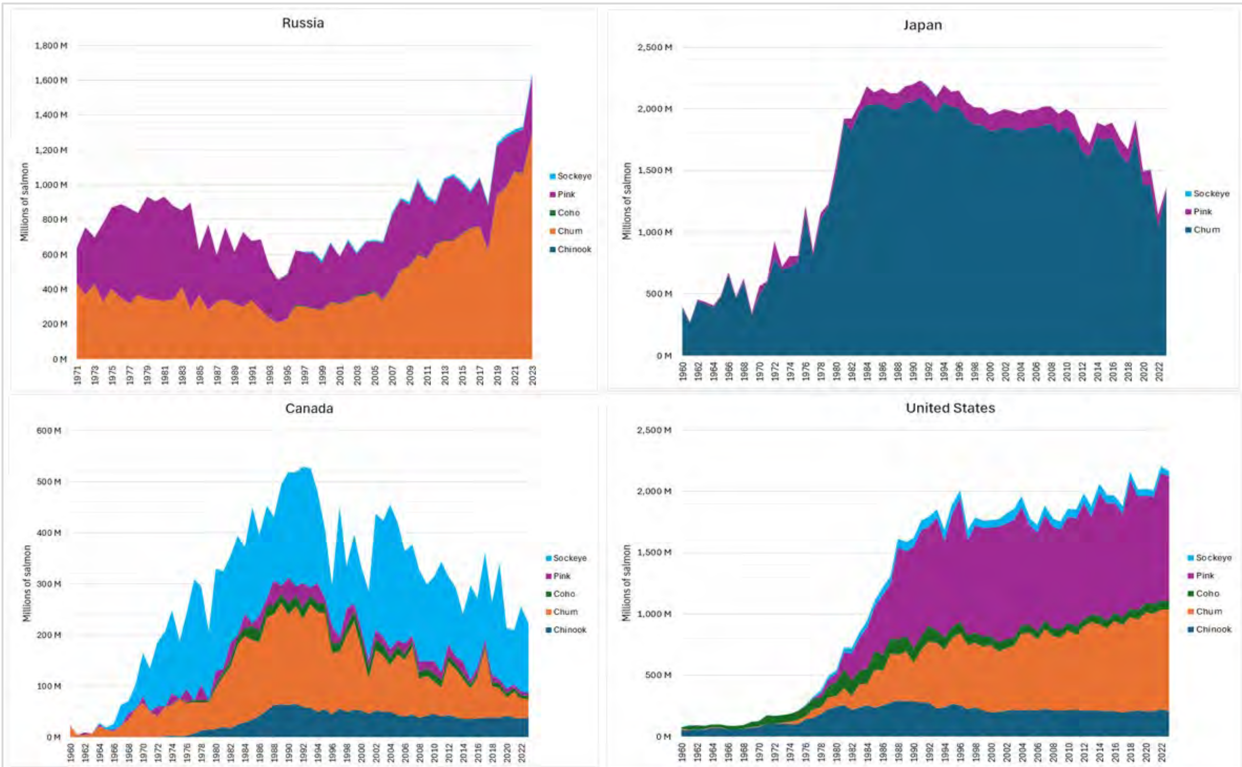

Figure A3-2 Total number of hatchery salmon (all species except cherry and steelhead) by Japan, Russia, United States and Canada, 1960 to 2024

Source: NPAFC Hatchery Statistics. 2024. Accessed November 2024. Available: https://www.npafc.org.

Western Alaska Chum Salmon Stock Status and Escapement Goals

Table A3-3 Summary of the type of escapement goal contained in the Sustainable Salmon Fisheries Policy, definition, and use in salmon fisheries management

Escapement goal	*Definition*	*Use in management*
BEG	Escapement that provides the greatest potential for maximum sustained yield	Expressed as a range Primary management objective for escapement unless an optimal or in-river run goal has been adopted
SEG	Level of escapement, indicated by an index or an escapement estimate, which is known to provide for sustained yield over a five-to-ten-year period	Expressed as a range or threshold Used when a BEG cannot be estimated or managed for Primary management objective for escapement unless an optimal or in-river run goal has been adopted
OEG	Specific management objective for salmon escapement that considers biological and allocative factors and may differ from the SEG or BEG	Sustainable and expressed as a range with the lower bound above the level of a SET; OEGs are set by the Board of Fisheries whereas all other EGs are set by ADF&G

Table A3-4 Arctic-Yukon-Kuskokwim Region chum salmon escapement goals and escapements, 2014 to 2022

	2022 Goal Range			Initial	Escapement								
System	Lower	Upper	Type	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022
CHUM SALMON													
Kuskokwim Area													
Middle Fork Goodnews River	12,000		LB SEG	2005	11,518	11,475	33,671	44,876	NS	38,072	NS	NS	NS
Kogrukluk River	15,000	49,000	SEG	2005	30,697	33,091	45,234	85,793	52,937	71,006	19,020	4,153	13,417
Yukon River Summer Chum													
Yukon River Drainage[a]	500,000	1,200,000	BEG	2016			1,866,200	2,997,200	1,432,100	1,398,400	705,880	153,120	471,730
East Fork Andreafsky River	40,000		LB SEG	2010	37,793	48,809	50,362	55,532	36,330	49,881	NS	2,531	NS
Anvik River	350,000	700,000	BEG	2005	399,796	374,968	337,821	415,139	305,098	249,014	NS	18,819	46,436
Yukon River Fall Chum													
Yukon River Drainage[a]	300,000	600,000	SEG	2010	741,000	541,000	832,000	1,706,000	654,000	528,000	194,000	94,525	239,687
Delta River	7,000	20,000	SEG	2019	32,000	33,000	22,000	49,000	40,000	52,000	9,900	1,613	5,670
Teedriinjik (Chandalar) River	85,000	234,000	SEG	2019	221,000	164,000	295,000	509,000	170,000	116,000	NS	21,162	69,333
Fishing Branch River (Canada)[b]	22,000	49,000	agreement	2008[c]	7,000	8,000	29,000	48,000	10,151	18,000	5,000	2,413	2,695
Yukon R. Mainstem (Canada)	70,000	104,000	agreement	2010[d]	156,000	109,000	145,000	401,000	154,000	98,000	23,500	23,170	22,059
Norton Sound													
Subdistrict 1 Aggregate	eliminated			2019	97,234	92,030	60,749	123,794	85,390				
Nome River	1,600	5,300	SEG	2019	5,589	6,100	7,085	6,321	5,240	3,164	2,822	216	2,763
Snake River	2,000	4,200	SEG	2019	3,982	4,241	3,651	4,759	3,028	2,374	842	2,352	5,562
Eldorado River	4,400	14,200	SEG	2019	27,038	25,549	18,938	73,882	42,361	28,427	11,333	6,283	7,520
Kwiniuk River	9,100	32,600	SEG	2019	39,597	37,663	8,523	32,541	41,620	18,029	4,953	3,862	10,127
Tubutulik River	3,100	9,000	SEG	2019	NS	9,835	NS	NS	NS	NS	NS	NS	NS
Kotzebue Sound													
Noatak and Eli Rivers	43,000	121,000	SEG	2019	490,814	NS	NS	NS	NS	NS	NS	NS	NS
Upper Kobuk w/ Selby River	12,000	32,100	SEG	2019	65,653	NS	NS	NS	NS	NS	NS	NS	NS

a A statistical model is used to estimate escapement. All historical escapement estimates are updated annually based on the most recent model run.
b Fishing Branch River fall chum salmon weir assessment project was not operated after 2012. Estimates are based on border sonar estimate minus community harvest with additional information from mark-recapture studies assuming most fish migrate to Fishing Branch River.
c Fishing Branch River fall chum salmon IMEG of 22,000-49,000 was implemented for 2008-2022 by Yukon River Panel.
d Yukon River Mainstem fall chum salmon IMEG of 70,000-104,000 was implemented for 2010-2022 seasons by Yukon River Panel.
*Updated and finalized information inclusive of 2023 escapement was not available to the analysts.

Chum Salmon Bycatch

Alternative 4

There are two primary designs of salmon excluders currently in use in the Bering Sea pollock fishery. One is called a “flapper” design and the other an “over/under” (see Figure A3).

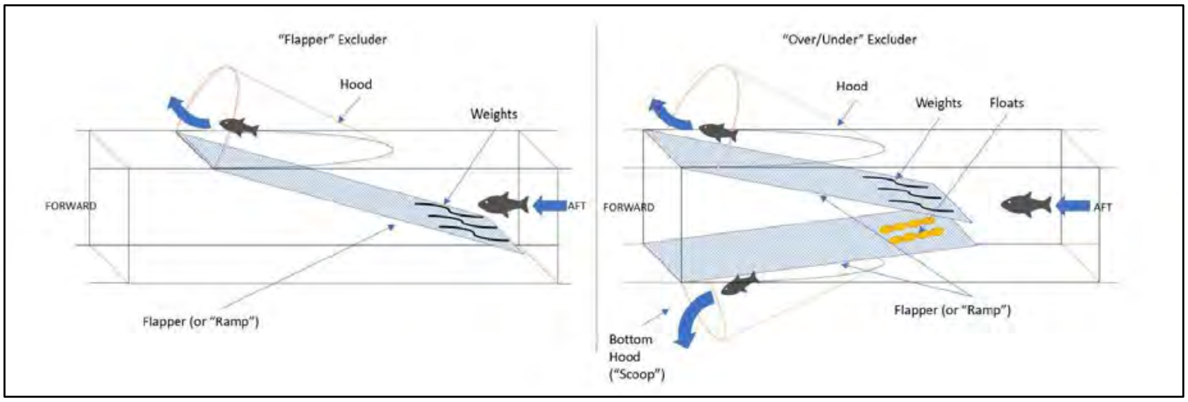

Figure A3-3 Conceptual diagrams of flapper (left) and over/under (right) excluder designs used by vessels in the Bering Sea pollock fishery
Source: EFP 2018-03 Final Report.

Alternative 5

The figures below show the spatial distribution of the Bering Sea pollock catch (mt) and chum salmon bycatch rates from 2019 –2023 broken out by June and July, August, and September through November 1. These figures are based upon fleet-wide data.

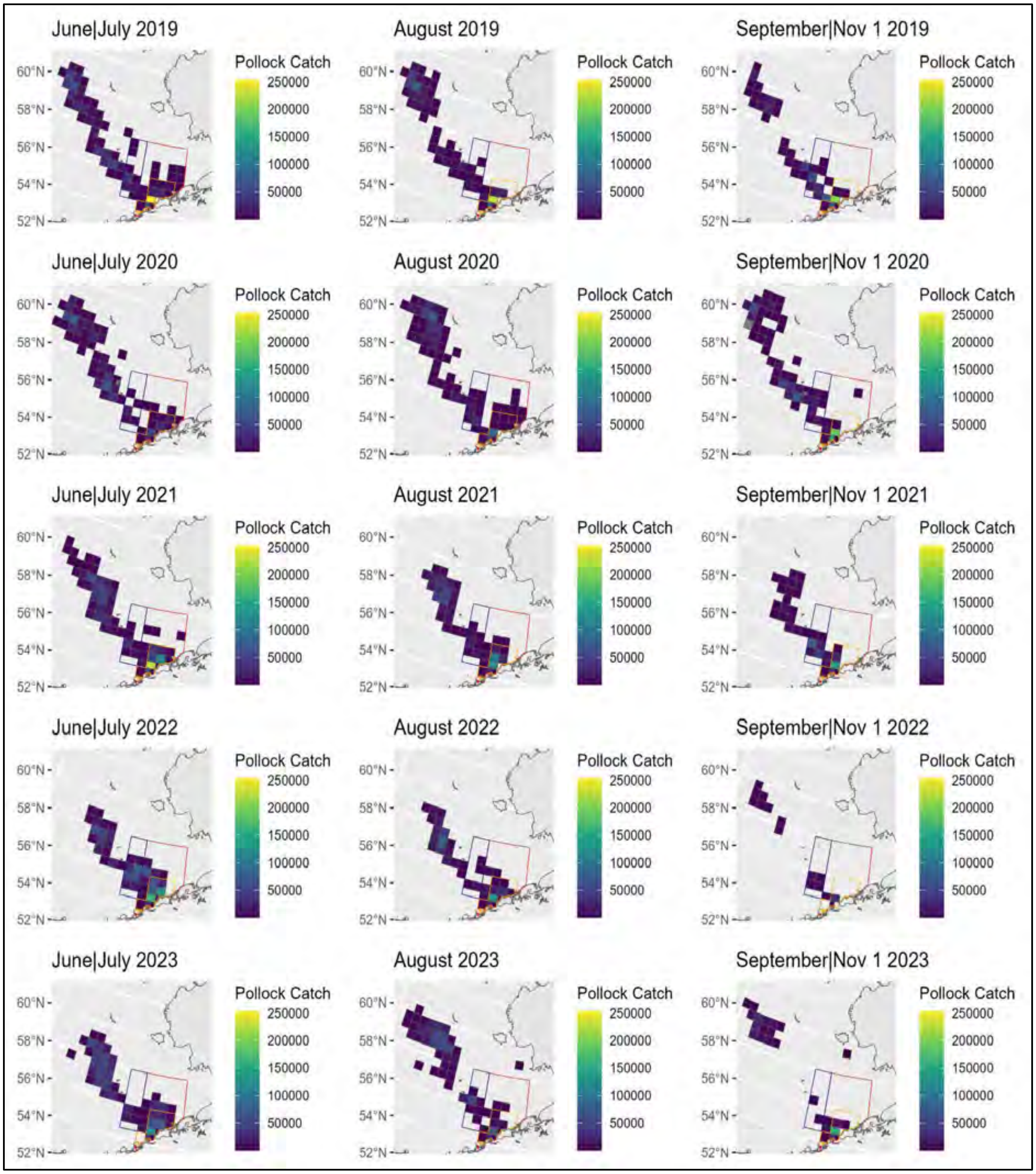

Figure A3-4 Distribution of pollock catch for all sectors broken out by monthly period, 2019–2023
Source: NMFS Alasa Region catch accounting system.
Notes: Cluster 1 is shown in red, Unimak in Orange, and Cluster 2 in blue.

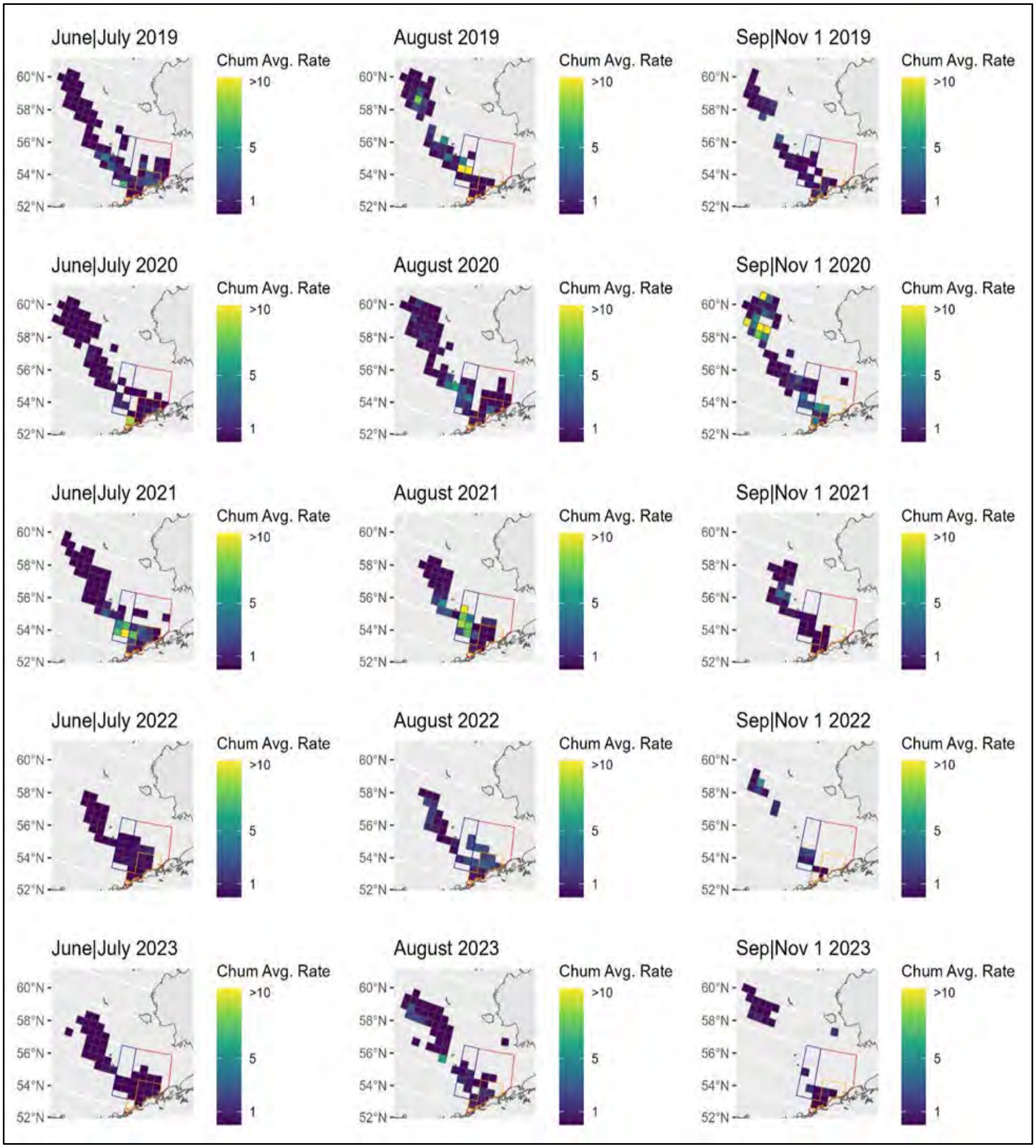

Figure A3-5 Distribution of chum salmon PSC rates for all sectors by monthly period, 2019–2023
Source: NMFS catch accounting system.

The subsequent tables provide the date each sector would have reached its apportionment of the corridor-specific PSC limit (2011–2023).

Table A3-5 Estimated date each sector would have reached the Cluster 1 corridor PSC limit of 50,000 to 200,000 chum salmon, 2011–2023

Sector	CDQ				CP				Mothership				Inshore			
Year	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA
2011					13-Aug	27-Aug			2-Jul	25-Jun	2-Jul	25-Jun	9-Jul	16-Jul	9-Jul	25-Jun
2012																
2013					13-Jul	10-Aug							3-Aug	3-Aug	27-Jul	13-Jul
2014													9-Aug	9-Aug	9-Aug	26-Jul
2015													15-Aug	15-Aug	15-Aug	8-Aug
2016	23-Jul	23-Jul	23-Jul	16-Jul	25-Jun	25-Jun	2-Jul	20-Aug	30-Jul	23-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	23-Jul
2017	15-Jul	15-Jul	15-Jul	15-Jul	24-Jun	15-Jul			15-Jul	15-Jul	15-Jul	15-Jul	15-Jul	15-Jul	8-Jul	8-Jul
2018	30-Jun	30-Jun	30-Jun	30-Jun	30-Jun	30-Jun			30-Jun	30-Jun	30-Jun	30-Jun	30-Jun	30-Jun	30-Jun	30-Jun
2019													29-Jun	29-Jun	29-Jun	22-Jun
2020																
2021	17-Jul	10-Jul	17-Jul	10-Jul					17-Jul	10-Jul	17-Jul	10-Jul	10-Jul	10-Jul	10-Jul	3-Jul
2022					16-Jul	16-Jul			6-Aug	6-Aug	6-Aug	6-Aug	30-Jul	30-Jul	23-Jul	23-Jul
2023													19-Aug	19-Aug	19-Aug	12-Aug
Year	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA
2011					27-Aug	27-Aug				20-Aug		27-Aug	27-Aug		20-Aug	23-Jul
2012																
2013					10-Aug	10-Aug										10-Aug
2014																16-Aug
2015													22-Aug	22-Aug	15-Aug	15-Aug
2016	13-Aug	30-Jul	6-Aug	30-Jul	25-Jun	25-Jun	16-Jul		6-Aug	30-Jul	30-Jul	30-Jul	13-Aug	13-Aug	6-Aug	30-Jul
2017	15-Jul	15-Jul	15-Jul	15-Jul	15-Jul				22-Jul	15-Jul	22-Jul	15-Jul	22-Jul	22-Jul	22-Jul	15-Jul
2018					30-Jun	30-Jun										30-Jun
2019													10-Aug	17-Aug	27-Jul	29-Jun
2020																
2021	17-Jul	17-Jul	17-Jul	17-Jul					24-Jul	17-Jul	24-Jul	17-Jul	24-Jul	24-Jul	17-Jul	10-Jul
2022					16-Jul	16-Jul			6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	30-Jul
2023																19-Aug
Year	150K3	150K5	150KP	150KA	150K3	150K5	150KP	150KA	150K3	150K5	150KP	150KA	150K3	150K5	150KP	150KA
2011					27-Aug	27-Aug										20-Aug
2012																
2013					10-Aug											
2014																
2015													5-Sep		29-Aug	15-Aug
2016					25-Jun	25-Jun	16-Jul		6-Aug	6-Aug	6-Aug	6-Aug				6-Aug
2017	22-Jul	22-Jul	22-Jul	22-Jul	15-Jul					22-Jul		22-Jul			5-Aug	22-Jul
2018					30-Jun	30-Jun										1-Sep
2019																27-Jul
2020																
2021	17-Jul	17-Jul	17-Jul	17-Jul					21-Aug	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	17-Jul
2022					16-Jul	16-Jul			13-Aug	13-Aug	13-Aug	13-Aug	20-Aug	20-Aug	13-Aug	6-Aug
2023																
Year	200K3	200K5	200KP	200KA	200K3	200K5	200KP	200KA	200K3	200K5	200KP	200KA	200K3	200K5	200KP	200KA
2011					27-Aug	27-Aug										
2012																
2013					10-Aug											
2014																
2015																22-Aug
2016					25-Jun	2-Jul	20-Aug		13-Aug	13-Aug	13-Aug	13-Aug				27-Aug
2017	22-Jul	22-Jul	22-Jul	22-Jul												29-Jul
2018					30-Jun	30-Jun										
2019																
2020																
2021	17-Jul	17-Jul	17-Jul	17-Jul											31-Jul	24-Jul
2022					16-Jul				13-Aug	13-Aug	13-Aug	13-Aug				13-Aug
2023																

Table A3-6 Estimated date each sector would have reached the Unimak corridor PSC limit of 50,000 to 200,000 chum salmon, 2011–2023

Sector	CDQ				CP				Mothership				Inshore			
YEAR	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA
2011									25-Jun	25-Jun	25-Jun	25-Jun	16-Jul	16-Jul	9-Jul	25-Jun
2012																
2013													3-Aug	10-Aug	3-Aug	13-Jul
2014																9-Aug
2015													15-Aug	15-Aug	15-Aug	8-Aug
2016	30-Jul	30-Jul	30-Jul	23-Jul					30-Jul	30-Jul	30-Jul	6-Aug	13-Aug	13-Aug	6-Aug	30-Jul
2017									15-Jul	15-Jul	15-Jul	22-Jul	15-Jul	15-Jul	8-Jul	8-Jul
2018									7-Jul	30-Jun	7-Jul	4-Aug	14-Jul	21-Jul	30-Jun	30-Jun
2019													29-Jun	29-Jun	29-Jun	22-Jun
2020																
2021	17-Jul	17-Jul	17-Jul	17-Jul					10-Jul	10-Jul	10-Jul	10-Jul	10-Jul	10-Jul	10-Jul	3-Jul
2022									6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	6-Aug	23-Jul
2023										19-Aug			19-Aug	19-Aug	19-Aug	19-Aug
YEAR	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA
2011									20-Aug	2-Jul	20-Aug					6-Aug
2012																
2013																10-Aug
2014																
2015													22-Aug	22-Aug	15-Aug	15-Aug
2016									20-Aug	13-Aug	27-Aug	3-Sep				27-Aug
2017													19-Aug		5-Aug	15-Jul
2018																11-Aug
2019													10-Aug	24-Aug	27-Jul	29-Jun
2020																
2021	17-Jul	17-Jul	17-Jul	17-Jul					17-Jul	17-Jul	17-Jul	24-Jul	24-Jul	24-Jul	17-Jul	10-Jul
2022									6-Aug	6-Aug	6-Aug	6-Aug	13-Aug	13-Aug	13-Aug	6-Aug
2023																
YEAR	150K3	150K5	150KP	150KA	150K3	150K5	150KP	150KA	150K3	150K5	150KP	150KA	150K3	150K5	150KP	150KA
2011																
2012																
2013																
2014																
2015															29-Aug	15-Aug
2016									6-Aug	6-Aug						
2017										22-Jul						5-Aug
2018																
2019																27-Jul
2020																
2021	17-Jul	17-Jul	17-Jul	17-Jul					21-Aug	31-Jul			31-Jul	14-Aug	31-Jul	17-Jul
2022									13-Aug	13-Aug	13-Aug					13-Aug
2023																
YEAR	200K3	200K5	200KP	200KA	200K3	200K5	200KP	200KA	200K3	200K5	200KP	200KA	200K3	200K5	200KP	200KA
2011																
2012																
2013																
2014																
2015																22-Aug
2016																
2017																
2018																
2019																
2020																
2021	17-Jul	17-Jul	17-Jul	17-Jul												24-Jul
2022																20-Aug
2023																

Table A3-7 Estimated date each sector would have reached the Cluster 2 PSC limit of 50,000 to 100,000 chum salmon, 2011–2023

Sector	CDQ				CP				Mothership				Inshore			
Year	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA	50K3	50K5	50KP	50KA
2011																
2012																
2013																
2014													9-Aug	9-Aug	9-Aug	2-Aug
2015																
2016	23-Jul	13-Aug	8-Jul	8-Jul	13-Aug	20-Aug	13-Aug	27-Aug								
2017	1-Jul	8-Jul	30-Jun	21-Jul	15-Jul	15-Jul	15-Jul	15-Jul						5-Aug	5-Aug	22-Jul
2018	30-Jun	30-Jun			7-Jul	14-Jul	14-Jul	21-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	28-Jul	21-Jul
2019					31-Aug	31-Aug	31-Aug	31-Aug								
2020														29-Aug	22-Aug	22-Aug
2021					31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul
2022	9-Jul	9-Jul			27-Aug	27-Aug	27-Aug									
2023																
Year	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA	100K3	100K5	100KP	100KA
2011																
2012																
2013																
2014																30-Aug
2015																
2016	13-Aug				27-Aug	27-Aug	27-Aug	27-Aug								
2017	8-Jul	8-Jul	8-Jul	8-Jul	22-Jul	22-Jul	22-Jul	22-Jul								
2018	30-Jun	30-Jun	7-Jul		21-Jul	28-Jul	21-Jul									
2019					31-Aug											4-Aug
2020																
2021					31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul	31-Jul
2022	9-Jul															
2023																

Table A3-8 Estimated pollock harvest (mt) displaced from Cluster 1 based on corridor specific PSC limits of 50,000 or 200,000 chum salmon for all sectors and apportionment methods, 2011–2023

Cluster 1								
Limit	**50,000**				**200,000**			
Sector	**CDQ**	**CP**	**M**	**CV**	**CDQ**	**CP**	**M**	**CV**
Sector Apportionment 1, 3-yr avg								
2011		1,353	6,105	56,699		351		
2012								
2013		856		34,104				
2014				26,931				
2015				46,568				
2016	13,971	57,420	25,906	103,697	11,123	57,420		
2017	14,294	4,490	23,459	155,006			14,964	
2018		80	5,049	156,947		80		
2019				202,785				
2020								
2021			31,271	149,319				
2022		4,491	4,288	67,109		4,491	805	
2023				12,236				
Sector Apportionment 2, 5-yr avg								
2011		351	8,503	50,933		351		
2012								
2013				34,104				
2014				26,931				
2015				46,568				
2016	13,971	57,420	31,269	103,697		35,686		
2017	14,294		23,459	155,006	11,123		14,964	
2018		80	5,049	156,947		80		
2019				202,785				
2020								
2021	10,322		35,791	149,319				
2022		4,491	4,288	67,109			805	
2023				12,236				
Sector Apportionment 3, pro rata								
2011			6,105	56,699				
2012								
2013				55,052				
2014				26,931				
2015				46,568				
2016	13,971	35,686	25,906	103,697				
2017	14,294		23,459	180,992	11,123	178	14,964	
2018			5,049	156,947				
2019				202,785				
2020								
2021			31,271	149,319				
2022			4,288	88,803			805	88,730
2023				12,236				
Sector Apportionment 4, AFA								
2011			8,503	77,725				
2012								
2013				67,069				
2014				45,564				
2015				64,532				25,379
2016	35,755	178	25,906	129,529				10,864
2017	14,294		23,459	180,992	11,123		14,964	107,342
2018			5,049	156,947				
2019				217,504				
2020								
2021	10,322		35,791	173,975				103,845
2022			4,288	88,803			805	27,017
2023				16,796				

Table A3-9 Estimated pollock harvest (mt) displaced from the Unimak Corridor based on corridor specific PSC limits of 50,000 or 200,000 chum salmon for all sectors and apportionment methods, 2011 – 2023

Unimak								
Limit	**50,000**				**200,000**			
Sector	**CDQ**	**CP**	**M**	**CV**	**CDQ**	**CP**	**M**	**CV**
Sector Apportionment 1, 3-yr avg								
2011			6,588	39,924				
2012								
2013				24,909				
2014								
2015				44,322				
2016	4,817		21,543	53,431				
2017			20,756	140,489				
2018			4,912	124,032				
2019				198,221				
2020								
2021			33,263	139,022				
2022			1,749	40,881				
2023				12,046				
Sector Apportionment 2, 5-yr avg								
2011			6,588	39,924				
2012								
2013				10,196				
2014								
2015				44,322				
2016	4,817		21,543	53,431				
2017			20,756	140,489				
2018			5,049	110,978				
2019				198,221				
2020								
2021			33,263	139,022				
2022			1,749	40,881				
2023				12,046				
Sector Apportionment 3, pro rata								
2011			6,588	45,628				
2012								
2013				24,909				
2014								
2015				44,322				
2016	4,817		21,543	71,198				
2017			20,756	161,276				
2018			4,912	149,734				
2019				198,221				
2020								
2021			33,263	139,022				
2022			1,749	40,881				
2023				12,046				
Sector Apportionment 4, AFA								
2011			6,588	66,033				
2012								
2013				51,471				
2014				22,402				
2015				62,280				23,218
2016	4,817		19,825	90,084				
2017			15,922	161,276				
2018			3,819	149,734				
2019				212,677				
2020								
2021			33,263	162,727				96,537
2022			1,749	76,431				15,690
2023				12,046				

Table A3-10 Estimated pollock harvest (mt) displaced from Cluster 2 based on corridor specific PSC limits of 50,000 or 100,000 chum salmon for all sectors and apportionment methods, 2011 –2023

Cluster 2								
Limit	**50,000**				**100,000**			
Sector	**CDQ**	**CP**	**M**	**CV**	**CDQ**	**CP**	**M**	**CV**
Sector Apportionment 1, 3-yr avg								
2011								
2012								
2013								
2014								
2015				5,155				
2016	1,075	47,923			51	16,937		
2017	27,405	77,471			18,984	64,431		
2018	5,650	23,104	173	9,801	5,650	7,173		
2019								
2020								
2021		3,139	973	9,459		3,139	973	9,459
2022	5,236	3,366			5,236			
2023								
Sector Apportionment 2, 5-yr avg								
2011						351		
2012								
2013								
2014								
2015				5,155				
2016	51	40,194				16,937		
2017	18,984	77,471			18,984	64,431		
2018	5,650	11,438	173	9,801	5,650	5,291		
2019								
2020								
2021		3,139	973	9,459		3,139	973	9,459
2022	5,236	3,366						
2023								
Sector Apportionment 3, pro rata								
2011								
2012								
2013								
2014				5,155				
2015				142				
2016	18,984	47,923			18,984	16,937		
2017	5,650	77,471			3,460	64,431		
2018		11,438	173	9,801		7,173		
2019								
2020								
2021		3,139	973	1,545		3,139	973	9,459
2022		3,366		9,459				
2023								
Sector Apportionment 4, AFA								
2011								
2012								
2013								
2014				9,586				1,002
2015								
2016	18,984	16,937			18,984	16,937		
2017	395	77,471		3,656		64,431		
2018		7,173	173	18,029		7,173		3,270
2019								
2020				1,545				
2021		3,139	973	9,459		3,139	973	9,459
2022								
2023								

Herring Bycatch

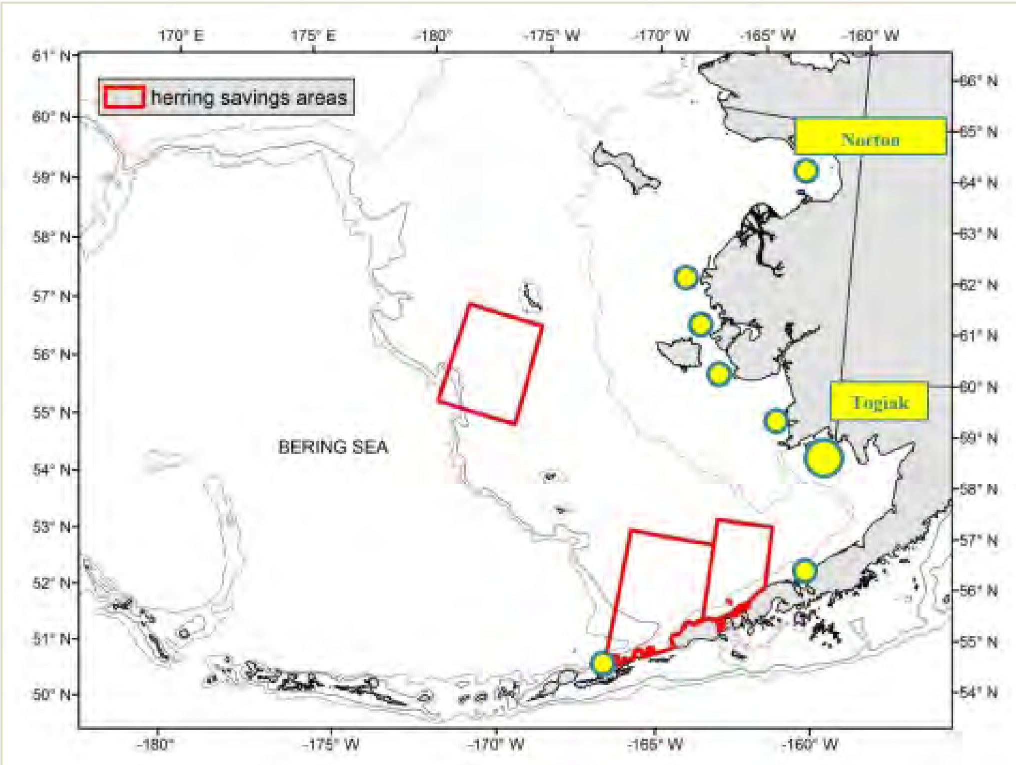

Figure A3-6 Locations of major herring fisheries in the BSAI area (yellow) with Herring Savings Area (red)
Source: Ormseth and Yasumiishi 2021
Notes: The two largest herring fisheries are labeled by name; the larger dot at Togiak indicates this is by far the largest fishery.

Table A3-11 Pacific herring mature biomass projections (mt) for spawning aggregations in the eastern Bering Sea provided to the North Pacific Fishery Management Council for the purpose of establishing the 2016 – 2024 PSC limits per Amendment 16a to the BSAI Groundfish FMP

Spawning area	2017	2018	2019	2020	2021	2022	2023	2024	2025
Norton	31,007	31,007	31,007	31,007	31,007	31,007	31,007	31,007	31,007
Cape	4,678	4,678	3,300	3,300	3,300	3,300	3,300	3,300	3,300
Nunivak Island	3,540	3,540	4,464	4,464	4,464	4,464	4,464	4,464	4,464
Nelson	4,785	4,785	4,916	4,916	4,916	4,916	4,916	4,917	4,917
Cape Avinof	3,126	3,126	1,890	1,890	1,890	1,890	1,890	1,890	1,890
Goodnews	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724
Security	4,781	4,781	4,762	4,762	4,762	4,762	4,762	4,762	4,762
Togia k	142,453	124,062	197,355	195,793	214,768	324,350	286,853	195,984	207,569
Port Moller/ Port Heiden	2,184	2,268	2,291	2,350	2,449	2,463	2,463	2,463	2,463
Total	**201,278**	**182,971**	**254,709**	**253,207**	**272,281**	**381,876**	**344,379**	**253,511**	**265,096**

Source: ADF&G
Notes: ADF&G estimates of Pacific herring mature biomass from 2017 to 2025 which are used to set the herring PSC limit.

Table A3-12 2024 herring fishery apportionments and bycatch by fishery

Trawl Gear						
Seasons	**Account**	**Units**	**Total Catch**	**Limit**	**Remaining**	**% Taken**
	Pacific Cod	MT	0	13	13	1%
	Pollock Pelagic	MT	1,276	2,256	980	57%
	Pollock, Atka Mackerel, Other Species	MT	4	30	26	14%
	Rock Sole, Flathead Sole, Other Flatfish	MT	60	74	14	81
	Rockfish	MT	1	8	7	18%
	Turbot, Arrowtooth, Kamchatka, Sablefish	MT	1	8	7	18%
	Yellowfin Sole	MT	20	146	126	14%
Total:			**1,363**	**2,535**	**1,172**	**54%**

Source: NMFS.

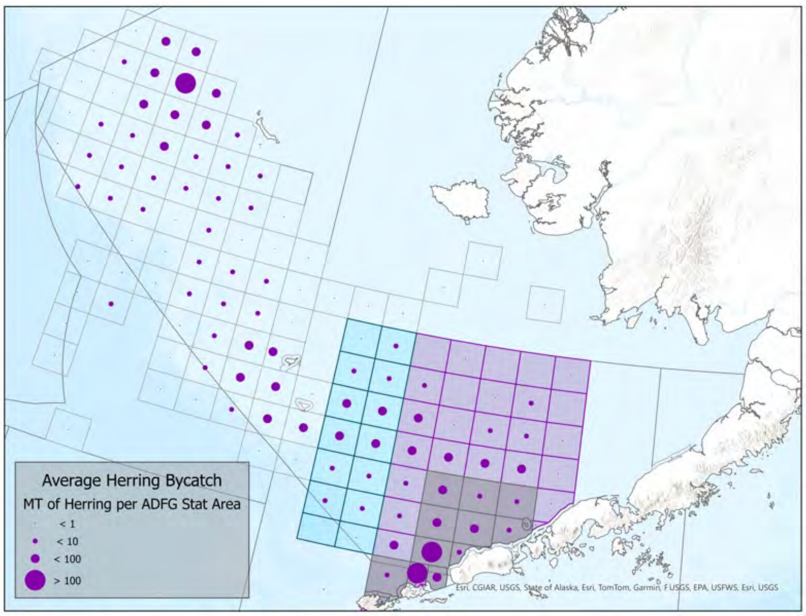

Figure A3-7 Average amount (mt) of herring PSC per ADF&G stat area where pollock fishing occurred, 2011 – 2023

Alternative 2

Table A3-13 Estimates on fleet-wide herring PSC reductions (mt) for all analyzed chum salmon PSC limits and apportionments under Alternative 2, 2011–2023

Cap	100,000				325,000				550,000			
Split	3-year avg.	5-year avg.	Pro rata	AFA	3-year avg.	5-year avg.	Pro rata	AFA	3-year avg.	5-year avg.	Pro rata	AFA
2011	216	217	217	156								
2012												
2013	165	169	169	170								
2014	31	31	31	26								
2015	60	60	60	59				13				
2016	56	47	47	105	11	4	4	0	0			
2017	418	417	418	418	19	19	19	19	19	19	19	2
2018	343	343	343	351	1	1	1					
2019	301	301	301	410	12	12	12	99				
2020	274	274	274	267	34	0	0	24				
2021	407	399	407	467	320	317	317	317	11	227	237	279
2022	293	293	293	481	0	0	0	0				
2023	116	177	177	199								

Marine Mammals

Whereas Chapter 3 of the preliminary DEIS contains a high-level overview of the marine mammal populations known to occur in the BSAI, this appendix contains detailed information on stock structure, critical habitat designations, population dynamics (including the years of observation used for estimates in M/SI causes), and major historical ecological events.

ESA-listed Marine Mammals

There are four marine mammals populations and subspecies listed as threatened or endangered under the Endangered Species Act (ESA) within the Action Area: 1) Steller sea lions (Western DPS); 2) bearded seal (Beringia DPS); 3) ringed seal (Arctic stock); and 4) humpback whale (multiple stocks).

Stellar Sea Lions (Western Designated Population Segment)

On November 26, 1990, NMFS issued the final rule to list the Steller sea lion (*Eumetopias jubatus*) as a threatened species under the ESA (55 FR 49204, November 26 1990). In 1997, NMFS reclassified Steller sea lions as two DPSs based on genetic studies and other information; the eastern DPS (EDPS) remained listed as threatened, and the western DPS (WDPS) was reclassified as endangered (62 FR 24345, May 5, 1997). On November 4, 2013, the eastern DPS was removed from the endangered species list (78 FR 66140, November 4, 2013). The WDPS remains endangered and is the population potentially affected by the proposed alternatives.

The WDPS of Steller sea lions includes animals born west of Cape Suckling, Alaska (144° W; 62 FR 24345). However, individuals move between rookeries and haul out sites regularly, even over long distances between eastern and western DPS locations (Jemison et al. 2013, Jemison et al. 2018, Hastings et al. 2019). Most adult Steller sea lions occupy rookeries during the summer pupping and breeding season and exhibit a high level of site fidelity (Raum-Suryan et al. 2002, Hastings et al. 2017). During the breeding season, some juveniles and non-breeding adults occur at or near the rookeries, but most are on haulouts (resting sites that provide regular retreat from the water on exposed rocky shoreline, gravel beaches, and wave-cut platforms or ice (Rice 1998, Ban 2005, Call and Loughlin 2005). Steller sea lions disperse widely after the breeding season (late May to July), likely to access seasonally important prey resources. During fall and winter many Steller sea lions disperse from rookeries and increase use of haulouts, particularly on terrestrial sites but also on sea ice in the Bering Sea (Calkins 1998, Sinclair et al. 2019).

Data from 1978–2022 indicate that WDPS Steller sea lions were at their lowest levels in 2002. Between 2007 to 2022, WDPS non-pup and pup counts increased 1.05% and 0.50% per year, respectively (Sweeney et al. 2023). However, there was high variability among regions. Steller sea lions in the western Aleutian Islands region continued to decline, along with pups in the adjacent central Aleutian Islands region. East of Samalga Pass, Aleutian Islands, pup production slowed or plateaued in the early 2010s, with subsequent non-pup plateauing or declines starting in the late 2010s in all regions (Sweeney et al. 2023). The 2014-2016 North Pacific marine heatwave, one of the most severe heat waves ever recorded, resulted in reduced survival of adult female Steller sea lions in the Gulf of Alaska and reduced survival of adult female and adult male Steller sea lions in Southeast Alaska (Hastings et al. 2022). It appears that adult females may have recovered from the effects of the heatwave, based on recent data (Hastings et al. 2023).

A draft of the 2023 Alaska Region Marine Mammal SAR lists the current minimum population estimate of the U.S. WDPS stock of Steller sea lions as 49,837 individuals; 11,987 pups and 37,333 non-pups , respectively[1].

Steller sea lions are predatory and consume a wide range of prey, foraging and feeding primarily at night on over a hundred species of fish and cephalopods. Their diet varies in different parts of their range and at different times of the year, depending on the abundance and distribution of prey species (Gende and Sigler 2006, Womble and Sigler 2006, Womble et al. 2009). Steller sea lions prey on Pacific herring during winter, forage fish spawning aggregations during spring, and migrating salmon species during summer and fall (Womble et al. 2009, Lander et al. 2020).

Steller sea lions are susceptible to a variety of threats including direct interactions with fishery operations and competition with fisheries for preferred prey items. Steller sea lions were the most commonly reported marine mammal with human-caused mortalities and serious injuries (M/SI) with 476 interactions, resulting in 429 M/SI events (2017 - 2021; Freed et al. 2023). The minimum estimated mean annual level (2017 – 2021) of M/SI for the U.S. portion of the WDPS is 267 sea lions, 39 of which occurred in U.S. commercial fisheries (89 FR 5495, Draft 2023 Alaska Region Marine Mammal SAR). All U.S. commercial fishery-related reports of M/SI of this stock came from U.S. commercial fishery observer or electronic monitoring data.

Interactions with Bering Sea Pollock Trawl Fisheries

From 2017 to 2021, 33 Steller sea lion mortalities were directly attributed to the BSAI pollock trawl fisheries (Freed et al. 2023). The BSAI pollock trawl fisheries may also indirectly affect Steller sea lions through competition for salmon and pollock prey.

Bearded Seal (Beringia DPS) (Ice Seal)

Bearded seals (*Erignathus barbatus spp.*) inhabit the seasonally ice-covered seas of the Northern Hemisphere, where they whelp and rear their pups and molt their coats on the ice in the spring and early summer. Bearded seals are boreoarctic species with circumpolar distribution (Fedoseev 1965; Johnson et al. 1966; Burns 1967, 1981; Burns and Frost 1979; Smith 1981; Kelly 1988). Two bearded seal subspecies are widely recognized: *E.b. barbatus* and *E.b. nauticus*, often described as inhabiting the Atlantic sector and the Pacific sector, respectively. Under the ESA, NMFS concluded that the *E. b.*

[1] A draft of the 2023 Marine Mammal SAR for the Alaska region. Red lines in the document reflect changes from the 2022 assessment. The period for public comments ended April 29, 2024 (89 FR 5495). Retrieved October 10, 2024 from: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports

nauticus subspecies consists of two DPSs, the Okhotsk DPS and the Beringia DPS, both of which were listed as threatened on December 28, 2012 (77 FR 76740). The primary threat to these populations is loss of sea-ice cover projected under climate change progression through the 21st century (Cameron et al. 2010). Only the Beringia DPS (which corresponds to the Beringia stock) occurs in US waters. While Section 4(b)(6)(C) of the ESA requires the Secretary to designate critical habitat concurrently with listing, such habitat has not yet been determined.

Bearded seals are strongly associated with sea ice. Male vocalizations have been detected year-round in areas with greater sea ice presence (>50%) (MacIntyre et al. 2013, 2015; Jimbo et al. 2019). In summer, adult bearded seals have been rarely observed hauled out on land and many follow the ice northward. Juveniles will sometimes remain near the coasts of the Bering and Chukchi seas rather than follow the retreating ice (Burns 1967, 1981; Heptner et al. 1976; Nelson 1981; Cameron et al. 2018).

Bearded seals primarily forage for demersal animals (i.e., those living on the seafloor) in water less than 650 feet deep. Bearded seals eat a variety of invertebrates (e.g., crab, shrimp, clams, snails) and some fish (e.g., sculpin, flatfish, cod).[2]

A reliable estimate of the entire Bering DPS population is not available. The portion of the population in US waters was estimated to be around 301,836 in 2012 (Conn et al. 2014). The minimum population estimate is 273,676 seals. No population trend information is available. The minimum estimated mean annual level of human-caused M/SI for the portion of the Beringia bearded seal stock in U.S. waters between 2014 and 2018 is 6,709 seals, with just 1.8 seal mortalities or serious injuries per year attributed to U.S. commercial fisheries.

Since 2011, NMFS has declared two unusual mortality events (UMEs) for ice seals in the Bering and Chukchi Seas in Alaska. The first UME in 2011 involved all four species of ice seals (bearded seals, as well as ringed, spotted and ribbon seals) and was characterized by abnormal molting with no definitive cause.[3] The second event was declared in 2019 after elevated numbers of stranded bearded seals, ringed, and spotted seals were found beginning in June 2018. This UME is attributed to ecosystem-driven changes in prey availability; seals manifested symptoms of starvation consistent with this conclusion.

Interactions with Bering Sea Pollock Trawl Fisheries

From 2017 to 2021, three mortalities or serious injuries were directly attributed to the BSAI pollock trawl fishery (Freed et al. 2023).

Ringed Seal (Arctic stock) (Ice Seal)

Ringed seals (*Pusa hispada*) exhibit a circumpolar distribution and are found in all seasonally ice-covered seas of the Northern hemisphere, as well as certain freshwater lakes (King 1983). Five subspecies of ringed seals are currently recognized, all of which are listed under the ESA: 1) Arctic Ocean 2) Sea of Okhotsk and northern Sea of Japan, 3) northern Baltic Sea, 4) Lake Lagoda, Russia, and 5) Lake Saimaa, Finland.

The Arctic subspecies of ringed seal, which is the only ringed seal subspecies found in U.S. waters, was listed as threatened under the ESA on December 28, 2012 (77 FR 76706), and corresponds to the Arctic stock. Critical habitat has not yet been designated under the ESA. Although no accurate population estimate exists for Arctic ringed seals, it is estimated that there are more than 2 million Arctic ringed seals worldwide. The most recent stock assessment suggests a minimum population abundance of 158,507 Arctic ringed seals in US waters. No reliable data for trends in abundance are available.

[2] *Bearded Seal (Erignathus barbatus)* (n.d.) Alaska Department of Fish and Game. Retrieved January 2, 2024, from https://www.adfg.alaska.gov/index.cfm?adfg=beardedseal.printerfriendly

[3] June 2016 Update: 2011 Arctic Pinniped Unusual Mortality Event (UME). NOAA Fisheries. Retrieved October 10, 2024 from: https://media.fisheries.noaa.gov/dam-migration/ume-factsheet062016-akr.pdf

Ringed seals are strongly associated with sea ice. During winter and early spring, when sea ice is at its maximal extent in Alaskan waters, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort Seas. In years with extensive ice coverage, ringed seals can be found as far south as Bristol Bay but are generally not abundant south of Norton Sound except in nearshore areas (Frost 1985). However, surveys conducted in the Bering Sea in the spring of 2012 and 2013 documented numerous ringed seals in both nearshore and offshore habitat extending south of Norton Sound (87 FR 19234, *April 1, 2022*). Most ringed seals that winter in the Bering, Chukchi, and Beaufort seas are thought to migrate north in spring as seasonal ice melts and retreats (Burns 1970, Kelly et al. 2010) and spend summers in the northern Chukchi and Beaufort seas where pack ice and some nearshore ice remnants persist (Frost 1985, Kelly et al. 2010). During summer, Arctic ringed seals range hundreds to thousands of kilometers to forage along ice edges or in highly productive open-water areas (Harwood and Stirling 1992, Freitas et al. 2008, Kelly et al. 2010b, Harwood et al. 2015, Quakenbush et al. 2019, Von Duyke et al. 2020).

Ringed seals dive to depths of 150 feet or more while foraging for a wide variety of mostly small prey. While ringed seals are known to predate a wide range of species, typically no more than two to four species are considered important in any geographic location. Fishes of the cod family (including pollock) tend to dominate Arctic ringed seals' diet from late fall through spring, and crustaceans tend to become more important as sea ice recedes into summer.

Ringed seals are dependent on ice availability and as such, are considered "ice seals." Since 2011, NMFS has declared two UMEs for ice seals in the Bering and Chukchi Seas in Alaska. The first UME (2011-2016) involved all four species of ice seals (bearded seals, ringed, spotted, and ribbon seals) and was characterized by abnormal molting with no definitive cause.[4] The second event was declared in 2019 after elevated numbers of stranded bearded, ringed, and spotted seals were found beginning in June 2018. This most recent UME is attributed to ecosystem-driven changes in prey availability; seals manifested symptoms of starvation consistent with this conclusion. Additional information on ringed seal biology, status, and threats, and UMEs is available at:

Interactions with Bering Sea Pollock Trawl Fisheries

Ringed seal M/SI events are rarely directly caused by BSAI pollock trawl fisheries. Between 2017 and 2021, one ringed seal mortality was attributed to the BSAI pollock trawl fishery (Freed et al. 2023). Ringed seals prey on young pollock and salmon and may therefore interact indirectly with the fishery through competition for prey.

Humpback whale (multiple stocks)

Humpback whales (*Megaptera novaeangliae*) occur worldwide and migrate seasonally from high latitude, subarctic and temperate summering areas to low latitude, subtropical, and tropical overwintering areas. Despite their vast migrations, humpback whales exhibit strong maternal site fidelity and therefore maintain genetically distinct population structure. NMFS recognizes 14 DPSs globally, with three of them occurring in the Bering Sea (81 FR 62260, *September 8, 2016*). The three DPSs found in the Bering Sea are 1) Western North Pacific DPS, 2) Hawaii DPS, and 3) Mexico DPS. Western North Pacific and Mexico DPSs as "endangered" and "threatened" under the ESA, respectively. Whales from these three DPSs overlap on feeding grounds off Alaska, and are visually indistinguishable unless individuals have been photo-identified on breeding grounds and again on feeding grounds. All waters off the coast of Alaska may contain ESA-listed humpbacks.

Between 2004 and 2006, a basin-wide study took place to estimate humpback whale populations. The study, known as SPLASH (Structure, Population Levels, And Status of Humpbacks), delivered

[4]June 2016 Update: 2011 Arctic Pinniped Unusual Mortality Event (UME). NOAA Fisheries. Retrieved October 10, 2024 from: https://media.fisheries.noaa.gov/dam-migration/ume-factsheet062016-akr.pdf

abundance estimates of 1,340 for Russia, 7,758 for the Bering Sea and Aleutian Islands, 2,129 for the Gulf of Alaska, 5,890 for Southeast Alaska and northern British Columbia, and 347 for southern British Columbia (Wade et al. 2016, Wade 2021). These estimates are based solely on geography and do not distinguish between the stocks, which are well-known to overlap in these regions. This survey is now more than 15 years old and is a poor determinant of present population abundances. As such, the population trends of all three stocks are unknown.

With regards to fishing activities generally, humpback whales' primary threats are entanglement in fishing gear and vessel strikes.

Interactions with Bering Sea Pollock Fisheries

Humpback whales have been known to be directly affected by the BSAI pollock trawl fishery. From 2017 to 2021, four humpback whale mortalities were reported in the BSAI pollock trawl fishery (Freed et al. 2023). Of these 4 mortalities, 3 were from the Western North Pacific DPS and 1 was from the Eastern North Pacific Alaska Resident stock.

Non-ESA Listed Marine Mammals

There are eight marine mammal species with stocks present in the Action Area that are not currently listed as endangered or threatened under the ESA: Northern fur seal (Alaska stock); harbor seal (Pribilof Islands and Bristol Bay stocks); ribbon seal (Alaska stock); spotted seal (Bering DPS); killer whale (multiple stocks); Pacific white-sided dolphin (North Pacific); harbor porpoise (Bering Sea stock); and beluga whale (multiple stocks).

Northern fur seal (Alaska stock)

Northern fur seals (*Callorhinus ursinus*) occur from southern California north to the Bering Sea and west to the Sea of Okhotsk and Honshu Island, Japan. During the summer breeding season, most of the worldwide population is found on the Pribilof Islands (St. Paul Island and St. George Island) in the southern Bering Sea with the remaining rookeries in Russia, on Bogoslof Island in the southern Bering Sea, on San Miguel Island off southern California, and on the Farallon Islands off central California (Lander and Kajimura 1982, NMFS 2007). Northern fur seals spend the summer and fall foraging within about 230 km (lactating females, Robson et al., 2004) and 360 km (juvenile males, Sterling and Ream 2004) of their breeding islands on the Pribilof Islands. They migrate from the Pribilof Islands in the winter and spend the remainder of the year at sea until returning to the Pribilof Islands. Non-breeding northern fur seals may occasionally haul out on land at other sites in Alaska, British Columbia, and on islets along the west coast of the United States (Fiscus 1983). Two stocks of northern fur seal are recognized within U.S. waters, an Eastern Pacific stock and a California stock. The Eastern Pacific stock occupies the Bering Sea, overlapping with the pollock A and B seasons, while males from all stocks intermix in the Bering Sea and North Pacific during the winter and spring.

The most recent estimate of the Eastern Pacific stock is 626,618 northern fur seals, based on pup production estimates from major rookeries in the eastern Bering Sea. The minimum population estimate is 530,376 northern fur seals. Recent population trends are inferred by opportunistic pup production counts across rookeries (St. Paul, Sea Lion Rock, St. George, and Bogoslof Islands). Temporary increases in the overall stock size are observed when opportunistic estimates are conducted at Bogoslof, but declines at the larger Pribilof colony (specifically St. Paul) continue to drive the overall stock estimate down over time. Recent (20-year and 10-year) trends in pup production were fit using agTrend (Johnson and Fritz 2014). Estimated pup production for the Eastern Pacific stock has been declining at 1.80% (95% CI: -2.36 to -1.19) per year from 1999 to 2019 but only at 0.55% (not significantly different from 0) per year from 2009 to 2019. The minimum estimate of the mean annual U.S.-commercial fishery-related mortality and serious injury for this stock is 3.5 seals (Young et al. 2023).

Northern fur seals are generalist or opportunistic foragers, consuming a wide variety of fish and squid species. Along the Bering Sea shelf, pollock comprise most of the northern fur seal diet. Recent diet studies indicate that fur seals consume both juvenile and mature pollock (Gudmundson et al. 2006; Zeppelin and Ream 2006; Call and Ream 2012). During the summer and fall while in the Bering Sea, male and female northern fur seals are central place foragers that segregate their use of marine habitats based on the rookeries where they were born (Robson et al. 2004; Sterling and Ream 2004). Gender and age-structured bioenergetic models found that, at a population level, Alaska northern fur seals consumed 41.4% to 76.5% pollock by weight (McHuron et al. 2020). Furthermore, interannual variation in pollock prey size was driven largely by the availability of juvenile fish. In years with poor age-1 pollock recruitment, up to 81% of pollock biomass in fur seal diet came from mature pollock (age 1+) (McHuron et al. 2020). As they forage off of the shelf, northern fur seals consume greater amounts of oceanic fish and squid species. Other primary prey include Pacific sand lance, Pacific herring, Northern smoothtongue, Atka mackerel, and Pacific salmon. The northern fur seal diet differs depending on geographic area and time of year.

Northern fur seals, like all marine mammals, are protected under the Marine Mammal Protection Act, but have additional protections under the Fur Seal Act.

Interaction with Bering Sea Pollock Trawl Fisheries

While northern fur seals have been observed with significant injuries due to entanglement with unknown discarded fishing gear and marine debris, no M/SI reported between 2017 and 2021 were attributed to the BSAI pollock trawl fishery (Freed et al. 2023).

Because pollock, and to a lesser extent Pacific salmon, comprise a large portion of the northern fur seal dietthe pollock trawl fishery could indirectly affect the population through prey competition.

Harbor seal (Pribilof Islands and Bristol Bay stocks)

Harbor seals (*Phoca vitulina*) live in coastal and estuarine waters ranging from Baja California north along the coast of North America, into the Bering Sea and north to the Pribilof Islands. Harbor seals are generally non-migratory, moving locally with factors such as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981; Hastings et al. 2004). Satellite tagging studies in Southeast Alaska, Prince William Sound, Kodiak Island, and Cook Inlet also support the theory that harbor seals are non-migratory (Swain et al. 1996; Lowry et al. 2001; Small et al. 2003; Boveng et al. 2012), though a few studies have found some long distance movements in Alaska (Pitcher and McAllister 1981; Lowry et al. 2001; Small et al. 2003; Womble 2012; Womble and Gende 2013).

Depending on prey availability, harbor seals complete shallow and short dives to forage for fish, shellfish, and crustaceans. Common prey species in Alaska include walleye pollock, Pacific cod, capelin, Pacific herring, sandlance, Pacific salmon, sculpin, flatfish, octopus, and squid.

In 2002, a genomic analysis identified 12 demographically independent clusters of harbor seals within Alaska (Westlake and O'Corry-Crowe 2002). In 2010, NMFS and the Alaska Native Harbor Seal Commission formally identified 12 stocks of harbor seals in Alaska, up from the previously recorded three stocks (Bering Sea, Gulf of Alaska, and Southeast Alaska). Of relevance to this analysis, the stocks that occur in the BS are the Pribilof Islands and Bristol Bay stocks. In 2017, the Bristol Bay stock was estimated to contain 44,781 harbor seals. The current 8-year estimate of the Bristol Bay stock's population trend is +1,127 seals per year, with a low probability of stock decrease, 0.218. In 2018, a survey of Pribilof Islands harbor seals onshore indicated 229 individuals, with no correction factor for seals in the water. The Pribilof Islands population trend is also unknown.

The minimum estimated mean annual level of human-caused M/SI for all harbor seal stocks between 2013 and 2017 is 1,135 harbor seals: 32 in U.S. commercial fisheries, 0.4 in unknown (commercial, recreational, or subsistence) fisheries, 3.7 due to other causes (illegal shooting, entanglement in ADF&G

research trawl gear), and 1,099 in the Alaska Native subsistence harvest. Between 2004 and 2008, no harbor seals were harvested in the Pribilof Islands and 141 seals were harvested in Bristol Bay.

Interactions with Bering Sea Pollock Trawl Fisheries

Harbor seals also occur closer to shore, reducing the likelihood of directly interacting with the pollock trawl fishery. Between 2013 and 2017, observers recorded only 1 harbor seal mortality in the BSAI pollock trawl fishery. However, harbor seals often consume pollock and salmon, and may therefore indirectly interact with the BSAI pollock trawl fishery through prey competition.

Ribbon seal (Alaska stock) (Ice Seal)

Ribbon seals (*Histriophoca fasciata*) in Alaska range from the North Pacific ocean and Bering Sea into the Chukchi and western Beaufort Seas. Ribbon seals are ice seals and as such are very rarely seen on shorefast ice or land. From late March to early May, ribbon seals inhabit the Bering Sea ice front (Burns 1970, 1981; Braham et al. 1984). The seals tend to be most abundant in the northern part of the ice front in the central and western parts of the Bering Sea (Burns 1970; Burns et al. 1981). As ice recedes with seasonal warming, ribbon seals move further north, into the Bering Sea, where they haul out on the receding ice edge (Burns 1970, 1981; Burns et al. 1981). As the ice melts further, the seals become more concentrated, with some moving to the Bering Strait and part of the Chukchi Sea.

NMFS considers only the portion of the Arctic ribbon seal stock that inhabits US waters, hereafter referred to as the Alaska stock. The most recent minimum population estimate of Alaskan ribbon seals is 163,086 during the spring season, in United States waters. There are no reliable population trend estimates available.

Ribbon seals forage for a wide variety of crustaceans (shrimp, mysiids, crabs) and cephalopods (mostly squid) but predominantly consume fish. Prey fish species include walleye pollock, arctic and saffron cod, eelpout, capelin, Greenland halibut, pricklebacks, herring and sandlance.[5]

The minimum estimated mean annual level of human-caused M/SI for the portion of the ribbon seal stock in U.S. waters between 2014 and 2018 is 163 seals: 0.9 in U.S. commercial fisheries and 162 in the Alaska Native subsistence harvest.

Since 2011, NMFS has declared two UMEs for ice seals in the Bering and Chukchi Seas in Alaska. The first UME (2011-2016) involved all four species of ice seals (bearded, ringed, spotted, and ribbon seals) and was characterized by abnormal molting with no definitive cause.[6] The second event was declared in 2019 but did not include ribbon seals.

Interactions with Bering Sea Pollock Trawl Fisheries

The proposed alternatives are not likely to have an effect on direct impacts to ribbon seals, as only one ribbon seal mortality (2014 to 2018) has been attributed to the BSAI pollock trawl fishery. No mortalities or serious injuries to ribbon seals caused by the Bering Sea pollock trawl were reported from 2017 to 2021 (Freed et al. 2021).However, ribbon seals could be indirectly affected by BSAI pollock trawl fisheries through competition for pollock prey and herring.

Spotted seal (Bering DPS) (Ice Seal)

Spotted seals (*Phoca largha*) are grouped into three DPSs: 1) the Bering, 2) the Okhotsk, and 3) the Southern. Only the Bering DPS is found within U.S. waters, bounded by the U.S. EEZ. Spotted seals move seasonally according to life-history events. In the late-fall through spring, whelping, nursing,

[5] *Ribbon Seal* (2008). Alaska Department of Fish and Game. Retrieved January 2, 2024, from https://www.adfg.alaska.gov/static/education/wns/ribbon_seal.pdf
[6] June 2016 Update: 2011 Arctic Pinniped Unusual Mortality Event (UME). NOAA Fisheries. Retrieved October 10, 2024 from: https://media.fisheries.noaa.gov/dam-migration/ume-factsheet062016-akr.pdf

breeding, and molting occur on sea ice. When the seasonal ice melts in summer through fall, spotted seals use haul out on land (Bovenge et al. 2009; Citta et al. 2018). Satellite tagging studies found that seals tagged in the Chukchi Sea moved south in October, passing into the Bering Sea sometime in November. Seals overwintered in the Bering Sea, making east-west movements along the ice edge (Lowry et al. 1998). During spring, the seals seem to prefer smaller ice floes and mainly stick to the southern margin of the ice in areas with water depth less than 200 meters, moving to coastal habitats after molting and the retreat of sea ice (Fay 1974; Shaughnessy and Fay 1977; Lowry et al. 2000; Simpkins et al. 2003). Along the western Alaska coast, spotted seals are known to occur around the Pribilof Islands, Bristol Bay, and the eastern Aleutian Islands.

Spotted seals closely resemble harbor seals and the two species are often seen near each other in the southern part of the Bering Sea, though spotted seals are more strongly associated with sea ice.

Spotted seals forage for a variety of crustaceans, cephalopods, and fish with variability according to age, location, and time of year. In the northern Bering Sea, Arctic cod are a large component of spotted seal diet with pollock and capelin becoming more important in the southern Bering Sea.

The minimum population estimate for spotted seals in the U.S. portion of the Bering Sea in spring is 423,237. There is no available data to report a population trend in spotted seals. The minimum estimated mean annual level of human-caused M/SI for the portion of the Bering Sea stock in U.S. waters between 2014 and 2018 is 5,254 seals. Of those average annual mortalities, just one was attributed to U.S. commercial fisheries.

Since 2011, NMFS has declared two UMEs for ice seals in the Bering and Chukchi Seas in Alaska. The first UME (2011-2016) involved all four species of ice seals (bearded seals, ringed, spotted, and ribbon seals) and was characterized by abnormal molting with no definitive cause.[7] The second event was declared in 2019 after elevated numbers of stranded bearded, ringed, and spotted seals were found beginning in June 2018. This most recent UME is attributed to ecosystem-driven changes in prey availability; seals manifested symptoms of starvation consistent with this conclusion.

Interaction with Bering Sea Pollock Trawl Fisheries

From 2017-2021, no spotted seal M/SI events have been attributed to the BSAI pollock trawl fishery.

However, spotted seals predate pollock preferentially, and may therefore indirectly interact with the BSAI trawl fleet through prey competition.

Killer whale (multiple stocks)

NMFS recognizes three stocks of killer whales (*Orcinus orca*) occurring in Bering Sea waters: 1) the Eastern North Pacific Alaska Resident; 2) the Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient, and 3) Eastern North Pacific Northern Resident. The most recent SAR acknowledges that NMFS has genetic information suggesting that the current stock structure in Alaska needs to be reassessed (Parsons et al. 2013). This genetic information is under ongoing evaluation, along with other available data to inform whether a stock structure revision is necessary and how it would be implemented.

Population estimates for killer whale stocks in Alaska rely largely on counts ofn photographically identifiable whales. The minimum population estimates across the stocks are as follows: 1) 1,920 whales in the Eastern North Pacific Alaska Resident stock; 2) 587 whales in the Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock, and 3) 302 whales in the Eastern North Pacific Northern Resident stock. No reliable trend data is available for the Alaska Resident stock or the transient

[7] June 2016 Update: 2011 Arctic Pinniped Unusual Mortality Event (UME). NOAA Fisheries. Retrieved October 10, 2024 from: https://media.fisheries.noaa.gov/dam-migration/ume-factsheet062016-akr.pdf

stock. Eastern North Pacific Northern Resident killer whale population growth rates have slowed over the past five census years, from 5.1% in 2014 to -0.3% in 2018 (Fisheries and Oceans Canada 2019).

Killer whales occur in a wide range of habitats, in both open seas and coastal waters. Killer whales are highly social, and most live in social groups called pods (groups of maternally related individuals seen together more than half the time). Individual whales tend to stay in their natal pods. Pods typically consist of a few to 20 or more animals, and larger groups sometimes form for temporary social interactions, mating, or seasonal concentrations of prey.

Killer whales rely on underwater sound to feed, communicate, and navigate. Pod members communicate with each other through clicks, whistles, and pulsed calls. Each pod in the eastern North Pacific possesses a unique set of calls that are learned and culturally transmitted among individuals. These calls maintain group cohesion and serve as family badges.

Although the diet of killer whales depends to some extent on what is available where they live, it is primarily determined by the culture (i.e., learned hunting tactics) of each ecotype. For example, one ecotype of killer whales in the U.S. Pacific Northwest (called Residents) exclusively eats fish, mainly salmon, and another ecotype in the same area (Transients or Bigg's killer whales) primarily eat marine mammals and squid. Killer whales often use a coordinated hunting strategy and work as a team to catch prey. They are considered an apex predator, eating at the top of the food web.

Killer whales are vulnerable to entanglement in fishing gear, prey limitations due to habitat loss and overfishing, contaminants such as wastewater treatment plants, sewer outfalls, and pesticide application, oil spills and disturbance from vessels and sound.

Interaction with Bering Sea Pollock Fisheries

While the majority (54%) of killer whale M/SI events are caused by trawl net fisheries, only 1 mortality (Alaska Resident) from 2017 to 2021 was attributed to the BSAI pollock trawl fishery (Bolling et al. 2023). Most recently, one killer whale entanglement (also an Alaska Resident whale) resulting in a serious injury in the summer of 2023 was in the BSAI pollock trawl fishery.[8]

Killer whales may also indirectly interact with the fishery through competition for preferred salmon prey.

Pacific white-sided dolphin (North Pacific stock)

For the MMPA stock assessment reports, Pacific white-sided dolphins within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington, and 2) Alaskan waters, commonly referred to as the North Pacific stock. This report considers the effects of the proposed alternatives on the North Pacific stock of Pacific white-sided dolphins.

The most recent population estimate of the North Pacific stock is based on surveys conducted during the 1987 to 1990 period. The current abundance estimate of Pacific white-sided dolphins in Alaskan waters is unknown. With no reliable population estimates, there is also no reliable information on trends in abundance.

Pacific white-sided dolphins forage mostly on small, schooling fish species such as anchovy, herring, and capelin. Squid are also a large component of the Pacific white-sided dolphin diet. Most preferred prey are concentrated in midwater depths, also known as the "deep scattering layer", and are known to use

[8] Press release available at: https://www.fisheries.noaa.gov/feature-story/cause-death-determined-11-killer-whales-incidentally-caught-fishing-gear-alaska-2023

cooperative foraging strategies. Pacific white-sided dolphins are often seen at dawn and dusk, feeding on surface bait balls, often in the company of gulls[9].

Pacific white-sided dolphins have historically been severely threatened by commercial fisheries but changes to fisheries management have dramatically reduced the impacts of fishing efforts on their persistence. There is no subsistence fishery for Pacific white-sided dolphins in Alaska.

Interactions with the Bering Sea Pollock Fisheries

From 2017 to 2021, two M/SI events of Pacific white-sided dolphins were attributed to the BSAI pollock trawl fishery (Freed et al. 2023). It is unlikely that Pacific white-sided dolphins would be indirectly affected by the BSAI pollock trawl fishery through prey competition, although they do feed on herring, a Bering Sea pollock fishery bycatch species.

Harbor Porpoise (Bering Sea stock)

Harbor porpoises (*Phocoena phoecena*) in the United States are not endangered or threatened. Harbor porpoises in the eastern North Pacific Ocean range from offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, Sitkalidak Strait (Dahlheim et al. 2000, 2009, 2015; Hobbs and Waite 2010; Castellote et al. 2015), and lower Cook Inlet (Shelden et al. 2014). In previous SARs, three harbor porpoise stocks were recognized in Alaska: 1) the Southeast Alaska stock, 2) the Gulf of Alaska stock, and 3) the Bering Sea stock. Recent genomic studies indicate that there are actually several stocks with discrete ranges in Southeast Alaska. The Bering Sea stock remains the same and is the only stock considered in this report as it is present in the area of the Bering Sea pollock fishery.

The most recent minimum population estimate for the Bering Sea harbor porpoise stock (5,713) is based on a 2008 aerial survey of a small portion of the stock's range. The current stock size and population trend are considered unknown.

Harbor porpoises feed on schooling fishes such as cod, herring, pollock, sardines, and whiting, as well as squid and octopus. They usually feed individually, consuming approximately 10% of their body weight each day. In general, harbor porpoises are often seen alone, but at times form small groups of less than ten individuals. They are shy animals and rarely show curiosity towards vessels and at times will actively avoid them. The harbor porpoise will occasionally "porpoise" out of the water, but generally they surface to breathe in a slow, gentle roll. Diving for an average of four minutes, they are frequent and shallow divers, although they have been observed diving to depths of up to 200 feet.

Harbor porpoise are mostly found in nearshore areas and inland waters, including bays, tidal areas, and river mouths (Dahlheim et al. 2000, 2009, 2015; Hobbs and Waite 2010). As a result, harbor porpoise are vulnerable to physical modifications of nearshore habitats resulting from urban and industrial development (including waste management and nonpoint source runoff) and activities such as construction of docks and other over-water structures, filling of shallow areas, dredging, and noise (Linnenschmidt et al. 2013). Harbor porpoises are also vulnerable to interactions with fishing gear and algal toxins are a growing concern in Alaska marine food webs, in particular the neurotoxins domoic acid and saxitoxin. Predation by large sharks, dolphins and killer whales is also of concern.

Interaction with Bering Sea Pollock Fisheries

[9] *Pacific White-sided Dolphin (Lagenorhynchus obliquidens) Species Profile*. (n.d.). Alaska Department of Fish and Game. Retrieved January 31, 2024, from https://www.adfg.alaska.gov/index.cfm?adfg=pacificwhitesideddolphin.main

No M/SI events of harbor porpoises were attributed to the BSAI pollock trawl fisheries from 2017 to 2021 (Freed et al. 2023). Harbor porpoises are known to feed on pollock and herring, and may therefore be indirectly affected by the BSAI pollock fishery through prey competition.

Beluga Whale (Multiple Stocks)

Five stocks of Beluga whales are recognized in Alaska: 1) Cook Inlet (ESA-listed Endangered), 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea. Four of the stocks (Beaufort Sea, Eastern Chukchi Sea, Eastern Bering Sea, and Bristol Bay) spend time in the Bering Sea and are considered. These three stocks overwinter in the Bering Sea and summer in the Beaufort Sea (Beaufort Sea and Eastern Chukchi Sea stocks) and Bering Sea (Eastern Bering Sea and Bristol Bay stocks). Genomic analyses indicate minimal mixing between stocks (O'Corry-Crowe et al. 2018).

The sources of information to estimate abundance for beluga whales have included both opportunistic and systematic observations. The minimum population estimates for the three beluga whale stocks considered in this report are as follows: 1) Beaufort Sea (32,453 whales), 2) Eastern Chukchi Sea (8,875 whales), 3) Eastern Bering Sea (11,112 whales), and 4) Bristol Bay (). However, these population estimates are all over 6 years old and potentially biased by spatial overlap of the stocks. The population trends of these stocks are considered unknown in US stock assessments.

Threats to beluga whales include stranding, sea ice entrapment, underwater noise pollution, contaminants, and climate change progression – particularly as it relates to warming and seasonal sea ice.

Beluga whales use their well-developed vision and echolocation to navigate their environment in search of prey.[10] Beluga whales eat a varied diet consisting of octopus, squid, shrimp, clams, snails, and sandworms. They also consume a variety of fish species including salmon, smelt, cod, herring, capelin, and flatfish.

Interactions with Bering Sea Pollock Fisheries

No M/SI events of beluga whales were attributed to the BSAI pollock trawl fishery from 2017 to 2021 (Freed et al. 2023). However, beluga whales may be indirectly affected by the BSAI pollock trawl fishery through competition for salmon and forage fish species (herring, capelin, smelt).

[10] *Beluga Whale (Delphinapterus leucas) Species Profile* (n.d.) Alaska Department of Fish and Game. Retrieved January 2, 2024, from https://www.adfg.alaska.gov/index.cfm?adfg=beluga.main

Appendix 4: Adult equivalent (AEQ) model and impact rate analysis of Western Alaska – Summer and Yukon River – Fall runs

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Introduction

In April 2024, the council requested that a simplified adult equivalent model (AEQ) for chum salmon be performed to evaluate the potential impact of bycatch on Western Alaska chum salmon stocks. The purpose of this appendix is to outline the approach taken to produce the simplified AEQ estimates for the Coastal Western Alaska (WAK) - Summer run and Yukon River - Fall run genetic groups. Historically, the Alaska Fisheries Science Center (AFSC) genetics program has analysed geographical aggregations of these populations that most closely match the neutral genetic structure (reporting groups of Western Alaska and Upper/Middle Yukon); however, these grouping do not match United States Fish and Wildlife Service (USFW) and Alaska Department of Fish and Game (ADFG) management units. All of the genetic stock identification analyses were redone with the new reporting groups that reflect management groups used in Alaska. The simplified AEQ, herein referred to as the AEQ, is similar to the approach that was taken for Chinook salmon and chum salmon in the 2012 analysis (NPFMC 2012), except for several key differences. The 2024 AEQ: (1) uses estimates of age specific stock compositions for the most frequent age classes (3-, 4-, and 5-year-old) instead, (2) does not use age-length keys to estimate the bycatch age distribution, and (3) compared to the chinook AEQ has substantially more uncertainty underlying the parameters within the model (*e.g.*, natural mortality and maturity). The 2024 AEQ estimates were compared with the estimates of each genetic groups overall B-season bycatch from 2011 through 2022 and an impact rate for the Yukon River – Fall run stock was calculated. This appendix explains the method, the major differences between the 2012 AEQ and the simplified approach taken here, estimates the AEQ for the WAK - Summer run and the Yukon River - Fall run stocks, and estimates the impact rate for the Yukon River - Fall run.

Methods

2012 AEQ

We describe the chum salmon AEQ approach taken in the 2012 Chum Salmon PSC Management Measures Environmental Assessment (NPFMC 2012) to help the reader compare and contrast differences between the approaches.

Estimates of chum salmon catch-at-age were calculated by constructing age-length keys for each sex in three time-area strata. The three strata were: (1) Eastern Bering Sea-wide for the early period (June-July), (2) west of 170°W late period (Aug-October) and (3) east of 170°W late period (Aug-October). Fisheries observers take length and weight measurements for more samples than are sampled for genetics and scales. The keys were then applied to randomly sampled catch-at-length frequency data from the stratum specific bycatch. Age-composition data, specific to sex and sampling stratum, were then weighted by the stratum catch to produce an annual age composition of the bycatch. This provides an estimate of the total number of chum salmon caught of each age.

The AEQ is then computed as

$$AEQ_t = \sum_{a=2}^{7} C_{t,a}\,\gamma_a + \sum_{j=2}^{6}\sum_{a=j+1}^{7}\left[\gamma_a C_{t-(a-j),j}\,\Pi_{i=j}^{a-1}(1-\gamma_i)s_a\right],$$

where $C_{t,a}$ is the bycatch of age a chum salmon in year t, s_a is the proportion of salmon surviving from age a to $a+1$, and γ_a is the proportion of salmon at sea that would have returned to spawn at age a. The 2012 AEQ is computed as the aggregate AEQ of all genetic groups. Genetic stock identification (GSI) data were applied to disaggregate the annual AEQ and produce stock specific AEQ estimates. This was done using stratum specific GSI results and a parametric bootstrap approach while modeling the annual stock proportion for a given stratum with a beta distribution.

2024 Simplified AEQ

Since 2012, age-specific stock composition estimates have shown substantial differences in the stocks comprising the most common chum salmon ages encountered in the bycatch (ages 4, 5, and 6). Additionally, preliminary analyses suggest that age-length keys differ by genetic grouping, in addition to sampling stratum and sex. Finally, the sampling strategy for chum salmon bycatch changed in 2011 with Amendment 91, such that sampling is representative of the overall bycatch with a systematic random sample of 1 in 30 chum salmon encountered.

The simplified method for this analysis forgoes the use of age-length keys for estimating the age composition of the bycatch in a given year. The age composition is instead, estimated from the random sample of scales. The estimted number of chum salmon of each age is then a product of the total B season bycatch and the annual age composition. Age-specific GSI results are then applied to the number of fish of each age to estimate the number of chum salmon of a given age and genetic group. The stock specific estimate for each age can then be used along with some assumptions about natural mortality, oceanic maturity to calculate the AEQ as:

$$AEQ_{r,t} = \sum_{a=2}^{7} C_{r,t,a}\,\gamma_{r,a} + \sum_{j=2}^{6}\sum_{a=j+1}^{7}\left[\gamma_{r,a} C_{r,t-(a-j),j} \Pi_{i=j}^{a-1}\left(1-\gamma_{r,i}\right)s_a\right],$$

where $C_{r,t,a}$ is the bycatch of stock group r, age a in year t, s_a is the proportion of salmon surviving from age a to $a+1$, and $\gamma_{r,a}$ is the proportion of salmon of stock group r at sea that would have returned to spawn at age a. The estimation of $C_{r,t,a}$ and its 95% credible intervals uses stock specific composition estimates from mixtures of the most frequent age classes caught in the bycatch, as discussed above. The other parameters in this model are either taken from prior work (s_a) or estimated from additional data $\gamma_{r,a}$. Estimates of survival were taken from the prior analysis of chum salmon adult equivalents in 2012 (NPFMC 2012). We focused on the scenario 2 (NPFMC 2012; Table A5-6) with mortality varying from 0.4 for age-1 to 0.0 to age-7 (but see the Sensitivity to Natural mortality section). Estimates of maturity ($\gamma_{r,a}$) for each reporting group were inferred from the age composition of fish on the spawning grounds.

It should be noted that in order to produce an AEQ for the 2011–2022 time period, we have to integrate age-specific stock compositions from 2006 to 2010. Individuals caught as age-2 fish in 2006 could have matured as age-7 fish in 2011. Prior to 2011, sampling was not conducted using the systematic random sampling protocol such that biases in the spatiotemporal extent of those samples exists. We know from prior work that the stock composition of the bycatch varies in both space and time. The bias introduced by using estimates from the 2006–2010 data will likely be less than using the long-term average over the dataset for each age class as there is interannual variability in the estimates that would be lost. Efforts could be made to correct for the sampling design with catch data; however, corrections were not made for this simplified analysis.

Additionally, the genetics collections only contain sufficient samples to estimate the age-specific stock compositions for the dominant age classes (3-, 4-, and 5-year-olds). There are individuals that are age 2, 6, and 7 caught in the bycatch. While relatively infrequent they must be accounted for in the AEQ. Applying the stock composition of the reporting group lagged a year to account for cohort dynamics was considered, but there was little relationship between the lagged age proportions (*e.g.*, 3-year-old proportion in 2011 and 4-year-old proportion in 2012) for the WAK - Summer Run group. We chose to apply the stock composition of the most similar age class for these fish with the understanding that this simplifying assumption does not account for changes in regional productivity that likely vary annually.

Results

Age Specific Stock Compositions

Genetic samples were reanalyzed for the new baseline arrangement to reflect the USFW and ADFG management units (WAK - Summer run, and Yukon River - Fall run). Estimates for the predominant age classes (3, 4, and 5) demonstrate both age-specific differences as well as interannual variability. Age-3 mixtures are composed of a large proportion Gulf of Alaska / Pacific Northwest chum salmon. In some years accounting for as much as 75%, but also as little as 4.2% depending on the year (Figure A4-1). Alternatively, The Northeast Asia (NE Asia) group comprises a larger proportion of the older age classes.

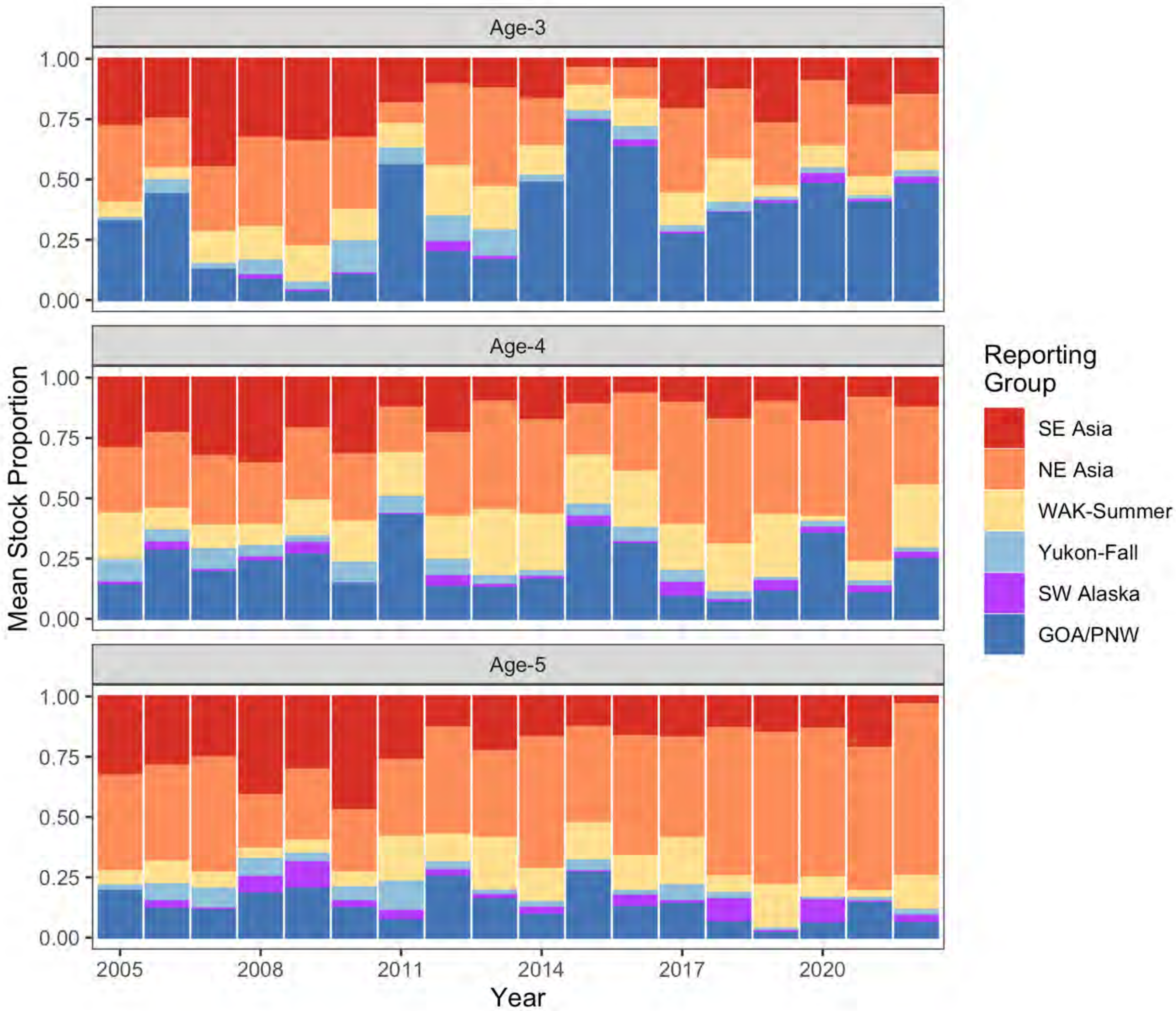

Figure A4-1: Annual age-specific stock composition of chum salmon bycatch for the three most common ages (3-, 4- and 5-year-olds) from 2005–2022 for Southeast Asia (SE Asia), Northeast Asia (NE Asia), Western Alaska-Summer (WAK-Summer), Yukon-Fall, Southwest Alaska (SW Alaska), and Gulf of Alaska/Pacific Northwest (GOA/PNW).

The WAK-Summer run and Yukon-Fall run stocks are minor contributors to all age classes from 2005 to 2022 with WAK-Summer representing a larger proportion than Yukon-Fall throughout the time series. This is not surprising based on prior GSI results for the Western Alaska and Upper/Middle Yukon age-specific analyses.

The marked decrease in SE Asia pre/post 2011 may be linked to non-systematic sampling of the bycatch, or it could be linked to decreases in hatchery releases across the time period. Data on hatchery releases were obtained from the North Pacific Anadromous Fish Commission (NPAFC) and plotted to evaluate changes in hatchery production across the time period. From 1991 through 2021, hatchery releases in Japan (SE Asia reporting group) have decreased while hatchery releases in Russia (NE Asia reporting group) have increased (Figure 3-3). While we cannot discount biases in stock composition estimates from the sampling design; changes in hatchery production could also account for some of the shift in stock group proportions between the two time periods. For the simplified AEQ approach taken here, and sample sizes precluding the estimation of age-specific stock composition for multiple spatiotemporal strata, we used the pre-2011 estimates without adjustment.

Annual estimates of the age composition of the chum salmon bycatch were estimated from scales collected by the Observer Program (Table A4-1). Age estimates were produced by NOAA Auke Bay Laboratory prior to 2020 and by the Alaska Department of Fish and Games Mark Tag and Age Lab from 2020-2022.

Table A4-1: Annual chum salmon scale ages inferred from scale pattern analysis.

	Age							Age					
Year	2	3	4	5	6	7	Year	2	3	4	5	6	7
2005	5	196	834	163	9	2	2014	3	342	806	131	6	2
2006	0	219	580	338	16	7	2015	3	745	657	147	25	0
2007	3	156	742	259	35	4	2016	2	370	1228	268	12	0
2008	0	50	373	157	20	2	2017	1	384	1015	207	15	0
2009	38	469	635	184	17	3	2018	3	303	1180	236	9	0
2010	3	139	474	253	28	1	2019	30	610	679	144	2	0
2011	0	130	788	217	9	2	2020	78	770	586	72	2	0
2012	0	79	299	112	5	0	2021	2	928	1946	148	2	2
2013	8	327	1914	421	38	0	2022	0	680	1731	241	2	0

A total of 27,518 chum salmon were successfully aged between 2005 and 2022. An average of 1529 chum salmon were aged annually. As noted previously, the majority of the samples were aged 3-5, from which we could produce age-specific stock compositions (Figure A4-2). Very few samples were estimated to be age 2, 6 and 7; never more than ~5% of the overall bycatch.

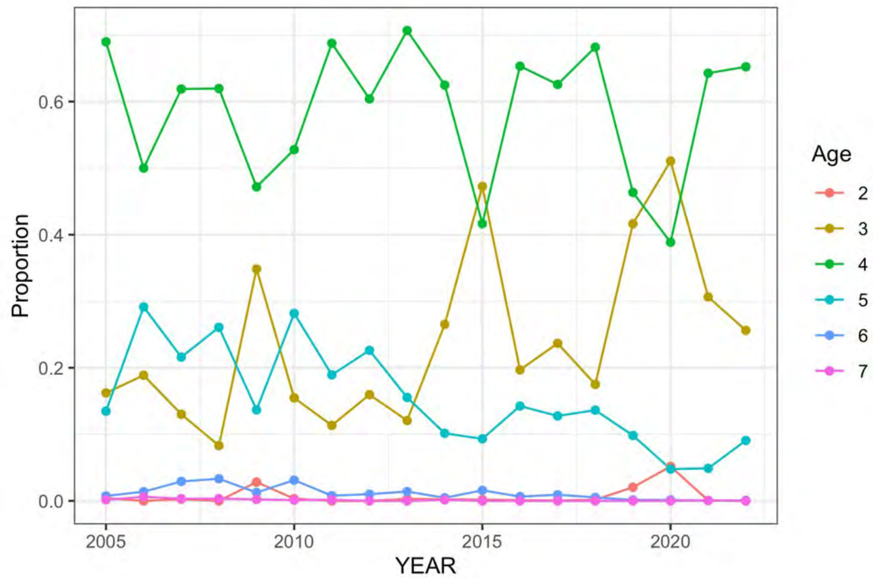

Figure A4-2: Proportion of each age in the total (all genetic groups) chum salmon bycatch from 2005–2022.

An annual estimate of the total number of each age class (Table A4-2) was produced by multiplying the age composition estimate by the total bycatch. The total non-chinook bycatch ranged from 13,243 in 2010 to 545,901 in 2021 (Table A4-2). In consideration of the AEQ, it is notable that years 2008–2010 were characterized by very low bycatch of chum salmon.

Table A4-2: Total annual bycatch from 2006–2022 and estimated number of chum salmon of six possible total ages (2– to 7-year-olds) from 2006 to 2022.

	Age						
Year	2	3	4	5	6	7	Total Bycatch
2006	0	57,485	152,244	88,721	4,200	1,837	304,487
2007	198	10,283	48,911	17,073	2,307	264	79,036
2008	0	1,224	9,128	3,842	489	49	14,732
2009	1,281	15,810	21,406	6,203	573	101	45,374
2010	44	2,050	6,990	3,731	413	15	13,243
2011	0	21,703	131,551	36,227	1,502	334	191,317
2012	0	3,539	13,393	5,017	224	0	22,173
2013	370	15,108	88,430	19,451	1,756	0	125,115
2014	509	58,030	136,761	22,228	1,018	339	218,885
2015	443	110,113	97,106	21,727	3,695	0	233,084
2016	361	66,765	221,586	48,359	2,165	0	339,236
2017	287	110,287	291,514	59,452	4,308	0	465,848
2018	511	51,586	200,897	40,179	1,532	0	294,705
2019	7,102	144,406	160,741	34,089	473	0	346,811
2020	17,746	175,188	133,325	16,381	455	0	343,095
2021	361	167,304	350,833	26,682	361	361	545,902
2022	0	62,084	158,040	22,003	183	0	242,310

Not all fish in Table A4-2 would contribute to the AEQ from 2011–2022. For instance, in 2007 only age 2 and 3 fish would contribute to the AEQ in year 2011 (*e.g.,* age-2 survive 4 years and mature at age-6 and age-3 fish survive 3 years and mature at age-7). Fish aged 3–7 in 2006 would not contribute to the AEQ in years 2011–2022. Again, we see that age 2, 6 and 7 are infrequent; however, while only ~5% of the bycatch in 2020 was age-2, that represents over 17,000 chum salmon (Table A4-2).

Estimates of the number of WAK - Summer run and Yukon River - Fall run are the product of the estimated number of chum salmon of each age (Table A4-2) and the age-specific stock composition (Figure A4-1). Age-specific stock composition estimates for the relatively infrequent age classes (2-, 6-, and 7-years total age) do not exist. They are already infrequent in the total bycatch and subsampling 1 in 30 by the observer program combined with subsequent subsampling within the genetics lab in years of high bycatch results in insufficient sample sizes to analyze these age classes. In the absence of age-specific stock composition estimates for ages 2, 6, and 7, we applied the most similar age class stock composition to those age classes (*e.g.,* use age-3 stock composition to estimate the number of Western Alaska - Summer and Yukon River Fall run age-2 fish).

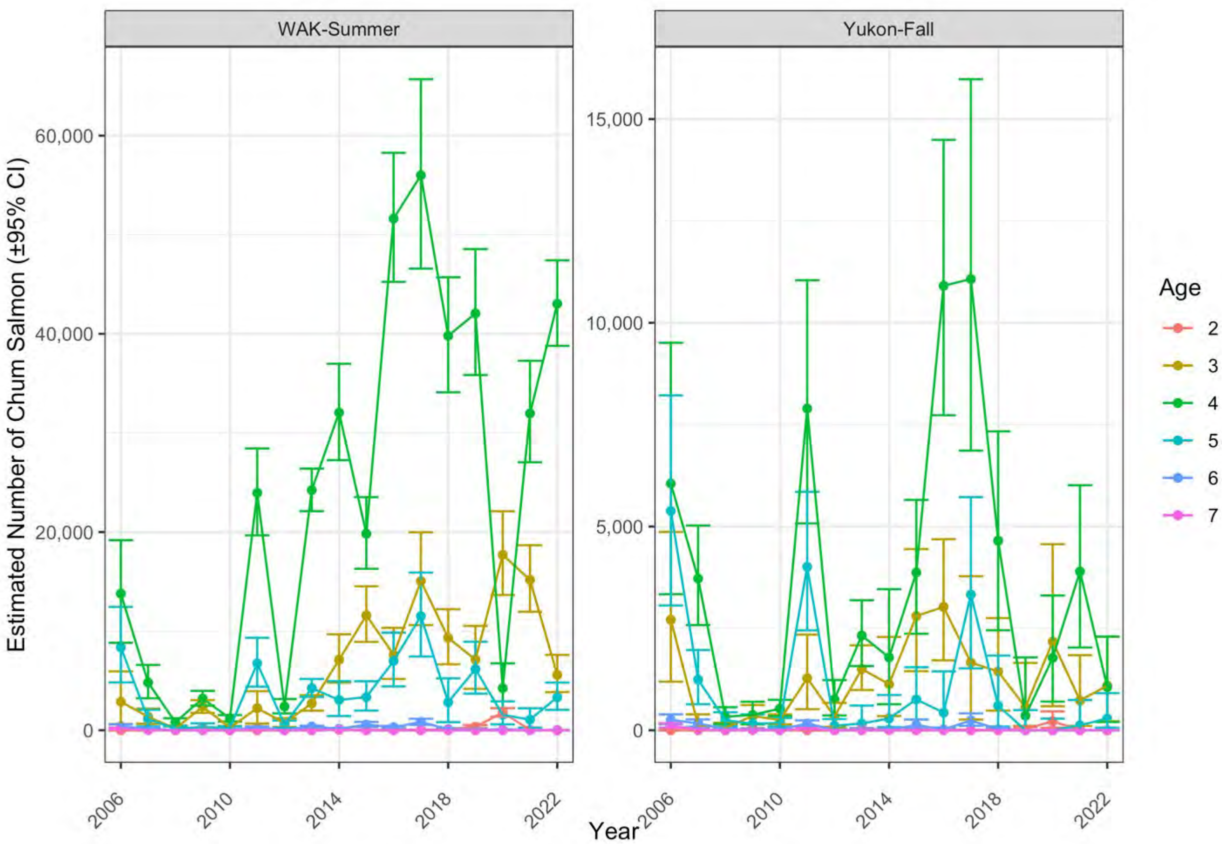

Figure A4-3: Estimated number of age 2–7 WAK-Summer run and Yukon River - Fall run chum salmon caught in the pollock trawl fishery B season with 95% credible intervals.

There was substantial interannual variability in the number of chum salmon originating from the WAK - Summer run and Yukon River Fall run stocks (Figure A4-3). Values found in Table A4-3 are the $C_{r,a}$ values applied in the AEQ model and represent the mean value without associated uncertainty. The amount of uncertainty in the number of fish of a given age can be quite large in some years (Figure A4-3). For instance, the estimate of age-4 Yukon River - Fall run chum salmon in 2017 was 11,074, but the 95% credible interval ranges from 6,863 to 15,978.

Table A4-3: Estimated number of chum salmon of Western Alaska – Summer and Yukon River – Fall run origin by age from 2006–2002.

		Age					
Stock	Year	2	3	4	5	6	7
WAK-Summer	2006	0	2,871	13,778	8,362	396	173
	2007	26	1,365	4,818	1,132	153	17
	2008	0	170	808	161	20	2
	2009	192	2,375	3,200	330	30	5
	2010	6	266	1,191	228	25	1
	2011	0	2,227	23,953	6,751	280	62
	2012	0	744	2,396	580	26	0
	2013	66	2,717	24,236	4,248	383	0
	2014	62	7,110	32,050	3,057	140	47
	2015	47	11,599	19,830	3,346	569	0
	2016	41	7,622	51,637	6,994	313	0
	2017	39	15,062	56,001	11,521	835	0
	2018	92	9,323	39,808	2,824	108	0
	2019	350	7,124	42,058	6,172	86	0
	2020	1,794	17,711	4,250	1,560	43	0
	2021	33	15,166	31,970	1,068	14	14
	2022	0	5,590	43,042	3,334	28	0
Yukon-Fall	2006	0	2,710	6,056	5,382	255	111
	2007	2	128	3,725	1,244	168	19
	2008	0	63	332	246	31	3
	2009	28	348	377	161	15	3
	2010	5	254	532	179	20	1
	2011	0	1,278	7,895	4,010	166	37
	2012	0	337	757	111	5	0
	2013	37	1,504	2,325	165	15	0
	2014	10	1,131	1,788	289	13	4
	2015	11	2,804	3,871	757	129	0
	2016	16	3,028	10,910	433	19	0
	2017	4	1,661	11,074	3,331	241	0
	2018	14	1,443	4,654	604	23	0
	2019	28	562	357	0	0	0
	2020	221	2,178	1,777	0	0	0
	2021	2	730	3,895	120	2	2
	2022	0	1,093	1,062	292	2	0

Of the estimated ~17,700 age-2 chum salmon in 2020, ~1,800 were of WAK - Summer run origin. The largest number of age-7 fish occured in 2006 for both the genetic groups.

In-River Age Composition

The in-river age composition data were compiled from prior work (Berry and Larson 2021, Yukon JTC 2024). These data consist of 6 systems within the Kuskokwim for WAK-Summer run fish and a time series from 2014 to 2018 for Yukon River - Fall run chum salmon.

Table A4-4: In-river age composition data were compiled from prior work (Berry and Larson 2021, Yukon JTC 2024).

System	Source	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
WAK - Summer	Goodnews (middle fork) 2014-2018	0.0	5.1	64.5	28.3	2.2	0.0
WAK - Summer	Kanektok 2002-2015	0.0	1.3	57.7	38.8	2.1	0.0
WAK - Summer	Salmon River Aniak 2014-2018	0.0	2.0	57.6	38.7	1.8	0.0
WAK - Summer	George River 2014-2018	0.0	3.1	64.7	29.8	2.3	0.1
WAK - Summer	Tatlawiksuk 2014-2018	0.2	3.6	59.0	34.0	3.2	0.1
WAK - Summer	Kogrukluk 2014-2018	0.0	3.0	56.8	38.2	2.0	0.0
	Avg.	0.0	3.0	60.0	34.6	2.3	0.0
Yukon - Fall	2014	0.0	6.1	80.2	13.4	0.3	0.0
Yukon - Fall	2015	0.0	3.8	85.0	11.1	0.1	0.0
Yukon - Fall	2016	0.0	7.7	85.6	6.2	0.6	0.0
Yukon - Fall	2017	0.0	3.8	59.1	36.0	1.2	0.0
Yukon - Fall	2018	0.0	0.4	75.3	23.0	1.3	0.0
	Avg.	0.0	4.3	77.0	17.9	0.7	0.0

Some interannual variation exists among the systems. Only one source has spawners that were age-2 fish, and only two sources have age-7 fish. Age-4 is the predominant age class across all systems, followed by age 5. The in-river age composition of the WAK - Summer run stocks combined with estimates of natural mortality can be used to estimate the oceanic maturity γ_a.

Oceanic maturity γ_a was estiamted to match the in-river age composition given the mortality vector (Figure A4-4). In the 2012 AEQ analysis, analysts accounted for the age-specific AEQ of the bycatch (NPFMC 2012). Here, we found the equilibrium $\gamma_{WAKsummer,a}$, without accounting for the chum salmon AEQ. With $\gamma_{WAKsummer,1-7} = 0,\ 0, 0.023, 0.581, 0.931, 0.991, 1.0$ there was a difference of 0.001 between the expected equilibrium age composition on the spawning grounds and the in-river estimates. The same approach was applied to the Yukon River Fall run group; apply the in-river age composition and estimates of natural mortality to estimate the oceanic maturity $\gamma_{YukonFall,a}$. With $\gamma_{YukonFall,1-7} = 0, 0, 0.035, 0.780, 0.959\ ,0.999, 1.0$ a difference of 0.002 between the expected equilibrium age composition on the spawning grounds and the in-river estimates.

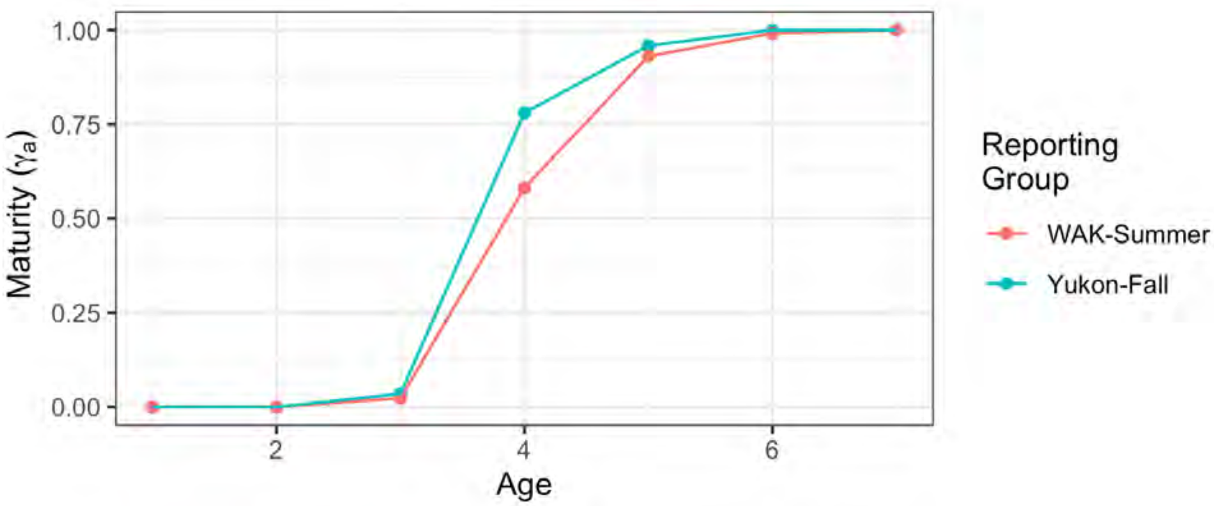

Figure A4-4: Estimates of maturity at age for the Western Alaska - Summer run and Yukon River - Fall run genetic groups inferred from in-river age composition data and natural mortality.

The Yukon River - Fall run matures at an earlier age on average and so we see a larger γ_a value for ages 3 through 6. Both genetic groups have $\gamma_7 = 1$ as this is the oldest age group observed in the bycatch and in-river age composition data suggest that fish this old are rare.

It should be noted that estimates of γ_a are slightly lower than those used in the 2012 analysis, especially for the younger aged maturing chum salmon (age 3 and 4) and would effectively subject chum salmon bycatch to additional mortality in future years before maturing (NPFMC 2012; Table A5-6). However, that analysis and senstitivity analyses below (assuming no oceanic mortality) show that the AEQ is relatively insensitive to mortality assumptions (Table A4-5). Differences in γ_a would then shift AEQ bycatch among years.

Table A4-5: Estimates of maturity (γ_a), mortality (M_a), and survival (S_a) at age a for the WAK-Summer and Yukon-Fall run chum salmon stocks.

Stock	Age	γ_a	M_a	S_a	Stock	Age	γ_a	M_a	S_a
Yukon-Fall	1	0.000	0.40	0.670	WAK-Summer	1	0.000	0.40	0.670
	2	0.000	0.30	0.741		2	0.000	0.30	0.741
	3	0.035	0.20	0.819		3	0.023	0.20	0.819
	4	0.780	0.15	0.861		4	0.581	0.15	0.861
	5	0.959	0.10	0.905		5	0.931	0.10	0.905
	6	1.000	0.05	0.951		6	0.991	0.05	0.951
	7	1.000	0.00	1.000		7	1.000	0.00	1.000

With annual age-specific estimates of the number of chum salmon for each reporting group, natural mortality, and oceanic maturity the AEQ can be calculated for WAK-Summer and Yukon River Fall run chum salmon.

AEQ comparison with B season bycatch levels

The AEQ for the WAK - Summer run group ranged from 11,608 in 2012 to 69,445 in 2017 and averaging 38,162 over the 12 years analyzed. While the AEQ is often lower than the overall bycatch level, in 2 of the 12 years the AEQ exceeds the point estimate for the B season bycatch. The AEQ exceeds the point estimate for the B season bycatch in 2012 because of the substantial drop in bycatch from 2011 to 2012. Bycatch of fish that would have matured in 2012 contributed to the AEQ in 2012. In 2018 we also see an instance where the AEQ exceeded the bycatch. Again, this is because of the large catches of chum salmon in 2016 and 2017 of fish that would have likely matured in 2018 combined with a large overall reduction in the bycatch between 2017 and 2018.

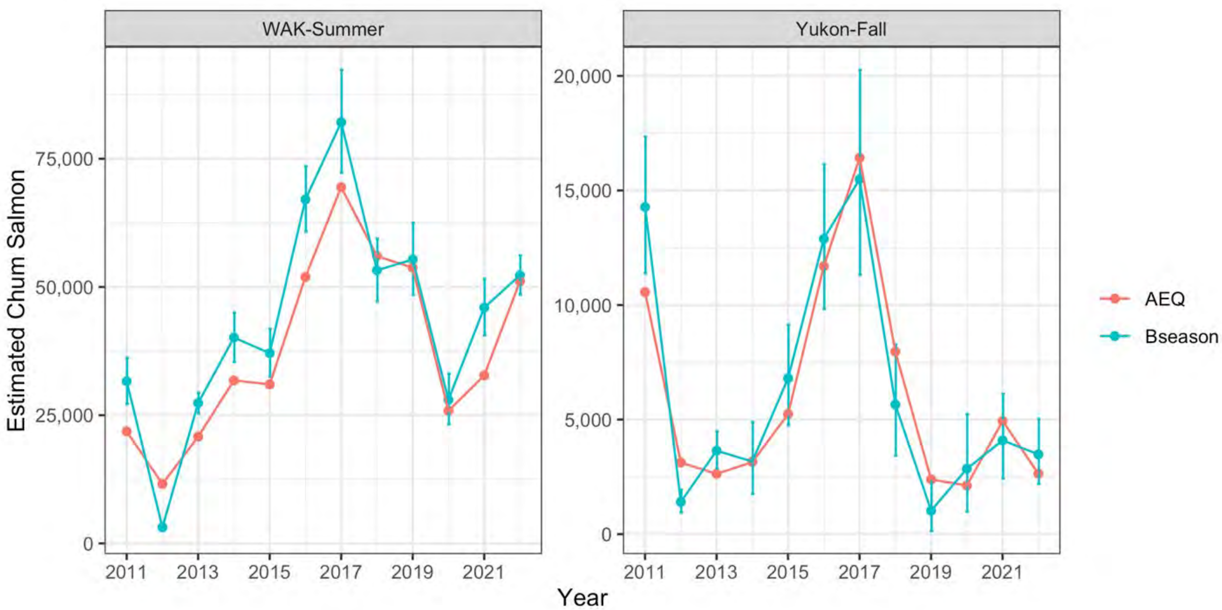

Figure A4-5: Estimated number of WAK-Summer run (left) and Yukon River – Fall run (right) chum salmon caught in the B season of the pollock trawl fishery (blue) and adult equivalents (red; number of chum salmon that would have returned had bycatch not occurred).AEQ estimates represent point estimates for genetic stock group bycatch numbers, maturity and survival (uncertainty in these estimates is addressed below).

Table A4-6: Annual adult equivalent (AEQ) and B season chum salmon bycatch estimates for the Western Alaska – Summer and Yukon River – Fall genetic groups from 2011–2022. Total bycatch is the census of the bycatch, including all genetic groups.

		WAK - Summer		Yukon - Fall	
Year	Total Bycatch	AEQ	B season	AEQ	B season
2011	191,317	21,848	31,624	10,565	14,276
2012	22,172	11,608	3,152	3,126	1,407
2013	125,114	20,815	27,364	2,629	3,643
2014	218,886	31,784	40,137	3,145	3,171
2015	233,085	31,011	37,090	5,239	6,805
2016	339,236	51,950	67,062	11,695	12,892
2017	465,848	69,445	82,103	16,429	15,495
2018	294,705	56,017	53,251	7,967	5,657
2019	346,812	53,753	55,361	2,387	1,022
2020	343,095	25,857	28,001	2,124	2,854
2021	545,901	32,751	45,976	4,939	4,093
2022	242,309	51,101	52,280	2,638	3,482

The AEQ for the WAK - Summer run group ranged from 2,124 in 2020 to 16,429 in 2017 and averaged 6,074 over the 12 years analyzed (Figure A4-5, Table A4-6). In contrast to the AEQ of the WAK-Summer stock, the AEQ of the Yukon River - Fall run exceeded the overall bycatch in 5 of 12 years (Figure A4-5, Table A4-6). This results from the lagged effect of the AEQ combined with the higher probability of the Yukon River Fall stock maturing earlier (Table A4-5). A higher proportion of 4-year-old fish would mature in a given year verses delaying maturity to ages 5-7 and incurring additional natural mortality. These results are consistent with the frequency that the 2012 chum salmon AEQ exceeded the annual bycatch (NPFMC 2012; Figure A5-8, Table A5-7).

AEQ savings under PSC limit and apportionment options

The effect of cap alternatives on the AEQ was evaluated by calculating the number of chum salmon that would have been taken as bycatch before a cap was reached, then calculating an AEQ based on that value. Those values can be compared with the AEQ under the status quo to see what AEQ savings would have occured under the alternatives. This approach was taken for caps of: 75,000, 100,000, 325,000, and 550,000 chum salmon (Figure A4-6).

Within each cap level there are multiple (4) different cap allocations. If there are no salmon saved for a given cap the analysis would not need to be run. We summed the number of salmon avoided across all years for a given cap and allocation. Between 2006 and 2023 all cap alternatives have some salmon saved over the 18-year time period each was analyzed.

Unsurprisingly a cap of 550,000 chum salmon leads to an AEQ estimate that resembles the status quo AEQ; however, depending on the allocation there were savings in years with very large bycatch (2016 and 2017). Lower chum salmon bycatch cap alternatives, lead to lower AEQ estimates for both genetic groups. AEQ savings estimates were produced by subtracting the the AEQ under each cap alternative (which estimates the AEQ up until the fishery would be closed) from the AEQ under no cap (the estimated number of adult equivalents removed from a genetic group).

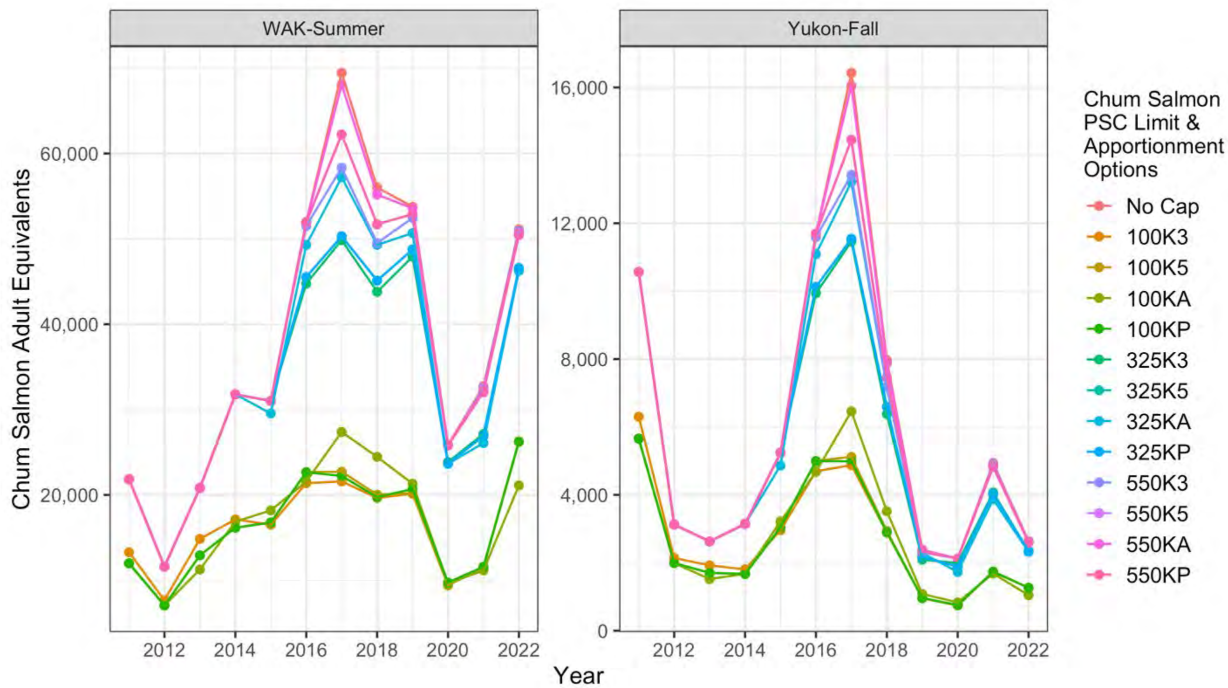

Figure A4-6: Chum salmon adult equivalent (AEQ) for the WAK-Summer and Yukon River – Fall stock groups under the status quo (no cap) and cap (100,000 to 550,000 chum salmon) and allocation (K3, K5, KA, and KP) alternatives.

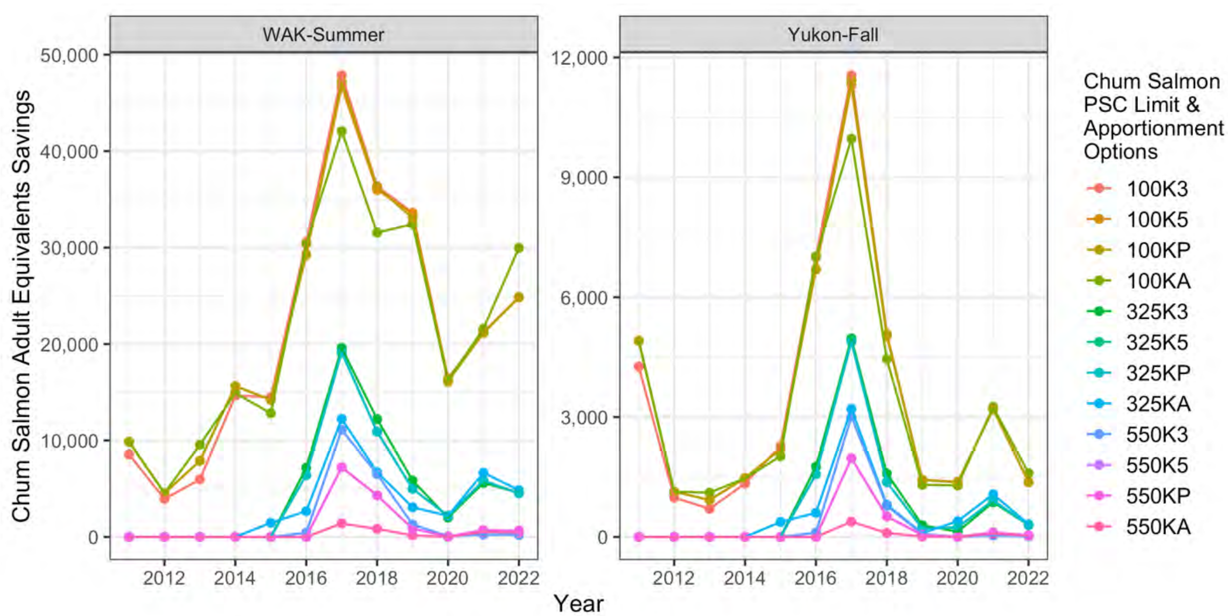

Figure A4-7: Chum salmon adult equivalent (AEQ) savings for the WAK-Summer and Yukon River – Fall stock groups under multiple cap (100,000 to 550,000 chum salmon) and allocation (K3, K5, KA, and KP) alternatives.

If we examine the AEQ savings, the number of fish that would have possibly returned to the WAK-Summer and Yukon-Fall populations if a cap had been in place, we see varying levels of savings across time (Figure A4-7). The savings would be largest for the smallest cap (75,000) as fewer fish would have been taken as bycatch. And the largest savings would occur in 2017 for both genetic groups. In the above graph which estimates the number of WAK-Summer and Yukon-Fall chum salmon in the bycatch we see that 2016 and 2017 had large numbers of age-4 individuals. With the assumed maturity schedule a large proportion of those fish would mature at age-4 and age-5.

Impact Rate for Yukon River - Fall run

The impact of bycatch on salmon populations, in this case aggregated to the genetic reporting group, measures the historical bycatch levels relative to the subsequent returning salmon run. The impact rate is calcualted as: $AEQ_{r,y}/\left(AEQ_{r,y} + S_{r,y}\right)$ where $AEQ_{r,y}$ is the adult equivalent bycatch for stock r in year y and $S_{r,y}$ is the size of stock r in year y.

The WAK - Summer run stock group is comprised of hundreds, if not thosands, of streams ranging from Kotzebue Sound in the North to the Nushagak in the South. A composite estimate of $S_{r,y}$ for that genetic group is not available and so an impact rate for the WAK - Summer run stock group is not possible. The Yukon River - Fall run, however, has a run reconstruction which provides annual estimates of $S_{r,y}$ for this group. This run reconstruction incorporates subdrainage escapement estimates as well as commercial and subsistence harvest within a Bayesian modeling framework (Fleischman and Borba 2009).

The impact rate of bycatch on the Yukon River - Fall run genetic group fluctuated annually from 2011 to 2022 averaging 1% over the time period (Figure A4-8). Impact was lowest in 2013 (0.22%) and 2019 (0.3%). In both years, overall bycatch was low (and was preceded by low bycatch years) resulting in lower-than-average AEQ estimates. Combined with the average escapements for the Yukon River – Fall run resulted in low impact rates for both years. In 2020, the AEQ was the smallest; however, escapement estimate was the second lowest of the time period which resulted in a higher impact rate on the Yukon River - Fall run chum salmon. The largest impact rate was observed in 2021, the year of lowest escapement, highest overall bycatch, and a slightly below average Yukon River - Fall run AEQ.

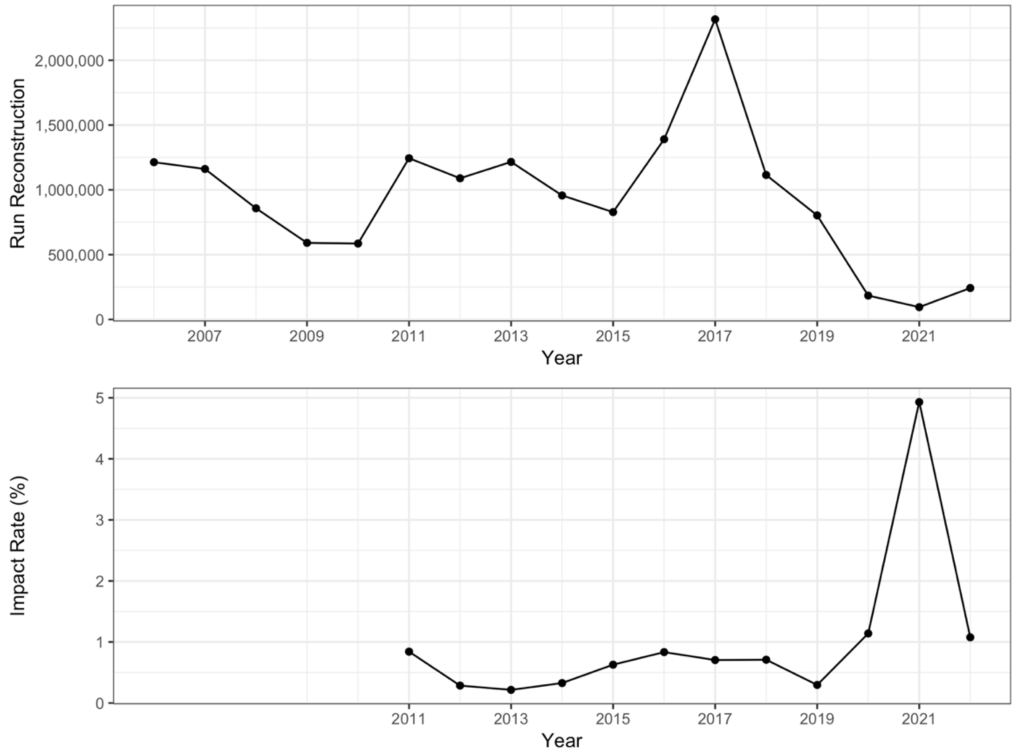

Figure A4-8: Run reconstruction (top) and the estimated impact rate of bycatch (bottom) of the Yukon River – Fall run.

Sensitivity to Natural Mortality

Natural mortality within the AEQ analysis discounts chum salmon caught as bycatch that would have otherwise died at sea from other causes. Natural mortality estimates in the 2024 AEQ were taken from the 2013 AEQ analysis. In order to assess the model's sensitivity to the natural mortality parameter values, we recalculating the AEQ under the assumption of no natural mortality (*i.e.*, all chum salmon bycatch would have survived). In this case only the maturity schedule $gamma_a$ changes how bycatch salmon are accounted for in the AEQ. Values for $gamma_a$ were not recalculated assuming no natural mortality.

If we assume that all fish survival from year to year (natural mortality in the ocean is 0), the AEQ and Impact Rate for the Fall Yukon group is minimally affected. The AEQ increases an average of 412 chum salmon, but ranges from a low of 73 in 2011 to a high of 914 in 2017. Similarly, the Impact Rate increases by an average of 0.078%, but ranges from a low of 0.006 in 2011 to a high of 0.368% in 2021. The values for age specific mortality (M_a) and their corresponding survival (S_a) may represent conservative values; however, the AEQ and impact rate for the Yukon River genetic group is relatively insensitive to increases in survival. It does not appear that assumptions of age specific survival are leading to unrealistically low estimates of impact or AEQ for the Yukon River - Fall Run genetic group. The insensitivity of the model to changes in natural mortality was consistent with results from the prior AEQ (NPFMC 2012).

Uncertainty in the AEQ

There are numerous sources of uncertainty in the AEQ model (*e.g.*, oceanic maturity, survival, in-river age composition, estimates of stock of origin, etc.). The vast amount of uncertainty in these parameter estimates is reviewed in the main text and not reiterated here. To account for some uncertainty a stochastic version of the AEQ was created which simulates values for each of the main parameters within the model. The approaches for survival and maturity were used in the prior chum AEQ analysis (NPFMC 2012).

1) **Number of chum salmon of each age**: Estimates of each age class in the total bycatch were estimated as the product of the age proporitons inferred from the annual scale samples and the total bycatch. Stocastic estimates for each age class can be simulated from the multinomial:

$$\dot{C}_{a,y} \sim Mult\left(n_y, \pi\right)$$

where n_y is the annual bycatch number and π is the age composition inferred from scale samples.

2) **Stock of origin**: The uncertainty in annual age-specific reporting group proportion is quantified with 95% credible intervals; however, in the above analysis we used the mean value. In the stochastic version of the AEQ we simulated the age-specific stock proportions with the normal distribution:

$$\dot{m}_{r,a,y} \sim N\left(m_{r,a,y}, \sigma^2_{r,a,y}\right)$$

where the proportion of fish of age a in a given year t of stock origin r is normally distributed with the mean and variance equal to the posterior estimate from the GSI analysis.

2) **Survival**: Survival estimates were taken from the 2012 chum salmon AEQ. Stochastic survival rates were simulated as:

$$\dot{S}_a = exp(-M_a + \delta), \quad \delta \sim N(0, 0.1^2)$$

with the assumption that survivial is not reporting group specific and temporally invariant.

3) **Maturity**: Maturity in a given year was drawn from a beta-distribution:

$$\dot{\gamma}_{a,R} \sim B\left(\alpha_{a,R}, \beta_{a,R}\right)$$

with parameters $\alpha_{a,R}, \beta_{a,R}$ made to satisfy the expected value of maturity from the in-river age composition data.

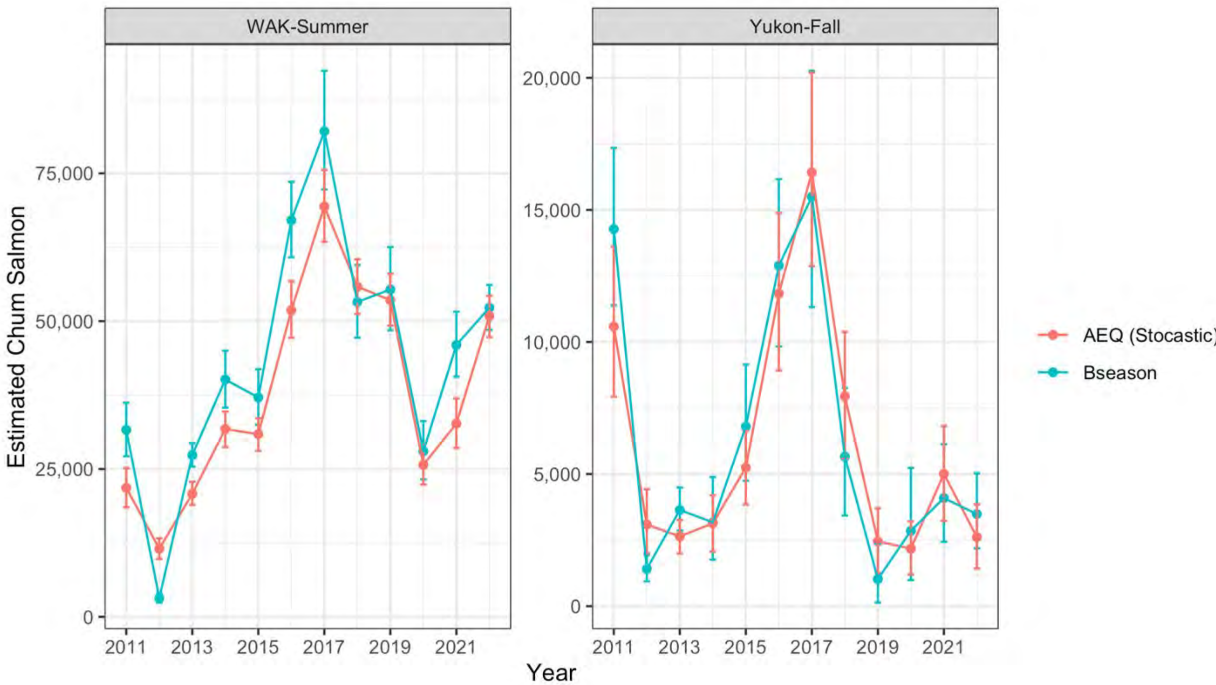

Figure A4-9: Stochastic version of the chum salmon adult equivalent (AEQ) model with uncertainty in age composition of the bycatch, stock of origin, survival, and maturity.

The mean AEQ estimates for the stochastic model overlap with the non-stochastic model and display identical patterns for each genetic group through time. Incorporating some uncertainty in the parameterization of the AEQ model results in overlap between the 90% quartiles of the AEQ and the 95% credible intervals from the B season analysis in some years. In 5 years, the AEQ (and its quantiles) is lower than the B season bycatch for the WAK - Summer run group. In only 2012 was the AEQ larger than the bycatch, stemming from the large reduction in bycatch and lagged effect of prior years contributing to the AEQ in that year.

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Fleischman, S.J. and B.M. Borba. 2009. Escapement estimation, spawner-recruit analysis, and escapement goal recommendation for fall chum salmon in the Yukon River drainage. Alaska Department of Fish and Game, Fishery Manuscript Series No. 09-08, Anchorage.

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Chinook salmon bycatch impact analysis

James Ianelli

2024-07-30

Contents

Background

The previous analysis was conducted in 2022 but the age data and extent of genetic stock identification (to reporting groups) was lower. The following analyses updates that work with the latest available information. Data details are highlighted and shown in subsquent sections.

Chinook salmon bycatch data

The Chinook salmon bycatch estimates are mainly derived from census counts by plant and at-sea scientifically trained NMFS observers. As noted the above the "strata" are defined

1. "A" season (all areas)
2. "B" season west of 170°W
3. "B" season east of 170°W

The age, length, and total catch of Chinook salmon was acquired through the AKFIN database using a web services script created by Matt Callahan. Note that the command: `chin_psc<-get_psc()` takes some time (1991-2023 all PSC data as presently configured).

A summary form was saved as: `cdf <- read_csv("rawdata/chin_psc.csv")` to facilitate accessing the data quickly. The strata were also defined as being stratum 1 = "A" season, stratum 2="B" season NW of 170°W, and stratum 3="B" season SE of 170°W.

The bycatch PSC results were compiled a number of ways including by stratum as shown in Figure 1 and season (Figure 2)) and by sector (Figure 3)). The values for PSC are provided in Table 1.

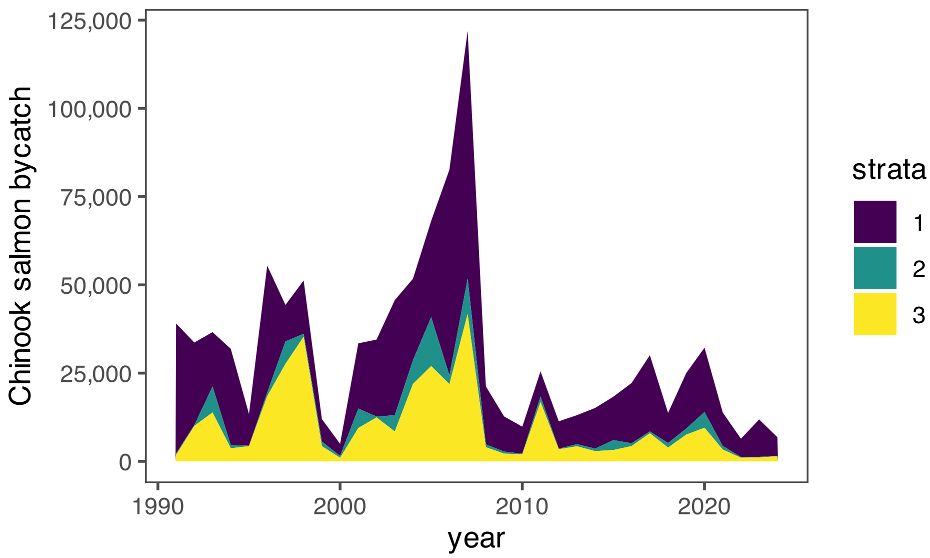

Figure 1: Chinook salmon bycatch by year and strata.

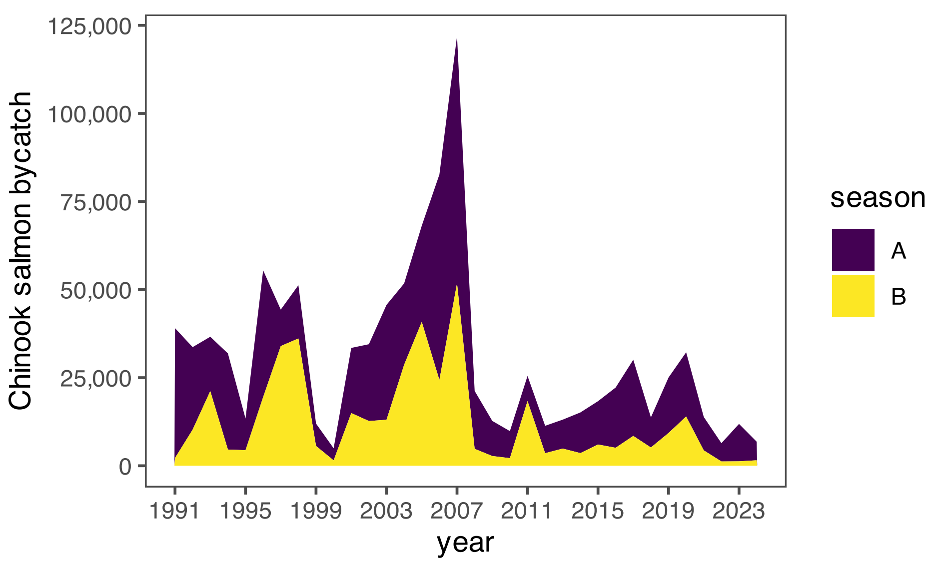

Figure 2: Chinook salmon bycatch by year and season

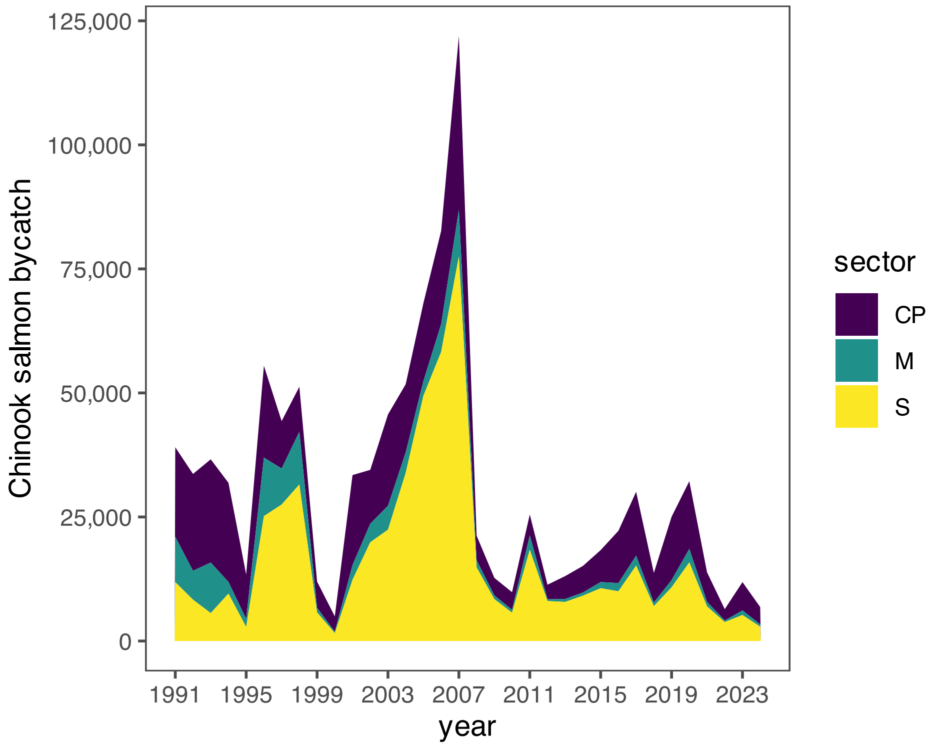

Figure 3: Chinook salmon bycatch by year and sector.

Table 1: Chinook salmon bycatch in the pollock fishery by season and sector. A_CP, A_M, A_S represents catcher-processors, motherships, and shorebased sectors during the A-season (those prefixed with B are for the B-season).

year	total	A_CP	A_M	A_S	B_CP	B_M	B_S
1991	39,054	17,645	9,001	10,192	397	152	1,667
1992	33,672	12,631	4,057	6,725	6,889	1,766	1,604
1993	36,619	8,869	3,529	3,017	11,932	6,657	2,615
1994	31,890	17,149	1,790	8,346	2,826	572	1,207
1995	13,403	5,971	971	2,040	2,973	667	781
1996	55,472	15,276	5,481	15,228	3,222	6,322	9,944
1997	44,320	3,832	1,561	4,954	5,721	5,702	22,550
1998	51,245	6,500	4,284	4,334	2,548	6,361	27,218
1999	11,978	2,694	554	3,103	2,590	374	2,662
2000	4,961	2,525	19	878	568	253	717
2001	33,444	8,264	1,664	8,555	9,863	1,318	3,779
2002	34,495	9,481	1,976	10,336	1,386	1,755	9,560
2003	45,661	14,361	2,880	15,365	4,039	1,940	7,075
2004	51,751	9,438	2,068	11,571	4,295	2,078	22,301
2005	68,126	11,384	2,107	13,792	4,319	887	35,637
2006	82,653	17,256	5,394	35,642	1,531	200	22,630
2007	121,956	27,894	5,861	36,410	7,147	3,542	41,102
2008	21,242	4,552	1,272	10,607	412	175	4,224
2009	12,731	3,130	601	6,235	402	152	2,212
2010	9,835	3,401	493	3,778	144	84	1,934
2011	25,499	2,236	459	4,441	1,986	2,426	13,951
2012	11,343	2,828	312	4,624	97	49	3,433
2013	13,091	4,038	557	3,622	571	48	4,255
2014	15,135	4,653	463	6,420	701	180	2,718
2015	18,329	3,820	689	7,789	2,624	559	2,848
2016	22,204	7,978	1,078	8,040	2,544	577	1,987
2017	30,079	11,016	1,530	9,060	1,863	476	6,134
2018	13,726	4,344	375	3,816	1,617	361	3,213
2019	25,038	8,857	927	5,954	3,899	538	4,863
2020	32,204	8,934	1,242	8,044	4,705	1,472	7,807
2021	13,852	4,368	700	4,407	1,584	222	2,571
2022	6,415	1,911	243	3,031	369	74	787
2023	11,874	5,515	735	4,359	200	183	882
2024	6,842	3,090	350 [4]	1,848	385	132	1,037

The number of samples that have been aged by year and season are shown in Table 2. while the number collected that have yet to be are provided in Table 3. The aged samples are used in combination with the length and stratified-catch to estimate the age composition. Comparisons of location of age samples occurred by season and year are shown in Figure 4.

Table 2: Number of Chinook salmon aged by year and season.

Year	A	B	Total
1997	842	756	1,598
1998	873	826	1,699
1999	645	566	1,211
2011	409	1,084	1,493
2012	461	222	683
2013	496	273	769
2017	1,159	466	1,625
2018	511	302	813
2019	790	361	1,151
2020	1,005	769	1,774
2021	419	192	611
2022	212	7	219

Table 3: Number of Chinook salmon age samples (but without age determinations by year and season

Year	A	B	Total
2011	295	725	1,020
2012	303	136	439
2013	312	200	512
2014	1,132	344	1,476
2015	1,222	588	1,810
2016	1,665	495	2,160
2017	990	354	1,344
2018	332	195	527
2019	751	509	1,260
2020	863	623	1,486
2021	519	228	747
2022	313	112	425
2023	1,051	120	1,171
2024	291		

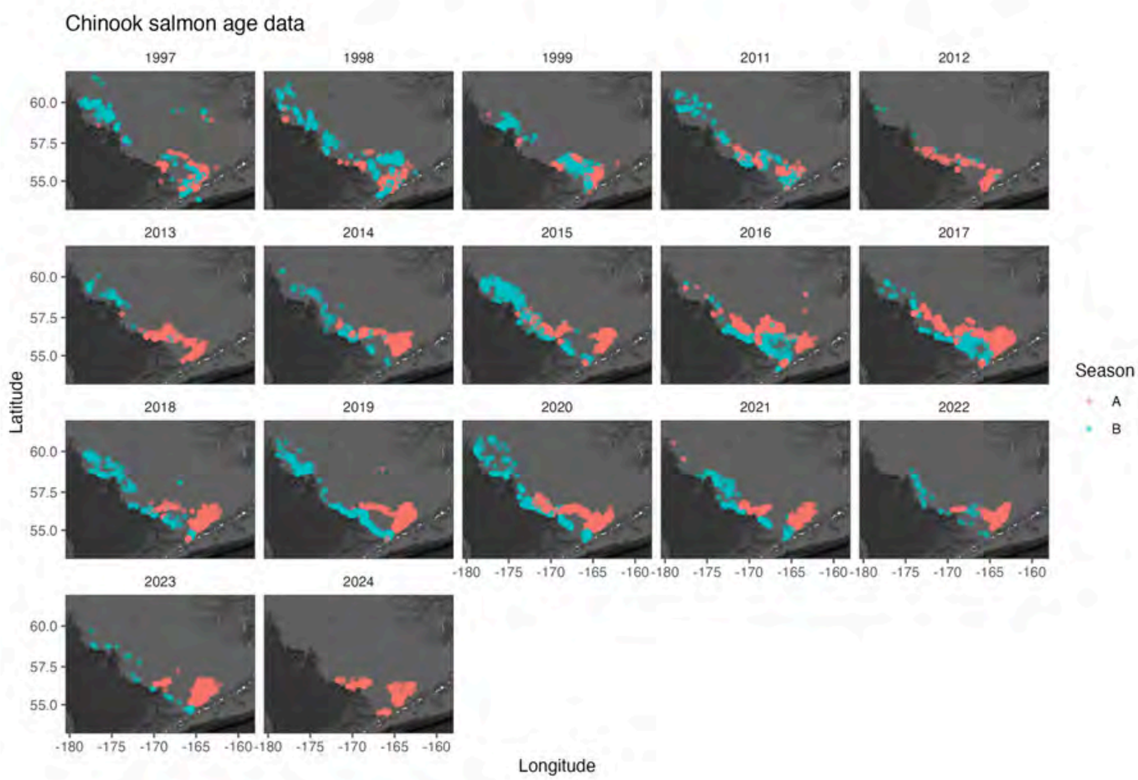

Figure 4: Map of locales where age samples from Chinook salmon were collected.

To evaluate how length-at-age of Chinook salmon in the bycatch may have changed over time, the raw data were broken out by season and plotted spatially (Figure 4). Most of the Chinook salmon occurring in the bycatch appear to be age 4 and 5 years old. To examine for trends over time, the length of these ages are shown below. This figure suggests that the mean lengths at age have been fairly consistent during the "A" season but that there is a decline observed in the "B" season, particularly for age 5 year old Chinook salmon (Figure 5)).

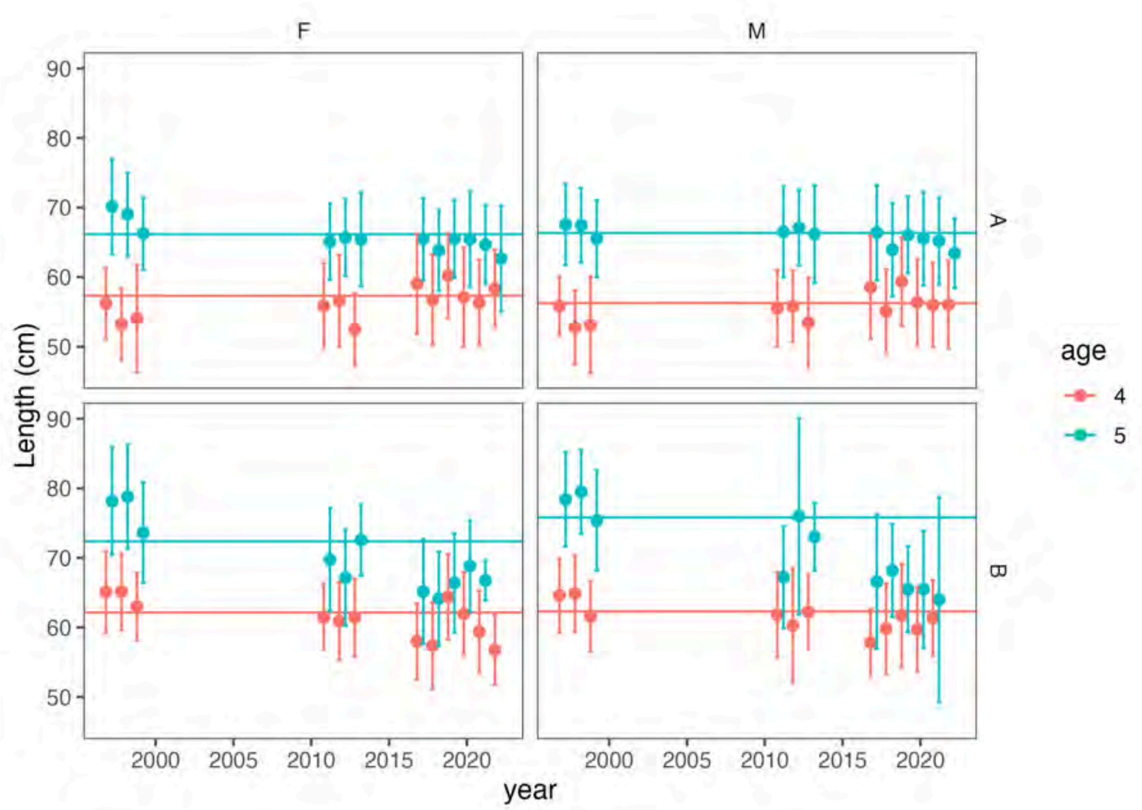

Figure 5: Mean length-at-age for Chinook salmon in the bycatch based on the available age data.

Age data

The following figures represent the available raw age data used for the analysis. Note that these data are used in conjunction with the length data using methods shown in the subsequent section.

The age composition by strata is shown in Figure 6. whereas those broken out by season and year are shown in Figure 7 and Figure 8.

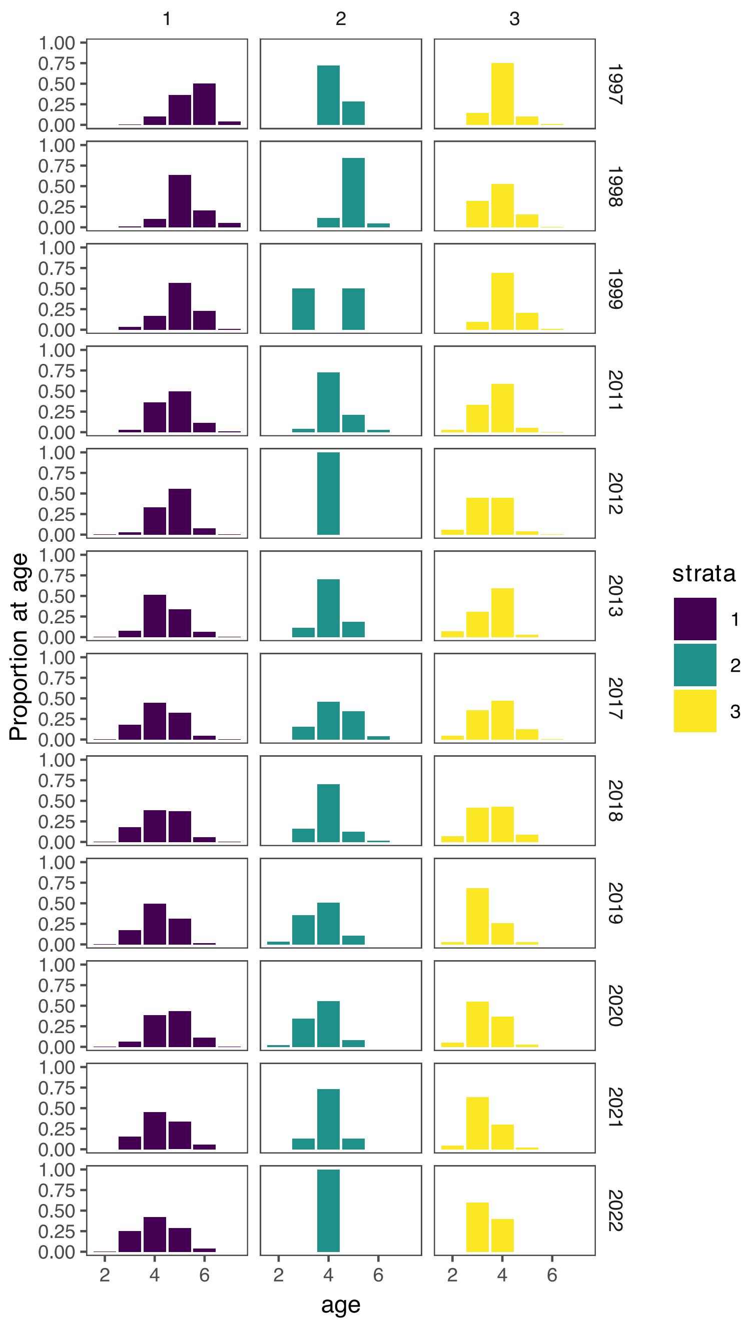

Figure 6: Raw Chinook salmon age frequency in the bycatch data by strata and year. Note that data for 2014-2016 are unavailable.

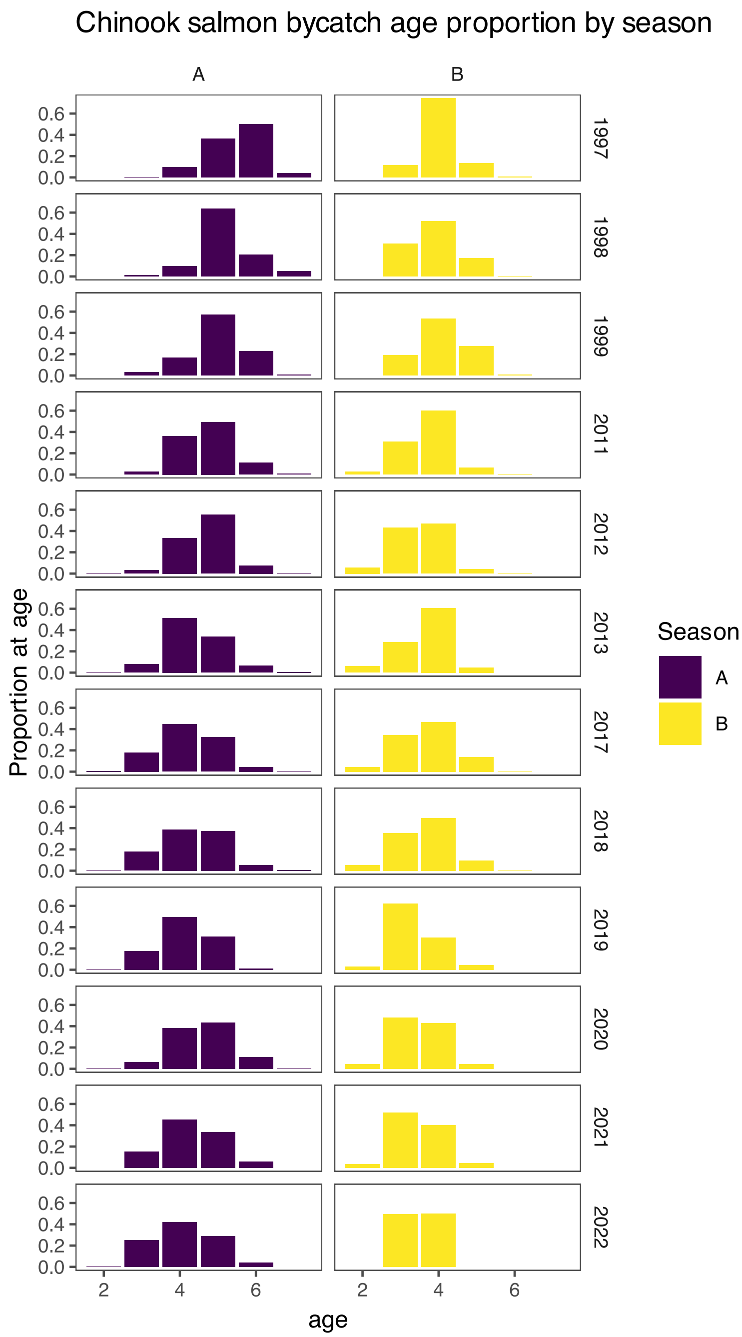

Figure 7: Raw Chinook salmon age frequency in the bycatch data by season and year.

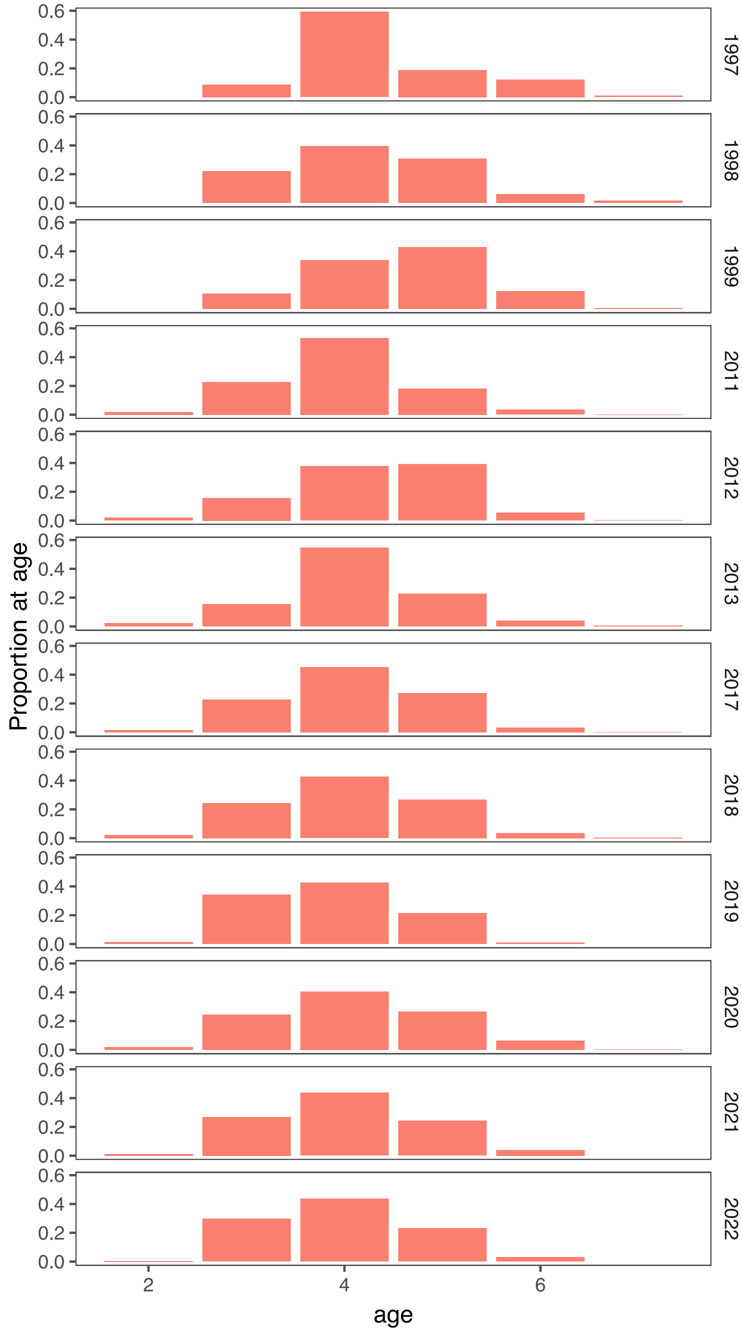

Figure 8: Raw Chinook salmon age frequency in the bycatch data by year.'

Length

Length frequency data are generally more numerous than ages, so accounting for the annual stratum-specific age-length key to come up with the annual age compositions is a standard approach. The length data presently available for Chinook salmon are shown in the next sections.

Length frequencies are shown in Figure 9 by season with sample size values provided in Table 4).

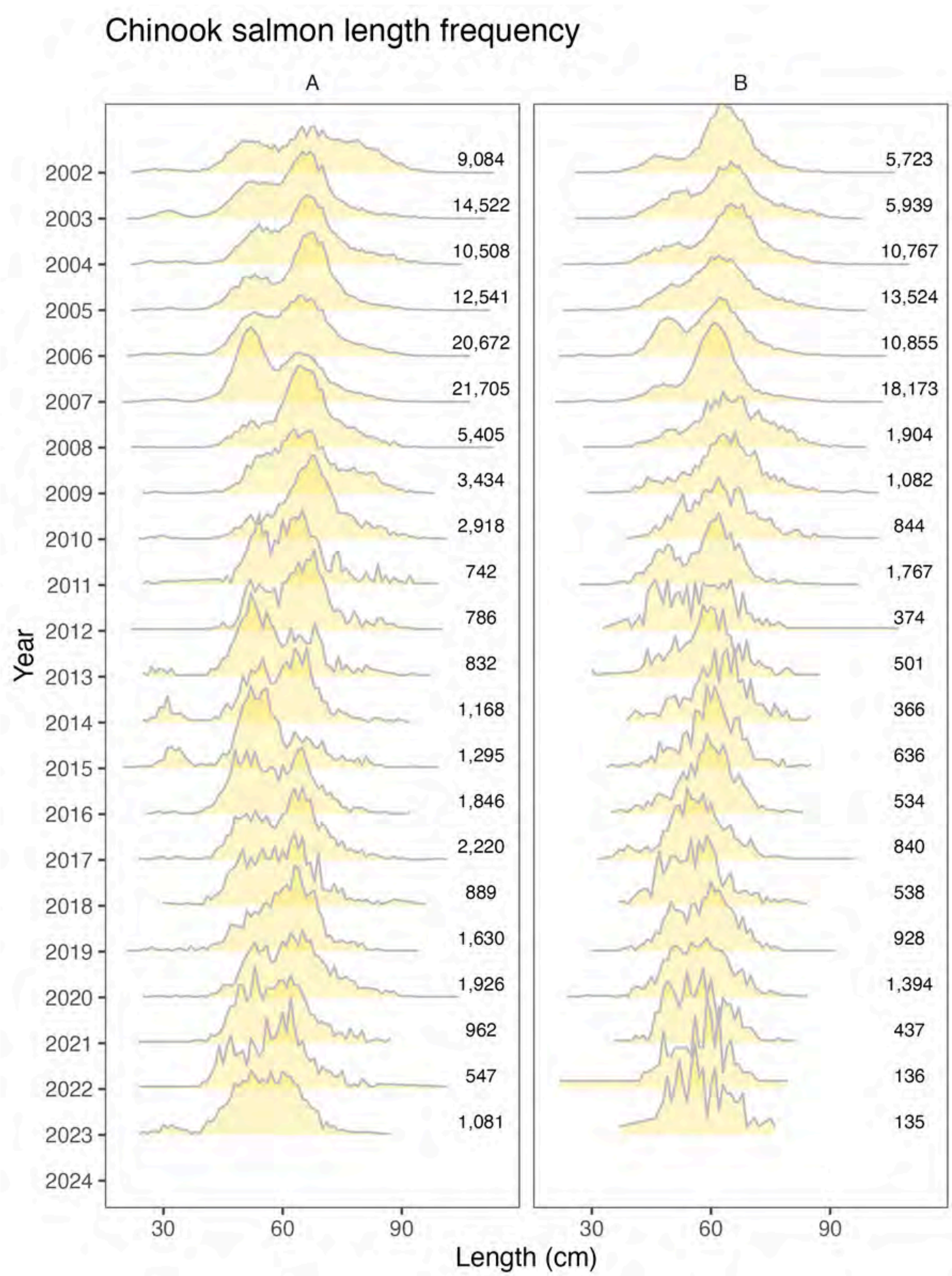

Figure 9: Length frequency of Chinook salmon bycatch by season.

Table 4: Number of Chinook salmon lengths by season and year.

Year	A	B	Total
2002	9084	5723	14807
2003	14522	5939	20461
2004	10508	10767	21275
2005	12541	13524	26065
2006	20672	10855	31527
2007	21705	18173	39878
2008	5405	1904	7309
2009	3434	1082	4516
2010	2918	844	3762
2011	742	1767	2509
2012	786	374	1160
2013	832	501	1333
2014	1168	366	1534
2015	1295	636	1931
2016	1846	534	2380
2017	2220	840	3060
2018	889	538	1427
2019	1630	928	2558
2020	1926	1394	3320
2021	962	437	1399
2022	547	136	683
2023	1081	135	1216
2024	16	NA	NA

The data collection locales by season and year are shown in Figure 10.

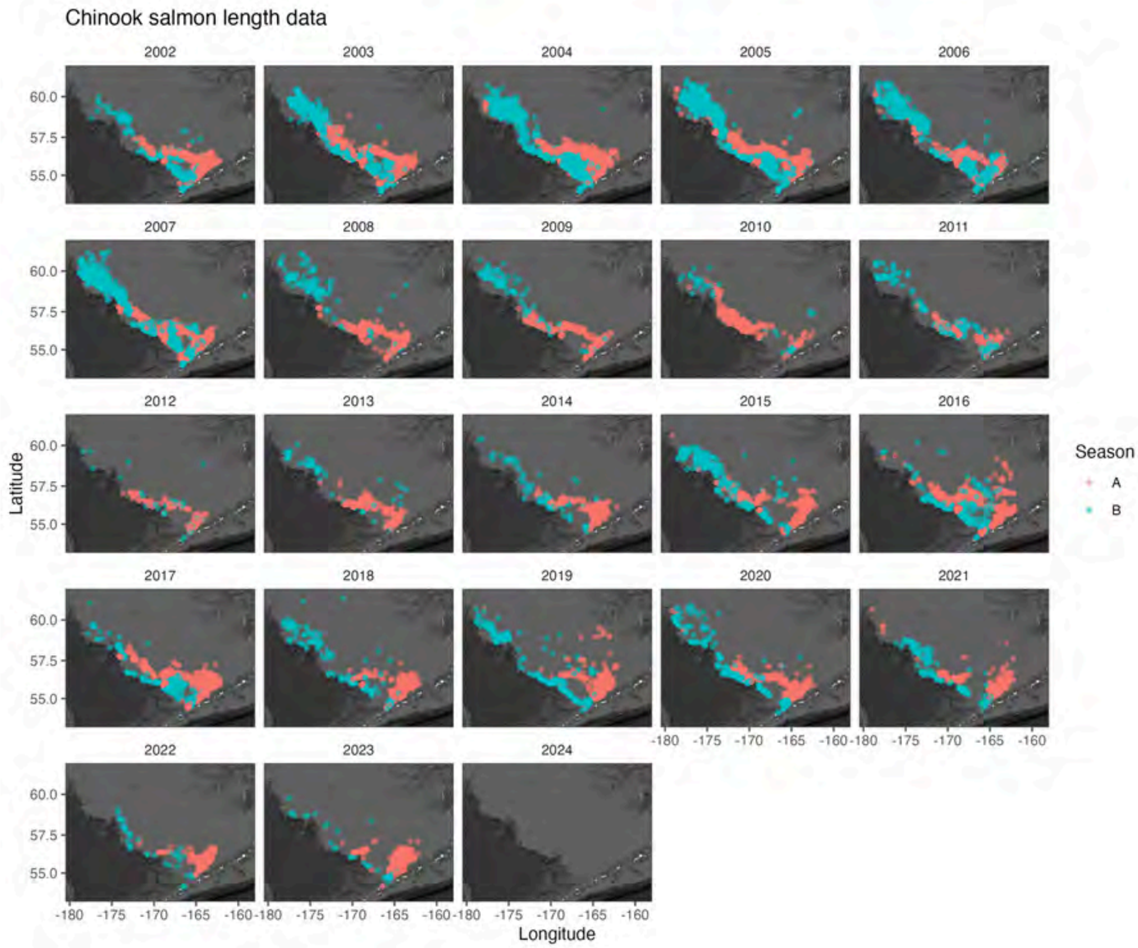

Figure 10: Chinook salmon length sample locales by season and year.

Estimating age composition

To estimate age compositions including information on the length frequency data
The catch-at-age estimates apply observer-collected length frequency and length-at-age data using the method of Kimura (1989) and modified by Dorn (1992). Age–length keys for each time–area stratum and sex are constructed and applied to randomly sampled catch-at-length frequency data. The stratum-specific age composition estimates are then weighted by the catch within each stratum to arrive at an overall age composition for each year. The length frequency data on Chinook salmon from the NMFS observer database were used to estimate the overall length and age composition of the bycatch for each season. The age data were used to construct annual stratified age–length keys when sample sizes were appropriate and stratified combined-year age–length

keys for years where age samples were limited. To the extent possible, sex-specific age–length keys within each stratum were created and where cells were missing, a "global" sex-specific age–length key was used. The global key was computed over all strata within the same season. For years where age data were unavailable, a combined-year age–length key (based on data spanning all years) was applied to observed catch length frequencies. Applying the available length frequencies with stratified catch and age data resulted in age composition estimates in the bycatch that were predominately age 4 (Figure 8). Generally, it is inappropriate to use the same age–length key over multiple years because the proportions at age for given lengths can be influenced by variability in relative year-class strengths. Combining age data over all the years averages the year-class effects to some degree, but may mask the actual variability in age compositions in individual years. This practice was evaluated and, given the relatively distinct length frequency modes corresponding to age, the results were found to be relatively insensitive (NPFMC/NMFS, 2018). The estimates of uncertainty in the age composition due to sampling have increased substantially due to the lower number of Chinook salmon sampled for lengths since 2008. Note that estimates of age composition were computed using a two-stage bootstrap application in which the first stage was resampling from a population of observed hauls (with replacement), then resampling individual fish within those hauls (also with replacement). Under the sampling protocol implemented in 2011 fewer Chinook salmon are being measured due to effort being shifted towards collecting genetic tissue for stock identification studies.

Compiling data

The code below sets up the main control files given that the age and length data have been collated and put in the `rawdata` subdirectory.

Running sampler

The steps to run a specific year can be looped through and results appear in the folder 'results'.

Sampler results

Bycatch-at-age

Below shows a sample of Chinook salmon bycatch age composition by year and relative age with older (top) and younger (bottom) by estimated age. Vertical spread of blobs represent uncertainty as estimated from the two-stage bootstrap re-sampling procedure.

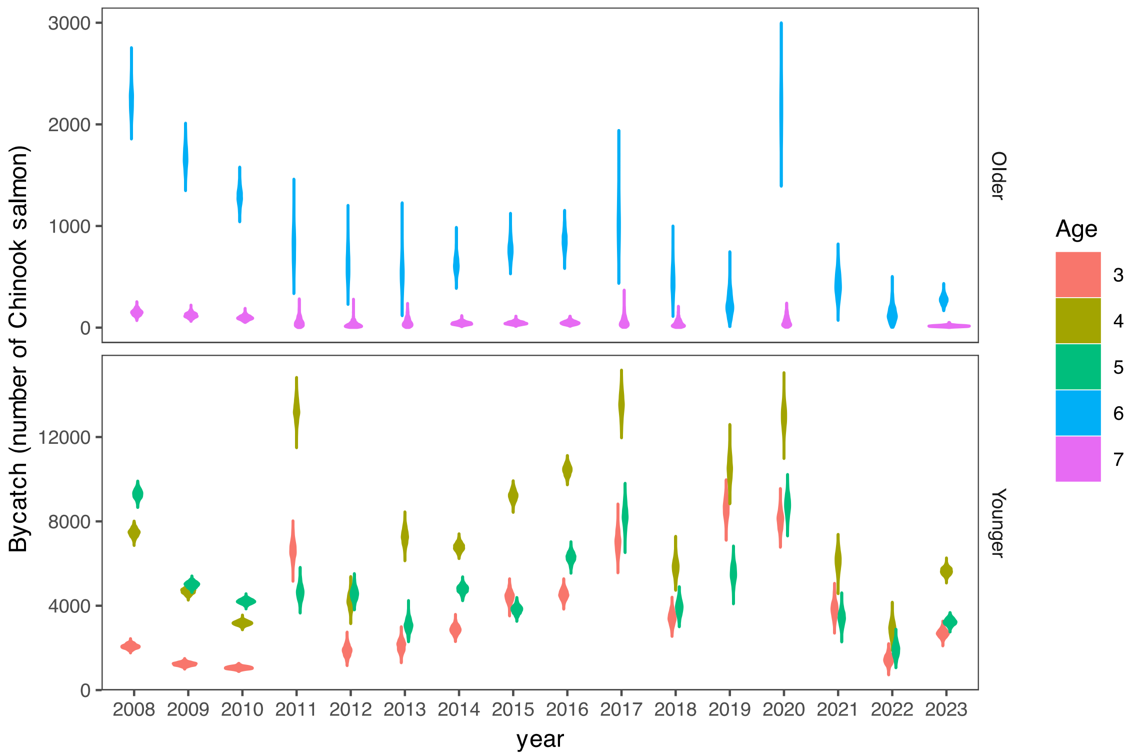

Table 5 shows the results of the bycatch-at-age estimates. Age specific Chinook salmon mean bycatch estimates by season and calendar age based on the mean of 1000 bootstrap samples of available length and age data, 1991-2021. Note that totals may differ from official totals due to random variability of the bootstrap sampling procedure.

Table 5: Catch-at-age estimates by year and season for Chinook salmon in the EBS pollock fishery.

year	season	3	4	5	6	7
1991	A	7,213	15,243	10,675	3,355	334
1991	B	363	1,035	609	174	35
1991	All	7,577	16,278	11,284	3,529	369
1992	A	1,550	6,842	11,349	3,363	304
1992	B	4,365	4,914	881	88	9
1992	All	5,914	11,756	12,231	3,451	313
1993	A	1,273	4,425	6,872	2,598	246
1993	B	3,239	12,657	4,301	899	98
1993	All	4,512	17,082	11,172	3,497	344
1994	A	1,190	7,291	15,033	3,459	308
1994	B	491	1,960	1,727	383	43
1994	All	1,681	9,251	16,760	3,842	351
1995	A	414	1,461	3,550	3,229	328
1995	B	674	2,692	861	160	33
1995	All	1,088	4,153	4,412	3,389	360
1996	A	2,058	10,957	18,473	4,134	360
1996	B	5,620	10,742	2,722	356	45
1996	All	7,679	21,699	21,195	4,490	405
1997	A	323	1,525	4,014	4,135	350
1997	B	6,083	22,668	2,987	2,093	142
1997	All	6,406	24,193	7,001	6,229	492
1998	A	855	2,236	9,117	2,410	500
1998	B	18,359	14,627	2,508	497	137
1998	All	19,214	16,863	11,624	2,907	636
1999	A	415	1,575	3,322	1,016	24
1999	B	427	3,663	1,219	314	4
1999	All	842	5,238	4,541	1,330	28
2000	A	532	1,258	1,166	431	35
2000	B	361	737	371	62	7
2000	All	893	1,995	1,537	493	43
2001	A	3,158	5,535	7,974	1,666	121
2001	B	4,990	7,968	1,781	199	20
2001	All	8,148	13,503	9,754	1,865	141
2002	A	2,404	5,931	8,182	4,853	416
2002	B	3,297	7,879	1,436	78	9
2002	All	5,701	13,810	9,617	4,931	424
2003	A	4,186	11,095	14,003	3,063	240
2003	B	3,235	7,057	2,330	399	32
2003	All	7,421	18,152	16,333	3,462	272
2004	A	1,951	6,982	10,506	3,335	291
2004	B	6,966	16,446	4,709	508	41
2004	All	8,917	23,429	15,216	3,844	331
2005	A	2,479	8,537	13,134	2,943	185
2005	B	11,829	22,552	5,654	752	52
2005	All	14,308	31,089	18,788	3,695	236
2006	A	6,515	20,734	24,540	6,078	402
2006	B	8,923	12,909	2,277	227	23
2006	All	15,438	33,643	26,817	6,305	425
2007	A	10,520	30,036	24,282	5,003	314
2007	B	15,366	31,150	4,780	460	28
2007	All	25,886	61,185	29,062	5,464	342
2008	A	1,005	4,774	8,379	2,128	144
2008	B	1,071	2,698	927	109	6
2008	All	2,076	7,472	9,305	2,237	151
2009	A	575	3,083	4,566	1,623	117
2009	B	662	1,606	439	55	5
2009	All	1,237	4,688	5,005	1,678	122
2010	A	429	1,915	3,960	1,272	95
2010	B	630	1,262	244	23	3
2010	All	1,059	3,177	4,204	1,295	98
2011	A	304	2,732	3,417	646	36
2011	B	6,350	10,538	1,226	158	14
2011	All	6,654	13,270	4,643	804	49
2012	A	394	2,596	4,199	555	20
2012	B	1,476	1,651	381	67	0
2012	All	1,870	4,247	4,579	622	20
2013	A	710	4,325	2,656	475	40
2013	B	1,389	2,959	420	79	9
2013	All	2,099	7,284	3,076	554	48
2014	A	1,901	4,628	4,367	579	43
2014	B	974	2,158	421	45	1
2014	All	2,875	6,786	4,788	625	44
2015	A	2,681	5,578	3,237	734	45
2015	B	1,761	3,645	584	37	2
2015	All	4,442	9,223	3,821	771	46
2016	A	2,822	7,427	5,951	845	49
2016	B	1,721	3,016	352	18	0
2016	All	4,543	10,443	6,303	863	49
2017	A	3,955	9,512	7,074	968	42
2017	B	3,055	4,048	1,209	59	3
2017	All	7,010	13,560	8,283	1,027	45
2018	A	1,427	3,393	3,257	414	30
2018	B	2,000	2,444	672	55	3
2018	All	3,426	5,837	3,928	469	33
2019	A	2,767	7,766	4,894	222	0
2019	B	5,841	2,762	664	11	0
2019	All	8,608	10,529	5,557	232	0
2020	A	1,151	6,938	7,997	2,049	54
2020	B	6,920	6,057	795	113	1
2020	All	8,071	12,995	8,792	2,161	55
2021	A	1,745	4,408	2,915	402	0
2021	B	2,085	1,738	514	30	0
2021	All	3,830	6,146	3,429	431	0
2022	A	1,213	2,264	1,570	132	0
2022	B	241	637	342	4	0
2022	All	1,453	2,901	1,913	137	0
2023	A	2,159	4,978	3,174	274	17
2023	B	536	663	64	2	0
2023	All	2,694	5,642	3,238	276	17

Genetics data

The genetics data available for this analysis were aggregated by season. The proportions to reporting group over time are shown in Figure 11 while when scaled to total PSC Chinook salmon bycatch across years shows the influence of higher levels in the B-season of 2011 (Figure 12). Table 6 contains the bycatch and proportional assignments to reporting groups.

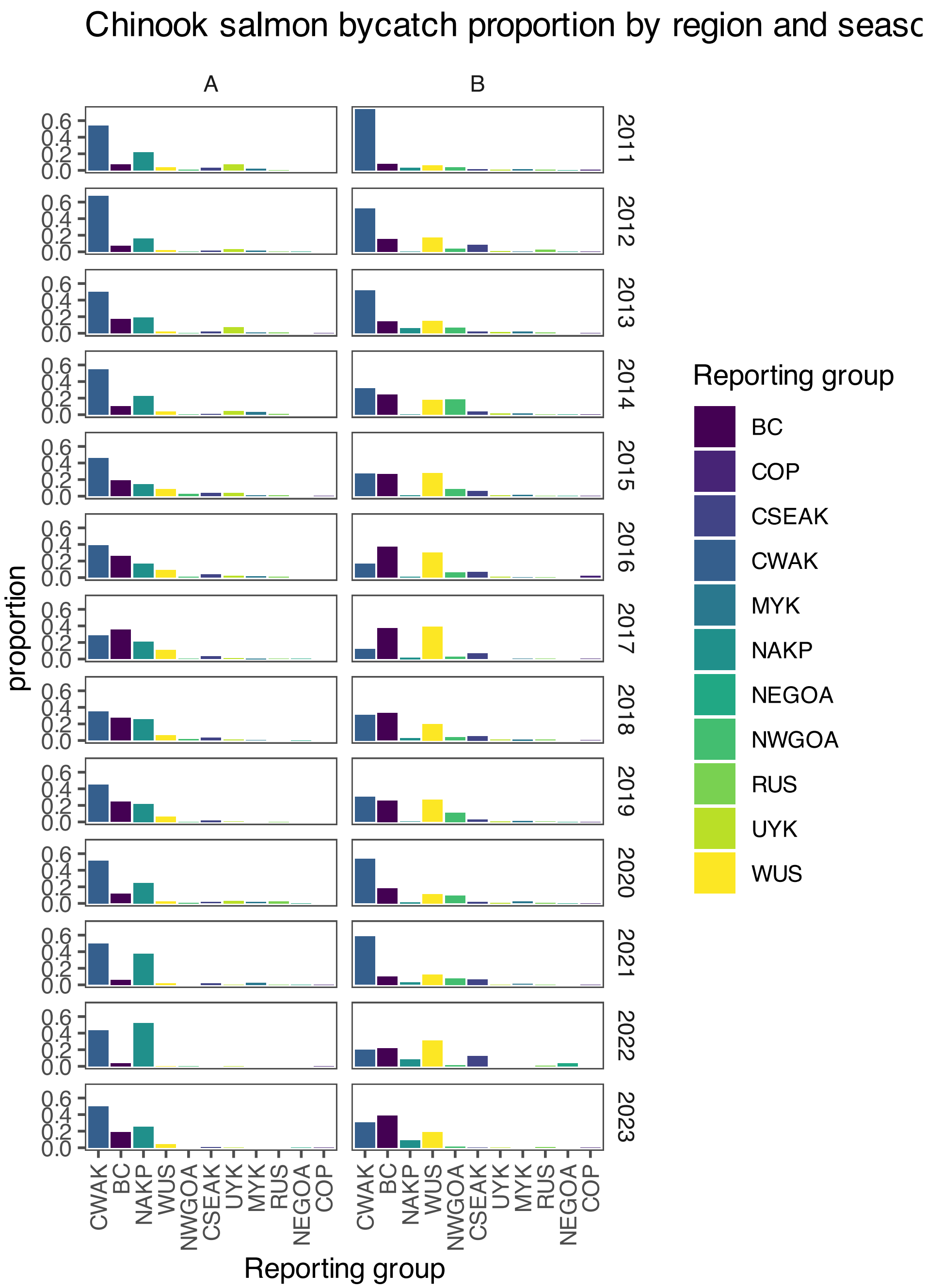

Figure 11: Chinook salmon bycatch proportions to reporting groups by year and season.

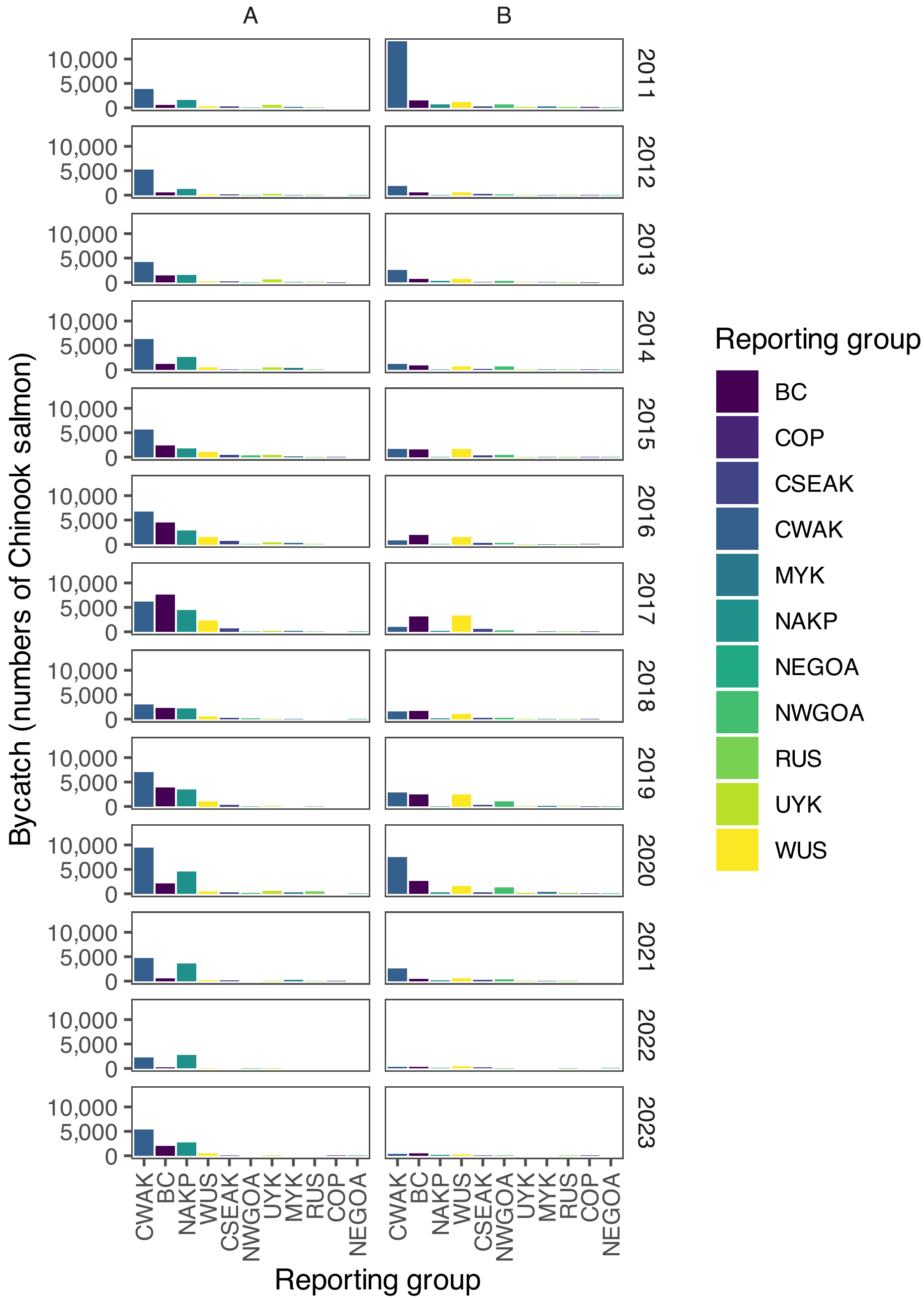

Figure 12: Chinook salmon PSC apportioned to reporting groups and scaled to totals by year and season.

The expanded bycatch estimates to reporting groups is shown in Table 6.

Table 6: Expanded table of bycatch estimates to reporting groups based on genetic analysis along with upper and lower credible intervals.

source	year	season	proportion	catch	lb	ub
RUS	2011	A	0.002	14	0	43
CWAK	2011	A	0.540	3,853	3,539	4,175
MYK	2011	A	0.018	128	43	257
UYK	2011	A	0.074	528	378	692
NAKP	2011	A	0.218	1,556	1,292	1,834
NWGOA	2011	A	0.006	43	0	157
COP	2011	A	0.000	0	0	14
NEGOA	2011	A	0.000	0	0	14
CSEAK	2011	A	0.031	221	114	350
BC	2011	A	0.072	514	364	685
WUS	2011	A	0.040	285	186	400
RUS	2011	B	0.010	184	110	294
CWAK	2011	B	0.738	13,552	13,093	13,993
MYK	2011	B	0.013	239	92	404
UYK	2011	B	0.007	129	18	257
NAKP	2011	B	0.034	624	404	881
NWGOA	2011	B	0.036	661	367	1,010
COP	2011	B	0.006	110	0	220
NEGOA	2011	B	0.001	18	0	147
CSEAK	2011	B	0.014	257	110	441
BC	2011	B	0.078	1,432	1,175	1,689
WUS	2011	B	0.064	1,175	973	1,414
RUS	2012	A	0.005	39	16	93
CWAK	2012	A	0.678	5,264	4,922	5,598
MYK	2012	A	0.012	93	0	241
UYK	2012	A	0.031	241	124	373
NAKP	2012	A	0.162	1,258	986	1,553
NWGOA	2012	A	0.002	16	0	93
COP	2012	A	0.000	0	0	23
NEGOA	2012	A	0.001	8	0	70
CSEAK	2012	A	0.017	132	23	264
BC	2012	A	0.073	567	404	745
WUS	2012	A	0.019	148	78	233
RUS	2012	B	0.024	86	39	154
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COP	2019	A	0.000	0	0	31
NEGOA	2019	A	0.000	0	0	16
CSEAK	2019	A	0.020	315	157	504
BC	2019	A	0.243	3,824	3,462	4,202
WUS	2019	A	0.065	1,023	834	1,243
RUS	2019	B	0.005	47	9	102
CWAK	2019	B	0.304	2,827	2,492	3,171
MYK	2019	B	0.014	130	47	242
UYK	2019	B	0.006	56	0	130
NAKP	2019	B	0.004	37	0	149
NWGOA	2019	B	0.112	1,042	791	1,311
COP	2019	B	0.002	19	0	84
NEGOA	2019	B	0.001	9	0	65
CSEAK	2019	B	0.029	270	140	409
BC	2019	B	0.259	2,409	2,120	2,706
WUS	2019	B	0.266	2,474	2,186	2,771
RUS	2020	B	0.009	123	59	210
CWAK	2020	B	0.536	7,499	7,037	7,956
MYK	2020	B	0.023	320	140	528
UYK	2020	B	0.009	130	37	257
NAKP	2020	B	0.015	208	93	354
NWGOA	2020	B	0.093	1,301	1,004	1,621
COP	2020	B	0.000	7	2	40
NEGOA	2020	B	0.001	12	3	72
CSEAK	2020	B	0.018	250	67	466
BC	2020	B	0.183	2,559	2,222	2,911
WUS	2020	B	0.113	1,576	1,324	1,846
RUS	2020	A	0.024	432	275	617
CWAK	2020	A	0.515	9,392	8,803	9,972
MYK	2020	A	0.015	279	128	477
UYK	2020	A	0.030	552	374	759
NAKP	2020	A	0.248	4,516	4,022	5,029
NWGOA	2020	A	0.008	142	57	387
COP	2020	A	0.000	0	0	70
NEGOA	2020	A	0.000	3	0	54
CSEAK	2020	A	0.016	294	121	513
BC	2020	A	0.116	2,121	1,768	2,484
WUS	2020	A	0.027	490	342	674
BC	2021	A	0.059	558	390	752
CSEAK	2021	A	0.021	200	74	349
CWAK	2021	A	0.496	4,702	4,288	5,121
COP	2021	A	0.000	5	0	52
MYK	2021	A	0.024	231	0	433
NAKP	2021	A	0.378	3,583	3,223	3,948
NEGOA	2021	A	0.000	1	0	31
NWGOA	2021	A	0.000	0	0	130
RUS	2021	A	0.001	9	0	52
UYK	2021	A	0.001	14	0	68
WUS	2021	A	0.018	173	81	289
BC	2021	B	0.102	445	299	633
CSEAK	2021	B	0.068	297	135	454
CWAK	2021	B	0.584	2,556	2,289	2,808
COP	2021	B	0.000	1	0	38
MYK	2021	B	0.011	48	11	112
NAKP	2021	B	0.029	125	36	249
NEGOA	2021	B	0.000	0	0	37
NWGOA	2021	B	0.078	340	182	526
RUS	2021	B	0.002	10	0	53
UYK	2021	B	0.000	2	0	36
WUS	2021	B	0.126	553	405	719
RUS	2022	A	0.000	0	0	15
CWAK	2022	A	0.436	2,261	1,964	2,561
MYK	2022	A	0.000	0	0	28
UYK	2022	A	0.001	4	0	35
NAKP	2022	A	0.522	2,709	2,405	3,010
NWGOA	2022	A	0.003	15	0	143
COP	2022	A	0.000	0	0	16
NEGOA	2022	A	0.000	0	0	28
CSEAK	2022	A	0.000	0	0	17
BC	2022	A	0.036	184	99	294
WUS	2022	A	0.002	13	0	54
RUS	2022	B	0.006	8	1	46
CWAK	2022	B	0.201	247	132	380
MYK	2022	B	0.000	0	0	15
UYK	2022	B	0.000	0	0	17
NAKP	2022	B	0.083	102	33	200
NWGOA	2022	B	0.013	17	1	102
COP	2022	B	0.000	0	0	40
NEGOA	2022	B	0.039	48	9	142
CSEAK	2022	B	0.126	155	63	268
BC	2022	B	0.221	272	160	405
WUS	2022	B	0.310	381	261	516
BC	2023	A	0.188	1,995	1,715	2,285
CSEAK	2023	A	0.006	69	0	211
CWAK	2023	A	0.500	5,303	4,917	5,689
COP	2023	A	0.002	21	0	84
MYK	2023	A	0.000	0	0	31
NAKP	2023	A	0.256	2,711	2,369	3,065
NEGOA	2023	A	0.004	41	4	104
NWGOA	2023	A	0.000	0	0	164
RUS	2023	A	0.000	0	0	11
UYK	2023	A	0.003	28	8	79
WUS	2023	A	0.042	442	306	597
BC	2023	B	0.387	489	357	624
CSEAK	2023	B	0.002	3	0	83
CWAK	2023	B	0.304	385	262	514
COP	2023	B	0.004	5	0	39
MYK	2023	B	0.000	0	0	12
NAKP	2023	B	0.089	112	45	204
NEGOA	2023	B	0.000	0	0	15
NWGOA	2023	B	0.016	20	5	88
RUS	2023	B	0.009	11	0	50
UYK	2023	B	0.000	0	0	18
WUS	2023	B	0.1[illegible]	239	144	350

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The stock-proportions table of the bycatch by season is provided in Table 7.

Table 7: Estimated reporting-groups proportions of Chinook salmon PSC bycatch by season.

year	season	RUS	CWAK	MYK	UYK	NAKP	NWGOA	COP	NEGOA	CSEAK	BC	WUS
2011	A	0.2%	54.0%	1.8%	7.4%	21.8%	0.6%	0.0%	0.0%	3.1%	7.2%	4.0%
2012	A	0.5%	67.8%	1.2%	3.1%	16.2%	0.2%	0.0%	0.1%	1.7%	7.3%	1.9%
2013	A	0.9%	50.2%	1.1%	7.2%	19.1%	0.5%	0.1%	0.0%	1.9%	17.0%	2.0%
2014	A	0.6%	54.6%	3.3%	4.1%	22.7%	0.1%	0.0%	0.0%	0.6%	10.2%	3.7%
2015	A	0.6%	45.9%	1.0%	3.6%	14.5%	2.8%	0.2%	0.0%	3.9%	19.1%	8.4%
2016	A	0.6%	39.0%	1.7%	2.2%	16.9%	0.6%	0.0%	0.0%	3.9%	26.1%	9.0%
2017	A	0.2%	28.3%	0.6%	0.7%	20.7%	0.4%	0.0%	0.1%	3.2%	35.2%	10.7%
2018	A	0.0%	34.8%	0.4%	0.8%	25.6%	1.5%	0.0%	0.1%	3.3%	27.3%	6.2%
2019	A	0.1%	44.8%	0.0%	0.3%	21.7%	0.2%	0.0%	0.0%	2.0%	24.3%	6.5%
2020	A	2.4%	51.5%	1.5%	3.0%	24.8%	0.8%	0.0%	0.0%	1.6%	11.6%	2.7%
2021	A	0.1%	49.6%	2.4%	0.1%	37.8%	0.0%	0.0%	0.0%	2.1%	5.9%	1.8%
2022	A	0.0%	43.6%	0.0%	0.1%	52.2%	0.3%	0.0%	0.0%	0.0%	3.6%	0.2%
2023	A	0.0%	50.0%	0.0%	0.3%	25.6%	0.0%	0.2%	0.4%	0.6%	18.8%	4.2%
2011	B	1.0%	73.8%	1.3%	0.7%	3.4%	3.6%	0.6%	0.1%	1.4%	7.8%	6.4%
2012	B	2.4%	52.1%	0.2%	1.0%	0.1%	3.8%	0.1%	0.1%	8.2%	15.3%	17.0%
2013	B	0.9%	51.9%	1.9%	1.4%	5.9%	6.9%	0.1%	0.0%	1.9%	14.3%	14.8%
2014	B	0.4%	31.8%	1.7%	1.6%	0.1%	18.4%	0.1%	0.1%	3.6%	24.5%	17.9%
2015	B	0.1%	27.4%	1.6%	1.1%	1.0%	8.2%	0.1%	0.1%	6.3%	26.6%	27.5%
2016	B	0.2%	16.5%	0.4%	0.7%	1.1%	5.9%	1.8%	0.0%	6.5%	37.0%	29.9%
2017	B	0.2%	12.0%	0.3%	0.0%	1.8%	2.7%	0.1%	0.0%	6.8%	37.1%	38.8%
2018	B	0.8%	31.1%	1.3%	1.1%	2.9%	4.0%	0.5%	0.0%	5.3%	33.0%	20.0%
2019	B	0.5%	30.4%	1.4%	0.6%	0.4%	11.2%	0.2%	0.1%	2.9%	25.9%	26.6%
2020	B	0.9%	53.6%	2.3%	0.9%	1.5%	9.3%	0.0%	0.1%	1.8%	18.3%	11.3%
2021	B	0.2%	58.4%	1.1%	0.0%	2.9%	7.8%	0.0%	0.0%	6.8%	10.2%	12.6%
2022	B	0.6%	20.1%	0.0%	0.0%	8.3%	1.3%	0.0%	3.9%	12.6%	22.1%	31.0%
2023	B	0.9%	30.4%	0.0%	0.0%	8.9%	1.6%	0.4%	0.0%	0.2%	38.7%	18.9%

Chinook salmon run sizes

Run-size data provided by ADF&G were converted into a uniform and machine-readable format. Details on each of the runs were provided in the previous analyses. These estimates use a 5 year average for subsistence and sport harvest above and below the sonar project. In-river age compositions are shown in Table 8 by year (since 2011). The mean in-river age compositions (most recent 10-years) among systems is shown in Table 9.

Table 8: In-river age composition estimates by year for the Coastal west Alaska Chinook salmon stocks.

Year	Run	Age 3	Age 4	Age 5	Age 6	Age 7
2011	Kuskokwim Bay	0.7%	47.9%	30.5%	20.5%	0.4%
2011	Kuskokwim River	0.2%	27.9%	38.4%	32.0%	1.4%
2011	Lower Yukon	0.0%	32.3%	50.5%	16.7%	0.4%
2011	Middle Yukon	0.0%	16.5%	45.0%	36.9%	1.6%
2011	Norton Sound and Point Clarence	2.2%	60.4%	25.7%	11.6%	0.0%
2011	Nushagak	0.7%	39.0%	38.8%	21.3%	0.2%
2011	Upper Yukon	0.0%	3.8%	34.7%	54.7%	6.7%
2012	Kuskokwim Bay	0.6%	24.2%	44.4%	29.9%	0.9%
2012	Kuskokwim River	0.2%	19.2%	53.0%	26.8%	0.9%
2012	Lower Yukon	0.0%	12.5%	60.2%	27.0%	0.4%
2012	Middle Yukon	0.0%	9.0%	44.7%	45.4%	1.0%
2012	Norton Sound and Point Clarence	0.0%	20.9%	56.9%	22.0%	0.2%
2012	Nushagak	0.7%	26.8%	52.3%	20.1%	0.2%
2012	Upper Yukon	0.0%	7.1%	37.2%	52.2%	3.5%
2013	Kuskokwim Bay	0.3%	28.6%	27.2%	42.8%	0.9%
2013	Kuskokwim River	0.1%	13.4%	30.9%	54.4%	1.0%
2013	Lower Yukon	0.0%	35.9%	28.1%	35.2%	0.8%
2013	Middle Yukon	0.0%	22.9%	25.9%	49.8%	1.4%
2013	Norton Sound and Point Clarence	1.9%	26.8%	34.6%	35.7%	1.1%
2013	Nushagak	0.8%	32.1%	45.9%	21.2%	0.0%
2013	Upper Yukon	0.0%	6.4%	30.1%	59.3%	4.2%
2014	Kuskokwim Bay	3.5%	23.0%	29.5%	42.3%	1.7%
2014	Kuskokwim River	2.2%	16.7%	41.4%	38.5%	1.1%
2014	Lower Yukon	0.0%	13.7%	74.2%	11.7%	0.5%
2014	Middle Yukon	0.0%	11.6%	69.1%	18.4%	1.0%
2014	Norton Sound and Point Clarence	0.8%	8.0%	74.0%	16.0%	1.1%
2014	Nushagak	3.8%	27.0%	48.1%	21.1%	0.0%
2014	Upper Yukon	0.0%	7.1%	50.3%	40.0%	2.6%
2015	Kuskokwim Bay	7.4%	53.9%	22.0%	16.3%	0.3%
2015	Kuskokwim River	0.5%	42.8%	33.1%	23.1%	0.5%
2015	Lower Yukon	0.0%	34.8%	22.2%	43.0%	0.0%
2015	Middle Yukon	0.0%	24.0%	29.9%	45.8%	0.3%
2015	Norton Sound and Point Clarence	0.5%	22.5%	38.5%	34.3%	4.2%
2015	Nushagak	1.3%	56.6%	29.7%	12.3%	0.1%
2015	Upper Yukon	0.0%	12.7%	33.8%	51.4%	2.1%
2016	Kuskokwim Bay	5.6%	58.4%	30.3%	5.6%	0.0%
2016	Kuskokwim River	0.3%	22.0%	63.0%	14.8%	0.0%
2016	Lower Yukon	0.0%	32.7%	52.6%	14.4%	0.3%
2016	Middle Yukon	0.0%	32.5%	50.2%	17.0%	0.4%
2016	Norton Sound and Point Clarence	0.0%	12.5%	62.5%	20.8%	4.2%
2016	Nushagak	0.7%	28.9%	61.1%	9.2%	0.0%
2016	Upper Yukon	0.0%	11.7%	63.8%	23.9%	0.6%
2017	Kuskokwim Bay	9.8%	20.9%	65.4%	3.8%	0.0%
2017	Kuskokwim River	0.8%	31.4%	45.7%	21.9%	0.1%
2017	Lower Yukon	0.0%	44.5%	42.3%	13.1%	0.0%
2017	Middle Yukon	0.0%	13.8%	58.6%	27.5%	0.1%
2017	Norton Sound and Point Clarence	1.9%	30.8%	48.4%	13.8%	5.0%
2017	Nushagak	1.6%	37.3%	43.1%	17.9%	0.2%
2017	Upper Yukon	0.0%	5.7%	48.2%	45.2%	0.9%
2018	Kuskokwim Bay	4.2%	33.3%	36.4%	25.3%	0.9%
2018	Kuskokwim River	2.3%	37.3%	43.7%	16.5%	0.1%
2018	Lower Yukon	0.0%	36.5%	60.2%	3.2%	0.1%
2018	Middle Yukon	0.0%	11.0%	41.6%	46.6%	0.8%
2018	Norton Sound and Point Clarence	0.6%	21.9%	62.9%	14.0%	0.6%
2018	Nushagak	0.1%	42.6%	45.2%	11.4%	0.7%
2018	Upper Yukon	0.0%	12.5%	44.0%	41.9%	1.6%
2019	Kuskokwim Bay	15.8%	29.3%	37.6%	17.3%	0.0%
2019	Kuskokwim River	5.5%	46.6%	33.7%	14.0%	0.2%
2019	Lower Yukon	0.0%	42.0%	42.2%	15.7%	0.1%
2019	Middle Yukon	0.0%	20.8%	45.4%	33.3%	0.4%
2019	Norton Sound and Point Clarence	0.9%	36.8%	46.9%	15.3%	0.0%
2019	Nushagak	1.4%	37.1%	44.3%	16.9%	0.3%
2019	Upper Yukon	0.0%	9.8%	48.3%	40.7%	1.2%
2020	Kuskokwim Bay	4.2%	33.3%	36.4%	25.3%	0.9%
2020	Kuskokwim River	1.0%	33.9%	41.7%	22.6%	0.8%
2020	Lower Yukon	0.0%	8.0%	60.6%	31.2%	0.1%
2020	Middle Yukon	0.0%	14.7%	51.3%	33.1%	0.9%
2020	Norton Sound and Point Clarence	0.0%	7.8%	68.6%	23.5%	0.0%
2020	Nushagak	0.6%	48.8%	38.9%	11.6%	0.1%
2020	Upper Yukon	0.0%	7.6%	40.7%	48.5%	3.2%
2021	Kuskokwim Bay	4.2%	33.3%	36.4%	25.3%	0.9%
2021	Kuskokwim River	1.6%	39.4%	37.6%	20.9%	0.6%
2021	Lower Yukon	0.0%	7.7%	61.4%	30.8%	0.0%
2021	Middle Yukon	0.0%	7.9%	65.6%	26.4%	0.1%
2021	Norton Sound and Point Clarence	3.8%	7.6%	43.0%	38.0%	7.6%
2021	Nushagak	NA%	NA%	NA%	NA%	NA%
2021	Upper Yukon	0.0%	2.2%	45.1%	48.6%	4.0%

The data shown in Table 9 show the age composition estimates for coastal west Alaska Chinook salmon.

Table 9: Mean in-river age composition estimates for the Coastal west Alaska Chinook salmon stocks.

Run	Age 3	Age 4	Age 5	Age 6	Age 7
Kuskokwim Bay	5.1%	35.1%	36.0%	23.1%	0.6%
Kuskokwim River	1.3%	30.0%	42.0%	26.0%	0.6%
Lower Yukon	0.0%	27.3%	50.4%	22.0%	0.2%
Middle Yukon	0.0%	16.8%	47.9%	34.6%	0.7%
Norton Sound and Point Clarence	1.1%	23.3%	51.1%	22.3%	2.2%
Nushagak	NA%	NA%	NA%	NA%	NA%
Upper Yukon	0.0%	7.9%	43.3%	46.0%	2.8%

The table below shows the weights given to each river systems' estimate of in-river age composition and the natural mortality assumption to derive the estimate of age-specific oceanic maturation rate (i.e., for a given age, what proportion of Chinook salmon are expected to return to spawn). Note that this "Oceanic maturity" is based on the observed mean in-river age composition of spawners and the assumed oceanic natural mortality.

	Age						
	3	4	5	6	7	Mean run size	Weighting factor
Kuskokwim Bay	5.1%	35.1%	36.0%	23.1%	0.6%	40,709	0.0770
Kuskokwim River	1.3%	30.0%	42.0%	26.0%	0.6%	124,100	0.2346
Lower Yukon	0.0%	31.7%	48.0%	20.0%	0.3%	57,554	0.1088
Middle Yukon	0.0%	18.2%	45.7%	35.3%	0.8%	46,245	0.0874
Norton Sound and Point Clarence	1.1%	23.3%	51.1%	22.3%	2.2%	9,417	0.0178
Nushagak	1.2%	37.6%	44.7%	16.3%	0.2%	178,144	0.3368
Upper Yukon	0.0%	8.6%	43.4%	45.4%	2.6%	72,836	0.1377
Weighted mean in-river age composition	1.1%	29.1%	43.8%	25.3%	0.7%		
Oceanic natural mortality	0.3	0.2	0.1	0.1	0.0		
Oceanic maturity (γ_a)	3%	23%	75%	97%	100%		

Table 2: Proportions at age by river system and resulting oceanic maturity based on the weighted mean run size. —

Table 10 shows the extent of available data for Chinook salmon run strengths and Table 11 and Figure 13 shows the time series of available run size estimates. For the past impact analyses, an aggregated run size estimate for coastal western Alaska is provided along with estimates from the Upper Yukon (Figure 14). For this analysis, we only present the AEQ and forego an evaluation of impacts to Chinook salmon runs due to uncertainties and availability of updated runsize estimates.

Table 10: Chinook salmon run-strength estimate most recent year data available.

Run	Most recent year estimate available
Kuskokwim Bay	2021
Kuskokwim River	2021
Lower Yukon	2021
Middle Yukon	2021
Norton Sound and Point Clarence	2021
Nushagak	2021
Upper Yukon	2021

Figure 13: Chinook salmon run estimates by river system.

Figure 14: Coastal western Alaska combined run size estimates along with the Upper Yukon.

Table 11: Run size estimates for Coastal west Alaska Chinook salmon stocks.

Year	Nushagak	Norton Sound and Point Clarence	Kuskokwim River	Kuskokwim Bay	Lower Yukon	Middle Yukon	Upper Yukon
1968	253,216						
1969	171,442						
1970	236,807						
1971	176,310						
1972	127,516						
1973	157,787						
1974	276,786						
1975	288,659						
1976	443,299		206,497				
1977	304,980		326,456				
1978	571,489		238,287				
1979	477,347		237,200				
1980	552,937		364,886				
1981	629,071		311,648		98,519	127,134	210,449
1982	602,595		143,792		71,254	95,416	151,297
1983	560,733		148,623		84,204	126,248	158,103
1984	325,136		175,387		111,302	88,345	124,368
1985	402,721		145,221		130,614	97,538	143,918
1986	160,813		124,380		153,123	85,306	157,945
1987	177,726		183,056		119,731	79,778	172,992
1988	205,459		207,428		123,254	66,569	155,127
1989	248,451		215,158		91,035	58,221	173,512
1990	169,906		268,544		155,749	104,297	191,760
1991	327,748		216,118		155,749	73,057	138,968
1992	296,559		261,317		110,857	80,098	166,209
1993	359,331		273,777		195,438	122,394	160,171
1994	409,217		399,365		153,584	144,062	203,822
1995	292,143		372,332		115,844	142,344	216,209
1996	238,232	19,893	341,902		68,050	79,937	193,107
1997	247,707	49,114	262,761		183,689	132,720	198,988
1998	395,933	29,176	255,174		100,912	56,331	92,411
1999	238,709	12,984	160,752		130,092	72,114	147,857
2000	181,861	8,313	122,487		62,881	39,975	41,689
2001	284,930	10,661	192,752		114,577	74,682	145,074
2002	297,152	12,064	238,306	38,390	95,320	57,068	85,050
2003	312,388	12,045	231,909	50,272	136,489	82,207	161,619
2004	445,076	12,106	365,032	109,651	107,474	79,858	115,266
2005	448,651	10,870	327,044	83,378	93,807	75,358	127,262
2006	278,173	7,525	323,372	86,910	102,130	74,384	121,055
2007	154,199	14,994	248,471	80,006	86,682	64,667	88,256
2008	175,080	5,992	214,922	43,324	81,471	43,695	65,447
2009	156,686	15,855	194,718	43,560	89,322	66,569	85,819
2010	122,884	5,497	116,026	42,733	52,680	47,810	61,023
2011	203,822	6,604	115,858	41,255	76,880	46,958	70,263
2012	334,369	4,775	75,242	17,797	48,485	39,183	49,513
2013	196,811	6,517	88,498	19,245	45,615	22,404	38,638
2014	155,593	10,441	82,133	18,871	67,643	47,763	64,926
2015	161,297	18,689	125,767	47,027	74,533	61,267	88,521
2016	219,916	9,254	130,678	39,695	51,175	53,263	83,617
2017	126,880	9,461	131,643	97,218	60,114	84,204	98,617
2018	190,995	9,558	135,711	31,434	52,628	53,960	76,420
2019	118,184	16,667	226,224	59,659	86,336	49,217	87,204
2020	73,571	8,304	124,540	38,144	54,557	33,456	51,741
2021	110,194	3,313	128,802	37,454	43,045	27,092	33,090

AEQ model

Methods

A method was developed to estimate how salmon bycatch numbers would propagate to adult equivalent spawning salmon. That is, how many and in what year would the salmon have returned had they not been taken as bycatch. A stochastic adult equivalence" (AEQ) model was developed, which accounts for sources of uncertainty and allows for estimating the impact on run strengths from selected regions (Ianelli and Stram 2015). The steps in this process are briefly outlined as:

1. Compile statistics on Chinook salmon bycatch by region and season in the pollock fishery including

- Total bycatch by season and strata
- Length and sex composition of the bycatch
- Date and location

2. Compile available age composition data organized by strata
3. Convert the seasonal and regional length compositions into age estimates for each year, area, season using the age-length keys from step 2.
4. Provide demographic characteristics of Chinook salmon for use in the AEQ model (updated from the oceanic survival-at-age and maturity-at-age and were the same values as used in Ianelli and Stram 2015).
5. Update the season-specific genetics information (the "Bayes" estimates were used from Iii et al. (2013, 2015, 2018), Guthrie et al. (2013, 2014, 2016) for the period 2011-2019).
6. Run the AEQ model with these inputs (extending the estimates back to 1994-2021) and compile/summarize results.
7. Compare a subset (where data are available) of the AEQ results against corresponding run-strength estimates.

The model on the reduction in Chinook salmon returns in year t, AEQt, can thus be expressed (without stock specificity) as:

$$AEQ_t = \sum_{a=3}^{7} c_{t,a}\gamma_a + \sum_{j=3}^{6}\sum_{a=j+1}^{7}[c_{t,a}\gamma_a \prod_{i=j}^{a-1}(1-\gamma_i)s_i]$$

where $c_{t,a}$ is the bycatch of age *a* salmon in year *t*, s_a is the proportion of salmon surviving from age *a* to *a+1*, and γ_a is the proportion of salmon at sea that would have returned to spawn at age a. In words, the first term to the right of the equals sign is simply the number of mature Chinook salmon in the bycatch in the current year whereas the second term accounts for the Chinook salmon caught in previous years that would have been mature in the current year. All age 7 Chinook salmon in the bycatch were assumed to be returning to spawn in the year they were caught (i.e. $\gamma_7 = 1$) and they represent the oldest fish in the model. We assume that 7 year-old Chinook salmon taken in the fall were returning to spawn that year. In fact, these fish would have been more likely to return the following year. This assumption simplified the model and data preparation. Also, relatively few fish this age were caught late in the season.

Given estimates of AEQ, the model partitions these into reporting groups (RG). This was done by assigning the stratum-specific AEQ estimates to each of the nine identified RGs (e.g., Table 5; Guthrie et al., 2013 for RG and GSI determinations). We assumed that given the number of samples used for GSI within each year (t) and stratum (i) that the numbers assigned to RG k can be assumed to follow a multinomial distribution with parameters

$$p_{t,i,1}, \ldots, p_{t,i,11}, \sum_k p_{t,i,k} = 1$$

The input sample size for these reporting group composition data was approximated based on the estimated precision of the estimates following the variance of a multinomial proportion. Dropping subscripts, we estimated the multinomial effective sample size (N_{eff}) given the reporting group uncertainty from the genetic analyses as:

$$\text{var}\ (Np) = Npq$$

where

$$q = (1 - p)$$

$$N_{eff} = pq/\ \text{var}\ (p)$$

For the years where GSI information is missing the estimated proportions by RGs were based on mean stratum-specific values from the years when GSI data were available. These additional parameters were constrained based on the estimated within-stratum inter-annual variability. That is, if the proportions assigned to RGs varied as estimated from the genetics data, then that variability was propagated to the years when genetic data were unavailable. This was a compromise which acknowledges sampling uncertainty for those years and correctly weights the information (due to sample size) between years when GSI information was available. For example, the new observer data collection system for genetic samples has resulted in more precise estimates of GSI in recent years hence those years have greater influence on stratum-specific GSI results. Adjusting the AEQ for RG requires estimation over a range of years when GSI results are available. This was accomplished here by applying the appropriate GSI results (i.e. estimates of proportions within RGs) for the years as lagged by AEQ. This step is needed to apportion the AEQ results to stock of origin based on genetic samples which consist of mature and immature fish. By splitting the AEQ estimates to relative contributions of bycatch from previous years, and applying GSI data from those years, they can then be realigned and renormalized to get proportions from systems by year. For years in which GSI information was unavailable, mean GSI data (with an error term which accounted for year-effect variability) were used.

Since Chinook salmon bycatch occurs in both the A and B season of the pollock fishery, data from these seasons were modeled separately. For each separate run, Monte-Carlo Markov Chain (M-CMC) samples from the posterior distribution were obtained based on chain lengths of 1 million (after burn in) and selecting every 200th parameter draw. Output resulted in 5,000 samples from each season (summed over strata) and then summed to get annual AEQ totals by RG. The model was implemented using ADMB (Fournier et al., 2012) software.

Separate estimates of run-strengths (from 1994-2021) were used assuming uncertainties in run size:

$$\dot{S}_{t,k}e^{\epsilon_t}, \epsilon_t \sim N(0, \sigma_s)$$

where was a pre-specified level of run-size variance (assumed to correspond to a conservative coefficient of variation of 10% for this study). The measure that relates the historical bycatch levels to the subsequent returning salmon run k in year t, the "impact", is thus:

$$u_{t,k} = \frac{AEQ_{t,k}}{AEQ_{t,k} + \dot{S}_{t,k}}$$

where $AEQ_{t,k}$ and $\dot{S}_{t,k}$ are the adult-equivalent bycatch and stock size (run return) estimates. The calculation of $AEQ_{t,k}$ includes the bycatch of salmon returning to spawn in year t and the bycatch from previous years for the same brood year (i.e. at younger, immature ages). Note that the allocation of the AEQ to RGs is necessarily independent of the age composition of the bycatch.

Files

In the `runs` directory the initial model update is in folder named `chin24_a` and `chin24_b`. The files `sba.dat` points to the data files being used. Assembling the datafiles so far has been done outside the R code and model but could be easily configured within R.

Results

Mean and credible intervals from the posterior distribution on adult equivalent mortality shows consistent patterns relative to the PSC bycatch with the largest mortality occurring between 2006-2008 (Figure 15). This was also reflected in the stock-specific AEQ mortality due to PSC bycatch (Figure 16). PSC bycatch (Figure 17). PSC bycatch (Table 12).

Table 12: Estimated number of Chinook salmon adult equivalent (AEQ) mortality due to PSC bycatch.

year	BC	CoastSEAK	CoastWAK	Copper	Mid-Yukon	NAKPenn	NEGOA	NWGOA	Russia	UpYukon	W.USA	total
1994	6,008	961	15,075	36	375	5,508	8	862	193	582	3,277	32,886
1995	3,468	548	8,963	18	220	3,443	5	453	112	357	1,789	19,377
1996	5,401	842	14,400	24	348	5,810	7	628	176	591	2,612	30,840
1997	6,520	1,083	14,823	54	388	4,419	9	1,203	206	508	4,164	33,378
1998	7,034	1,195	14,993	68	406	3,755	10	1,472	220	468	4,888	34,509
1999	5,017	867	10,137	54	283	2,115	8	1,146	156	289	3,706	23,775
2000	2,879	501	5,691	32	161	1,086	4	680	89	156	2,177	13,455
2001	3,021	488	7,412	20	187	2,599	4	463	97	279	1,715	16,285
2002	4,599	732	11,677	26	289	4,355	6	636	148	456	2,454	25,379
2003	6,011	958	15,217	35	377	5,647	8	840	194	593	3,226	33,105
2004	6,969	1,130	16,914	47	428	5,808	10	1,100	223	629	4,029	37,287
2005	8,705	1,444	19,887	71	519	5,996	13	1,590	276	686	5,523	44,709
2006	11,136	1,798	27,339	73	688	9,597	16	1,704	357	1,030	6,313	60,049
2007	13,466	2,166	33,355	85	835	11,906	19	2,008	432	1,269	7,517	73,058
2008	10,719	1,748	25,652	76	654	8,562	15	1,756	342	938	6,342	56,804
2009	5,225	849	12,601	36	320	4,274	7	839	167	465	3,052	27,835
2010	2,168	341	5,645	11	138	2,196	3	276	70	226	1,102	12,176
2011	1,358	293	6,334	17	134	1,561	3	278	69	255	817	11,118
2012	1,421	351	8,534	24	161	1,452	4	359	89	249	935	13,580
2013	1,484	305	6,488	18	131	1,295	3	303	74	256	833	11,190
2014	1,731	302	5,863	12	156	1,817	3	336	70	290	945	11,525
2015	2,167	361	5,489	11	151	1,699	3	374	69	282	1,222	11,828
2016	3,656	534	6,176	13	194	2,186	4	371	88	324	1,801	15,346
2017	5,970	686	6,172	16	213	3,036	5	362	106	318	2,746	19,631
2018	5,057	571	4,897	16	170	2,688	4	309	88	237	2,329	16,366
2019	4,029	452	5,303	14	147	2,455	4	340	80	200	1,844	14,867
2020	3,844	519	9,816	18	249	3,818	5	571	154	392	1,744	21,131
2021	2,676	447	8,172	22	222	2,972	5	648	119	269	1,529	17,081
2022	1,395	297	5,130	15	140	2,191	3	403	69	152	879	10,674
2023	1,283	213	3,865	7	87	1,997	2	166	45	122	621	8,407

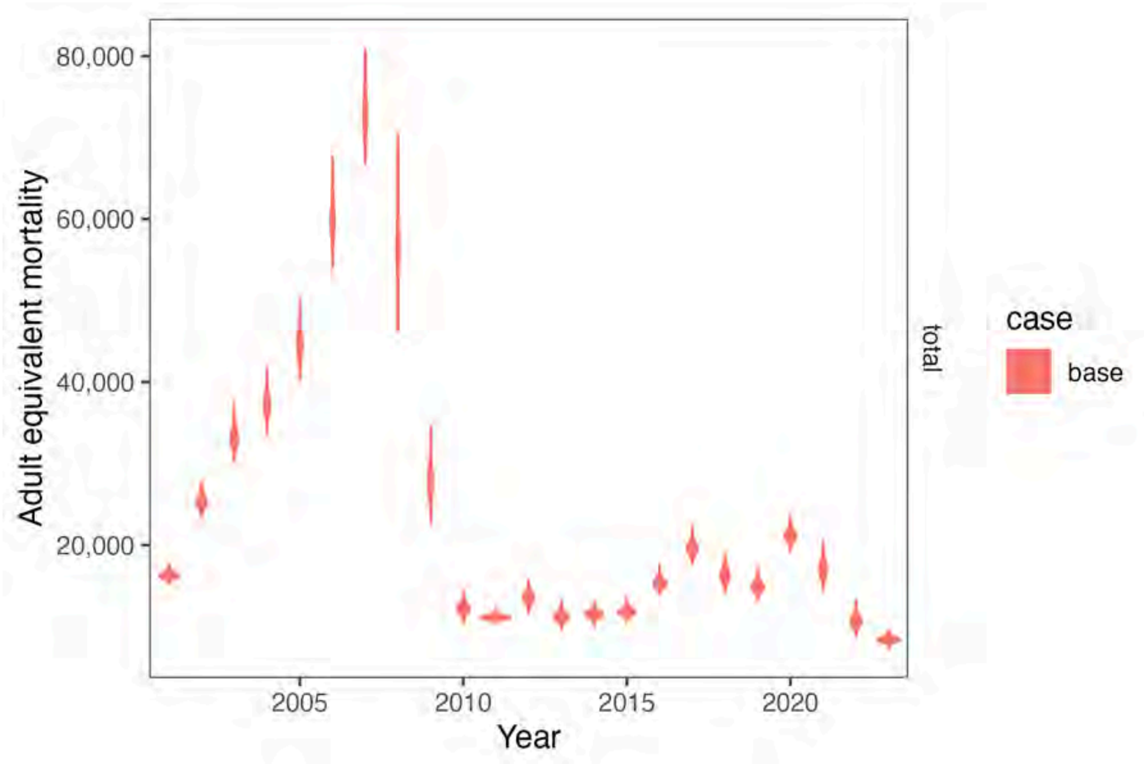

Figure 15: Chinook salmon PSC adult equivalence summarized for all stocks combined.

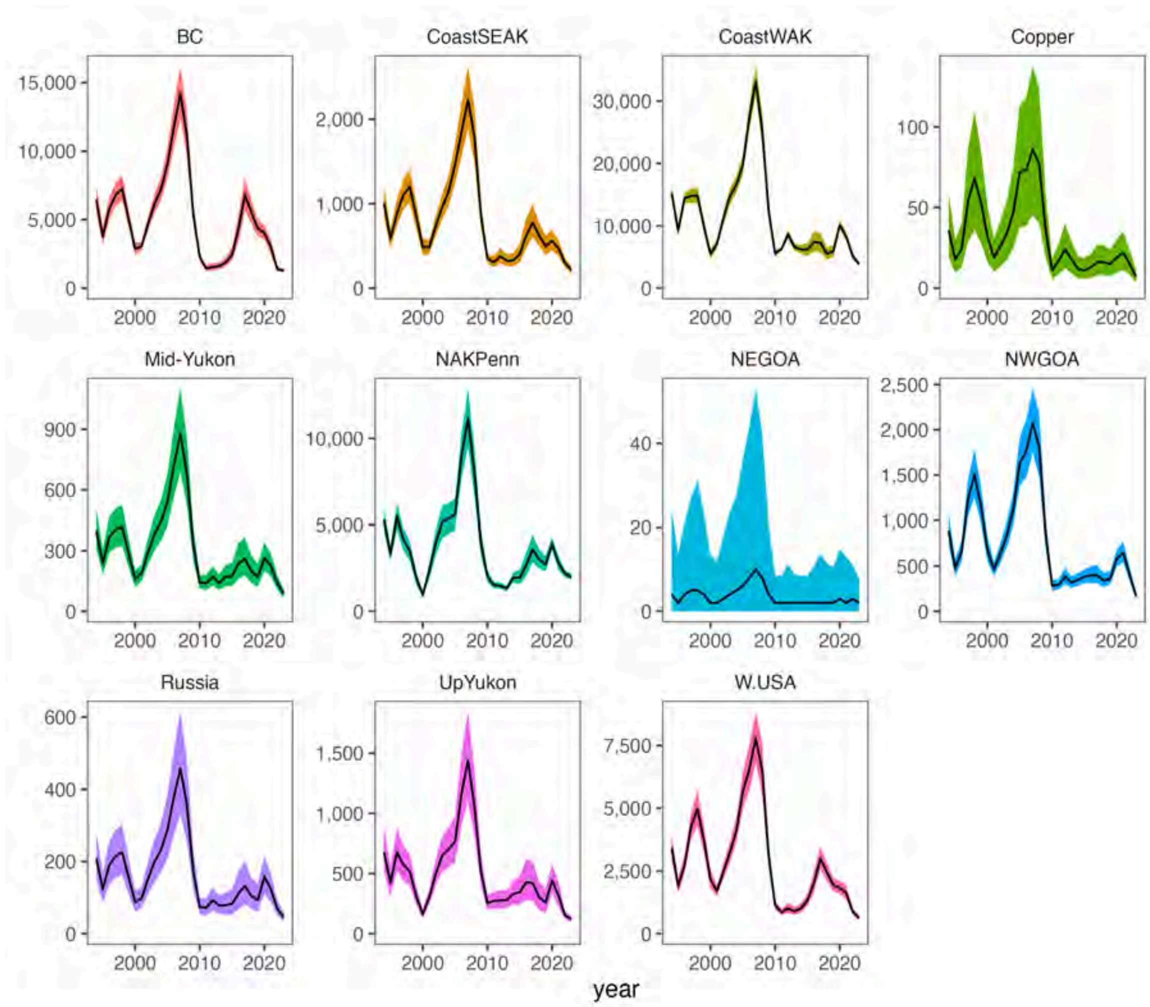

Figure 16: Chinook salmon PSC adult equivalence by stock. Note that the scales vary among panels.

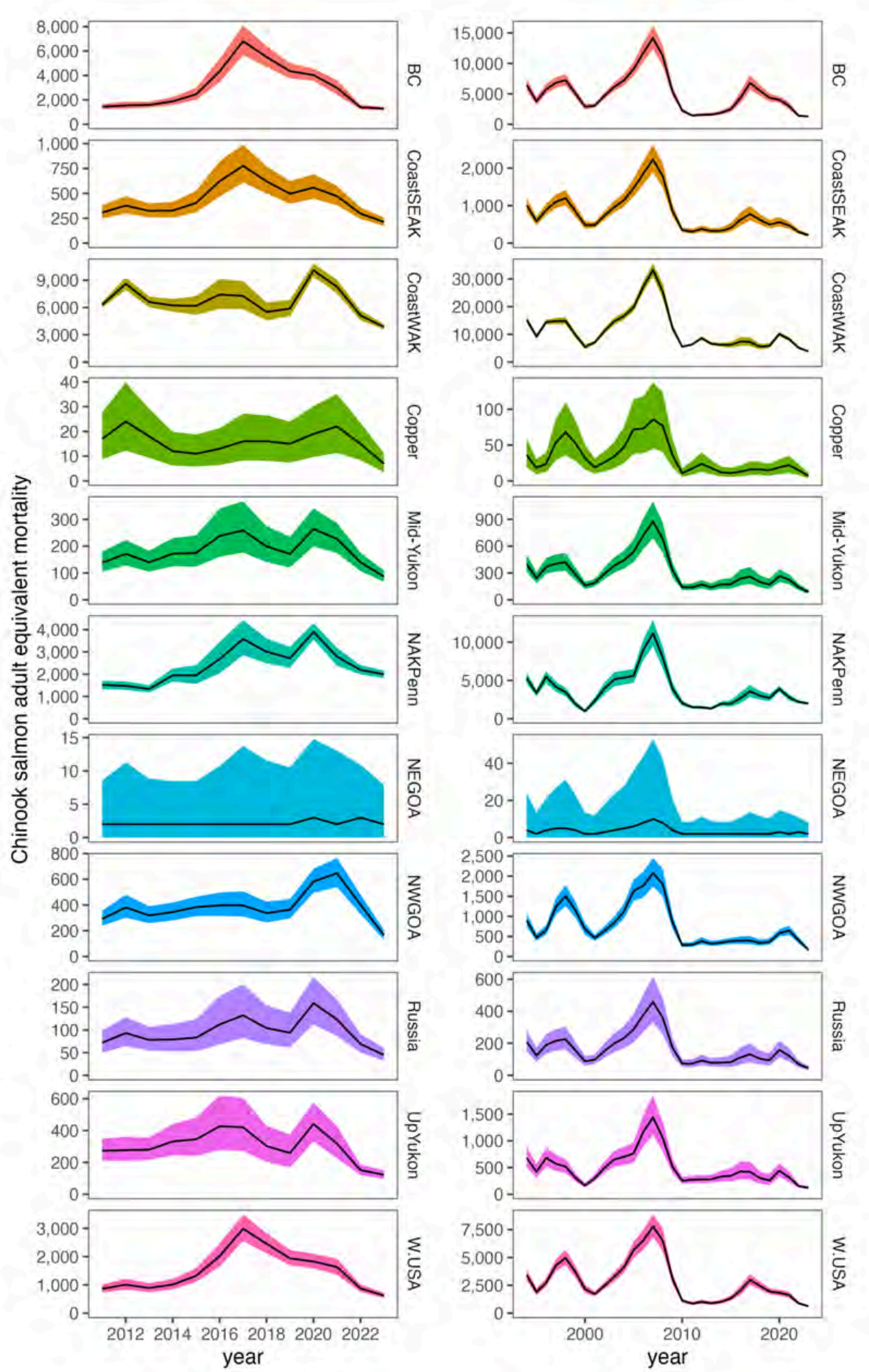

Figure 17: Chinook salmon PSC adult equivalence by stock. Note that the scales vary among panels–right column shows the time series of estimates whereas the left shows just for recent years.

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Appendix 6: Supplement to Chapter 4

6.1 Methods Used for Impact Analysis

Communities Engaged in or Dependent on B Season Pollock

The analysis of community engagement and dependence on B season pollock relies on a series of tables based on existing quantitative fishery information were developed to identify patterns of engagement (or participation) in the Bering Sea pollock fishery. The distribution and relative magnitude of community engagement in the Bering Sea pollock fishery was measured by information on a vessel's ownership address, which is listed in the Alaska Commercial Fisheries Entry Commission (CFEC) vessel registration files.

Some caution is warranted for how vessel ownership information is interpreted because it is not unusual for these vessels to have complex ownership structures that involve more than one entity in more than one community or region. Additionally, the community identified by ownership address may not directly indicate where a vessel spends most of its time, purchases services, or hires its crew from.

However, information on a vessel's community ownership address does provide is an approximate indicator of the distribution and magnitude of ownership ties to a particular community and region. In this way, vessel ownership address can be used as a proxy for some level economic activity in the community that is associated with the fishery/sector that may be potentially affected by one or more of the proposed alternatives. The listed ownership address was also used in this analysis as a way to connect vessels to communities rather than other indicators, such as vessel homeport information, to be consistent with other SIAs prepared for FMP amendment analyses for the Council, and because prior SIAs have described the problematic nature of the existing vessel homeport data (AECOM 2010; NPFMC 2021).

To understand the distribution and relative magnitude of community engagement in the Bering Sea pollock fishery through the shore-based processing component, shore-based processors were identified in data provided by the Alaska Fishery Information Network (AFKIN) using the F_ID (intent to operate), SBPR (shore-based processor), and FLTR (floating processor codes). This approach provides information based on the operating location of the plant, rather than other indicators such as company ownership address. The physical location of a plant can be a relative indicator of the local volume of fishery-related activity, and a rough proxy for the relative level of associated employment and local government revenues.

This portion of the analysis also includes a series of tables used to identify patterns of economic dependence on the Bering Sea pollock fishery for communities affiliated with the various sectors by ownership address and those Alaska communities where shore-based processing occurs, noting the analysts acknowledge that "dependence" is a complex concept with economic and social dimensions that could be considered in multiple ways. For communities affiliated with the Bering Sea pollock fishery by vessel ownership address, economic dependence is characterized by comparing the gross ex-vessel or first wholesale revenues earned from the pollock fishery to the total revenues generated by the same vessels in all other fisheries (species, gear, and areas). The same general procedure is used for the shore-based processing component.

Estimates of Taxable Revenue

The State of Alaska levies two fishery resource taxes and shares a portion of these tax revenues with qualified local governments in Alaska. The State's **Fisheries Business Tax (FBT)** is typically paid by the first processor of fish, or the exporter of unprocessed fish, on the raw fish landed in the state. The current tax rates are 3% for fishery resources processed at shoreside plants and 5% for those processed at floating processors. The State's **Fishery Resource Landing Tax (FRLT)** is levied at a 3% rate on fishery resources that are processed outside the 3-mile limit but, within the U.S. EEZ, and first landed in Alaska. This tax is levied whether the product is destined for local consumption or shipment abroad. Under Alaska Statute (AS) 43.77, CPs and motherships are required to pay this tax at a rate that is equivalent to rates paid by catcher vessels and shore-based processors under the FBT (AS 43.75).

The analysts have prepared estimates of the FBT and FRLT levied on B season pollock by deriving the estimated taxable value of the fishery. These values were provided by AKFIN and are based on the value of unprocessed landings (the ex-vessel price for inshore deliveries). The State determines the unprocessed value for CP production by multiplying a statewide average price per pound of unprocessed fish (derived from ADF&G data) by the unprocessed weight. Next, a 3% tax rate representing the FBT was applied to the estimated taxable value of Bering Sea pollock from inshore cooperatives and the inshore open access fishery in applicable years. A 3% tax rate representing the FRLT was applied to the estimated taxable value of Bering Sea pollock for the CDQ, CP, and mothership sectors. As described previously, CDQ pollock has historically been harvested by AFA affiliated CPs except for 2016 when one mothership CV harvested a relatively small amount of CDQ pollock.

Incorporated cities and organized boroughs may also levy their own local taxes on the unprocessed value of fishery resource landings made in the relevant jurisdiction. The municipalities in which an AFA inshore processor is located and accepted B season deliveries during the analyzed period include the Cities of Unalaska/Dutch Harbor (2%), King Cove (2%), and Akutan (1.0% in 2011-2012 and 1.5% from 2013-2023). The Aleutians East Borough, in which Akutan and King Cove are located, also levies a local fish tax of 2%.

The Alaska DOR deposits all revenue from the FBT and the FRLT into the State's General Fund, and 50% of those shared revenues are subject to revenue sharing with local governments in the following way: 1) If the landings occur in an incorporated city within an organized borough, the 50% shareable amount is divided between the city and the borough; 2) If the landings occur outside of an incorporated city but still within an organized borough, the entire 50% shareable amount accrues to the borough; 3) If the landings occur in an incorporated city within an unorganized borough, the 50% shareable amount accrues to the city; 4) If the landings occur in neither an incorporated city nor an organized borough, the 50% shareable amount is distributed through an allocation program administered by the Alaska Department of Commerce, Community, and Economic Development (DCCED).[1]

Environmental Justice

Environmental justice is defined in E.O. 12898, *Federal Actions to Address Environmental Justice in minority Populations and Low-Income Populations*. It requires that proposed projects, programs, and policies be evaluated for disproportionately high and adverse human health or environmental effects on minority populations, low-income populations, and Alaska Native/Indian tribes. In the context of an environmental justice analysis, "disproportionately high" refers to the negative impacts of an action falling more heavily on marginalized or vulnerable groups than others.[2]

Consistent with CEQ guidelines for evaluating the potential environmental justice effects of a proposed agency action under NEPA (CEQ 1997), this analysis defines the term "minority population" to include people who are American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Black or African American, some other race (other than White), a combination of two or more races, or

[1] DCCED first allocates the revenues raised statewide in proportion to the share of statewide pounds of fish and shellfish processed in each of the 19 fisheries management areas (FMA) during the preceding calendar year, and then within an FMA by a formula that may vary by FMA (NMFS 2014).

[2] While the environmental justice analysis is largely driven by relevant E.O.s and CEQ regulations, it is worth noting NOAA Fisheries released its Equity and Environmental Justice Strategy in 2023 that establishes goals and objectives to ensure the fair treatment and meaningful involvement of all people, regardless of race, color, gender, sexual orientation, national origin, tribal affiliation, religion disability, or income during the development, implementation, and enforcement of environmental laws, regulations and policies (NOAA 2023).

Hispanic. In other words, all individuals other than non-Hispanic, White are considered to be part of one or more minority populations. Also consistent with CEQ guidelines, this analysis defines the term "low-income population" to include people who are living in poverty according to the U.S. Census Bureau's annual statistical poverty thresholds. In this environmental justice analysis, any American Indian or Alaska Native identified in the Census data is considered part of a tribal population, whether or not they are a member of a federally recognized tribe.

Information on minority and low-income populations was sourced from either the 2020 U.S. Decennial Census or the 2022 ACS 5-year estimates (2018-2022). The 2020 U.S. Census is the most recent information available for an official count of the U.S. population.[3] The ACS is conducted on a monthly basis (by the U.S. Census Bureau), and its strength is in its ability to estimate characteristic distributions across a population.[4] The 2022 ACS 5-year estimates (2018-2022) are the most recent information available; additionally, it would not be appropriate to use one-year ACS estimates for this analysis because one-year ACS estimates are available for areas with populations of 65,000 residents or more. The majority of Alaska communities, and all CDQ communities, do not meet this population threshold.

According to CEQ (1997) guidelines, an environmental justice analysis should identify population groups within the study area that have a higher concentration of low-income and/or minority populations compared with a reference population. For this analysis, population groups were determined to meet this criterion when either the proportion of minority and/or low-income residents exceeds 50% of the area's total population or their minority and/or low-income population is meaningfully greater[5] than the minority and/or low-income population percentage in the reference population.

For this analysis, population groups were evaluated in three different categories: communities identified as being substantially engaged in or dependent on B season pollock, CDQ communities, and Census Areas and/or Boroughs that encompass Western and Interior Alaska and align with the WAK genetic reporting group. These Census tracts include the Bethel Census Area, the Dillingham Census Area, the Kuslivak Census Area, the Lake and Peninsula Borough, the Nome Census Area, the Northwest Arctic Borough, and the Yukon-Koyukuk Census Area.

6.2 Data that Would Have Been Useful but Were Unavailable

Usable Product Transfer Report Data

For this analysis, it would have been useful to have systematically collected time series data available for fishery support services provided to, and other economic activity associated with, CPs during port calls or product offloads. Examples of other economic activities it would be useful to have information on include fuel purchases, services related to crew changes, cold storage use, longshoring and stevedore services, among others. **Additionally, it would have been useful to have reliable information available to understand the distribution and potential magnitude (i.e., amount of product) offloads across communities.**

Product Transfer Reports were identified as a potential data source because they are required to be completed for CP offloads and submitted to NOAA Fisheries Office of Law Enforcement. However,

[3] It is worth noting the COVID-19 pandemic affected data collection during the 2020 Census through delays in data collection and processing as the Bureau modified its operations to protect staff and the public operational requirements. Some minority and non-English speaking communities relevant to this environmental justice analysis may have been disproportionately affected by the pandemic which exacerbated existing challenges with data collection.
[4] All ACS data are estimates because the survey collects data from a sample of the population in the U.S. and Puerto Rico. Sampled information is the extrapolated across the general population. The ACS's periodic estimates are based on data collected throughout a calendar year, which are then consolidated and averaged for the selected period. The ACS is administered to approximately 1 in 12 households which can result in substantial margins of error for the estimates produced, particularly in smaller communities.
[5] In this environmental justice analysis, the meaningfully greater threshold is defined as follows: if the minority and/or low-income population percentage in a given area is greater than 5% above the minority and/or low-income population percentage in a geographic reference area. For the purposes of this analysis, Alaska is the reference area.

Product Transfer Reports are not a reliable source of information for either **a)** gauging the relative economic activity associated with a port call because Product Transfer Reports simply do not collect this information, and **b)** the magnitude of offloads across communities. On this latter point, a primary problem is with apparent errors in weights which are reported in pounds, metric tons, and kilograms. It is not uncommon for data entries to have been made in kilograms but with the units noted as metric tons, greatly overestimating the weight offloaded. Additionally, for the purposes of this analysis, Product Transfer Report data do not contain key fishery specific data that would have been useful.

Socioeconomic Information for Bering Sea Pollock Crew and Processing Facilities

For this analysis, it would have been useful to have comprehensive and updated information on socioeconomic indicators for crew members working aboard Bering Sea pollock vessels in each sector and the labor forces at shoreside processing facilities accepting deliveries of Bering Sea pollock. E.O. 12898 directs federal agencies to consider the impact of potential actions on minority and low-income populations, and the Interim Justice40 Guidance (E.O. 14008, *Tackling the Climate Crisis at Home and Abroad*) directs federal agencies to define communities as either "a group of individuals living in geographic proximity to one another or a geographically dispersed set of individuals (such as migrant workers, Alaska Natives, or Native Americans), where either type of group experiences common conditions."

There is some general information available that suggests the workforces at shorebased processing facilities and onboard Bering Sea pollock vessels (a primary focus appears to have been CPs) may typically be minorities (Downs & Henry 2023; PEIS 2004). However, there is no comprehensive, updated, and readily available information on the demographics of these workforces for all sectors of the Bering Sea pollock fishery. Companies or cooperatives may be able or willing to provide this type of information to the analysis, but coordinating this effort in a meaningful way under the analytical timeline for initial review was not possible. The analysts also acknowledge this is sensitive information that companies may not be able or willing to share for incorporation into a public document used to inform decision-making and may thus be unavailable regardless of the analytical timeline.

Patterns of AFA Vessel Crew Employment

More broadly, **it would have been useful to have information on patterns of crew employment including the communities where crew members for CVs, CPs, and motherships participating in the Bering Sea pollock fishery are from, the relative frequency of crew changes in Alaska communities, crew earnings from the fishery, among other information**. Had this information been available it would have been useful to provide a more comprehensive analysis of the human dimensions of the Bering Sea pollock fishery (e.g., a wider community footprint and social impacts associated with the proposed alternatives).

These data are distinct from NMFS observer records on the number of crew-persons onboard AFA vessels and the Chinook Salmon Economic Data Report (EDR) Program (often referred to as the Amendment 91 EDR Program). The Amendment 91 EDR was initially identified as a potentially useful source of information. This program is managed primarily by the Alaska Fisheries Science Center (AFSC) with support from NMFS Alaska Region, and it is administered in collaboration with Pacific States Marine Fisheries Commission (PSMFC). The EDR is a mandatory reporting requirement for all entities participating in the Bering Sea pollock fishery (see 50 CFR 679.65). This includes all vessel masters and businesses that own or lease one or more AFA-permitted vessels active in fishing or processing Bering Sea pollock, CDQ groups receiving allocations of Bering Sea pollock, and representatives of sector entities receiving an apportionment of the Chinook salmon PSC limit. The Chinook Salmon EDR has three main elements comprised of separate survey forms: the Chinook salmon PSC Compensated Transfer Report, the Vessel Fuel Survey, and the Vessel Master Survey. These program elements do not contain the sought information related to patterns of crew employment that is linked to communities.

Understanding Shifts in Subsistence Species Replacements

It would have been useful to have comprehensive, consistent, annual composites of all subsistence harvests (e.g., salmon, nonsalmon fish, moose, caribou, and marine mammals) by region which includes the upper/middle/lower Yukon, upper/middle/lower Kuskokwim, Norton Sound-Port Clarence, and statewide. This would help to characterize the role chum salmon has played in the subsistence diet by region and across the state, as well as how and with what subsistence communities are replacing the absence of chum (and other species of salmon), or lesser amounts of chum and other salmon, with other species.

Salmon is part of a mix of wild food sources that support communities in rural Alaska. Harvesting a mix of wild foods helps to build resiliency to shortfalls in the harvest level of one particular species due to annual variability in abundance. Lower harvests of chum salmon might be replaced by a higher level of harvest of other types of fish or wildlife, but the magnitude of these changes across communities as well as the cultural preferences of communities is unknown.

It is also possible that other wild foods do not compensate for low subsistence harvests of chum salmon in a particular (poor) year (NPFMC 2017). Depressed local economies may result in an out-migration of families from the community and a loss of population when the harvests of other wild food sources are not, or cannot be, increased to compensate for reductions in subsistence harvests of salmon (Wolfe et al., 2010:14-15). There is some work that addresses communities' shifts in subsistence harvest in relation to Chinook declines (for example, Wolfe & Spaeder 2009; Moncrieff 2017). However, social science research on the recent chum salmon declines (2020-to present) across Western and Interior Alaska is not yet available.

Social Science of Local Knowledge and Traditional Knowledge Related to Salmon

The analysts would note that, compared to other fisheries or subsistence resources with a clear connection to federal fisheries management, there is a large body of social science research based on LK and TK focused on the importance (cultural, spiritual, and economic role) of salmon. **However, it would have been useful to have more published or publicly available sources of social science based on LK and TK related to chum salmon that could inform decision-making.** TK held by Alaska Native peoples is traditionally shared orally; is not always shared freely or regarded as public data by the knowledge holder; and only in recent decades has begun to be recorded in written, audio, and video forms. Since this analysis relies upon published, publicly available data, more social science on LK and TK observations about salmon, particularly chum salmon, would have aided the analysis of, for example, traditional and contemporary human-salmon relationships, the relative dependence of communities on chum salmon as a food source, and adaptations to historical and current chum salmon declines. It may also have added to Western scientific knowledge of the causes of declines of chum salmon.

Community Profiles for the Western and Interior Alaska Regions

It would have been useful to have salmon community profiles from the Western and Interior Alaska region, including up to date socioeconomic and demographic information alongside information on the subsistence harvests of various species. Profiles of individual communities within the region—or at least of key population hubs—would have aided analysts in providing more specificity of regional socioeconomic context that is supported by subsistence (and commercial) salmon fishing and other activities of the subsistence way of life.

6.3 Communities Engaged in or Dependent on the B Season Pollock Fishery

This section of the appendix provides the full set of tables and figures for quantitative indicators of community engagement and dependence on the B season pollock fishery. This information mirrors what was provided in the April 2024 SIA, except that 2023 data has been included as the most recent year for which complete fisheries-dependent data are available.

Offshore Component

Table A6-1 Catcher Processors harvesting B season AFA pollock by community of vessel ownership address, 2011-2023

Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (number)	Annual Average 2011-2023 (percent)	Unique Vessels 2011-2023 (number)
Anchorage Alaska	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	7.30%	1
Seattle Washington	14	13	13	14	13	13	13	13	12	12	12	12	11	12.7	92.70%	15
Grand Total	15	14	14	15	14	14	14	14	13	13	13	13	12	13.7	100.00%	16

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Table A6-2 Catcher Processors harvesting B season Bering Sea pollock, 2011-2023 (2023 dollars)

	Program	2011	2012	2013	2014	2015	2016**	2017	2018	2019	2020	2021	2022	2023	Average 2011-2023 (dollars)
Ex-Vessel	AFA	118,471,252	123,145,462	111,710,221	114,845,750	115,915,259	108,230,624	98,566,465	107,399,360	106,921,175	95,961,061	101,458,383	97,777,257	95,916,887	107,409,166
	CDQ	31,233,081	35,415,628	31,964,367	33,244,040	33,152,877	30,480,164	27,582,568	30,817,395	30,054,595	24,475,161	29,268,690	28,457,091	27,852,544	30,307,554
	Total	149,704,333	158,561,090	143,674,588	148,089,790	149,068,136	138,710,788	126,149,033	138,216,755	136,975,769	120,436,222	130,727,073	126,234,347	123,769,431	137,716,720
Wholesale Value	AFA	403,820,925	400,076,743	344,265,677	354,958,988	364,711,546	379,634,733	359,361,364	333,394,223	380,779,557	309,275,049	325,244,578	302,552,595	304,201,745	350,944,440
	CDQ	106,529,695	115,142,762	98,513,029	102,272,255	104,383,658	107,075,988	100,920,937	96,029,662	107,601,758	79,381,318	94,132,103	88,186,293	88,301,378	99,113,141
	Total	510,350,620	515,219,506	442,778,706	457,231,242	469,095,205	486,710,721	460,282,301	429,423,885	488,381,315	388,656,367	419,376,681	390,738,888	392,503,124	450,057,582

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

*Ex-Vessel Value based on shoreside price

**Includes catcher vessel targetted BS CDQ Pollock delivered to a mothership in 2016 to show all CDQ BS pollock

Table A6-3 First wholesale value diversification for CPs harvesting AFA or CDQ pollock, 2011-2023 (2023 dollars)

Fishery	Annual Average Number of Vessels	Annual Average First Wholesale Value for Fishery	Annual Average Total Wholesale Value from All Area, Gear, and Species Fisheries	Pollock Value as a Percentage of Total Wholesale Value Annual Average
AFA	13.9	613,355,590	804,413,684	76.25%
B Season AFA	13.7	350,944,440	800,895,107	43.82%
CDQ Pollock	14.1	174,690,155	784,986,871	22.25%
B Season CDQ Pollock	11.5	99,113,141	693,059,447	14.30%
B Season AFA+B Season CDQ Pollock	14.2	450,057,582	812,841,429	55.37%
AFA+CDQ Pollock	14.5	788,045,744	818,043,910	96.33%
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT				

Table A6-4 First wholesale value diversification for communities with Catcher Processors harvesting B season AFA or CDQ pollock, 2011–2023 (millions of 2023 real dollars)

Fleet	Community	B Season Annual Average Number of Vessels	Annual Average Number of All Commercial Fishing Vessels in those Same Communities*	Annual Average 2011-2023 (dollars)	Annual Average Total First Wholesale Value from All Areas, Gears, and Species Fisheries for the Community Fleet*	Participant Wholesale Value as a Percentage of Total Community Wholesale Revenue Annual Average
AFA Catcher Processors	Seattle/Anchorage	14.2	523.9	450,057,582	2,141,770,565	21.0%
\ccounting System, data compiled by AKFIN in Comprehensive_BLEND_CA						

Table A6-5 Number of Motherships/floating processors accepting B season pollock deliveries by community of ownership address, 2011–-2023

Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (number)	Annual Average 2011-2023 (percent)	Unique Processors 2011-2023 (number)
Dutch Harbor	2	2	2	2	2	1	1	2	2	2	2	2	1	1.8	52.27%	2
Seattle	2	2	2	2	2	2	2	2	1	1	1	1	1	1.6	47.73%	3
Grand Total	4	4	4	4	4	3	3	4	3	3	3	3	2	3.4	100.00%	4

FEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Table A6-6 First wholesale revenues earned y Mothership/floating processors accepting deliveries of B season pollock by community of ownership address, 2011–2023 (millions of 2023 real dollars)

Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (millions)	Unique Processors 2011-2023 (number)
Dutch Harbor/Seattle	$140.71	$135.95	$125.51	$131.97	$121.76	$133.43	$113.48	$127.30	$83.98	$72.85	$77.59	76.14	*	$109.70	4

Table A6-7 First wholesale revenue diversification for motherships/floating processors accepting deliveries of B season pollock, 2011–2023 (millions of 2022 real dollars)

Geography	Annual Average Number of Processors	Annual Average First Wholesale Revenues B Season AFA Pollock Only (millions 2022 real $)	Annual Average Total First Wholesale Revenues from All Area, Gear, and Species Fisheries	AFA Pollock First Wholesale as a Percentage of Total First Wholesale Revenue Annual Average
Dutch Harbor/Seattle	3.5	$109.7	$188.5	58.19%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Table A6-8 Mothership/floating processors B season pollock revenue as percent of total, 2011–2023 (number of processors)

AFA B Season Pollock Rev as a % of Total	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023
0-10%	0	0	0	0	0	1	0	0	0	0	0	0	0	0.08
10-20%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20-30%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30-40%	1	0	0	0	0	0	0	0	0	0	0	0	0	0.08
40-50%	0	1	1	1	1	0	0	0	1	0	0	0	0	0.38
50-60%	2	2	1	2	0	1	2	3	1	3	3	2	0	1.69
60-70%	1	1	2	1	3	2	1	1	1	0	0	1	2	1.23
70-80%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
80-90%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90-100%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Grand Total	4	4	4	4	4	4	3	4	3	3	3	3	2	3.46

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Shoreside Component

Table A6-9 Number of CVs harvesting B season pollock and delivering to shore-based processors by community of vessel ownership address, 2011–2023

Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (number)	Annual Average 2011-2023 (percent)	Unique Vessels 2011-2023 (number)
Anchorage/Wasilla	0	0	0	0	0	0	0	0	0	0	0	3	3	0.5	0.69%	3
Kodiak	5	5	5	5	4	4	4	4	4	5	3	3	3	4.2	6.23%	6
Alaska	5	5	5	5	4	4	4	4	4	5	3	6	6	4.6	6.92%	9
Seattle	51	54	55	57	59	55	55	54	54	55	53	46	47	53.5	80.16%	66
Other WA	3	2	3	3	4	3	2	2	2	2	4	2	2	2.6	3.92%	7
Washington	54	56	58	60	63	58	57	56	56	57	57	48	49	56.1	84.08%	70
Newport	8	6	5	4	5	5	4	4	4	4	3	5	4	4.7	7.04%	10
Other OR/Other States	5	5	1	1	1	1	0	1	0	1	0	0	0	1.2	1.85%	7
Oregon/Other States	13	11	6	5	6	6	4	5	4	5	3	5	4	5.9	8.88%	16
Grand Total	72	73	69	70	73	68	65	65	64	67	63	59	59	66.7	100.00%	83

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Table A6-10 Number of CVs harvesting B season pollock and delivering to motherships by community of historic vessel ownership address, 2011–2023

Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (number)	Annual Average 2011-2023 (percent)	Unique Vessels 2011-2023 (number)
Anchorage/Wasilla	0	0	0	0	0	0	0	0	0	0	0	1	1	0.2	1.18%	1
Kodiak	1	1	1	1	1	1	1	0	1	1	1	0	0	0.8	5.92%	1
Alaska	1	1	1	1	1	1	1	0	1	1	1	1	1	0.9	7.10%	2
Seattle	13	14	13	12	14	11	12	11	12	12	12	11	9	12.0	92.31%	17
Other WA	0	0	0	1	0	0	0	0	0	0	0	0	0	0.1	0.59%	1
Washington	13	13	12	12	13	10	11	10	11	11	11	10	9	11.2	86.39%	18
Grand Total	14	15	14	14	15	12	13	11	13	13	13	12	10	13.0	100.00%	18

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Table A6-11 Gross ex-vessel revenues earned by CVs harvesting B season pollock by community of vessel ownership address, 2011–2023 (2023 dollars)

Fleet	Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (dollars)	Annual Average 2011-2023 (percent)
AFA Mothership Catcher Vessels	Total	31,783,713	30,670,610	28,081,325	29,645,921	28,934,019	27,052,222	24,305,540	27,883,068	26,749,231	26,791,241	27,398,650	26,077,254	26,477,085	27,834,606	100.00%
AFA Shoreside Catcher Vessels	Total	140,245,544	152,440,642	138,678,056	142,468,597	145,165,126	133,772,042	125,593,511	139,083,129	148,832,966	120,354,262	129,479,610	122,063,130	123,667,675	135,526,484	100.00%
AFA Vessels (All Sectors)	Anchorage/Wasilla	0	0	0	0	0	0	0	0	0	0	0	6,655,518	6,524,755	1,013,867	0.60%
	Kodiak	3,796,200	4,657,369	4,215,360	4,444,195	3,712,717	3,972,786	4,929,192	2,500,128	3,923,982	3,049,082	3,691,541	1,510,271	1,837,314	3,556,934	2.09%
	Alaska Total	3,796,200	4,657,369	4,215,360	4,444,195	3,712,717	3,972,786	4,929,192	2,500,128	3,923,982	3,049,082	3,691,541	8,165,789	8,362,069	4,570,801	2.69%
	Seattle	141,016,033	*	143,712,822	148,447,972	150,942,033	137,419,800	*	*	*	*	138,079,272	*	*	141,389,665	68.08%
	Other WA*	8,895,029	*	12,403,649	13,045,427	13,064,914	12,166,221	*	*	*	*	11,568,198	*	*	10,229,456	6.00%
	Washington	149,911,061	162,594,532	156,116,471	161,493,399	164,006,948	149,586,021	139,865,878	159,325,220	166,374,542	140,759,967	149,647,470	133,999,860	137,367,196	151,619,120	74.07%
	Newport	10,094,864	9,380,512	*	*	*	*	5,103,981	*	5,283,673	*	3,539,249	5,974,735	4,415,496	5,933,033	3.49%
	Other OR/Other Sta	8,227,132	6,478,839	*	*	*	*	0	*	0	*	0	0	0	1,238,135	7.89%
	Oregon/Other States	18,321,995	15,859,351	6,427,550	6,176,924	6,379,481	7,265,457	5,103,981	5,140,848	5,283,673	3,336,453	3,539,249	5,974,735	4,415,496	7,171,169	23.23%
	Total	172,029,257	183,111,252	166,759,381	172,114,518	174,099,145	160,824,264	149,899,050	166,966,197	175,582,197	147,145,503	156,878,260	148,140,384	150,144,761	163,361,090	100.00%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT
* Other WA includes: Anacortes, Chinook, Mount Vernon, Neah Bay and Vancouver
**Other OR/Other States includes: (Depoe Bay, Florence, Independence, Keizer, Port Ortford, Portland, South Beach)Oregon and Half Moon Bay California

Table A6-12 Gross ex-vessel value diversification for CVs harvesting B season pollock by community of ownership address, 2011–2023 (2023 dollars)

Fleet	Community	Annual Average Number of Vessels	Annual Average Ex Vessel Value from B Season AFA	Annual Average Total Ex Vessel Value from All Area, Gear, and Species Fisheries	AFA Value as a Percentage of Total Ex-Vessel Value Annual Average
AFA Mothership Catcher Vessels	Total	13.0	27,834,606	58,756,779	47.37%
AFA Shoreside Catcher Vessels	Total	66.7	135,526,484	289,343,756	46.84%
AFA Vessels (All Sectors)	Anchorage/Wasilla	0.5	1,013,867	2,085,889	48.61%
	Kodiak	4.3	3,556,934	12,815,759	27.75%
	Alaska Total	4.8	4,570,801	14,901,648	30.67%
	Seattle	60.9	141,389,665	269,274,516	52.51%
	Other WA*	2.7	10,229,456	18,609,592	54.97%
	Washington	63.6	151,619,120	287,884,108	52.67%
	Newport	4.7	5,933,033	16,106,755	36.84%
	Other OR/Other States	1.3	1,238,135	4,224,857	29.31%
	Oregon/Other States	6.0	7,171,169	20,331,612	35.27%
	Total	74.4	163,361,090	323,117,369	50.56%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Table A6-13 Gross ex-vessel value diversification for communities with CVs harvesting B season AFA pollock, 2011-2023 (2023 dollars)

Fleet	Community	B Season Annual Average Number of Vessels	Annual Average Number of All Commercial Fishing Vessels in those Same Communities	B Season Annual Average 2011-2023 (dollars)	Annual Average Total Ex-Vessel Revenues from All Areas, Gears, and Species Fisheries for the Community Fleet	Participant Ex-Vessel Value as a Percentage of Total Community Ex-Vessel Revenue Annual Average
AFA Mothership Catcher Vessels	Total	13.0	862.6	27,834,606	933,869,524	3.0%
AFA Shoreside Catcher Vessels	Total	66.7	984.3	135,526,484	995,952,689	13.61%
AFA Vessels (All Sectors)	Anchorage/Wasilla	0.5	275.8	1,013,867	88,794,511	1.14%
	Kodiak	4.3	244.1	3,556,934	126,391,450	2.81%
	Alaska Total	4.8	519.9	4,570,801	215,185,961	2.12%
	Seattle	60.9	336.5	141,389,665	702,241,997	20.13%
	Other WA	2.7	94.6	10,229,456	37,697,531	27.14%
	Washington	63.6	431.1	151,619,120	739,939,528	20.49%
	Newport	4.7	14.9	5,933,033	28,515,794	20.81%
	Other OR/Other States	1.3	18.5	1,238,135	12,311,406	10.06%
	Oregon/Other States	6.0	33.4	7,171,169	40,827,200	17.56%
	Total	74.4	984.4	163,361,090	995,952,689	16.40%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT and NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Table A6-14 Number of shore-based processors accepting B season deliveries by community of operation, 2011-2023

Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (number)	Annual Average 2011-2023 (percent)	Unique Processors 2011-2023 (number)
Akutan	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	18.57%	1
King Cove	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	18.57%	1
Dutch Harbor	3	3	3	3	3	3	3	3	4	4	4	4	4	3.4	62.86%	5
Grand Total	5	5	5	5	5	5	5	5	6	6	6	6	6	5.4	100.00%	7
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT																

Table A6-15 Gross first wholesale revenues earned by shore-based processors from B season pollock deliveries, 2011-2023 (2023 dollars)

Community	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023 (millions)	Annual Average 2011-2023 (percent)
Akutan/Dutch Harbor/King Cove	$383.37	$413.91	$366.17	$378.28	$353.95	$364.39	$326.46	$354.24	$431.73	$349.01	$368.56	$360.35	$414.33	$374.21	100.00%
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT															

Table A6-16 Gross first wholesale revenue diversification for shore-based processors accepting B season pollock deliveries, 2011-2023 (2023 dollars)

Geography	Annual Average Number of Processors	Annual Average First Wholesale Revenues B Season AFA Pollock Only (millions 2023 real $)	Annual Average Total First Wholesale Revenues from All Area, Gear, and Species Fisheries	AFA Pollock First Wholesale as a Percentage of Total First Wholesale Revenue Annual Average
Akutan/Dutch Harbor/King Cove	5.4	$374.2	$853.9	43.82%
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT				

Table A6-17 Gross first wholesale revenue diversification for shore-based processors accepting B season pollock deliveries, 2011-2023 (2023 dollars)

Geography	Annual Average Number of Processors	Annual Average Number of All Commercial Fishing Processors in those Same Communities	Annual Average First Wholesale Revenues from B Season AFA Pollock (millions 2023 real $)	Annual Average Total First Wholesale Revenues from All Areas, Gears, and Species Fisheries for the Community Fleet (millions 2023 real $)	B Season AFA Pollock First Wholesale Revenue as a Percentage of Total Community First Wholesale Revenue Annual Average
Akutan/Dutch Harbor/King Cove	5.4	7.3	$374.2	$1,060.2	35.30%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Table A6-18 Shore-based processor's B season pollock revenue as percent of total, 2011-2023 (number of processors)

AFA B Season Pollock Rev as a % of Total	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Annual Average 2011-2023
0-10%	1	0	1	0	1	1	1	0	0	0	1	1	0	0.54
10-20%	0	1	0	1	0	0	0	1	1	1	0	0	1	0.46
20-30%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30-40%	1	0	0	0	0	0	0	0	0	1	1	0	0	0.23
40-50%	2	2	3	3	2	3	3	3	3	3	0	3	3	2.54
50-60%	1	2	1	1	2	1	1	1	2	1	4	1	2	1.54
60-70%	0	0	0	0	0	0	0	0	0	0	0	1	0	0.08
70-80%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
80-90%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90-100%	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Grand Total	5	5	5	5	5	5	5	5	6	6	6	6	6	5.38

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT

Pollock Dependent Communities School Enrollment Information

Below are figures portraying school enrollment information for select Alaska communities and Newport, Oregon (2014-2023). Declining school enrollments can signal communities in transition.

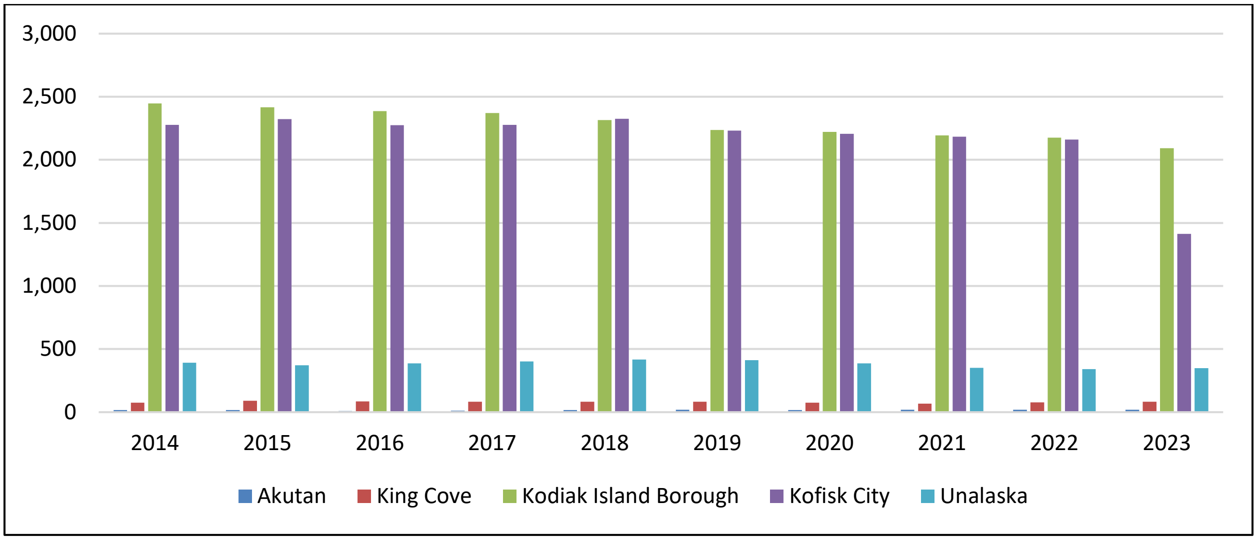


Figure A6-1 K-12 school enrollment (number of students) for Alaska communities substantially engaged in or dependent on B season pollock, 2014-2023
Source: Alaska Department of Education

Figure A6-2 shows school enrollment in Newport from 2014 to 2023. There are 18 schools in Newport, with a total enrollment of 5,122 students in 2023. The number of students dropped substantially during the Covid-19 pandemic and have still not recovered from pre-pandemic enrollment.

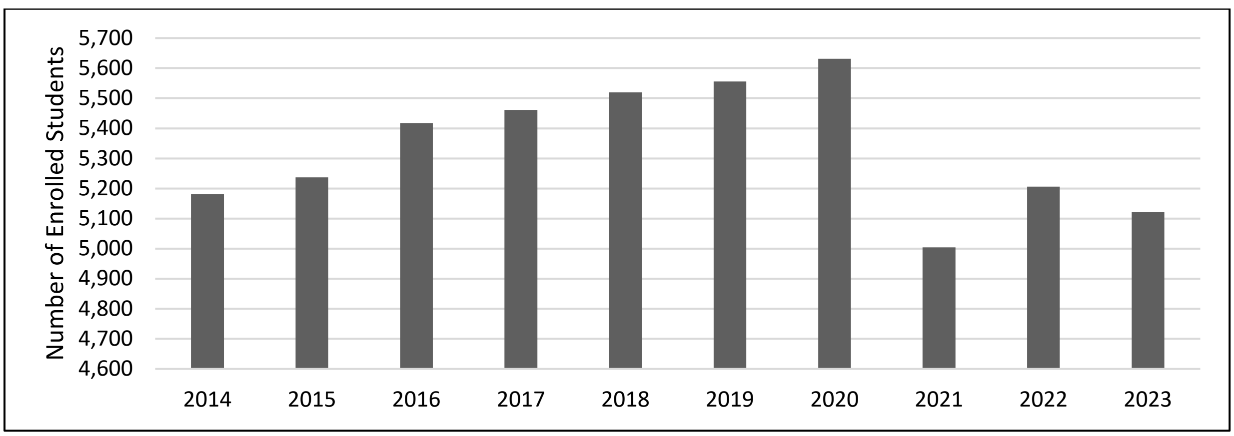


Figure A6-2 K-12 school enrollment (number of students) for Newport, Oregon, 2014-2023
Source: Oregon Department of Education

6.4 Effects on the Pollock Fisheries and Communities

The following sections provide supplementary analysis for Section 4.2 of the preliminary DEIS.

Vessel-level Analysis for Alternative 2 or 3

This section is intended to respond to AP request in April 2024 to include additional analysis on vessel apportionments and vessel-level impacts of the alternatives.

The analysis of economic impacts of a chum PSC limit (Alternative 2 and 3) and the corridor cap (Alternative 5) on the pollock industry (Section 4.2 of the preliminary DEIS) is often focused at the AFA and CDQ sector-level because there are intrinsic characteristics and practical constraints that are shared among vessels within a sector. However, within a sector, impacts from the proposed actions will also be experienced differently by participating entities. Even if a sector or cooperative is able to fully harvest its B season pollock apportionment, impacts from a chum salmon PSC limit under Alternative 2 or 3 or an area closure under Alternative 5 could still be experienced at the cooperative-, company-, and vessel-level.

Decisions of whether and how to operate in the B season with chum salmon PSC limit or corridor caps will be made by an AFA company and within the cooperatives. This includes consideration of the risk of a chum PSC limit even before the B season begins. This assessment will be made with imperfect information on catch rates and chum PSC encounters. Although additional seasons operating under a chum salmon PSC limit may provide more insight to the degree of constrain, annual factors (e.g., pollock aggregation, encounters with other PSC species, ocean and weather, etc.) will continue to add uncertainty. There are substantial fixed and initial variable costs associated with any participation in the pollock B season fishery and if a company perceives the risk of operation to be too great, they may choose to operate differently even prior to incurring any avoidance costs or before a closure results in forgone revenue. This could include consolidation of pollock quota onto other vessels owned by the same company or leased to an unaffiliated vessel within their cooperative. If this occurred, that vessel owner may receive a fraction of the revenue they would have earned from harvesting the pollock directly. This decision would also reduce income and opportunity for the captains and crew. This type of impact may not be apparent at the sector level if all of the sector's quota was harvested but could nonetheless result in adverse distributional impacts for vessels/companies and the individuals associated with them.

It is anticipated that if a chum salmon PSC limit is implemented, similar to Chinook salmon PSC, the sector or cooperative would choose to apportion the limit to the vessel-level. This could provide further accountability and reduce the risk that the cooperative or sector would exceed their apportionment of the total chum salmon PSC limit. While NMFS would apportion any chum salmon PSC limit to cooperatives and CDQ groups, a sub-division of the apportionment could occur through contractual agreement (i.e., IPA or inter-cooperative agreement). If a vessel reached their individual limit, it is likely these agreements would require them to stop fishing. While it might be possible for them to receive chum salmon PSC or a PSC/ pollock pairing by transfer from other vessels within their cooperative, based on the limited transfer patterns for Chinook salmon PSC and the incentive for a vessel to maintain their own PSC in reserve, this is not expected to be common. More likely, to the extent it is possible,[6] it is expected that a vessel that still has a chum salmon PSC apportionment available would lease the remainder of that vessel's pollock quota. Therefore again, the pollock could be fully harvested at the sector or cooperative level; while adverse impacts are still experienced for the vessel owner and crew of the vessel that exceeded its vessel-level apportionment.

To further demonstrate this point, the analysts used information provided in the inshore CV inter-cooperative reports on vessel-level apportionments of Chinook PSC (including transfers) to provide illustrations of how individual inshore CVs may have performed relative to a vessel-level apportionment of chum salmon PSC during 2021, 2022, and 2023. The chum salmon PSC limit and apportionment from Alternative 2 that resulted in the lowest amount for inshore cooperatives (100,000 chum salmon and AFA apportionment) and highest PSC limit and apportionment (550,000 chum salmon and 3-year average apportionment) were included and are referred to as lowest PSC limit and highest PSC limit here. Each calculated vessel-level chum salmon PSC apportionment was then compared to the actual chum salmon

[6] Some vessels may have additional constraints on leasing B season pollock. For instance, GOA sideboard-exempt CVs could face penalties if they leased Bering Sea B season pollock while fishing above the sideboard limits in the GOA in the same year (see the section following this one on spillover impacts for more detail).

catch by each vessel. The figures demonstrate the number of chum salmon PSC over or under a vessel could have been relative to a hypothetical vessel-level chum PSC apportionment. As noted in the DEIS, had these limits been in place in these years, these vessels would have been expected to alter their fishing strategies, to the degree they could.

There are several additional notes associated with these examples. The allocations and catch do not account for Amendment 69 harvest[7] and the figures do not include inshore CVs that were not active in the Bering Sea pollock B season. Therefore, the figures do not represent the cooperative-level impacts, which would both include both the additional catch from the Amendment 69 fishing and the additional allocation of chum salmon PSC from vessels that did not fish (although transfers were accounted for). The analysts are not aware of all the joint ownerships and relationships between vessels and therefore these are also not accounted for. Presumably if two or more vessels are owned by the same company, then shifting pollock or associated PSC from one vessel to another in under the same ownership structure would not be as impactful for that company; however, it may still have implications for the captain and crew.

As would be expected, lower PSC limits/apportionments have the greatest potential impact on the largest number of vessels. However, there is substantial interannual variability between 2021-2023.

2021:

- In 2021, the lowest chum salmon PSC level could have halted the operations of up to 42 of the 62 active inshore CVs, if they did not receive PSC transfers from within their cooperative or alter their fishing behavior.
- Additionally in a year like 2021, many of the vessels that potentially would have exceeded their vessel-level chum salmon PSC limit at the lower PSC limit, would have still exceeded it at the highest chum salmon PSC limit considered. Of the 62 active inshore CVs, 23 vessels would have exceeded their vessel-level allocations if they did not receive PSC transfers from within their cooperative or alter their fishing behavior.
- In 2021, the inshore CV sector as a whole would have reached it sector-level chum salmon PSC limit if the fleet did not alter fishing behavior, whether the chum salmon PSC limit was set to 100,000 or 550,000, if the AFA appointment was selected. If the 3-year average apportionment was selected with a chum PSC limit of 550,000, the inshore CV sector would not have reached the sector-level limit in 2021, however there would still be a substantial number of vessels at their hypothetical vessel-level limit.

2022:

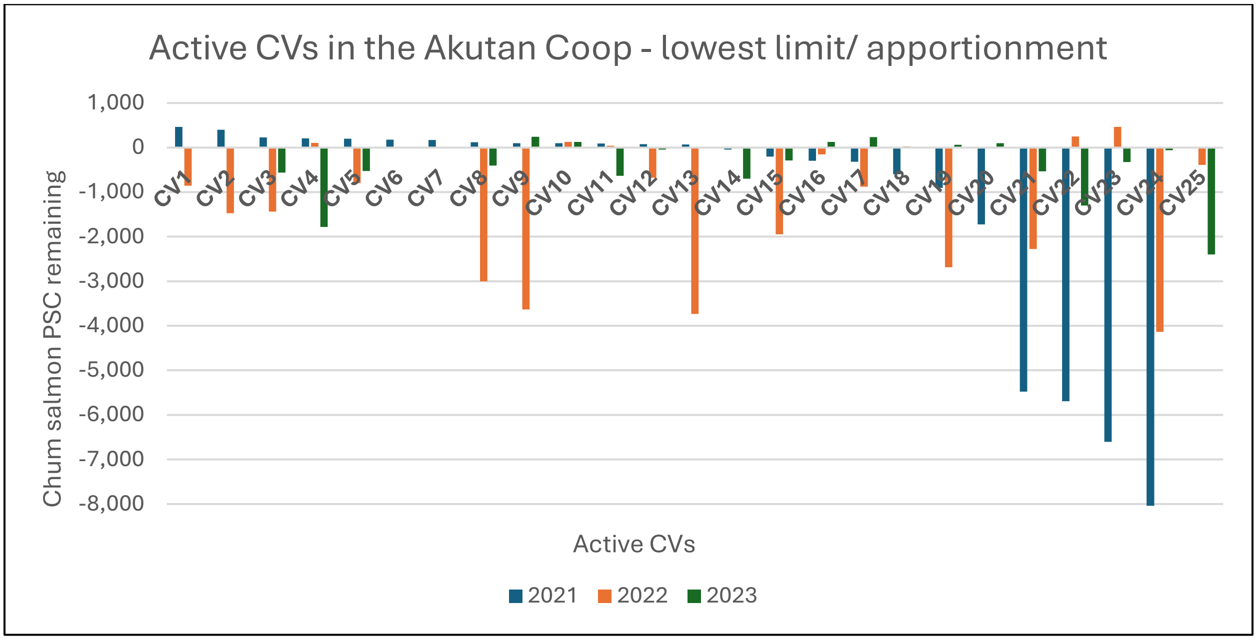
- In 2022, 42 of the 61 active inshore CVs potentially would have exceeded their vessel-level chum salmon PSC limit at the lower PSC limit and 3 of the active 61 inshore CVs potentially would have exceeded their vessel-level chum salmon PSC limit at the highest PSC limit.
- In 2022, the inshore CV sector would have reached the lowest chum salmon PSC limit under all apportionments. The sector would not have reached the highest PSC limit under any apportionment.

2023:

7 Amendment 69 to the BSAI groundfish FMP provided each inshore cooperative an opportunity to lease a portion its pollock allocation to a non-member AFA inshore catcher vessel. This leasing does not imply that quota is transferred from one cooperative to another, but rather that the non-member AFA catcher vessel becomes a de facto member of the cooperative to which the quota is allocated.

- In 2023, 29 of the 57 active inshore CVs potentially would have exceeded their vessel-level chum salmon PSC limit at the lower PSC limit and 8 of the active 57 inshore CVs potentially would have exceeded their vessel-level chum salmon PSC limit at the highest PSC limit.
- In 2023, the inshore CV sector would have reached the lowest chum salmon PSC limit under all apportionments. The sector would not have reached the highest PSC limit under any apportionment.

This analysis demonstrates another layer of impacts that may be experienced by the vessels/ companies using the inshore sector as an example. As shown for all three years, at the higher chum salmon PSC limit/ apportionment the sector would not have reached its apportionment, yet adverse impacts could have still been experienced for the vessel owner and crew of the vessel that exceeded its vessel-level apportionment in all three years.



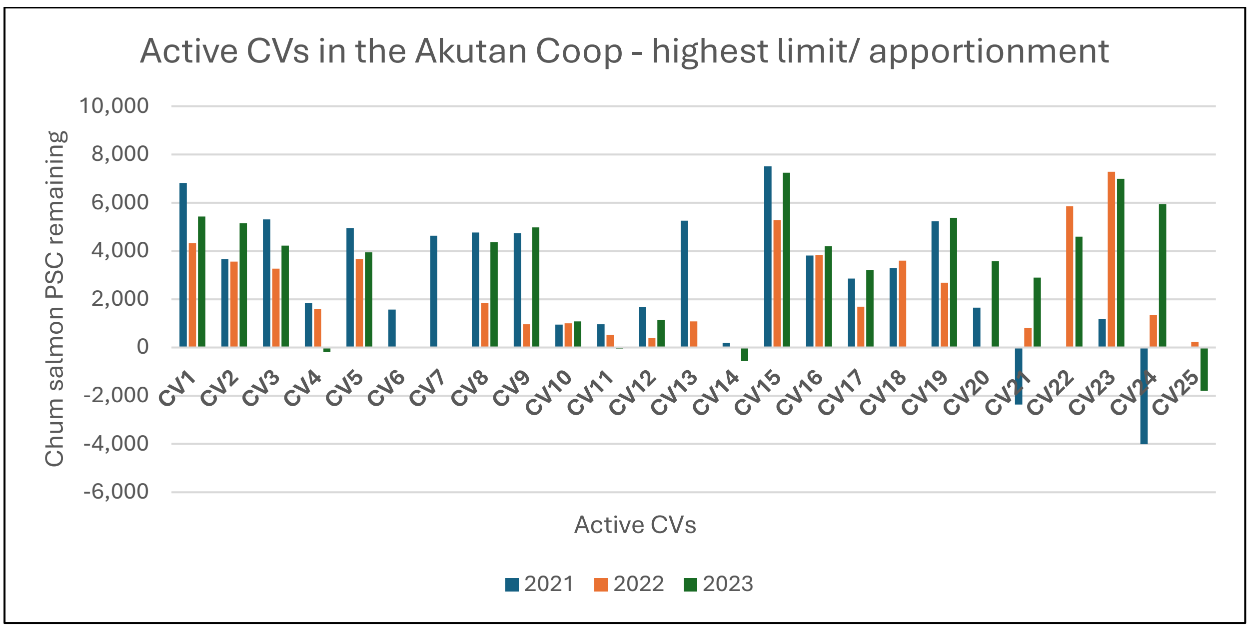
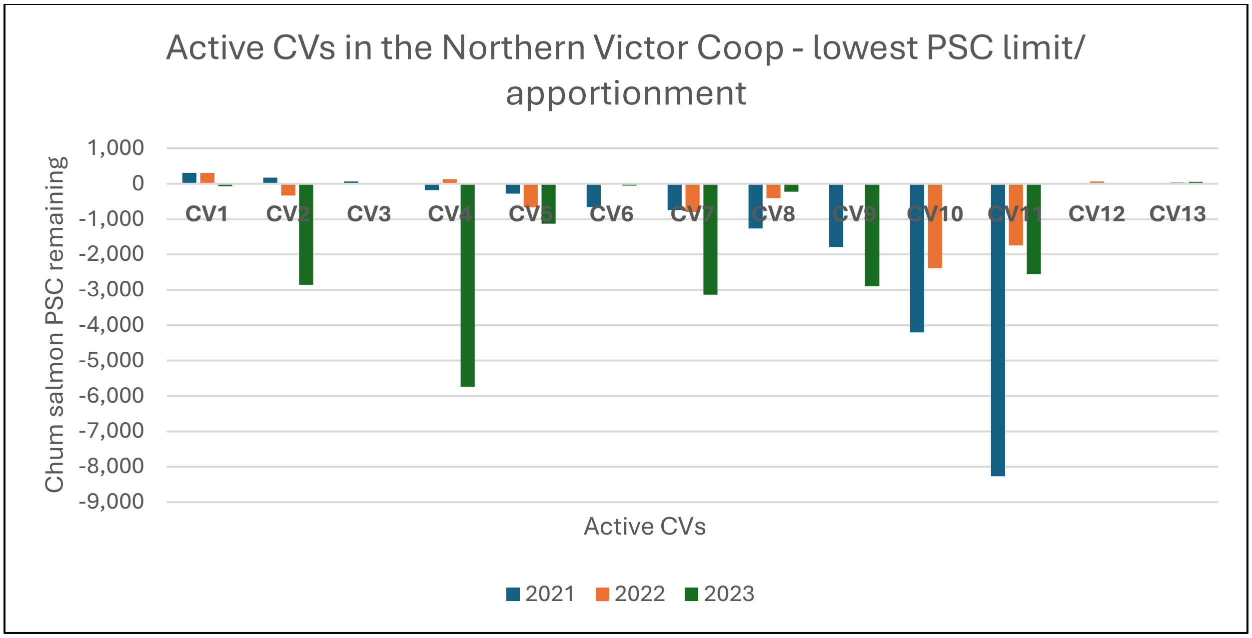


Figure A6-3 Akutan Cooperative: Potential vessel-level impacts for CVs active in the Bering Sea pollock B season, demonstrated by subtracting annual vessel-level chum salmon bycatch by a vessel-level PSC limit generated from the lowest PSC limit and apportionment (100,000 chum salmon and AFA apportionment; upper figure) and highest PSC limit and apportionment (550,000 chum salmon and 3-year avg apportionment; bottom figure), 2021-2023

Source: AFA Annual Catcher Vessel Inter-coop Reports, 2021-2023



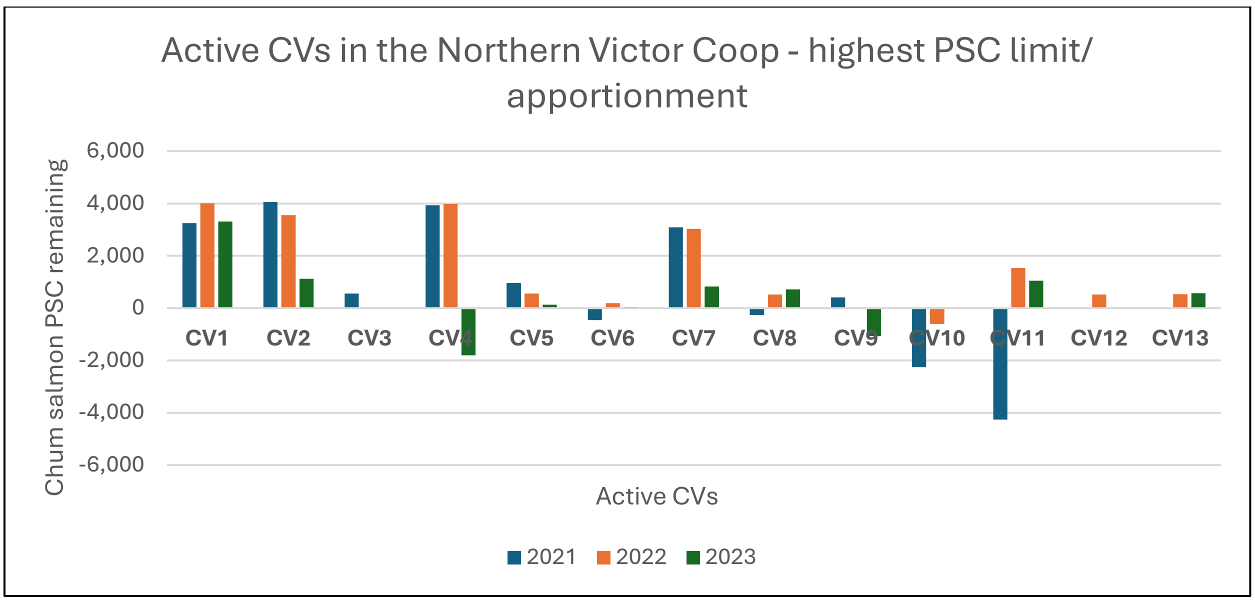
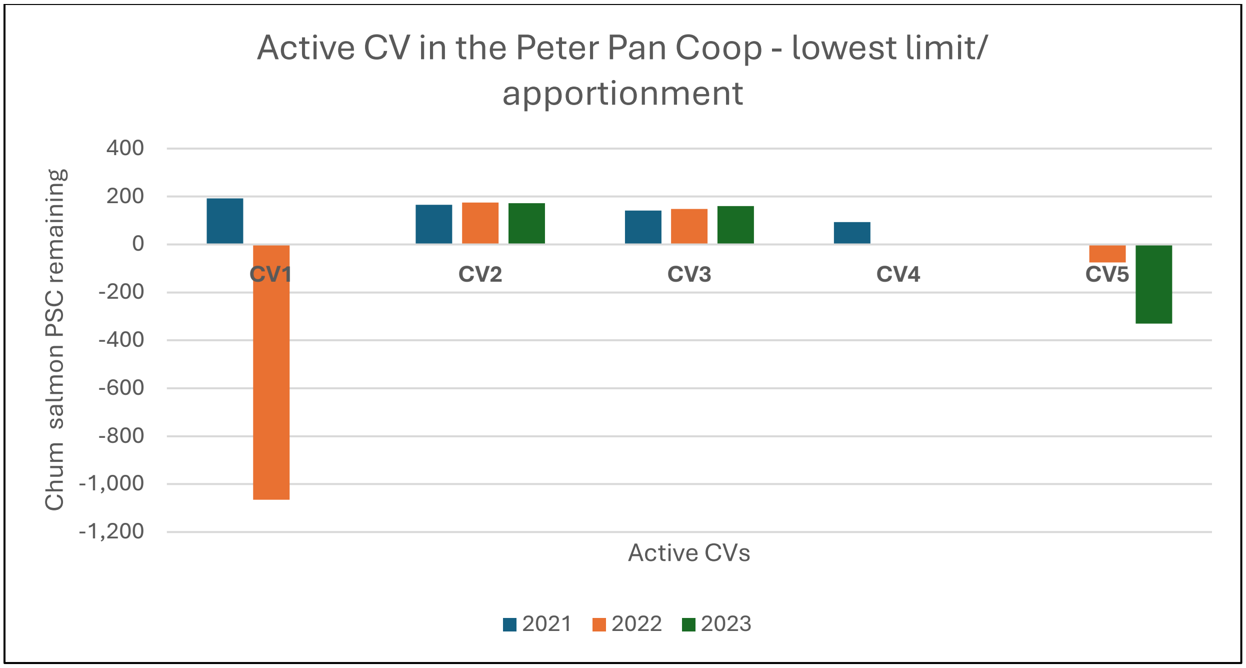


Figure A6-4 Northern Victor Cooperative: Potential vessel-level impacts for CVs active in the Bering Sea pollock B season, demonstrated by subtracting annual vessel-level chum salmon bycatch by a vessel-level PSC limit generated from the lowest PSC limit and apportionment (100,000 chum salmon and AFA apportionment; upper figure) and highest PSC limit and apportionment (550,000 chum salmon and 3-year avg apportionment; bottom figure), 2021-2023

Source: AFA Annual Catcher Vessel Inter-coop Reports, 2021-2023



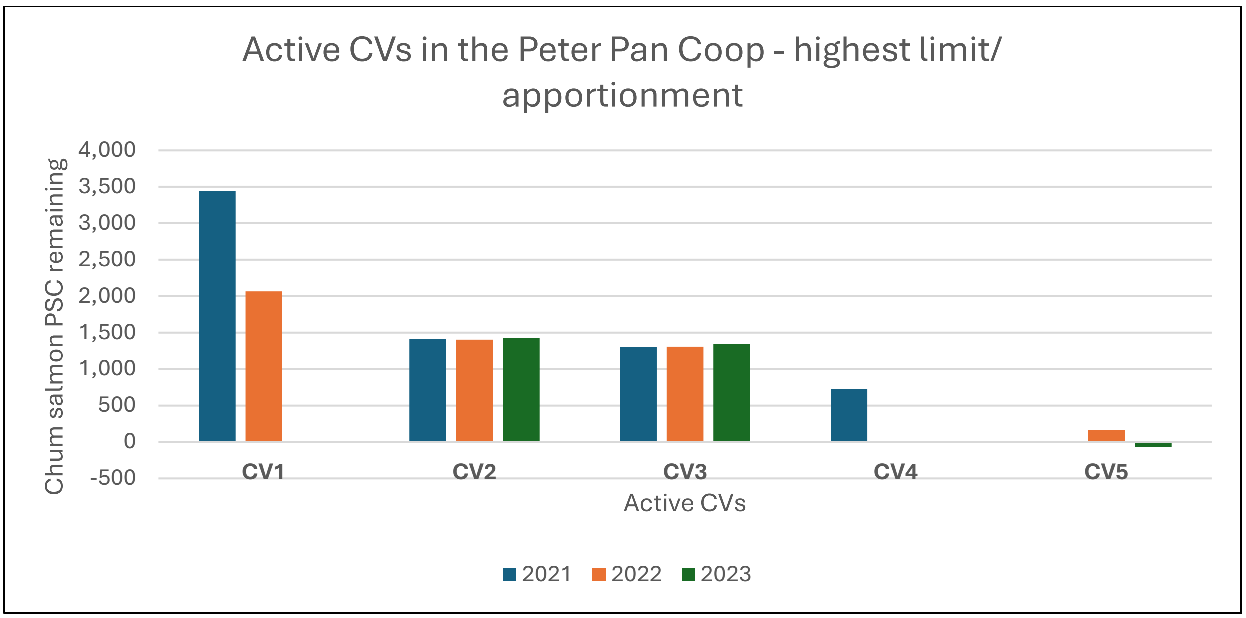
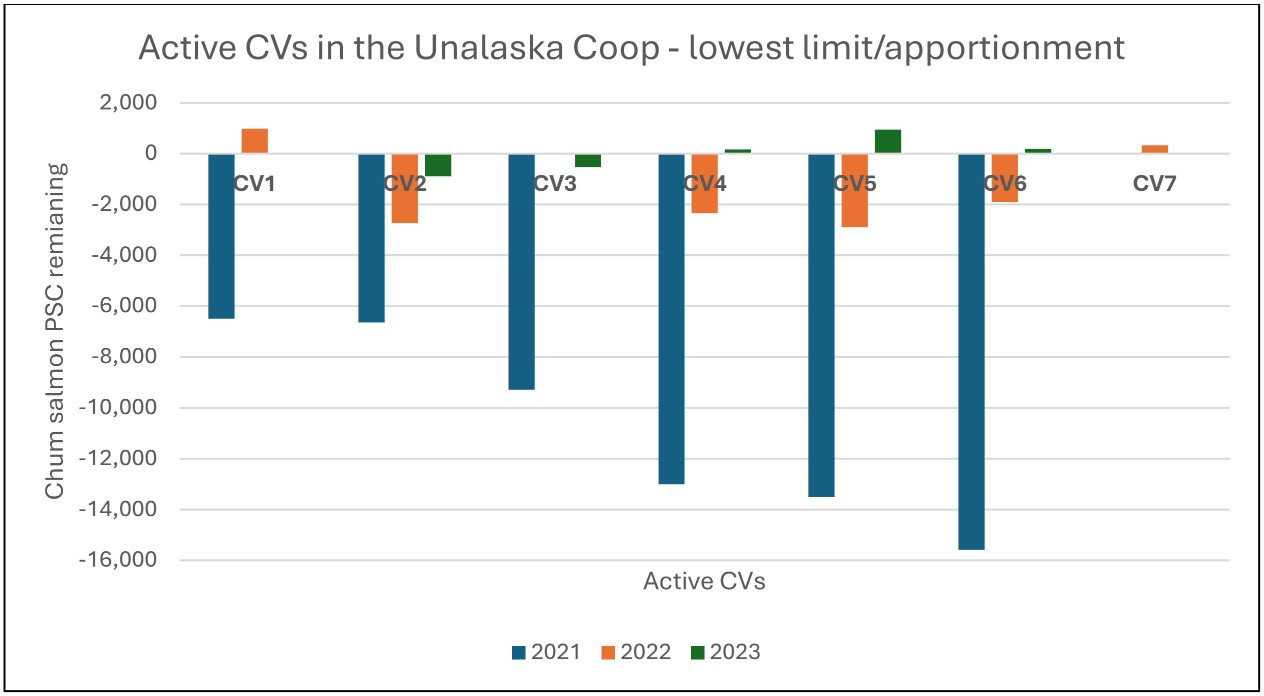


Figure A6-5 Peter Pan Cooperative: Potential vessel-level impacts for CVs active in the Bering Sea pollock B season, demonstrated by subtracting annual vessel-level chum salmon bycatch by a vessel-level PSC limit generated from the lowest PSC limit and apportionment (100,000 chum salmon and AFA apportionment; upper figure) and highest PSC limit and apportionment (550,000 chum salmon and 3-year avg apportionment; bottom figure), 2021-2023

Source: AFA Annual Catcher Vessel Inter-coop Reports, 2021-2023



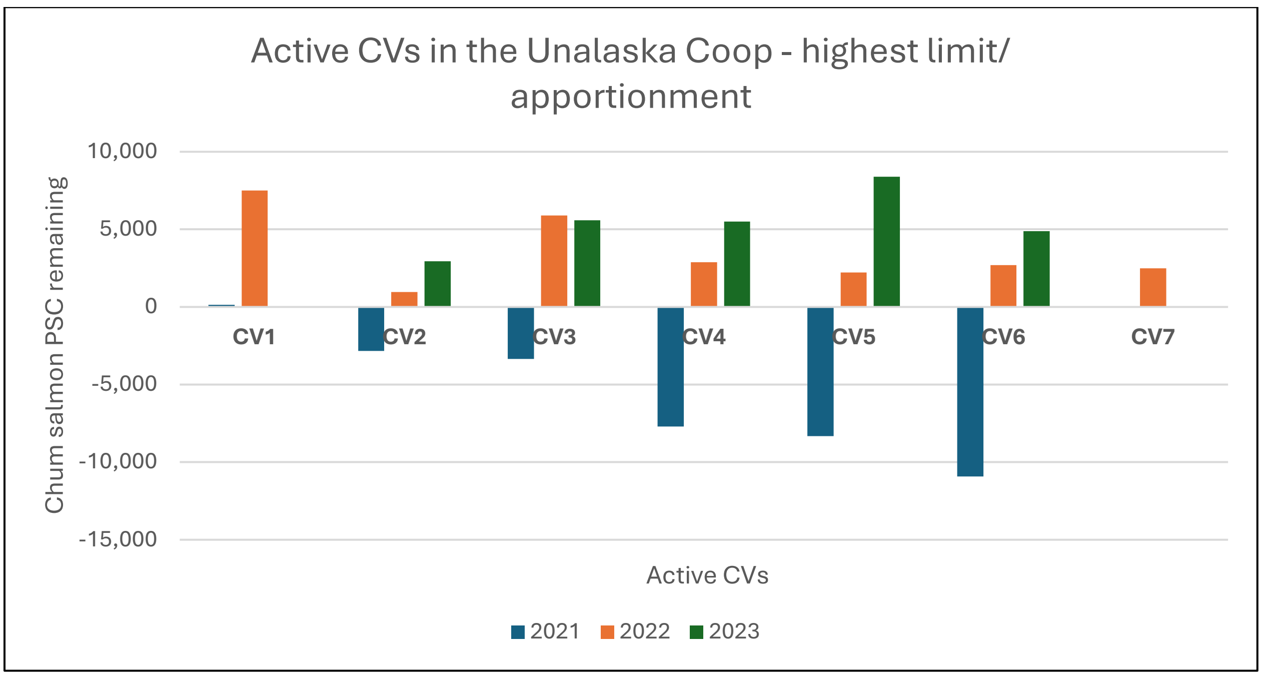
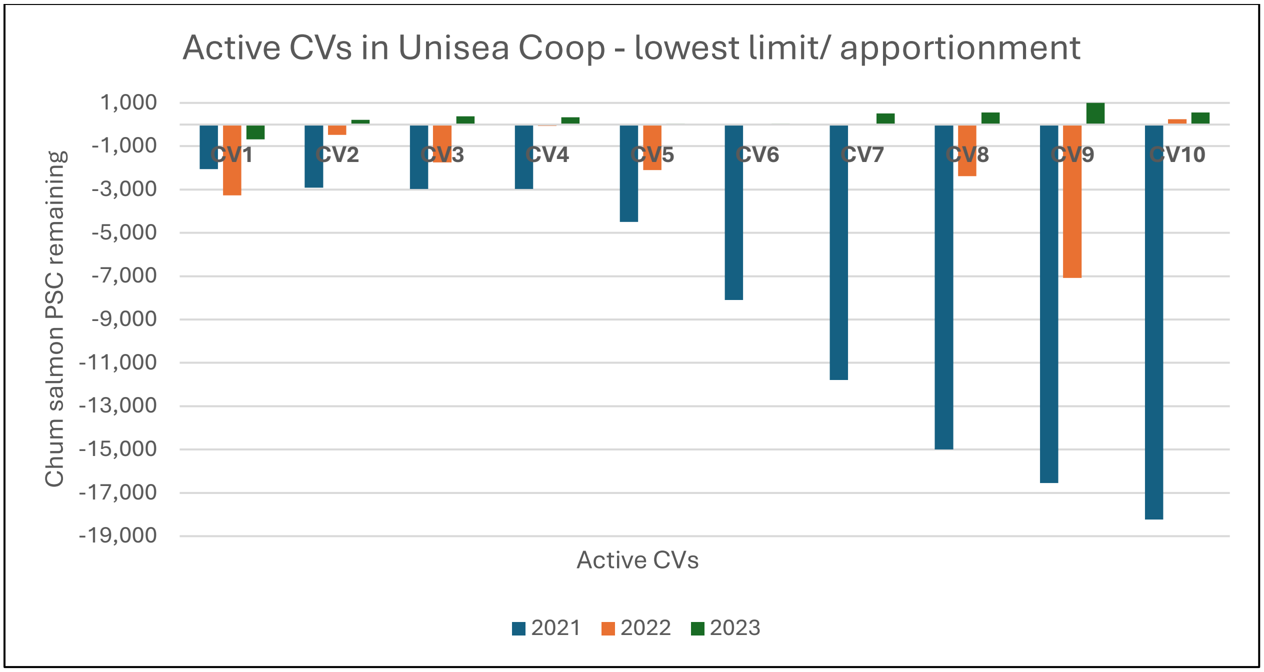


Figure A6-6 Unalaska Cooperative: Potential vessel-level impacts for CVs active in the Bering Sea pollock B season, demonstrated by subtracting annual vessel-level chum salmon bycatch by a vessel-level PSC limit generated from the lowest PSC limit and apportionment (100,000 chum salmon and AFA apportionment; upper figure) and highest PSC limit and apportionment (550,000 chum salmon and 3-year avg apportionment; bottom figure), 2021-2023

Source: AFA Annual Catcher Vessel Inter-coop Reports, 2021-2023



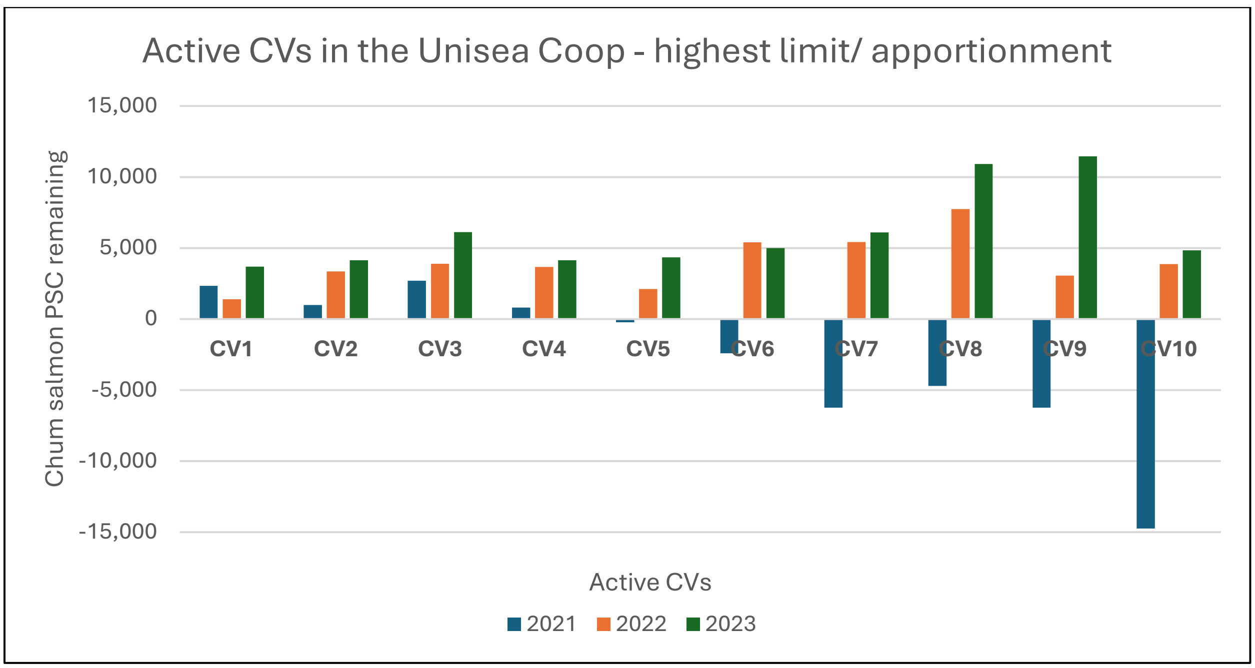
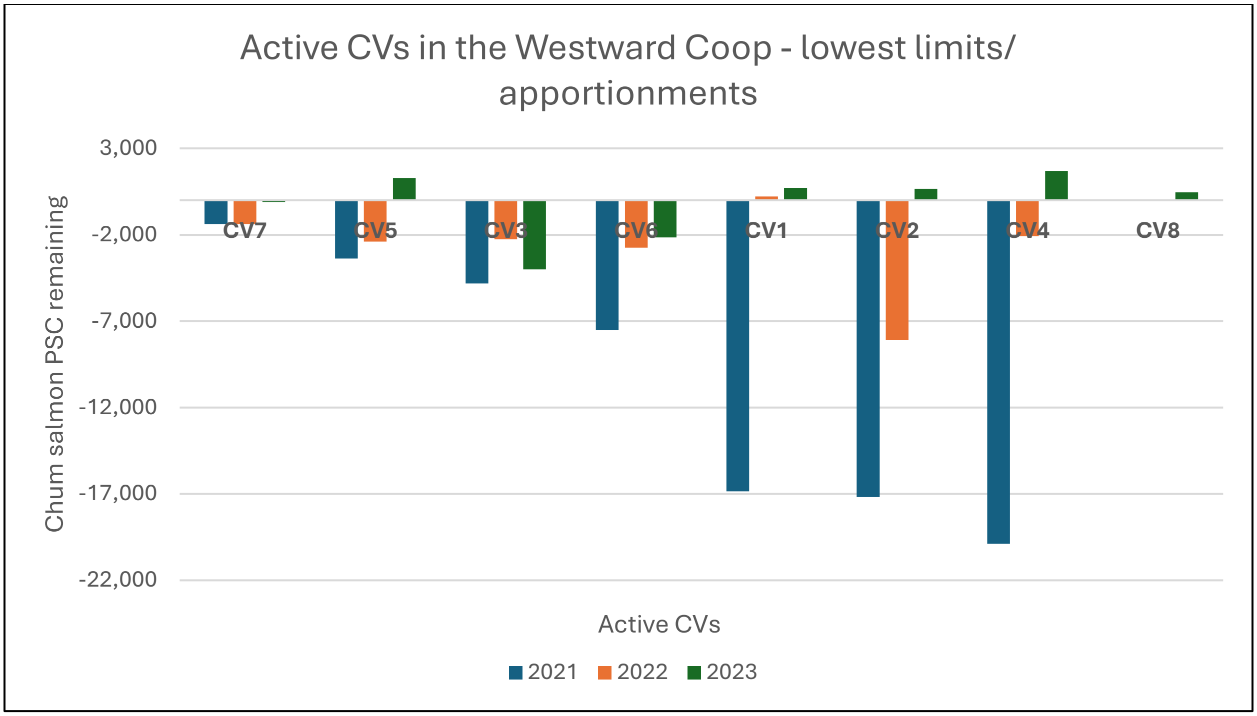


Figure A6-7 Unisea Cooperative: Potential vessel-level impacts for CVs active in the Bering Sea pollock B season, demonstrated by subtracting annual vessel-level chum salmon bycatch by a vessel-level PSC limit generated from the lowest PSC limit and apportionment (100,000 chum salmon and AFA apportionment; upper figure) and highest PSC limit and apportionment (550,000 chum salmon and 3-year avg apportionment; bottom figure), 2021-2023

Source: AFA Annual Catcher Vessel Inter-coop Reports, 2021-2023



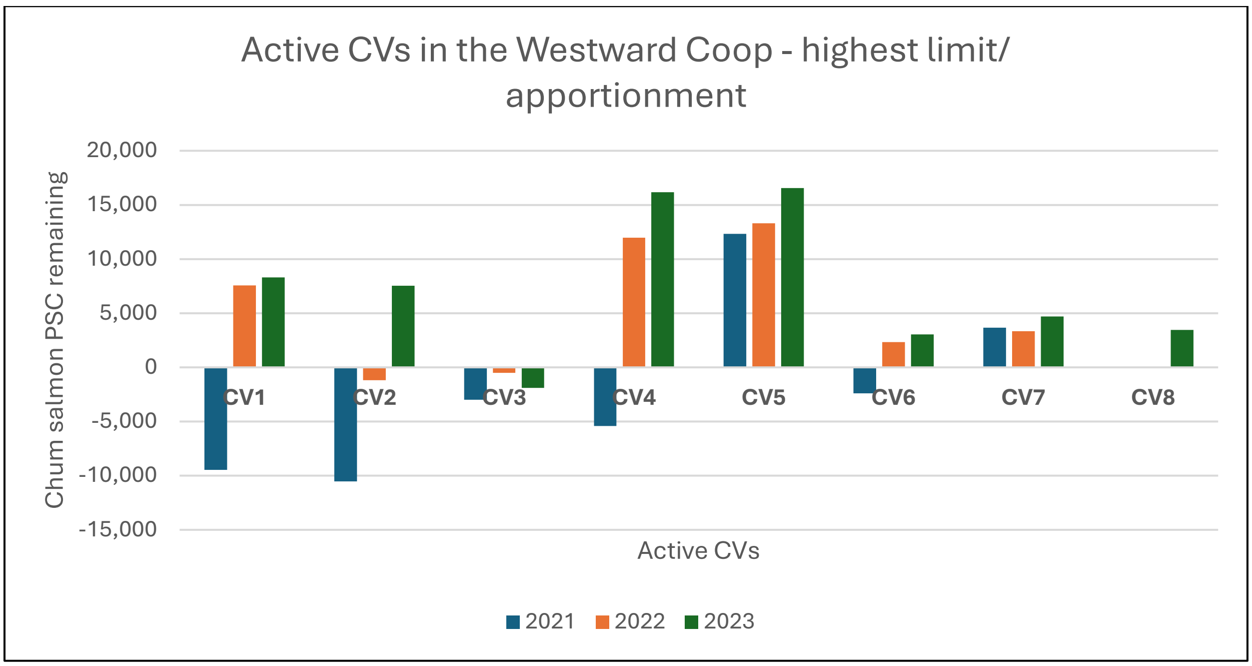


Figure A6-8 Westward Cooperative: Potential vessel-level impacts for CVs active in the Bering Sea pollock B season, demonstrated by subtracting annual vessel-level chum salmon bycatch by a vessel-level PSC limit generated from the lowest PSC limit and apportionment (100,000 chum salmon and AFA apportionment; upper figure) and highest PSC limit and apportionment (550,000 chum salmon and 3-year avg apportionment; bottom figure), 2021-2023

Source: AFA Annual Catcher Vessel Inter-coop Reports, 2021-2023

Spillover Impact Analysis for Alternative 2 or 3

This section is an expansion of Section 4.2.2 in considering the potential impacts of a chum PSC limit on AFA vessels. If the B season pollock fishery was closed early due to meeting a chum PSC limit or there was incentive to consolidate pollock quota, AFA vessels may try to shift effort into other fisheries. If they are successful, this could alleviate some of the financial impacts of leaving pollock quota unharvested or not directly fishing their quota. However, it could also potentially have spillover impacts to historical participants in these fisheries. The AP requested additional consideration of potential spillover impacts that could occur if the B season pollock fishery was closed early due to meeting a chum PSC limit or consolidation of the pollock quota were to occur if operations became less profitable. In response to AP requests, this section walks through the most likely opportunities for AFA vessels to move into other BSAI or GOA fisheries based on LLP endorsements, sideboards, season timing and other practical considerations.[8]

Catcher Processors

CPs listed in the AFA are prohibited from fishing in the GOA; therefore, if Bering Sea pollock fishing was less profitable or closed for the B season, **CPs would not be able to shift effort into GOA fisheries**.

Within the BSAI, CPs have limited options for non-pollock fishing. **Some AFA CPs have routinely harvested CDQ allocations of non-pollock BSAI species such as Pacific cod or flatfish species. In addition to CDQ, the BSAI non-pollock fisheries in which at least one AFA CP engaged in directed fishing are the Pacific cod, yellowfin sole, and Atka mackerel fisheries**. Therefore, this section describes the potential for spillover into these BSAI fisheries and any expected impacts to existing participants.

Pacific Cod Trawl CP Allocation

Under Amendment 85 to the BSAI groundfish FMP, which was implemented in 2008, AFA CPs are allocated 2.3% of the BSAI Pacific cod TAC. The establishment of a separate BSAI Pacific cod allocation to this sector negated the need for the BSAI Pacific cod sideboard, which protected the historic share of the non-AFA trawl CP sector (Amendment 80 sector) from being eroded by AFA CPs. Therefore, this amendment also removed the sideboard limit for BSAI Pacific cod for the AFA CPs. However, this apportionment of the BSAI Pacific cod TAC is coordinated by the CP cooperative (Pollock Conservation Cooperative). Since 2019, this apportionment of Pacific cod has either been targeted by one vessel or caught only incidental to AFA pollock harvest. Additionally, if spillover impacts occurred from a shortened B season, this would occur between June 10 – Nov 1, the pollock B season. Since Amendment 85 the CP allocation of Pacific cod is apportioned only to the A and B seasons and not to the C season, which runs from June 10- Nov 1. Unharvested rollover from the A and B season may occur; however, it has resulted in highly variable amounts. Moreover, Pacific cod is typically disaggregated and harder to fish this time of year. Any amount of remaining quota is typically rolled to other sectors rather than fished in the C season by CPs. **Therefore, Pacific cod is unlikely to present much opportunity for CPs during the pollock B season.**

Trawl Limited Access Yellowfin Sole

Amendment 80 divided the ITAC for yellowfin sole between the Amendment 80 sector and the Trawl Limited Access sector (TLAS). The TLAS fisheries provide additional harvesting opportunities for Amendment 80 species for AFA CPs, CVs, and non-AFA CVs through a shared apportionment. The proportion of yellowfin sole ITAC allocated between the Amendment 80 and BSAI TLA sectors

[8] Some CPs also participate in the at-sea C/P Pacific Whiting fishing (i.e., hake of the WA coast) and some CVs also participate in the shorebased IFQ or mothership cooperative program in the Pacific Whiting fishing. This season runs from May 1 to December 31 and thus overlaps with the Bering Sea pollock B season. However, these are limited access privilege programs and therefore, there is no opportunity to expand operations in this fishery without purchasing additional permits. Therefore, additional spillover impacts are likely limited.

fluctuates with the yellowfin sole TAC. When the ITAC is greater than 125,000 mt, TLAS is apportioned 40% and the sideboards (which limit harvest by TLAS CVs and CPs) are removed. Since 2008, the yellowfin sole ITAC has been higher than 125,000 mt, so sideboard limits have not been in place for AFA vessels. There are no seasonal splits in this fishery, but higher halibut PSC in the summer months means this fishery is typically prosecuted January – May and then September through November. Between 2015 and 2023, the number of AFA CPs participating in the BSAI yellowfin sole fishery ranged from a low of 2 vessels to a high of 7 vessels. **Given the varying participation in this fishery over the years, an early B season closure of the pollock fishery could potentially lead to increased competition in the yellowfin sole TLAS fishery from CPs**. Again, there are substantial costs to converting the fishing gear and the onboard process factory of a pollock operation and therefore it would be unlikely to occur on an ad hoc basis.

Trawl Limited Access Atka Mackerel

The TLAS Atka Mackerel fishery is unlikely to provide additional harvest opportunities for AFA CPs. The ITAC for Atka Mackerel is split with 90% apportioned to the Amendment 80 fishery and 10% to the TLAS fisheries. Within the TLAS fishery, this apportionment is also equally split between an A (January 20 through June 10) and B season (June 10 through December 31) and between subareas (Eastern Aleutian district/Bering Sea and Central Aleutian district), with a potential for rollover if the apportionment is unharvested. This TLAS apportionment is shared between CPs and CVs. CP fishery participation has been consistently low in the Atka Mackerel fishery, with two unique vessels participating in the fishery from 2015 through 2023, with most years having only one active vessel.

<u>Catcher Vessels</u>

In response to AP requests, this section considers potential spillover impacts on non-AFA fisheries from displaced CV effort. This displaced effort could result from a B season closure or incentives to avoid chum salmon due to the presence of a PSC limit. This section walks through the most likely opportunities for AFA CVs to move into other BSAI or GOA fisheries based on sideboards, LLP endorsements, season timing and other practical considerations.

Gulf of Alaska

While there is no overall prohibition for AFA CVs in the GOA, there are several regulatory and operational considerations that substantially limit the amount of spillover that would be possible in the GOA.

CVs Exempt from GOA Sideboards

AFA CVs are divided into two categories to fish in the GOA – those vessels exempt from sideboard limits that can fish the GOA directed fishery allocation and those that are subject to sideboard limits. The Council provided a sideboard exemption for AFA CVs that demonstrated dependence on GOA fisheries, while having limited history in the BSAI pollock fishery. Of the 116 permitted AFA CVs, 20 CVs are exempt from the GOA sideboards. Of these 20 exempt CVs, 17 have been active between 2015-2023 and most of these vessels have had recent consistent participation in both the BS pollock fishery as well as GOA fisheries. Table 13-25 highlights the AFA GOA exempt CVs harvesting activities in the GOA from 2015 through 2023. Since 2015, 12 of the 17 active exempt CVs have consistently participated in GOA fisheries and 11 of the 17 CVs have consistently participated in AFA pollock fishing in the Bering Sea.

Additionally, the Central GOA (CGOA) Rockfish Program is a limited access privilege program in which quota share was allocated based on historic participation among fishing vessels and processors in Pacific ocean perch, northern rockfish, and pelagic shelf rockfish (now dusky rockfish) in the CGOA. In addition, allocations are also made for secondary species harvested while fishing for the primary species. These species include Pacific cod, rougheye rockfish, shortraker rockfish, sablefish, and thornyhead rockfish. A number of AFA vessels (3 GOA non-exempt vessels and 14 GOA exempt vessels) receive allocations under the Rockfish Program (and an associated halibut PSC allowance). AFA vessels that participate in this program may seek greater participation by purchasing or leasing additional quota. However, as a quota-based program, this possible expansion would not likely have spillover effects.

While there may be some ways for GOA exempt CVs to change or expand their participation in other GOA fisheries, there are also some non-regulatory constraints limiting what might be a viable opportunity for these vessels. For instance, the Council encouraged a policy that no AFA CV exempt from the GOA groundfish sideboards should lease any portion of such vessel's AFA pollock allocations to another person or vessel during a year when that exempt vessel harvests fish in a GOA fishery other than the Central GOA Rockfish Program fishery. In response, the CV Inter-cooperative agreement, which these vessels are a party to, states that 'GOA exempt vessel that harvests in excess of the otherwise applicable GOA groundfish sideboard must not have transferred any amount of such vessel's AFA pollock allocation to another vessel such that the aggregate amount of such exempt vessel's annual AFA pollock allocation is reduced by such transfer(s).' If an exempt vessel exceeds a GOA groundfish sideboard and fails to comply with the BSAI pollock transfer limitations, they could essentially lose their ability to use their GOA exemption status.[9] This inter-cooperative provision creates a strong incentive for GOA exempt vessels that choose to fish in the GOA, to also fish their allocation of Bering Sea pollock. If they do not fish their Bering Sea pollock, rather than lease it and risk penalties, they could choose to leave it unharvested.

As a typical schedule, some GOA sideboard exempt vessels may choose to fish A season pollock in the GOA (Jan 20-May 31). If they have a CGOA Rockfish Program allocation, they would typically participate in this fishery in May. Then in order to retain their GOA-exemption status, they would travel to the Bering Sea to participate in the Bering Sea pollock B season. If they are less than 125 ft LOA (50 CFR 679.23(i)), they could choose to travel back to the GOA to participate in B season for GOA (610, 620, and 630) which spans Sept 1- Nov 1. If they are greater than or equal to 125 ft LOA, they cannot participate in both BSAI and GOA in the same season. Therefore, reduced participation in the Bering Sea may or may not affect their participation in GOA B season pollock.

Table A6-19 Harvest (mt) and number of GOA sideboard exempt AFA CVs by species from 2015 through 2023

Species		2015	2016	2017	2018	2019	2020	2021	2022	2023
Pollock	Harvest (mt)	52,381	52,785	58,334	46,001	30,881	23,335	27,885	39,160	37,891
	Number of exempt CVs	15	15	14	16	14	14	14	13	13
Pacific cod	Harvest (mt)	2,557	1,424	1,791	437	310	159	601	1,461	1,147
	Number of exempt CVs	15	15	14	15	14	13	14	13	13
Arrowtooth Flounder	Harvest (mt)	1,615	2,872	2,062	1,141	1,668	1,312	113	136	112
	Number of exempt CVs	15	15	14	16	14	14	14	13	13
Flathead Sole	Harvest (mt)	254	408	93	168	226	204	26	11	26
	Number of exempt CVs	15	15	14	16	14	14	14	13	12
GOA Deep Water Flatfish	Harvest (mt)	10	24	13	1	3	7	0	0	1
	Number of exempt CVs	10	13	7	9	12	4	8	4	7
GOA Rex Sole	Harvest (mt)	148	227	60	67	67	68	8	4	15
	Number of exempt CVs	15	15	13	13	12	13	13	11	11
GOA Shallow Water Flatfish	Harvest (mt)	158	348	298	515	119	94	34	78	62
	Number of exempt CVs	15	15	12	15	10	9	12	12	10
Northern Rockfish	Harvest (mt)	19	43	9	8	1	1	*	0	0
	Number of exempt CVs	12	13	12	7	10	7	2	5	6
Pacific Ocean Perch	Harvest (mt)	64	806	983	715	387	237	286	992	848
	Number of exempt CVs	15	15	14	16	14	14	14	13	13

Source: AKFIN; file source BSAI_PCOD_LAPP_GOA_SB_LANDINGS(7-22-24)

GOA Sideboarded CVs

NMFS manages the AFA sideboard limits. Sideboard limits allow the cooperative members to catch up to their "historical" percentage of species they harvested in non-rationalized GOA groundfish fisheries.

[9] H.Berns, personal communications.

Sideboard limits are not an allocation. The sideboard is a limit on the maximum amount of a species that catch share program participants can catch. Of the 116 permitted AFA CVs, 96 CVs are not exempt and would be subject to sideboards should they fish groundfish in the GOA. However, these vessels must also hold an LLP license that is properly endorsed to fish trawl gear in the sub-area of the GOA they wish to pursue. Of the remaining 96 CV permits, currently only 14 non-exempt vessels are endorsed to fish in the Central GOA with trawl gear and 10 are endorsed to fish in the Western GOA with trawl gear.

In 2019, an amendment was implemented to streamline and simplify NMFS's management of AFA groundfish sideboard limits, prohibiting directed fishing for numerous BSAI and GOA species with historically small sideboards (84 FR 2723, February 8, 2019). This regulatory change was an alternative to prohibiting directed fishing each year through the BSAI and GOA annual harvest specifications. This amendment also helps to narrow the focus for this action around fisheries that have provided genuine opportunities for CVs in past years, as shown in Table 2. If there was additional opportunity for non-exempt (sideboarded) AFA CVs to fish in the GOA, it would be in these fisheries.

However, when the Pacific cod Trawl Cooperative (PCTC) Program was implemented on 10/7/24, the GOA sideboard limits and associated GOA halibut PSC limit for the non-exempt AFA vessels and LLP license holders were changed, in addition to modifying regulations to prohibit directed fishing where sideboard limits were too small to support a directed fishery. This modification set the sideboard ratios for non-exempt AFA CVs that will be used in the annual GOA harvest specifications to the ratio of catch to the TAC in the more recent qualifying years of 2009–2019. This more recent fishing history reduced the amount of GOA groundfish species available for AFA vessels that are sideboarded (as seen in Table A6-26). **This means that overall, the 19 AFA vessels non-exempt from GOA sideboards that have LLP endorsed for these areas have limited opportunities to expand into GOA fisheries. Other non-exempt CVs do not have opportunities to fish in the GOA.**

Table A6-20 GOA sideboards for AFA vessels before and after PCTC

Target Species	Apportionments by season/gear	Area/component	Existing Sideboard Ratio	New Sideboard Ratio
Pollock	A Season Jan 20 - May 31	Shumagin (610)	0.6047	0.057
		Chirikof (620)	0.1167	0.064
		Kodiak (630)	0.2028	0.091
	B Season Sep 1 - Nov 1	Shumagin (610)	0.6047	0.057
		Chirikof (620)	0.1167	0.064
		Kodiak (630)	0.2028	0.091
	Annual	WYK (640)	0.3495	0.026
		SEO (650)	0.3495	0.000
Pacific cod	A Season Jan 1 - Jun 10	W	0.1331	0.009
		C	0.0692	0.011
	B Season Sept 1 - Dec 31	W	0.1331	0.009
		C	0.0692	0.011
Shallow-water flatfish	Annual	W	0.0156	0.000
		C	0.0587	0.011
Deep-water flatfish	Annual	C	0.0647	0.002
		E	0.0128	0.000
Rex sole	Annual	C	0.0384	0.014
Arrowtooth flounder	Annual	C	0.028	0.011
Flathead sole	Annual	C	0.0213	0.007
Pacific ocean perch	Annual	E	0.0466	0.001

In the BSAI

There are unlikely to be many external opportunities for most of the AFA CVs in the Bering Sea. **In recent years there has been AFA CV participation in the Pacific cod trawl fisheries and the**

yellowfin sole TLAS fishery, therefore this section explores possible spillover impacts in these fisheries in more detail.

Pacific Cod Trawl CV Allocation in the C Season

The trawl CV allocation of BSAI Pacific cod is divided into three seasons. The PCTC Program allocated Pacific cod cooperative quota to cooperatives for harvest by eligible trawl CVs during the A season (January 20-April 1) and B season (April 1-June 10). However, the BS pollock B season overlaps with the BSAI Pacific cod trawl C season (June 10- Nov 1). The C season apportionment receives 15% of the trawl CV apportionment and can also receive rollovers from the A and B seasons. This fishery has remained a limited access fishery open to all trawl CVs with an LLP license endorsed in the BS and/or AI with trawl gear, which qualifies all AFA CVs. The AFA trawl CV sideboard limit for BSAI Pacific cod for the C season and associated PSC sideboards were not modified by the PCTC Program and remain in effect. However, the sideboard amount is 86% of the initial TAC for the C season so other CVs not exempt from the sideboards may have opportunities as well.

While there could be spillover impacts to this fishery and other Pacific cod fisheries from increased CV trawl participation, the opportunities in this fishery are expected to be limited and due to challenging fishing conditions. Specifically, fishing BSAI Pacific cod with trawl gear is not known to be as efficient in the summer and fall. Pacific cod can be more disaggregated and result in higher bycatch. Participation and prosecution of this fishery has been low in recent years. Between 2020-2024 between 1-4 vessels have participated in the C season trawl open access fishery, with only one vessel showing consistent participation. In 2023, less than 30% of the initial C season TAC was harvested. Given the low prosecution rates, the remaining amount of Pacific cod has typically been reallocated to other sectors. In particular, this includes a reallocation first to the under 60 ft pot or HAL sector, which has consistently relied on this additional amount of Pacific cod in the fall. Additionally, Pacific cod sector allocations are calculated based on the total TAC available in the BS and AI combined, but there are still separate TACs for the BS and AI. In recent years, the BS has closed to directed fishing to all sectors before December 31 due to the overall BS directed fishing allowance (DFA) being reached. If CV trawl participation increases in the BS in the C season, then this issue could be exacerbated and result in earlier closures of directed Pacific cod fishing for all sectors in the BS. For instance, if the overall BS Pacific cod DFA was met before September 1 due to an increase in AFA CV activity in the Pacific cod C season, the BS Pacific cod directed fisheries for all sectors would close before the pot sectors' regulatory opening date of September 1. As a result, the pot sectors would not have an opportunity to harvest any of their B season allocation. However, this scenario seems unlikely, given the challenges with Pacific cod trawl fishing during the C season, as well as more recently, challenging market conditions.

Trawl Limited Access Yellowfin Sole

The TLAS yellowfin sole apportionment is shared by AFA CPs, AFA CVs, and non-AFA CVs. However, Amendment 116 (83 FR 49994), effective November 5, 2018, limited access to the TLAS directed yellowfin sole fishery for vessels that deliver their catch of yellowfin sole to motherships for processing. This action essentially qualified 8 CVs to participate in this fishery by delivering to motherships by requiring a specific endorsement on the LLP licenses. Of these 8 LLP licenses that are endorsed for delivering BSAI TLAS yellowfin sole to motherships, two are AFA derived LLP licenses and the remaining 6 are non-AFA derived LLP licenses. Beginning in 2019, there have been 7 consistent trawl AFA CVs participating in the BSAI yellowfin sole fishery on an annual basis and delivering to motherships.

While there are not the same eligibility restrictions on CVs delivering to shoreside processors, this type of participation has not occurred and is not expected to be a viable opportunity for CVs. The historical absence of an inshore market for BSAI yellowfin sole is likely due to the challenges of shoreside offloading, processing the multiple groundfish species that are normally delivered with a yellowfin sole trip, and the distance from fishing grounds. **Given these factors, this fishery is unlikely to experience spillover effects from the proposed actions.**

Additional Potentially Forgone Revenue Tables for Alternative 2 or 3

Table A6-21 Percent of the B season gross ex vessel revenue potentially forgone under Alternative 2/ 3, 2011-2023

Year	100,000				325,000				550,000			
	CDQ	CP	M	CV	CDQ	CP	M	CV	CDQ	CP	M	CV
Sector apportionment 1, 3-year average												
2011		36%	60%	40%								
2012												
2013				25%								
2014		31%		40%								
2015		23%	23%	35%								
2016	28%	78%	60%	36%		42%	18%			14%		
2017	65%	69%	61%	59%	55%	61%			55%	50%		
2018	83%	90%	78%	73%	76%	65%						
2019	34%	43%	58%	72%		25%	22%					
2020	25%	34%	30%	44%		8%		9%				
2021	63%	47%	66%	64%	63%	31%	49%	51%	63%		16%	
2022		9%	28%	21%								
2023		1%	48%	14%								
Sector apportionment 2, 5-year average												
2011		36%	60%	45%								
2012												
2013				30%								
2014		31%		40%								
2015		16%	18%	35%								
2016	28%	71%	60%	36%		32%	18%					
2017	65%	69%	53%	59%	55%	61%			38%	50%		
2018	83%	90%	78%	73%	70%	11%						
2019	34%	43%	58%	72%		25%	22%					
2020	19%	34%	30%	44%				14%				
2021	63%	47%	57%	64%	63%	13%	49%	51%	63%			44%
2022		9%	28%	21%								
2023			48%	20%								
Sector apportionment 3, pro rata												
2011		36%	60%	45%								
2012												
2013				30%								
2014		31%		40%								
2015		16%	23%	35%								
2016	28%	71%	60%	36%		32%	18%					
2017	65%	69%	61%	59%	55%	61%			38%	50%		
2018	83%	90%	78%	73%	70%	11%						
2019	34%	37%	58%	72%		25%	22%					
2020	19%	34%	30%	44%				14%				
2021	63%	47%	66%	64%	63%	13%	49%	51%	63%		16%	44%
2022		9%	28%	21%								
2023			48%	20%								
Sector apportionment 4, AFA												
2011		3%	60%	66%								
2012												
2013				38%								
2014		14%		40%								
2015		2%	23%	35%				16%				
2016	21%	59%	60%	44%		14%	18%					
2017	65%	61%	61%	59%	55%	50%		7%	38%	1%		
2018	83%	83%	78%	79%								
2019	17%	31%	58%	84%			22%	10%				
2020		22%	30%	44%			0%	30%				
2021	63%	47%	66%	71%	63%		49%	51%	3%		34%	44%
2022		9%	28%	30%								
2023			48%	26%								

Source: NMFS Alaska Region CAS, data compiled by AKFIN

Table A6-122 Percent of the B season gross first wholesale revenue potentially forgone under Alternative 2/ 3, 2011-2023

Year	100,000				325,000				550,000			
	CDQ	CP	M	CV	CDQ	CP	M	CV	CDQ	CP	M	CV
Sector apportionment 1, 3-year average												
2011		36%	60%	40%								
2012												
2013				25%								
2014		31%		40%								
2015		23%	23%	35%								
2016	28%	78%	60%	37%		42%	18%			14%		
2017	65%	69%	61%	59%	55%	61%			55%	50%		
2018	83%	90%	78%	73%	76%	65%						
2019	34%	43%	58%	71%		25%	22%					
2020	25%	33%	30%	44%		8%	0%	8%				
2021	63%	47%	66%	64%	63%	31%	49%	51%	63%		16%	
2022		9%	28%	21%								
2023		1%	47%	14%								
Sector apportionment 2, 5-year average												
2011		36%	60%	45%								
2012												
2013				31%								
2014		31%		40%								
2015		16%	18%	35%								
2016	28%	71%	60%	37%		32%	18%					
2017	65%	69%	52%	59%	55%	61%			38%	50%		
2018	83%	90%	78%	73%	70%	11%						
2019	34%	43%	58%	71%		25%	22%					
2020	19%	33%	30%	44%				13%				
2021	63%	47%	58%	64%	63%	13%	49%	51%	63%			44%
2022		9%	28%	21%								
2023			47%	20%								
Sector apportionment 3, pro rata												
2011		3%	60%	66%								
2012												
2013				38%								
2014		14%		40%								
2015		2%	23%	35%				17%				
2016	21%	59%	60%	45%		14%	18%					
2017	65%	61%	61%	59%	55%	50%		8%	38%	1%		
2018	83%	83%	78%	79%								
2019	17%	31%	58%	84%			22%	11%				
2020		22%	30%	44%				29%				
2021	63%	47%	66%	71%	63%		49%	51%	3%		34%	44%
2022		9%	28%	30%								
2023			47%	26%								
Sector apportionment 4, AFA												
2011		36%	60%	45%								
2012												
2013				31%								
2014		31%		40%								
2015		16%	23%	35%								
2016	28%	71%	60%	37%		32%	18%					
2017	65%	69%	61%	59%	55%	61%			38%	50%		
2018	83%	90%	78%	73%	70%	11%						
2019	34%	37%	58%	71%		25%	22%					
2020	19%	33%	30%	44%				13%				
2021	63%	47%	66%	64%	63%	13%	49%	51%	63%		16%	44%
2022		9%	28%	21%								
2023			47%	20%								

Source: NMFS Alaska Region CAS, data compiled by AKFIN

6.5 Subsistence Harvests of Salmon

This section is an extension of Section 4.4 of the preliminary DEIS that describes recent and historical patterns of subsistence harvests of salmon for the Kotzebue, Norton Sound, Port Clarence, Yukon, Kuskokwim, and Bristol Bay Areas.

State and federal laws define subsistence uses as the "customary and traditional uses" of wild resources for food, clothing, fuel, transportation, construction, art, crafts, sharing, and customary trade (see also Chapter 3 of the preliminary DEIS). Subsistence uses are central to the customs and traditions of many cultural groups in Alaska, including Unangax̂, Athabascan, Alutiiq, Haida, Inupiaq, Tlingit, Tsimshian, Yup'ik, among others. State law (AS 16.05.258(c)) requires the Joint Board of Fisheries and Game to identify "nonsubsistence areas" where subsistence is not "a principal characteristic of the economy, culture, and way of life."[10] Outside these nonsubsistence areas, called "rural areas" subsistence fishing and hunting are important sources of employment and nutrition as discussed below (Fall 2018).[11]

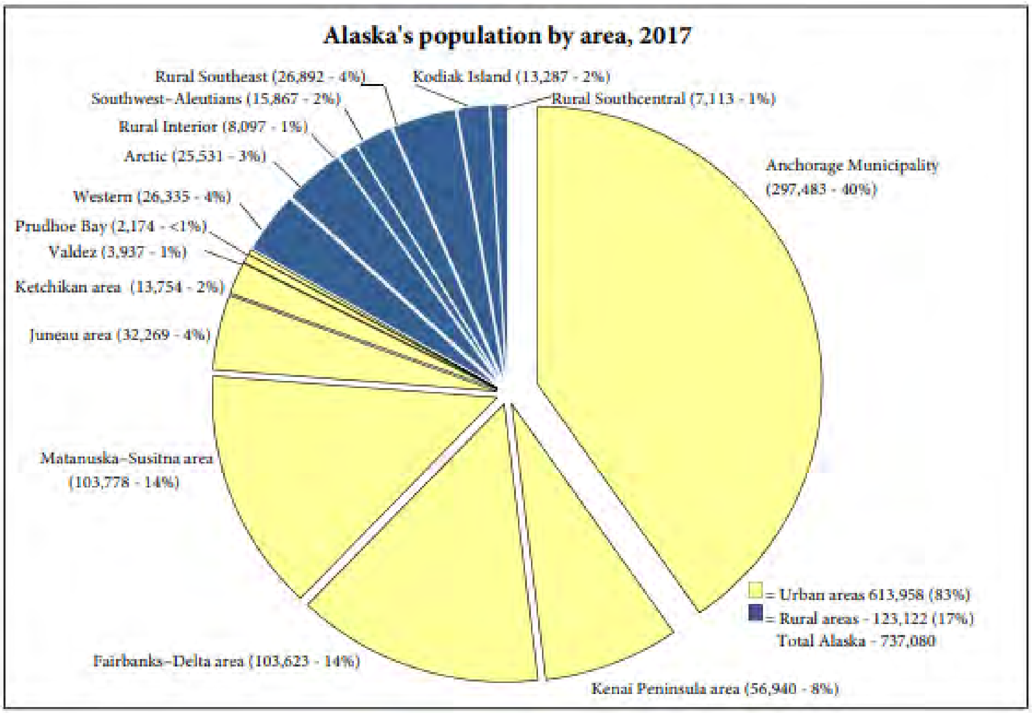


Figure A6-9 Alaska's population by area (urban and rural), 2017; Fall (2018)

Most families and households outside of Alaska's nonsubsistence areas depend on subsistence hunting and fishing (Wolfe 2004; Brown et al. 2020). Fish resources account for a significant component of annual subsistence harvests throughout rural Alaska. For surveyed communities outside nonsubsistence areas, 92-100% of sampled households used fish, 79-92% used wildlife, 75-98% harvested fish, and 48-70% harvested wildlife (Fall 2018).

[10] The Joint Board of Fisheries and Game is required to identify nonsubsistence areas, which are defined as areas where dependence upon subsistence (customary and traditional uses of fish and wildlife) is not a principal characteristic of the economy, culture, and way of life (AS 16.05.258(C)). There are 12 socioeconomic characteristics that the Joint Board examines when it defines nonsubsistence areas. The Alaska BOF may not authorize subsistence fisheries in nonsubsistence areas – in these areas the subsistence priority does not apply. Personal use fisheries provide opportunities for harvesting fish with gear other than rod and reel in nonsubsistence areas. The Joint Board has identified five nonsubsistence areas: Ketchikan, Juneau, Anchorage-Matsu-Kenai, Fairbanks, and Valdez.

[11] Federal and state laws currently differ in who qualifies for participation in subsistence fisheries and hunts. Rural Alaska residents qualify for subsistence harvesting under federal law. Under state law, all state residents have qualified.

Percentage of households participating in subsistence activities in rural areas				
Area	Harvesting game	Using game	Harvesting fish	Using fish
Arctic	63%	92%	78%	96%
Interior	69%	88%	75%	92%
Southcentral	55%	79%	80%	94%
Southeast	48%	79%	80%	95%
Southwest	65%	90%	86%	94%
Western	70%	90%	98%	100%
Total rural	**60%**	**86%**	**83%**	**95%**

Figure A6-*10* Percentage of households participating in subsistence activities in rural areas, 2017; Fall (2018)

In terms of the composition of subsistence harvest, outside the nonsubsistence areas, most of the wild food harvested by local residents is composed of fish (about 54% by weight), along with land mammals (22%), marine mammals (14%), birds (3%), shellfish (3%), and plants (4%). Fish varieties include salmon (32% of all harvests), Pacific halibut, Pacific herring, and whitefishes. Seals, sea lions, walruses, and whales compose the marine mammal harvest. Moose, caribou, deer, bears, Dall sheep, mountain goats, and beavers are commonly used land mammals, depending on the community and area.

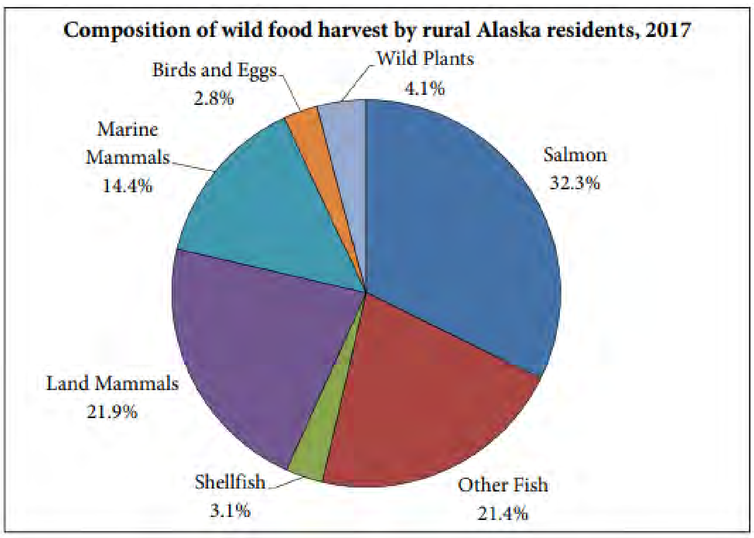


Figure A6-*11* Composition of wild food harvest by rural Alaska residents, 2017; Fall (2018)

ADF&G, Division of Subsistence, estimated in 2017 that approximately 33.6 million pounds of wild foods were harvested annually by residents of rural Alaska, which represents approximately 276 usable pounds per person (Fall 2018). Annual per capita subsistence harvest rates in rural Alaska range from 402 pounds of wild foods per person in Arctic communities to 293 pounds per person in rural Interior Alaska communities along the Yukon River, to 379 pounds per person among Yukon-Kuskokwim Delta and Kuskokwim River communities (Fall 2018). Despite these significant contributions to the food supply in Alaska, subsistence harvests (fishing and hunting) account for less than 1% of the total harvest of Alaska's wild resources. Commercial fishing takes the largest component at 98.6% of the total resource harvest while nonresidents take about 0.3% (Fall 2018:2).

Figure A6-6 below shows the proportion of subsistence harvests of chum salmon by area in 2022, the most recent year of available information.

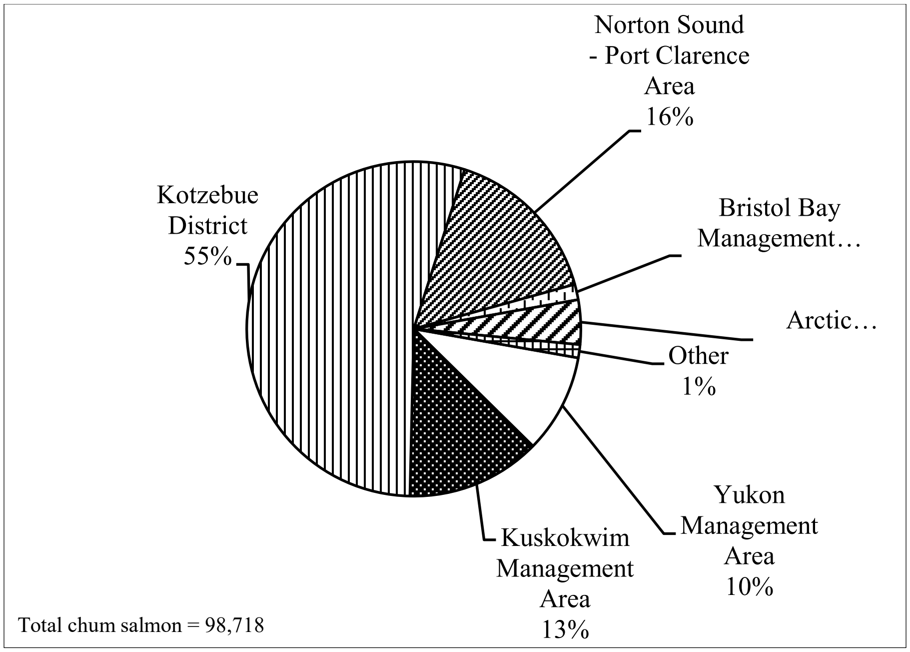


Figure A6-12 Subsistence chum salmon harvest by area, 2022
Source: ADF&G

Historical Subsistence Harvests by Area

The following section and series of tables provide estimates on subsistence harvests of salmon for each area of Western and Interior Alaska.

The species of salmon that return to an area, and when these species return and are available to harvest, varies by area. While run timing can be affected by environmental factors, Chinook salmon are the first to arrive in the Yukon, Kuskokwim, and Norton Sound areas and they co-occur with later arriving species. In the Yukon, Chinook salmon overlap with summer chum salmon until mid- to late-July when fall chum salmon and coho salmon enter the river and become the dominant species. In the Kuskokwim Area, Chinook salmon overlap with chum salmon and sockeye salmon until mid-July and August when chum salmon and coho salmon are common. In the Northwest region that encompasses the Norton Sound and Port Clarence Districts, pink salmon are more abundant in the region in even-numbered years, and usually arrive in June and are present through July. Chum salmon are common throughout the Norton Sound and Port Clarence District through July until coho salmon arrive in August.

The overlap in species run timing can pose challenges for managers as they aim to provide subsistence fishing opportunities across the run, and balance subsistence opportunities for some species with the conservation concerns of others. For example, in the Yukon, the allowable subsistence gear for summer chum salmon has been limited to dip nets, beach seines, and manned fish wheels during recent years when concerns about the conservation of Chinook salmon have prevented the use of gillnets.

In the Kuskokwim Area, drift gillnets are the favored gear type for all species of salmon and many non-salmon species. However, it is difficult for subsistence fishers to harvest significant numbers of abundant sockeye salmon and non-salmon species with drift gillnets without impacting chum and Chinook salmon populations as the run timing of these species overlaps from mid-June to mid-July. As a result of this overlapping run timing, drift gillnet harvest opportunities have been restricted to minimize impacts to Chinook and chum salmon, and the adaptive use of selective gear types, like dipnets, rod and reel, and fishwheels, has been encouraged to target abundant sockeye salmon. Providing harvest opportunities thus requires the management of all three species to ensure Chinook and chum salmon conservation and rebuilding goals.

Table A6-23 Historic subsistence salmon harvests in the Kotzebue Area, 1994 to 2022

Historic subsistence salmon harvests, Kotzebue Area, 1994 to 2022

Year	Chinook	Sockeye	Coho	Chum	Pink	Total
1994	137	461	963	50,075	3,386	55,022
1995	149	489	1,820	95,901	564	98,924
1996	550	471	317	99,137	951	101,426
1997	468	531	848	57,149	1,190	60,186
1998	378	392	461	48,974	2,116	52,321
1999	9	478	1,334	94,260	841	96,922
2000	210	74	2,546	62,582	75	65,486
2001	26	15	776	49,481	59	50,356
2002	94	16	304	51,092	123	51,628
2003	467	223	1,790	27,444	964	30,888
2004	124	21	1,647	31,770	1,123	34,686
2005	729	739	1,327	38,082	721	41,598
2006	951	2,469	4,203	39,906	3,334	50,863
2007	872	1,131	1,286	36,359	832	40,480
2008	929	1,271	1,671	43,605	948	48,425
2009	766	1,237	1,928	45,264	983	50,177
2010	752	1,148	1,783	44,678	964	49,325
2011	761	1,303	2,151	46,160	951	51,326
2012	31	668	1,274	37,915	757	40,645
2013	301	560	4,042	58,075	1,773	64,751
2014	814	3,070	6,288	64,580	5,111	79,864
2015	364	748	3,068	48,911	1,454	54,545
2016	364	748	3,068	48,911	1,454	54,545
2017	364	748	3,068	48,911	1,454	54,545
2018	633	552	6,912	56,209	3,079	67,385
2019	560	713	5,527	51,861	2,975	61,636
2020	560	713	5,527	51,861	2,975	61,636
2021	580	779	5,538	53,856	3,412	64,165
2022	580	779	5,538	53,856	3,412	64,165
5-year average (2017–2021)	539	701	5,314	52,540	2,779	61,873
10-year average (2012–2021)	457	930	4,431	52,109	2,444	60,372
Historical average (1994–2021)	462	777	2,552	52,965	1,592	58,348

Source: ADF&G

Table A6-24 Historic subsistence salmon harvests in the Norton Sound District, 1994-2022

Historic subsistence salmon harvests, Norton Sound District, 1994–2022.

	Norton Sound District						
Year	Number of households	Chinook	Sockeye	Coho	Chum	Pink	Total
1994	839	7,212	1,161	22,108	24,776	70,821	126,077
1995	851	7,766	1,222	23,015	43,014	38,594	113,612
1996	858	7,255	1,182	26,304	34,585	64,724	134,050
1997[a]	1,113	8,998	1,892	16,476	26,803	27,200	81,370
1998[a]	1,184	8,295	1,214	19,007	20,032	51,933	100,480
1999	898	6,144	1,177	14,342	19,398	20,017	61,078
2000	860	4,149	682	17,062	17,283	38,308	77,485
2001	878	5,576	767	14,550	20,213	30,261	71,367
2002	935	5,469	763	15,086	17,817	64,354	103,490
2003	940	5,290	801	14,105	13,913	49,674	83,782
2004	1,003	3,169	363	8,225	3,200	61,813	76,770
2005	1,061	4,087	774	13,896	12,008	53,236	84,000
2006	1,066	3,298	901	19,476	10,306	48,764	82,745
2007	1,041	3,744	923	13,564	18,170	21,714	58,116
2008	1,151	3,087	399	18,889	11,505	56,096	89,976
2009	1,200	5,131	388	15,852	10,599	26,110	58,080
2010	1,030	2,074	554	11,517	14,295	38,710	67,149
2011	925	1,645	562	10,155	12,946	18,576	43,883
2012	1,245	1,290	437	11,500	16,247	47,050	76,524
2013	1,062	859	571	13,343	15,491	18,007	48,271
2014	1,239	1,713	766	18,257	23,802	39,673	84,210
2015	1,329	2,524	1,855	15,628	21,538	24,167	65,712
2016	1,435	2,649	1,423	16,514	18,144	42,051	80,781
2017	1,124	1,076	1,354	21,083	14,230	31,977	69,720
2018	1,226	1,162	850	15,868	6,571	29,615	54,066
2019	1,077	1,710	1,104	13,234	5,813	26,389	48,251
2020	1,117	2,134	905	8,413	1,928	19,390	42,770
2021	1,003	1,703	402	6,101	1,681	9,444	19,331
2022	1,013	834	1,436	8,568	10,961	31,397	53,196
5-year average (2017–2021)	1,109	1,557	923	12,940	6,045	23,363	46,828
10-year average (2012–2021)	1,186	1,682	967	13,994	12,545	28,776	58,964
Historical average (1994–2021)	1,060	3,900	907	15,485	16,297	38,167	75,112

Source ADF&G

a. Includes Gambell and Savoonga.

Table A6-25 Historic subsistence salmon harvests in the Port Clarence District, 1994 to 2022

Historic subsistence salmon harvests, Port Clarence District, 1994–2022.

	Port Clarence District						
Year	Number of households	Chinook	Sockeye	Coho	Chum	Pink	Total
1994	151	203	2,220	1,892	2,294	4,309	10,918
1995	151	76	4,481	1,739	6,011	3,293	15,600
1996	132	194	2,634	1,258	4,707	2,236	11,029
1997	163	158	3,177	829	2,099	755	7,019
1998	157	289	1,696	1,759	2,621	7,815	14,179
1999	177	89	2,392	1,030	1,936	786	6,233
2000	163	72	2,851	935	1,275	1,387	6,521
2001	160	84	3,692	1,299	1,910	1,183	8,167
2002	176	133	3,732	2,194	2,699	3,394	12,152
2003	242	176	4,436	1,434	2,425	4,108	12,578
2004	371	278	8,688	1,131	2,505	5,918	18,520
2005	329	152	8,532	726	2,478	6,593	18,481
2006	345	133	9,862	1,057	3,967	4,925	19,944
2007	362	85	9,484	705	4,454	1,468	16,196
2008	399	125	5,144	562	2,499	7,627	15,957
2009	328	40	1,643	799	3,060	1,887	7,429
2010	295	57	824	596	5,232	5,202	11,911
2011	271	56	1,611	393	4,338	2,610	9,008
2012	335	44	1,422	703	7,802	5,201	15,172
2013	431	38	5,243	651	6,588	1,788	14,308
2014	429	21	3,969	564	5,085	4,940	14,579
2015	549	64	13,872	550	4,231	2,982	21,699
2016	659	40	12,140	627	4,303	4,322	21,432
2017	664	39	15,424	697	6,886	5,365	28,411
2018	683	55	12,381	764	5,625	4,556	23,381
2019	668	60	12,309	733	2,906	5,654	21,662
2020	793	40	7,745	560	2,297	6,049	16,691
2021	667	31	2,869	363	1,719	2,805	7,787
2022	484	12	662	335	4,621	1,797	7,427
5-year average (2017–2021)	695	45	10,146	623	3,887	4,886	19,586
10-year average (2012–2021)	588	43	8,737	621	4,744	4,366	18,512
Historical average (1994–2021)	366	101	5,874	948	3,713	3,898	14,534

Source ADF&G

Table A6-26 Historic subsistence salmon harvests in the Yukon Area, 1976 to 2022

Historic subsistence salmon harvests, Yukon Area, 1976–2022.

	permits[a]		Estimated salmon harvest[a]					
Year	Total	Surveyed or returned	Chinook	Coho	Summer chum	Fall chum	Pink	Total
1976			17,530	12,737		1,375		31,642
1977			16,007	16,333		4,099		36,439
1978			30,785	7,965	213,953	95,532		348,235
1979			31,005	9,794	202,772	233,347		476,918
1980			42,724	20,158	274,883	172,657		510,422
1981			29,690	21,228	210,785	188,525		450,228
1982			28,158	35,894	260,969	132,897		457,918
1983			49,478	23,905	240,386	192,928		506,697
1984			42,428	49,020	230,747	174,823		497,018
1985			39,771	32,264	264,828	206,472		543,335
1986			45,238	34,468	290,825	164,043		534,574
1987			55,039	46,213	300,042	226,990		628,284
1988	2,700	1,865	45,495	69,679	229,838	157,075		502,087
1989	2,211	983	48,462	40,924	169,496	211,303		470,185
1990	2,666	1,121	48,587	43,460	115,609	167,900		375,556
1991	2,521	1,261	46,773	37,388	118,540	145,524		348,225
1992	2,751	1,281	47,077	51,980	142,192	107,808		349,057
1993	3,028	1,397	63,915	15,812	125,574	76,882		282,183
1994	2,922	1,386	53,902	41,775	124,807	123,565		344,049
1995	2,832	1,391	50,620	28,377	136,083	130,860		345,940
1996	2,869	1,293	45,671	30,404	124,738	129,258		330,071
1997	2,825	1,309	57,117	23,945	112,820	95,141		289,023
1998	2,986	1,337	54,124	18,121	87,366	62,901		222,512
1999	2,888	1,377	50,515	19,984	79,250	83,420		233,169
2000	3,209	1,341	36,844	16,650	77,813	19,402	1,591	152,300
2001	3,072	1,355	56,103	23,236	72,392	36,164	403	188,298
2002	2,775	1,254	44,384	16,551	87,599	20,140	8,425	177,100
2003	2,850	1,377	56,872	24,866	83,802	58,030	2,167	225,737
2004	2,721	1,228	57,549	25,286	79,411	64,562	9,697	236,506
2005	2,662	1,406	53,547	27,357	93,411	91,667	3,132	269,114
2006	2,833	1,473	48,682	19,985	115,355	84,320	4,854	273,196
2007	2,819	1,495	55,292	22,013	93,075	99,120	2,118	271,618
2008	3,030	1,664	45,312	16,905	86,652	89,538	9,529	247,936
2009	2,853	1,508	33,932	16,076	80,847	66,197	2,300	199,352
2010	3,066	1,659	44,721	14,107	88,692	71,854	4,199	223,573
2011	3,060	1,574	41,069	12,576	96,459	80,549	2,291	232,944
2012	3,133	1,575	30,486	21,633	127,313	99,719	5,150	284,301
2013	3,228	1,607	12,575	14,566	115,252	113,767	1,079	257,239
2014	3,195	1,704	3,287	17,072	87,135	92,507	6,932	206,933
2015	3,141	1,567	7,582	18,252	83,787	86,680	2,645	198,946
2016	3,589	1,965	21,684	9,088	88,258	84,933	8,719	212,682
2017	3,119	1,619	38,225	7,513	87,875	85,719	2,449	221,781
2018	3,320	1,912	32,013	5,527	77,435	65,008	3,712	183,695
2019	3,441	1,958	48,623	5,887	63,597	64,270	5,029	187,406
2020	3,424	1,987	22,663	2,922	42,592	6,207	5,444	79,828
2021	3,365	2,199	1,984	296	1,234	705	2,650	6,869
2022	3,296	2,133	1,773	1,090	6,692	2,766	8,590	20,911
5-year average (2017–2021)	3,334	1,935	28,702	4,429	54,547	44,382	3,857	135,916
10-year average (2012–2021)	3,296	1,809	21,912	10,276	77,448	69,952	4,381	183,968
Historical average (1976–2021)	2,974	1,513	39,860	23,265	133,784	103,617	4,296	296,764

Source Padilla et al. (2023)

Note Cells that do not contain data have no data available.

a. Estimates prior to 1988 are based on fish camp surveys and sampling information is unavailable.

Table A6-27 Historic subsistence salmon harvests in the Kuskokwim Area, 1989 to 2022

Historic subsistence salmon harvests, Kuskokwim Area, 1989–2022.

	Households		Estimated salmon harvest					
Year	Total	Surveyed	Chinook	Sockeye	Coho	Chum	Pink[a]	Total
1989	3,422	2,135	85,322	37,088	57,786	145,106	--	325,302
1990	3,317	1,448	114,219	48,752	63,084	157,335	--	383,390
1991	3,340	2,033	79,445	50,383	44,222	89,008	--	263,058
1992	3,308	1,308	88,106	45,994	56,907	119,794	--	310,801
1993	3,269	1,786	92,305	53,442	32,207	64,966	--	242,920
1994	3,169	1,801	111,027	46,172	40,706	89,508	--	287,413
1995	3,638	1,907	105,805	32,019	39,492	72,054	--	249,370
1996	3,630	1,524	100,437	41,644	45,101	102,033	--	289,215
1997	3,501	1,919	83,000	39,868	31,293	38,419	--	192,580
1998	3,497	1,940	85,928	38,296	27,408	73,145	--	224,777
1999	4,165	2,512	80,545	51,321	27,757	52,414	--	212,037
2000	3,317	1,448	75,201	53,498	49,158	72,896	--	250,753
2001	4,469	2,215	81,927	55,163	33,031	57,410	--	227,531
2002	4,804	2,687	84,701	34,890	43,433	94,759	--	257,783
2003	4,513	2,292	70,375	34,772	37,242	47,949	--	190,338
2004	4,638	2,398	102,336	41,558	48,693	65,805	--	258,392
2005	4,603	1,593	90,311	44,933	35,170	59,762	1,343	231,519
2006	4,671	1,439	96,733	47,763	43,211	93,091	2,710	283,508
2007	4,620	1,279	100,297	49,613	35,890	76,281	1,259	263,340
2008	4,735	949	92,977	56,205	47,476	66,275	1,341	264,274
2009	4,808	1,702	83,838	38,795	31,933	46,047	561	201,174
2010	4,215	1,739	70,576	41,722	35,695	46,797	751	195,541
2011	4,241	1,790	65,850	46,290	33,943	55,990	739	202,812
2012	4,294	1,527	25,353	50,781	30,086	82,030	2,160	190,410
2013	4,314	1,755	50,708	42,834	27,841	55,828	741	177,952
2014	4,229	1,862	15,434	53,030	52,587	70,687	2,620	194,358
2015	4,349	1,615	19,437	39,429	36,816	43,516	1,233	140,431
2016	4,163	1,820	36,268	54,627	39,388	46,026	4,527	180,836
2017	4,087	1,655	22,150	53,522	40,082	54,459	2,292	172,505
2018	4,302	1,741	26,478	39,057	21,922	47,843	1,776	137,076
2019	4,229	1,631	44,542	52,535	33,291	35,521	932	166,821
2020	4,291	1,816	41,476	46,952	34,120	28,149	1,095	151,793
2021	4,037	1,639	31,837	50,048	24,324	10,690	794	117,693
2022	4,107	1,114	39,335	55,242	17,024	12,844	1,074	125,519
5-year average (2017–2021)	4,189	1,696	33,297	48,423	30,748	35,332	1,378	149,178
10-year average (2012–2021)	4,230	1,706	31,368	48,282	34,046	47,475	1,817	162,987
15-year average (2007–2021)	4,328	1,635	48,481	47,696	35,026	51,076	1,521	183,801
Historical average (1989–2021)	4,066	1,785	71,362	45,848	38,827	68,533	1,581	225,385

Source ADF&G Division of Subsistence, ASFDB 2022 (ADF&G 2023).

a. Prior to 2008, harvest estimates for pink salmon were calculated by ADF&G Division of Subsistence.

-- Data not available.

Table A6-28 Historic subsistence salmon harvests in the Bristol Bay Area, 1983 to 2022

Estimated historical subsistence salmon harvests, Bristol Bay Area, 1983–2022.

	Permits		Estimated salmon harvest					
Year	Issued	Returned	Chinook	Sockeye	Coho	Chum	Pink	Total
1983	829	674	13,268	143,639	7,477	11,646	1,073	177,104
1984	882	698	11,537	168,803	16,035	13,009	8,228	217,612
1985	1,015	808	9,737	142,755	8,122	5,776	825	167,215
1986	930	723	14,893	129,487	11,005	11,268	7,458	174,112
1987	996	866	14,424	135,782	8,854	8,161	673	167,894
1988	938	835	11,848	125,556	7,333	9,575	7,341	161,652
1989	955	831	9,678	125,243	12,069	7,283	801	155,074
1990	1,042	870	13,462	128,343	8,389	9,224	4,455	163,874
1991	1,194	1,045	15,245	137,837	14,024	6,574	572	174,251
1992	1,203	1,028	16,425	133,605	10,722	10,661	5,325	176,739
1993	1,206	1,005	20,527	134,050	8,915	6,539	1,051	171,082
1994	1,193	1,019	18,873	120,782	9,279	6,144	2,708	157,787
1995	1,119	990	15,921	107,717	7,423	4,566	691	136,319
1996	1,110	928	18,072	107,737	7,519	5,813	2,434	141,575
1997	1,166	1,051	19,074	118,250	6,196	2,962	674	147,156
1998	1,234	1,155	15,621	113,289	8,126	3,869	2,424	143,330
1999	1,219	1,157	13,009	122,281	6,143	3,653	420	145,506
2000	1,219	1,109	11,547	92,050	7,991	4,637	2,599	118,824
2001	1,226	1,137	14,412	92,041	8,406	4,158	839	119,856
2002	1,093	994	12,936	81,088	6,565	6,658	2,341	109,587
2003	1,182	1,058	21,231	95,690	7,816	5,868	1,062	131,667
2004	1,100	940	18,012	93,819	6,667	5,141	3,225	126,865
2005	1,076	979	15,212	98,511	7,889	6,102	1,098	128,812
2006	1,050	904	12,617	95,201	5,697	5,321	2,726	121,564
2007	1,063	917	15,444	99,549	4,880	3,991	815	124,679
2008	1,178	1,083	15,153	103,583	7,627	5,710	2,851	134,924
2009	1,063	950	14,020	98,951	7,982	5,052	442	126,447
2010	1,082	979	10,852	90,444	4,623	4,692	2,627	113,238
2011	1,122	1,039	14,106	101,017	7,493	3,794	333	126,744
2012	1,107	932	12,136	100,728	3,837	4,007	1,874	122,582
2013	1,162	986	12,858	98,765	8,635	5,173	333	125,764
2014	1,158	1,031	17,417	99,008	8,984	6,677	2,689	134,775
2015	1,169	1,072	13,874	99,535	7,659	3,573	458	125,100
2016	1,172	1,057	18,712	85,989	6,255	5,243	4,945	121,144
2017	1,110	1,000	12,985	89,704	8,154	4,907	553	116,303
2018	1,105	925	13,758	78,666	6,913	4,030	1,135	104,502
2019	1,106	860	11,488	75,320	6,219	3,451	398	96,876
2020	1,001	749	9,369	78,679	5,493	2,425	595	96,561
2021	1,017	469	7,099	96,165	7,709	1,707	597	113,276
2022	919	562	8,201	69,760	2,623	1,479	1,245	83,307
5-year average (2017–2021)	1,068	801	10,940	83,707	6,898	3,304	656	105,504
10-year average (2012–2021)	1,111	908	12,970	90,256	6,986	4,119	1,358	115,688
Historical average (1983–2021)	1,097	945	14,278	108,709	7,978	5,873	2,095	138,933

Source ADF&G Division of Subsistence, ASFDB 2022 (ADF&G 2023).

Appendix 7 Additional Information about Causes, Impacts, and Recommendations to Restore Abundance of Kuskokwim River Chum Salmon

Authored by the Kuskokwim River Inter-Tribal Fish Commission
Last updated: November 4, 2024

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1. Introduction and Acknowledgements

This appendix was authored by the Kuskokwim River Inter-Tribal Fish Commission (KRITFC) as a cooperating agency to this Environmental Impact Statement process. It was last updated on November 4, 2024. The intent of this appendix is to provide additional information to decision makers and the public about: the critical role of chum salmon in Kuskokwim communities and ecologies; Tribal understandings of anthropogenic causes of chum salmon declines; Tribal analyses of chum salmon abundance assessments; and Tribal recommendations for ways in which this action could benefit Western Alaska chum salmon and build environmental justice for Kuskokwim River Tribes and rural residents dependent on salmon

While this appendix focuses on chum salmon in the Kuskokwim River region, KRITFC is acutely aware that other watersheds throughout the state, and particularly in Western and Interior Alaska, are facing similar multi-year, multi-species disasters. Indigenous communities in each of these regions are suffering resounding impacts to their holistic health and well-being and the dissolution of generations-old cultures and traditions; and ecosystems across Alaska are missing keystone species that, for thousands of years, have uniquely connected the rivers to the seas. KRITFC additionally acknowledges that experiences with and impacts from salmon declines vary within the Kuskokwim region and are felt distinctively by each community, family, and individual.

This appendix is not meant to be a complaint or to dismiss gratitude for the salmon and fish families are able to harvest on the Kuskokwim River, nor is this appendix fully comprehensive to the community-, region-, or species-level. Rather, KRITFC hopes this document elevates the insight and voices of Kuskokwim Tribal fishers, managers, Elders, and communities so effective, equitable, and meaningful action can take place for the benefit of Kuskokwim salmon, people, and their interwoven ways of life.

Please reach out to KRITFC's leads for additional information or with questions: Kevin Whitworth (kevinwhitworth@kritfc.org) and Terese Vicente (terese@kritfc.org).

2. Chum Salmon of the Kuskokwim River

The Kuskokwim River stretches 700 miles from the southwestern coast of Alaska into the interior region south of Denali National Park. From the headwaters to the Kuskokwim Bay, the river provides life, nutrients, and habitat for myriad species of vegetation, berries, flowers, land and marine mammals, migratory and resident birds, and freshwater and ocean fish. Of these species, salmon provide a key link between the marine and freshwater ecosystems.

Located south of the Yukon River and north of Bristol Bay, the Kuskokwim is known for prolific Pacific salmon runs. Substantial populations of Chinook, chum, coho, and sockeye salmon— and to a lesser extent, pink salmon—also spawn and are harvested in the watershed. While all of these species provide critical ecosystem services for the Kuskokwim region, this document focuses on chum salmon as the focus of this draft Environmental Impact Statement (DEIS) analysis and the Council's established Purpose and Need.

Historically, chum salmon were one of the most abundant and reliable species of salmon in the Kuskokwim region. While no total return estimates exist for chum salmon on the Kuskokwim, a sonar operating at the mouth of the Aniak River drainage—a middle Kuskokwim tributary with one of the highest chum salmon productivities in the watershed—provides some indication at historical chum salmon abundance. The Aniak sonar counted a passage of over 1,169,400 chum salmon in 1980, its first year of operation. During its 30-year operation, an annual average of 400,000 chum salmon spawners returned to the Aniak River alone (Figure 1; AYKDBMS 2024).

When factoring in subsistence harvests, commercial harvests, and returns to other tributaries, annual chum salmon returns to the Kuskokwim likely averaged around 1 million fish. These returns bring millions of pounds of marine-derived nutrients to support ecosystem biodiversity in the Kuskokwim region (see DEIS Sections 4.3.3.2.3 and 4.4.5.3.3).

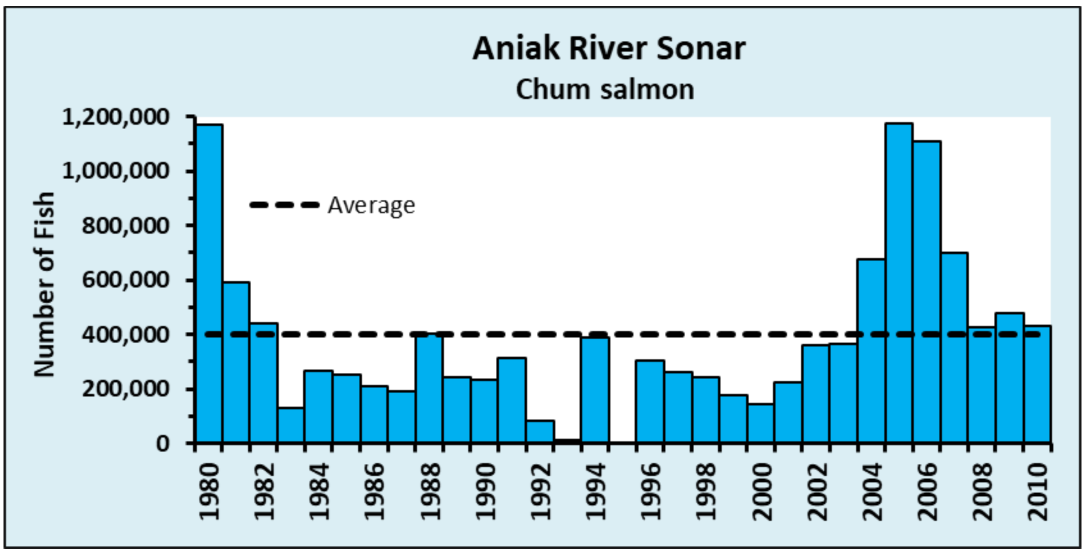

Figure 1. Aniak River sonar chum salmon passage 1980-2010 compared to 30-year average (dashed green line). Note: No data were available in 1995. Source: AYKDBMS.

As discussed in this DEIS and elsewhere (e.g., KRITFC 2021, 2023, 2024), Kuskokwim chum salmon abundance dramatically declined in 2021 and has remained low. Estimates at Kuskokwim River assessment projects, including the George River weir Kuskokwim River sonar, showed marginal improvement in 2024 compared to recent years, but counts are still well-below historic levels (Figure 2).

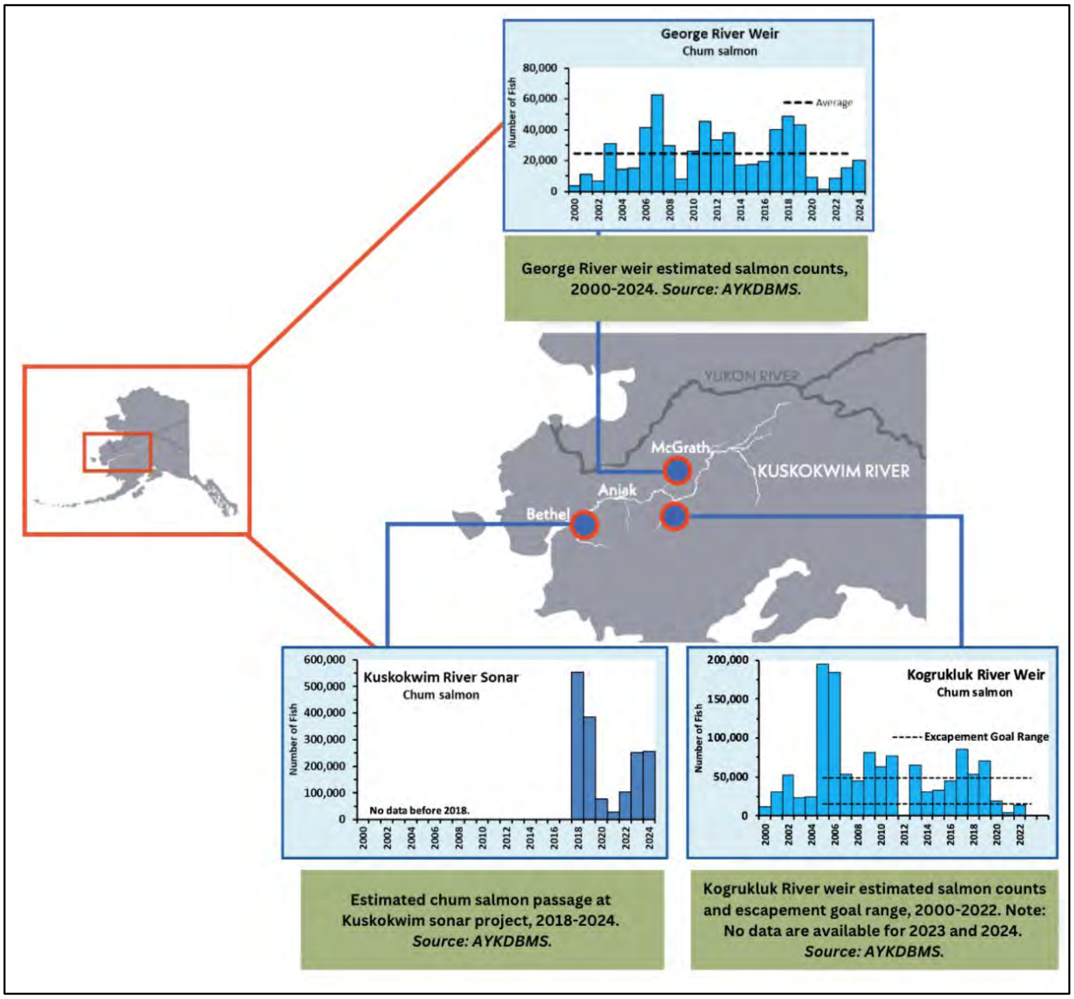

Figure 2. Chum salmon abundance at the George River weir, Kogrukluk River weir, and Kuskokwim River sonar, through 2024. Note: Sonar data is available beginning 2018, and no data are available from the Kogrukluk River weir in 2023 and 2024. Source: AYKDBMS.

3. Tribal Nations and Fisheries Co-Stewardship on the Kuskokwim River

➢ *3.A. Ancestral Communities' Relationships with Chum Salmon*

Human communities have inhabited and harvested salmon in the Yukon-Kuskokwim region for over 11,000 years (Halffman et al. 2015). In the Kuskokwim region, archaeological evidence shows Indigenous humans from the coast at Nunalleq (Quinhagak) to the interior headwaters at Tochak' (McGrath) have relied on salmon for at least 800 years (KUAC 2013; Nunalleq 2024). The stewardship relationship between Alaska Native people and Kuskokwim salmon—careful and respectful harvest, preparation, consumption, and celebration of annual, reliable runs of fish—have been intentionally developed and passed down across generations.

Four major ethnolinguistic groups of people call the Kuskokwim watershed home: the Central Yupiit, Deg Xit'an, Stony River Dena'ina, and Upper Kuskokwim Athabascan (see Figure 4-23). Each group has its own distinct language with its own name for chum salmon, signifying this species is a key part of the life and language of these people. These names are listed in Table 1 next to English and Latin scientific names (Table 1).

Name	Language	Peoples/Regions where this name lives
Iqalluk	Yugtun	Central Yupiit peoples of the lower and middle Kuskokwim
Nalay	Deg Xinag	Deg Xit'an peoples of the middle and upper Kuskokwim
Alima	Tanaina	Dena'ina peoples of Lime Village and the Stony River region
Srughot'aye	Dinak'i	Upper Kuskokwim Athabascan peoples in the headwaters of the Kuskokwim
Oncorhynchus keta	Latin	Western scientific researchers and agencies throughout the Kuskokwim
Chum salmon	English	English speakers throughout the Kuskokwim
Dog salmon	English	English speakers throughout the Kuskokwim

Table 1. Common names for chum salmon, languages of these names, and peoples/regions in which this name is used.

➢ ***3.B. Kuskokwim River Tribes and Inter-Tribal Fish Commission***

Forty federally recognized Tribal Nations have cultural and traditional ties to salmon in the Kuskokwim drainage. Listed from coast to headwaters, these are: Newtok Village (Mertarvik), Native Village of Tununak, Nunakauyarmiut (Toksook Bay), Native Village of Nightmute, Native Village of Mekoryuk, ***Village of Chefornak***, *Native Village of Kipnuk*, ***Native Village of Kwigillingok,*** *Native Village of Kongiganak*, Platinum Traditional Village, Native Village of Goodnews Bay, ***Native Village of Kwinhagak (Quinhagak), Native Village of Tuntutuliak, Native Village of Eek, Native Village of Napakiak, Native Village of Napaskiak, Kasigluk Traditional Elders Council, Native Village of Nunapitchuk, Village of Atmautluak,*** *Oscarville Traditional Village,* ***Orutsararmiut Traditional Native Council (Bethel)***, ***Organized Village of Kwethluk***, ***Akiachak Native Community, Akiak Native Community, Tuluksak Native Community, Village of Lower Kalskag, Village of Kalskag, Village of Aniak, Native Village of Chuathbaluk, Native Village of Napaimute, Village of Crooked Creek, Native Village of Georgetown,*** *Village of Red Devil*, ***Village of Sleetmute, Village of Stony River***, *Lime Village*, ***Takotna Village, McGrath Native Village, Telida Village, and Nikolai Edzeno' Village***.

Of these, 33 Tribes (italicized) were originally invited to join KRITFC because of their direct geographical connection to the Kuskokwim drainage, and 28 of those Tribes (bolded and italicized) have ratified KRITFC's constitution, joined its compact, and appointed a Commissioner to represent the Tribe. A seven-member Executive Council, including a Chair, Vice-Chair, and Secretary, is elected from the Commissioners to represent the seven Tribally determined governance units of the Kuskokwim River (Figure 3). The Chairmanship rotates among the lower, middle, and upper portions of the river every two years to foster opportunity for river-wide engagement and leadership. Any number of Elder Advisors may also be appointed to provide guidance to KRITFC, and as of the time of this writing, KRITFC has two Elder Advisors.

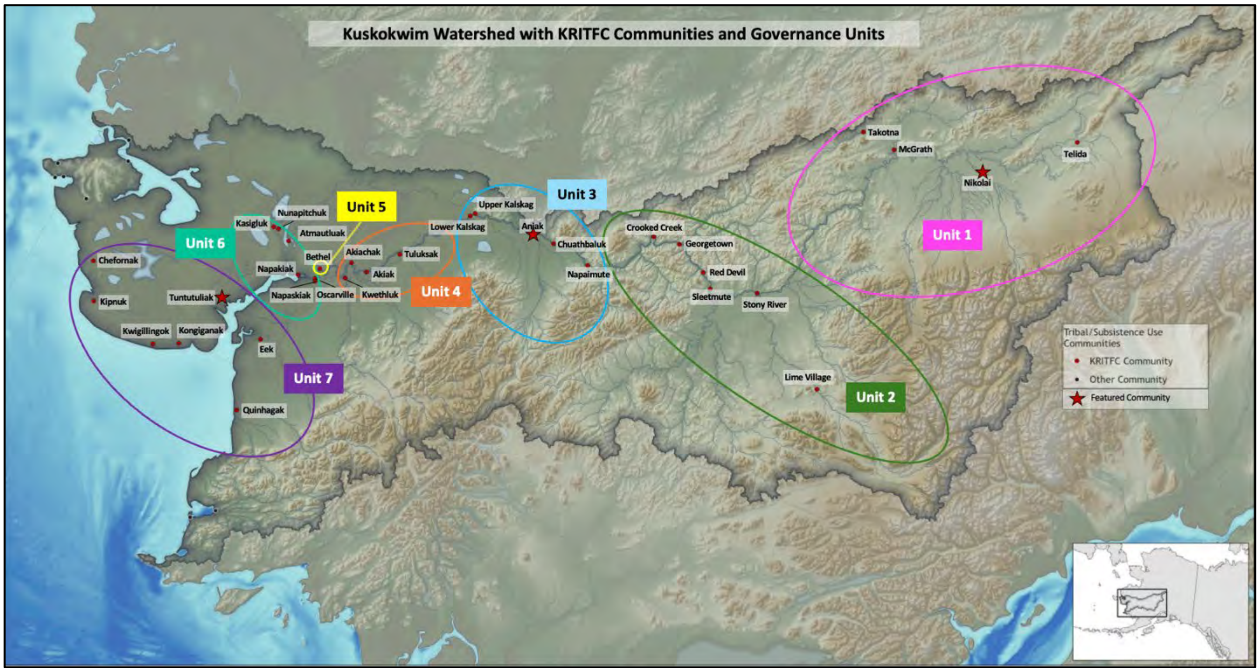

Figure 3. KRITFC's seven governance units along the Kuskokwim River, self-designated by Member Tribes according to geographical and cultural similarities. Read more about featured communities Nikolai, Aniak, and Tuntutuliak in Section 4.D. of this appendix. Adapted from map by J. Davies.

The mission of KRITFC is to be the voice of the Kuskokwim, living and sharing our traditional ways of life. Its vision is sovereign Indigenous stewardship, detailed in the preamble to KRITFC's constitution:

> *"We, the Tribes of the Kuskokwim River and its tributaries, proclaim that our fisheries are essential to our cultural, nutritional, economic and spiritual well-being and our way of life. We recognize our responsibility and authority to exercise our inter-tribal treaty rights to act as stewards to our common traditional territories and resources. Since time immemorial, we have properly cared for the fishery resources of the Kuskokwim River Drainage. We commit to conserve, restore, and provide for tribal use of fisheries based on indigenous knowledge systems and scientific principles. Founded on tribal unity, and striving for consensus, we form the Kuskokwim River Inter-Tribal Fisheries Commission for the health and well-being of our tribal members, our future generations, and all Alaskans who rely upon the health of the fisheries."*[1]

➢ *3.C. Kuskokwim Fisheries Co-Stewardship*

The KRITFC was established in May 2015 out of a longstanding desire among Kuskokwim River Tribal Nations to have a role in fisheries management. Regional subsistence, commercial and sport fishery salmon management had primarily been led by the Alaska Department of Fish and Game (ADF&G) since statehood. When Chinook salmon declines triggered federal management under Title VIII of the Alaska National Interests Lands Conservation Act

[1] Available on KRITFC's website at https://static1.squarespace.com/static/5afdc3d5e74940913f78773d/t/5aff1e7570a6adafa2afcf9e/1526669051355/41Z8707-KRITFC+Constitution.PDF

(ANILCA) shortly after 2010, the Federal Subsistence Board became the second party to subsistence salmon management in federal waters of the Kuskokwim River, typically delegating authority to the U.S. Fish and Wildlife Service (USFWS) at Yukon Delta National Wildlife Refuge (YDNWR).

Before KRITFC was established, Tribal citizens and rural residents could engage in fisheries management on the Kuskokwim only in an advisory role (e.g., the state Kuskokwim River Salmon Management Working Group or federal Regional Advisory Councils), and Tribal governments or authorized Tribal organizations were not designated parties of management arrangements. Moreover, the dual management system on the Kuskokwim—with half of the watershed falling under federal (USFWS) jurisdiction and half under the state's (ADF&G)—bifurcated fisheries regulations and qualifications foster confusion and intra- and inter-regional tensions among fishers and communities. One of KRITFC's primary aims is to promote unity and collaboration among Kuskokwim Tribes as a key part of Indigenous values and knowledge; in recognition that all Tribes along the Kuskokwim are sharing in the burden of salmon conservation; and for the inclusion of river-wide Tribal voices and knowledge in fisheries management.

In a momentous step towards these goals, KRITFC signed a memorandum of understanding (MOU) with USFWS in May 2016 to formalize the Tribal-federal salmon co-stewardship partnership in federal waters of the Kuskokwim, which extend from the mouth of the river to Aniak as part of the YDNWR.[2] Under this arrangement, KRITFC Commissioners annually elect five In-Season Managers to represent Tribes from the coast to the headwaters in "substantive consultation" with the federal in-season manager (historically, the Federal Subsistence Board, and more recently, the YDNWR Manager) in the process of developing federal fisheries management decisions. The MOU provides pathways for including both Traditional Knowledge (TK) and Western scientific information in decision-making and planning.

Though some of these In-Season Managers and KRITFC Member Tribes reside outside of YDNWR's boundaries, all salmon destined for tributaries upstream of Aniak must first pass through federal waters. Middle and upper river Tribal fishers are thus represented and included in decision-making about fisheries occurring downstream from their harvest areas. **This provides an example for how Tribes could be involved in co-management of fisheries occurring downstream from the Kuskokwim in the Bering Sea** (see Section 7 of this appendix).

However, the collaborative partnership between KRITFC and YDNWR was neither seamless nor wholly equitable in the years following the signing of the MOU. For instance, some former YDNWR Managers largely ignored KRITFC's In-Season Managers' TK in favor of Western scientific models—which, unlike natural indicators interpreted by TK holders, have incorrectly forecasted salmon run sizes on more than one occasion (see Peltola 2021)—and have consulted more closely with ADF&G than with KRITFC. Recent YDNWR Managers have worked to

[2] Additional information about the development of this MOU and its terms of agreement can be found on KRITFC's website at https://static1.squarespace.com/static/5afdc3d5e74940913f78773d/t/5dcb2a0ebc75324ecc635451/1573595663976/MOU_Final_wSignatures.pdf.

foster a more genuinely collaborative, government-to-government relationship with KRITFC, including holding the TK of KRITFC's In-Season Managers on par with Western scientific indicators and employing local, Indigenous staff on the YDNWR fisheries team. Additionally, KRITFC has addressed internal inequities on its in-season management team by expanding this team from three to five In-Season Managers in the years since 2016. The addition of two In-Season Managers has helped better represent geographically and culturally distinct Tribes at the management table. Concerns about KRITFC's and YDNWR's partnership have largely been ameliorated through these intentional acts to reevaluate governance structures and build toward equity, with consultation mechanisms in place to continually improve this relationship. This co-stewardship partnership has thus become one of the strongest in the state.

Since 2021, KRITFC and YDNWR have jointly developed salmon management and harvest strategies to guide their co-stewardship and decision-making. These strategies are publicly available on KRITFC's website and are kept in "living draft" form, as consultation on, and development of, this joint approach is continuous.[3] Key principles and objectives in these strategies are to avoid collective (cumulative) overharvest of salmon while aiming to rebuild stocks; taking a conservation-based and precautionary management approach; maintaining a drainage-wide perspective while making decisions that affect federal waters of the Kuskokwim; and meaningfully relying on IK and local knowledge as part of the best available information. The KRITFC recommends these principles be extended to the management approach of the Council and National Marine Fisheries Service (NMFS) to meet the Purpose and Need of this action (see Section 7 of this appendix).

4. Chum Salmon Support Holistic Well-Being of People and Place

Section 4.3.3.2 of the DEIS, co-authored by KRITFC and Tanana Chiefs Conference (TCC), describes the ways in which chum salmon foster holistic well-being in Indigenous communities and ecosystems in the Kuskokwim, Yukon, and other regions of Western and Interior Alaska. To summarize this section: chum salmon are vital to Indigenous peoples and ways of life of these regions, including the Kuskokwim, where physical, cultural, economic, social, and ecological health and well-being are intricately interconnected with the abundance of chum and other salmon. In addition, an overview of Kuskokwim subsistence and commercial management systems and harvest levels can be found in Sections 4.3.3.1 and 4.3.4.1, respectively, of the DEIS.

KRITFC wishes to expand upon these three sections by providing (a) additional TK and observations of Kuskokwim fishers on the importance of chum salmon in traditional ways of life; (b) a deeper analysis of the role of chum salmon in regional Kuskokwim subsistence fisheries and harvests; (c) a brief history of chum salmon commercial fisheries on the Kuskokwim; and (d) glimpses of life in three Kuskokwim communities particularly affected by chum salmon declines.

[3] Available at https://www.kuskosalmon.org/documents.

➢ *4.A. Additional TK of the Importance of Chum Salmon*

Here, we provide additional TK and local knowledge (LK) about the centrality of chum salmon to the way of life to the people of the Kuskokwim..[4] This section should be read in partnership with Section 4.3.3.2 of the DEIS and the TK, LK, and information about Kuskokwim and Yukon Salmon People provided therein.

Salmon, including chum salmon, are the keystone food for people on the Kuskokwim, and to which Kuskokwim people have a deep stewardship relationship:

> *"In Yup'ik, the general word for food is neqa, which is also the word for fish. So if neqa is not how you view fish—if food is not the first thing you think of—then we come from different worlds. For us, we wouldn't exist without salmon. On the river, we coexist, salmon and people. And it's always been that way. We have this deep spiritual relationship that we have the obligation, but also the privilege, to maintain between fish and people." – Jonathan Samuelson (in KRITFC 2021:12).*

Beyond food, chum salmon were harvested to create waterproof fish-skin clothing, boots, and containers (Fienup-Riordan et al. 2007). They were also used to teach young fish cutters the art of respectfully and carefully processing salmon. Elder women often recall their grandmothers, mothers, and aunties allowing them to learn how to cut Chinook salmon only after they mastered their *uluaq*s and skills on chum salmon first (Fienup-Riordan et al. 2020). This may be because of the immense abundance of chum salmon in the region, as well as because many were used to feed dog teams, and thus did not need to be cut perfectly for presentation to human consumers.

The importance of harvesting and processing chum salmon to feed dog teams cannot be overstated. Until more frequent use of airplanes in the 1930s and snowmachines in the 1970s, dog teams were the primary transportation of people, mail, goods, and harvests (Pennyoyer 1965; Ikuta et al. 2013). Elders recall when every family had a dog team so they could travel between villages, check their traplines, go to ice-fishing holes, and haul people and supplies (Mikow et al. 2019; Native Village of Georgetown 2021). It was thus critical for families to put up hundreds to thousands of fish as good fuel for their teams, and chum salmon were the ideal fish for this, hence their nickname "dog salmon." As two middle Kuskokwim Elders recall:

> *"They pressed them, they had a press, had a couple of, like little rag, about a foot apart, those bundles were supposed to weigh 30 pounds a bundle, they had posts a foot apart – they'd load them with head to tail, head to tail, with dry fish. They'd put sticks down on them and press them down…They'd bale fish…I remember flying them out to trappers." – Richard Wilmarth (in Native Village of Georgetown 2021:57)*
>
> *"Yeah, that was one of my favoritest things to do was bale…make bales of dog food. And then my dad used to get, [o]h, my word, they used to cut thousands and thousands of dog*

[4] KRITFC staff and partners spent significant time between May and August 2024 documenting TK of Kuskokwim salmon with 23 Elders throughout the Kuskokwim. At the time of the submission of this appendix (November 4, 2024), these Elders have not yet reviewed and approved for public sharing the TK disclosed during their interviews. KRITFC plans to work with these Elders to review, finalize, and confirm consent to share their TK and interview transcripts with the public in the coming months. This TK may be available to bring to the Council in February 2025. In the meantime, general information from these and other public records has been paraphrased by KRITFC staff, and direct quotes and sources of TK/LK have been provided where they have been published for public access.

> *salmon for dog fish. Thousand, and I remember long time ago when we used to get like 3,000 dog fish a day, my mom and dad would cut them all." – Judy Vanderpool (in Native Village of Georgetown 2021:57)*

Chum salmon were—and are—as important for human consumption as for sled dog diets. Elders were taught that, without dryfish provided by chum and other salmon, winter starvation and sickness are likely. Chum salmon are especially important for Elders, the sick and those with open wounds, and those who cannot stomach oilier fish, like Chinook salmon and whitefish (Fienup-Riordan et al. 2020; KRITFC 2023).

A key part of traditional culture in the Kuskokwim includes sharing harvests of chum salmon and other fish, especially with Elders, widows and orphans, travelers, and people without means to harvest their own fish. This tradition of sharing with those in need continues today, and many people on the Kuskokwim aim to harvest enough salmon to be able to share generously throughout the year. As explained by Kuskokwim TK holders:

> *"Our culture is, and has always been, one where we believe in the importance of sharing, especially with those who are less fortunate; widows or those who don't have the equipment or transportation to go out and process fish." – O. Morgan (in Esquible et al. 2024:11)*

> *"I remember by grandparents, my parents, and a lot of old people always talked about how you have to share. You never, never let anyone go hungry. If you have something, they don't have it, you offer." – Debby Hartman (in Native Village of Georgetown 2021:73)*

Along with sharing, avoiding all waste is a key traditional teaching of the stewardship of salmon (and all traditional foods):

> *"The most important one [value] would be to respect the salmon as if they were humans and had a spirit and soul…part of that respect is never to waste any part of the salmon. We were told that if we are wasteful of this resource it will stop giving itself to us in the end…I was taught to give the utmost respect toward any living thing, not just salmon…" – J. Cleveland (in Esquible et al. 2024:10)*

Elders and old-timers of the Kuskokwim region remember eras when chum and other salmon were so plentiful, one would feel fish tails slap across their legs and feet while swimming or wading in the river on a hot day, and one could imagine crossing sloughs and creeks by using the backs of fish as steppingstones. The Aniak River in particular was known to be an incredibly productive tributary for chum salmon, known for its "stink" in the late summer and fall as hundreds of thousands of chum salmon carcasses decomposed on its banks (KRITFC 2023:5).

Chum salmon no longer swim in abundance on the Kuskokwim. TK holders on the Kuskokwim discuss numerous factors driving chum salmon declines. These include: wasting fish and improperly disposing of inedible fish parts, including in bycatch and intercept fisheries; a decline in traditional education of youth; fighting and arguing over fish, including among regions of the Kuskokwim and with in-river and marine managers, agencies, and outside fisheries; increasing subsistence restrictions as well as Western storebought foods and technology leading to the decline of fish harvests, and subsequent decline in fish giving themselves to be harvested; excessive overharvest in bycatch and intercept fisheries, as well as in former in-river commercial fisheries; disruption of chum salmons' marine food webs and habitat; and climate change (see Fienup-Riordan 2020; KRITFC 2021; KRITFC 2023; KRITFC 2024; Esquible et al. 2024).

Many on the Kuskokwim feel immense anxiety about how future generations of Kuskokwim fishers will learn how to care for fish, their families and communities, and themselves, as shared by one TK holder:

> *"I feel that the traditional knowledge of processing our fish isn't going to be passed down to our children/grandchildren because of the fishing restrictions. There won't be any fish caught to show and carry on the tradition of how to catch our fish, cut them, hang them, smoke them, and putting them away once dried." – O. Morgan (Esquible et al. 2024:13)*

Declines in chum salmon and loss of this critical part of Kuskokwim peoples' lives are posing significant, existential threats to regional food security and health, millennia-old cultural traditions, spiritual wellness, economic security, and holistic well-being. These threats are compounded with declines in other salmon, like Chinook and coho salmon, and non-fish traditional foods, like caribou.

➢ *4.B. Subsistence Fisheries & Role of Chum Salmon in Subsistence Diets*

Subsistence harvests of chum salmon have steadily declined across the Kuskokwim in the last decade, with record-low harvests in 2021 and 2022 (Figure 4). Per household harvest of chum salmon (Figure 5) shows a starker downward trend across KRITFC governance units (Figure 3) since 1990. The Amounts Reasonably Necessary for Subsistence (ANS) for Kuskokwim chum salmon (41,200-116,400 fish) have not been met since 2019 (Smith et al. 2022; KRITFC 2024). The lack of achieving chum ANS compounds concerns over food security given that the Chinook salmon ANS was last met in 2010.

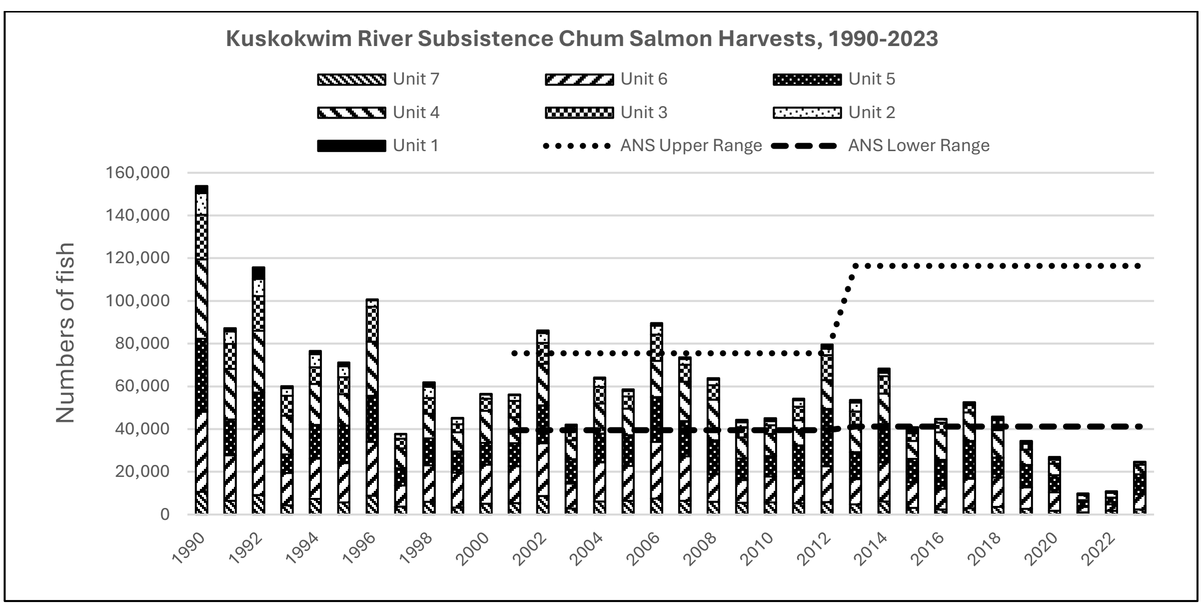

Figure 4. Kuskokwim River chum salmon subsistence harvests, compared with ANS, by KRITFC governance units, 1990-2023. Sources: Bembenic and Koster 2024; D. Koster, ADF&G, pers. comm.

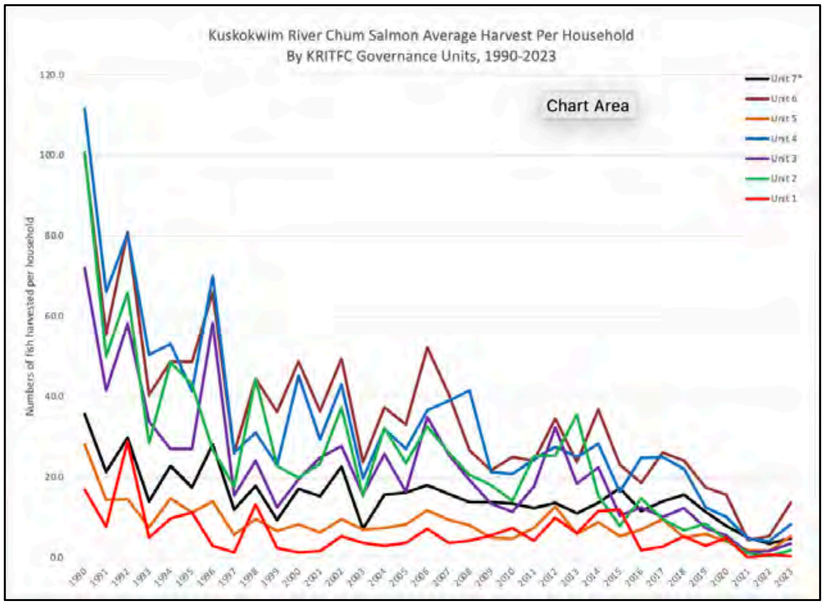

Figure 5. Kuskokwim River chum salmon average harvest per household by KRITFC governance units (see Figure 3), 1990-2023. Sources: Bembenic and Koster 2024; D. Koster, ADF&G, pers. comm.

The following subsistence harvest figures show ADF&G subsistence data pooled over 1984–2013. Data were derived as percentages of total edible pounds of harvested wild foods to allow comparison of individual resource categories to better understand community subsistence economies. The quantities and quality of the available subsistence resources, as well as the underlying subsistence economies, have changed over the past four decades (Godduhn et al. 2020; Bembenic and Koster 2024). Notably, Chinook and chum salmon declines in recent years have resulted in a greater reliance on other salmon and non-salmon species and other subsistence resources, as available, to meet food security needs (see DEIS Section 4.4.3.5). However, the years portrayed in this section roughly represent years of high or historical abundance of chum salmon relative to recent years' declines.

The information in Figure 6 below represents recent data on the role of salmon species, including chum salmon, in the overall subsistence economies of Kuskokwim area communities during the study years. Data were compiled from ADF&G Division of Subsistence reports and the Community Subsistence Information System, (CSIS 2024; J. Simon, pers. comm. as consultant to KRITFC, 2018). These generalized subsistence harvest figures show the overall contribution of individual salmon species to community economies and ways of life in different portions of the Kuskokwim watershed, but do not show how total resource use has changed by subsistence users following the collapse of Chinook and chum salmon returns over the past decade. Data are summarized by KRITFC governance unit (see Figure 3) to provide an overview of the varying composition of wild food harvests along the Kuskokwim River drainage and coastal areas, with a focus on the reliance of specific salmon species for subsistence purposes.

The Upper Kuskokwim Athabascan communities forming Unit 1 (Figure 3) are in the Kuskokwim watershed headwaters. Furthest from the coast, Unit 1 residents rely heavily on non-coastal resources, with salmon availability primarily limited to Chinook, chum, and coho salmon (Godduhn et al. 2020). Land mammals comprised the highest percentage (47%) of the total subsistence harvest, but that percentage has likely increased given salmon declines in the past decade (Figure 6). In previous times of abundance, salmon contributed a total of 35% to the overall subsistence economy in the headwaters. Chinook salmon was the second highest resource harvest in headwaters communities (14% of total), followed by chum salmon (13%). Notably, sockeye salmon contribute only 1% of the subsistence diet in Unit 1 communities, which is the smallest contribution of sockeye salmon to regional subsistence diets found among the KRITFC governance units. Most sockeye salmon populations in the Kuskokwim spawn within or downriver of the Stony River drainage, with only very small populations of sockeye found to spawn in or near Unit 1 communities fishing areas. Thus sockeye, while a uniquely abundant and reliable source of salmon for many communities on the Kuskokwim during present multi-species declines, are not available to fill food security needs for Unit 1 communities.

Unit 2 communities (Figure 3) had a higher reliance on salmon (66% of total) than any other resource, and a higher reliance on fish (80% of total) when including non-salmon species, compared to other KRITFC units (Figure 6). Chinook salmon comprised 24% of the total subsistence harvest, followed by sockeye salmon (18%), chum salmon (14%), and coho salmon (10%). Large land mammal harvests were only 12% of overall subsistence harvests in the study years, likely due to declines in caribou and moose.

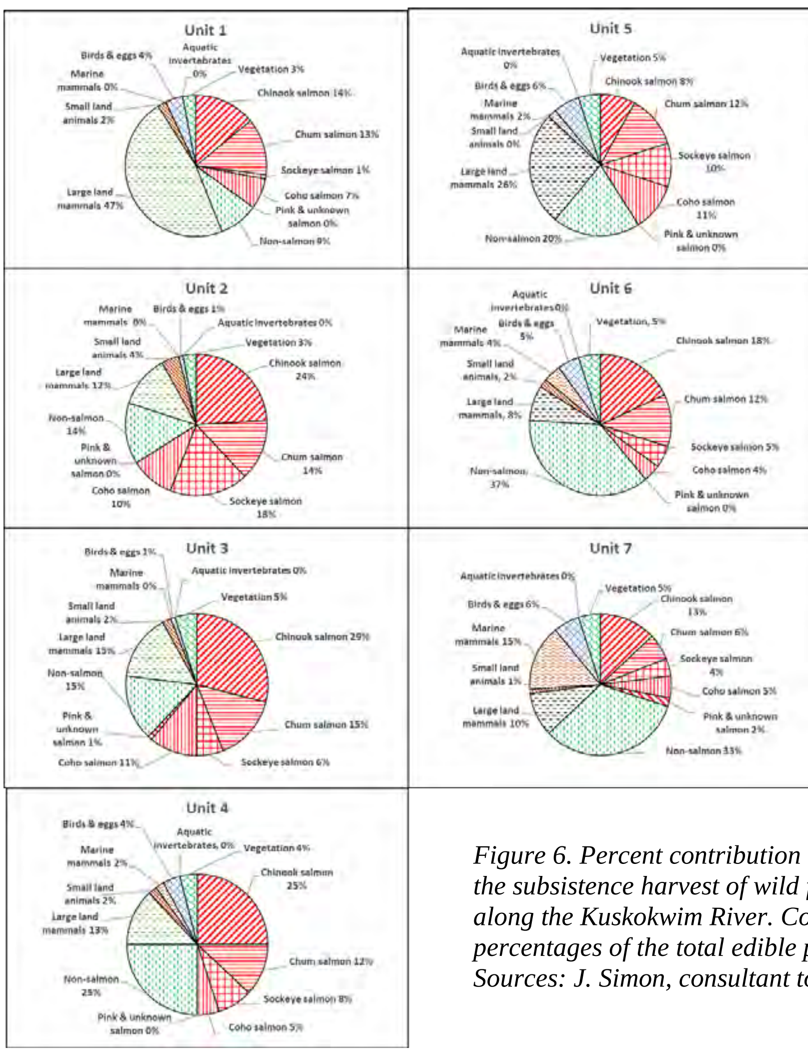

Figure 6. Percent contribution of primary species or species groups to the subsistence harvest of wild foods within KRITFC management units along the Kuskokwim River. Compositions were calculated as percentages of the total edible pounds of the wild food groups shown. Sources: J. Simon, consultant to KRITFC, pers. comm. 2019; CSIS 2024.

Unit 3 communities (Figure 3) also had a high reliance on salmon (62% of total) compared to other resources, and also a high reliance on fish (77% of total) when including non-salmon species (Figure 6). A 29% contribution of Chinook salmon to subsistence harvests was the highest among KRITFC management units. Chum salmon, non-salmon, and large land mammals each comprised 15% of the Unit 3 subsistence harvests.

Unit 4 communities (Figure 3) also had a higher reliance on salmon (50% of total) than other resource groups (Figure 6). Chinook salmon contributed 25% of total subsistence harvests, followed by chum salmon (12%). Non-salmon fishes tied with Chinook salmon in providing a 25% contribution to the Unit 4 subsistence economy, with the harvest of fish at 75% when including non-salmon species.

Bethel, the major hub in the Yukon-Kuskokwim Delta region, is largest community by population and has the largest Tribal government (Orutsararmiut Traditional Native Council) by citizenship in the Kuskokwim. It is the only community in Unit 5 (Figure 3). Annual compositions of Bethel subsistence harvests are more diverse with less reliance on a single harvest group compared to most Kuskokwim area communities, likely owing both to its diverse populace as well as its central location to freshwater, marine, and terrestrial foods. Salmon species in total comprised 41% of annual subsistence harvests, with chum salmon providing the largest total contribution at 12% (Figure 6). Fish species in aggregate represented 61% of the subsistence harvest, while large land mammals contributed the largest single group harvest (26%) by Bethel residents.

Unit 6 (Figure 3) communities relied on salmon more than any other resource group, with 39% of the total annual subsistence harvest (Figure 6). Chinook salmon comprised 18% of total subsistence harvests, followed by chum salmon (12%), and fish groups in total comprised 76% of all subsistence harvests.

Residents in coastal Unit 7 (Figure 3) relied more on non-salmon fishes (33%) than other resource groups, with pooled salmon comprising 30% of total annual subsistence harvests (Figure 6). Chinook salmon contributed 13% of total subsistence harvests, followed by chum salmon at 6%. Marine mammals comprised 15% of annual subsistence harvests.

In terms of long-term trends, these data show the importance of chum salmon as a core component of annual subsistence harvests. However, for many communities, the 2022 chum salmon harvest was >75% less than the recent 10-year average and four communities reported no chum salmon harvests (Bembenic and Koster 2024). Declines in subsistence harvests are having tremendous negative impacts to holistic well-being in Indigenous communities in the Kuskokwim, as detailed in Section 4.3.3.2.2 of the DEIS.

- ***4.C. Commercial Fisheries***

In addition to being a key subsistence food throughout the Kuskokwim watershed, chum salmon have had a long history of being sold commercially, dating back to at least 1913 in Kuskokwim Bay and 1935 in the mainstem Kuskokwim River (Pennoyer et al. 1965). While early commercial fisheries opportunistically sold chum salmon (and other species) in Chinook salmon-focused fisheries, in 1967, chum salmon began to be intentionally targeted for commercial use

(Estensen et al. 2009). However, a lack of accurate biological data, including annual subsistence harvest surveys, “greatly hindered any formulation of regulations for proper utilization of the salmon resources” during this time (Pennoyer et al. 1965:42). Harvest guidelines were gradually increased in order to explore the relationship between harvests and escapements (Burkey et al. 2000) without necessarily having the data—beyond economics—to justify quotas set arbitrarily by USFWS prior to statehood, and by ADF&G post-1959.

Annual commercial harvests increased following the 1983 change from a harvest-guideline management strategy to an escapement-objective strategy, with commercial harvest peaking at 1,381,700 chum salmon in 1988 (Figure 7). Beginning in the late 1990s, the commercial chum salmon fishery was constrained by low market interest in chum salmon and limited processing capacity. Poor Chinook and chum salmon returns during 1999–2001 resulted in few commercial fishing opportunities during June and July (Elison et al. 2015). While Chinook and chum salmon returns improved in the mid-2000s, another slump in their abundance, poor market conditions, limited processing capacity, and an increased need to prioritize salmon harvests for subsistence uses in line with the state statutory obligations have caused commercial fishing opportunities since the mid-2000s to be minimal(Smith et al. 2022). Commercial harvests have since been limited to a small number of catcher-sellers mainly targeting coho salmon.

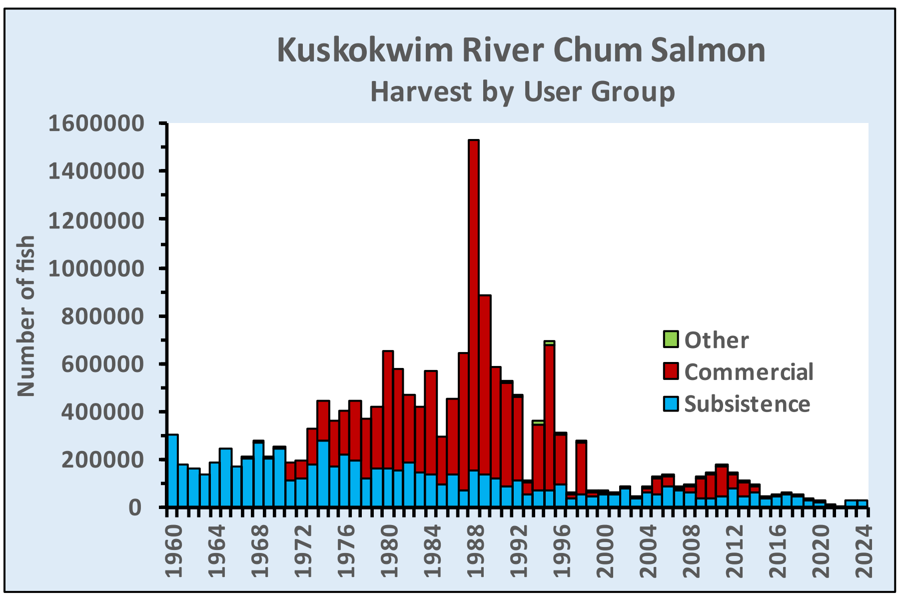

Figure 7. Kuskokwim River chum salmon harvest for subsistence, commercial, and other (e.g., sport fish) uses. Note: Data for 2023 and 2024 are preliminary; and no commercial fishing data is available since 2015 due to confidentiality requirements for few harvesters. Sources: Bembenic and Koster 2024; Chythlook 2024; D. Koster, ADF&G, pers. comm.

Between the 1970s and 1990s, the commercial salmon of chum salmon (and other salmon species) was an important source of annual revenue for the mixed economies of the Kuskokwim River drainage, especially in communities in the lower Kuskokwim (see DEIS Section 4.3.4.1 and 4.3.3.2.2.3). Many Kuskokwim Elders fondly remember the days of successful commercial fishing harvests and continue to carry their Commercial Fishery Entry Permit (CFEC) cards in their wallets, despite no longer being able to use them for commercial fishing. For these residents, commercial harvesting was a key part of the seasonal round in the modern mixed economy of rural Alaska post-statehood, second in importance only to subsistence fishing chores during the summertime.

At the same time, other Kuskokwim TK holders and Elders recall the lines of boats lined up by commercial tenders with a grimace and wonder if management allowing the commercial harvest of such large numbers of salmon contributed to contemporary declines. This sentiment is especially held by residents of the middle and upper Kuskokwim, who did not participate in and benefit from commercial fishing like those in the lower and coastal portions of the river.

➢ *4.D. Glimpses into the Role of Chum Salmon: Tuntutuliak, Aniak, and Nikolai, AK*

While harvesters throughout the Kuskokwim River drainage are feeling impacts of recent chum salmon declines to food security, culture, and holistic well-being, certain regions and communities may be experiencing intensified impacts because of the role chum salmon play in regional diets, economies, and ecosystems.

The Kuskokwim communities of Tuntutuliak, Aniak, and Nikolai are three such communities that may be experiencing intensified impacts of chum salmon declines (Figure 3). KRITFC has selected these communities as case studies because of their different geographical location in the Kuskokwim watershed (Nikolai is located in the headwaters, Aniak in the middle river, and Tuntutuliak near the coast), distinctive sociocultural/socioeconomic reliance on chum salmon, and recent work with KRITFC staff and partners to document TK of salmon in these communities. KRITFC does not intend to illustrate that families in these communities are more dependent upon chum salmon than those other communities, nor that other communities are not suffering from chum salmon declines and harvest restrictions.

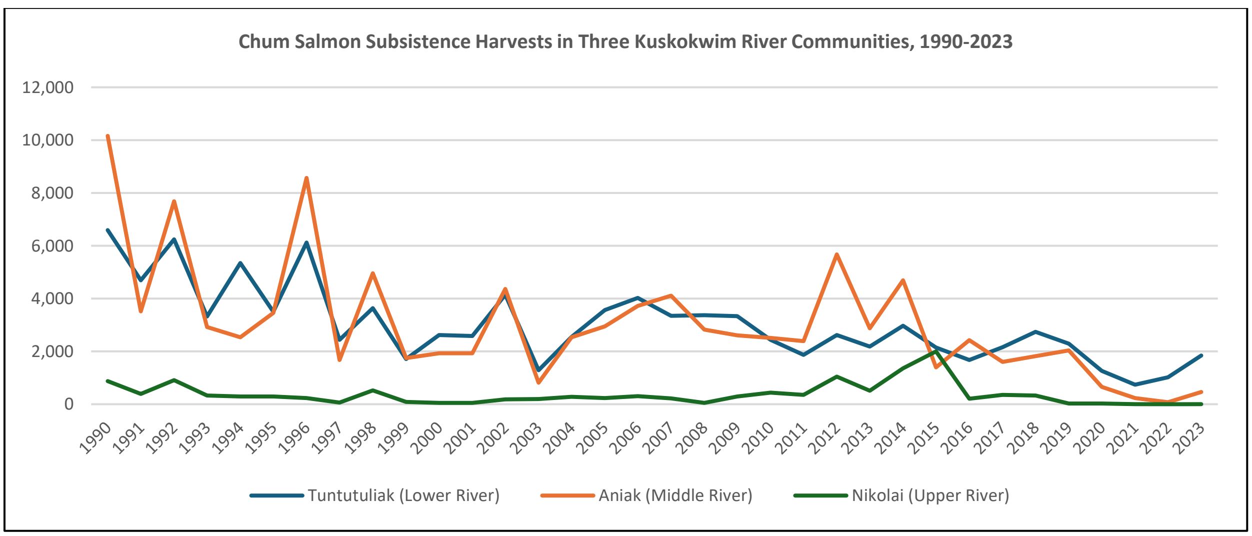

Figure 8. Chum salmon subsistence harvests in three communities representing the full span of the Kuskokwim River: Tuntutuliak (lower river), Aniak (middle river), and Nikolai (upper river), 1990-2023. Sources: Bembenic and Koster 2024; D. Koster, ADF&G, pers. comm.

Tuntutuliak:[5] The community of Tuntutuliak, or *Tuntutuliaq* in Yugtun (meaning "the place of many caribou/deer"), is located on the banks of the Qinaq (Kinak) River in the lower Kuskokwim. The community was established in the mid-1940s after resettling from the old village, called *Qinaq*. One of the coastal communities of the Kuskokwim, Tuntutuliak's 490 residents[6] are familiar with their estuarine, tundra environment and tidal flooding. They are also among the first Kuskokwim fishers to encounter and harvest salmon each year, traveling down the Qinaq River and navigating sandbars near the mouth of the Kuskokwim River to harvest these fish. Tuntutuliak residents primarily use drift and set gillnets to harvest chum and other salmon species, as the regional tidal influence, copious sandbars, and wide river make other gear types challenging to operate effectively.

Panel 1. In Tuntutuliak, one can see boats lining the muddy banks of the Kinak River (left), boardwalks leading to town (center), and fish camps in the center of the village (right). Many families are opting to process fish in the village rather than moving seasonally to Tunt Fish Camp near the mouth of the Johnson River. Credit T. Vicente/KRITFC (left, center) and K. Maxie/KRITFC (right).

Commercial chum salmon fishing used to be an important part of the way of life of Tuntutuliak families. Most Elders recall their families being heavily involved in commercial fisheries between the 1960s and 1990s, with men in the families boating from Tuntutuliak fish camp ("Tunt Fish Camp") near the mouth of the Johnson River to Bethel to sell chum and other salmon at tenders there. The income from commercial fisheries was valuable for families in a region where jobs and income can be scarce, and it provided support for subsistence fishing and the harvest of other traditional foods. The last commercial fishery for chum salmon occurred in 2015, when 48 active CFEC salmon permit holders in Tuntutuliak collectively earned $93,586 from commercially harvested salmon (CFEC 2024). However, in 1988, the peak year of commercial fishing on the Kuskokwim (Figure 7), 49 Tuntutuliak permit holders generated $894,159 in fish sales (CFEC 2024).

Subsistence harvest of chum and other salmon has been and continues to be a key part of the seasonal harvest cycle in Tuntutuliak. However, as with harvest patterns in Nikolai and Aniak, subsistence chum salmon harvests have trended to decline, particularly with the displacement of regular dog team use by snowmachines and other vehicles in the latter half of the 20th century, as well as recent fishing restrictions during the chum salmon season. Between 1990 and 2019, Tuntutuliak residents harvested an average of 3,251 chum salmon per year for subsistence. This

[5] Additional, comprehensive socioeconomic information about Tuntutuliak, compiled by Alaska Fisheries Information Network in 2011, can be found at https://apps-afsc.fisheries.noaa.gov/REFM/Socioeconomics/Projects/communityprofiles/Tuntutuliak_Profile_2000_2010.pdf.
[6] Census estimates for Tuntutuliak, Aniak, and Nikolai are current as of July 2023, from Alaska Department of Labor and Workforce Development, https://live.laborstats.alaska.gov/data-pages/alaska-population-estimates.

has dropped to 1,214 fish between 2020 and 2023 (Figure 8). In recent years, increasing numbers of Tuntutuliak families are processing fish in the village, rather than moving to Tunt Fish Camp. As shared by one Tuntutuliak Elder:

> *"I'm one of the fish campers...but I don't go to fish camp because of the fish closures. There's only maybe 5 in Tunt [who use their] fish camp right now. No, that's not that many." – Adolph Lupie (in KRITFC 2021:7).*

Restrictions reducing the amount of time families can fish, as well as increasing dependence on "9-to-5" jobs and rising costs of fuel and equipment, are heavily influencing families' decisions to spend summers in the village (DEIS Section 4.3.3.2.2.2; see also KRITFC 2024:13).

Aniak:[7] The community of Aniak, or *Anyaraq* in Yugtun (meaning "the place where it comes out," referring to the Aniak River) is located in the middle river at the confluence of the Kuskokwim and Aniak rivers (Mikow et al. 2019). The 439 residents of Aniak rely heavily on chum salmon, among other traditional foods, to meet subsistence needs and practice their way of life. Between 1990 and 2019, an average of 3,416 chum salmon were annually harvested for subsistence by Aniak residents, with a community harvest of 10,160 chum salmon reported in 1990. This decreased to an average of 357 fish per year between 2020 and 2023, with only 76 chum salmon harvested by community subsistence fishers in 2022 and 158 in 2023 (Figure 8). Chum salmon are primarily harvested with drift gillnets, set gillnets, fish wheels, and rod and reel by Aniak residents in the past and present.

Panel 2. Gillnet, fish cutting station, and boats along the shore in Aniak, August 2024. Credit T. Vicente/KRITFC.

As has been discussed in Section 2 of this appendix, the Aniak River is a primary spawning tributary for salmon and is one of the most productive chum salmon tributaries within the Kuskokwim River drainage (Figure 1). People in Aniak have starkly noticed the loss of chum salmon in this tributary, noticeably marked by the lack of "stink" of chum carcasses decomposing on riverbanks. As one Elder and LK holder in Aniak shared:

> *"When I first came to Aniak in the 1960s, there were people who made their money off fur in the winter and fish in the summer; that's how they could buy a new outboard or net. They were able to do that because the chum salmon went up the Aniak valley to die. Elders talk about the stink up there, and the first year we had a sonar on the Aniak, we had a million chums up there; but no longer. We should think of chums as the sponsor of marine-derived nutrients and make sure we don't downplay this." – LaMont Albertson (in KRITFC 2023:5).*

[7] Additional, comprehensive socioeconomic information about Aniak, compiled by Alaska Fisheries Information Network in 2011, can be found at https://apps-afsc.fisheries.noaa.gov/REFM/Socioeconomics/Projects/communityprofiles/Aniak_Profile_2000_2010.pdf.

Chum salmon declines in the Aniak region are tangibly felt not just by human residents, but by the ecosystem.

Nikolai:[8] The community of Nikolai, or *Edzeno' Nikolai* in Dinak'i (referring to the traditional name of the South Fork of the Kuskokwim), is located along the forested banks of the South Fork of the headwaters of the Kuskokwim River. Most of Nikolai's 92 residents are Upper Kuskokwim Athabascan (Alaska Department of Labor and Workforce Development 2024).

Chum salmon, most often called "dog salmon" by residents in English or *srughot'aye* by Dinak'i language speakers, are a key part of the subsistence salmon diet in Nikolai alongside Chinook and coho salmon (best known as "red" salmon in this community). Traditional and modern chum salmon harvest methods by Nikolai residents include set gillnets, fish wheels, rod and reels, dipnets, and fish traps/weirs. Chum salmon are often cut into kites by Nikolai fish cutters at their Blackwater and Big River fish camps. To process fish in this way, the cutter removes the head, guts, and backbone of the fish, leaving its two filets and tail intact. They may make cuts in the flesh of the salmon to speed the drying process and wedge a stick horizontally between the filets to keep them from curling in on one another. Half-dried, half-baked fish is another popular way to process and serve chum salmon.

Chum salmon harvests in Nikolai have been steadily declining for many years. During 1990–2019, an average of 430 chum salmon were harvested by community fishers. In 2023, only 1 chum salmon was reported to have been caught; in 2022, this number was 0 (Figure 8).

Sockeye salmon are rare in Nikolai and on the South Fork–Kuskokwim, if present at all. When interviewing TK holders in Nikolai in June 2024 about types of salmon they have seen and/or harvested in or near Nikolai in their lifetimes, only 1 of 7 people said they were familiar with sockeye salmon. Unlike many residents of the middle and lower Kuskokwim, fishers in Nikolai were thus unable to rely on abundant sockeye salmon to fill food security needs during recent concurrent declines of chum, Chinook, and coho salmon.


Panel 3. View of the South Fork Kuskokwim (left) and front road (right) of Nikolai, June 2024. Credit T. Vicente/KRITFC.

[8] Additional, comprehensive information about the history and culture of Nikolai, compiled by Ray Collins in 2000 and revised in 2004, can be found at https://www.nps.gov/dena/learn/historyculture/upload/Dichinanek-Hwtana-508.pdf.

5. Cumulative Factors Contributing to Kuskokwim Chum Salmon Declines

Numerous compounding environmental and anthropogenic drivers are contributing to Kuskokwim River chum salmon declines (Figure 9; see also DEIS Section 4.5). Oftentimes, these drivers are both environmentally and anthropogenically induced, as is the case with climate change and ecological imbalances.

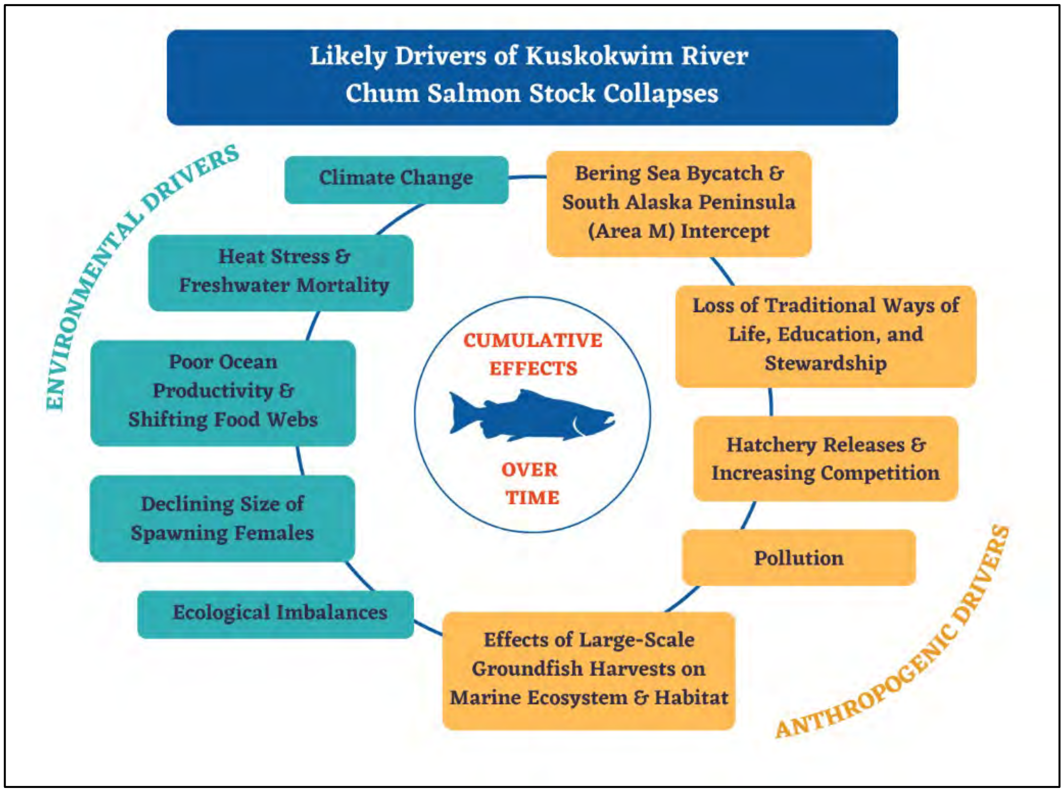

Figure 9. Likely environmental and anthropogenic drivers of chum salmon stock collapses on the Kuskokwim River. These drivers accumulate over time.

Over time, these drivers act together to contribute to low abundance of chum salmon. Figure 10, adapted from a figure published in the 2022 Eastern Bering Sea Ecosystem Status Report, illustrates these co-occurring factors that, over the course of one life cycle, likely contributed to low 2023 chum salmon returns to the Kuskokwim and Yukon rivers. Without the cessation or lessening of the intensity of these factors, it is challenging—perhaps impossible—for chum salmon stocks to rebound, rebuild, and be restored to former abundances.

Critical to understanding how to rebuild chum salmon stock abundance is recognizing that many of these drivers—particularly those that are anthropogenic in nature—can be mitigated by changes to fisheries management. This includes the management practices and policies of the National Marine Fisheries Service (NMFS) and the North Pacific Fishery Management Council (Council), ADF&G and the Alaska Board of Fisheries (BOF), and entities operating outside of Alaska and the United States. This section focuses on drivers that can and must be addressed by management intervention.

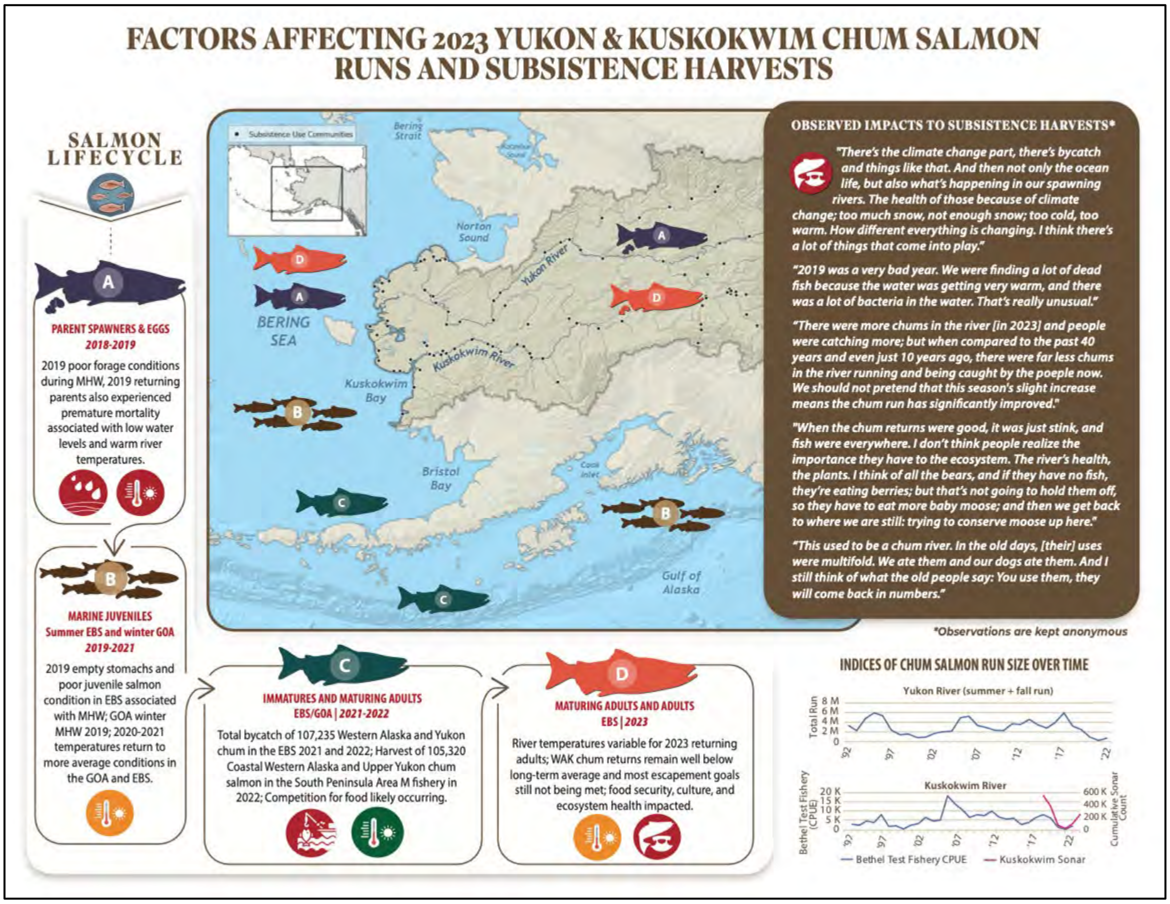

Figure 10. Factors affecting 2023 Yukon and Kuskokwim chum salmon and subsistence harvests, adapted by P. Chambers from 2023 Eastern Bering Sea Ecosystem Status Report (Whitworth et al. 2023).

➢ *5.A. Bycatch and Intercept*

Chum salmon bycatch in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries and intercept in the South Alaska Peninsula Unimak and Shumagin Islands (Area M) June fisheries are leading anthropogenic drivers of Kuskokwim chum salmon declines.

This analysis focuses on bycatch in the BSAI pollock trawl fishery, and NMFS and the Council are currently responsible for minimizing bycatch in only this fishery. However, **from a Tribal perspective, it is nearly impossible to silo the impacts of bycatch by BSAI fisheries—especially the inshore catcher-vessel fleet fishing north of the Alaska Peninsula—from those of the Area M June fishery, managed by ADF&G and the BOF.**

Western Alaska chum salmon, including Kuskokwim stocks, annually encounter both fisheries as they migrate through False Pass and the Aleutian Islands from wintering grounds in the Gulf of Alaska and summering grounds in the Bering Sea (Figure 11). In addition to the cumulative impacts of chum salmon removals by these fisheries, the disjointed management of chum salmon in these critical migratory corridors (e.g., NMFS/Council vs. ADF&G/BOF) contributes to the failure to conserve and rebuild Western Alaska and Kuskokwim chum salmon. Consistently, the inshore catcher-vessel fleet has caught the highest numbers of Western Alaska chum salmon, which aligns with knowledge of the migratory pathway of these fish through waters just north of the Alaska Peninsula, where the trawl fleet fishes.

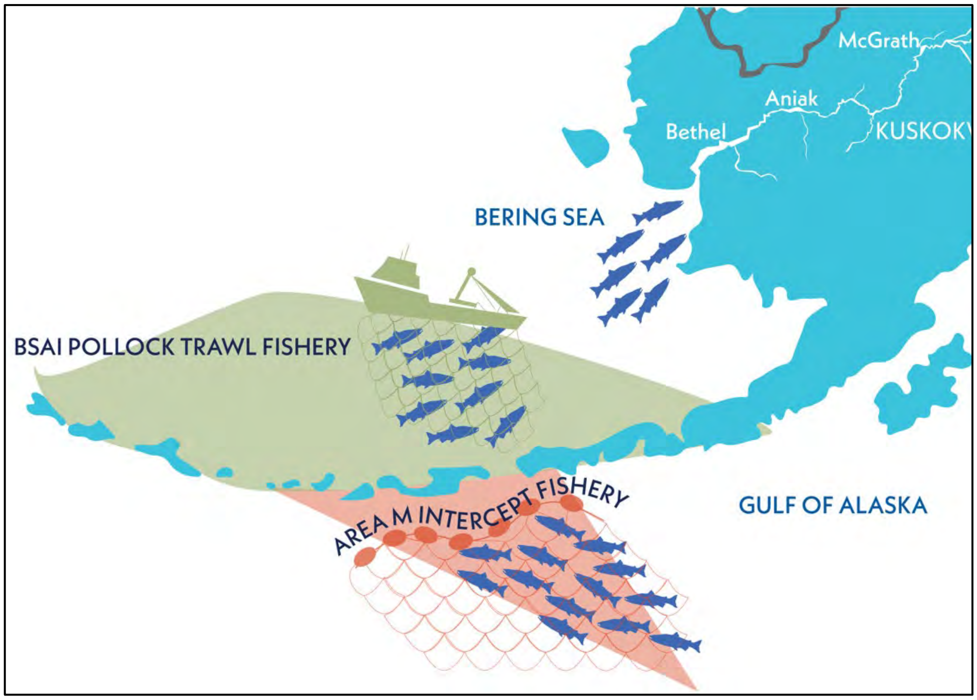

Figure 11. Migratory pathway of Western Alaska chum salmon, including those of Kuskokwim River origin. As they travel between the Gulf of Alaska and Bering Sea to rear or head to their natal rivers to spawn, Western Alaska chum salmon are encountered and removed by the Area M intercept fishery and Bering Sea/Aleutian Island pollock trawl fisheries.

High levels of BSAI groundfish bycatch and Area M June harvest annually remove significant numbers of chum salmon, including Western Alaska chum salmon. Figures 12 and 13 respectively show total numbers of historic BSAI bycatch and Area M June fishery intercept of chum salmon. In these cases, "total" signifies raw reported numbers of chum salmon removals from all genetic stock reporting groups, including Japanese and Russian hatchery releases, and not just from Western Alaskan wild stocks.

The 1991–2024 long-term average BSAI chum salmon bycatch from all stock groupings (including Western Alaska stocks, like the Kuskokwim) is 183,161 fish (Figure 12). The five-year average (2020–2024) surpasses this at 255,932 chum salmon, which has been marginally reduced from the ten-year average (2015–2024) of 297,104 fish. The three highest years of chum salmon bycatch in the BSAI groundfish fisheries occurred in 2005 (711,520 chum salmon), 2021 (550,598 chum salmon) and 2017 (471,447 chum salmon). Figure 13 shows that since 1980, the average Area M June fishery harvest is 455,461 chum salmon from all stock groupings, including Coastal Western Alaska fish. Similar to BSAI bycatch levels, this average has increased in the last 5 years to an average of 566,412 fish. The highest annual harvests of chum salmon from all stock groupings in the Area M June fisheries occurred in 2021 (1,168,601 fish), 1982 (1,094,044 fish), and 1991 (772,705 fish).

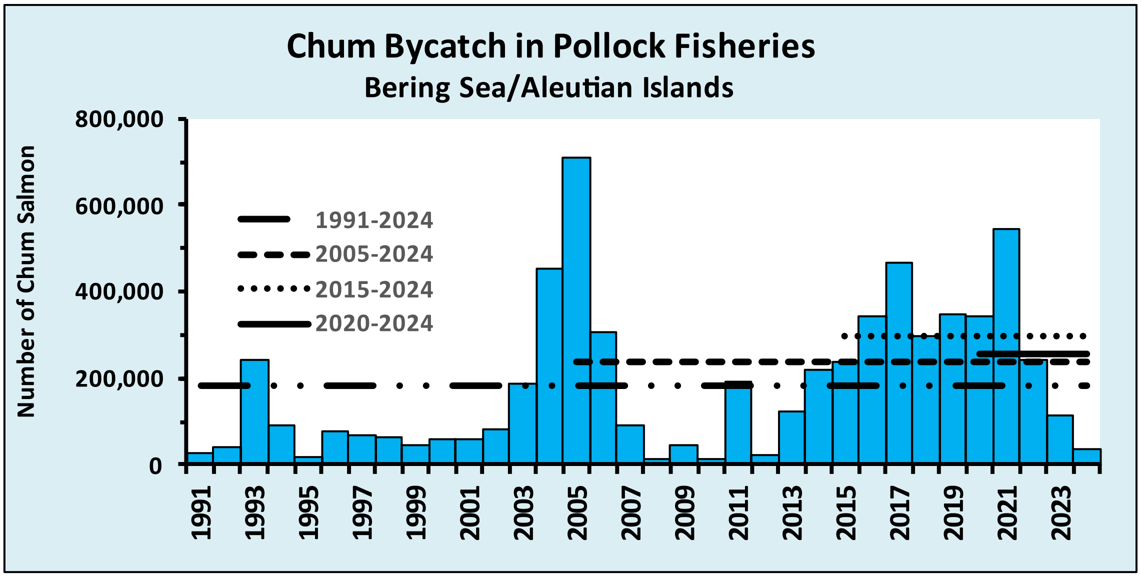

Figure 12. Total chum salmon (all genetic reporting groups, including Western Alaska) bycatch in BSAI pollock trawl fisheries, 1991-2024. Long-term (1991–2024), 20-year (2005–2043), 10-year (2015–2024), and 5-year (2020–2024) averages are also provided. 2024 bycatch data provided through October 31, 2024. Data source: NOAA Fishery Landings and Catch Reports in Alaska 2024.[9]

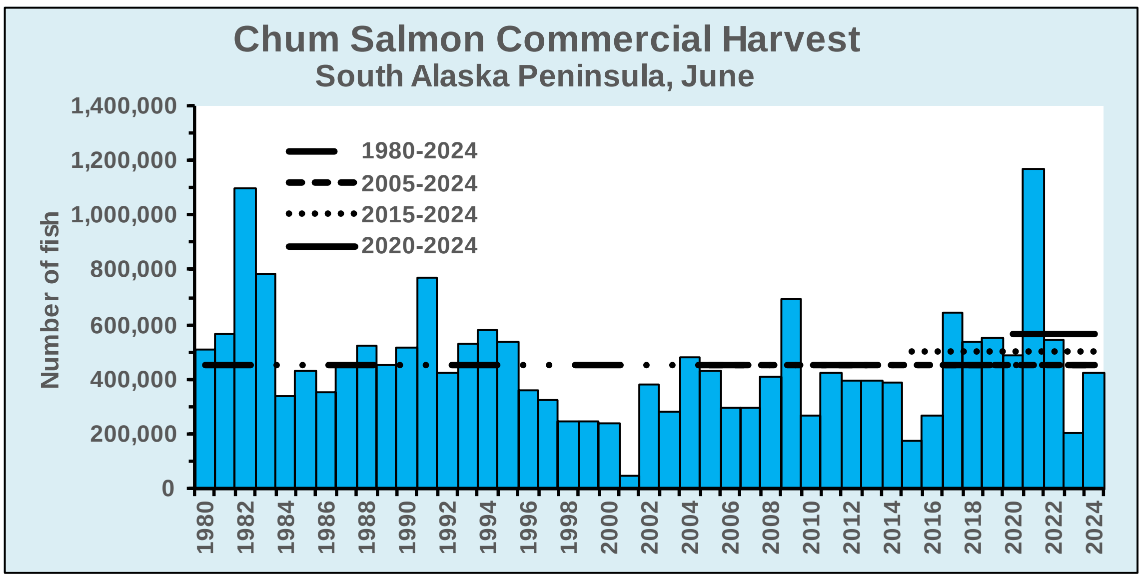

Figure 13. Total chum salmon (all genetic reporting groups, including Coastal Western Alaska) intercept in June Area M fisheries, 1980-2024. Long-term (1980–2024), 20-year (2005–2024), 10-year (2015–2024), and 5-year (2020–2024) averages are also provided. Note that long-term and 20-year average levels (456,172 fish and 454,006 fish, respectively) are close and overlap on this graph. Data source: Fox et al. 2022; Dann et al. 2023; ADFG Commercial Harvest Estimates 2024).[10]

Reliable genetics analysis of BSAI bycatch dates only to 2021 (pers. comm., P. Barry and W. Larson, NOAA). Geneticists estimate that approximately 96,070 and 50,797 Western Alaska chum salmon were caught as bycatch in 2017 and 2021, respectively (Figure A; NPFMC

[9] Available at https://www.fisheries.noaa.gov/sites/default/files/akro/chum_salmon_mortality2024.html.
[10] Available at https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareaakpeninsula.salmonharvestsummary.

2024:27). Figure 14 shows Western Alaska chum salmon caught by the BSAI pollock trawl fleet compared to chum salmon escapement at two Kuskokwim tributaries (Kogrukluk and George rivers). While it is unclear each year how many Western Alaska chum are of Kuskokwim origin and how many of those would have returned to the Kuskokwim in a given year, it is plausible that the increasing number of years that Western Alaska chum salmon bycatch surpassed in-river escapement, with this bycatch peaking in 2017 at 96,070 fish, contributed to low Kuskokwim chum salmon abundance and escapement in 2020–2023. In other words, what happens in the oceans is felt in-river not long after.

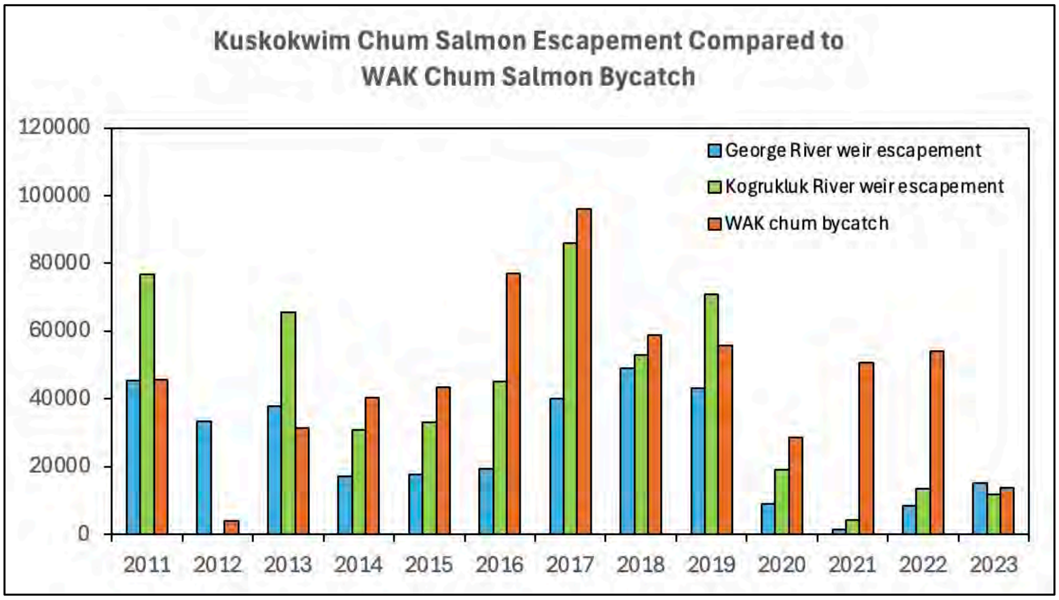

Figure 14. Kuskokwim chum salmon escapement at the George River and Kogrukluk River compared to Western Alaska (WAK) chum salmon bycatch in the BSAI pollock fishery (in numbers of fish) and pollock harvest (in tons of fish), 2011-2023. Sources: AYKDBMS 2024, NOAA Fishery Landings and Catch Reports in Alaska 2024.

Figures 15 and 16 again look at Western Alaska stock contributions of chum bycatch compared to in-river experiences—this time, of subsistence fishers. Figure 15 provides a side-by-side comparison of Western Alaska chum salmon bycatch in the BSAI pollock fishery and Kuskokwim subsistence harvests between 2011–2023. Figure 16 shows this same information, with Western Alaska chum salmon shown in context as part of the annual total chum salmon bycatch in the BSAI pollock fishery between 2011 and 2023. Again, this information provides insight to how the 2017 spike in Western Alaska chum salmon bycatch may be linked to low Kuskokwim chum salmon harvests in subsequent years—and how, for many years, the bycatch of chum salmon from the Kuskokwim and other Western Alaska rivers towered over subsistence harvests by subsistence fishers.

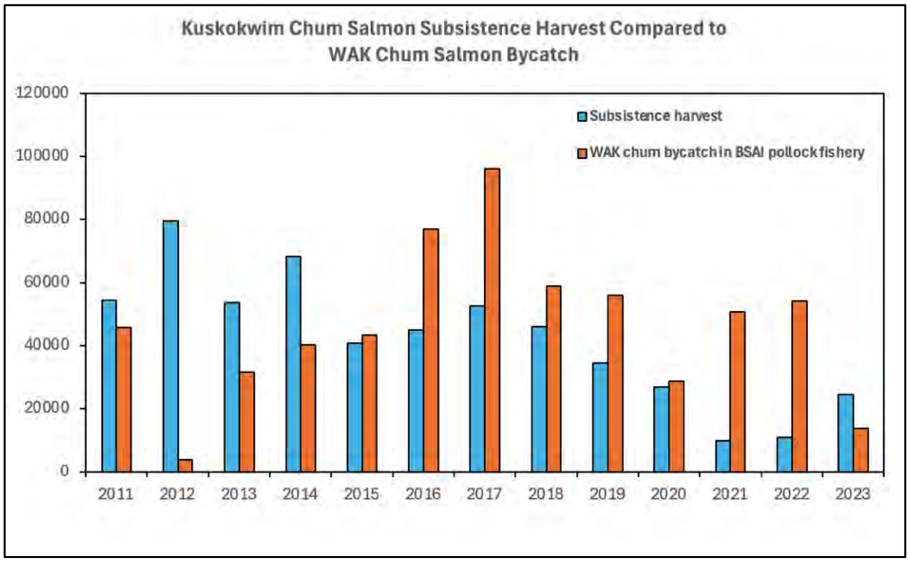

Figure 15. Kuskokwim River chum salmon subsistence harvests compared to Western Alaska (WAK) chum salmon bycatch in the BSAI pollock fishery, 2011–2023. Sources: Bembenic and Koster 2024; D. Koster, ADF&G, pers. comm.; NOAA Fishery Landings and Catch Reports in Alaska 2024.

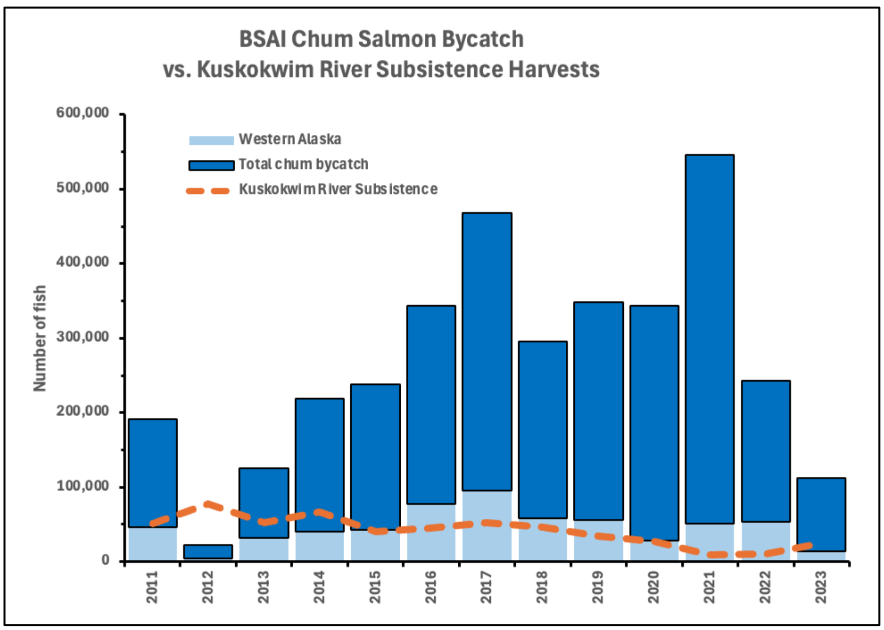

Figure 16. Total chum salmon bycatch and Western Alaska chum salmon bycatch in the BSAI pollock trawl fishery compared to Kuskokwim River chum salmon subsistence harvests, 2011–2023. Sources: Bembenic and Koster 2024; D. Koster, ADF&G, pers. comm.; NOAA Fishery Landings and Catch Reports in Alaska 2024.

In Area M, Western Alaska chum salmon have historically been intercepted in the highest proportion during the month of June, aligning with chum salmons' seasonal migration through these fishing grounds while in route to the Bering Sea or their spawning grounds. On average, 12% to 57% of all chum salmon harvested in the Area M June fishery are of Coastal Western Alaska origin, which includes Kuskokwim chum salmon stocks (Seeb and Crane 1999; Dann et al. 2023). Because genetic analyses in Area M have been inconsistent, Figure 17 shows the potential contributions of the Coastal Western Alaska chum salmon stock grouping harvested in the June Area M fisheries between 1980 and 2024. There is high inter-annual variability in both the number of chum salmon harvested in June and the contribution of Coastal Western Alaska stocks to the total harvest. Based on the limited number of years analyzed for genetic contribution, harvests of Coastal Western Alaska stocks were likely within the range of 197,000-635,000 chum in 1982 and 210,000-678,000 chum in 2021, the peak years of Coastal Western Alaska stock catches in this time series.

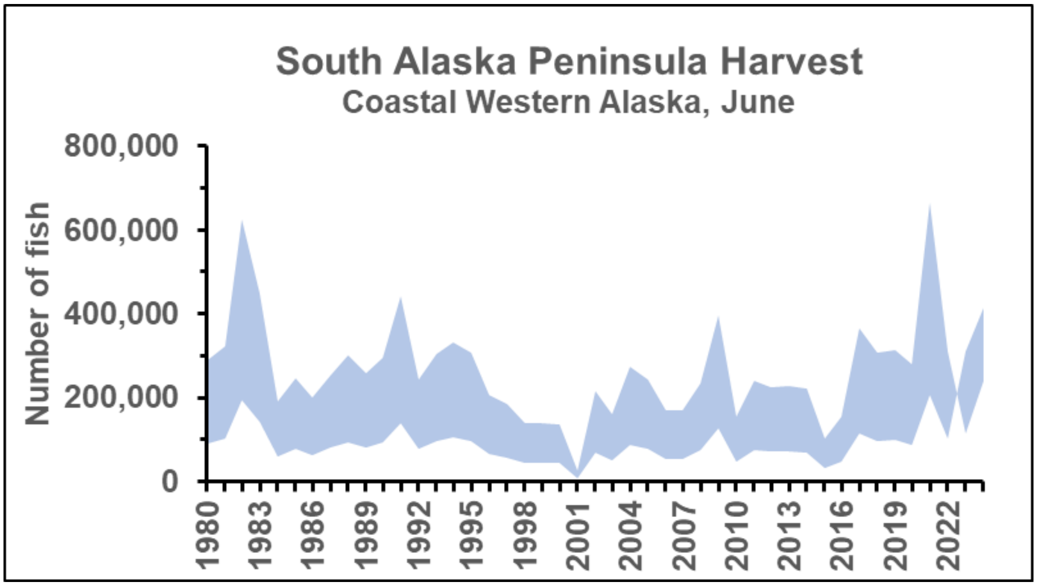

Figure 17. Potential catches of Coastal Western Alaska chum salmon in South Alaska Peninsula fisheries in June, based on genetic studies in 2007–2009 and 2022 (Foster and Dann 2022; Fox et al. 2022; Dann et al. 2023; ADFG Commercial Harvest Estimates 2024).

As stated in Section 4.A. of this appendix, TK holders understand that bycatch and intercept disrespectfully waste fish, and, coupled with argument between user groups, drive salmon declines. This is illustrated in this narrative from Fienup-Riordan et al. 2007:

> *"In February 1992 [the late Toksook Bay Elder] Paul John spoke before the Alaska Board of Fisheries, opposing the board's earlier decision to increase the amount of salmon that commercial fishermen are allowed to catch in the Bering Sea (King 1992). At the close of his statement he said he was compelled to illustrate his feelings with a story about a good hunter and a bad hunter. Even though the bad hunter lacked the needed skills to provide for his family, they never went hungry because his responsible wife carefully preserved and stored his meager catch. But the good hunter had a careless wife, and much of his catch spoiled. Pointing his finger at board members, Paul said simply, 'You are a careless wife.'…*
>
> *"Paul John also addressed the decline of the Bering Sea fishery due to wasteful practices: 'The Kass'at [non-Natives] carelessly handle the fish down below us in the ocean where our food resources grow. As unwanted fish get caught in their nets they throw them back in the water. Our subsistence lifestyle is harmed by their action. This adage, which tells that if something is abused it will dwindle, is certainly the truth. But if they begin to follow what we say, the numbers can begin to climb. Besides telling people not to waste, they also told them not to fight over it or their number would dwindle.'" (Fienup-Riordan 2007:23)*

However, the same authors note that "[j]ust as conflict can drive animals away, acts of compassion will encourage their return. Paul John testified to the importance of cooperation and listening to one another to resolve resource management issues" (Fienup-Riordan et al. 2007:23). There is hope amongst TK holders, including those in the Kuskokwim, that working together can help rebuild salmon stocks.

Over decades, these chum salmon removals accumulate and contribute to the sustained decline in stock abundance. Every chum salmon lost to bycatch and intercept is a salmon that cannot complete its life cycle and spawn, pass on climate resilience genetics to its offspring, help rebuild stock abundance, and support the continuation of subsistence fishing traditions. Reducing the levels of chum salmon bycatch and intercept are ultimately within the control of NMFS, the Council, the BOF, ADF&G, and the fleets themselves.

The return of a single chum salmon can support the viability of discrete spawning populations: tributary stocks with significant spatial separation such that they may be genetically distinct. Kuskokwim salmon populations vary in their productivity, carrying capacity, and life history characteristics. This variation contributes to their sustainability as a result of portfolio effects, and it is especially important for climate resilience of chum salmon stocks (Schindler et al. 2010). Sustained levels of chum salmon removals (including through bycatch and intercept) likely have greater negative impacts to viability of discrete spawning populations at times of low abundance (e.g., in 2020–2023) compared to periods of high abundance. In other words, as chum salmon decline, every salmon that returns becomes biologically more important for the sustainability of its discreet spawning population as well as overall stock abundance.

Figure 18 illustrates this point through three scenarios of varying (e.g., low, medium, high) chum salmon removals. When fish removals (e.g., from fisheries, predation, bycatch, etc.) are low (Scenario 1), abundance of all populations is likely to remain high. The impact on genetic diversity within the watershed is low, and genetic diversity of discreet spawning populations remains high. When fish removals are moderate (Scenario 2), abundance of a population(s) may decrease, and the risk for losing genetic diversity of a discreet spawning population(s) increases moderately. When fish removals are high (Scenario 3), abundance of most populations may decrease, and the risk for losing genetic diversity of most discrete spawning populations may increase significantly.

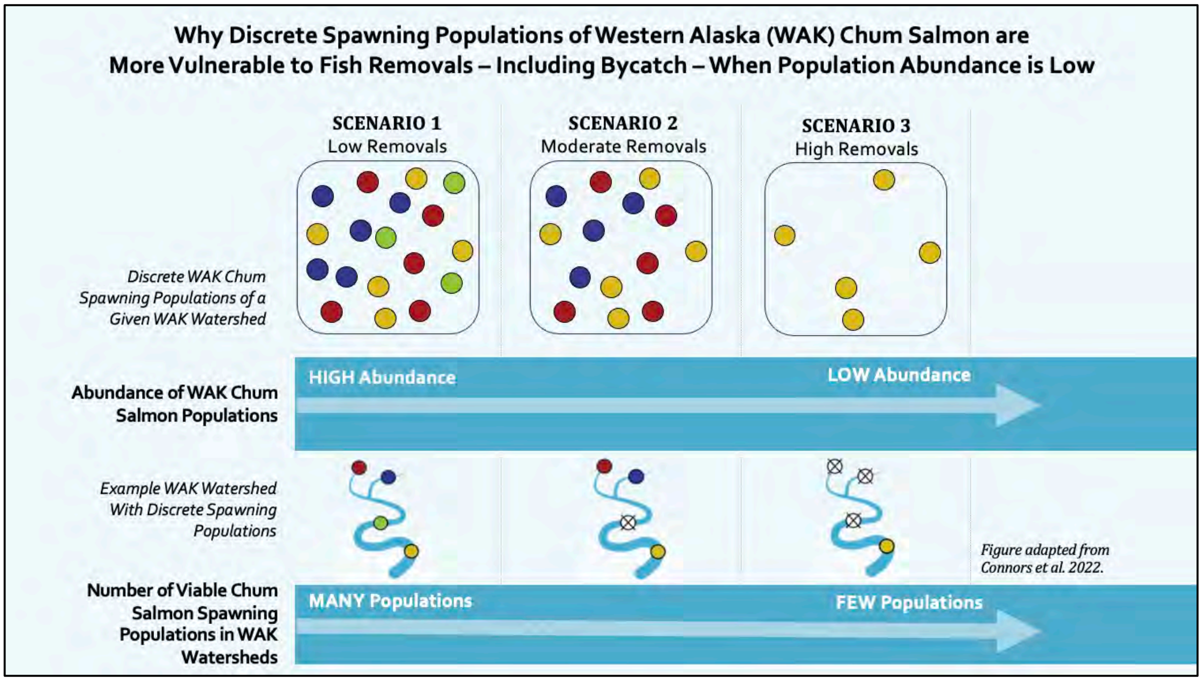

Figure 18. Schematic showing why discrete spawning populations of Western Alaska chum salmon are more vulnerable to overharvest when populations are low, as adapted from Connors et al. (2022). Different color circles represent discrete spawning populations within chum salmon stocks of a Western Alaska river.

It is likely that spikes in the removal of Western Alaska chum salmon in BSAI trawl fisheries and Area M June fisheries depleted key discrete spawning populations of chum salmon in the Kuskokwim River. It is crucial to keep in mind the potential negative impacts to discrete spawning populations under the status quo Alternative 1, as well as the potential positive impacts Alternatives 2-5 could have. Impacts to discrete spawning populations are mitigable by NMFS and Council action, especially with ongoing advances toward improving the Western Alaska genetic stock portfolio (see Attachment 1), modeling Western Alaska chum salmon movements in the Bering Sea (see Attachment 2) and employing in-season bycatch genetic analysis by Bristol Bay Science and Research Institute (see Attachment 3; BBSRI 2023; BBSRI 2024).

➢ *5.B. Impacts to Food Webs, Habitat, and Rivers-to-Seas Ecosystems*

In addition to removing actual chum salmon, large-scale industrial fisheries, particularly pelagic and bottom trawl fisheries in the BSAI, have altered food webs and habitat, unbalancing and reducing biodiversity in the rivers-to-seas ecosystems of the North Pacific.

The BSAI pollock fishery is a high-volume fishery that can remove significant amounts of biomass from the North Pacific, biomass that would otherwise feed and support the productivity of chum salmon, Chinook salmon, and other species. Removals of chum salmon and low chum salmon abundance also likely affect chum salmon-reliant predators such as killer whales, Stellar sea lions (including populations in the Gulf of Alaska), and Northern fur seals, some of whose populations are depleted. Habitat impacts from both pelagic and bottom trawl fisheries exacerbate negative impacts to these ecosystems and food webs (Stratton and Wilson 2023). **Large-scale industrial trawl fisheries have altered North Pacific food webs and habitat, inducing a trophic cascade of negative impacts throughout the marine ecosystem.**

Because the Kuskokwim's freshwater ecosystem is connected to that of the North Pacific—especially through anadromous salmon—these impacts ripple out, extending into the headwaters of the river system in the Interior region of Alaska. For instance, TK holders and regional harvesters have observed bears, hungry for salmon, shifting to target young moose, decreasing the abundance of another important traditional food for communities (KRITFC 2024). Many TK holders in the Kuskokwim observed low abundances of whitefish and trout in salmon spawning tributaries in 2022 and linked these species abundance drops with near record-low chum salmon abundance. Impacts to food webs, habitat, and ecosystems are thus cascading across the Arctic, especially when compounded by climate change.

The reduction of bycatch of Western Alaska chum salmon is one mitigable driver of these impacts that could help restore chum salmon abundance and rebalance these ecosystems. Furthermore, a decrease in the amount of net-in-water time of the trawl fleets is likely to have a measurable impact in decreasing the number of salmon (and other species) caught as bycatch. The TK holders on the Kuskokwim understand the relationship between the amount of fishing time and the number of fish left in the ecosystem and thus have often called for "stand downs" by the trawl fleet (and Area M fleet) until salmon stocks recover.

The practice of harvest closures or reductions for species conservation is regularly employed by fisheries managers and subsistence harvesters in the Kuskokwim region. For instance, KRITFC, USFWS, and ADF&G annually implement a "front-end closure" for fishing with drift gillnets is during the first 11 days of the month of June. This allows the first Chinook salmon that return to the river, which genetically are those bound for the upper reaches of the drainage, to pass through the lower and middle river without heavy harvests. Similarly, during recent periods of chum salmon declines, subsistence fishers on the Kuskokwim face closures that protected chum salmon but prevented harvesters from catching abundant sockeye salmon simultaneously migrating up the Kuskokwim.

In a game management context, Kuskokwim harvesters and TK holders often recall the 2004–2009 fall moose hunting moratorium, in which Tribes and local residents drastically limited their moose harvests to successfully restore abundance of Kuskokwim moose populations to harvestable levels. The five-year moose moratorium is often brought up as a model for a fishing moratorium by the BSAI and Area M fleets, in which several years of fleet stand-downs could help rebuild chum (and Chinook) salmon stocks.[11]

It is important to recognize that Kuskokwim communities do not bear these conservation closures painlessly, but heavily sacrifice harvests and traditions necessary to restore and sustain depleted species and to build equity among regional harvest patterns. **Parallel stand-down measures taken in the BSAI fleet would similarly not come without sacrifice to the fleet, but are equally necessary for stock restoration and equity in bearing the burden of conservation during times of scarcity.** Should the fleet sacrifice some of its pollock quota during such a stand-down, they would leave increased numbers of pollock in the Bering Sea. This could significantly benefit juvenile chum salmon that depend upon age-0 pollock as an

[11] It is important to note the intent of these fleet stand-downs would be to rebuild these stocks for terminal fishers in the Kuskokwim and other Western Alaska rivers, and not for the increased take of the local fleets themselves, which deviates from the moose hunting moratorium's purpose to benefit local harvesters.

important prey source, especially when abundance of copepods and other foods have been in a state of decline (Farley et al. 2024; NOAA 2023c).

A reduction in trawl fleet net-in-water time would also decrease the time nets spend dragging the seafloor and destroying critical benthic habitat. This would help this habitat, like slow-growing corals, to rest from continued net impacts, though sustained closures to bottom-contact trawling and changes to bottom-contact trawling practices and policies, including in the pelagic trawl fleet, are likely necessary to allow these delicate habitats to fully recover and support the trophic ecology of the North Pacific (Stratton and Wilson 2023).

➢ *5.C. Hatcheries and Competition*

Hatchery salmon releases in the North Pacific are another driver of Kuskokwim salmon declines as they increase competition for prey, habitat, and other resources while juvenile chum salmon mature. Figure 19 shows hatchery releases of all salmon species across the North Pacific Rim during 1980–2023. Figures 20 and 21 show hatchery chum and pink salmon releases across the same region. These species are featured here because they are competitor species with wild Kuskokwim chum salmon stocks. **The sheer abundance of hatchery chum, pink, and other salmon in the North Pacific for the last three decades until today undoubtedly has driven wild chum salmon declines in the Kuskokwim and across Western Alaska—even across the state—as these different fish compete for finite space and resources.**

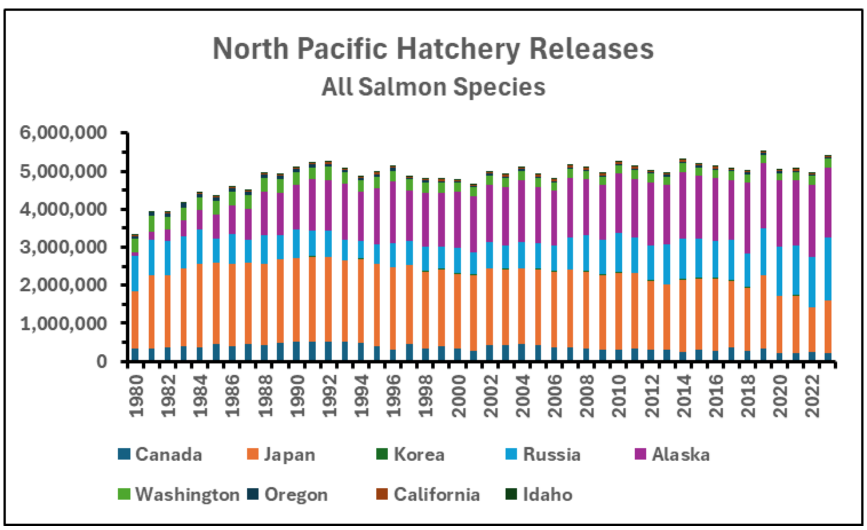

Figure 19. Hatchery releases of all salmon species from hatcheries in areas bordering the North Pacific Ocean, 1980–2023. Source: NPAFC 2024.

Hatchery releases of chum salmon across the North Pacific increased rapidly from the 1960s to the 1990s and have since remained stable, averaging 3.05 billion (range 2.72-3.53 billion) chum salmon released during 1990–2023 (NPAFC 2024). **In the last decade, Japan has reduced chum salmon hatchery output, while Russia and Alaska have increased theirs** (Figure 20).

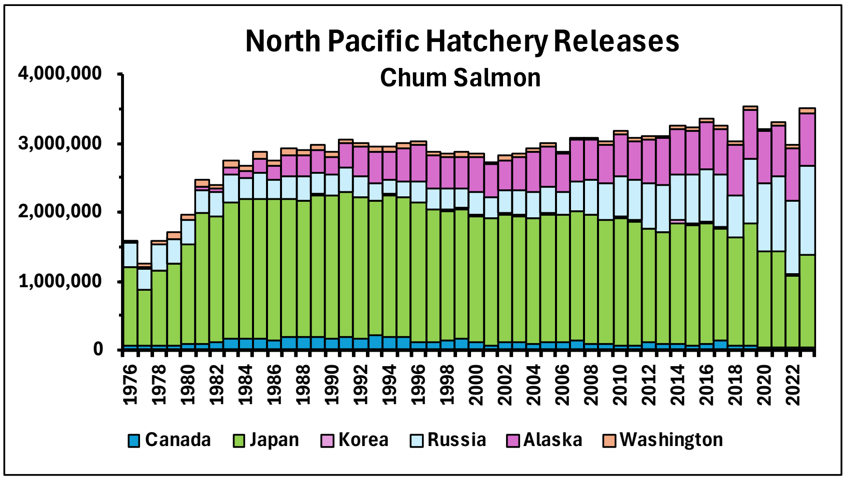

Figure 20. Hatchery releases of chum salmon from hatcheries in areas bordering the North Pacific Ocean, 1976–2023. Source: NPAFC 2024.

Hatchery releases of pink salmon across the North Pacific also increased rapidly from the 1960s to the 1990s and have since been relatively stable, averaging 1.35 billion (range 1.12-1.51 billion) pink salmon during 1990–2023 (NPAFC 2024). Alaska's contribution to pink salmon hatchery production in the North Pacific has increased from 57% in 1990 to 74% in 2023 (Figure 21). **Hatchery pink salmon are voracious eaters and may have particularly strong negative impacts on wild chum salmon stocks, including those on the Kuskokwim** (AYK SSI 2024; Ruggerone et al. 2021).

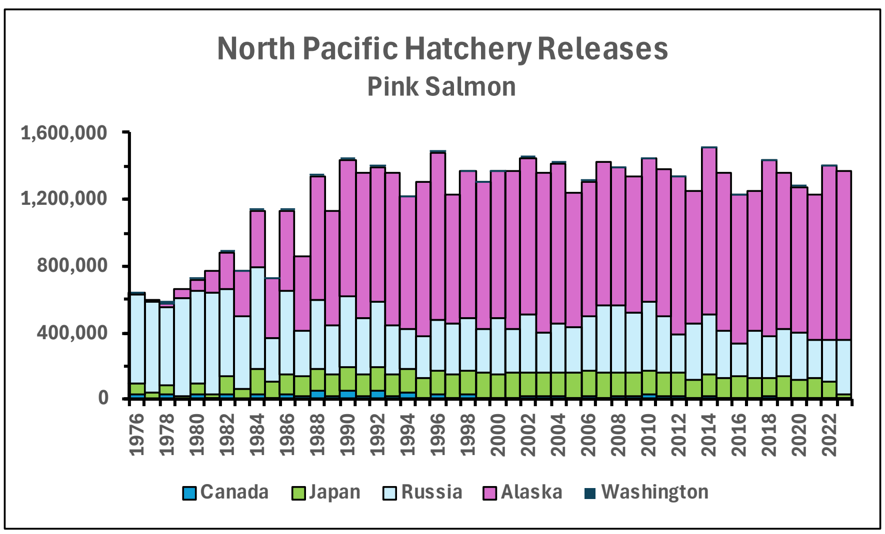

Figure 21. Hatchery releases of pink salmon from hatcheries in areas bordering the North Pacific Ocean, 1976–2023. Source: NPAFC 2024.

Impacts from hatchery releases are mitigable with management and policy intervention. While outside the direct scope of NMFS and this Council, they could collaborate with the State of Alaska and the U.S. State Department to evaluate the potential benefits to natural salmon production by reduced hatchery production by Alaska, other U.S. states, and other countries in the North Pacific.

➢ ***5.D. Erasure of Indigenous Stewardship and Loss of Traditional Ways of Life***

The erasure of Indigenous salmon stewardship from contemporary fisheries management has resulted from the colonization of salmon management and exclusion of Indigenous people, knowledge systems, and values from management systems. These inequities, and the Western colonial management systems that produced them, have driven chum salmon declines as well as the loss of traditional ways of life that are vital to holistic well-being of Indigenous Kuskokwim communities (see DEIS Sections 4.3.3.2.1 and 4.3.3.2.2).

Specific to NMFS' management and the Council process, Western fishery management principles of "Maximum Sustained Yield" (MSY) and "Optimum Yield" (OY) that form the basis of North Pacific fishery management and the Magnuson-Stevens Act National Standards Guidelines frame management in terms of the maximization of harvest and profit. This approach and goal directly conflicts with, and contradicts, Indigenous stewardship of traditional foods, which is based on values of sharing in times of abundance and scarcity, taking only what is needed, avoiding all waste, and respecting the dignity and life-gift of all beings, including non-human relatives. These Indigenous stewardship principles—and particularly the Elders and TK holders who instructed harvesters and communities about these principles—guided traditional, pre-contact salmon management within and among communities on the Kuskokwim River, and they continue to guide KRITFC's management strategies today.

Moreover, these Indigenous salmon stewardship principles are both community-oriented and ecosystem-based in nature. Communities and fish camps connected by the Kuskokwim River recognize the upstream effects of downstream harvest and accordingly value taking only what fish are needed and can be processed while allowing others to pass upriver to feed other families and the ecosystem. Traditional salmon stewardship also recognizes the inherent value chum salmon provide for ecosystems, placing equal importance on allowing salmon to reach spawning grounds—thus supporting future generations of fish returns and harvests as well as other non-human salmon harvesters (e.g., bears and eagles)—as is placed on meeting subsistence harvest needs. These Indigenous stewardship principles thus balance river-wide community harvest needs with those of the ecosystem; in practice, they are lived principles of environmental justice.

The same cannot be said for MSY, OY, and other principles and policies that guide NMFS, the Council, and other Western management entities. **Profit-driven and -guided management as it currently exists, even while ostensibly operating within the bounds of MSY and OY, does not consider balancing community harvest and ecosystem services. Rather, it focuses only on single, profitable species and industries (e.g., pollock and the trawl fleet) at the expense of other species (e.g., salmon and subsistence users) and the interconnected rivers-to-seas ecosystem.** This management approach thus "sustains" yield only for the profitable target fisheries at the expense of other fisheries and ecosystem services. It is dubious whether the level of extraction supported by economically-geared MSY and OY models and analyses will sustain target fisheries in the long-term without adequately accounting for multi-species, ecosystem-based assessments.

Moreover, it is an environmental injustice that terminal harvesters within the Kuskokwim are (in)voluntarily sacrificing the take of chum salmon while other user groups (primarily trawl and intercept fleets) are not. There is a grave misalignment between NMFS' and the Council's current practices and their stated goals of both equity and environmental justice (EEJ) and ecosystem-based management (EBM) (NOAA 2023b; NMFS 2024).

The minimization of bycatch "to the extent practicable" is another Western management practice that undermines and ignores Indigenous stewardship principles that could support the recovery of Kuskokwim chum salmon stocks. To TK holders on the Kuskokwim River, bycatch is a form of wasting and disrespecting salmon, which are key acts to avoid in Indigenous salmon stewardship because they contribute to fish refusing to return to river systems and harvesters in Indigenous stewardship (see DEIS Section 4.3.3.2.2.2). Kuskokwim TK holders express that wasting salmon must be avoided not only by in-river fishers, but by all who encounter salmon, including pollock trawl vessels in the Bering Sea and fishers in Area M.

Furthermore, Indigenous people are not equitably represented in most fishery management systems, and their values and knowledge systems are not considered equal to Western management practices and values (Esquible et al. 2024). This is a detriment to best management practices; ignores federal and agency policy to include TK as part of best available science (including as required in National Standard 2 and referenced in the purpose and need of this action) and work alongside Tribal Nations to manage traditional foods and subsistence areas (OSTP 2022; NOAA 2023a; NPFMC 2023b); and drives the decline of traditional foods like chum salmon. Without correction, these Western-oriented, profit-driven systems perpetuate the decline of chum salmon and resulting fishery closures, and low harvests contribute to the loss of traditional ways of life, educating youth, and stewarding salmon and one another (see DEIS Section 4.3.3.2.2.2).

The erasure of Indigenous salmon management is anthropogenic in nature and can be corrected by NMFS and the Council, particularly through seeking co-management and Indigenous-led management with Tribal Nations and (inter-)Tribal organizations to uplift gravel-to-gravel salmon stewardship and conservation. Though there is considerable work needed to achieve environmentally just and equitable fisheries management in the North Pacific, and to remedy the disastrous effects of decades of Indigenous erasure, significant efforts are beginning to be made to address these past and ongoing injustices. Section 7 of this appendix provides further details on this.

6. Recommendation: Use Kuskokwim River Sonar to Measure Kuskokwim Chum Salmon Abundance in Alternative 3, Option 1

Alternative 3 of this DEIS analysis proposes to establish an overall PSC limit that is linked to chum salmon abundance within the Yukon, Kuskokwim, and Norton Sound regions (Option 1) or of Yukon summer and fall chum salmon stocks (Option 2). Linking bycatch avoidance measures, and specifically PSC limits, to in-river abundance could benefit salmon and Salmon People because these measures directly tie and measure the effectiveness of bycatch avoidance with freshwater spawner abundance.

If NMFS and the Council opt for Alternative 3 and pursue linking bycatch avoidance measures to in-river abundance, KRITFC recommends choosing Option 1 to include all three areas, rather than just the Yukon River stocks. The large historical return of chum salmon primes the Kuskokwim River for inclusion in a three-area index as an indicator of annual stock status of chum salmon returns to Western and Interior Alaska drainages. Moreover, this would align bycatch avoidance measures for Chinook salmon and chum salmon.

However, data available to indicate Kuskokwim River stock status differ substantially for Chinook and chum salmon. Notably, the estimated return of Chinook salmon to the Kuskokwim River is based on a run reconstruction model informed by direct observations dating back to 1976 of escapement (weirs and aerial surveys), harvests (subsistence and, historically, commercial), test-fishing (to apportion historical commercial catch), and limited mark–recapture studies (Bue 2005; Larson 2024). Currently, no comparable run reconstruction model or adequate data sources to inform such a model exist for Kuskokwim River chum salmon.

Given these data limitations for chum salmon, Alternative 3, Option 1 provides two suboptions for establishing a Kuskokwim chum salmon abundance threshold using Bethel Test Fishery (BTF) cumulative catch-per-unit-effort (CCPUE). These suboptions are 2,800 fish and 5,200 fish, which approximate the 25th and 50th percentiles of BTF CCPUE during 1992–2022. Rationale provided in previous analyses (NPFMC 2023) and on the Council record (October 8, 2023; April 8, 2023) states BTF CCPUE should be used because of its reliability, use in in-river salmon management, and availability post-season for NMFS' and the Council's management.

KRITFC disagrees with this assessment of BTF CCPUE based on our experience with using multiple indicators of salmon abundance for in-season salmon co-management on the Kuskokwim, as well as recent comparison of BTF CCPUE data to other in-season assessment projects. KRITFC uses a suite of in-season data (e.g., Kuskokwim sonar, BTF, in-season harvest information, TK and LK) to collaboratively manage Kuskokwim salmon fisheries with USFWS, as no one source of data paints a comprehensive picture of these. Data uncertainty due to climate change, as well as funding and staffing limitations, underscore the need for holistic abundance assessments. Moreover, such holistic assessments would align the bycatch management proposed in Alternative 3 with in-river management approaches. **KRITFC recommends NMFS and the Council pursue establishing a chum salmon abundance threshold reliant on multiple sources of data, and to work with KRITFC as a cooperating agency and co-manager of Kuskokwim salmon fisheries to identify data sources and threshold levels.**

However, **if NMFS and the Council opt for Alternative 3, Option 1, and to use only one source of data to establish an abundance threshold, KRITFC recommends the Council base this threshold on the Kuskokwim Sonar Project (sonar) as opposed to BTF CCPUE.**

Following are evidence and justification for understanding why BTF does not provide reliable estimates of Kuskokwim salmon abundance, as well as for using sonar as a more accurate, consistent, and reliable indicator of the mainstem total estimate of chum salmon run abundance for the Kuskokwim River.

- ***5.A. Sonar Provides an Estimate of Total Fish Passage***

While the sonar provides an estimate of total fish passage, BTF provides only a relative index of abundance. BTF is therefore incompatible with the other data sources proposed for use in the chum salmon 3 three-area index (Alternative 3, Option 1) that provide direct estimates of fish passage.

The BTF CCPUE is also incompatible with existing Chinook salmon bycatch management that relies on the annual three-system index, calculated from in-river Chinook salmon total run size estimates from the Kuskokwim, upper Yukon, and Unalakleet river systems (Vincent-Lang 2024. This bycatch reduction measure adopted by the Council for Chinook salmon uses actual estimates of total salmon passage that can be compared within and across drainages and years. The estimates provided by the sonar more accurately align with this three-system index approach used for Chinook salmon.

In contrast, the BTF CCPUE serves only as a relative index of salmon abundance. It cannot be used to estimate the total number of chum salmon (or any other salmon species) in the mainstem but can only be compared to previous years of data to provide a relative measure of abundance. It is not clear how the BTF CCPUE data would be scaled to accurately compare with other Western Alaska indices of chum salmon returns. Previous analyses that BTF "data are the only readily available information on total run abundance" is misleading as BTF is neither the only source of mainstem chum salmon abundance nor does it provide an estimate of total run abundance of chum salmon.

- ***5.B. Accuracy of Abundance Estimates Compared to Test Fisheries***

Alaska's Sustainable Salmon Policy (5 AAC 39.222) and NOAA stock assessment guidelines recommend use of the best available scientific information to guide stock assessment that inform fisheries management decisions. **Mainstem sonar-based estimates constitute the best available science standard for the enumeration of Kuskokwim River chum salmon because salmon abundance estimates with sonar technology are objectively more accurate at measuring abundance compared to test fisheries.** An apt analogy for comparing the fish passage accuracy from BTF to the sonar would be to compare the accuracy of windspeed measured by a windsock versus an anemometer.

The operation of BTF involves technicians in a small boat fishing a series of gillnet drifts following each high tide, with a total of four drifts made at a set of three consistent stations at the test fish site (Lipka and Poetter 2016). Each drift is made with either a 5 3/8-inch or an 8-inch mesh net based on a predetermined sampling design, with species CPUE calculated from the number of fish caught, the net length, and the time the net was in the water. The standardized CPUE by day is summed across the season. The resulting cumulative CPUE data provides only an index of the run strength for each species and not an actual estimate of the return.

The sonar counts the number of fish passing within the insonified beam in front of the transducer, with species composition for the Kuskokwim River based on test fishing using gillnets composed of a combination of six different mesh sizes. Gillnets are 25 fathoms in length (45.7 m) and range from 4.2 to 8.0 m in depth to match river depth (Birchfield 2023). The sonar site is located approximately 20 river km upriver from Bethel. While the sonar equipment can be operated 24/7, most sonar projects, including on the Kuskokwim, record sonar data during a scheduled portion of the 24-hour day. Ultimately fish counts and species compositions are extrapolated to a full passage estimate for the season of sonar operation, which provides for a more accurate measure of abundance than BTF CCPUE.

➢ ***5.C. Changing Migratory Channels Questions Reliability of BTF Data***

The Alaska Department of Fish and Game's own data, as well as Local and Traditional Knowledge (LK, TK), indicates that BTF is no longer providing a reliable estimate of run abundance. In 2024, the run index from BTF significantly differed from the run abundance data from ADF&G's sonar indications. The 2024 drop in BTF values for most salmon species, including chum salmon, compared to sonar counts, suggests a systematic change might have occurred, or that salmon availability to the Bethel Test Fishery gear may have changed due to changes in the lower river morphology (Figure 22).

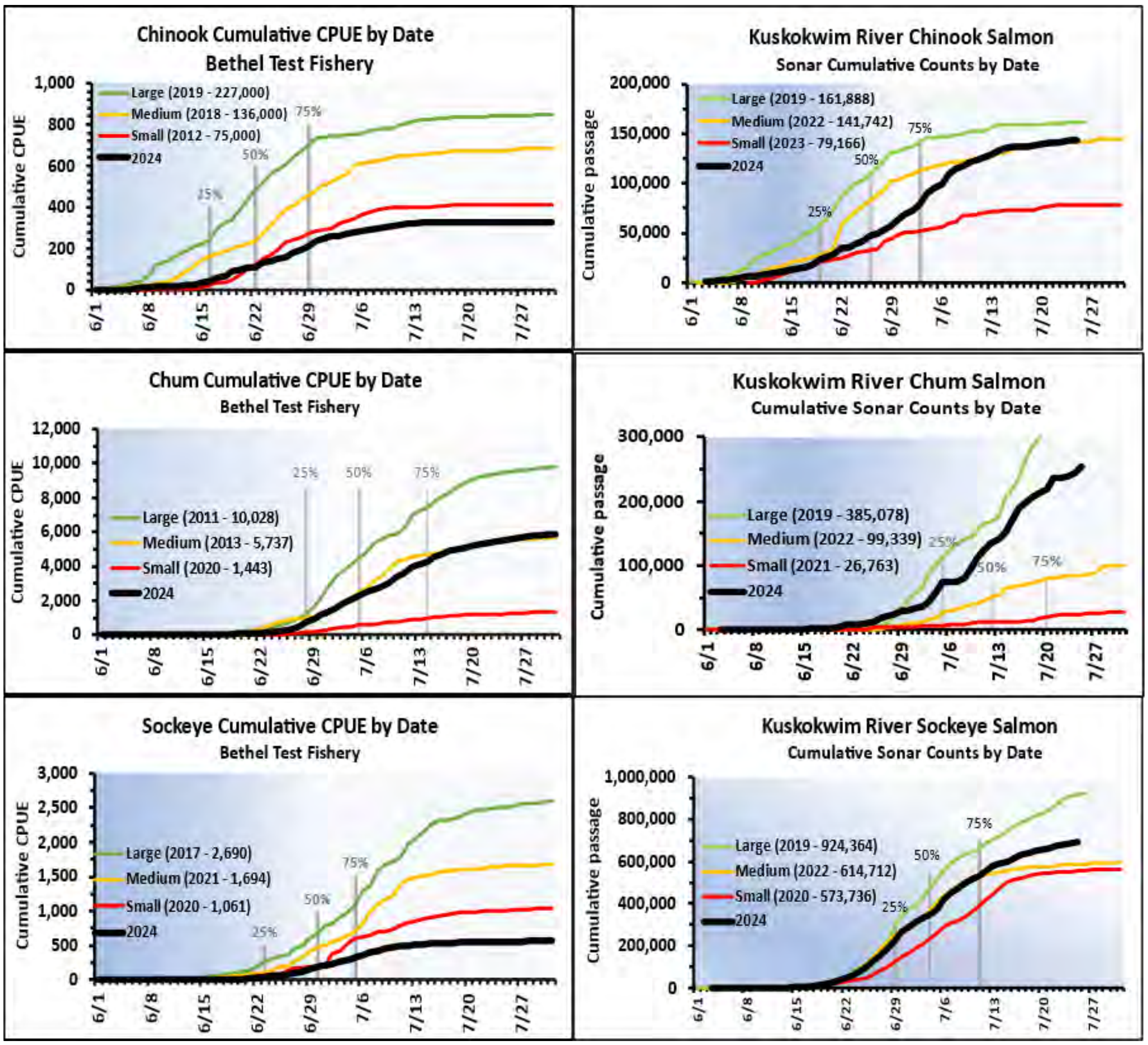

Figure 22. Different portrayals of the 2024 Chinook (top), chum (middle), and sockeye (bottom) salmon runs as shown by cumulative counts in the Bethel Test Fishery (left) and Kuskokwim River sonar (right) compared to representative past years with large (green), medium (orange), and small (red) returns. Vertical lines represent the historical average dates of 25%, 50%, and 75% of the total run. Source: AYKDBMS (2024).

To be useful as a metric, key assumptions of the BTF project must remain constant. But ADF&G has not verified that these fundamental assumptions critical to the validity of the entirety of the data collected have not been violated. Chief among these is the assumption is that the bottom profile in the area where BTF operates has not changed. However, LK and TK from Kuskokwim fishers suggests the river channels have changed and that most fish, particularly chum and Chinook salmon, are now taking a different migratory route that circumvents the BTF fishing sites. BTF is thus likely missing counts of substantial numbers of fish and providing lower-than-actual CCPUE counts. Meanwhile, the sonar project is located on an unbraided channel of the mainstem lower Kuskokwim River, downstream from key spawning tributaries (e.g., Kwethluk River, Aniak River), and thus counts the passage of all salmon above Bethel (Figure 23).

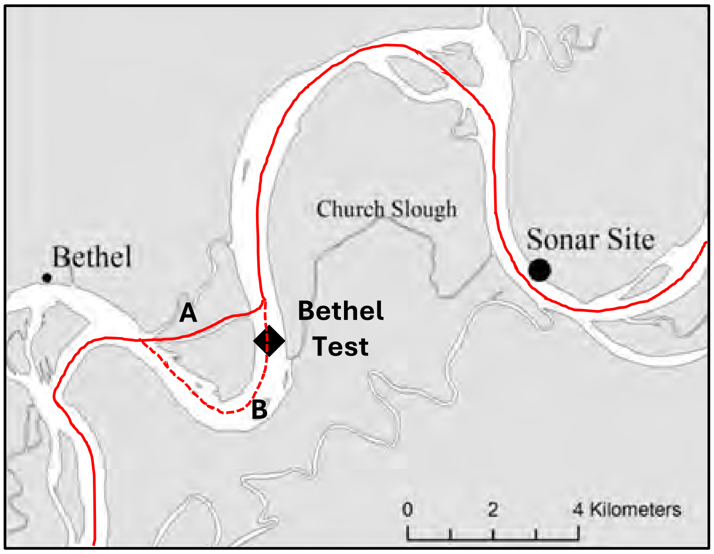

Figure 23. Site locations for the Bethel Test Fishery (diamond) and the Kuskokwim River Sonar (circle) projects on the Kuskokwim River (adapted from Birchfield 2023). The solid red line indicates the general migratory path of chum salmon through this area as indicated by LK, TK, and assessment project data. Most chum salmon swimming from downstream (lower left) to upstream (middle right) now use the deeper channel in Straight Slough (A), circumventing the historical BTF site in channel B around Joe Pete's fish camp and shown by the dashed line.

Operationally, managers at USFWS, KRITFC, and ADF&G have already shifted away from BTF and instead rely more heavily on sonar and other assessment projects (like in-season subsistence harvest monitoring) to inform in-season management decisions for chum and other species of salmon. The use of sonar would thus align NMFS' and the Council's management of chum salmon bycatch avoidance with in-river salmon management on the Kuskokwim.

➢ ***5.D. Possibility of Discontinuing BTF***

The sonar has been in operation since 2018, although project operations ended in late July in 2018, 2019, and 2024 at a time when 81-95% of the run had passed in prior years. **Discussions are underway to discontinue BTF operations in the coming years—as soon as 2025—and the sonar project was intended to replace BTF after several years of parallel operation** (Z. Liller, ADF&G, pers. comm.; S. Larson, ADF&G, pers. comm.). While BTF has a long time series of data and shows relative changes over time, it remains only an index for chum salmon abundance. This time series thus does not benefit the Council's bycatch reduction measures, particularly if the BTF project is to be discontinued.

Operationally, KRITFC/USFWS managers and ADF&G managers have already shifted away from reliance on BTF to inform in-season management decisions. This shift was reinforced in

2024, when BTF results began to significantly depart from assessments by the sonar (Figure 22) and in-season harvest monitoring (e.g., Bechtol et al. 2024).

- ***5.E. Availability of Sonar Data***

One rationale for using BTF CCPUE to establish a threshold for Kuskokwim chum salmon abundance is its availability following the salmon season. This data availability would align with the timing of the Council's consideration of the chum salmon three-area index in conjunction with its annual harvest specifications process each fall (Vincent-Lang 2024). **Sonar project data is equally available at this same time post-season and thus align with the Council's timelines**.

- ***5.F. Sonar as Standard for State-wide Salmon Management***

Sonar projects have become a standard source of salmon stock assessment in subsistence and commercial fisheries management in Alaska, including by ADF&G. On the Yukon, ADF&G uses sonar as its principle mainstem stock assessment, and the Pilot Station and Eagle sonars are primary sources of data to build run reconstructions and inform inseason managenent. There is no intrinsic reason why the Kuskokwim Sonar project is less reliable than other sonar projects as its methods and statistical analysis are based on standard procedures implemented by ADF&G across the state.

- ***5.G. Correlation to Chinook Salmon Run Reconstruction***

While operating over only a small number of years, Chinook salmon estimates from the Kuskokwim River Sonar Project are strongly correlated to the independently estimated Chinook salmon run reconstruction (Figure 24). **Though a run reconstruction does not yet exist for Kuskokwim chum salmon, KRITFC assumes similar correlations would exist between a total run size estimate and sonar passage estimates.**

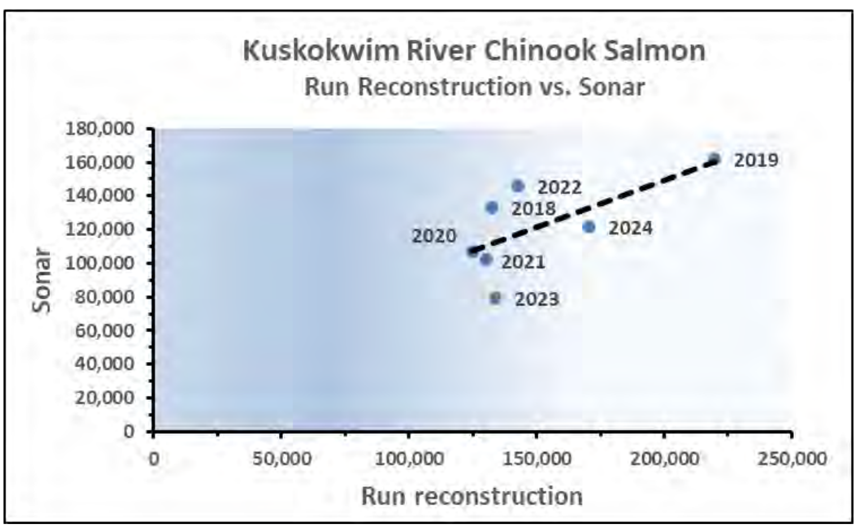

Figure 24. Relationship between run reconstruction estimates and sonar project cumulative counts for Kuskokwim River Chinook salmon, 2018–2024. It is likely a similar correlation would exist for chum salmon.

Based on the seven rationales above, KRITFC recommends the Council use the Kuskokwim River Sonar Project data to establish a threshold for Kuskokwim River chum salmon run abundance in Alternative 3, Option 1, as opposed to using BTF CCPUE. KRITFC offers to work with NMFS and the Council to determine the appropriate thresholds for analysis.

7. Recommendation: Pursue Gravel-to-Gravel Co-Management to Support Equity & Environmental Justice and Ecosystem-Based Management

A foundational driver of chum salmon stock depletions is the exclusion of Indigenous people and their values and knowledge systems from modern fisheries management, which is instead based on principles of profit maximization and economically-driven biological research (see Section 5.D. of this appendix).

If NMFS and the Council wish to reduce Western Alaska chum salmon bycatch so as to minimize harm to salmon-dependent communities and ecosystems in Western Alaska, including in the Kuskokwim, KRITFC recommends NMFS pursue gravel-to-gravel co-management agreements with Tribes. KRITFC defines “gravel-to-gravel” salmon stewardship as the ecosystem-wide, inter-generational stewardship of salmon at all their life stages, from the time salmon hatch from eggs in freshwater streams, through their rearing in the oceans, until they return as spawners, ready to lay their own eggs in the gravel. The pursuit of formal, gravel-to-gravel co-management between Tribes and NMFS would help meet the Purpose and Need of this action by involving Tribes in the development of bycatch reduction mechanisms using best available science, including TK.

NMFS, the Council, and ADF&G currently work together for North Pacific fisheries management, and ADF&G’s is the recognized lead for marine and freshwater salmon management across the state. However, without the involvement of Tribes, this management system lacks the direct involvement of TK holders as well as a true, integrated gravel-to-gravel stewardship vision that seeks salmon conservation and restoration both in-river and in the ocean. Furthermore, Tribes have a government-to-government relationship with the federal government, and NMFS, as the federal agency, has a distinctive federal trust responsibility to Tribes and Tribal resources. Co-management between Tribes and NMFS would enhance inter-governmental relationships and elevate Indigenous ways of knowing for the benefit of salmon, Alaskans, and the pursuit of stated policy goals of EEJ and EBM.

Direct work with Tribal Nations and authorized inter-Tribal organizations through formal salmon bycatch/ecosystem co-management and co-stewardship agreements would help bridge Indigenous and Western knowledge and value systems as well as restore Tribal food sovereignty. Co-management with Tribes would help NMFS and the Council to integrate sound precautionary-management and ecosystem-driven principles that are steeped in both TK and Western science into its management plans. As a minimum step, increasing Indigenous representation on the Council and its associated bodies, as well as within NMFS staff, would come closer to equity in these systems to the benefit of both ecosystems and communities across the region. Substantial time and relationship-building is required for effective co-management agreements, and thus efforts to pursue these arrangements should begin early with regular, sustained two-way engagement.

Co-management and co-stewardship agreements between Tribes in the Kuskokwim (and throughout Western Alaska) and NMFS would represent one step toward dissolving the management silos that prevent comprehensive, gravel-to-gravel salmon stewardship. In the years between their hatching from eggs in the gravel to returning to natal streams to lay their own eggs, Kuskokwim salmon cross nearly a dozen different management jurisdictions and divisions. The variations in regulations and policy across salmon habitat do not benefit salmon, and they provide significant hurdles for managers and users to effectively pursue EBM.

For example, this analysis is exploring ways in which NMFS and the Council could use time and area closures to minimize the bycatch of Western Alaska chum salmon during a season (June to August) and region (the North Alaska Peninsula) in which they are known to be caught in higher amounts than in other areas of the Bering Sea. These are outlined in Alternative 5 of this analysis. **However, this proposed protective in-season corridor cap is likely to be only partially effective until a similar protective corridor is established in the South Alaska Peninsula (Area M) during the month of June** (see Figure 11). A cross-regional passageway would help Western Alaska chum salmon can pass through this region unharmed so they can to their natal streams and helping rebuild their populations.

Furthermore, though the Area M region extends into federal waters, its management has been delegated to the state. While NMFS and the Council may be required to take management steps in the future, management of the fishery currently rests with ADF&G and the BOF, clearly highlighting the need for a comprehensive, inter-jurisdictional, ecosystem-wide management system. Through co-management partnerships, Tribal entities can bring considerations for a gravel-to-gravel stewardship approach and in co-management partnerships with NMFS, helping to build more consistent management across the North Pacific salmon ecosystem.

KRITFC thus recommends NMFS pursue government-to-government co-management and co-stewardship agreements with Tribes as a step towards the comprehensive, gravel-to-gravel management of Kuskokwim and Western Alaska chum salmon vital to effectively rebuild and sustain their abundance, and to work toward practices of EEJ and EBM in the Alaska region.

8. Additional Data Needs

To fill in knowledge gaps about Kuskokwim chum salmon and inform this analysis and subsequent action, KRITFC recommends the pursuit of:

- The development of an annual chum salmon run reconstruction.
- Additional salmon spawner abundance monitoring, including the Tatlawiksuk River weir and Aniak River sonar.
- Additional salmon smolt abundance and outmigration monitoring.
- The establishment of escapement goal ranges aimed at rebuilding, and not just sustaining, chum salmon abundance across multiple tributaries of the Kuskokwim.
- Innovative and alternative means of spawner assessment, including drone- and camera-based imagery and environmental DNA (eDNA) collection, which improve spawner abundance estimates. Research using these methods are currently underway through partnerships between KRITFC and Washington State University (drone- and camera-based spawner

assessments), and KRITFC and University of Alaska Fairbanks, ADF&G, and USFWS (eDNA).
- Freshwater and marine salmon habitat assessments and remediation, and environmental assessment data collection.
- Refinement and consistency of chum salmon bycatch and intercept stock groupings and age-at-catch information.
- Sustained funding and staff capacity to operate these projects and meet data needs.

Additionally, KRITFC would like to highlight the following ongoing research projects which have the potential for improving genetic stock resolution for WAK chum salmon populations and improving real-time chum salmon bycatch avoidance in the Bering Sea:
- A project led by Dr. Wes Larson at NOAA's Auke Bay Lab is exploring the feasibility of using genomic methods (whole genome resequencing) to improve resolution of stock structure. If successful, this newly developed tool would allow for more precise estimation of bycatch impacts in drainages across western Alaska (see Attachment 1).
- A project led by Dr. Curry Cunningham and Dr. Joe Langan at UAF is utilizing quantitative methods such as machine learning to develop much more comprehensive distribution models for western Alaska chum salmon that integrate environmental variables. The goal of this project is to better understand the distribution of western Alaska chum salmon and what processes influence this distribution to provide more accurate data to the fleet that can be used to attempt to minimize bycatch of this stock (see Attachment 2).
- The Bristol Bay Science and Research Institute is investigating real-time genetic analysis of chum salmon bycatch in the inshore sector during the B-season of the pollock trawl fishery (see Attachment 3; BBSRI 2023; BBSRI 2024).

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Attachment 1: Project Summary: Genomics for Chum Salmon Stock Identification

Contact: Wes Larson (wes.larson@noaa.gov)

Project summary: Chum salmon runs in Western Alaska have declined dramatically over the past few years, resulting in widespread fisheries closures. It is important to understand all sources of mortality for these stocks to ensure that they can recover as effectively as possible. Chum salmon from western Alaska are primarily intercepted in two marine fisheries before reaching their natal rivers: (1) as bycatch in the Bering Sea pollock fishery and (2) as targeted harvest in South Peninsula salmon fisheries. Genetic data from both fisheries is currently analyzed, but chum salmon from Western Alaska can only be assigned to large stock groups, with the Coastal Western Alaska group including many drainages (Norton Sound, Lower Yukon, Kuskokwim, Nushagak, and other smaller drainages). Improved resolution of stock structure could eventually allow managers to estimate the stock-specific impacts of harvest at a much finer scale.

This project will use whole genome sequencing to create a baseline of genetic diversity by genotyping millions of markers in approximately 80 populations across western Alaska (most tissue samples already available from ADF&G archives) then using that high-resolution baseline to assign unknown individuals back to their population of origin. Whole genome sequencing allows researchers to genotype orders of magnitude more genetic markers than previous techniques, which should greatly increase resolution for differentiating stocks. This work will be guided by local and Indigenous knowledge in the region. Knowledge holders can help identify populations that can be distinguished by outward characteristics, interpret the geographic patterns in genetic structure, and highlight ways in which this information could eventually be used in management. This novel approach represents our best chance to use genetics to solve the longstanding challenge of stock identification for western Alaska chum salmon.

The reporting groups in Western Alaska that are possible to define with the current marker panel are: Kotzebue Sound, Middle Upper Yukon (Yukon Fall run), Upper Kuskokwim, and Coastal Western Alaska (includes Norton Sound, Lower Yukon, Lower Kuskokwim, Nushagak and most of Bristol Bay). With the proposed effort we anticipate that at minimum we will be able to differentiate Norton Sound. We also anticipate being able to differentiate the Lower Yukon from the rest of Coastal Western Alaska. Additionally, we expect to be able to differentiate other fine-scale groups such as the middle Kuskokwim or the Togiak area (e.g., similar groups are possible in Chinook). We hope to be able to differentiate the Lower Kuskokwim and Goodnews Bay from the Nushagak but it is difficult to postulate whether or not that will be possible. Once reporting groups are defined, we will work with fisheries biologists, local knowledge holders, and leadership at state and federal agencies and tribal entities to determine the best course of action for integrating the whole genome stock identification tool into management.

Attachment 2: Project Summary: Stock-Specific Modeling of Bering Sea Chum Salmon

Contact: Curry Cunningham (cjcunningham@alaska.edu)

Project summary: Recent returns of chum salmon have been poor throughout their range in Alaska. This trend is particularly problematic in western Alaska, where record low chum salmon runs, compounded by low return abundance of Chinook salmon, have threatened a vital component of subsistence food security. While many factors influencing the abundance of western Alaska chum salmon (e.g. trophic interactions, climate and ocean conditions) likely cannot be controlled, mitigating the impacts of prohibited species catch in the US walleye pollock fishery presents a significant opportunity to minimize unnecessary mortality. Prohibited species catch of chum salmon has increased substantially during the past decade, with incidental harvest exceeding 500,000 fish in 2021. Concerns about the impacts of these incidental chum (and Chinook) salmon catches resulted in petitions from regional Tribal organizations for the closure of the 2022 pollock fishery and implementation of a quota for chum salmon prohibited species catch. However, it remains unclear how the spatial distribution of western Alaska chum salmon compares to stocks from other regions (e.g. Asia) and if this vulnerable metapopulation can be avoided by altering spatial or temporal patterns of fishing effort.

In order to address this pressing issue, the proposed research seeks to leverage genetic stock identification efforts focused on salmon caught as prohibited species catch in the Eastern Bering Sea to construct stock-specific spatial distribution models for chum salmon during the fishing season. Two separate model structures will be explored to describe: I) the total PSC rates of chum salmon and II) the stock composition of chum salmon PSC. A wealth of data exists that could be used to parameterize stock-specific distribution models for salmon in the Bering Sea. In addition to the data used to develop haul-level estimates of stock composition, this includes environmental data collected by NOAA and other organizations from in situ observations and remote sensing, data on the number and location of salmon caught as PSC, and age and length data for genotyped individuals. A number of modeling approaches able to characterize spatial correlation and spatiotemporal abundance patterns will be considered for model I, including generalized additive models (GAMs), vector autoregressive spatiotemporal (VAST) models, and spatiotemporal conditional autoregressive (STCAR) models, to determine which is best suited for modeling chum PSC data (1991-2021).

The development of haul-level estimates of chum salmon PSC stock composition, with accurate propagation of the uncertainty in the posterior probabilities of individual stock assignments, will allow for descriptive analyses of past PSC rates across both space and time. Chum salmon PSC in the Bering Sea pollock fishery has been increasing since the early 2010s and seasonal patterns are often punctuated by short, and thus far unpredictable, periods of high catches. This project will generate a new understanding of the stock composition of these PSC patterns and clarify where, when, and to what degree WAK chum salmon have been impacted by pollock fishing activities. Beyond such management insights, characterization of the stock compositions encountered by various fishing events will provide a window into the spatial ecology of chum salmon and how different stocks interact in the marine environment. Results of the descriptive analyses will also inform the structure of the spatiotemporal models developed to predict patterns of chum salmon PSC across the Eastern Bering Sea continental shelf within and among years.

Although the ability of the constructed models to explain nuanced spatiotemporal PSC patterns, and potentially link them to environmental conditions, will need to be determined based upon the nature of the available data, the results will represent a large step forward in understanding and mitigating PSC impacts on WAK chum salmon. Furthermore, the nature of the limitations of these models caused by data availability can be used to inform future genetic stock identification data collection procedures such that predictive capacity can be further expanded. Ultimately, these models will serve as critical tools in understanding the marine ecology of chum salmon and supporting the subsistence harvest that is vital to the food security and culture of western Alaska.

Attachment 3: Project Summary: Western Alaska Chum Salmon Bycatch Assessment in the Inshore Bering Sea Pollock Fishery[12]

Contact: Jordan Head (jordan@bbsri.org)

Project Summary: The Bristol Bay Science and Research Institute (BBSRI) plans to conduct a research project to quantify the stocks of origin of the chum salmon caught in the inshore pollock B-season in 2024 and 2025. The work is funded by a direct Legislative Grant from the State of Alaska, BBSRI, and Coastal Villages Region Fund (CVRF). Chum salmon will be sampled at shoreside processing plants in Dutch Harbor and Akutan and analyzed at a Dutch Harbor based genetics lab run by BBSRI personnel. The goal of the project is to demonstrate the feasibility of providing weekly estimates of the stock-specific chum bycatch to industry, fisheries managers, and stakeholders. The information from the project will provide more timely information than the current annual estimates that are typically provided ~8-10 months following the fishing season. Given greater samples sizes needed for weekly estimates, the project will provide additional temporal and spatial resolution of when and where Western Alaska chum salmon are caught in the fishery. The work will use widely accepted salmon genetic research methods, and the stock of origin "reporting groups" will mirror those currently provided to the North Pacific Fishery Management Council by NOAA's genetics laboratory under the direction of Drs. Wes Larson and Patrick Barry. BBSRI will work closely with NOAA personnel and this project will augment (and not replace) the work done by its lab. NOAA will produce the stock composition estimates for this project and both organizations will work together to generate in-season and postseason reports

Project Goal: Produce weekly in-season estimates of the stock-specific chum salmon bycatch in the inshore B-season Bering Sea pollock fishery in 2024 and 2025.

Project Objectives:

- Sample chum salmon from processing plant landings for scales (age), Sex, Length, and fin tissues in proportion to the catch during the B-season pollock fishery.
- Use standard genetic analysis methods using Single-Nucleotide-Polymorphisms (SNPs) to provide stock-specific estimates of the origins of chum salmon caught in the Pollock fishery on a weekly basis from June through September or October 2024 and 2025.
- Age chum salmon to estimate the age-specific catch of chum salmon in the Pollock fishery in 2024 and 2025.
- Determine whether this type of project could provide adequate information to support voluntary or regulatory measures to reduce the number of Western Alaska chum salmon.

BBSRI will work closely with ADF&G, NOAA, industry, and regional stakeholders to accomplish the objectives above. In 2024, project results will not be made public during the season to provide time to master any challenges we expect in the first year of a project of this nature, but all results will be provided in the annual report. If all logistical challenges can be

[12] This project summary has been adapted from BBSRI 2023 with permission from BBSRI. An update from the 2024 project season can be found at BBSRI 2024.

addressed in 2024, our current expectation is that 2025 results will be made public as they are obtained within the season.

Timeline:

- October 2023 – May 2024
    - Project planning and preparation.
- June – October 2024, 2025
    - Sample the Bering Sea inshore pollock B-season and, with NOAA's collaboration, produce weekly estimates of stock-specific and age-specific chum salmon bycatch.
- September 2024 – May 2025
    - Update to the NPFMC in October and/or December 2024
    - Prepare the annual report. Prepare for the 2025 season.
- October 2025 – February 2026
    - Update to the NPFMC in October and/or December 2025
    - Prepare final report.

Benefits of this work:

- *Timeliness of information* – This project will provide weekly estimates within the days following the week that chum salmon are captured.
- *Facilitate meaningful communication among stakeholders* – Project results will dramatically shorten the 8- to 10-month period between when the chum salmon are caught, and when results are available. Currently, only raw chum catch is available to industry and upriver users during the fishing season. The lag to stock of origin stifles information-rich dialogue. Project results will facilitate informed conversations among industry, managers, and Western Alaska residents.
- *Greater temporal and spatial resolution of the origin of chum bycatch* – This project will analyze up to 3 times as many fish as is currently done. The existing NOAA program produces annual estimates by 2 or 3 temporal strata and limited single-season spatial strata. Greater numbers analyzed will facilitate a better understanding of the temporal and spatial distribution of Western Alaska chum salmon caught in the inshore pollock fishery than is currently available. Whether this information is used and in what ways to manage fishing effort in-season will only be known once obtained and considered. For example, if there is little spatial or temporal homogeneity, the utility to inform fishing effort locations will be less than if there is heterogeneity in space or time and Western Alaska salmon catch can be predicted and/or detected in time to assist the industry with avoiding W. Alaska chum salmon.

Notes: This project is not intended or expected to inform or affect day-to-day fishing vessel movements. Rather, this project is designed to simply provide weekly accounting of stock-specific chum bycatch. Cumulating weekly Western Alaska chum catches across the season from generalized areas will keep the industry informed as to the degree of harvest within a given season and such information might affect the behavior of the fleet in some limited ways.

Tanana Chiefs Conference

Appendix 8-1: Communities in our Region

November 1, 2024

This report was compiled with Traditional Knowledge contributions from the Tribes within the Tanana Chiefs Conference Region.

Krystal Lapp, Natural Resource Policy Analyst, Tribal Resource Stewardship Division

Cooperating Agency for the Environmental Impact Statement Bering Sea Chum Salmon Bycatch Management

Introduction

Overview of Our Region

Tanana Chiefs Conference (TCC) is an Alaska Native non-profit organization, also organized as Dena' Nena' Henash, meaning "Our Land Speaks." It represents 42 member communities, including 39 villages, and 37 federally recognized tribes in the Interior Alaska region. Our region is an extensive area of about 235,000 square miles, comprising roughly 37% of the state. Tanana Chiefs Conference is subdivided into six subregions: Yukon Koyukuk, Yukon Tanana, Lower Yukon, Upper Kuskokwim, Yukon Flats, and Upper Tanana. Each community within these subregions holds unique cultural, environmental, and social attributes that reflect the deep-rooted heritage of the Alaska Native peoples living there.

Purpose of this Report

Understanding and sharing the stories of the communities within the Tanana Chiefs Conference (TCC) region offers a window into the unique attributes and deep cultural heritage of the Alaska Native Tribes that call this area home. These communities, spanning across interior Alaska’s vast and varied landscape, embody resilience, unity, and a profound connection to the land. Their subsistence practices—encompassing hunting, fishing, and gathering—are not only essential for survival but serve as a testament to their dedication to preserving traditional knowledge and sustaining cultural identity. By highlighting these aspects, readers can appreciate the communities’ strengths and the innovative initiatives that support their self-determination, such as renewable energy projects and community-driven development efforts. This understanding underscores both the enduring legacy and the modern-day challenges these Tribes navigate, offering a richer perspective on their commitment to blending tradition with progress.

Our History

While Tanana Chiefs Conference was not officially formed until 1962, the history of how our organization came to be can be dated back over one hundred years, when tribal Chiefs from throughout the region banded together to protect their native land rights, an issue that has continued after Alaska's statehood in 1959 and is still relevant today.

Our Story[1]

In 1915, tribal Chiefs from throughout the region banded together to protect their native land rights. The Chiefs organized a meeting with the Government to protect a burial ground in Nenana from the Alaska Railroad. Present at that meeting were representatives from Tanana (or Ft. Gibbon), Crossjacket, Tolovana, Minto, Chena, and Salchaket, as well as Judge James Wickersham.

This meeting signified the beginning of a formal relationship with Athabascan Tribes and the United States Government. The Chiefs clearly expressed their priorities: to sustain the villages through employment, education, health care, lands protection, and specifically to protect access and management of tribal hunting and fishing resources. At the meeting, Julius Pilot of Nenana demanded the Chiefs receive notice of all federal actions which impact the tribes.

Becoming Tanana Chiefs Conference

Land conflicts became an increasing problem and statehood in 1959 only enhanced the threat to Native land interests. Although the Alaska Statehood Act recognized Native land rights, the State quickly put forward plans for projects that would have severely damaged Native land interests. In response, Al Ketzler, Sr. of Nenana helped organize a meeting of 32 villages at Tanana in June 1962. Tanana Chiefs Conference in its modern form was born out of this meeting, although it was not formally incorporated until 1971.

Acting as the conference's first president, Ketzler organized a statewide coalition of Alaska Native leaders that resulted in Secretary of the Interior Stewart Udall freezing State land selections in 1966 until Native land claims were settled. After an historic struggle in which Ketzler and dozens of other Alaska Natives lived in Washington D.C. for weeks, Congress authorized

[1] This section is based on content from our official website to ensure an accurate and authentic representation of our communities and their unique attributes. https://www.tananachiefs.org/about/our-history/

a settlement of more than 44 million acres and nearly $1 billion to Alaska Natives through a corporate structure.

Alaska Native Claims Settlement Act (ANCSA)

The Alaska Native Claims Settlement Act (ANCSA) of December 1971 set up 13 regional for-profit corporations for Alaska Natives and nearly 200 village corporations. TCC incorporated Doyon, Limited as its regional for-profit corporation. ANCSA left a place for non-profit corporations to administer health and social service programs for the people, which TCC filled.

Early on, TCC developed a regional health authority to deliver Tribal health services. TCC acted quickly when the Indian Self Determination and Education Assistance Act of 1975 allowed it to become the regional provider for dozens of Bureau of Indian Affairs (BIA) programs. Also known as Public Law 93-638 or PL 638, this Act allowed Indian Tribes or Tribal consortiums to contract with the federal government to provide Indian program services directly to their own Tribal members.

Under PL 638, TCC contracted with the BIA to manage and deliver services such as housing, lands management, Tribal government assistance, education and employment, and natural resources management. TCC also contracted with the Alaska Area Native Health Service to provide services such as Community Health Aide, outreach, environmental health, mental health, and substance abuse counseling.

Tanana Chiefs Today

In an effort to preserve traditional Athabascan culture and to utilize the knowledge of the region's Elders, TCC established the office of the Traditional Chief within its corporate structure. The Traditional Chief, and the Second Traditional Chief in his absence, sits as an ex-officio (or non-voting) member of TCC's Board. The Traditional Chief also serves as an ambassador of traditional knowledge and the Athabascan culture. TCC remains committed to the principles of leadership, advocacy, and Athabascan and Alaska Native culture that were initiated in their modern sense by the Tanana Chiefs generations.

Our Vision

Healthy, Strong, Unified Tribes

Our Mission

Tanana Chiefs Conference provides a unified voice in advancing sovereign tribal governments through the promotion of physical and mental wellness, education, socioeconomic development, and culture of the Interior Alaska Native people

Our Leadership[2]

Tanana Chiefs Conference works under the leadership and guidance of our Full Board of Directors, Executive Board, Health Board, and Traditional Chiefs. Each play an important role in shaping the organization, guiding its direction and ensuring that TCC's vision is in alignment with our tribes and tribal members.

[2] More information on TCC Leadership can be found on our website: https://www.tananachiefs.org/about/our-leadership/

Communities of Our Region

Within our region are six subregions:

Lower Yukon Subregion
- Anvik
- Grayling
- Holy Cross
- Shageluk

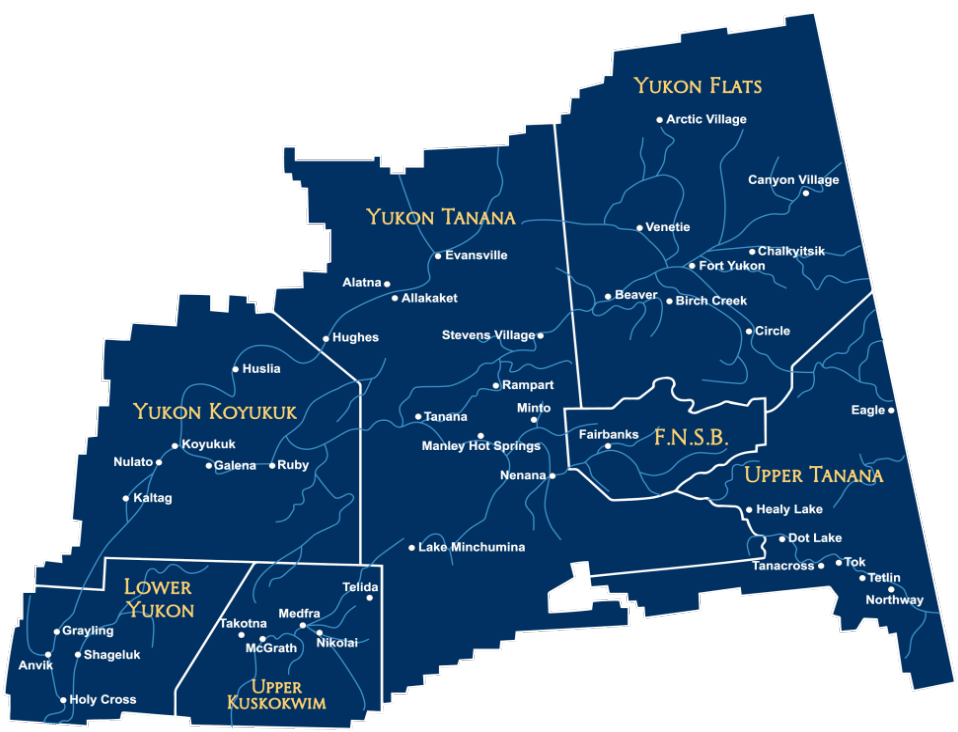
Upper Kuskokwim Subregion
- McGrath
- Medfra
- Nikolai
- Takotna
- Telida

Upper Tanana Subregion
- Eagle
- Dot Lake
- Healy Lake
- Northway
- Tanacross
- Tetlin
- Tok

Yukon Flats Subregion
- Arctic Village
- Beaver
- Birch Creek
- Canyon Village
- Chalkyitsik
- Circle
- Fort Yukon
- Venetie

Yukon Koyukuk Subregion
- Allakaket
- Galena
- Huslia
- Kaltag
- Koyukuk
- Nulato
- Ruby

Yukon Tanana Subregion
- Alatna
- Evansville
- Hughes
- Lake Minchumina
- Manley Hot Springs
- Minto
- Nenana
- Rampart
- Stevens Village
- Tanana



Languages of Our Region

The Tanana Chiefs Conference (TCC) region is linguistically diverse, reflecting the rich cultural heritage of the Alaska Native communities across interior Alaska. The primary languages spoken in this region include various Athabascan languages, which are part of the larger Na-Dené language family. These languages have been passed down through generations and remain central to the identity and cultural practices of the people.

These languages are more than just modes of communication; they embody cultural values, traditions, and worldviews. Efforts to revitalize and sustain these languages are active, with communities emphasizing education, language programs, and intergenerational teaching to keep their linguistic heritage vibrant and resilient

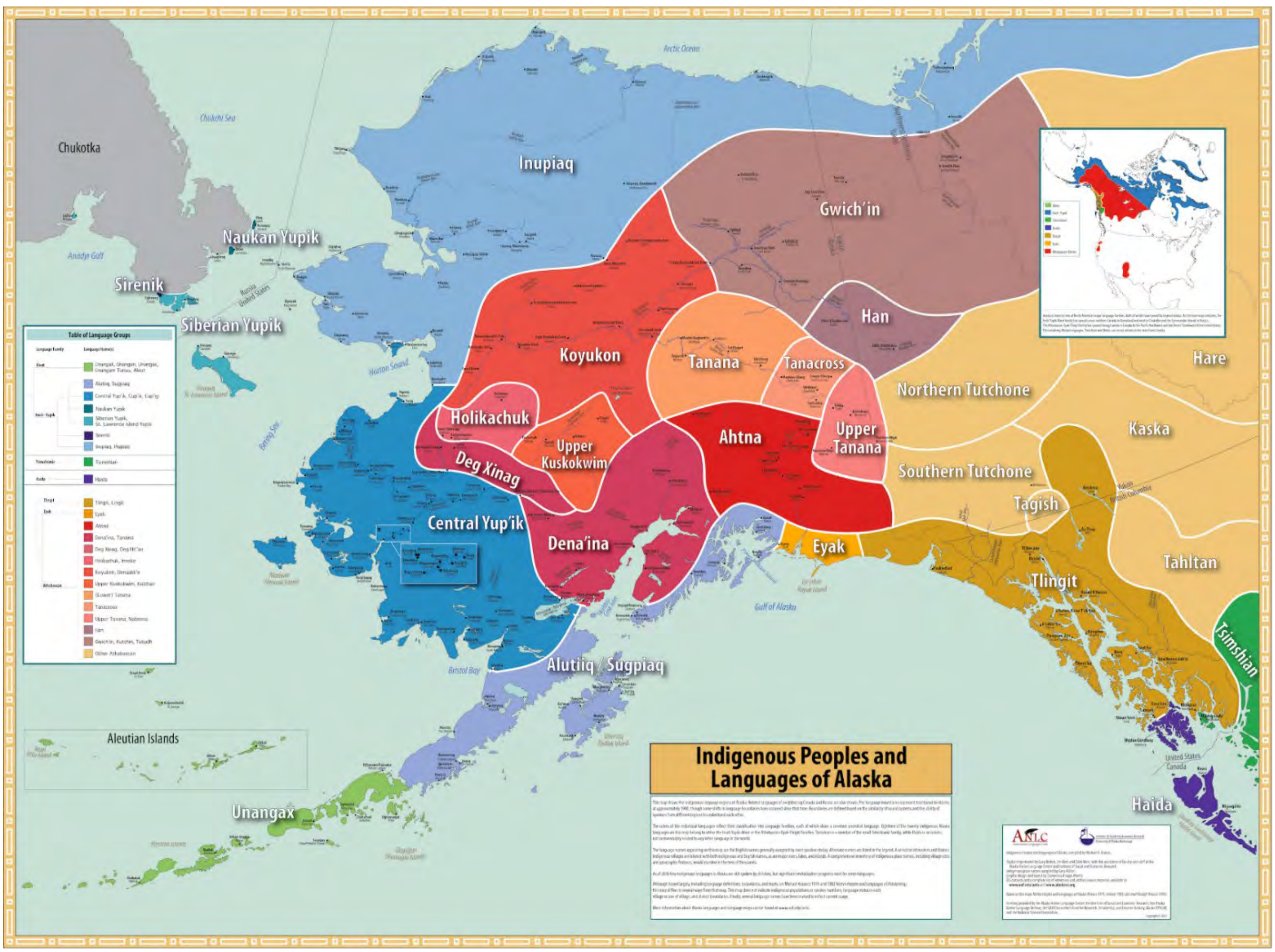


Figure 1: Map Credit: https://www.uaf.edu/anla/collections/map/

Name	Chinook Salmon	Chum salmon
Common	King Salmon	Dog Salmon
Scientific	Oncorhynchus tshawytsha	Oncorhynchus keta
Central Yupik	taryaqvuk	teggmaarrluk
Deg Hit'an	ggath	nalay
Holikachuk	ggath	nalay
Koyukon	gal	nulaga
Lower Tanana	gath or gał	nulaghi, gath or k'edenadlyoyi
Middle Tanana	łuuge che'e	nuleghi
Tanacross	łuug delt'el chox	*
Upper Tanana	ts'ernah'	*
Ahtna	łuk'ece'e	luk'ae seyi
Gwich'in	luk choo	khii
Han	tr'ojà', łuk cho	tth'ay
Northern Tutchone	gyo	thí'
Southern Tutchone	gyü	thí'
Tagish	gēs	*
Tlingit	t'á	tíł'
Kaska	gēs	*

* = name not available

Figure 2: Yukon River Salmon Agreement Handbook, https://www.yukonriverpanel.com/publications/yukon-river-salmon-agreement/

The Lower Yukon Subregion

The Lower Yukon Subregion of the Tanana Chiefs Conference (TCC) region is composed of communities such as Anvik, Grayling, Holy Cross, and Shageluk. This subregion is situated along the lower stretches of the Yukon River and is characterized by its remote and often rugged terrain. The communities within this subregion have a strong cultural identity rooted in subsistence living, with fishing, hunting, and gathering being integral to their way of life. The river plays a vital role, not just as a source of food and resources, but also as a primary means of transportation and connection among the villages.

Anvik

Anvik, Alaska, is a small Alaska Native village located on the west bank of the Yukon River in the Yukon-Koyukuk Census Area. It is primarily home to the Deg Hit'an people, who are part of the Athabascan Alaska Native group. The name "Anvik" derives from a native word meaning "bluff" or "high ground," which describes its geographical location above the river floodplain.

Anvik is a small, close-knit community with a population of under 100 residents, reflecting traditional and modern subsistence lifestyles. The village maintains a strong emphasis on preserving cultural heritage while adapting to contemporary changes.

The primary language historically spoken by the Anvik tribe was Deg Xinag, an Athabascan language. Efforts to preserve this language have been made through education and revitalization programs. Traditional storytelling, art, and music are key aspects of cultural expression, serving to pass down oral histories and values from one generation to the next.

The Anvik community largely relies on subsistence activities, including fishing, hunting, and gathering. Salmon fishing is particularly significant, given the village's proximity to the Yukon River. Moose, caribou, and various small game are also hunted, supplementing the diet and supporting community bonds through shared labor and distribution of resources.

Holy Cross

Holy Cross, Alaska, is a small village situated on the Yukon River, within the Yukon-Koyukuk Census Area. The community is predominantly composed of Alaska Native Athabascan people, specifically the Deg Hit'an subgroup. The village is rich in cultural heritage and traditional practices, while also incorporating modern elements into their way of life.

Holy Cross is home to a population of fewer than 200 residents, maintaining a close-knit environment where family and community ties are essential. The village operates with a strong communal spirit, and most residents are connected through kinship or shared heritage.

The primary language historically spoken by the Alaska Native people of Holy Cross is Deg Xinag, one of the Athabascan languages. Although English is more commonly spoken today, efforts to revitalize the language continue through educational programs and cultural workshops. The community holds traditional practices such as storytelling, dancing, and drumming, which play a significant role in passing down cultural values and history.

The lifestyle in Holy Cross is heavily rooted in subsistence activities, including hunting, fishing, and gathering. The Yukon River provides ample opportunities for fishing, especially salmon, which is vital to the community's diet and traditions. Additionally, hunting for moose and smaller game, as well as berry picking, are essential activities that support the residents’ food security and cultural practices.

Grayling

Grayling, Alaska, is a small Alaska Native village located along the Yukon River in the Yukon-Koyukuk Census Area. The community primarily consists of the Holikachuk, an Athabascan group, with some Deg Hit'an influences. The residents of Grayling continue to practice their cultural traditions while adapting to contemporary developments.

Grayling has a small population, typically fewer than 200 people. The community maintains strong familial and social ties, which are essential to the residents' way of life. Social cohesion is emphasized through shared activities and cooperative efforts.

The Holikachuk language, historically spoken in Grayling, is part of the Athabascan language family. While the language has become less commonly spoken over time, efforts to document and revitalize it are ongoing, often involving cultural programs and educational initiatives. Oral storytelling, dance, and traditional music play a significant role in preserving the community's heritage and teaching younger generations about their roots.

The residents of Grayling rely heavily on subsistence activities such as fishing, hunting, and gathering. Salmon fishing on the Yukon River is particularly important for food security and cultural practices. The community also engages in hunting moose, caribou, and smaller game, and gathering berries and other local plant life. These practices not only provide sustenance but also reinforce social bonds and teach essential survival skills.

Shageluk

Shageluk, Alaska, is a small Alaska Native village located on the Innoko River in the Yukon-Koyukuk Census Area. It is primarily home to the Deg Hit'an people, part of the Athabascan group, known for their rich cultural heritage and strong community ties. The village embodies a blend of traditional practices and modern adaptations.

Shageluk is a close-knit community with a population of fewer than 100 residents. The village thrives on a shared sense of identity and familial relationships, emphasizing cooperation and mutual support among its members.

The primary language historically spoken in Shageluk is Deg Xinag, one of the Athabascan languages. While English is widely spoken today, there are efforts to revive and teach the Deg Xinag language to preserve the cultural identity of the community. Traditional storytelling, singing, and dancing are important aspects of cultural life, used to transmit values, beliefs, and historical knowledge to younger generations.

The people of Shageluk continue to rely heavily on subsistence practices, which form the backbone of their lifestyle. Fishing, particularly for salmon, and hunting for moose, caribou, and smaller game are essential for food and community bonding. Seasonal activities such as trapping and gathering berries and plants are also significant, providing both nourishment and opportunities for teaching traditional knowledge.

The Upper Kuskokwim Subregion

The Upper Kuskokwim Subregion is an area in Alaska characterized by its cultural and geographical significance, particularly to the Native communities that inhabit the region. This subregion includes villages such as Medfra, Nikolai, Takotna, Telida, and McGrath, and it lies within the larger Yukon-Kuskokwim Delta area, which is defined by its vast river systems and boreal forest landscape. The Upper Kuskokwim Subregion is home to the Upper Kuskokwim Athabascans, an Alaska Native group that has adapted to the subregion's unique environment for generations.

Nikolai

Nikolai, Alaska, is a remote village located in the Upper Kuskokwim Subregion, along the South Fork of the Kuskokwim River. This small Alaska Native community is primarily home to the Upper Kuskokwim Athabascans, who have deep roots in the region and maintain a strong connection to their traditional lifestyle while embracing certain modern practices.

The village of Nikolai has a small population, typically fewer than 100 residents, emphasizing the tight-knit nature of the community. Most residents are connected through familial ties and shared cultural heritage, contributing to a strong sense of identity and communal cooperation.

The primary language of the Upper Kuskokwim people in Nikolai is Dinak'i, a distinct Athabascan language. While English is the dominant language used today, preserving Dinak'i is vital to maintaining the tribe's cultural identity. Language revitalization efforts are present, involving teaching and storytelling sessions aimed at younger generations. These initiatives are crucial for passing down not just linguistic knowledge but the history and traditions embedded within the language.

Subsistence living is central to life in Nikolai. The community relies on the natural environment for food and materials, engaging in activities such as salmon fishing, moose and caribou hunting, and trapping smaller game like beaver and rabbit. The village's location along the Kuskokwim River provides abundant fish, particularly during salmon runs. Gathering berries and other native plants also supports the diet and is used for traditional medicinal purposes. These activities are more than just economic necessities—they reinforce community bonds and the transmission of skills from one generation to the next.

Telida

Telida, Alaska, is a remote and small village located within the Upper Kuskokwim Subregion along the South Fork of the Kuskokwim River. This village is home to the Upper Kuskokwim Athabascan people, who are known for their close ties to their environment, traditional practices, and strong community values. Despite modern challenges, the people of Telida maintain a rich cultural heritage that has been passed down through generations.

Telida is one of the smallest and most remote villages in Alaska, with a population often fluctuating between just a handful of families. This close-knit community is defined by deep-rooted familial relationships and a communal way of life that prioritizes cooperation, mutual support, and shared responsibilities.

The language spoken by the Alaska Native people of Telida is Dinak'i, the Upper Kuskokwim dialect of the Athabascan language family. This language is integral to the identity of the people and is an important means of passing down cultural traditions, oral histories, and communal values. While English is commonly spoken today, language preservation remains a critical focus for the village, supported by elders who teach and share traditional stories and teachings with younger generations.

The lifestyle in Telida is heavily reliant on subsistence activities, which form the cornerstone of daily life. Hunting, fishing, and trapping are essential practices for providing food and resources. The Kuskokwim River is a vital source of fish, particularly salmon, which sustains the community throughout the year. Moose and caribou hunting, along with trapping small game like rabbits and beavers, also contribute significantly to the village's diet and economic resilience. Gathering berries, edible plants, and medicinal herbs from the surrounding forest further supports their subsistence living and maintains traditional knowledge of the land.

McGrath

McGrath, Alaska, is a remote community located at the confluence of the Kuskokwim and Takotna Rivers in the Upper Kuskokwim Subregion. It serves as a cultural and logistical hub for the surrounding villages, including the smaller communities of Telida and Nikolai. McGrath is home to a mix of Alaska Native peoples, predominantly Upper Kuskokwim Athabascans, who have long inhabited the region. The town is known for its strong cultural heritage, resilience, and blend of traditional practices with modern adaptations.

McGrath is a larger settlement compared to other nearby villages, with a population that includes both Alaska Native and non-Alaska Native residents. The community is diverse, though it maintains a strong presence of Upper Kuskokwim Athabascans. The town functions as a service center for the Upper Kuskokwim Subregion, connecting more remote villages to broader economic and social opportunities.

The Upper Kuskokwim Athabascans in McGrath speak Dinak'i, a dialect within the Athabascan language family. While English is widely used, efforts to preserve and revitalize Dinak'i have been an integral part of the cultural landscape. These initiatives often include language workshops, educational programs, and community events that promote speaking and learning the native language. Cultural traditions such as storytelling, which convey the community's history, values, and beliefs, play a crucial role in maintaining the tribe's heritage.

The Alaska Native people of McGrath have deep-rooted traditions that include hunting, fishing, crafting, and ceremonial activities. Subsistence practices remain essential to the community, with activities such as moose and caribou hunting, trapping, and salmon fishing along the Kuskokwim River being cornerstones of daily life. The community also engages in crafting traditional items such as beadwork, woven baskets, and carved objects, which are both practical and symbolic of their cultural identity.

The Upper Kuskokwim people in McGrath maintain a lifestyle heavily focused on subsistence. Fishing is crucial, especially during salmon runs, which provide a significant portion of the community's protein intake. Hunting for moose, caribou, and small game, along with gathering berries and edible plants, supplements the diet and supports traditional medicinal practices. These activities are not only practical for survival but also reinforce social bonds and traditional knowledge, passed down through generations.

Takotna

Takotna, Alaska, is a small and historically significant village situated along the Takotna River, which flows into the Kuskokwim River. The community is located within the Upper Kuskokwim Subregion and is home to a mix of Alaska Native peoples, primarily Upper Kuskokwim Athabascans. Takotna holds cultural, historical, and economic importance for the local population, serving as a representation of both traditional ways of life and the integration of modern influences.

Takotna is a small village with a population that fluctuates around a few dozen residents. The community is composed of Alaska Native Upper Kuskokwim Athabascans and non-Alaska Native residents who contribute to the village's social and economic fabric. This close-knit community is marked by strong familial and social bonds that emphasize cooperation, resilience, and shared traditions.

The primary language of the Upper Kuskokwim people in Takotna is Dinak'i, part of the Athabascan language family. While the language has experienced a decline in everyday use due to the dominance of English, efforts to preserve and revitalize Dinak'i have been ongoing. This includes community gatherings, workshops, and educational programs aimed at teaching the language to younger generations. Storytelling, a significant cultural practice, serves as a vehicle for passing down legends, moral lessons, and historical knowledge.

The Upper Kuskokwim people in Takotna maintain a subsistence lifestyle that has been central to their survival for generations. Fishing, especially for salmon, is crucial during seasonal runs and provides an essential food source. Moose and caribou hunting, trapping of smaller game such as beavers and rabbits, and gathering berries and other native plants contribute to a well-rounded diet and support traditional medicinal practices. These activities not only ensure physical sustenance but also reinforce cultural ties and the transmission of essential skills

Medfra

Medfra, Alaska, is a historically significant, though now largely uninhabited, area in the Upper Kuskokwim Subregion. Located near the Kuskokwim River, Medfra once served as an important gathering and trading location for the Upper Kuskokwim Athabascans, contributing to the region's rich Alaska Native history. Though few people reside there today, the legacy of the Upper Kuskokwim Athabascans and their traditions are deeply intertwined with the history of Medfra. The primary language of the Upper Kuskokwim Athabascans in Medfra was Dinak'i.

The Upper Kuskokwim Athabascans, part of the larger Athabascan language group, were the original inhabitants of Medfra. The area's proximity to the Kuskokwim River made it a valuable location for settlement, subsistence activities, and trade. The river provided essential resources, including fish, waterfowl, and access to various hunting grounds. The landscape, composed of boreal forests and rich ecosystems, supported a sustainable lifestyle centered on traditional hunting, fishing, and gathering.

Today, Medfra is remembered through oral traditions, stories, and the practices carried on by descendants in surrounding communities. It represents an era when Alaska Native knowledge and adaptive strategies were essential for survival, showcasing a blend of traditional life and external influences that continue to shape the cultural identity of the region. The heritage of Medfra remains a cornerstone for understanding the broader narrative of the Upper Kuskokwim Athabascans and their enduring connection to the land and traditions of Alaska.

The Upper Tanana Subregion

The Upper Tanana Subregion is located in eastern Alaska, near the Canadian border, encompassing areas along the Tanana River and its tributaries. This subregion is home to the Upper Tanana Athabascan people, who have lived in the region for thousands of years and maintain a rich cultural heritage intertwined with the land and its resources. The Upper Tanana Subregion includes villages such as Tok, Northway, Tetlin, and Tanacross, each contributing to the area's diverse cultural and social landscape.

Eagle

Eagle, Alaska, is a small community located near the Canadian border along the Yukon River. This area has significant historical importance due to its Alaska Native roots and its role as a trading and transportation hub during the early settlement and gold rush eras. The primary Alaska Native group associated with Eagle is the Hän people, a subgroup of the larger Athabascan language family. The history of the Hän people in Eagle showcases their adaptability, cultural richness, and enduring connection to the land.

The Hän people have inhabited the region surrounding Eagle and the upper Yukon River for thousands of years. Their traditional territory extended into both Alaska and the Yukon Territory in Canada. The area provided a rich environment for subsistence living, with access to fish from the river, game from the surrounding forests, and plant life that supported their way of life.

The Hän people's culture is deeply rooted in the land, with a lifestyle that revolves around fishing, hunting, and gathering. Salmon fishing, in particular, was a vital activity, with fish providing a primary food source and being used for trade. The Hän also hunted caribou, moose, and smaller game, while berries and plant materials were gathered for food and medicinal purposes. These activities were embedded in social customs and spiritual practices that emphasized respect for nature and the interconnectedness of all life.

Traditional knowledge was passed down through storytelling, a key cultural practice among the Hän. These oral histories preserved the values, beliefs, and lessons essential for survival and social cohesion.

The Hän language is a branch of the Athabascan language family and served as a cornerstone of cultural identity. Though English is now predominant, efforts to preserve and revitalize the Hän language have been made through education programs and cultural workshops. Oral traditions, shared by elders, conveyed important aspects of history, spirituality, and cultural values, reinforcing the social fabric of the community.

Healy Lake

Healy Lake, Alaska, is a small, historically significant community located in the eastern interior of Alaska, near the Tanana River and southeast of Fairbanks. This area has been home to the Upper Tanana Athabascans, an Alaska Native group known for their rich cultural heritage, deep connection to the land, and resilient history. The story of the Upper Tanana people in Healy Lake is marked by their traditional subsistence lifestyle, adaptation to external influences, and efforts to preserve their cultural identity.

The Upper Tanana Athabascans have inhabited the region surrounding Healy Lake for thousands of years. The area provided a strategic location due to its proximity to lakes, rivers, and forests, supporting a subsistence lifestyle centered around fishing, hunting, and gathering. The Upper Tanana people were semi-nomadic, moving with the seasons to optimize their use of resources

Dot Lake

The Tribe in Dot Lake, Alaska, also known as the Native Village of Dot Lake, is a federally recognized tribe of the Athabascan Alaska Native peoples. This community is located in the Upper Tanana region, approximately 155 miles southeast of Fairbanks and along the Alaska Highway. Dot Lake serves as an essential residential and cultural hub for its tribal members.

The Dot Lake Tribe is part of the broader Athabascan group, whose ancestors have inhabited central and interior Alaska for thousands of years. Historically, the Athabascan people were semi-nomadic, moving seasonally to follow game, fish, and other resources essential for their survival. The settlement of Dot Lake emerged in the early 20th century and became more established with the construction of the Alaska Highway during World War II. This development brought changes to the community, facilitating increased contact with the outside world while also posing challenges to their traditional way of life.

The Dot Lake Tribe's culture is deeply intertwined with the natural environment. Subsistence activities such as hunting moose, caribou, and small game, fishing for salmon and whitefish, and gathering berries and medicinal plants are integral parts of daily life. These practices are not only vital for physical sustenance but are also culturally significant, reinforcing the community's connection to the land and their ancestral knowledge.

The community places a strong emphasis on oral traditions, storytelling, and traditional songs. These elements are central to passing down cultural practices, histories, and values. Elders hold a revered position within the tribe, serving as keepers of knowledge and guiding younger generations. The Athabascan language, although facing pressures of decline, remains an important part of cultural expression, with efforts in place to preserve and teach it to younger members.

Tanacross

The Tribe in Tanacross, Alaska, known as the Tanacross Village, is an Alaska Native community of the Athabascan peoples located in the eastern interior region of Alaska. Tanacross is situated near the Tanana River, about 12 miles east of Tok, and is part of the Upper Tanana region. This community is marked by its strong cultural traditions, historical significance, and continued commitment to preserving its heritage while navigating modern challenges.

The Tanacross Tribe is historically connected to the Upper Tanana Athabascan people, who have lived in this part of Alaska for thousands of years. Their ancestors followed a semi-nomadic lifestyle, moving seasonally to hunt, fish, and gather resources essential for their survival. The area around Tanacross was known for its abundant wildlife, including caribou, moose, and various fish species, which were critical for the tribe's subsistence.

The modern village of Tanacross became more defined in the early 20th century, particularly during the construction of telegraph stations and later the Alaska Highway in the 1940s. This period brought significant changes, including increased contact with non-Alaska Native settlers and a shift in the tribe's social and economic landscape.

The Tanacross people place a strong emphasis on traditional practices that connect them to their heritage. Subsistence activities, including hunting, fishing, and berry picking, remain central to the community's way of life. These activities not only provide sustenance but also reinforce cultural identity and social bonds. Elders play a vital role in transmitting traditional knowledge and practices, such as crafting tools, building traditional shelters, and using native plants for medicinal purposes.

Language is another key component of the Tanacross Tribe's culture. The Tanacross language is part of the Athabascan language family and has been passed down through generations.

While it faces challenges related to preservation, there are concerted efforts to teach and revitalize the language through educational programs and community initiatives. Storytelling and oral traditions are crucial in teaching younger generations about the tribe's history, beliefs, and values.

Tok

The community of Tok, Alaska, is home to members of the Upper Tanana Athabascan people, though it is not a federally recognized tribe itself. Instead, Tok is part of a region that includes various nearby Alaska Native communities and tribes such as the Tanacross and Tetlin tribes. While Tok serves as a significant population center and hub in the Upper Tanana region, it is often considered an intersection point where several tribal members and cultural traditions converge.

Tok is located at the junction of the Alaska and Glenn Highways, approximately 200 miles southeast of Fairbanks. It has historically been a trading and meeting place for Athabascan groups due to its central location. The area has long been inhabited by the Upper Tanana Athabascan peoples, who have deep connections to the surrounding rivers, forests, and wildlife. These natural resources were critical for traditional subsistence activities such as hunting, fishing, and gathering.

The development of Tok gained momentum during the mid-20th century, particularly with the construction of the Alaska Highway during World War II. This development brought increased accessibility and contact with non-Native populations, influencing the cultural and economic landscape of the area.

Athabascan people in the Tok region maintain a lifestyle that reflects traditional subsistence practices. Activities such as hunting moose and caribou, fishing, and gathering berries and medicinal plants are integral to both daily life and cultural identity. These practices are passed down through generations and reinforce the community's relationship with the land.

Traditional knowledge and storytelling are essential for transmitting cultural values and skills. Elders play a significant role in teaching younger generations about subsistence techniques, spiritual beliefs, and community values. The Upper Tanana language, while at risk of becoming endangered, remains an important part of cultural expression and is being preserved through revitalization efforts and educational initiatives.

Tetlin

The Native Village of Tetlin, Alaska, is a federally recognized tribe of the Upper Tanana Athabascan people. Tetlin is located in the eastern interior of Alaska, approximately 20 miles southeast of Tok and near the Tanana River. The village is surrounded by the scenic wilderness of the Tetlin National Wildlife Refuge, an area rich in diverse ecosystems that have sustained the tribe for generations.

The Tetlin people have inhabited this region for thousands of years, maintaining a close connection to the land and its natural resources. Traditionally, the Athabascan people in Tetlin followed a semi-nomadic lifestyle, migrating seasonally to hunt, fish, and gather plants and berries. The village itself became more settled with the advent of modern infrastructure and increased contact with non-Alaska Native populations, particularly after the construction of the Alaska Highway during World War II.

The name "Tetlin" is derived from an Athabascan word meaning "rock," reflecting the area's geographical features and significance within the community's traditional territory.

The Tetlin tribe's culture is deeply intertwined with subsistence practices that include hunting, fishing, and gathering. Moose, caribou, and various fish species, especially salmon, are staple sources of food. The gathering of berries and edible plants during the summer months also plays an essential role in their diet and traditional medicine.

Oral traditions, storytelling, and the preservation of the Athabascan language are vital to maintaining the tribe's cultural identity. The elders of Tetlin are highly respected and are seen as the keepers of traditional knowledge, passing down skills such as crafting tools, building traditional dwellings, and making clothing from animal hides and furs.

Spiritual beliefs and customs in Tetlin often revolve around a deep respect for nature and a sense of stewardship over the land. Ceremonial practices and seasonal celebrations serve as a means to reinforce these beliefs and bring the community together.

Northway

The Native Village of Northway, Alaska, is a federally recognized tribe that belongs to the Upper Tanana Athabascan people. Situated near the Alaska-Canada border and approximately 50 miles southeast of Tok, Northway is one of the most eastern settlements in the state. This village, positioned along the Northway Airport and the Nabesna and Chisana Rivers, is integral to the cultural fabric of the Upper Tanana region.

Northway, known as Naabia Niign in the Athabascan language, has been home to Alaska Native peoples for thousands of years. The village's location in a resource-rich area has historically supported a semi-nomadic lifestyle, where families would migrate seasonally to hunt, fish, and gather food. The development of Northway accelerated during World War II, with the construction of an airfield and the Alaska Highway, bringing new challenges and opportunities to the community.

The name "Northway" is believed to have originated from a chief or elder named Tetlin Northway, highlighting the village's connection to prominent leaders and traditional governance.

The tribe in Northway maintains a rich cultural heritage centered on subsistence activities. Hunting, fishing, and gathering remain essential components of life in Northway, with moose, caribou, and salmon forming the backbone of the local diet. The seasonal cycle dictates many traditional practices, such as preparing and preserving food for the winter months.

Craftsmanship and traditional skills, including the making of beadwork, sewing garments from animal hides, and building tools, are passed down through generations. These practices are more than utilitarian; they are expressions of cultural identity and pride. Elders play an especially important role in teaching these skills and in sharing stories and oral histories that preserve the tribe's heritage and moral lessons.

The Yukon Flats Subregion

The Yukon Flats subregion is a remote and ecologically rich area within the Tanana Chiefs Conference (TCC) in northeastern Alaska. It encompasses a network of rivers, wetlands, and boreal forests centered around the Yukon River and its tributaries. Home to several Alaska Native Athabascan communities, such as Fort Yukon, Arctic Village, and Venetie, the subregion is characterized by a deep connection to traditional subsistence practices, cultural heritage, and the preservation of language and customs. Despite facing modern challenges like economic limitations and climate change, the communities in the Yukon Flats demonstrate resilience and a commitment to maintaining their way of life while promoting sustainable development and cultural continuity.

Arctic Village

The Tribe of Arctic Village, Alaska, known as the Arctic Village Council, is a federally recognized tribe of the Gwich'in Athabascan people. Situated within the boundaries of the Arctic National Wildlife Refuge (ANWR) and near the eastern Brooks Range, Arctic Village is one of the most northern Alaska Native communities in the United States. This remote village is approximately 100 miles north of Fort Yukon and 250 miles north of Fairbanks, accessible primarily by air and snowmobile in winter. Arctic Village holds deep cultural, environmental, and historical significance for the Gwich'in people who have called this region home for thousands of years.

Arctic Village is part of the Gwich'in Nation, which extends across northeastern Alaska and into parts of Canada's Yukon and Northwest Territories. The Gwich'in people have a long history rooted in a subsistence lifestyle that relies heavily on the natural resources provided by their environment. Historically, they have followed the migration patterns of the Porcupine caribou herd, which remains essential for their cultural, nutritional, and spiritual well-being. The relationship between the Gwich'in and the caribou is profound, with the animal playing a central role in their identity, traditions, and stories passed down through generations.

The Gwich'in language, which is part of the Athabascan language family, is spoken in Arctic Village and is vital to preserving the cultural heritage of the community. Storytelling, songs, and oral traditions are crucial in teaching younger generations about the community's history, ethics, and beliefs.

The people of Arctic Village maintain a strong connection to their land through subsistence activities such as hunting, fishing, and gathering. Caribou hunting is the cornerstone of life in Arctic Village, providing food, clothing, and materials for traditional crafts. The Porcupine caribou herd migrates through the region annually, and the health of this herd is intricately tied to the community's well-being. Additionally, fishing for salmon and whitefish, trapping, and collecting berries and medicinal plants are essential to the village's diet and cultural practices.

Traditional skills such as making clothing from animal hides, creating beadwork, and building traditional dwellings and tools are passed down through the generations. These practices not only meet practical needs but also reinforce the Gwich'in identity and their sustainable relationship with the environment.

Canyon Village

Canyon Village has historically been a seasonal site for the Gwich'in, utilized during specific periods of migration and subsistence activities. The Gwich'in have lived in this region for thousands of years, their lives deeply intertwined with the natural rhythms of the land and wildlife, particularly the Porcupine caribou herd. This relationship is a cornerstone of Gwich'in culture, providing not only food but also clothing and materials for crafting tools and shelters.

Oral traditions and historical accounts suggest that Canyon Village was a strategic location for the Gwich'in, serving as a base for hunting and gathering expeditions. The site was often part of larger networks of seasonal camps and settlements that allowed the Gwich'in to adapt to the harsh subarctic climate and changing availability of resources.

The people of Canyon Village practiced a subsistence lifestyle characterized by caribou hunting, fishing for salmon and whitefish, and gathering berries and other edible plants. Caribou hunting is a particularly vital practice, central to the Gwich'in identity and way of life. The region's proximity to caribou migration routes meant that Canyon Village was an advantageous location for this activity. Other traditional practices included trapping smaller animals such as rabbits and crafting essential items from animal hides and bones.

These activities are not merely economic but are also deeply connected to cultural values, such as respect for the land and sustainable living. Elders have traditionally played an important role in teaching younger generations the skills necessary for survival and the spiritual significance of these practices.

Venetie

The Tribe of Venetie, Alaska, known as the Native Village of Venetie Tribal Government, is a federally recognized tribe of the Gwich'in Athabascan people. Venetie is located in the interior of Alaska, along the Chandalar River, approximately 45 miles northwest of Fort Yukon. This village is one of the most significant Alaska Native communities in the region, known for its deep cultural traditions, commitment to self-governance, and active role in protecting their lands and way of life.

The Native Village of Venetie is part of the broader Gwich'in Nation, whose history in the region spans thousands of years. Venetie was established in the early 20th century by the amalgamation of people from several smaller Gwich'in settlements who sought to centralize their community along the Chandalar River. The region's rich natural resources and strategic location provided ample opportunities for subsistence living, a hallmark of Gwich'in culture.

The Gwich'in have historically maintained a semi-nomadic lifestyle, following the migration of the Porcupine caribou herd, which is central to their cultural, spiritual, and physical sustenance. Venetie, along with other Gwich'in communities, places great cultural and spiritual importance on caribou, considering it a sacred and indispensable part of their identity.

The people of Venetie continue to engage in a subsistence lifestyle, which remains central to their culture and daily life. Hunting, fishing, and gathering provide not only sustenance but also reinforce traditional practices and community cohesion. The Porcupine caribou herd is especially significant, and the well-being of the caribou is directly linked to the spiritual and physical health of the community. Other important subsistence activities include fishing for salmon and whitefish, trapping fur-bearing animals, and gathering berries and medicinal plants.

Cultural preservation in Venetie involves teaching traditional skills such as beadwork, sewing clothing from animal hides, and crafting tools and instruments from natural materials. These activities are passed down through generations, ensuring that younger members of the community maintain a connection to their heritage.

Fort Yukon

The Tribe of Fort Yukon, Alaska, is part of the Gwich'in Athabascan people and is represented by the Native Village of Fort Yukon. Located at the confluence of the Yukon and Porcupine Rivers, Fort Yukon is situated within the Arctic Circle, approximately 145 miles northeast of Fairbanks. The village holds significant cultural, historical, and strategic importance for the Gwich'in people and serves as a central hub for several Alaska Native communities in the region.

The Gwich'in people have inhabited the Fort Yukon area for thousands of years, maintaining a lifestyle closely linked to the land and its resources. Historically, Fort Yukon was a seasonal site for gathering and trading among various Athabascan groups due to its strategic location along two major rivers. The establishment of Fort Yukon as a trading post by the Hudson's Bay Company in the 1840s marked the first permanent non-Native settlement in the region and brought significant changes to the Gwich'in way of life, including increased contact with traders and settlers.

Despite these changes, the people of Fort Yukon adapted by blending traditional practices with new influences, maintaining a strong connection to their cultural roots while engaging in trade and commerce.

The traditional lifestyle in Fort Yukon revolves around subsistence activities, which remain vital to the community's cultural identity and survival. Hunting, fishing, and gathering are cornerstones of life, with the Yukon and Porcupine Rivers providing ample fish, especially salmon and whitefish, and the surrounding forested areas supporting populations of moose and caribou. The Porcupine caribou herd, in particular, holds profound cultural and nutritional significance for the Gwich'in people.

Subsistence activities are not only essential for providing food but also play a role in community cohesion. Skills such as trapping, crafting tools, sewing garments from animal hides, and preparing traditional foods are passed down from elders to younger generations. These practices reinforce the values of sustainability, respect for nature, and the importance of communal support.

Chalkyitsik

The Tribe of Chalkyitsik, Alaska, represented by the Chalkyitsik Village Tribal Government, is a federally recognized tribe of the Gwich'in Athabascan people. Located in northeastern Alaska along the Black River, approximately 50 miles northeast of Fort Yukon, Chalkyitsik is a remote village characterized by its deep-rooted cultural traditions and commitment to preserving its way of life amidst the challenges of modernity and environmental change.

Chalkyitsik, which means "place of fish" in the Gwich'in language, has been inhabited by the Gwich'in people for thousands of years. The village's name reflects its historical significance as a place abundant with fish and wildlife, critical to the survival and sustenance of its inhabitants. The Gwich'in have long practiced a semi-nomadic lifestyle, closely following the migration patterns of animals and seasonal availability of natural resources.

This region, rich in rivers, lakes, and forested areas, has been vital for hunting, fishing, and gathering. Chalkyitsik's strategic location along the Black River made it an essential site for the Gwich'in, who utilized its resources for food, clothing, and trade. The area served as a meeting place for families and groups, facilitating social interactions and reinforcing cultural practices.

The people of Chalkyitsik maintain a subsistence lifestyle deeply connected to the land. Hunting, fishing, and gathering remain integral aspects of life in the village, with moose, caribou, and fish being primary sources of food. The Porcupine caribou herd holds special significance for the Gwich'in people, and the well-being of this herd is directly tied to the community's cultural and physical survival. Fishing for species such as salmon and whitefish, as well as trapping and gathering berries, adds to the dietary and economic sustenance of the village.

Traditional crafts, such as sewing clothing from animal hides and creating beadwork, are passed down from generation to generation. These activities are more than practical—they reinforce cultural identity, skills, and values. The Gwich'in practice a deep respect for the land and animals, guided by a belief in sustainable use and stewardship to ensure that resources are available for future generations.

Circle

The Tribe of Circle, Alaska, is represented by the Circle Native Community, a federally recognized tribe of the Gwich'in people. Circle is a small, historic village located along the banks of the Yukon River, approximately 160 miles northeast of Fairbanks. This remote community has significant cultural and historical importance for the Athabascan people, serving as a testament to their deep connection to the land, traditional lifestyle, and resilience in the face of modern challenges.

Circle, known historically as "Circle City," was initially established as a mining camp in the late 19th century during the gold rush era. It was named Circle because early miners mistakenly believed it was located on the Arctic Circle, though it is actually about 50 miles south of that line. The gold rush brought an influx of non-Native settlers and economic activity to the region, significantly impacting the Alaska Native Gwich'in people who had inhabited the area for thousands of years prior.

Despite these external influences, the Native community of Circle has managed to retain its cultural roots. The village remains a symbol of Athabascan heritage, with traditions that have been preserved and adapted over generations.

The lifestyle in Circle is deeply connected to the natural environment, characterized by a strong emphasis on subsistence activities. Hunting, fishing, and gathering continue to play a vital role in the community's way of life. Moose hunting, fishing for salmon and whitefish, and trapping fur-bearing animals are common subsistence practices that provide food and economic support for the village. Additionally, gathering berries, edible plants, and medicinal herbs helps sustain the community throughout the year.

The transmission of traditional knowledge is essential in Circle, where elders teach younger generations about the skills and cultural practices needed for survival. These include crafting tools from natural materials, sewing garments from animal hides, and creating beadwork and other decorative arts. These skills are not only practical but serve to strengthen cultural identity and reinforce communal bonds.

Birch Creek

The Tribe of Birch Creek, Alaska, represented by the Birch Creek Tribal Council, is a federally recognized tribe. Birch Creek, known in the Athabascan language as "Dendu Gwich'in," is a small and remote village located in the interior of Alaska, approximately 26 miles southwest of Fort Yukon and about 110 miles northeast of Fairbanks. This village, situated along Birch Creek and near the Yukon Flats, is a place rich in cultural history and traditional practices that have been maintained over generations.

The people of Birch Creek are part of the Athabascan Alaska Native group, which has a long history of inhabiting the interior of Alaska. The village's location in the resource-rich Yukon Flats region has historically allowed for a lifestyle centered around seasonal movement to follow game, fish, and plants. Birch Creek served as a vital settlement that provided shelter, sustenance, and a communal gathering point for extended families and neighboring tribes.

The community's history is closely tied to a subsistence-based way of life, rooted in the knowledge of the land and its seasonal cycles. The residents of Birch Creek have adapted over centuries to the harsh climate of the Alaskan interior, using traditional skills and practices passed down through generations.

The traditional lifestyle in Birch Creek is based heavily on subsistence practices, which continue to play a central role in the community's daily life and cultural identity. Hunting, fishing, and gathering are essential activities, with moose, caribou, and fish (particularly salmon and whitefish) being primary food sources. Trapping of fur-bearing animals such as beavers and muskrats also contributes to the economy and provides materials for traditional crafts.

The practice of gathering berries, roots, and medicinal plants during the summer and fall seasons is crucial for sustaining the community throughout the winter. These subsistence activities are more than mere survival strategies; they are culturally significant, reinforcing values of self-reliance, cooperation, and respect for the environment.

Traditional crafts such as beadwork, sewing garments from animal hides, and making tools from natural materials are passed down from elders to the younger generation. These practices are integral to maintaining cultural continuity and fostering a sense of pride and identity among community members.

Beaver

The Tribe of Beaver, Alaska, represented by the Beaver Village Council, is a federally recognized tribe. Beaver is a small, remote village situated on the south bank of the Yukon River, approximately 110 miles northwest of Fairbanks and about 60 miles southwest of Fort Yukon. The community of Beaver, while small, plays a significant role in preserving Athabascan culture and traditions in the Interior of Alaska.

Beaver has been an important settlement for the Athabascan people for centuries. The village was originally established as a seasonal camp used for hunting, fishing, and trapping, which are crucial activities for sustaining the community. The town of Beaver itself was formally established in the early 20th century, largely in response to the construction of a trading post that supported trappers, hunters, and gold prospectors in the area. Despite the changes brought by increased contact with non-Native settlers, the people of Beaver have maintained a strong connection to their cultural roots and traditional way of life.

The village's name, Beaver, reflects the abundance of beaver populations in the area, which have historically been a source of food, fur, and other materials for the community. The location along the Yukon River has provided essential resources and served as a strategic point for trade and travel.

The lifestyle in Beaver is centered around a deep connection to the land and a reliance on subsistence practices. Hunting, fishing, and gathering are integral to the community's way of life, providing both nourishment and a means of preserving cultural identity. Moose and caribou are the primary game animals hunted in the region, while the Yukon River supplies salmon, whitefish, and other fish species. Trapping is also a significant part of life in Beaver, with beaver, lynx, and muskrat being commonly trapped for their furs and meat.

Gathering berries and other edible and medicinal plants during the warmer months is an important aspect of subsistence living and helps sustain the community through the long winter. These practices are passed down through generations, with elders teaching younger community members essential skills such as making clothing from animal hides, creating beadwork, and crafting tools from natural materials.

The Yukon Koyukuk Subregion

The Yukon Koyukuk Subregion is a part of the larger Tanana Chiefs Conference (TCC) and encompasses a vast area of interior Alaska that includes many Alaska Native communities, primarily those of the Athabascan people. This subregion is defined by its remote wilderness, extensive river systems such as the Yukon and Koyukuk Rivers, and a reliance on subsistence activities such as hunting, fishing, and gathering. The communities within this subregion, including villages like Ruby, Galena, and Nulato, maintain a strong cultural connection to the land and are known for their traditional practices, storytelling, and communal lifestyle. Despite facing challenges like economic limitations, geographic isolation, and climate change, the Yukon Koyukuk Subregion exemplifies resilience, cultural preservation, and a commitment to environmental stewardship, with tribal councils advocating for sustainable development and the well-being of their people.

Huslia

Huslia, Alaska, is home to the Huslia Tribal Council**,** which represents the Koyukon Athabascan people. Situated along the Koyukuk River in the Yukon-Koyukuk Census Area of interior Alaska, Huslia is approximately 260 miles northwest of Fairbanks. Known as the "village with a song," Huslia has a deep cultural heritage rooted in traditional Athabascan practices and a strong connection to the land and river systems that have sustained its people for generations.

The Koyukon Athabascan people of Huslia have inhabited the region for thousands of years, relying on the abundant resources of the Koyukuk River and surrounding forested areas for their sustenance and survival. The community developed as a seasonal camp for hunting, fishing, and trapping before becoming more permanently settled. The establishment of the village in the early 20th century was influenced by the movement of families seeking a more stable location that offered better access to fishing and hunting grounds.

Huslia gained recognition during the mid-20th century for producing some of the best dog sled racers in the state, with the community's connection to sled dog mushing becoming an important cultural symbol. This legacy continues to be a source of pride for the residents of Huslia.

The people of Huslia maintain a traditional lifestyle centered on subsistence practices. Hunting, fishing, and trapping are vital for providing food and materials. Moose is a primary source of meat, while fish, particularly salmon and whitefish, are caught from the Koyukuk River and preserved for winter. Trapping fur-bearing animals such as beavers, lynx, and marten is also important, both for traditional use and as a source of income.

Ruby

The Tribe of Ruby, Alaska, represented by the Ruby Tribal Council, is a federally recognized tribe of the Koyukon Athabascan people. Ruby is located on the south bank of the Yukon River, approximately 230 miles west of Fairbanks, and serves as an important cultural and historical settlement in the Yukon-Koyukuk Census Area. Known for its deep-rooted traditions, reliance on the land, and a strong sense of community, Ruby exemplifies the resilience and heritage of the Athabascan people in interior Alaska.

Ruby's origins as a settlement can be traced back to its role as a trading post and a mining camp during the early 20th century gold rush. The influx of miners and traders brought significant changes to the area, but the Alaska Native Koyukon Athabascan people have inhabited this region for thousands of years' prior, living off the land and maintaining a semi-nomadic lifestyle centered around hunting, fishing, and gathering. Despite the impact of the gold rush and the presence of non-Native settlers, the Athabascan people of Ruby preserved their cultural practices and adapted to the changes in their environment.

Ruby is named after the precious stones reportedly found in the area by miners, though the gold rush's initial promise dwindled over time. Today, Ruby stands as a testament to the Athabascan people's ability to sustain their cultural identity through resilience and adaptation.

The community of Ruby maintains a lifestyle deeply connected to the natural environment. Subsistence activities are central to daily life and essential for both nutritional and cultural reasons. Hunting for moose and caribou provides a major source of meat, while the Yukon River supplies salmon and whitefish. Trapping is another important activity in Ruby, with animals such as beavers, minks, and muskrats providing fur and food. The harvesting of berries, edible plants, and medicinal herbs adds to the community's diet and serves traditional medicinal purposes.

These practices are more than just a means of sustenance; they are integral to maintaining the cultural heritage of the Koyukon people. Traditional knowledge is passed down from elders to the younger generation, ensuring the continuation of skills such as crafting tools, making clothing from animal hides, and performing traditional beadwork. These activities reinforce community bonds and reflect values of respect for nature and sustainability.

Galena

The Tribe of Galena, Alaska, is represented by the Galena Village (Louden Tribal Council), which is a federally recognized tribe of the Koyukon Athabascan people. Galena is located on the north bank of the Yukon River, approximately 270 miles west of Fairbanks in the Yukon-Koyukuk Census Area. Known for its strategic location and historical significance, Galena serves as a vital cultural and economic hub for the surrounding Alaska Native communities. The village embodies the rich traditions and resilience of the Koyukon Athabascan people, who have lived in the interior of Alaska for thousands of years.

Galena has long been an important settlement for the Koyukon Athabascan people, who traditionally inhabited the riverine and forested regions of interior Alaska. Historically, the area was used for seasonal hunting, fishing, and gathering camps before becoming a permanent settlement. The arrival of non-Native traders and the construction of a military airfield during World War II brought significant changes to the community. Despite these influences, the Alaska Native people of Galena have maintained a strong connection to their cultural roots, blending traditional practices with modern adaptations.

The village's name, "Galena," originates from the mineral galena (lead sulfide) found in the region. The development of Galena as a trading post and later as a military base played a role in shaping its economy and infrastructure, but the Koyukon Athabascan community has continuously adapted to these changes while preserving their way of life.

Subsistence practices remain central to life in Galena, with hunting, fishing, and gathering playing vital roles in the community's diet and cultural identity. Moose and caribou hunting provide a primary source of meat, while fishing for salmon and whitefish in the Yukon River is essential for sustenance and cultural practices. Trapping of fur-bearing animals such as beavers, lynx, and marten is also important, contributing to both practical use and local commerce.

Gathering berries, edible plants, and traditional medicinal herbs adds to the community's food supply and supports traditional health practices. These subsistence activities are not only practical but hold cultural significance, reinforcing the values of respect for the land, sustainability, and communal sharing.

The skills needed for these activities—such as crafting tools, making clothing from animal hides, and practicing beadwork—are passed down through generations. Elders play a crucial role in teaching these skills, ensuring that the younger members of the community learn the importance of their cultural heritage.

Koyukuk

The Tribe of Koyukuk, Alaska, represented by the Koyukuk Native Village Council, is a federally recognized tribe of the Koyukon Athabascan people. Koyukuk is a small, remote village located at the confluence of the Yukon and Koyukuk Rivers in the Yukon-Koyukuk Census Area of interior Alaska, approximately 290 miles west of Fairbanks. The community of Koyukuk holds deep cultural and historical significance for the Athabascan people, embodying a way of life that has persisted for thousands of years in harmony with the natural environment.

The Koyukon Athabascan people have lived in the interior of Alaska for millennia, relying on the rich resources of the land and waterways for sustenance. The village of Koyukuk served as a strategic location for seasonal camps due to its proximity to the rivers, which provided essential resources for fishing, hunting, and transportation. The area became more permanently settled in the late 19th and early 20th centuries, influenced by the arrival of fur traders and gold prospectors.

Despite these historical shifts, the residents of Koyukuk have maintained their cultural identity and adapted to changes while preserving their traditions. The village's name, derived from the nearby Koyukuk River, underscores the importance of the river system to the community's sustenance and cultural practices.

The lifestyle in Koyukuk is closely connected to the land and the seasons. Subsistence activities such as hunting, fishing, trapping, and gathering are fundamental aspects of life and integral to the village's cultural identity. Moose hunting and caribou provide vital sources of meat, while the Yukon and Koyukuk Rivers supply fish, including salmon and whitefish, which are caught and preserved for winter use. Trapping fur-bearing animals like beavers, lynx, and marten is also important, both for their practical uses and as a means of supplementing income.

Gathering berries and medicinal plants is another key part of the subsistence lifestyle, supporting the community's diet and traditional medicine. These practices are passed down through generations, with elders teaching the younger members of the community essential skills and reinforcing cultural values such as respect for nature, sustainable use of resources, and cooperation.

Nulato

The Tribe of Nulato, Alaska, is represented by the Nulato Tribal Council, a federally recognized body that serves the Koyukon Athabascan people. Nulato is located on the west bank of the Yukon River, approximately 310 miles west of Fairbanks and 58 miles south of Galena. Known for its strong cultural heritage, traditional lifestyle, and resilience, the village of Nulato embodies the values and practices that have sustained the Koyukon people for generations.

Nulato has a rich history that dates back thousands of years as an important settlement for the Koyukon Athabascan people. The village originally served as a seasonal camp and a strategic location for trade and gathering, given its position along the Yukon River. In the 19th century, Nulato became a key site in the fur trade era and saw increased contact with Russian traders and later American settlers. Despite these interactions, the people of Nulato preserved their cultural identity and adapted to changes while maintaining their traditions.

The traditional lifestyle in Nulato is deeply rooted in a subsistence-based economy. Hunting, fishing, and gathering continue to be central to the village's way of life, providing not only food but also cultural and spiritual fulfillment. Moose hunting and caribou are primary sources of meat, while fishing for salmon, whitefish, and other species in the Yukon River is vital for the community's sustenance. The trapping of fur-bearing animals, such as beaver, marten, and fox, is also practiced and provides materials for clothing and economic support.

Gathering berries, edible plants, and medicinal herbs supplements the community's diet and traditional medicine. These activities are essential for maintaining the knowledge and practices passed down through generations, emphasizing respect for nature and sustainable living.

Craftsmanship, including the making of clothing from animal hides, beadwork, and tool crafting, is taught by elders to younger generations, ensuring that the traditional skills of the Koyukon Athabascan people are preserved.

Kaltag

The Tribe of Kaltag, Alaska, is represented by the Kaltag Tribal Council, a federally recognized body serving the Koyukon Athabascan people. Kaltag is located on the west bank of the Yukon

River, approximately 335 miles west of Fairbanks and 75 miles south of Galena. The village has long been a hub for trade, culture, and subsistence activities, embodying the traditions and resilience of the Athabascan people who have lived in the region for thousands of years.

Kaltag's history is deeply rooted in its strategic location along the Yukon River, which has historically served as an important route for trade and travel. The area was used as a seasonal fishing and hunting camp before becoming a permanent settlement. In the 19th century, Kaltag became a key location for trading between interior Alaska Native communities and Russian traders, followed by American settlers during the fur trade era. The name "Kaltag" is derived from a Koyukon Athabascan word that reflects the region's historical and cultural significance.

Despite the impacts of colonization and trade, the Koyukon people of Kaltag have managed to preserve their cultural practices and adapt to changes while maintaining their traditional values.

Subsistence living is central to life in Kaltag, with activities such as hunting, fishing, and gathering forming the foundation of the community's culture and economy. Moose and caribou hunting provide essential meat, while fishing in the Yukon River supplies salmon, whitefish, and other fish species that are preserved for winter. Trapping fur-bearing animals like beaver, marten, and lynx is also common, contributing to the local economy and providing materials for traditional crafts and clothing.

Gathering berries, edible plants, and medicinal herbs is an important seasonal activity that supports both dietary needs and traditional medicine. These subsistence practices are passed down through generations, reinforcing cultural teachings about respect for nature, resourcefulness, and sustainability.

The Yukon Tanana Subregion

The Yukon Tanana Subregion is part of the Tanana Chiefs Conference (TCC) and encompasses a significant portion of interior Alaska. This subregion includes a diverse array of Alaska Native communities, primarily composed of Athabascan tribes. The subregion's communities, such as Minto, Manley Hot Springs, and Nenana, maintain a strong cultural heritage rooted in hunting, fishing, trapping, and gathering. The tribes in this area place great importance on oral traditions, language preservation, and the transmission of traditional knowledge from elders to younger generations. The Yukon Tanana Subregion is characterized by a deep respect for the land and sustainable living practices, reflecting the Athabascan belief in environmental stewardship.

Evansville

The Tribe of Evansville, Alaska, also known as the Evansville Tribal Council; Evansville is a small, remote village located near Bettles in the interior of Alaska, approximately 180 miles northwest of Fairbanks. This village is unique due to its close proximity to the Brooks Range and its connection to the historical and cultural life of the Athabascan people who have inhabited the region for generations.

Evansville's history is deeply rooted in the traditional practices and seasonal movements of the Koyukon Athabascan people. The area has historically served as a vital site for hunting, fishing, and gathering, with a rich landscape that provided resources essential for subsistence living.

The development of Evansville in the mid-20th century was influenced by its strategic location near Bettles, which acted as a supply hub during the construction of the oil pipeline and supported activities related to aviation and trade.

Despite external influences and changes brought about by development projects, the residents of Evansville have maintained a strong connection to their cultural roots and traditional lifestyle.

The traditional lifestyle in Evansville, like many other interior Alaska communities, revolves around subsistence activities. Hunting, fishing, and gathering are essential for providing food and maintaining the cultural fabric of the community. Moose and caribou are important sources of meat, while fish such as salmon and whitefish are harvested from local rivers and preserved for winter use. Trapping fur-bearing animals like beaver, marten, and lynx also plays a role in the local economy and provides materials for clothing and crafts.

Gathering berries and edible plants, as well as preparing traditional medicines, supports the dietary and health needs of the community. These subsistence activities are not only practical but also imbue a sense of identity and continuity, emphasizing the importance of living in harmony with nature. Elders play an essential role in teaching these practices, ensuring that traditional knowledge is passed down to younger generations.

Alatna

Alatna, Alaska is a small, rural community located on the Koyukuk River, within the boundaries of the Arctic Circle. The village is closely associated with the Alaska Native Koyukon Athabascans, who are part of the broader Athabascan linguistic and cultural group native to Alaska and western Canada.

he Koyukon Athabascans, who make up the primary Alaska Native group in Alatna, have lived in the region for thousands of years. They are descendants of the early inhabitants who migrated across the Bering Land Bridge and settled in interior Alaska. Alatna was traditionally a seasonal encampment used by the Koyukon people for fishing, hunting, and trapping, crucial for their subsistence lifestyle. The strategic location near the Koyukuk River facilitated easy access to resources such as salmon and game.

The traditional language of the Alatna community is Koyukon, a Northern Athabaskan language. While English is widely spoken today, efforts have been made to preserve and revitalize the Koyukon language through educational and cultural initiatives. Alatna is situated on the south bank of the Koyukuk River, opposite the village of Allakaket. The surrounding environment is characterized by boreal forests, tundra, and river systems. Winters are extremely cold, with temperatures often plunging below -40°F, while summers bring long daylight hours and milder temperatures.

Allakaket

Allakaket, Alaska, is a village with a rich cultural history and heritage tied to the Koyukon Athabascan people, who have inhabited the region for thousands of years. The community is located on the banks of the Koyukuk River, near its confluence with the Alatna River, and lies within the Arctic Circle. The Alaska Native Koyukon Athabascans, the primary inhabitants of Allakaket, have lived in the region since time immemorial. The Koyukon people are one of the eleven distinct Athabascan groups in Alaska, traditionally semi-nomadic, adapting their movement and lifestyle to the seasonal availability of resources. The village became more formalized in the early 20th century when a mission was established by the Episcopal Church.

This development led to a more permanent settlement structure, consolidating the Koyukon people and providing a base for interactions with European and American settlers.

The traditional language spoken by the Koyukon Athabascans of Allakaket is Koyukon, a Northern Athabaskan language. Though English is widely used, language preservation initiatives are vital to keeping the Koyukon language alive among younger generations. Oral history is a revered practice, where stories passed down through generations teach moral lessons, recount historical events, and reinforce cultural values. These stories often feature themes involving the natural world, survival, and the interconnectedness of all life.

Hughes

Hughes, Alaska, is a small, remote community located along the Koyukuk River, surrounded by the expansive wilderness of the Alaskan interior. It is home to the Koyukon Athabascan people, a group known for their deep cultural roots, subsistence lifestyle, and resilience in adapting to their environment.

The Koyukon Athabascans of Hughes trace their lineage back thousands of years to some of the earliest inhabitants of the Alaskan interior. These Alaska Native people are part of the broader Athabascan language family that stretches across Alaska and into western Canada. Hughes developed as a semi-permanent settlement due to its strategic location along the Koyukuk River.

The river provided a reliable source of fish and facilitated trade and travel. The community gradually expanded as people established more permanent structures in the 20th century. The primary language historically spoken by the Hughes community is Koyukon, a Northern Athabaskan language. Although English is now the dominant language for communication, there are ongoing efforts to teach and preserve the Koyukon language among the youth. The Koyukon people have a deep respect for the land and its resources, viewing nature as alive with spirits that must be treated with reverence. Spiritual beliefs are tied closely to hunting and fishing practices, emphasizing balance, respect, and gratitude for nature's provisions.

Stevens Village

Stevens Village, Alaska, is a small and traditional Alaska Native community located along the Yukon River, with a rich heritage and history that centers around the Koyukon Athabascan people. The community is known for its deep cultural roots, strong connection to the land, and reliance on a subsistence-based lifestyle. The Koyukon Athabascan people of Stevens Village have lived in the Alaskan interior for thousands of years, descending from one of the oldest Alaska Native groups in North America. Their ancestors migrated across the Bering Land Bridge and adapted to the harsh conditions of Alaska’s interior.

The community of Stevens Village was formally established around the late 19th and early 20th centuries as a trading post and gathering spot for the Koyukon people. The strategic location on the Yukon River provided access to trade routes and resources, fostering a community that blended traditional practices with the new opportunities brought by interaction with traders and settlers. The traditional language of the Koyukon Athabascans is Koyukon, a Northern Athabaskan language. While many residents speak English, there are active efforts to revitalize and maintain the use of the Koyukon language through educational programs and cultural initiatives.

The subsistence lifestyle in Stevens Village is centered around the natural cycles of the Yukon River and surrounding wilderness. Residents rely on hunting moose and caribou, fishing for salmon and whitefish, and trapping animals such as beavers, lynx, and marten for food and materials. The community's life is closely tied to the seasons. In the summer, fishing and berry-picking are common activities, while hunting and trapping dominate the fall and winter months. Subsistence activities provide more than just food; they reinforce cultural identity, traditional skills, and community bonds. Sustainable practices are important to the people of Stevens Village. Knowledge passed down from elders helps ensure that hunting, fishing, and gathering are done responsibly, preserving resources for future generations.

Rampart

Rampart, Alaska, is a small, historically significant Alaska Native village located on the south bank of the Yukon River. It is primarily associated with the Koyukon Athabascan people, who have deep-rooted traditions and a strong connection to their environment. The Koyukon Athabascan people of Rampart have lived in the interior region of Alaska for thousands of years, tracing their lineage back to some of the earliest inhabitants of North America. Their ancestors migrated across the Bering Land Bridge and developed a way of life that was closely adapted to the Yukon River and surrounding boreal forests.

Rampart was established in the late 19th century as a supply and trade center during the short-lived gold rush era. It initially flourished as a booming settlement due to its strategic location, but with the decline of the gold rush, the population dwindled, leaving behind a more tightly knit Koyukon community that continued to thrive through subsistence living. After the decline of the gold rush, Rampart shifted back to focusing on traditional lifestyles. The community's adaptation to the post-boom era included maintaining their subsistence practices and preserving their cultural identity amidst changing economic conditions.

The traditional language of the Rampart tribe is Koyukon, part of the larger Athabascan language family. While English is commonly spoken today, there are concerted efforts to teach and maintain the Koyukon language through community programs and oral storytelling traditions. The Koyukon people of Rampart have a deep spiritual connection to nature, embodying animistic beliefs where all living things and elements of the natural world possess a spirit. These beliefs are reflected in rituals and practices related to hunting, fishing, and interactions with the environment. The introduction of Christianity by missionaries led to a blend of traditional beliefs and Christian practices, creating a unique spiritual identity within the community.

Subsistence hunting and fishing are at the core of life in Rampart. The Koyukon people rely on moose, caribou, bear, and small game for food and materials. Fishing, particularly for salmon and whitefish, is vital during the warmer months and helps sustain the community through long winters.

Tanana

Tanana, Alaska, is a historic Alaska Native community located at the confluence of the Tanana and Yukon Rivers. It is a significant center for the Koyukon and Lower Tanana Athabascan people, who have long maintained their cultural heritage and strong connection to the land.

The Koyukon and Lower Tanana Athabascan people of Tanana have inhabited this region for thousands of years. Their ancestral lineage traces back to some of the earliest inhabitants of Alaska, who migrated across the Bering Land Bridge and developed a way of life adapted to the unique environment of the Alaskan interior. Tanana became a prominent settlement in the late

19th century, especially during the Klondike Gold Rush when it served as a trade and supply center for miners and settlers. The arrival of traders and missionaries brought significant changes, including new goods and the introduction of Christianity, which influenced traditional beliefs. Despite these external influences, the Koyukon and Lower Tanana Athabascans of Tanana preserved many of their cultural practices, integrating new elements while retaining their traditional lifestyle and values.

The Koyukon and Lower Tanana Athabascan languages are both spoken in Tanana, though English is now prevalent due to modern education and external interactions. Efforts to preserve and revitalize these languages include language programs in schools and community initiatives led by elders and cultural leaders. The people of Tanana rely heavily on subsistence hunting and fishing for survival and cultural identity. Moose, caribou, bear, and waterfowl are hunted seasonally, while the rivers provide salmon and other fish. These activities not only support physical sustenance but also foster community cohesion and the transfer of traditional skills. Gathering wild berries, roots, and medicinal plants is another vital aspect of subsistence. Trapping animals such as beavers, marten, and foxes is also common, with furs traditionally used for clothing and trade.

The subsistence lifestyle in Tanana is closely tied to the seasonal cycles. Summer is marked by fishing and gathering, fall by hunting and trapping, and winter by the preservation of food and materials. These activities reinforce a deep connection to the land and the community's cultural practices.

Minto

Minto, Alaska, is a rural village located in the interior of the state, known for being home to the Lower Tanana Athabascan people. This community has maintained a strong cultural identity and traditions that date back thousands of years. The Lower Tanana Athabascans of Minto are part of the larger Athabascan linguistic and cultural group that has inhabited the interior of Alaska for millennia. Their ancestors migrated across the Bering Land Bridge and settled along the rich river systems of Alaska.

The modern village of Minto, sometimes referred to as New Minto, was established in the 1960s after flooding issues at the original settlement, Old Minto, led to relocation. Despite this change, the community retained its traditional practices, adapting to new challenges while preserving cultural identity. The people of Minto have managed to sustain their traditions despite various external influences, including contact with European explorers, traders, and missionaries. This contact brought new goods and religious practices that have been interwoven with Alaska Native beliefs.

The traditional language of the Minto people is Lower Tanana, a subset of the Athabascan language family. Although English is widely spoken today, efforts to revive and preserve the Lower Tanana language include community education programs and the involvement of elders in language teaching. Traditional beliefs of the Minto Athabascans emphasize the interconnectedness of all living and non-living things. Animistic traditions, where spirits are believed to inhabit elements of nature, are deeply respected. The community blends these beliefs with Christianity, introduced by missionaries, resulting in a unique spiritual synthesis that features both church services and traditional practices.

Subsistence hunting and fishing are central to life in Minto. Moose, caribou, and waterfowl are hunted for food, while the nearby rivers provide fish, including salmon and whitefish. These practices are more than a means of sustenance; they are vital for cultural identity and community cohesion. Trapping animals such as beaver, marten, and fox has historical and economic importance. Furs from these animals have traditionally been used for clothing and sold for income, maintaining a balance between practical use and trade.

Manley Hot Springs

Manley Hot Springs, Alaska, is a small, remote community located at the end of the Elliott Highway, known for its unique geographic features and its Alaska Native heritage linked to the Athabascan people. The area is historically associated with the Koyukon and Tanana Athabascan tribes.

The Alaska Native people of Manley Hot Springs are primarily associated with the Koyukon and Tanana Athabascan groups. These tribes have inhabited the Alaskan interior for thousands of years, developing a way of life that harmonizes with the rivers, forests, and wildlife of the region. Manley Hot Springs gained attention during the early 20th century when gold mining brought an influx of miners and settlers to the area. While the gold rush era introduced new challenges and opportunities, the local Athabascan population maintained their traditional practices while incorporating some new influences. The Koyukon and Tanana Athabascans of Manley Hot Springs adapted to the arrival of traders and missionaries by integrating new goods and religious practices. Despite these influences, they preserved core cultural values and practices that emphasize respect for nature and community.

The traditional languages spoken by the Alaska Native groups in Manley Hot Springs are Koyukon and Tanana Athabascan. Although many residents today primarily speak English, efforts to revive and maintain these languages include community programs and the involvement of elders in teaching. The Koyukon and Tanana Athabascans traditionally hold animistic beliefs, viewing nature as imbued with spirits. This perspective fosters a deep respect for the environment and influences their hunting, fishing, and gathering practices. The introduction of Christianity by missionaries has led to a blend of traditional and Christian beliefs, shaping unique spiritual practices within the community.

The Koyukon and Tanana Athabascans in Manley Hot Springs have historically relied on subsistence hunting and fishing for sustenance. Moose, caribou, and smaller game such as hares are hunted, while the nearby rivers provide fish such as salmon and whitefish. Hunting and fishing are not only vital for food but are also essential for cultural identity and traditional knowledge.

Nenana

Nenana, Alaska, is an important community located in the interior of Alaska along the Tanana River, about 55 miles southwest of Fairbanks. It is primarily inhabited by the Lower Tanana Athabascan people, who have a rich cultural heritage and deep historical roots in the region. The Lower Tanana Athabascan people, who make up the Alaska Native population of Nenana, have lived in the Alaskan interior for thousands of years. Their history dates back to early migrations across the Bering Land Bridge, where they adapted to the region's rivers, forests, and climate.

Nenana was established as a trade and meeting place due to its strategic location at the confluence of the Tanana and Nenana Rivers. The area became more formally recognized with the arrival of European traders and missionaries in the late 19th and early 20th centuries. The construction of the Alaska Railroad in the early 1900s and the subsequent building of the Nenana Ice Classic (a popular local event) further solidified the town's significance. The Lower

Tanana Athabascans of Nenana adapted to the influx of European settlers, traders, and missionaries by incorporating new goods and practices while maintaining their core cultural values. The blend of Alaska Native traditions and introduced elements helped shape a unique cultural identity.

The Lower Tanana language is part of the larger Athabascan language family. Although English is widely spoken in Nenana today, there are active efforts to revitalize the Alaska Native language through educational programs and community involvement by elders. Artistic expression is important in Nenana's culture. Traditional crafts include beadwork, basket weaving, and the creation of clothing from animal hides, which often feature intricate designs and symbolic patterns. These items are used for both practical purposes and ceremonial occasions.

The subsistence lifestyle is integral to the people of Nenana. Moose, caribou, and small game are hunted throughout the year, while the Tanana River provides ample fishing opportunities for salmon and whitefish. These activities are not only vital for sustenance but are also central to maintaining cultural traditions and community identity. Seasonal gathering of berries, roots, and other plant materials plays a key role in the diet and traditional medicine. Blueberries, cranberries, and other wild berries are commonly harvested and used to make traditional dishes and preserves.

Lake Minchumina

Lake Minchumina, Alaska, is a remote and sparsely populated area in the interior of the state, traditionally associated with the Athabascan people. The Alaska Native population of Lake Minchumina is primarily connected to the Koyukon and Tanana Athabascan groups, who have historically inhabited the region for thousands of years. These groups are part of the larger Athabascan language family that spans the interior of Alaska and extends into parts of Canada.

Lake Minchumina served as a strategic location for seasonal camps and gathering spots due to its rich natural resources, including access to fish, game, and plants. The area was an important part of the nomadic lifestyle practiced by the Athabascan people, who moved according to seasonal availability of resources. The arrival of European traders, missionaries, and settlers in the 19th and early 20th centuries introduced new goods and religious influences, significantly impacting the Alaska Native way of life. However, the people of Lake Minchumina adapted to these changes while maintaining their cultural practices.

The Koyukon and Tanana Athabascan languages were traditionally spoken by the people in the Lake Minchumina area. Although English is predominant today, community initiatives often include efforts to preserve and revitalize these Alaska Native languages through educational programs and the involvement of elders. Although Lake Minchumina does not have a large, formally recognized tribal government, it is often represented in regional native organizations that oversee and advocate for the interests of the Athabascan people. These organizations help manage resources, maintain cultural heritage, and support community well-being.

Conclusion

In conclusion, this document offers a brief overview of our region, communities, and Tribes. While it highlights key aspects of who we are, it only begins to capture the depth of our rich heritage, resilience, and profound connection to the land that has sustained us for generations. Our traditions are woven into the fabric of daily life, reflecting a unique blend of historical wisdom and modern adaptation. The strength of our communities lies in our ability to honor these traditions while facing contemporary challenges with unity and determination. To truly appreciate the full scope of our identity, contributions, and aspirations, we encourage further exploration beyond this summary.

For a more thorough understanding and to explore the full scope of our traditions, history, and current initiatives. We invite you to visit the following links for detailed information and to gain a deeper insight into our region, communities, and Tribes. These resources provide comprehensive perspectives on our cultural heritage, ongoing projects, and current efforts to support and uplift our people.

Communities in Our Region
https://www.tananachiefs.org/about/communities/

Tanana Chiefs Conference History
https://www.tananachiefs.org/about/our-history/

Tanana Chiefs Conference – Village Contacts
https://www.tananachiefs.org/contact/village-contacts/

Languages of Alaska
https://www.uaf.edu/anla/collections/map/

U.S. Dept. of the Interior – Indian Affairs - Tribal Leaders Directory
https://www.bia.gov/service/tribal-leaders-directory

Our Vision

Healthy, Strong, Unified Tribes

Our Mission

Tanana Chiefs Conference provides a unified voice in advancing sovereign tribal governments through the promotion of physical and mental wellness, education, socioeconomic development, and culture of the Interior Alaska Native people.

Tanana Chiefs Conference

Tanana Chiefs Conference

Appendix 8-2: Analysis of the Financial, Cultural, and Health Impacts of Chum Salmon Decline on Tribes within the Tanana Chiefs Conference Region

November 1, 2024

This report was compiled with Traditional Knowledge contributions from the Tribes within the Tanana Chiefs Conference Region.

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Cooperating Agency for the Environmental Impact Statement Bering Sea Chum Salmon Bycatch Management

Acknowledgement

Tanana Chiefs Conference acknowledges that many other Alaska Native and First Nations communities face similarly complex and profound challenges related to the decline of chum salmon. These struggles include not only economic hardships but also the disruption of cultural practices, food security, and the erosion of long-standing traditions that are intimately tied to the health of salmon populations. This report is not intended to serve as an all-encompassing overview of the unique and multifaceted experiences of each region or Nation, but rather as a contribution to the broader dialogue that recognizes and respects the diverse impacts felt across different communities.

1. Introduction

1.1 Scope

This analysis examines the multifaceted impacts of the Yukon River chum salmon decline on the Alaska Native communities within the Tanana Chiefs Conference (TCC) region, focusing on how this crisis disrupts not only food security but also the cultural, social, and economic fabric of these communities. Grounded in an Alaska Native perspective, this analysis considers how salmon scarcity intensifies historical and ongoing inequities, particularly regarding access to natural resources, environmental stewardship, and participation in decision-making processes.

The approach prioritizes the values, practices, and knowledge systems inherent to Alaska Native ways of life. By centering Traditional Ecological Knowledge (TEK), this analysis seeks to convey how Alaska Native relationships with the land, water, and salmon are inseparable from community well-being, resilience, and identity. This perspective moves beyond typical ecological and economic assessments to highlight the spiritual and cultural significance of salmon, recognizing that, for Alaska Native communities, the health of the salmon is intricately tied to the health of the people.

The analysis also examines the role of legal and policy structures, such as the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National Interest Lands Conservation Act (ANILCA), exploring how these frameworks have historically limited Alaska Native sovereignty over resource management. This Alaska Native-centered approach critiques how existing policies often favor commercial and state interests over subsistence rights, further exacerbating the impacts of the salmon decline on TCC communities.

Ultimately, this analysis advocates for solutions that align with Alaska Native worldviews, emphasizing co-management, restorative justice, and the protection of subsistence rights. By centering Alaska Native voices and leadership, this study underscores the need for culturally attuned and ecologically sustainable interventions that support not only the revival of salmon populations but also the enduring cultural legacy, health, and autonomy of Alaska Native communities along the Yukon River.

1.2 Background

Over the past four years, Yukon River chum salmon stocks have sharply declined, a crisis that has prompted fisheries closures aimed at mitigating overharvesting and preventing further depletion. These restrictions, however, significantly impact both commercial and subsistence fishing—two activities that are vital to Alaska Native communities in the Tanana Chiefs Conference (TCC) region. Subsistence fishing, in particular, is central to these communities, providing not only food security but also a link to cultural practices and traditional knowledge. With limited access to these essential salmon resources, TCC communities face a series of logistical, financial, and health challenges that put their resilience and sustainability at risk.

The logistical hurdles are considerable. As salmon stocks decline and fishing closures extend over multiple seasons, communities that have traditionally relied on salmon must now seek alternative food sources, often from distant markets. This shift creates transportation and distribution challenges, particularly in remote areas where the cost of shipping food and supplies is high. Additionally, replacing salmon with other protein sources is not straightforward; alternative foods may be difficult to source locally or may not align with dietary and cultural preferences, further complicating food access.

Financially, the salmon crash is placing a heavy burden on TCC communities. Many households that previously relied on salmon for their primary protein source now face increased expenses to purchase store-bought alternatives, which are often costlier and less nutritious. This financial strain is compounded by the added costs of importing food to remote locations, where prices for staples are already high due to transportation challenges. Furthermore, the loss of commercial fishing opportunities has reduced income for those who depend on fishing as part of their livelihoods, deepening economic challenges within these communities.

The health implications of restricted access to salmon are equally concerning. Salmon is a nutritious, locally available food that has sustained these communities for generations, providing essential nutrients and supporting balanced diets. As families shift toward store-bought and processed foods, health risks associated with non-traditional diets—including obesity, diabetes, and cardiovascular disease—are expected to rise. The loss of traditional diets also disconnects community members from cultural practices of harvesting and preparing salmon, which hold deep significance for physical and spiritual well-being.

The cumulative effect of these logistical, financial, and health challenges underscores the urgency of finding sustainable solutions to the salmon crisis along the Yukon River. Without access to their traditional salmon resources, TCC communities face threats not only to their immediate food security but also to their long-term resilience, cultural identity, and overall sustainability.

2. Financial Impacts of Chum Salmon Decline

2.1 Cost Analysis of Replacement Salmon Distribution

The ongoing decline in Yukon River chum salmon has created a critical food security issue for communities that traditionally rely on salmon as a staple. To address this shortfall, replacement salmon distribution has become essential, although it involves a complex and costly process. Over the past three years, salmon populations have dropped sharply, leading to multiple years of fishery closures aimed at preserving remaining stocks. These closures, impacting both commercial and subsistence fishing, have created a significant food gap in affected communities.

Replacing local salmon requires sourcing fish from other regions, sometimes out-of-state. This process drives up costs due to geographic distance and market competition, as demand increases across regions facing similar shortages. Distributing fish to remote communities along the Yukon River adds further logistical challenges due to limited road access, severe winter conditions, and reliance on costly air transport. Storage and handling requirements—processing, freezing, and transporting salmon—necessitate specialized facilities, often only available in urban areas, which means salmon must be stored centrally before being distributed to rural communities. Limited local cold storage capacity further inflates distribution costs through additional storage rentals and transportation fees.

Coordinating effective distribution involves collaboration among state agencies, nonprofits, and tribal organizations, each managing logistics, assessments, and distribution plans. Labor costs are high due to the need for on-ground planning, transport, and distribution, with many community members either volunteering or working to deliver fish in remote villages. Adherence to regulatory standards, including food safety and transportation permits, adds compliance costs and oversight, while environmental monitoring is needed to assess the impacts of increased fishing pressures on substitute fish species, adding another layer of regulatory expense.

Based on recent efforts, the annual costs of sourcing, transporting, storing, and distributing replacement salmon to Yukon River communities are estimated to range from $500,000 to over $1 million, varying with fuel prices, salmon availability, and seasonal demands (NOAA Fisheries, 2022). However, reliance on salmon imports is financially and environmentally unsustainable in the long term. High distribution costs and increased fishing pressure in other areas could worsen salmon scarcity, prompting initiatives to diversify food sources and increase local storage capacity. Despite these efforts, limited funding and geographic isolation pose substantial barriers. With ongoing instability in salmon populations, there is an urgent need for support focused on habitat restoration and co-managed efforts to restore local stocks.

For the Yukon River Tribes and the Tanana Chiefs Conference (TCC), the annual average expenditure to distribute salmon reaches $1.96 million. This recurring expense diverts funds from essential services like healthcare, education, and infrastructure. For subsistence-dependent communities, this additional burden is unsustainable, particularly with limited state and federal funding. The TCC has increasingly relied on federal disaster relief from NOAA Fisheries and the Pacific States Marine Fisheries Commission, but these funds vary annually and require formal disaster declarations, placing the tribes in a vulnerable financial position that complicates long-term planning for salmon distribution and other essential programs (Pacific States Marine Fisheries Commission, 2024; Yukon Salmon Sub-Committee, n.d.).

"To provide protein, sustenance, and heritage, we are now supporting commercial fisheries by buying salmon for our people; in 2022 we distributed over 90 thousand pounds of salmon including purchase, shipping, charters, storage, and packaging, and in 2023 we distributed another 90 thousand pounds." - Chief Chairman, Brian Ridley, Tanana Chiefs Conference[3]

In addition to distribution costs, the lack of local salmon has led to job losses and increased community expenses for alternative foods, often store-bought and less nutritious. This shift not only raises food expenses but diminishes the cultural connection to traditional diets, impacting social cohesion. The reliance on processed foods poses health risks and elevates long-term healthcare costs due to reduced dietary quality.

2.2 Opportunity Costs

Opportunity costs associated with the funds allocated to salmon distribution highlight potential investments that could otherwise support community development. For instance, resources could improve local infrastructure, strengthen food storage capacity, and foster sustainable economic opportunities. Addressing salmon population decline and restoring local ecosystems could decrease reliance on costly replacement fish, allowing for reinvestment in tribal services and infrastructure.

The resources currently devoted to emergency salmon distribution could otherwise support sustainable economic development, cultural preservation, and infrastructure improvements within Yukon River communities. These opportunity costs underscore the need to address the root causes of salmon decline—such as overfishing, habitat loss, and climate change—to reduce financial strain on tribes, enabling reinvestment in community resilience and growth.

3. Socioeconomic and Cultural Impacts on Fish Camps

3.1 Economic Implications of Fish Camp Maintenance

Fish camps are essential infrastructure for subsistence fishing, providing storage and preparation facilities along the Yukon River. Construction or maintenance costs for fish camps are substantial, ranging from $10,000 to $25,000 per camp (B. Sanderson, personal communication, September 12, 2024). High transportation costs for building materials and limited access to skilled labor in rural areas inflate these expenses. Diminished salmon stocks make maintaining these camps financially unsustainable for many families, disrupting local economies reliant on subsistence practices (Senapati & Gupta, 2014).

[3] (Ridley, *The Impact of the Historic Salmon Declines on the Health and Well-Being of Alaska Native Communities along Arctic, Yukon, and Kuskokwim Rivers*, U.S. Senate Committee on Indian Affairs, 2023) (CHRG-118shrg54782).

3.2 Cultural and Community Consequences

[4]Fish camps hold significant cultural value, functioning as sites for intergenerational knowledge transfer and community bonding. The decline of fish camp activity diminishes cultural practices, eroding community cohesion and reducing the cultural continuity of Alaska Native fishing practices. As families disengage from these camps, the collective heritage of salmon fishing and the traditional skillsets tied to it face potential decline (Yusriadin et al., 2024).

2 - Helen, Faith and Kathleen Peters cut fish at Rampart Rapids

Fish camps are crucial not only for sustenance but also for preserving cultural heritage and fostering community cohesion among Alaska Native communities along the Yukon River. These camps serve as essential hubs for intergenerational knowledge transfer, where traditional fishing practices and cultural customs are taught and practiced. The decline of fish camp activity, largely due to reduced fish stocks, erodes these cultural traditions, weakening the social fabric and diminishing the community's cultural continuity.

As fewer families are able to use fish camps, there is a growing disconnection from cultural practices integral to the heritage of Yukon River communities. The reduced activity in these spaces limits opportunities for younger generations to learn traditional skills and customs, which are key to maintaining cultural identity and community resilience. Without active engagement in these cultural practices, the collective heritage tied to salmon fishing is at risk of being lost, leading to feelings of disconnection and identity loss within the community.

3.3 Trespassing and Financial Loss

Reduced use of fish camps due to declining fish stocks has led to an increase in trespassing and vandalism, as these once-vital spaces fall into disuse and become susceptible to unauthorized activity. With fewer families able to maintain these camps, they are left unprotected, making them vulnerable to trespassers and increasing the risk of property damage. Reports of trespassing have steadily grown, with incidents documented at 43 in 2022, rising to 62 in 2023, and further escalating to 84 in 2024 (Monroe, A. 2024). This trend highlights the vulnerability of fish camps, which traditionally function as community hubs and cultural sites, fostering

[4] Photo courtesy of Stan Zuray

stewardship and community presence. The increase in trespassing and vandalism not only damages physical property but also deepens the emotional and cultural loss experienced by families who are no longer able to safely return to these meaningful spaces.

The financial implications of trespassing on unused fish camps are multifaceted, with effects that go beyond immediate repair costs to include legal expenses, lost potential revenue, and reduced access to critical natural resources. Often, trespassers damage or steal essential camp equipment, such as fishing nets and boats, leading to significant replacement costs for owners. For communities with limited resources, these expenses can heavily strain budgets, gradually depleting vital assets for fishing and subsistence activities.

Efforts to enforce trespass regulations also present financial challenges for Alaska Native communities. Legal costs for consultations, signage, and potential actions against repeat trespassers consume resources that could otherwise support essential services. For many Alaska Native corporations and village councils, limited funds for ongoing enforcement restrict the capacity to protect these lands effectively.

Unused fish camps present a potential financial opportunity for cultural tourism, as they could attract tourists and stakeholders. Fish camps, even without active fishing, can attract tourism by offering cultural heritage tours, traditional skills workshops, nature observation, and immersive educational programs, allowing visitors to experience Alaska Native customs, ecological stewardship, and the historical significance of these sites. However, as trespassing and vandalism have increased, the costs to repair these camps have compounded, making it increasingly challenging to transform them into revenue-generating infrastructure. This ongoing damage not only raises maintenance expenses but also deters potential partners, leading to missed income opportunities and higher costs to secure and restore these sites

Ecological impacts from unauthorized access further compound the issue. Trespassers may cause environmental degradation, including littering, fire damage, and overfishing, which reduces the future productivity of these sites. This ecological damage can have a long-term impact on local fish stocks, leading to lower revenue potential and necessitating costly restoration efforts to return the sites to productive use.

Moreover, the degradation of culturally significant lands due to trespassing compromises the intrinsic and cultural value of these sites. For Alaska Native communities, fish camps are deeply tied to heritage, and damage to historical landmarks and traditional fishing grounds results in social and cultural losses. Trespassing diminishes the potential for cultural tourism, educational programs, and heritage conservation funding, further undermining valuable income sources.

The ongoing risk of trespassing also affects property insurance, as repeated incidents may increase premiums or deductibles, making coverage financially prohibitive for some communities and further limiting resilience. [5]

3 - Chief Rhonda Pitka's grandmother's fish camp, which has been abandoned for four years due to a lack of salmon on the Yukon River. Christian Thorsberg/USFWS

4. Health Implications of Salmon Scarcity

4.1 Food Security and Nutrition Deficits

Communities dependent on salmon for nutrition are now increasingly reliant on processed, store-bought foods that are less nutritious and costlier. This shift from a salmon-based diet contributes to food insecurity, negatively affecting health outcomes with higher rates of diabetes, obesity, and cardiovascular issues reported. Key studies indicate that reliance on ultra-processed food, high in sodium and unhealthy fats, independently increases the risk of metabolic disorders, exacerbating existing health disparities (Stevenson et al., 2023; Donets et al., 2022).

Chum salmon is a staple food source in many Yukon River communities, providing essential nutrients critical to the health and well-being of Alaska Native residents. However, the scarcity of salmon has led to food insecurity, with residents increasingly relying on processed, store-bought foods that are both less nutritious and more expensive than traditional salmon. The decline in chum salmon populations has raised significant concerns about nutritional health in communities that depend on salmon as a dietary cornerstone, and studies have linked reduced salmon access to heightened food insecurity and nutritional deficits (Donets et al., 2022).

[5] ChiefRhondaPitkaFishCamp4.jpg, Christian Thorsberg/USFWS, Public Domain, https://www.fws.gov/media/chiefrhondapitkafishcamp4jpg

With local salmon supplies dwindling, Alaska Native communities face the need to shift to costlier, less nutritious foods that lack the benefits of a traditional salmon-based diet. Processed foods are often higher in sodium, sugars, and unhealthy fats, which contribute to health disparities by increasing the risks of obesity, diabetes, and cardiovascular diseases. As a result, the loss of salmon access is not merely a reduction in food supply but a loss of vital nutrients, including omega-3 fatty acids and vitamin D, essential for both physical and mental health. Compounding these health risks are the increased costs of store-bought alternatives, which strain household budgets and diminish food sovereignty.

The Tanana Chiefs Conference (TCC) has responded to this crisis by enhancing food security initiatives, including events and workshops focused on sustainable food alternatives. These workshops introduce non-traditional but nutritious foods and teach preparation methods that reduce added sugars, fats, and sodium. Additionally, TCC promotes gardening, hunting, and foraging to empower community members with skills that diversify their diets sustainably while aligning with cultural practices. Through these efforts, TCC bridges traditional and modern dietary needs, helping families adapt to resource scarcity and maintain their nutritional health.

Figure 2: TCC's First ever Food Security Summit, 2023

A recent study also highlights the risks of increased ultra-processed food consumption, showing a link to elevated rates of Type 2 diabetes. This is especially relevant for Alaska Native communities, where processed foods have begun to replace nutrient-dense traditional diets. The shift to processed foods, often characterized by added sugars and unhealthy fats, raises significant health concerns, emphasizing the need for public health programs to promote traditional diets that reduce chronic disease risks (Stevenson et al., 2023).

Katie Garrity, RD, LD, from TCC's Diabetes & WIC Program, explains that community members often express frustration when encouraged to consume more fish yet lack access to their traditional salmon. "Patients feel sadness and frustration when they cannot enjoy the subsistence foods that are culturally meaningful to them," she notes. This lack of access to traditional foods not only increases health risks but also impacts mental and cultural well-being.

As access to traditional foods diminishes, these communities face increased risks of chronic diseases and a loss of food-related heritage. Sustainable food security efforts and culturally aligned dietary interventions are essential to mitigate these adverse effects, supporting the health and resilience of Alaska Native populations. Holistic approaches that prioritize traditional practices and ensure food access are critical to maintaining both the physical well-being and cultural identity of these communities (Redwood et al., 2019).

4.2 Mental Health and Cultural Identity Impacts

Loss of traditional fishing practices has far-reaching mental health implications, disrupting community cohesion and cultural identity. Fishing is integral to the cultural and spiritual life of Alaska Native communities, and reduced access to salmon undermines these social structures, increasing anxiety, depression, and cultural disconnection. A recent study highlights the challenges faced by Alaska's Interior Region, where restrictive regulations and environmental changes prevent participation in traditional harvest practices (Brinkman et al., 2022). Without these practices, younger generations risk losing the cultural and spiritual heritage tied to subsistence fishing.

> *"One of the questions Indian Health Services asks is, "Are you depressed?" Standard question. Standard answer is always no. I don't think that is true anymore for all of us who harvested king salmon. When our source of salmon disappeared, it was a weird depression that could not be explained in a clinical setting but there were signs. What do you do now in mid-June and July?" – Katie Kangas, Ruby*[6]

Figure 3: Katie Kangas in her smokehouse in Ruby, Alaska

The loss of traditional fishing practices has profound impacts beyond physical health, deeply affecting the mental health and cultural well-being of Alaska Native tribes along the Yukon River. For these communities, fishing is far more than subsistence—it is central to their cultural heritage, spiritual life, and community bonds. Losing the ability to fish disrupts community cohesion, undermines spiritual practices, and interrupts the transfer of generational knowledge essential for cultural continuity. This loss leads to feelings of isolation, sadness, and disconnection from identity, amplifying mental health challenges and weakening the resilience of communities long sustained by fishing as a source of unity, purpose, and spiritual fulfillment.

[6] Quote retrieved from Jones, I. (2022, August 16). Fish camp in Alaska — without the fish. High Country News. https://www.hcn.org/issues/fish-camp-in-alaska-without-the-fish/

As Karen Kallen-Brown, LPC, CDC-II, TCC Child & Family Mental Health Clinician, shares, “All summer and fall, I've listened to parents, grandparents, and Elders grieving over the absence of fish. Their eyes show deep sorrow as they recount motoring long distances for little or no catch, unable to bring their children to fish camp. Many families, unable to access traditional foods, turn to costly junk food, which does nothing for healthy growth or respect for food origins. Kids are growing disconnected, anxious, and increasingly unfamiliar with their cultural heritage. They worry, 'Our kids won’t know how to live anymore.'"

A recent study highlights the decline of traditional harvest practices (THPs) like fishing and hunting in Alaska’s Interior Region over the past decade, due to both environmental and regulatory challenges (Brinkman et al., 2022). These barriers increase household stress and erode practices essential to the cultural identity, nutrition, and social cohesion of Alaska Native communities. Regulatory restrictions on salmon harvesting further exacerbate these issues, limiting Alaska Native residents' ability to manage and sustain this vital resource. The study also points to growing tensions between state, federal, and Alaska Native entities over salmon management, with Alaska Native communities concerned that current policies restrict their cultural and spiritual rights related to THPs. This combination of environmental and institutional factors significantly impacts the resilience of Alaska Native communities in Alaska’s Interior Region, underscoring the need for more inclusive management practices that honor traditional knowledge and support local stewardship.

The decline in mental health among Alaska Native communities following the chum salmon crisis is extensive, affecting not only individuals but also entire families and communities. The loss of salmon disrupts traditional ways of life, weakens cultural practices, and strains the social bonds rooted in subsistence fishing. For many, salmon represents more than sustenance—it is a source of identity, an ancestral connection, and a way to teach and bond across generations. Losing access to these practices fosters grief, loss, and frustration, which can lead to increased rates of anxiety, depression, and disconnection within the community. This shift highlights the urgent need for culturally sensitive mental health support, sustainable food security measures, and policies that empower Alaska Native communities to preserve their traditions, resilience, and collective well-being.

5. Impacts on Dog Mushing Practices

5.1 Significance of Dog Mushing to Alaska Native Communities

Alaska Natives have a long history of using dog teams along the Yukon River, a tradition that dates back thousands of years. For Alaska Native groups like the Yup’ik, Athabascan, and Inupiat, dog teams were essential to life, serving as the primary means of transportation across Alaska’s harsh landscape. Dog teams supported various activities crucial to survival, including hunting, trapping, trading, and later, carrying mail. In the rugged terrain of the Yukon River region, where winters are severe and infrastructure is sparse, dog sleds allowed people to transport goods, connect villages, and access remote areas, making them integral to community survival by enabling hunters to reach remote areas and transport supplies over ice and snow.

During the 19th century, the importance of dog teams increased with the rise of the fur trade. Trading posts along the Yukon relied on dog teams to deliver furs and goods, facilitating commerce between Alaska Native groups and European traders. By the late 1800s, during the Gold Rush, dog teams became even more prominent, as Native mushers guided prospectors and settlers through Alaska's terrain. Dog teams remained vital well into the early 20th century, famously celebrated during events like the All-Alaska Sweepstakes and the 1925 serum run to Nome, which brought national attention to the sled dog culture.

With the advent of snowmobiles and airplanes in the mid-20th century, the reliance on dog teams began to decline. Still, dog mushing remains a culturally significant tradition for many Alaska Natives, symbolizing resilience, connection to ancestral practices, and respect for the land and animals. Today, dog mushing is preserved through events like the Iditarod and local races, maintaining its legacy as a symbol of Alaska Native ingenuity and adaptation along the Yukon River.

The decline of chum salmon has significantly impacted traditional mushers, for whom salmon has long been a primary food source for sled dogs, providing an affordable, high-protein diet essential for the health and endurance of working dog teams. With declining salmon stocks, mushers must find alternative, often costly, food sources, or reduce the size of their teams. While commercial dog food is an option, it is expensive and lacks the cultural connection that comes with feeding sleddogs salmon. This shift places a financial burden on mushers, who already operate within tight budgets, making it increasingly challenging to sustain their dog teams at historical levels.

Figure 5[7]

F5 -: Effie Kokrine of Tanana Racing, 1952

[7] Photo retrieved from University of Alaska Fairbanks. (n.d.). Effie Kokrine's dog mushing slideshow. Jukebox Project.

This decline has cultural implications as well. For generations, the seasonal cycle of salmon fishing, processing, and feeding sled dogs has connected families to their heritage, reinforcing the bond between people, dogs, and the river's ecosystem. As salmon becomes scarcer, mushers lose both a critical resource and a key aspect of their cultural identity tied to the cycles of fishing and mushing along the Yukon River. Fewer dog teams in the region also impact the intergenerational transmission of mushing knowledge, weakening social continuity. In response, some mushers are exploring alternative strategies, although these can be difficult to implement in traditional ways. The decline of chum salmon ultimately threatens the viability of traditional mushing in the Yukon, highlighting the interdependencies within Alaska Native livelihoods. *Figure 5*[8]

Communities like Tanana and Fort Yukon have relied on dog mushing for transportation, survival, and cultural expression. Located along Alaska's interior, these villages depended on dog teams to navigate challenging terrain, especially in winter when snow and ice made trails accessible by sled. For centuries, Athabascan and other Alaska Native groups in these villages used dog teams to reach hunting grounds, traplines, and neighboring villages, ensuring access to food, supplies, and social connections despite isolation.

Dog mushing was integral to seasonal life in these villages. Mushers used dogs to haul firewood, hunt moose and caribou, and transport supplies from trading posts. When trading posts were established along the Yukon in the 19th century, dog teams helped Alaska Native mushers support local economies by transporting furs and goods. Dog mushing also played a crucial role in rural Alaska's mail delivery system. Before snowmobiles and airplanes, dog sleds were the most reliable way to connect isolated villages to the outside world.

Beyond transportation, mushing holds deep cultural significance in these communities. It represents resilience, interdependence with the natural environment, and a traditional knowledge system passed down through generations. Families in Tanana and Fort Yukon raised and trained their own dog teams, developing skills honed over lifetimes and shared through community races and gatherings. While modern transportation has reduced reliance on dog teams, mushing remains a cherished practice, reflecting a strong connection to heritage and the land. For many, maintaining dog teams preserves an ancestral legacy, even as challenges like salmon scarcity and high costs increasingly threaten its sustainability.

Several villages in Alaska's interior, including Tanana, Fort Yukon, Huslia, Galena, Allakaket, Ruby, and Nulato, have long histories of using dog teams for subsistence. These communities, primarily inhabited by Athabascan and other Alaska Native groups, relied on dog teams for transportation, hunting, trapping, and connecting with neighboring villages. The harsh, snow-covered terrain, especially during winter, made dog sleds essential for survival.

The decline in chum salmon has forced many mushers in Alaska's interior villages to make difficult choices, including rehoming their sled dogs due to the high cost of feeding them. Traditionally, chum salmon provided an affordable, high-protein source for sled dogs, allowing mushers to maintain larger teams without significant financial strain. However, with the decline in salmon, many mushers now rely on commercial dog food, which costs around $100 for a 40-pound bag, making it unsustainable for many, especially in remote areas where the cost of importing dog food is even higher.

This shift has led some mushers to rehome their dogs, while others have turned to snowmachines as an alternative. Although snowmachines offer a fast and practical option, they come with high initial costs, often several thousand dollars. Snowmachines also require regular maintenance to function in Alaska's rugged terrain, adding ongoing costs for parts and repairs. Fuel costs further complicate the issue, as high gasoline prices in remote villages make snowmachines an expensive alternative for long distances.

For mushers, this shift represents not only a financial burden but also a cultural loss. Dog mushing embodies generations of knowledge, skill, and a deep connection to the land. Transitioning from dog teams to snowmachines disrupts this legacy, and the high costs of snowmachine ownership and operation present additional challenges for subsistence users, underscoring the extensive impacts of chum salmon decline on Alaska Native and rural communities.

6. Conclusion

The decline in chum salmon populations along the Yukon River poses an urgent and multifaceted challenge for Alaska Native communities, impacting financial stability, cultural continuity, and public health. The financial strain on these communities is significant, as funds that might otherwise improve local infrastructure, health services, and education are diverted to cover the costs of acquiring alternative food sources and distributing salmon from other regions. This economic burden limits long-term community development and exacerbates existing inequalities, straining the resources needed to sustain local infrastructure and services that are vital for resilience.

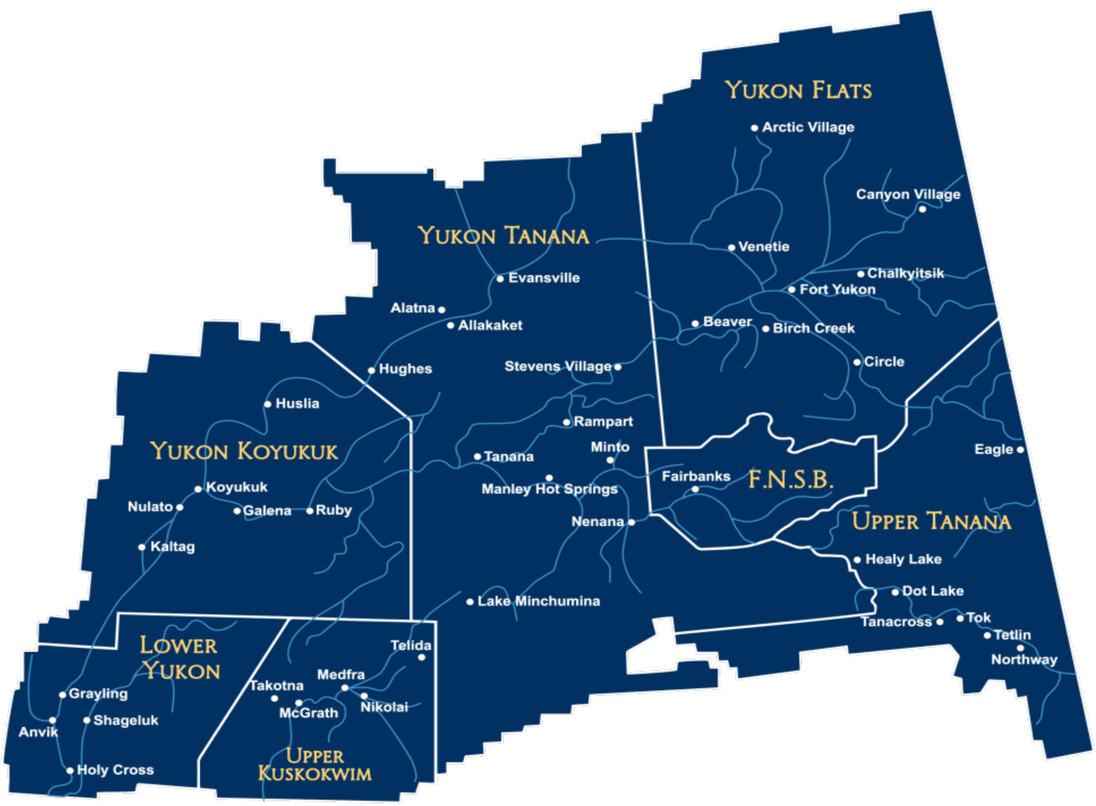
Culturally, the effects are profound and far-reaching. Salmon fishing is more than an economic activity for these communities; it is central to cultural practices such as fish camps, which are spaces for intergenerational knowledge transfer, storytelling, and traditional ecological education. Dog mushing, another practice tied to subsistence activities and community identity, is also under threat as diminished salmon stocks reduce the availability of fish used to feed sled dogs. The loss of these practices erodes the foundation of Alaska Native cultural identity, weakening the bonds that sustain community cohesion and cultural heritage.

Food insecurity adds another dimension to these challenges, as the loss of salmon—a nutritious, locally available food—pushes communities toward costly and often less nutritious alternatives. Dependence on store-bought foods, which are frequently high in processed ingredients and low in essential nutrients, introduces long-term health risks, including increased rates of diabetes, cardiovascular disease, and other diet-related conditions. This shift away from a traditional diet not only impacts physical health but also severs connections to cultural practices of harvesting and preparing salmon that have been handed down for generations.

Addressing these impacts requires a coordinated approach that prioritizes habitat restoration, sustainable food security, and culturally aligned policy support. Targeted habitat restoration initiatives can help revive salmon populations by improving spawning grounds, restoring riparian vegetation, and reducing industrial impacts on rivers and tributaries. Sustainable food security programs, focused on ensuring access to locally sourced, culturally appropriate food, would reduce the economic burden on Alaska Native communities and mitigate health risks linked to non-traditional diets.

Furthermore, policy interventions must be culturally attuned, integrating Alaska Native leadership and Traditional Ecological Knowledge (TEK) into conservation and management practices. Co-management frameworks, stricter bycatch regulations, and legal reforms to secure Alaska Native subsistence rights would enable communities to exercise greater control over the resources essential to their livelihoods and cultural practices.

Ultimately, ecologically sustainable and culturally aligned solutions are essential for these communities to maintain their cultural legacy, health, and economic stability amid a rapidly changing ecosystem. With Alaska Native perspectives guiding resource management and policy decisions, there is an opportunity to rebuild resilient ecosystems that support both the salmon populations and the enduring cultural heritage of Alaska Native peoples along the Yukon River.



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Our Vision

Healthy, Strong, Unified Tribes

Our Mission

Tanana Chiefs Conference provides a unified voice in advancing sovereign tribal governments through the promotion of physical and mental wellness, education, socioeconomic development, and culture of the Interior Alaska Native people.

Tanana Chiefs Conference

APPENDIX 8-3: YUKON RIVER PATTERNS OF SUBSISTENCE USES OF CHUM SALMON, 1990-2023

November 1, 2024

This report was jointly developed by Tanana Chiefs Conference and the Yukon Inter-Tribal Fish Commission to provide insight into the diversity of salmon use along the Yukon River Drainage

Produced by Jim Simon, PhD, Principal Anthropologist

APPENDIX 7-3

YUKON RIVER PATTERNS OF SUBSISTENCE USES OF CHUM SALMON, 1990-2023

INTRODUCTION

The Yukon River Inter-Tribal Fish Commission (YRITFC) first was established by its member tribes in 2014. Upon ratification of revisions to the YRITFC Constitution in 2023, now more than 40 federally recognized tribal governments are active voting members of YRITFC. Since 2014, YRITFC has been administered as a program within the Tanana Chiefs Conference (TCC) with plans for YRITFC to eventually become a stand-alone organization independent of TCC.

In 2023, with revisions occurring in May 2024, YRITFC member tribes designated 9 distinct geographic territories within the Yukon Fisheries Management Area to ensure broad geographic representation in governance and data representation throughout the region (Figure A1). Several Yukon River communities include tribal citizens of more than one federally recognized tribal government.

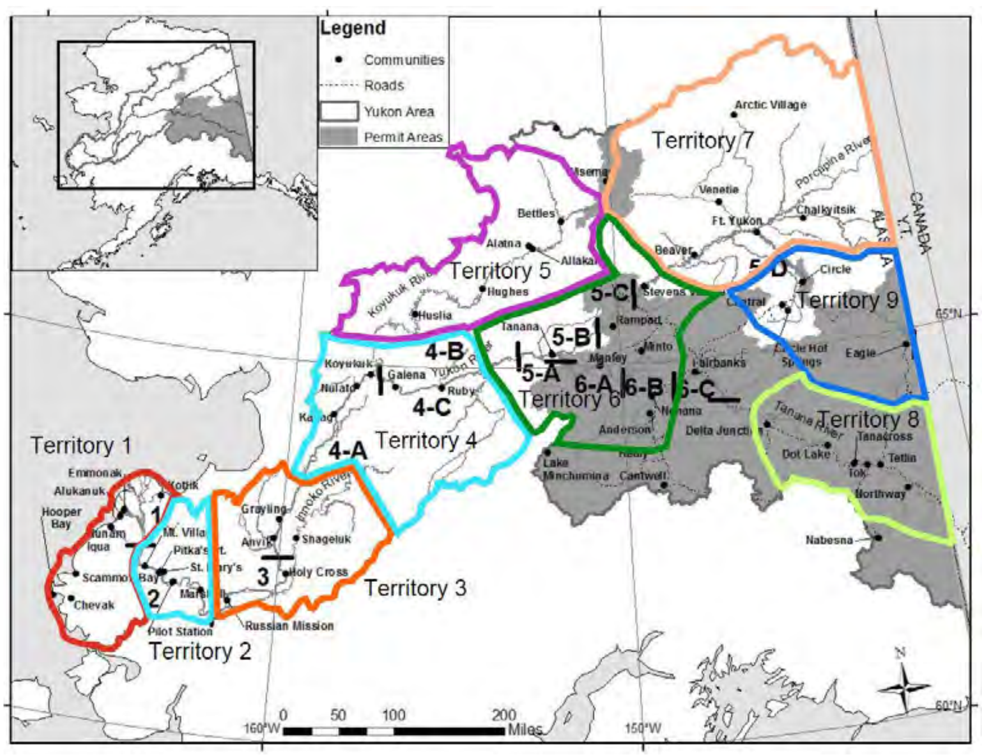

Figure A1. YRITFC preliminary Territorial boundaries (shaded areas indicate where subsistence fishing permits are required; non-shaded areas represent where post-season household surveys document annual fish harvests).

Moving from the communities along the coast of the Yukon Delta and around the mouths of the Yukon River and then upriver, YRITFC member tribes and other tribal communities served by YRITFC are listed in Table A1. Not all listed federally recognized tribes are currently active voting members of YRITFC. Data presented in this report are limited to those available for Alaska tribal communities.

Table A1. Tribal Communities Served by Yukon River Inter-Tribal Fish Commission by YRITFC territories.

Territory 1:	**Territory 2**:	**Territory 3**:
Alakanuk Traditional Council	Algaaciq Native Community (St. Mary's)	Anvik Tribal Council
Native Village of Bill Moore's Slough (Kotlik)	Asa'carsarmiut Tribal Council (Mountain Village)	Grayling IRA Council
Chevak Traditional Council	Native Village of Marshall	Holy Cross Traditional Council
Chuloonawick Native Village (Emmonak)	Ohogamiut Traditional Council (Marshall)	Shageluk IRA Council
Emmonak Tribal Council	Pilot Station Traditional Village	Iqugmiut Tribal Council (Russian Mission)
Hamilton Tribal Council (Kotlik)	Pitka's Point Traditional Council	
Native Village of Hooper Bay	Yupiit of Andreafski (St. Mary's)	
Village of Kotlik		
Nunam Iqua Traditional Council		
Paimiut Traditional Council (Hooper Bay)		
Scammon Bay Traditional Council		
Territory 4:	**Territory 5**:	**Territory 6**:
Kaltag Tribal Council	Alatna Traditional Council	Manley Village Council
Koyukuk Tribal Council	Allakaket Traditional Council	Native Village of Minto
Louden Tribal Council (Galena)	Evansville Tribal Council (Bettles/Evansville)	Nenana Native Village Council
Nulato Tribal Council	Hughes Village Council	Rampart Tribal Council
Ruby Tribal Council	Huslia Tribal Council	Stevens Village IRA Council
		Tanana Tribal Council
Territory 7:	**Territory 8**:	**Territory 9**:
Arctic Village Traditional Council	Dot Lake Village Council	Circle Village Council
Beaver Village Council	Healy Lake Village Council	Eagle IRA Council
Chalkyitsik Village Council	Northway Traditional Council	(Other Canadian First Nations of
Denduu Gwich'in Tribal Council (Birch Creek)	Tanacross Village Council	the Yukon River, which are eligible to join YRITFC)
Gwichyaa Zhee Gwich'in Tribal Government (Fort Yukon)	Tetlin IRA Council	
Old Crow (Yukon Territory)		
Native Village of Venetie Tribal Government		

METHODS

The Role of Yukon River Chum in the Overall Subsistence Economies of Yukon River Tribal Communities

ADF&G occasionally collects subsistence resource harvest data at the household level and summarizes data results at the community level based upon household community of residence. ADF&G Subsistence staff conduct door-to-door surveys to document for a particular year all subsistence harvests of fish, wildlife, and plants in addition to harvest search areas, resource sharing patterns, household income and demographics among other information categories to develop community profiles that serve to represent the overall subsistence economy of participating communities for a particular study year. Each resource harvested is converted to usable/edible pounds so that different resources harvested are comparable. Comprehensive subsistence household survey projects are relatively limited as compared to the annual door-to-door surveys conducted each fall to document subsistence salmon harvests following the bulk of the year's salmon fishing opportunities. Comprehensive surveys provide opportunities to understand the relative contribution and importance of salmon to the overall subsistence economy in a community.

During the period 1980-2021, ADF&G Subsistence staff conducted comprehensive subsistence surveys in 41 communities of the Yukon Fisheries Management Area in Alaska representing a total of 61 community-data-years given that 18 Yukon River drainage communities had comprehensive subsistence research conducted more than once. Of the 61 community-data-years, 27 were conducted between 1980 and 1990 and 34 were conducted during the period 2008-2021. During the latter period, subsistence harvests of Yukon River Chinook salmon, for example, fell below the Alaska Board of Fisheries established "amounts reasonably necessary for subsistence uses" finding in all years except 2019. Therefore, comprehensive survey results in 56% of the data years were during years of poor Chinook salmon returns to the Yukon River. As a result, data from the 1980s and 1990s are combined with more recent comprehensive data in those cases where more than one data point exists for a particular community to better understand long-term patterns of use and reliance on fish and wildlife and to avoid problems associated with shifting baseline syndrome (e.g., Alleway et al. 2023). Results of this research are summarized below including text descriptions and pie chart graphics for each YRITFC territory.

Among the nine geographic territories identified by YRITFC, subsistence harvest and uses of chum salmon differ from one part of the river to another. TCC and YRITFC prepared subsistence harvest composites using comprehensive subsistence harvest surveys collected by ADF&G over a broad period of time (1980-2021).[1] ADF&G provides harvest numbers that are also converted into usable or edible pounds so that individual resource categories or species of harvest can be compared with others to better understand a particular community's or YRITFC territory's subsistence patterns of harvest and use or subsistence economies.

Representing the best available information on the role of salmon species in the overall subsistence economies of Yukon area communities, these generalized subsistence harvest composition metrics help to show the overall importance of individual salmon species to community economies and ways of life in the various geographic territories of the Yukon watershed in Alaska. The data are summarized by YRITFC

[1] All data is sourced from https://www.adfg.alaska.gov/sb/CSIS/; see also Andrews (1988), Brown et al. (2014, 2015, 2016), Brown and Kostik (2017), Case and Halpin (1990), Coleman et al. (2023), Fall et al. (2012), Godduhn and Kostick (2016), Holen et al. (2012), Ikuta et al. (2014), Ikuta et al. (2016), Kofinas et al. (2016), Marcotte (1986), Marcotte (1990), Marcotte and Haynes (1985), Marcotte et al. (1991), McDavid and Cunningham (2020), Park et al. (2020), Sumida (1988), Sumida (1989), Sumida and Andersen (1990), Trainor et al. (2020a, 2020b), Wheeler (1993), Wilson and Kostick (2016), and Wolfe (1981).

territory to provide an overview of the varying composition of wild food harvests along the Yukon River drainage and coastal areas, with a particular focus on the reliance of summer chum salmon and fall chum salmon for subsistence purposes. The results of these studies show that salmon provide a large portion of the total subsistence food supply in Yukon River communities in Alaska and that the role salmon contributes to community and territorial subsistence economies generally increases as one progresses upriver. However, based upon differences in species availability, salmon species life histories, and the variable distribution of chum salmon stocks throughout the Yukon River drainage, different YRITFC territorial regions have dramatically different patterns of subsistence harvest and use patterns.

Yukon River Salmon Use Rates by Household and Per Capita by YRITFC Territory

ADF&G collects subsistence salmon harvest data following much of the salmon fishing season (post-season) in communities where subsistence salmon fishing permits are not required. These post-season subsistence salmon harvest surveys are conducted by ADF&G Commercial Fisheries staff through door-to-door surveys to document salmon harvests at the household level and summarizes data results at the community level based upon household community of residence. ADF&G integrates the results of the post-season surveys with subsistence fishing permit data to provide a comprehensive annual overview of subsistence salmon harvests and uses for subsistence purposes. Methods employed to develop community subsistence salmon harvest estimates are detailed in the annual post-season survey program annual reports from which the 1990-2023 data presented here originate.[2]

[2] Holder and Hamner (1991), Bromaghin and Hamner (1993), Holder and Hamner (1995, 1998a, 1998b), Borba and Hamner (1996, 1997, 1998, 1999, 2000, 2001), Brase and Hamner (2002, 2003), Busher and Hamazaki (2005), Busher et al. (2007, 2008), Jallen et al. (2012a, 2012b), Busher et al. (2009), Jallen and Hamazaki (2011), Jallen et al. (2012c, 2012d, 2015, 2017a, 2017b, 2017c), Padilla et al. (2021, 2023a, 2023b, 2023c), and Padilla and

Hamazaki (2024). Preliminary subsistence uses and total number of household data for 2021-2023 provided by email from Andrew Padilla on August 16, 2024.

In 2021, Chinook salmon and summer chum salmon harvests for Holy Cross and Shageluk were together reported as "Other District 3" harvests due to confidentiality concerns because so few households fished. As a result, the combined harvest of 9 Chinook salmon and 32 summer chum salmon were divided equally between the two communities at 4.5 Chinook salmon and 16.0 summer chum for Holy Cross and 4.5 Chinook salmon and 16.0 summer chum for Shageluk. Similarly, because of confidentiality concerns due to the low number of households that fished for salmon, the 2021 Chinook salmon harvest and subsistence use for Anvik, Grayling, Kaltag, Nulato, Koyukuk, and Ruby were reported together as "Other District 4" for a total of 12 Chinook salmon. As a result, the aggregated harvest of Chinook salmon was assigned as 2.0 Chinook salmon per community. Anvik and Grayling are part of Territory 3 while Kaltag, Nulato, Koyukuk, and Ruby are part of Territory 4. Similarly, in 2021, because of the small number of Manley households that fished, Manley harvest was aggregated with "Other District 5" harvests for a total of 22 Chinook salmon and 5 summer chum salmon used for subsistence, which included harvests by fishing households from Anchorage, Douglas, Eagle River, and Wasilla. As a result, 4.4 Chinook salmon and 1.0 summer chum salmon were assigned to Manley by dividing the 22 Chinook and 5 summer chum reported by the five communities reflected in the Other District 5 category. Similarly, the 2021 coho salmon harvest and subsistence use for Manley was aggregated with "Other District 6" harvests for a total of 4 coho salmon, which included harvests by fishing households from Anchorage, Delta Junction, Lake Minchumina, Tok, and Wasilla. As a result, 0.67 coho

salmon was assigned to Manley by dividing the 4 coho reported by the six communities reflected in the "Other District 6" category.

In 2022, Chinook salmon harvests and uses for Grayling, Kaltag, Nulato, Koyukuk, Galena, and Ruby were aggregated together due to confidentiality concerns associated with the few numbers of households that fished in each community. As a result, the 75 Chinook salmon were apportioned among these six communities at 12.50 fish

each. Similarly, Chinook salmon harvest and use data for Manley and Minto were aggregated with Other District 6 data, which included Anchorage, Delta Junction, Lake Minchumina, Tok, and Wasilla. The one Chinook salmon harvested by these 7 aggregated communities was apportioned to each community as 0.14 Chinook salmon. In 2022, summer chum salmon harvests and uses for Grayling, Kaltag, Nulato, Koyukuk, Galena, and Ruby were aggregated

TCC and YRITFC have jointly developed a database of subsistence salmon use information, which includes salmon harvested under subsistence fishing regulations as well as salmon harvested in commercial fisheries that were retained for home use and salmon harvested in Yukon River test fisheries and distributed to communities for subsistence uses.[3] These data are summarized by YRITFC tribally-defined territories below and include harvest rates used for subsistence by household and per person for each of the nine YRITFC territories, including salmon use information for territories outside the TCC region (e.g., the lower Yukon River within the Association for Village Council Presidents (AVCP) service area).

This database does not contain harvests by residents of the Fairbanks North Star Borough, residents of Alaska communities outside YRITFC membership and service[4], nor Upper Tanana tribal communities of Territory 8. Communities in the uppermost reaches of the Tanana River in Alaska (YRITFC Territory 8) are associated with subsistence fishing permit requirements and local subsistence salmon fishing opportunities are limited; therefore, residents of Territory 8 sometimes travel elsewhere to subsistence fish for salmon and their Yukon River or Tanana River salmon harvests are documented in a category that includes other Alaskan communities and are not specified by community. Furthermore, some residents of Territory 8 travel to the Copper River to subsistence fish for salmon or participate in the Chitina Subdistrict personal use salmon fishery such that those harvests are documented elsewhere. As a result, YRITFC Territory 8 annual subsistence salmon use information cannot be derived from existing Yukon River salmon harvest data and therefore are not included here.

Household salmon use rates are based upon the total number of households identified by ADF&G staff for each participating community in the post-season subsistence salmon harvest survey program and reported

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together due to confidentiality concerns associated with the few numbers of households that fished in each community. As a result, the 56 summer chum salmon were apportioned among these six communities at 9.33 fish

each. Similarly, fall chum salmon and coho salmon harvest and use data for Manley and Minto were aggregated with Other District 6 data, which included Anchorage, Delta Junction, Lake Minchumina, Tok, and Wasilla. The 7 fall chum salmon and 12 coho harvested by these 7 aggregated communities was apportioned to each community as 1.0 fall chum salmon and 1.71 coho salmon.

In 2023, Chinook salmon and summer chum salmon harvests and uses for Nulato and Ruby were aggregated together into the "Other District 4" category due to confidentiality concerns associated with the few numbers of households that fished. As a result, the 3 Chinook salmon and 134 summer chum salmon reported were apportioned between the two communities at 1.5 Chinook salmon and 67 summer chum salmon each for Nulato and Ruby.

Similarly, coho salmon harvest and use data for Manley were aggregated with Other District 6 data, which included Anchorage, Delta Junction, Lake Minchumina, and Tok. The 5 coho salmon harvested by these 5 aggregated communities was apportioned as 1.0 coho salmon for each community.

[3] Hooper Bay and Scammon Bay along the Bering Sea Coast within the Yukon Fisheries Management Area were not included in the post-season subsistence salmon survey program until 1992, therefore data for these communities were lacking for 1990 and 1991. As a result, the 1992-1994 average harvests were used to estimate salmon harvests in Hooper Bay and Scammon Bay for 1990 and 1991.

[4] In 2016, ADF&G began reporting Nenana subsistence salmon harvests combined with Healy, Alaska, which is not a tribal community and therefore not a member of the YRITFC Territory 6. However, because it is not possible to separate the two communities' harvests, the human population and number of households estimated for Healy have been added to Nenana data from 2016 forward so that household and per capita subsistence salmon harvest and use metrics can be developed for Territory 6. Similarly, in 2016, ADF&G began reporting Circle salmon harvest information combined with Central, Alaska, another non-tribal community not part of YRITFC Territory 9.

Therefore, since 2016 Central harvest, human population, and number of household data have been included in Territory 9 data presentations. Data are similarly aggregated for Allakaket, Alatna, and Bettles (Territory 5), Huslia and Hughes (Territory 5), Rampart and Stevens Village (Territory 6), Fort Yukon and Birch Creek (Territory 7), and Venetie and Chalkyitsik (Territory 7) since 2016. However, because each is a YRITFC tribal community located in the same YRITFC territory, no database accommodation or adjustment is warranted.

in the annual technical reports. For communities not part of the program due to subsistence fishing permit requirements, total number of households are based upon decadal US Census data and the relationships between community populations and the number of occupied households and the Alaska Department of Labor (ADOL) annual community population estimates. Per capita salmon use rates rely similarly on decadal US Census human population estimates by Census Designated Places and annual ADOL community population estimates.[5]

Evaluating trends in household and per capita salmon use rates serves to more objectively compare salmon use patterns among YRITFC Territories because these data compensate for varying community population sizes and the number of households from one part of the watershed to another as well as changes in a particular community through time. Salmon use rates per person (per capita) data provide another perspective on YRITFC territorial use patterns that account for the differing household sizes and the availability of housing in Yukon River tribal communities.

RESULTS

Comprehensive subsistence harvest surveys provide information on the role of chum salmon in the overall subsistence economy of rural Yukon River communities and is summarized in Table A2. Patterns of reliance and use of summer chum salmon differ from those associated with fall chum salmon, which likely result from life history differences among these stocks, variations in resource availability in different parts of the watershed, and variations among Yukon River indigenous cultures and ways of life. For example, summer chum salmon typically do not migrate all the way to the Canadian border and become less palatable for human food as they reach spawning grounds and exhaust their fat reserves. This pattern contrasts with higher quality of fall chum salmon migrating to Canada.

For example, Table A2 illustrates that summer chum salmon did not contribute substantially to the subsistence economies of YRITFC Territories 8 and 9 whereas fall chum salmon contributed more than 74% of the total subsistence harvests of the Territory 9 communities of Circle and Eagle in 2017. Conversely, fall chum salmon proportionally contribute less to the subsistence economies of lower river territories where summer chum salmon contribute more to the overall subsistence economy than other salmon except Chinook salmon. Based upon available data, the middle river (e.g., YRITFC Territories 4-6) utilizes both summer chum salmon and fall chum salmon to a greater extent than Chinook salmon whereby chum salmon contribute 47% to 52% to the overall subsistence economy of Territories 4, 5, and 6. Territory 7 (e.g., Yukon Flats communities) rely on chum salmon for 35% of their total subsistence harvests, which when considered along with a 22% dependency on Chinook salmon, demonstrates that more than 57% of Territory 7's subsistence economy is dependent upon chum and Chinook salmon alone.

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[5] https://live.laborstats.alaska.gov/pop/estimates/data/TotalPopulationPlace_1990to1999.xls; https://live.laborstats.alaska.gov/pop/estimates/data/TotalPopulationPlace_2000to2010.xls; https://live.laborstats.alaska.gov/pop/estimates/data/TotalPopulationPlace_2010to2020.xls; https://live.laborstats.alaska.gov/pop/estimates/data/TotalPopulationPlace.xlsx.

Table A2. Overview of the role of chum salmon in the total subsistence economy of tribally defined Yukon River YRITFC territories.

Proportions of Total Subsistence Harvests (%)	Territory 1	Territory 2	Territory 3	Territory 4	Territory 5	Territory 6	Territory 7	Territory 8	Territory 9
Chinook Salmon	7.00	10.51	13.96	13.21	4.09	10.19	22.50	0.71	11.57
Summer Chum Salmon	**6.04**	**10.23**	**11.55**	**36.23**	**29.67**	**14.41**	**12.62**	**0.00**	**0.00**
Fall Chum Salmon	**0.03**	**2.30**	**4.27**	**11.09**	**3.48**	**37.87**	**20.77**	**0.00**	**74.24**
Unknown Chum Salmon	**9.51**	**9.81**	**0.00**	**0.03**	**17.80**	**0.00**	**1.64**	**0.14**	**0.00**
Coho Salmon	1.78	2.37	2.94	1.68	0.15	8.14	0.17	3.46	0.00
Other Salmon	1.59	0.91	0.21	0.26	0.15	0.49	0.12	5.10	0.11
Non-Salmon Fish	24.68	34.37	19.00	8.93	15.07	15.35	10.24	42.82	1.41
Large Land Mammals	12.86	17.37	36.78	24.49	23.97	9.54	23.71	32.19	10.33
Small Land Mammals	1.79	3.70	6.20	2.10	1.79	1.66	3.57	7.10	0.34
Marine Mammals	26.09	3.53	0.18	0.00	0.00	0.00	0.00	0.00	0.00
Birds and Eggs	5.75	3.18	3.61	1.08	2.86	1.43	4.13	4.64	0.90
Marine Invertebrates	0.11	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00
Vegetation	2.76	1.69	1.29	0.89	0.97	0.93	0.53	3.84	1.08
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The pattern of chum salmon, and salmon overall, contributing approximately half or more of the total subsistence economies of Territories 4, 5, 6, 7, and 9 contrasts with Territories 1, 2, and 3 where 15%, 22%, and 16% of their total subsistence harvests comprise chum salmon and all salmon combined represent 26%-36% of the overall subsistence economies of these lower river and coastal territories. It is also important to note that commercial salmon fisheries in the lower river have contributed important income that is often reinvested into their subsistence economy (e.g., Wolfe 1981), which is not accounted for in comprehensive subsistence harvest survey data reported here.

The lesser dependence of Territories 1-3 on salmon for subsistence uses, and particularly chum salmon, is not because residents of the lower river are not equally dependent upon salmon to meet important food security, cultural, and spiritual needs, but rather because they also have a pattern of utilizing marine mammals and non-salmon to a greater extent than territories further upriver. For example, marine mammals contribute to only the subsistence economies of Territories 1-3 as marine mammals are largely unavailable to residents upriver in Territories 4-9. Similarly, non-salmon fish harvests are greatest in Territories 1-3 where a variety of non-salmon species are more abundant and more widely available, except for Territory 8 where non-salmon fishes contribute 43% of the total subsistence economy of Upper Tanana communities in the absence of local salmon stocks available for subsistence fishing.[6] The number of fish species available for subsistence fishing along with their abundances decline as one moves upriver from the Bering Sea Coast and lower Yukon River into Interior Alaska and these representative subsistence harvest composition data reflect these patterns.

Yukon River Patterns of Salmon Used for Subsistence, 1990-2023

Annual post-season subsistence salmon harvest and use surveys provide comparable information from 1990 to the present and are useful in understanding the change patterns of salmon use throughout the Yukon River drainage in Alaska.

Figure A2 illustrates the number of Yukon River salmon used for subsistence from 1990-2023 focusing on Chinook salmon, summer and fall chum salmon, and coho salmon.[7] Overall, salmon available from

[6] Tribal communities in Territory 8 have long considered themselves as whitefish people.

[7] While pink salmon may have become more significant sources of salmon used for subsistence in coastal waters and the lower Yukon River given salmon fishing closures to conserve Chinook and chum salmon, historically, pink salmon have not been used for subsistence in significant quantities within the TCC region of Interior Alaska. For example, in the period 2000-2010, average pink salmon harvests were 154 fish in District 4 and 28 fish in District 5, which together encompass YRITFC Territories 3-7 and 9 (Jallen et al. 2012c:Appendix B8). Average pink salmon

subsistence fishing, test fisheries distributions, and retained from commercial fishing for subsistence uses has declined significantly since 1990. While tribal elders and other long-time Yukon River fishing households have noted that salmon abundance and subsistence harvests began to decline well before 1990, the data reported here demonstrate the previous salmon crash of Chinook and chum salmon in the late 1990s and early 2000s with its resulting

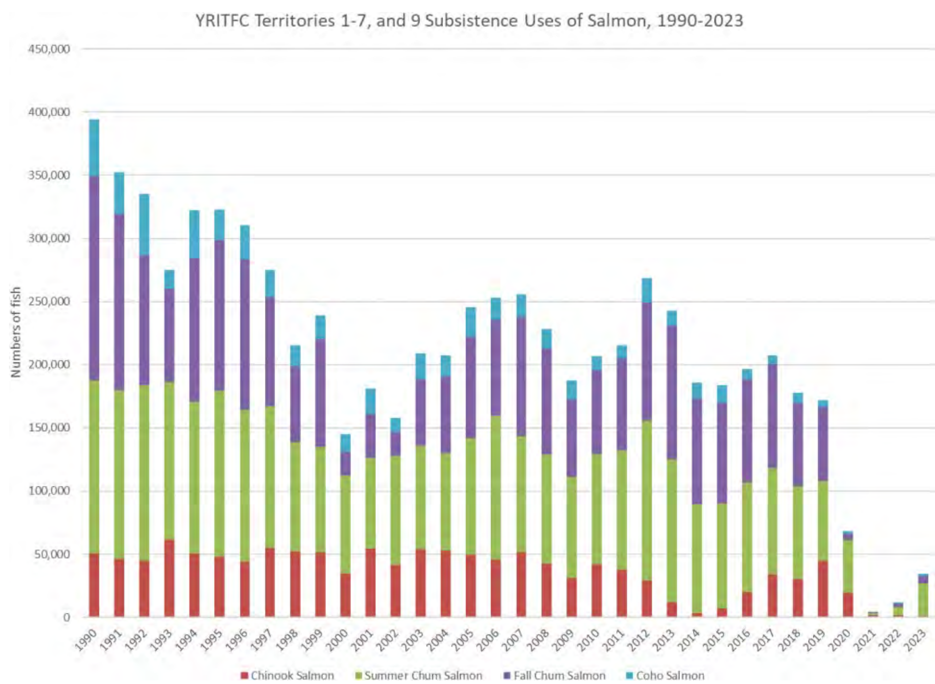

Figure A2. Yukon River salmon used for subsistence, including Chinook, summer chum, fall chum, and coho salmon, 1990-2023.

impacts on salmon availability for subsistence uses. Also of note is that the post-2000 "recovery" of Yukon River salmon populations failed to restore subsistence salmon uses to levels experienced in the 1990s.

Much of the decline in Yukon River salmon subsistence uses related directly to Chinook salmon. Subsistence uses of Yukon River Chinook salmon used to approach 50,000 fish annually in the 1990s. For example, the 1990-1994 five-year average number of Chinook salmon used for subsistence by YRITFC Territories was 50,631 fish and 50,082 fish during the subsequent five-year period of 1995-1999. Then, in 2000, only 34,447 Chinook salmon were used for subsistence followed by 2002 (41,368 fish), 2005 (49,364), 2006 (45,824), 2008 (42,718), and 2009 (31,111). Subsistence uses of Chinook salmon exceeded 50,000 fish in 2001, 2003, 2004, and 2007. The average number of Chinook salmon used was 47,322 fish in 2000-2004 and 44,094 fish in 2005-2009. The five-year averages dramatically declined for the 2010-2014 and 2015-2019 periods with 24,747 fish and 27,167 Chinook salmon used for subsistence,

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harvests from 2010-2020 in District 4 was 27 fish and in District 5 six fish (Padilla and Hamazaki 2024:Appendix C5). As a result, pink salmon are not considered in this report.

respectively. In 2020, YRITFC territorial uses of Chinook salmon was 19,566 fish, with a 2021-2023 average of only 1,463 Yukon River Chinook salmon available for subsistence uses.

Summer Chum Salmon

Declines in the availability of summer chum salmon also contributed to the overall decline in the number of Yukon River salmon used for subsistence as depicted in Figure A3.

The 1990-2023 average number of summer chum salmon annually used for subsistence was 88,965 fish among all YRITFC territories. The 1990-1994 average number of summer chum salmon used for subsistence was 131,165, which declined to an average of 106,781 fish during the subsequent 1995-1999 period, reflecting the impacts of the weak returns of chum salmon in 1997 and 1998. The 2000s represented further declines in summer chum salmon uses for subsistence with a 2000-2004 average of 79,170 fish and a 2005-2009 average of 92,845 fish. The 2010-2014 average number of Yukon River summer chum salmon available for subsistence use was 101,664 fish reflecting the relatively high harvests of 2012 and 2013 both of which exceeded 110,000 fish. The 2015-2019 average dropped to 78,253 summer chum salmon used for subsistence followed 41,575 in 2020 and the catastrophic collapse of chum salmon in 2021 with only 1,304 fish available for subsistence uses and 2022 with 6,745 summer chum salmon used.

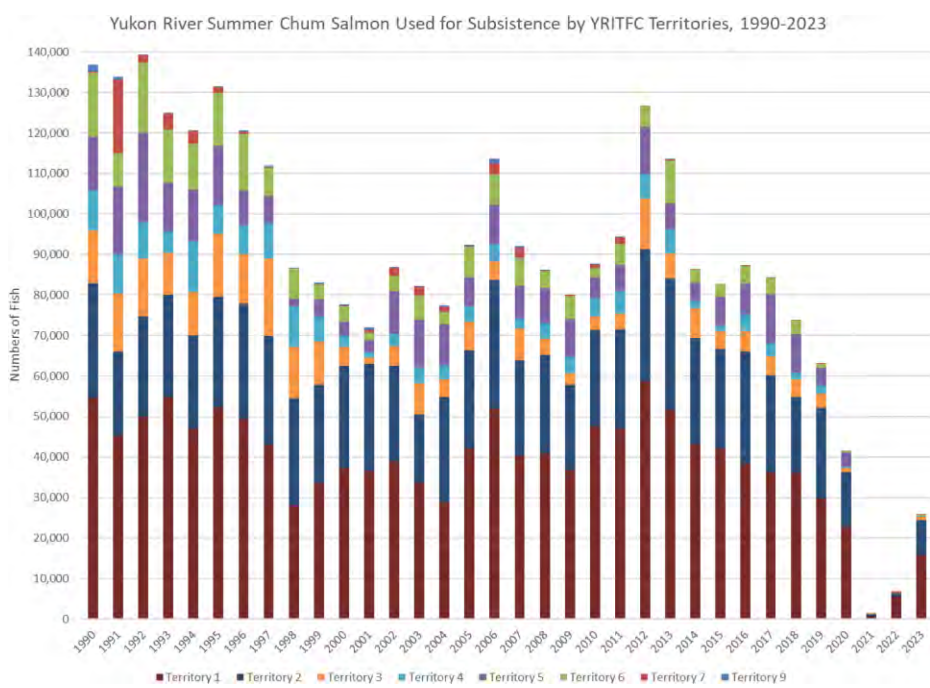

Figure A3. Yukon River summer chum salmon used for subsistence, by YRITFC Territory, 1990-2023.

Yukon River summer chum salmon returns were reported to have improved somewhat in 2023, but only 25,804 summer chum salmon were available for subsistence uses.

Figure A4 and Figure A5 illustrate summer chum salmon household use rates, while Figure A6 and Figure A7 illustrate the number of summer chum salmon used per person within YRITFC Territories, all of which serve to further demonstrate the overall decline in summer chum salmon availability for subsistence uses.

Figure A4 reflects the total number of summer chum salmon per household used for subsistence by YRITFC territories each year from 1990-2023 demonstrating a declining trend since 1990 as well as the recent collapse of chum salmon returns to the Yukon River. Figure A5 represents those same data but rather than stacking the number of salmon per household for each territory to reflect the entire river, each Territory's household use rate is charted individually by a line so that each territory's patterns of use might be more clearly distinguished from one another.

Household patterns of summer chum salmon use

During the period of 1990-2023, the number of Yukon River summer chum salmon used for subsistence per YRITFC territorial households declined from a high of 407 summer chum salmon used for subsistence per household in 1992 to a low of 2.19 fish per households in 2021. The 1990-1994 average was 346.48 summer chum used per household, which declined to an average of 257.95 fish per household in 1995-1999, an average of 181.37 summer chum used per household in 2000-2004, an average of 217.79, 199.66, and 150.82 fish per household in 2005-2009, 2010-2014, and 2015-2019 periods, respectively. In 2020, only 75.08 summer chum salmon were used for subsistence per household river wide, followed by 2.19 fish per household in 2021, 9.47 fish per household in 2022, and 36.94 summer chum salmon used per household in 2023.

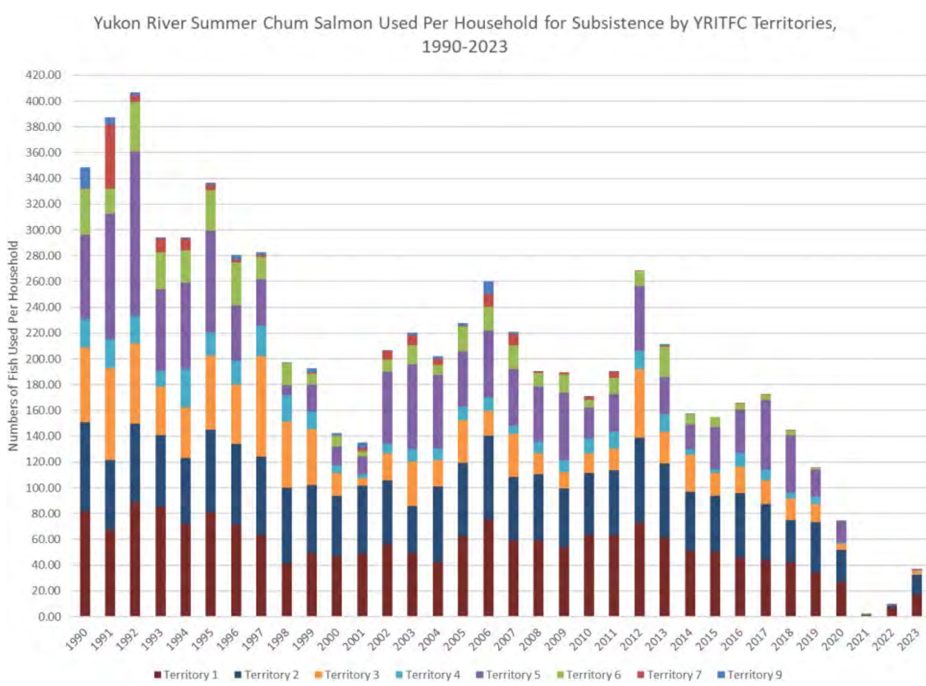

Figure A4. Yukon River summer chum salmon used for subsistence per household, by YRITFC Territory, 1990-2023.

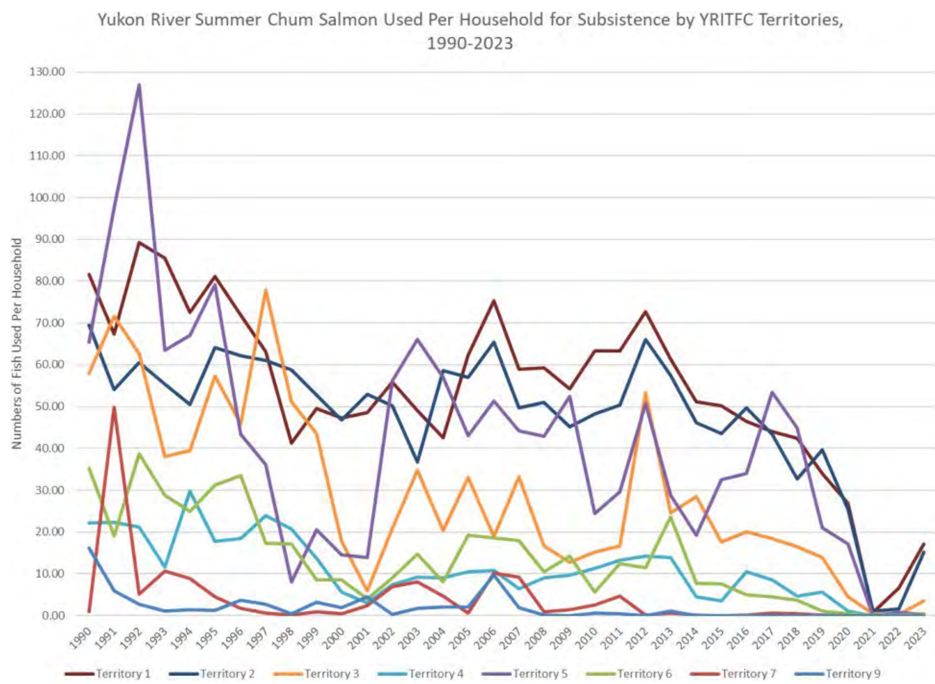

Figure A5. Yukon River summer chum salmon used for subsistence per household, by YRITFC Territory, 1990-2023.

Household use rates of Yukon River summer chum salmon varied dramatically for some territories more than others. In the early 1990s, for example, typically the highest number of summer chum salmon used per household for subsistence were from YRITFC Territories 1 (Bering Sea Coast), 2 (Lower Yukon River) and 5 (Koyukuk River). The highest household rate of summer chum salmon use throughout the time series was 127.04 fish per household within Territory 5 of the Koyukuk River in 1992. The second highest rate of 97.52 summer chum salmon per household was in 1991 also from Koyukuk River communities that comprise YRITFC Territory 5. The 1990-1994 average household use rate for summer chum salmon for Territory 5 was 84.09 fish per household, which exceeded all other territories for this period, followed by Territory 1 with an average of 79.23 summer chum salmon used for subsistence per household, then Territory 2 at 57.97 and Territory 3 at 53.92 fish per household. During the next five-year period, 1995-1999, Territory 5's household use rate dropped in rank to fourth at 37.43 fish per household compared to 61.37, 59.77, and 55.15 summer chum salmon used for subsistence per household by Territories 1, 2, and 3, respectively. Consistently ranking fifth in number of summer chum salmon harvested per household in the 1990s was Territory 6, followed by Territory 4. Territory 7's summer chum salmon household use rate was an average of 15.10 fish per household in 1990-1994 and 1.57 in 1995-1999. Territory 9's summer chum salmon use rate was an average of 5.42 fish per household in 1990-1994 and 2.24 fish per household in the 1995-1999 period.

Territory 5 subsistence uses of summer chum salmon per household returned to the highest rate among all territories in 2002 at 56.15 fish, followed by Territory 1 with 55.81 fish per household, Territory 2 with 50.11 fish per household, and Territory 3 with 20.88 fish per household. The year 2003 represented a similar pattern with 66.08 summer chum used per household in Territory 5, 49.01 fish per household, 36.78 fish per household, 34.71 fish per household for Territories 1-3, respectively. However, during the 2000s, Territory 5 ranked third highest for uses of summer chum salmon per household with a 2000-2004 and 2005-2009 average of 41.51 and 46.77 fish per household, respectively. Territory 1's 2000-2004 average household use rate was 48.63 summer chum salmon per household and 2005-2009 average household use rate was 62.00 fish per household. Territory 2's respective rates were 49.04 fish per household and 53.66 summer chum per household. Territory 3 consistently ranked fourth in household use rates in the 2000s, followed by Territories 6, 4, 7, and 9.

In the 2010s, Territory 5 consistently ranked third in household use rates of summer chum salmon following Territories 1 and 2 except for 2012 and 2014 when Territory 3's household rates exceeded those of Territory 5 such that Territory 3 ranked third those years and Territory 5 ranked fourth. Territories 6, 4, 7, and 9 consistently ranked below the other territories. The 2010-2014 average household summer chum salmon use rate for Territory 6 was 12.12 fish used per household compared to Territory 4's average of 11.42. However, the 2015-2019 average for Territory 6 was 4.37 fish used per household whereas the average during the same time period for Territory 4 was 6.57 summer chum salmon used per household.

Per capita patterns of summer chum salmon use

Yukon River summer chum salmon rates of subsistence use per person illustrated in Figure A6 demonstrate similar patterns of decline across the watershed as those for household rates (cf. Figure A4). Figure A7, however, illustrates that uses of summer chum salmon per capita consistently were highest among the residents of YRITFC Territory 5 within the Koyukuk River drainage except following the weak chum salmon returns of 1997 and 1998. Throughout the 1990-2023 period, the highest use of summer chum per capita documented was 45.47 fish per person in Territory 5 in 1992 with a 1990-1994 five-year average of 30.70 fish per person, followed by Territory 1 (15.82 fish per person), Territory 3 (12.94 fish per person), Territory 2 (11.48 fish per person), Territory 6 (10.75 fish per person), Territory 4 (5.66 fish per person), Territory 7 (5.31 fish per person), and Territory 9 (2.13 summer chum salmon per person). In 1997, Territory 5 per capita uses of summer chum salmon ranked second with 13.09 fish per person, following Territory 3's 19.62 fish per person used for subsistence. In 1998, Territory 5 per capita use rate dropped in rank to sixth at 3.39 summer chum salmon used per person, following Territory 3's 12.57 fish per person, Territory 2's 11.48 fish per person, Territory 1's 7.65 fish per person, Territory 4's 6.81 fish per person, and Territory 6's 6.37 fish per person. In 1998, Territory 9 used 0.19 summer chum salmon per person and Territory 7 used 0.04 fish per person. However, despite the reductions in Territory 5's per capita uses of summer chum salmon following the weak returns of chum salmon in 1997 and 1998, the 1995-1999 average for Territory 5 overall remained the second highest use rate at 13.81 fish per person following Territory 3's average of 14.15. Territory 2 ranked third with 11.88 fish per person and Territory 1 ranked fourth with 11.59 fish per person, followed by Territory 6 (7.77 fish per person), Territory 4 (5.38 fish per person), Territory 9 (0.87 fish per person), and Territory 7 (0.52 fish per person).

In the 2000s, the Koyukuk River's Territory 5 once again had the highest uses of Yukon River summer chum salmon per capita except for the years 2000 and 2001 when Territory 5 ranked third after Territory 2 and Territory 1. The 2000-2004 average uses of summer chum salmon per person was 13.52 fish per person for Territory 5, followed by Territory 2 (10.24 fish per person), Territory 1 (9.49 fish per person), Territory 3 (4.89 fish per person), Territory 6 (3.38 fish per person), Territory 4 (1.88 fish per person), Territory 7 (1.28 fish per person), and Territory 9 (0.86 summer chum salmon used for subsistence per person). The 2005-2009 five-year averages demonstrated that Territory 5 remained the territory with the highest per capita uses of summer chum salmon (15.38 fish per person), followed by Territory 1 (11.36 fish per person), Territory 2 (10.52 fish per person), Territory 6 (6.22 fish per person), Territory 3 (6.04

fish per person), Territory 4 (2.74 fish per person), Territory 7 (1.29 fish per person), and Territory 9 (1.13 fish per person).

During the five-year period 2010-2014, the ranking of territories with the highest per capita uses of Yukon River summer chum salmon varied considerably from year to year. However, on average, Territory 1 ranked first (12.44 fish per person), followed by Territory 2 (11.15 fish per person), Territory 5 (10.93 fish per person), Territory 3 (7.73 fish per person), Territory 6 (4.84 fish per person), Territory 4 (3.87 fish per person), Territory 7 (0.61 fish per person), and Territory 9 (0.18 fish per person). The subsequent five-year period of 2015-2019 resulted in average per capita uses of summer chum salmon once again ranking Territory 5 at the highest levels of use with 12.59 fish per person, followed by Territory 2 (9.03 fish per person), Territory 1 (8.39 fish per person), Territory 3 (4.66 fish per person), Territory 4 (2.15 fish per person), Territory 6 (1.78 fish per person), and 0.10 fish per person used by Territory 7. Territory 9 had no documented per capita uses of summer chum salmon during the 2015-2019 period.

The years 2020-2023 witnessed the worst returns of summer chum salmon to the Yukon River documented in recent history. The four-year average per capita uses of summer chum salmon for the Alaska portion of the Yukon River totaled only 7.24 fish per person. Territory 1 ranked highest with an average use of 2.55 summer chum salmon per person, followed by Territory 2 (2.44 fish per person), Territory 5 (1.50 fish per person), Territory 3 (0.52 fish per person), Territory 4 (0.13 fish per person), and Territory 6 (0.10 fish per person). There were no documented uses of summer chum salmon in Territories 7 and 9 during the 2020-2023 period.

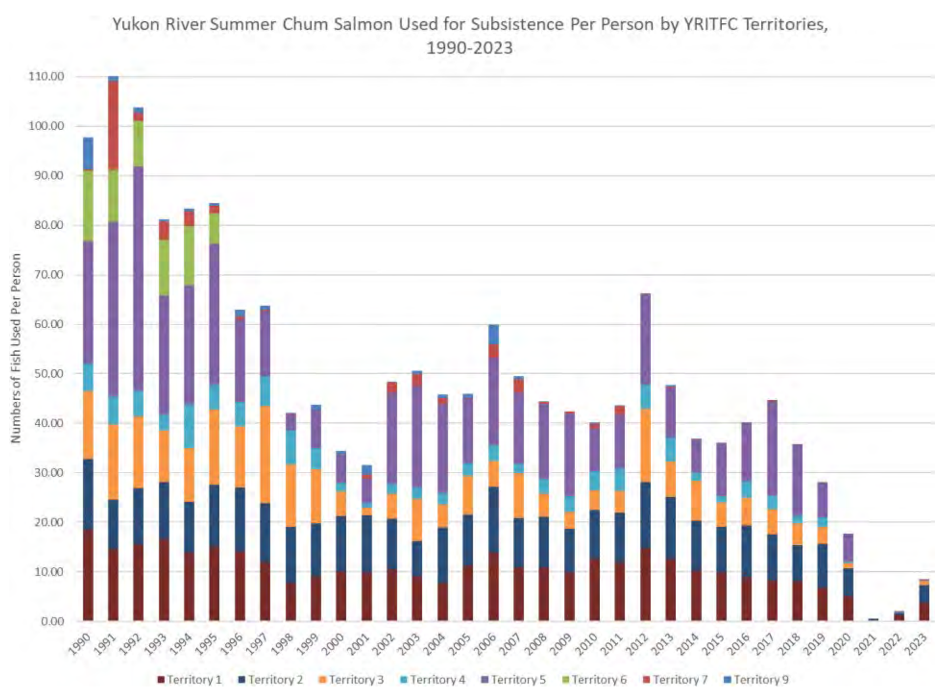

Figure A6. Yukon River summer chum salmon used for subsistence per person, by YRITFC Territory, 1990-2023.

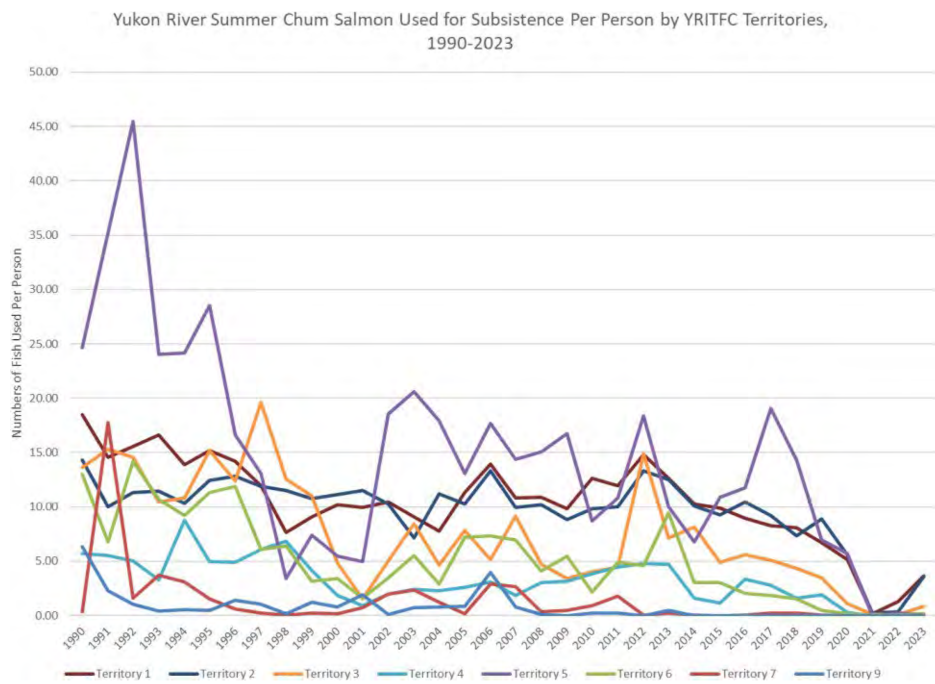

Figure A7. Yukon River summer chum salmon used for subsistence per person, by YRITFC Territory, 1990-2023.

Fall Chum Salmon

Declines in the availability of fall chum salmon also contributed to the overall decline in the number of Yukon River salmon used for subsistence as depicted in Figure A8.

The 1990-2023 average number of fall chum salmon annually used for subsistence was 72,021 fish among all YRITFC territories. The 1990-1994 average number of fall chum salmon used for subsistence was 118,266, which declined to an average of 94,047 fish during the subsequent 1995-1999 period, reflecting the impacts of the weak returns of chum salmon in 1997 and 1998. The 2000s represented further declines in fall chum salmon uses for subsistence with a 2000-2004 average of only 37,101 fish and a 2005-2009 average of 79,386 fish. In 2002, only 18,489 Yukon River fall chum salmon were used for subsistence, representing the lowest uses on record since 1990 until the most recent chum salmon collapse beginning in 2020. In 2000, only 19,086 and in 2001 only 34,657 fall chum salmon were used for subsistence representing the second and third lowest fall chum salmon uses on record prior to 2020. The collapse in the number of fall chum salmon used for subsistence in the early 2000s was followed by modest recovery of fall chum salmon uses beginning in 2003 when the total number of fall chum salmon used for subsistence once again exceeded 50,000 fish until the most recent crash beginning in 2020. Since 1996, the number of fall chum salmon used for subsistence exceeded 100,000 fish only once in 2013 with 105,716 fish, which nevertheless failed to reach the 1990-1994 average of 118,266 fall chum salmon used for subsistence across the watershed.

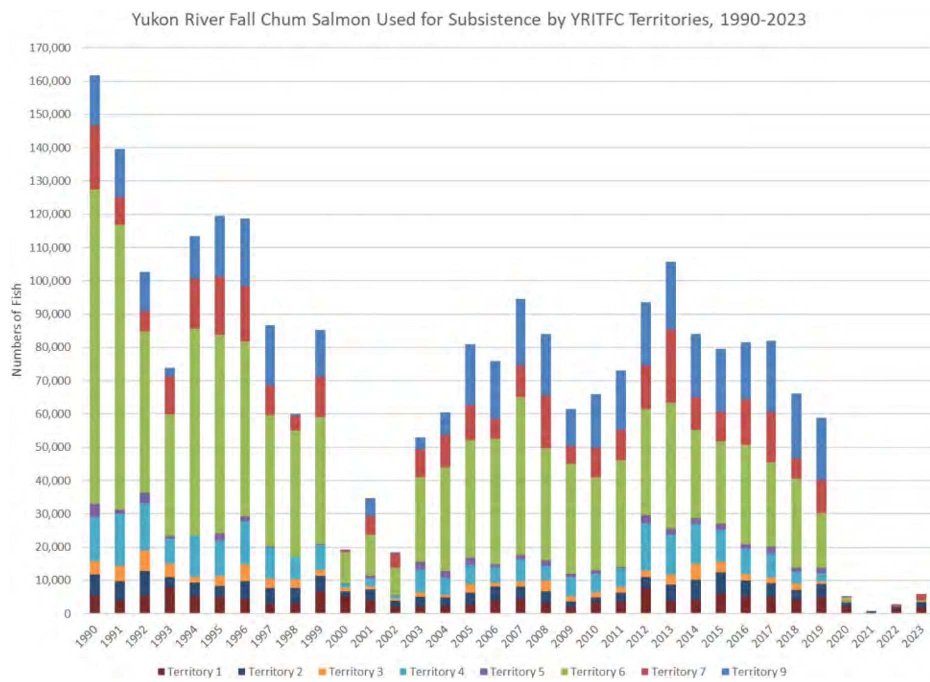

Figure A8. Yukon River fall chum salmon used for subsistence, by YRITFC Territory, 1990-2023.

The 2010-2014 average number of Yukon River fall chum salmon used for subsistence was 84,438 fish and the 2015-2019 average was 73,616 fall chum salmon. In 2020, only 5,128 fall chum salmon were used for subsistence throughout the Yukon River drainage, followed by 704 fall chum salmon in 2021, 2,657 in 2022, and 5,947 in 2023.

Figures A9 and A10 illustrate fall chum salmon household use rates, while Figures A11 and A12 illustrate the number of fall chum salmon used per person within YRITFC Territories, all of which serve to further demonstrate the overall decline in subsistence uses of fall chum salmon punctuated by the collapses in 2000-2002 and 2020 to the present.

Household patterns of fall chum salmon use

Figure A9 reflects the total number of fall chum salmon per household used for subsistence by YRITFC territories each year from 1990-2023. Figure A10 represents those same data but rather than stacking the number of salmon per household for each territory to reflect the entire river, each Territory's household use rate is charted individually by a line so that each territory's patterns of use might be more clearly distinguished from one another.

During the period of 1990-2023, the number of Yukon River fall chum salmon used for subsistence per YRITFC territorial households declined from a high of 491 fall chum salmon used for subsistence per household in 1990 to a low of 1.15 fish per households in 2021. The 1990-1994 average was 363.38 fall chum used per household, which declined to an average of 339.46 fish per household in 1995-1999, an average of 116.88 fall chum used per household in 2000-2004, an average of 318.86, 321.29, and 247.67 fish per household in 2005-2009, 2010-2014, and 2015-2019 periods, respectively. In 2020, only 8.28 fall chum salmon were used for subsistence per household river wide, followed by 1.15 fish per household in 2021, 5.07 fish per household in 2022, and 11.14 fall chum salmon used per household in 2023.

Household use rates of Yukon River fall chum salmon varied dramatically for some territories more than others. Territory 9, for example, typically demonstrated the highest territorial uses of fall chum salmon throughout most of 1990-2023 time series with dramatic declines in household rates of use in 1993, 1998, 2000-2002, and the most recent period beginning in 2020 consistent with weak chum salmon returns to the Yukon River in those years. YRITFC Territory 6 typically demonstrated the second highest uses of fall chum salmon per household following Territory 9 except in 1990, 1991, 1993, 1994, 1998, 2000, 2002-2004, and 2020-2023 when Territory 6's household rates of fall chum salmon use exceeded those of Territory 9. The years when Territory 9 uses of fall chum salmon ranked second were years of poor fall chum salmon returns to the Yukon watershed, except for 1990, 1991, and 1994, which demonstrates how poor salmon returns oftentimes disproportionately affect those most dependent on Yukon River fall chum salmon.

Five-year average household use rates of Yukon River fall chum salmon for subsistence provide a general overview of use patterns across YRITFC territories. The average household use of fall chum salmon from 1990-1994 demonstrated the highest use rate occurred in Territory 6 with 147.09 fish per household, followed by Territory 9 with 105.16 fish per household, then Territory 7 (32.58 fish per household), Territory 4 (29.23 fish per household), Territory 3 (17.90 fish per household), Territory 2 (12.75 fish per household), Territory 5 (9.75 fish per household), and

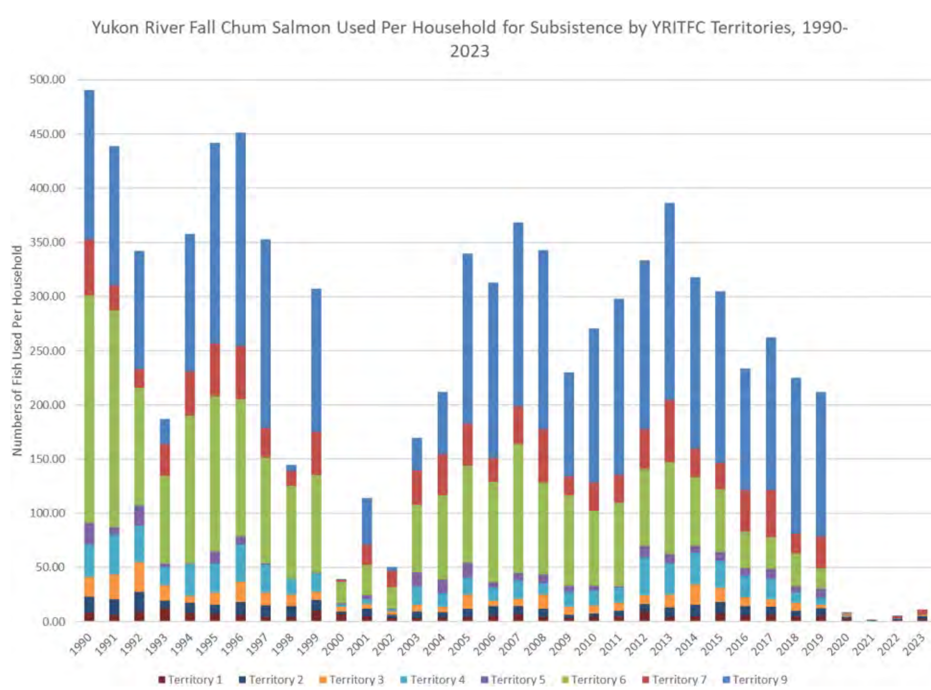

Figure A9. Yukon River fall chum salmon used for subsistence per household, by YRITFC Territory, 1990-2023.

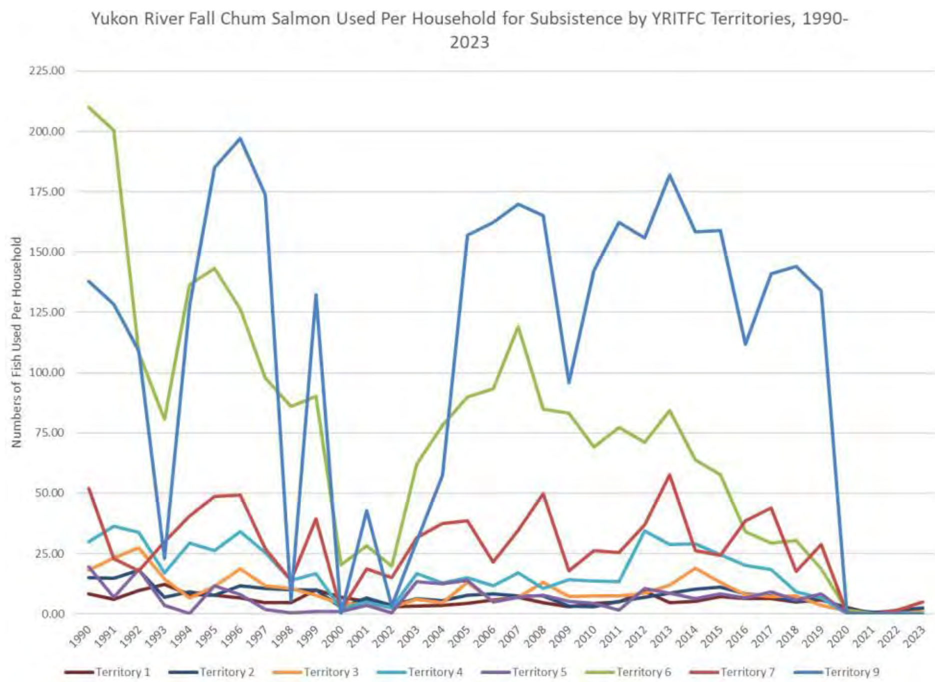

Figure A10. Yukon River fall chum salmon used for subsistence per household, by YRITFC Territory, 1990-2023.

Territory 1 (8.92 fish per household). The 1995-1999 average saw Territory 9 rank first with 138.69 fall chum used per household, followed by Territory 6 (108.65 fish per household), Territory 7 (35.63 fish per household), Territory 4 (23.28 fish per household), Territory 3 (11.97 fish per household), Territory 2 (10.01 fish per household), Territory 1 (6.71 fish per household), and Territory 5 (4.52 fish per household). The 2000-2004 five-year average rates of fall chum salmon used per household illustrated the poor fall chum salmon returns during that period with Territory 6 ranking first with only 41.70 fish per household, followed by Territory 9 (26.77 fish per household), Territory 7 (20.92 fish per household), Territory 4 (7.75 fish per households), Territory 5 (6.15 fish per household), Territory 2 (4.89 fish per household), Territory 1 (4.41 fish per household), and Territory 3 (4.28 fish per household). In the 2005-2009 five-year period, Territory 9 ranked first with 149.98 fish per household used for subsistence followed by Territory 6 (94.05 fish per household), Territory 7 (32.47 fish per household), Territory 4 (13.73 fish per household), Territory 3 (9.13 fish per household), Territory 5 (7.74 fish per household), Territory 2 (6.81 fish per household), and Territory 1 (4.95 fish per household). Territory 9 again ranked first in household use rates of Yukon River fall chum salmon during the subsequent 2010-2014 five-year period with 160.14 fall chum salmon used per household followed by Territory 6 (73.14 fish per household), Territory 7 (34.47 fish per household), Territory 4 (23.90 fish per household), Territory 3 (10.87 fish per household), Territory 2 (6.75 fish per household), Territory 5 (6.28 fish per household), and Territory 1 (5.74 fish per household). The five-year average household use rates during 2015-2019 demonstrated the same ranking of household use rates as the previous five-year period with Territory 9 ranked first with 137.90 fall chum salmon used per household, followed by Territory 6 (34.06 fish per household), Territory 7 (30.64 fish per household), Territory 4 (15.81 fish per household), Territory 3

(7.82 fish per household), Territory 2 (7.74 fish per household), Territory 5 (7.58 fish per household), and Territory 1 (6.12 fish per household). Household rates of fall chum salmon use for 2000-2023 are discussed below.

Throughout the data series 1990-2023, YRITFC Territory 7 household uses of Yukon River fall chum salmon are consistently ranked the third highest typically following Territories 9 and 6 household use rates as demonstrated by the five-year average rates for 1990-1994 (32.58 fish per household), 1995-1999 (35.63 fish per household), 2000-2004 (20.92 fish per household), 2005-2009 (32.47 fish per household), 2010-2014 (34.47 fish per household), and 2015-2019 (30.64 fish per household) where Territory 7 always ranked third on average. However, in 1991, 1992, 1993, 2000, 2003, 2014, 2015, 2017, and the 2019-2023 period, Territory 7 ranked other than third in the number of fall chum salmon used per household. For example, in 1993, 2003, 2017, 2019, and 2022, Territory 7's household use rates of fall chum salmon ranked second across the watershed, exceeding Territory 9's rates in 1993 and 2003 and Territory 6's rates in 2017 and 2019, and exceeding Territory 1's household use rate in 2022. In 2023, Territory 7's uses of fall chum salmon per household was the highest across the YRITFC territories, but with only 4.89 fish used per household.

In 1991, Territory 7 ranked fifth with only 22.83 fall chum salmon used per household following Territory 6 (200.29 fish per household), Territory 9 (128.29 fish per household), Territory 4 (36.23 fish per household), and Territory 3 (23.07 fish per household). In 1992, Territory 7 ranked sixth with only 17.76 fall chum salmon used per household following Territory 9 (109.07 fish per household), Territory 6 (108.27 fish per household), Territory 4 (33.83 fish per household), Territory 3 (27.27 fish per household), and Territory 2 (18.05 fish per household). In 2000, household uses of fall chum salmon in Territory ranked sixth with only 1.51 fall chum salmon per household following Territory 6 (20.27 fish per household), Territory 1 (6.82 fish per household), Territory 3 (4.08 fish per household), Territory 2 (2.63 fish per household), and Territory 4 (2.12 fish per household). In 2014 and 2015, the household use rate of fall chum salmon of 26.21 fish and 24.26 fish, respectively, ranked fourth following Territory 9 (158.38 and 158.85 fish per household, respectively), Territory 6 (63.76 and 57.76 fish per household, respectively), and Territory 4 (29.14 and 24.67 fish per household, respectively). In 2020, Territory 7's household use rate ranked fifth with only 0.51 fish per household exceeded by Territory 1 (2.65 fish per household), Territory 2 (1.74 fish per household), Territory 6 (1.64 fish per household), and Territory 3 (1.27 fish per household). In 2021, Territory 7's use of fall chum salmon per household ranked fourth with a mere 0.02 fish per household following Territory 2's 0.82 fall chum salmon per household, Territory 1's 0.22 fish per household, and Territory 6's 0.10 fish per household.

Territory 4 and Territory 3 typically ranked fourth and fifth, respectively, throughout the 1990-2023 time series, with Territory 4 only exceeding 30 fall chum salmon used per household in 1991, 1992, 1996, and 2012. Territory 3's household use rates only exceeded 15 fall chum per household in 1990-1992, and 1996. Territory 5's household fall chum use rates only exceeded 15 fish per household in 1990 and 1992. Territory 2's household use rates exceeded 15 fish per household only in 1990 and 1992 while Territory 1 used more than 10 fall chum per household only in 1993.

Per capita patterns of fall chum salmon use

Yukon River fall chum salmon rates of subsistence use per person illustrated in Figure A11 demonstrate similar patterns of decline across the watershed as those for household rates, especially in the past decade (cf. Figure A9). Figure A12, illustrates that uses of fall chum salmon per capita consistently were highest among the residents of YRITFC Territories 9, 6, and 7 consistent with territorial household rates of fall chum salmon uses. Yukon River fall chum salmon per capita use rates across the watershed ranged from 175.39 fish per person in 1990 to a historical low of 0.27 fish per person in 2021.

The 1990-1994 five-year average use of fall chum per capita for all territories combined was 125.87 fish per person, ranging from average highs of 53.63 fish per person in Territory 6, 40.99 fish per person in Territory 9, and 11.52 fish per person in Territory 7 to average lows of 1.77 fish per person in Territory 1 and 2.50 fish per person in Territory 2. The 1995-1999 average was similar at 119.05 fish per person overall with an average range of 53.82 fish per person in Territory 9, 39.27 fish per person in Territory 6, and 11.43 fish per person in Territory 7 to average lows of 1.26 fish per person in Territory 1 and 1.67 fish per person in Territory 5. Per capita uses of fall chum were particularly low in 1993 and 1998 at 63.14 and 48.44 fish per person during those years of poor chum salmon returns to the Yukon River. All other years in the 1990s demonstrated per capita use rates that exceeded 100 fish per person.

The average number of Yukon River fall chum salmon used per person during the 2000-2004 five-year period was the lowest documented uses of fall chum salmon until the most recent crash of Yukon River chum salmon returns with only 39.76 fish used per person throughout the YRITFC territories of the Yukon watershed in Alaska. This historical low was driven particularly by the lows of 2000 and 2002 among all YRITFC territories with only 12.92 and 16.09 fish used per person, respectively. Despite these poor years of fall chum salmon returns in 2000 and 2002, the 2000-2004 averages demonstrated that Territory 6 ranked first with 15.72 fish per person, followed by Territory 9 with 11.13 fish per person and Territory 7 with 5.92 fish per person consistent with overall patterns throughout the data time series albeit with much lower levels of use.

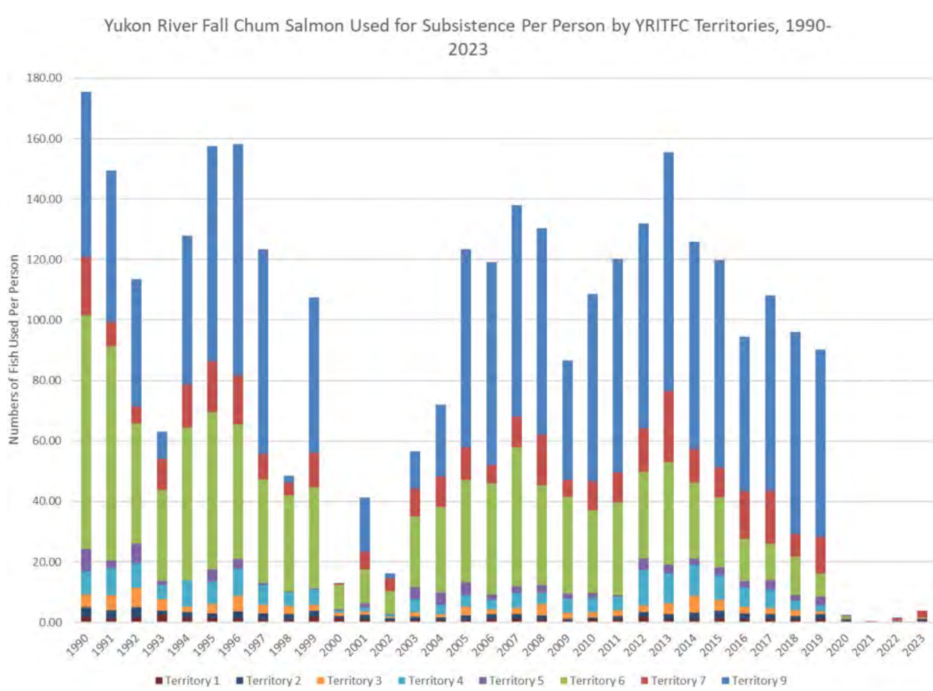

Figure A11. Yukon River fall chum salmon used for subsistence per person, by YRITFC Territory, 1990-2023.

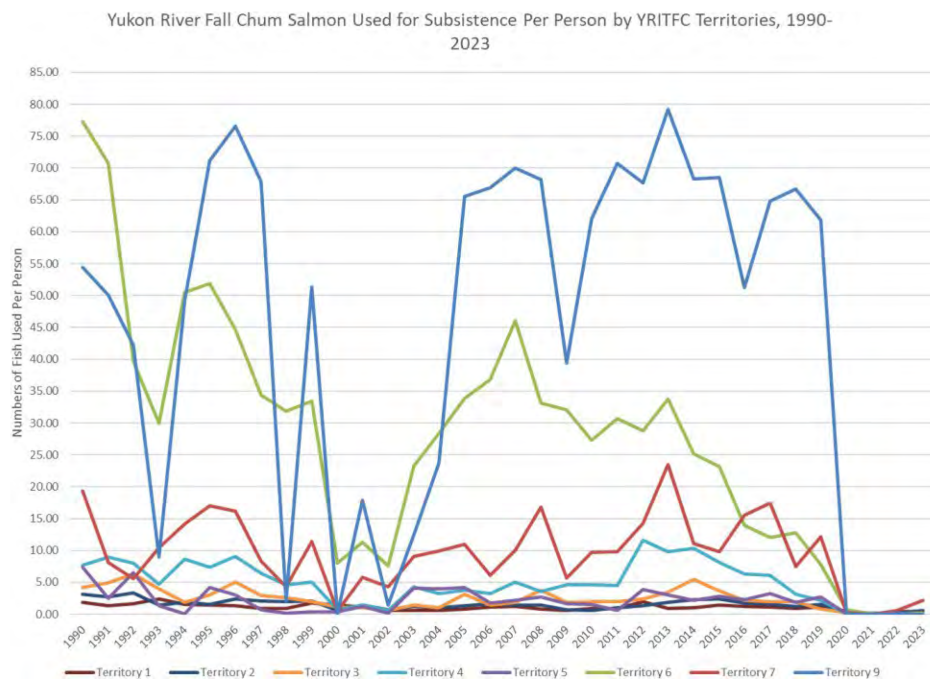

Figure A12. Yukon River fall chum salmon used for subsistence per person, by YRITFC Territory, 1990-2023.

The 2005-2009 average per capita uses of fall chum salmon recovered to 119.49 fish per person overall with 61.99, 36.38, and 9.90 fish used per person in Territories 9, 6, and 7, respectively. Ranking fourth during the 2005-2009 period was Territory 4 (4.04 fish per person) followed by Territory 5 (2.51 fish per person), Territory 3 (2.42 fish per person), Territory 2 (1.33 fish per person), and Territory 1 (0.91 fish per person).

The 2010-2014 average number of fall chum salmon used for subsistence across all YRITFC Territories was 128.43 fish per person with a generally consistent pattern among territories of Territory 9 ranking first (69.59 fish per person), followed by Territory 6 (29.14 fish per person), Territory 7 (13.66 fish per person), Territory 4 (8.18 fish per person), Territory 3 (3.06 fish per person), Territory 5 (2.23 fish per person), Territory 2 (1.42 fish per person), and Territory 1 (1.15 fish per person). All years during 2010-2014 exceeded 100 fall chum salmon used per person across all territories.

The 2015-2019 average per capita uses of fall chum salmon was 101.75 fish per person overall, with Territory 9 again ranking highest with 62.62 fish per person, followed by Territory 6 (13.92 fish per person), Territory 7 (12.49 fish per person), Territory 4 (5.18 fish per person), Territory 5 (2.57 fish per person), Territory 3 (2.13 fish per person), Territory 2 (1.67 fish per person), and Territory 1 (1.18 fish per person). During the 2015-2019 five-year period, only 2015 and 2017 demonstrated overall subsistence per capita uses of fall chum salmon that exceeded 100 fish per person, with 94.58 fish per person overall in 2016, 95.99 and 90.23 fish per person in 2018 and 2019, respectively.

Overall per capita uses of Yukon River fall chum salmon in 2020-2023 were the lowest documented rates of use on record with only 2.28 fish per person used in 2020, 0.27 fish per person in 2021, 1.47 fish per person in 2022, and 3.73 fish per person in 2023. In 2020, the highest rate of use was Territory 6 with 0.69 fish used per person, followed by Territory 1 (0.51 fish per person), Territory 2 (0.38 fish per person), Territory 3 (0.31 fish per person), Territory 7 (0.23 fish per person), Territory 5 (0.11 fish per person), Territory 9 (0.03 fish per person), and lastly Territory 4 (0.02 fish per person). In 2021, the only documented per capita uses of fall chum salmon occurred in Territory 2 (0.18 fish per person), Territories 1 and 6 (0.04 fish per person each), and Territory 7 (0.01 fish per person). Territories 3-5 and Territory 9 used no fall chum salmon in 2021. In 2022, per capita uses ranked first in Territory 7 (0.60 fish per person), followed by Territory 1 (0.33 fish per person), Territory 2 (0.21 fish per person), Territory 9 (0.15 fish per person), Territory 5 (0.10 fish per person), Territory 3 (0.04 fish per person), Territory 6 (0.03 fish per person), and Territory 4 (0.01 fish per person). In 2023, Territory 7 again ranked first with 2.20 fish per person, followed by Territory 2 (0.60 fish per person), Territory 1 (0.49 fish per person), Territories 3 and 6 (0.22 fish per person each), and Territory 5 (0.01 fish per person). Territories 4 and 9's per capita uses of fall chum salmon were zero in 2023.

Recent years of poor fall chum salmon returns demonstrated that those territories most dependent upon Yukon River fall chum salmon (i.e. Territories 9 and 6) did not maintain their respective ranks in per capita uses of fall chum salmon unlike the previous chum crash in the early 2000s. Whether these hardships result from fishery management actions, different perspectives on conservation among the residents of various territories, or for other reasons remain uncertain.

YRITFC Territorial Patterns of Salmon Uses for Subsistence

This section focuses on patterns of Yukon River salmon uses during the 1990-2023 time series to better understand the role of chum salmon relative to other salmon stocks for each YRITFC territory beginning in Territory 1 consisting of Bering Sea Coastal tribal communities located near the mouths of the Yukon River and moving upriver to Territory 9 near the Canadian border. Territory 8, representing the upper Tanana River, is discussed in little detail since salmon uses are not well represented in existing ADF&G data documenting subsistence uses of Yukon River salmon and many residents of Territory 8 obtain their salmon from the Copper River or elsewhere outside the Yukon Fisheries Management Area.

Territory 1

Figure A13 illustrates the subsistence harvest composition for communities in YRITFC Territory 1. Territory 1 communities reflected in this analysis include Chevak (data year 2021), Scammon Bay (2013), Hooper Bay (2021), Nunam Iqua (1980), Alakanuk (1980), Kotlik (1980), and Emmonak (1980, 2008) along the Bering Sea coast and the lowest reaches of the Yukon River drainage. Territory 1 residents are the most coastal oriented harvesters of Yukon River salmon where marine mammals (26.09%) and salmon (25.95%) made up the highest percentages of the total subsistence harvest among Territory 1 communities followed by non-salmon fishes (24.68%) and large land mammals (12.86%). Chum salmon, including both summer chum and fall chum along with unknown chum salmon, contributed 15.58% to the overall subsistence economy based upon this generalized model. ADF&G studies conducted in the 1980s often did not distinguish between summer chum and fall chum salmon; therefore, the proportion of each chum salmon stock is difficult to determine. The generalized model of Territory 1 subsistence harvest composition estimates summer chum salmon at 6.04%, fall chum salmon at 0.03%, and unknown chum salmon at 9.51% of the overall subsistence economy.

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 1 tribal communities in 1990-2023, except Scammon Bay and Hooper Bay for the years 1990 and 1991. The 1992-1994 average salmon harvests were used to estimate the 1990 and 1991 harvests for both communities in this analysis. Figure A14 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence. Summer chum salmon dominate the subsistence uses of salmon in YRITFC Territory 1 representing an average of 75% of total salmon uses in 1990-1994 and 2015-2019, 74% in 1995-1999 and 2000-2004, 79% in 2005-2009, 81% in 2010-2014, and an average of 66% during the period 2020-2023.

The proportion of total subsistence salmon uses contributed by fall chum salmon in Territory 1 ranged from 4% to 13%, except in 2022 when the proportion of fall chum was 18% of total salmon uses. In the 1990s, the average proportion of fall chum salmon uses was 8% followed by 6-7% in the 2000s, an average of 7% in 2010-2014 and 11% in 2015-2019. Territory 1's proportion of fall chum salmon relative to other salmon was 7%, 11%, 18%, and 11% in 2020, 2021, 2022, and 2023, respectively.

Chinook salmon represented 4-19% of total Territory 1 subsistence uses of salmon except in 2021 when Chinook represented 45% of salmon uses and in 2023 when Chinook represented only 2% of salmon uses for subsistence. Coho salmon uses ranged from 2% to 8% of total salmon uses.

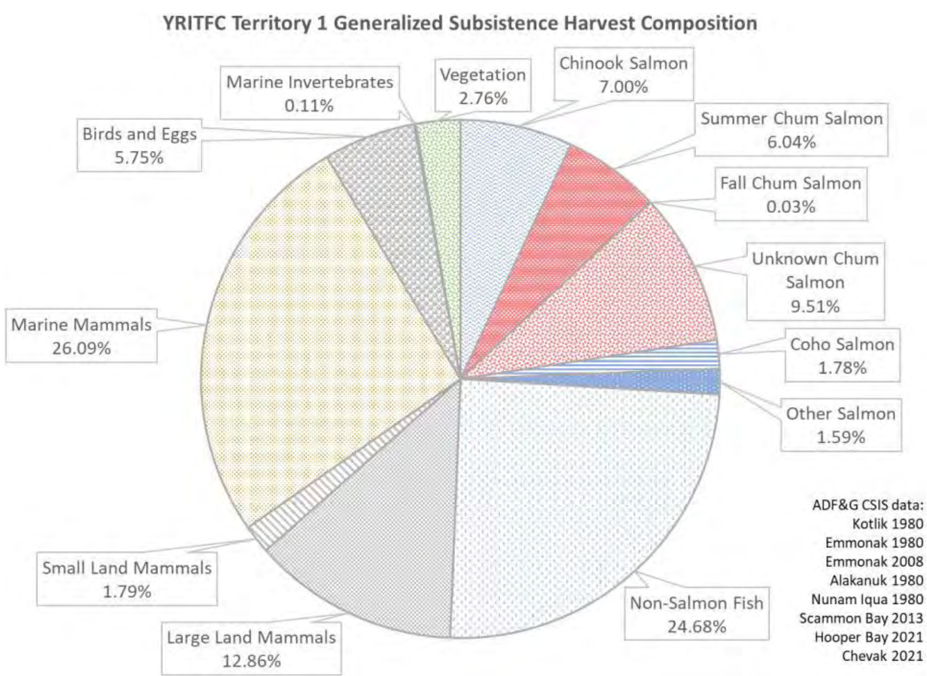

Figure A13. YRITFC Territory 1 generalized subsistence harvest composition (in edible pounds).

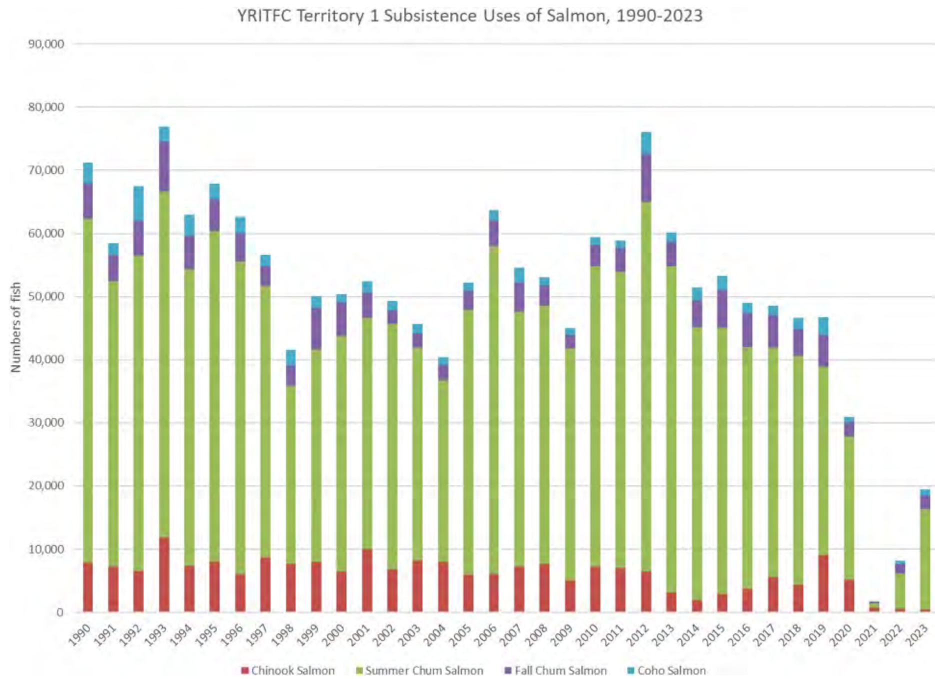

Figure A14. YRITFC Territory 1 subsistence uses of salmon, 1990-2023.

Pink salmon, not considered in this analysis, likely also contributes to Territory 1 subsistence uses of salmon, especially during years of restricted subsistence salmon fishing for Chinook, chum, and coho salmon.

Figure A15 represents Territory 1 subsistence uses of summer chum salmon and Figure A16 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series. The number of summer chum salmon used in YRITFC Territory 1 ranged from a high of 58,611 fish in 2012 to a low of 657 salmon in 2021, the worst year on record for summer chum salmon uses. The 1990-2023 average number of summer chum salmon annually used for subsistence was 38,864 fish in Territory 1, representing an average of 44% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence was 50,297 fish, followed by 41,343 summer chum salmon in 1995-1999, 35,079 summer chum salmon in 2000-2004, 42,423 summer chum salmon in 2005-2009, and an average of 49,590 summer chum salmon in 2010-2014, and 36,575 fish in 2015-2019. In 2020, 22,668 summer chum salmon were used for subsistence, followed by 657 fish in 2021, 5,601 fish in 2022, and 15,916 summer chum salmon in 2023. The number of summer chum salmon used in Territory 1 exceeded 45,000 fish in the 1990s, except in 1997-1999 with 42,959, 28,250, and 33,630 fish, respectively. In the 2000s, uses of summer chum salmon exceeded 40,000 fish only in 2005-2008, otherwise ranging from 28,882 fish in 2004 to 38,903 fish in 2002. In the 2010s, Territory 1's uses of summer chum salmon exceeded 40,000 fish in 2010-2015, but fell below 40,000 in 2016-2019 with 38,402, 36,312, 36,236, and 29,815 fish, respectively.

Territory 1 household use rates of summer chum salmon averaged 79.23 fish per household in 1990-1994, 61.37 fish per household in 1995-1999, 48.63 fish per household in in 2000-2004, 62.00 fish per household in 2005-2009, 62.35 fish per household in 2010-2014, and 43.40 fish per household in 2015-2019. Household use rates fell to 26.76 summer chum salmon per household in 2020, 0.78 fish per household in 2021, 6.60 fish per household in 2022, and 17.17 fish per household in 2023. The number of summer chum salmon used for subsistence by Territory 1 households declined over the time series with rates of use almost halved during the chum salmon declines of the late 1990s and early 2000s when rates fell to less than 50 fish per household in 1998-2004, except 2002 when 55.81 fish per household were used. Household rates of summer chum salmon use somewhat recovered in 2005-2015 when use rates exceeded 50 fish per household; however, only in 2006 and 2012 did rates exceed 70 fish per household and approached historic levels of household uses in the early to mid-1990s. The number of summer chum salmon used per Territory 1 household once again fell below 50 fish per household in 2016, fell below 40 fish per household in 2019 where rates have continued to decline during the most recent chum salmon crash.

Territory 1 per capita uses of summer chum salmon averaged 15.82 fish per person in 1990-1994, 11.59 fish per person in 1995-1999, 9.49 fish per person in 2000-2004, 11.36 fish per person in 2005-2009, 12.44 fish per person in 2010-2014, and 8.39 fish per person in 2015-2019. In 2020-2023, per capita uses of summer chum salmon were 5.12, 0.15, 1.28, and 3.65 fish per person, respectively. The number of summer chum salmon used per person for subsistence exceeded 10 fish per person in most years except in 1998, 1999, 2001, 2003, 2004, 2009, and 2015-2023.

Figure A17 represents Territory 1 subsistence uses of fall chum salmon and Figure A18 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. The number of fall chum salmon used in YRITFC Territory 1 ranged from a high of 7,890 in 1993 to a low of 182 in 2021, the worst year on record for both summer and fall stocks of

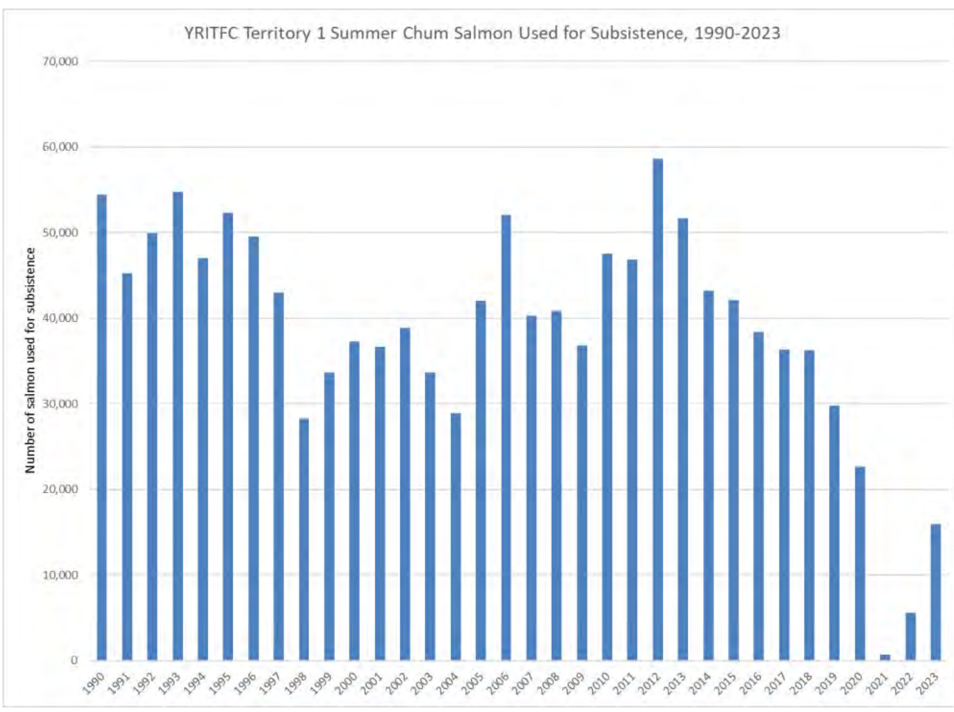

Figure A15. YRITFC Territory 1 subsistence uses of summer chum salmon, 1990-2023.

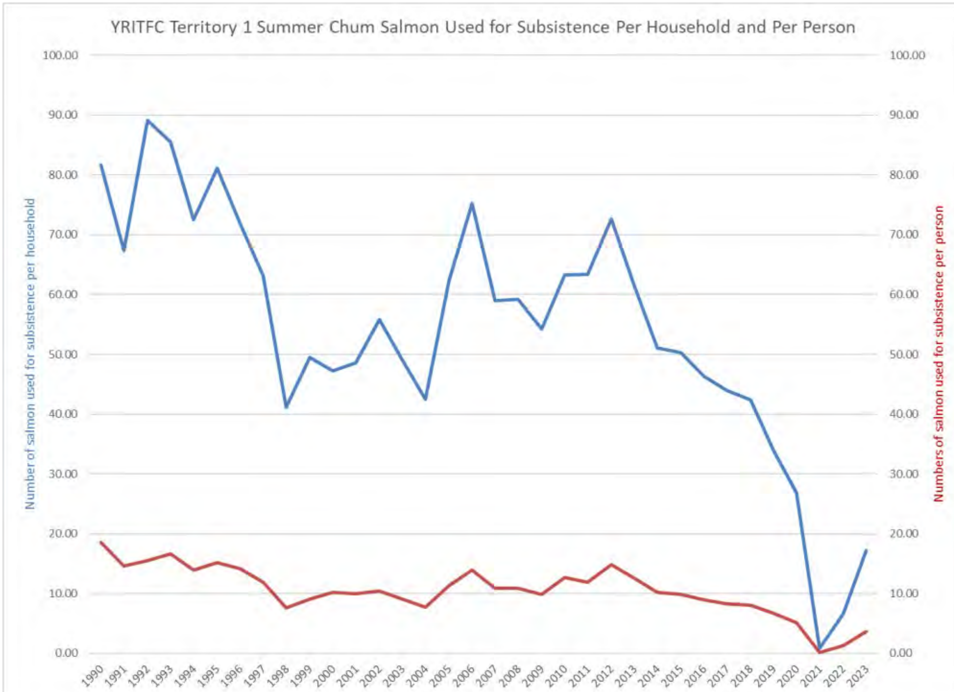

Figure A16. YRITFC Territory 1 subsistence uses of summer chum salmon per household and per person, 1990-2023.

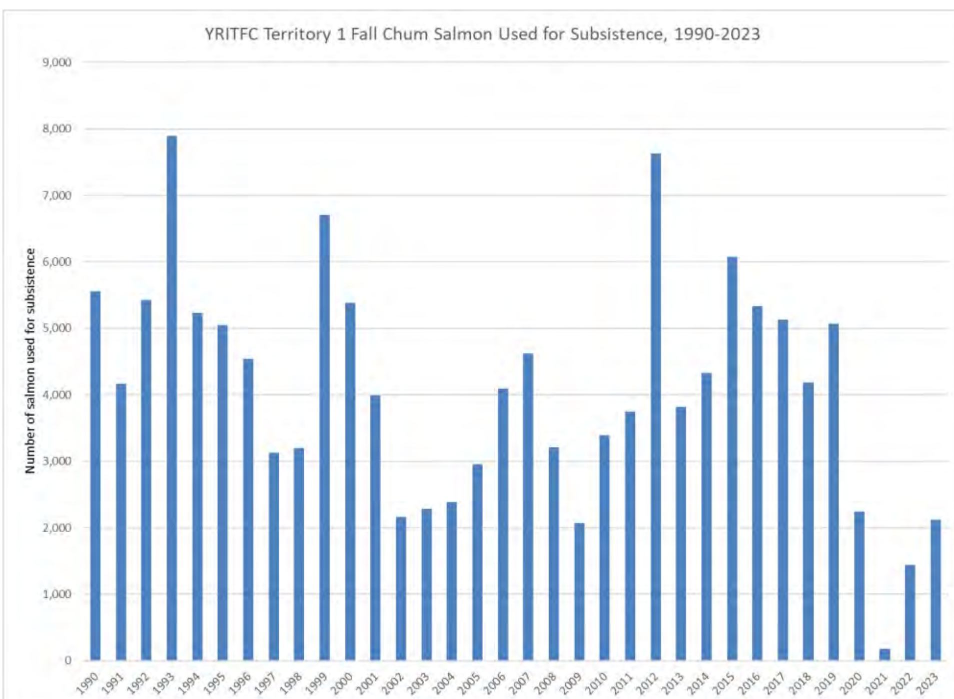

Figure A17. YRITFC Territory 1 subsistence uses of fall chum salmon, 1990-2023.

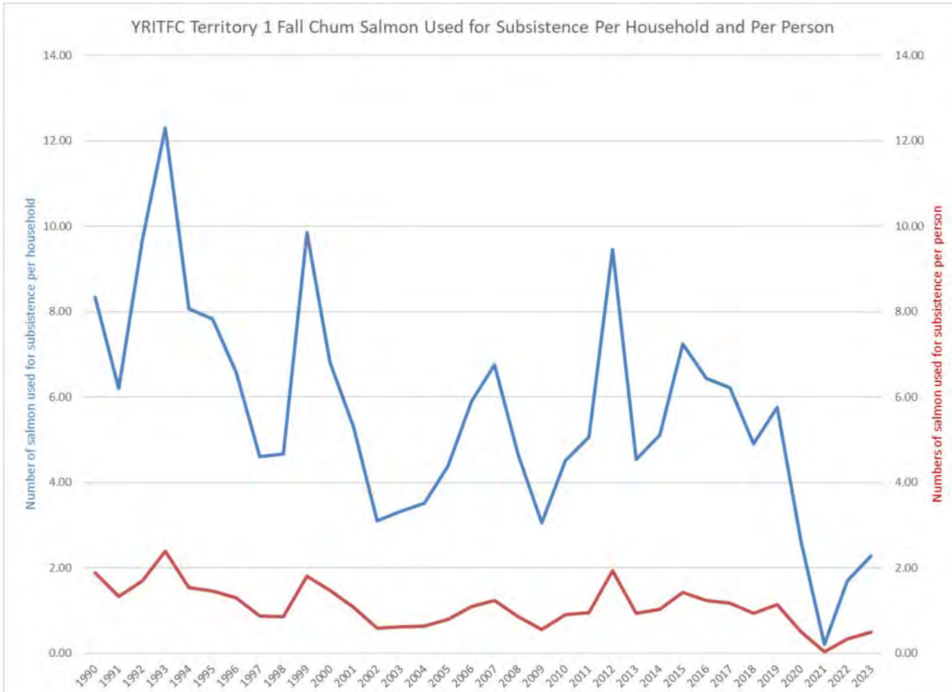

Figure A18. YRITFC Territory 1 subsistence uses of fall chum salmon per household and per person, 1990-2023.

chum salmon. The 1990-2023 average number of fall chum salmon annually used for subsistence was 4,081 fish in Territory 1, representing an average of 6% of the total uses among all territories. The 1990-1994 five-year average number of fall chum salmon used for subsistence was 5,653 fish, followed by 4,525 fall chum salmon in 1995-1999, 3,243 fall chum salmon in 2000-2004, 3,391 fall chum salmon in 2005-2009, and an average of 4,583 fall chum salmon in 2010-2014, and 5,159 fish in 2015-2019. In 2020, 2,246 fall chum salmon were used for subsistence, followed by 182 fish in 2021, 1,444 fish in 2022, and 2,121 fall chum salmon in 2023. Territory 1 household use rates of fall chum salmon varied considerably annually throughout the 1990-2023 time series from a high of 12.31 fish per household in 1993 to a historic low of 0.22 fish per household in 2021. The number of fall chum salmon used per household averaged 8.92 fish in 1990-1994, 6.71 fish per household in 1995-1999, 4.41 fish per household in in 2000-2004, 4.95 fish per household in 2005-2009, 5.74 fish per household in 2010-2014, and 6.12 fish per household in 2015-2019. Household use rates fell to 2.65 fall chum salmon per household in 2020, 0.22 fish per household in 2021, 1.70 fish per household in 2022, and 2.29 fish per household in 2023. Territory 1 household use rates of fall chum salmon only exceeded 10 fish per household in 1993 and only fell below 4 fish per household in 2002-2004 and 2009 prior to the most recent chum salmon disaster beginning in 2020.

Territory 1 per capita uses of Yukon River fall chum salmon ranged from a high of 2.39 fish per person in 1993 to a low of 0.04 fish per person in 2021. The 1990-1994 average per capita rates of fall chum salmon use were 1.77 fish per person, an average of 1.26 fish per person in 1995-1999, 0.88 fish per person in 2000-2004, 0.91 fish per person in 2005-2009, 1.15 and 1.18 fish per person in 2010-2014 and 2015-2019, respectively. Territory 1's per capita use of fall chum salmon was 0.51, 0.04, 0.33. and 0.49 fish per person, respectively, during the 2020-2023 period. The number of fall chum salmon used per person in Territory 1 exceeded 1 fish per person in the 1990s except in 1997 and 1998 when only 0.87 fish per person were used each year. During the 2000s, per capita uses exceeded 1 fish per person only in

2000, 2001, 2006, and 2007. In the 2010s, Territory 1 per capita rates of fall chum salmon use fell below 1 fish per person only in 2010 (0.90 fish per person), 2011 (0.95 fish per person), 2013 (0.93 fish per person), and 2018 (0.93 fish per person). In 2020, the number of fall chum salmon used per person in Territory 1 was 0.51 fish per person, followed by 0.04 fish per person in 2021, 0.33 fish per person in 2022, and 0.49 fish per person in 2023.

Territory 2

Figure A19 shows the results of a generalized model of subsistence harvest composition for communities in YRITFC Territory 2 for which comprehensive subsistence harvest data are available. Territory 2 communities reflected in this analysis include Mountain Village (data years 1980, 2010), Marshall (2010), and Pilot Station (2013). Territory 2 residents depend upon fish for 70.50% of their overall subsistence economy, with all salmon combined contributing 36.13% and non-salmon fishes contributing 34.37%. Large land mammals contribute the next highest proportion of the total subsistence economy of Territory 2 communities at 17.37%. ADF&G studies conducted in the 1980s often did not distinguish between summer chum and fall chum salmon; therefore, the proportion of each chum salmon stock is difficult to determine with precision. Chum salmon, including both summer chum and fall chum along with unknown chum salmon, contributed 22.34% to the overall subsistence economy, whereas Chinook salmon harvests represent 10.51% and other salmon such as coho and pink salmon contribute only 3.28% of the overall subsistence economy.

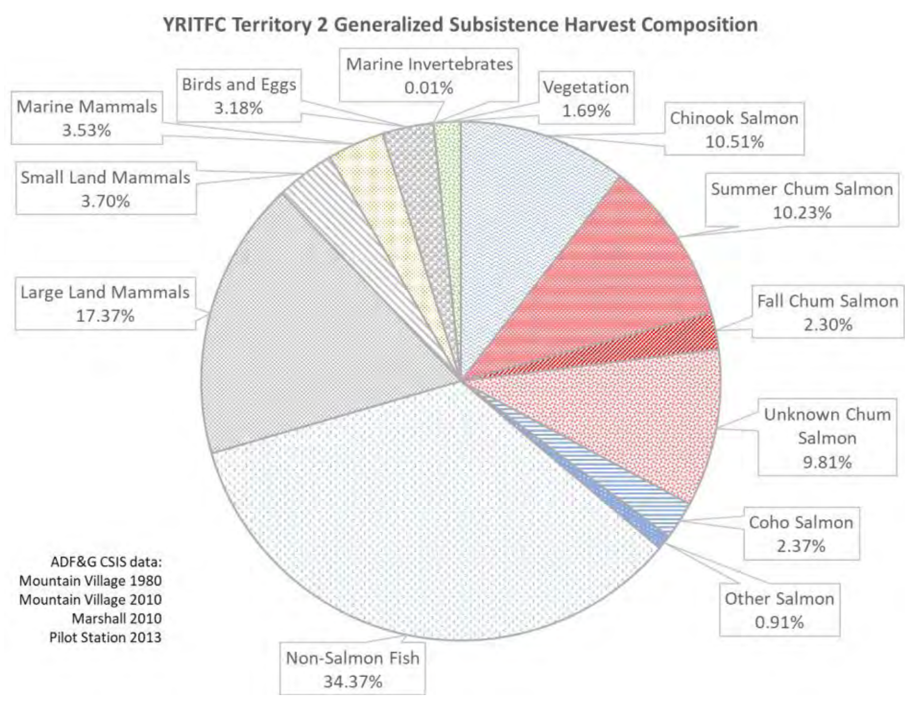

Figure A19. YRITFC Territory 2 generalized subsistence harvest composition (in edible pounds).

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 2 tribal communities in 1990-2023.

Figure A20 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence. Summer chum salmon dominate the subsistence uses of salmon in YRITFC Territory 2 representing an average of 57% of total salmon uses in 1990-1994, 62% in 1995-1999 and 2000-2004, 65% in 2005-2009, 74% in 2010-2014, 70% in 2015-2019, and an average of 55% during the period 2020-2023.

The proportion of total subsistence salmon uses contributed by fall chum salmon in Territory 2 ranged from 4% (2000 and 2010) to 18% (2015), except in 2021 and 2022 when the proportion of fall chum was 24% and 25% of total salmon uses, respectively. In the 1990s, the average proportion of fall chum salmon uses was 10-12% followed by an average of 6-8% in the 2000s, an average of 10% in 2010-2014 and 13% in 2015-2019. Territory 2's proportion of fall chum salmon relative to other salmon was 5% in 2020 and 14% in 2023.

Chinook salmon represented overall 15-31% of total Territory 2 subsistence uses of salmon except in 2013 (3% Chinook salmon), 2014 (2%), 2015 (3%), 2016 (9%), 2017 (14%), 2021 (40%), and 2023 (3%). Coho salmon uses ranged from 2% to 14% of total salmon uses. Pink salmon, not considered in this analysis, likely also contributes to Territory 2 subsistence uses of salmon, especially during years of restricted subsistence salmon fishing to conserve other salmon stocks.

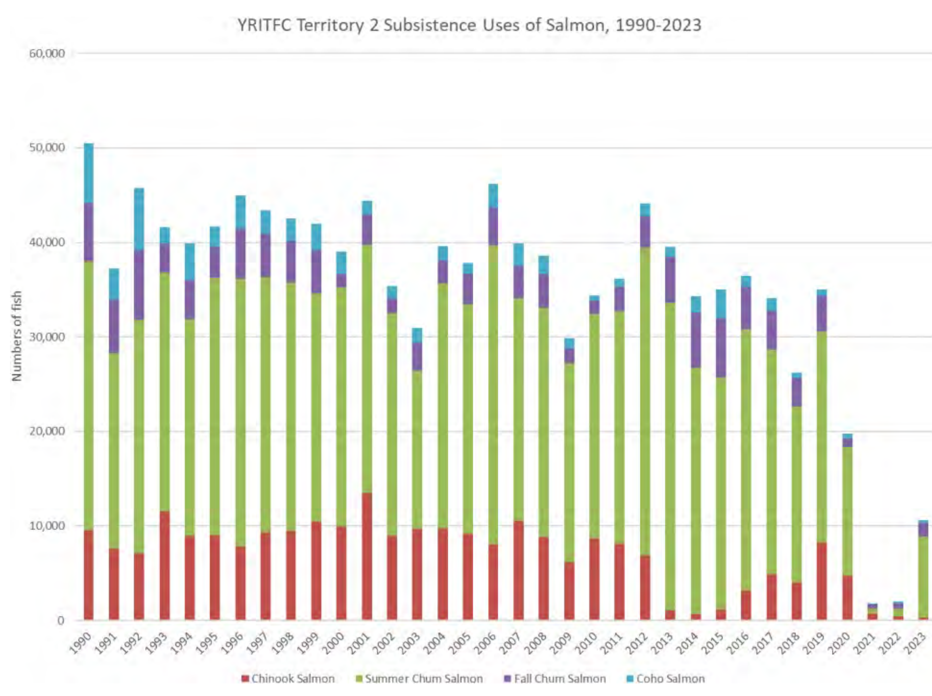

Figure A20. YRITFC Territory 2 subsistence uses of salmon, 1990-2023.

Figure A21 represents Territory 2 subsistence uses of summer chum salmon and Figure A22 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series.

The number of summer chum salmon used in YRITFC Territory 2 ranged from a high of 32,500 fish in 2012 to 16,773 fish in 2003 between 1990 and 2019. Figure A21 does not reflect a particularly noticeable pattern of overall decline in the number of Yukon River summer chum salmon used for subsistence as found in other YRITFC territories.

The 1990-2023 average number of summer chum salmon annually used for subsistence was 22,881 fish in Territory 2, representing an average of 26% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence was 24,418 fish, followed by 26,601 summer chum salmon in 1995-1999, 23,578 summer chum salmon in 2000-2004, 24,964 summer chum salmon in 2005-2009, and an average of 27,926 summer chum salmon in 2010-2014, and 23,389 fish in 2015-2019. In 2020, Territory 2 used 13,635 summer chum salmon, followed by 539, 840, and 8,567 fish in 2021, 2022, and 2023, respectively. Subsistence uses of summer chum salmon in Territory 2 fell below 20,000 fish only in 2003 (16,773 fish), 2018 (18,616 fish), and in 2020-2023. Territory 2 uses of summer chum salmon exceeded 25,000 fish in 1990, 1993, 1995-1998, 2000-2001, 2004, 2006, 2012-2014, and 2016.

Territory 2 household use rates of summer chum salmon averaged 57.97 fish per household in 1990-1994, 59.77 fish per household in 1995-1999, 49.04 fish per household in in 2000-2004,

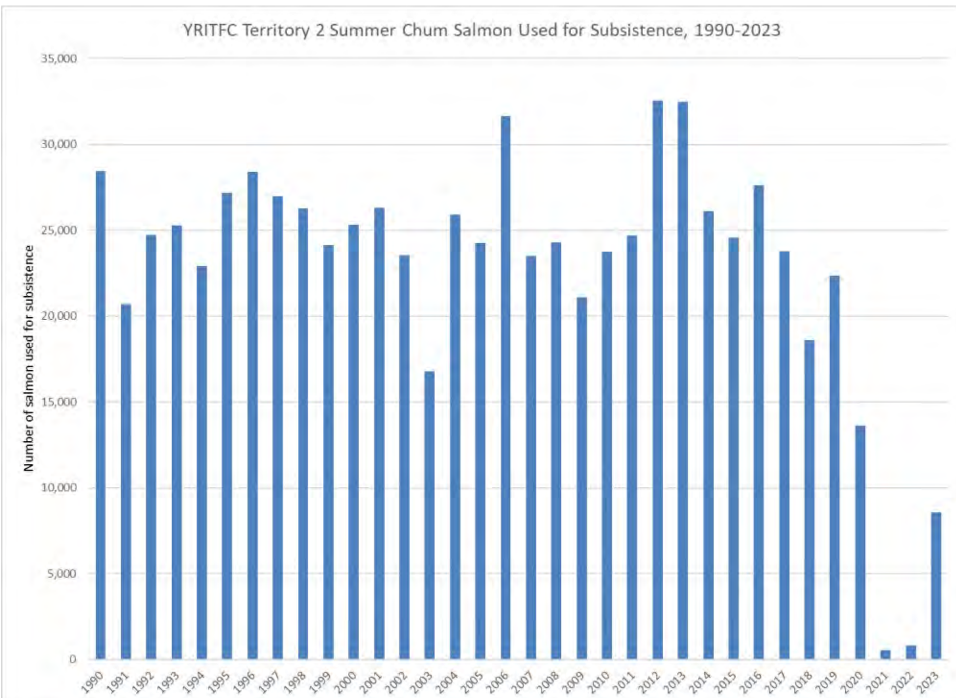

Figure A21. YRITFC Territory 2 subsistence uses of summer chum salmon, 1990-2023.

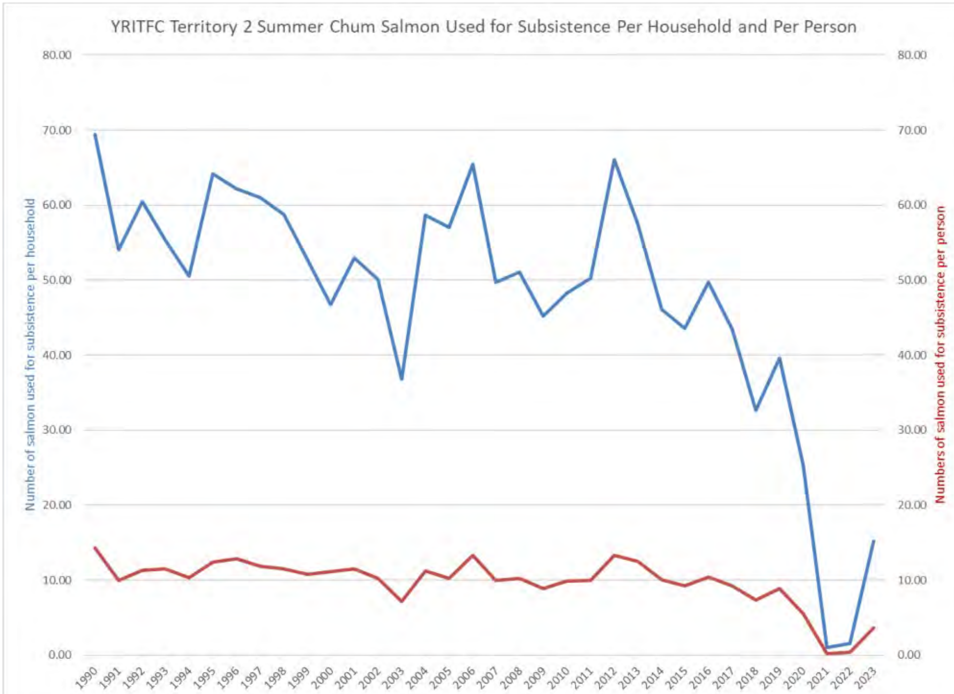

Figure A22. YRITFC Territory 2 subsistence uses of summer chum salmon per household and per person, 1990-2023.

53.66 fish per household in 2005-2009, 53.62 fish per household in 2010-2014, and 41.79 fish per household in 2015-2019. Household use rates fell to 25.34 summer chum salmon per household in 2020, 1.01 fish per household in 2021, 1.59 fish per household in 2022, and 15.22 fish per household in 2023. The number of summer chum salmon used per Territory 2 households exceeded 50 fish per household in the 1990s, 2001-2002, 2004-2006, 2008, and 2011-2013 during which household use rates exceeded 40 fish per household, except in 2003 (36.78 fish per household), 2018 and 2019 (32.66 and 39.62 fish per household, respectively), and during the most recent chum crash of 2020-2023 (see above).

Territory 2 per capita uses of summer chum salmon averaged 11.48 fish per person in 1990-1994, 11.88 fish per person in 1995-1999, 10.24 fish per person in 2000-2004, 10.52 fish per person in 2005-2009, 11.15 fish per person in 2010-2014, and 9.03 fish per person in 2015-2019. In 2020-2023, per capita uses of summer chum salmon were 5.57, 0.22, 0.35, and 3.60 fish per person, respectively. The number of summer chum salmon used per person for subsistence exceeded 10 fish per person in most years except in 1991 (9.99 fish per person), 2003 (7.14 fish per person), 2007 (9.98 fish per person), 2009 (8.84 fish per person), 2010 (9.85 fish per person), 2011 (9.99 fish per person), 2015 (9.26 fish per person), 2017-2019 (9.22, 7.35, 8.88 fish per person, respectively), and 2020-2023 (see above).

Figure A23 represents Territory 2 subsistence uses of fall chum salmon and Figure A24 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. The number of fall chum salmon used in YRITFC Territory 2 ranged from a high of 7,382 in 1992 to a low of 435 in 2021, the worst year on record for both summer and fall stocks of chum salmon. The 1990-2023 average number of fall chum salmon annually used for subsistence was 3,508 fish in Territory 2, representing an average of 5% of the total uses among all territories. The 1990-1994 five-year average number of fall chum salmon used for subsistence was 5,288 fish, followed by 4,472 fall chum salmon in 1995-1999, 2,324 fall chum salmon in 2000-2004, 3,166 fall chum salmon in 2005-2009, and an average of 3,605 fall chum salmon in 2010-2014, and 4,334 fish in 2015-2019. In 2020, 937 fall chum salmon were used for subsistence, followed by 435 fish in 2021, 512 fish in 2022, and 1,436 fall chum salmon in 2023. Territory 2 subsistence uses of fall chum salmon exceeded 3,000 fish in the 1990s and 2000s, except in 2000 (1,425 fish), 2002-2004 (1,618, 2,901, and 2,421 fish, respectively), 2009 (1,563 fish) and in the 2010s, except in 2010-2011 and 2018 (1,419, 2,578 fish, and 2,985 fish, respectively).

Territory 2 household use rates of fall chum salmon varied considerably annually throughout the 1990-2023 time series from a high of 18.05 fish per household in 1992 to a historic low of 0.82 fish per household in 2021. The number of fall chum salmon used per household averaged 12.75 fish in 1990-1994, an average of 10.01 fish per household in 1995-1999, 4.89 fish per household in in 2000-2004, 6.81 fish per household in 2005-2009, 6.75 fish per household in 2010-2014, and 7.74 fish per household in 2015-2019. Household use rates fell to 1.74 fall chum salmon per household in 2020, 0.82 fish per household in 2021, 0.97 fish per household in 2022, and 2.55 fish per household in 2023. Territory 2 household use rates of fall chum salmon exceeded 10 fish per household in the 1990s, except in 1993-1995 (6.77, 9.16, and 7.82 fish per household, respectively) and exceeded 5 fish per household in the 2000s, except in 2000 (2.63 fish per household). and only fell below 4 fish per household in 2002-2004 and 2009 prior to the most recent chum salmon disaster beginning in 2020.

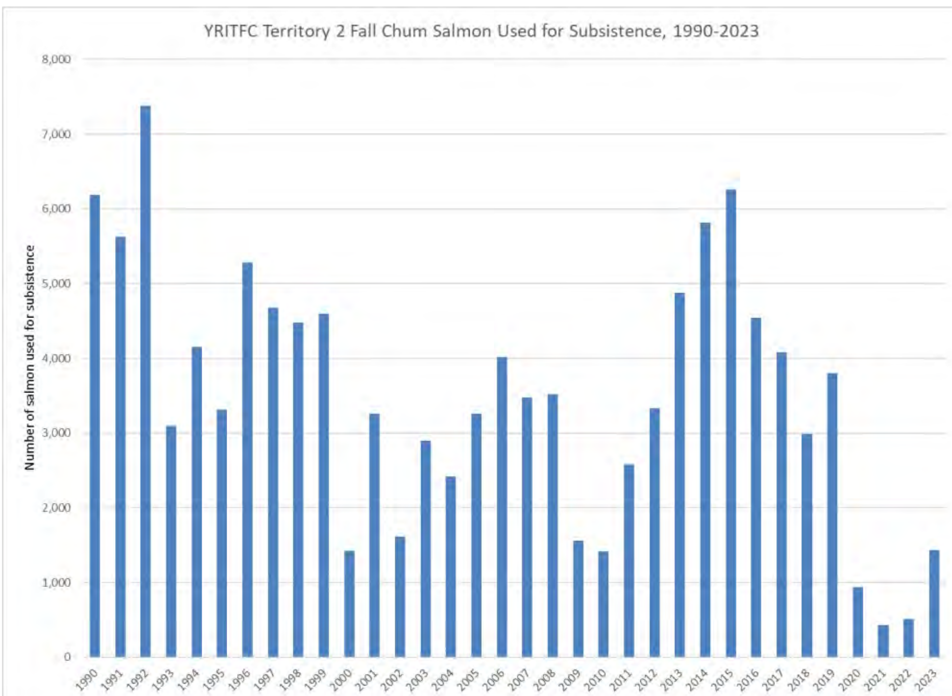

Figure A23. YRITFC Territory 2 subsistence uses of fall chum salmon, 1990-2023.

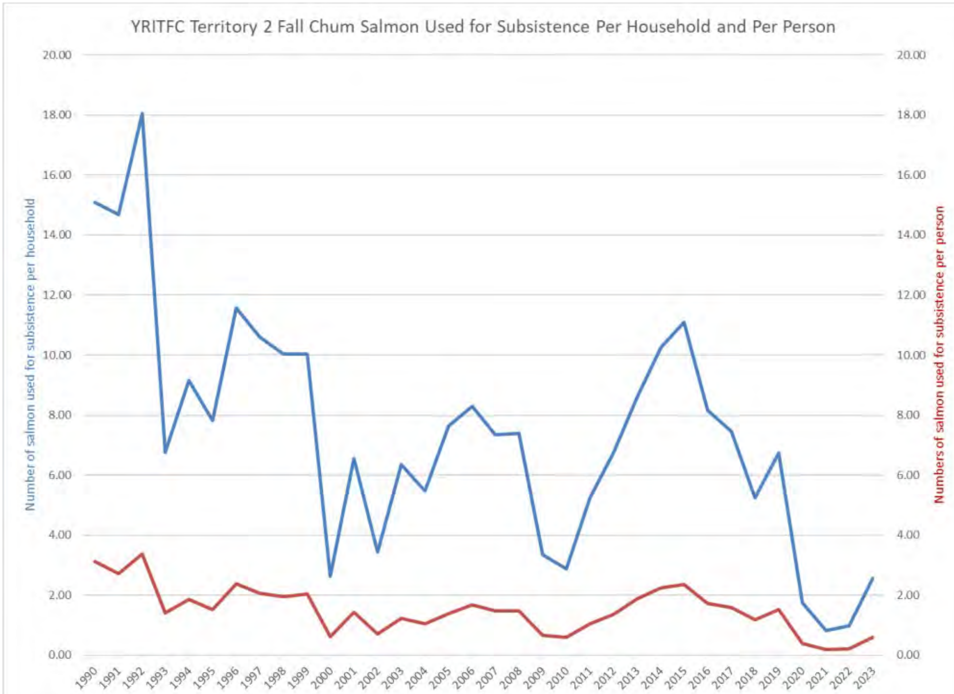

Figure A24. YRITFC Territory 2 subsistence uses of fall chum salmon per household and per person, 1990-2023.

Territory 2 per capita uses of Yukon River fall chum salmon ranged from a high of 3.38 fish per person in 1992 to a low of 0.18 fish per person in 2021. The 1990-1994 average per capita rates of fall chum salmon use were 2.50 fish per person, an average of 1.99 fish per person in 1995-1999, 1.01 fish per person in 2000-2004, 1.33 fish per person in 2005-2009, 1.42 and 1.67 fish per person in 2010-2014 and 2015-2019, respectively. The number of fall chum salmon used per person in Territory 2 exceeded 2 fish per person in the 1990s, except in 1993-1995 (1.40, 1.87, and 1.52 fish per person, respectively) and 1998 when 1.96 fish per person were used. Between 2000-2023, the number of fall chum salmon used in Territory 2 fell below 2 fish per person in all years except in 2014 and 2015 with 2.24 and 2.36 fish per person, respectively. During this same period (2000-2023), per capita uses of fall chum salmon fell below one fish per person in 2000 (0.63 fish per person), 2002 (0.70 fish per person), 2009 (0.66 fish per person), 2010 (0.59 fish per person), and 2020-2023 (see above). In 2020, the number of fall chum salmon used per person in Territory 2 was 0.38 fish per person, followed by 0.18 fish per person in 2021, 0.21 fish per person in 2022, and 0.60 fish per person in 2023.

Territory 3

Figure A25 shows the subsistence harvest composition for communities in YRITFC Territory 3 for which comprehensive subsistence harvest data are available. Territory 3 communities include Grayling (data years 1990, 2011), Anvik (1990, 2011), Shageluk (1990, 2013), Holy Cross (1990), and Russian Mission (2011). Territory 3 residents depend upon large land mammals for 36.78% of the overall subsistence economy, followed by all salmon combined at 32.93%, and non-salmon fishes at 19.00%. Chum salmon represent 15.82% of the total generalized subsistence economy of YRITFC Territory 3, followed by Chinook salmon (13.96%) and coho salmon (2.94%).

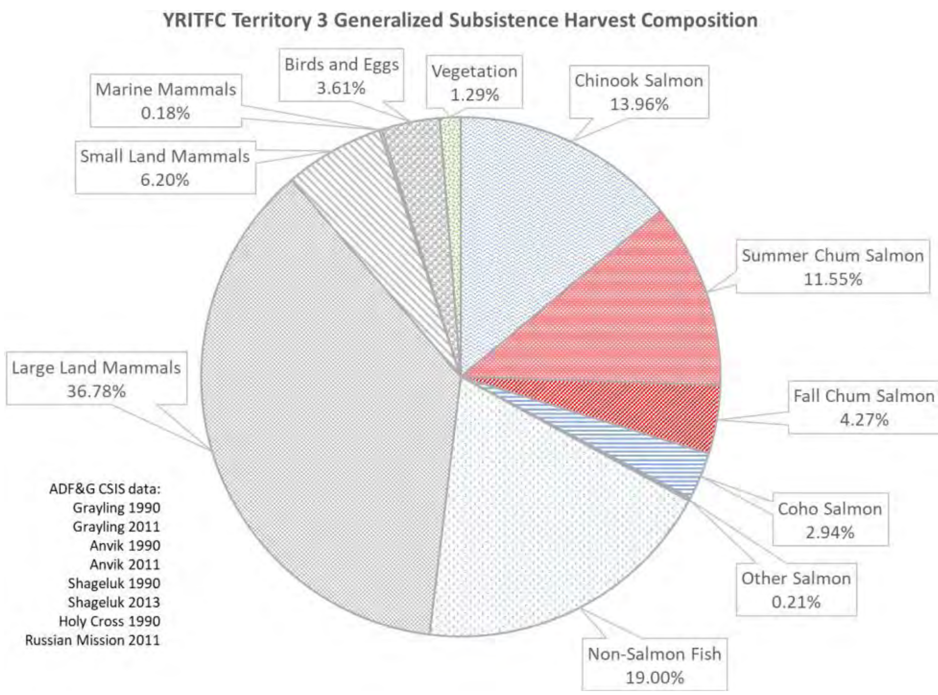

Figure A25. YRITFC Territory 3 generalized subsistence harvest composition (in edible pounds).

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 3 tribal communities in 1990-2023. Figure A26 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence and an overall declining trend in subsistence uses of salmon in Territory 3.

Summer chum salmon and Chinook salmon dominate the subsistence uses of salmon in YRITFC Territory 3 representing an average of 51% summer chum and 26% Chinook salmon during 1990-1994, an average of 52% summer chum and 33% Chinook salmon in 1995-1999, an average of 34% summer chum and 54% Chinook salmon in 2000-2004, an average of 34% summer chum salmon and 48% Chinook salmon in 2005-2009, an average of 49% summer chum salmon and 27% Chinook salmon in 2010-2014, and an average of 45% summer chum salmon and 30% Chinook salmon in the 2015-2019 period. During 2020-2023, an average of 54% of Territory 3 subsistence uses were of summer chum salmon and 24% Chinook salmon. The proportion of total subsistence uses of salmon contributed by summer chum salmon ranged from a high of 65% in 2012 (excluding 2021 and 2023 with 66% and 73% summer chum) to a low of 14% with a corresponding Chinook salmon proportion of 75% in 2001.

The proportion of total subsistence salmon uses contributed by fall chum salmon in Territory 3 ranged from a high of 37% in 2014 and 2015 to a low of 5% in 2002. The average proportion of total salmon uses contributed by fall chum salmon was 17% and 11% in the 1990-1994 and 1995-1999 periods, respectively, followed by a 2000-2004 average of 8% fall chum, a 2005-2009 average of 13% fall chum, a 2010-2014 average of 19%, and a 2015-2019 average of 20%. In 2020-2023, fall chum contributed 11%, 0%, 21%, and 19% of total subsistence salmon uses, respectively.

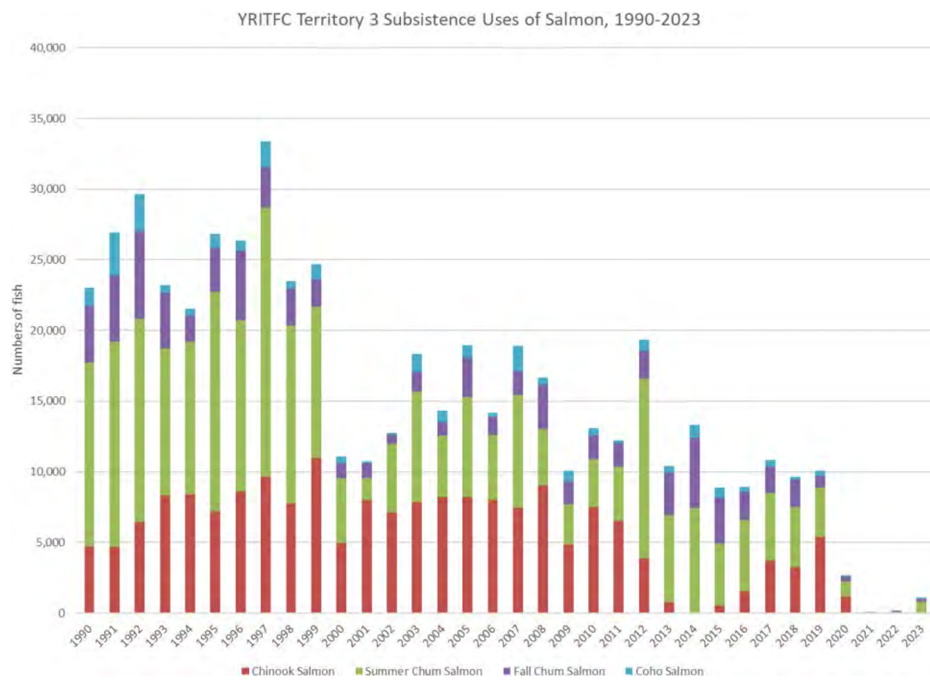

Figure A26. YRITFC Territory 3 subsistence uses of salmon, 1990-2023.

Pink salmon, not considered in this analysis, likely also contributes to Territory 3 subsistence uses of salmon, especially during years of restricted subsistence salmon fishing to conserve other salmon stocks.

Figure A27 represents Territory 3 subsistence uses of summer chum salmon and Figure A28 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series. The number of summer chum salmon used in YRITFC Territory 3 ranged from a high of 19,068 fish in 1997 to a low of 68 fish in 2022. In 2021, 81 summer chum salmon were used in Territory 3, which was the worst year on record for summer chum salmon uses. The 1990-2023 average number of summer chum salmon annually used for subsistence was 7,061 fish in Territory 3, representing an average of 8% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence was 12,614 fish, followed by 14,022 summer chum salmon in 1995-1999, and average of 4,619 and 5,283 summer chum salmon in 2000-2004 and 2005-2009 periods, respectively. In 2010-2014, an average of 6,686 summer chum salmon were used in Territory 3 and 4,390 fish in the subsequent period of 2015-2019. In 2020, Territory 3 used 1,042 summer chum salmon for subsistence, followed by 81, 68, and 798 fish in 2021-2023, respectively. YRITFC Territory 3 uses of summer chum salmon exceeded 10,000 fish each year of the 1990s but fell below 5,000 fish in the 2000s in all years except 2003 (7,774 fish), 2005 (7,078 fish), and 2007 (7,947 fish). Similarly, in the 2010s, subsistence uses of summer chum salmon fell below 5,000 fish, except in 2012-2014, when 12,677, 6,140, and 7,417 summer chum salmon were used, respectively, and except in 2016, when 5,059 fish were used in Territory 3.

Territory 3 household use rates of summer chum salmon averaged 53.92 fish per household in 1990-1994, 55.15 fish per household in 1995-1999, 19.91 fish per household in 2000-2004, 22.84 fish per household in 2005-2009, 27.59 fish per household in 2010-2014, and 17.30 fish per household in 2015-2019. Household use rates fell to 4.40 summer chum salmon per household in 2020, 0.35 fish per household in 2021, 0.30 fish per household in 2022, and 3.47 fish per household in 2023. The number of summer chum salmon used per Territory 3 households exceeded 40 fish per household in the 1990s, except in 1993 (37.99 fish per household) and 1994 (39.48 fish per household). In the 2000s and 2010s, household use rates of summer chum salmon exceeded 15 fish per household, except in 2001 (5.91 fish per household), 2009 (12.68 fish per household), and 2019 (13.94 fish per household). Notably, in 2012, Territory 3 used 53.26 fish per household, which was only exceeded in 1990-1992, 1995, and 1997. In 2020-2023, Territory 3 household uses of summer chum salmon fell below 5 fish per household (see above).

Territory 3 per capita uses of summer chum salmon averaged 12.94 fish per person in 1990-1994, 14.15 fish per person in 1995-1999, 4.89 fish per person in 2000-2004, 6.04 fish per person in 2005-2009, an average of 7.73 fish per person in 2010-2014, and 4.66 fish per person in 2015-2019. In 2020-2023, per capita uses of summer chum salmon were 1.07, 0.09, 0.08, and 0.87 fish per person, respectively. The number of summer chum salmon used per person for subsistence exceeded 10 fish in the 1990s, exceeded 4 fish per person in the 2000s and 2010s, except in 2001 (1.51 fish per person), 2009 (3.38 fish per person), and 2019 (3.48 fish per person).

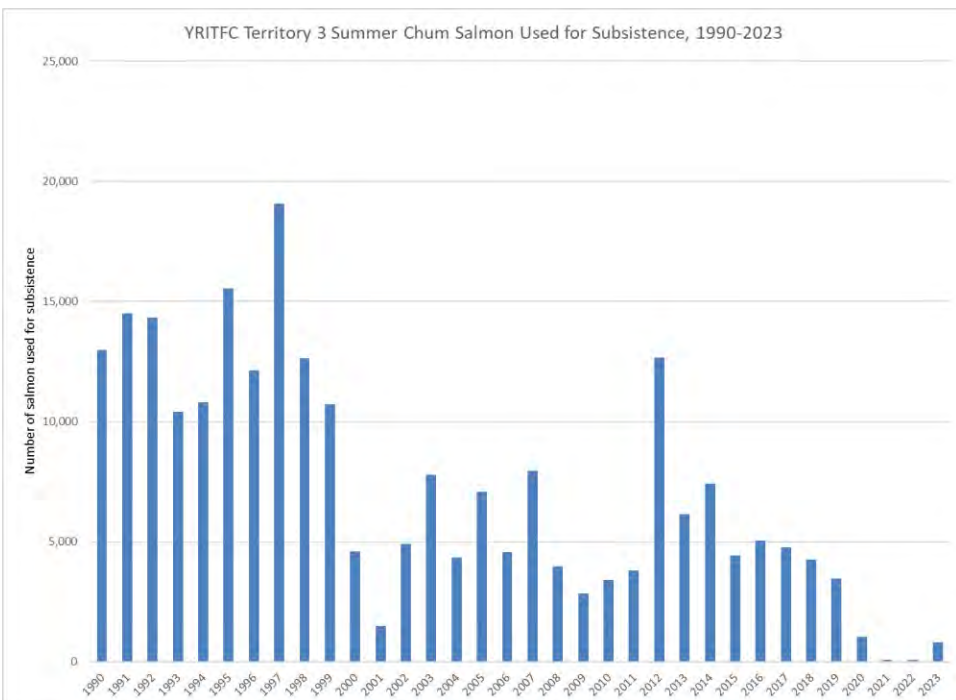

Figure A27. YRITFC Territory 3 subsistence uses of summer chum salmon, 1990-2023.

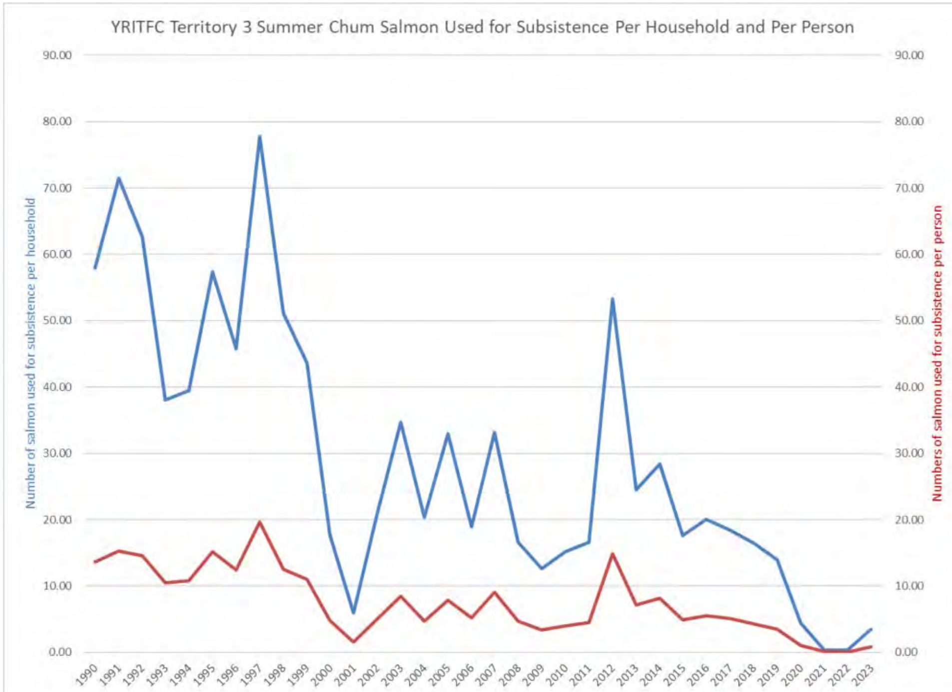

Figure A28. YRITFC Territory 3 subsistence uses of summer chum salmon per household and per person, 1990-2023.

Figure A29 represents Territory 3 subsistence uses of fall chum salmon and Figure A30 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. The number of fall chum salmon used in YRITFC Territory 3 ranged from a high of 6,245 in 1992 to a low of zero fish in 2021, the worst year on record for both summer and fall stocks of chum salmon. Figure A29 demonstrates a declining trend in the number of fall chum salmon used for subsistence in Territory 3 from the historic high number used in 1992 through 2002, followed by a variable but increasing trend in numbers until the second largest number of fall chum salmon used occurred in 2014 (4,936 fish), which was followed by another declining trend in uses leading up to the current period of poor chum salmon returns to the Yukon River.

The 1990-2023 average number of fall chum salmon annually used for subsistence was 2,220 fish in Territory 3, representing an average of 3% of the total uses among all territories. The 1990-1994 five-year average number of fall chum salmon used for subsistence was 4,150 fish, followed by 3,072 fall chum salmon in 1995-1999, 1,008 fall chum salmon in 2000-2004, 2,105 fall chum salmon in 2005-2009, and an average of 2,670 fall chum salmon in 2010-2014, and 1,984 fish in 2015-2019. In 2020, 302 fall chum salmon were used for subsistence, followed by zero fish in 2021, 39 fish in 2022, and 203 fall chum salmon in 2023. Territory 3 subsistence uses of fall chum salmon exceeded 3,000 fish in the 1990s, except in 1994 (1,828 fish), 1997-1999 (2,832, 2,597, and 1,911 fish, respectively). In the 2000s and 2010s, the number of fall chum salmon used in Territory 3 exceeded 1,000 fish, except in 2002 (617 fish), 2004 (963 fish), and 2019 (844 fish). In 2020, 302 fall chum salmon were used in Territory 3, followed by zero fall chum in 2021, 39 fall chum in 2022, and 203 fish in 2023.

Territory 3 household use rates of fall chum salmon varied considerably annually throughout the 1990-2023 time series from a high of 27.27 fish per household in 1992 to a historic low of zero fish per household in 2021. The number of fall chum salmon used per household averaged 17.90 fish in 1990-1994, an average of 11.97 fish per household in 1995-1999, 4.28 fish per household in in 2000-2004, 9.13 fish per household in 2005-2009, 10.87 fish per household in 2010-2014, and 7.82 fish per household in 2015-2019. Household use rates fell to 1.27 fall chum salmon per household in 2020, zero fish per household in 2021, 0.17 fish per household in 2022, and 0.88 fish per household in 2023. Territory 3 household use rates of fall chum salmon exceeded 10 fish per household in the 1990s, except in 1994 (6.67 fish per household) and 1999 (7.77 fish per household). Household use rates exceeded 4 fall chum salmon per household in the 2000s and 2010s, except in 2002 (2.63 fish per household) and 2019 (3.40 fish per household) prior to the most recent chum salmon disaster beginning in 2020 (see above).

Territory 3 per capita uses of Yukon River fall chum salmon ranged from a high of 6.33 fish per person in 1992 to a low of zero fish per person in 2021. The 1990-1994 average per capita rates of fall chum salmon use were 4.26 fish per person, an average of 3.10 fish per person in 1995-1999, 1.06 fish per person in 2000-2004, 2.42 fish per person in 2005-2009, 3.06 and 2.13 fish per person in 2010-2014 and 2015-2019, respectively. The number of fall chum salmon used per person in Territory 3 exceeded 2 fish per person in the 1990s, except in 1994 (1.82 fish per person) and 1999 (1.96 fish per person). In the 2000s, the number of fall chum salmon used in Territory 3 fell below 2 fish per person in all years, except in 2005 and 2008 with 3.10 and 3.74 fish per person, respectively. During this same period, per capita uses of fall chum salmon fell below one fish per person in 2002 (0.63 fish per person). In the 2010s, per capita uses of fall chum salmon exceeded 2 fish, except in 2010 (1.99 fish per person), 2017-2019 (1.97, 1.97, and

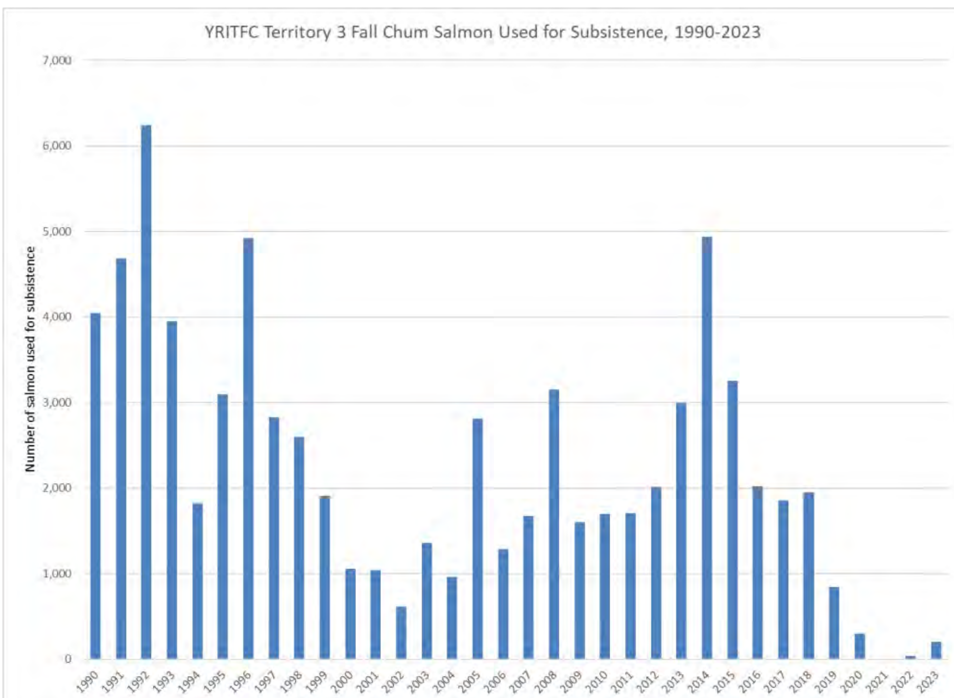

Figure A29. YRITFC Territory 3 subsistence uses of fall chum salmon, 1990-2023.

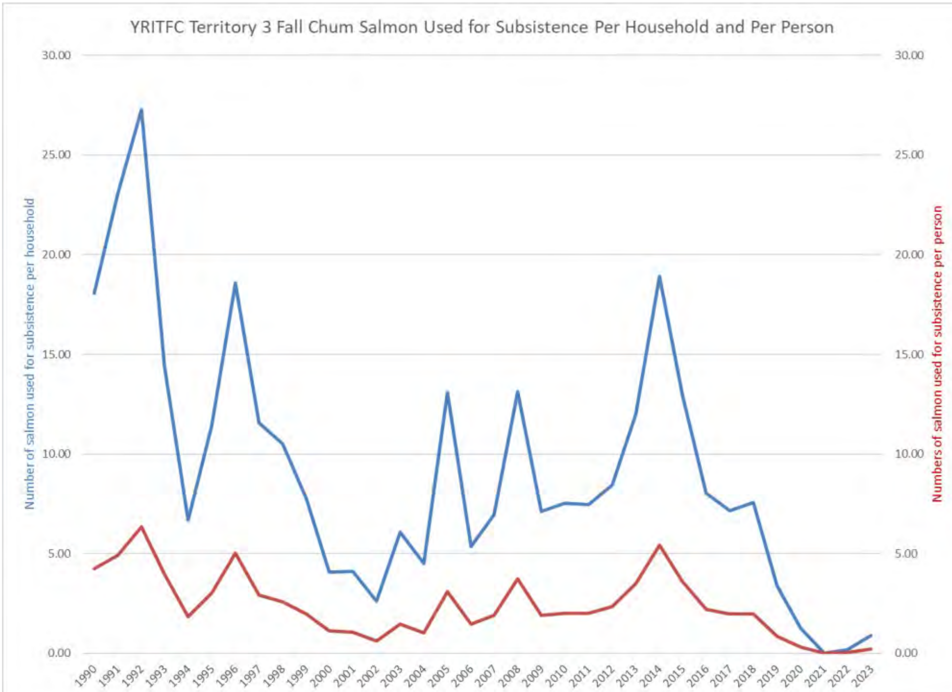

Figure A30. YRITFC Territory 3 subsistence uses of fall chum salmon per household and per person, 1990-2023.

0.85 fish per person, respectively) and exceeded 3 fish in 2013-2015 with 3.49, 5.43, and 3.61 fish per person, respectively. In 2020, the number of fall chum salmon used per person in Territory 3 fell to 0.31 fish per person, followed by zero fish in 2021, 0.04 fish per person in 2022, and 0.22 fish per person in 2023.

Territory 4

Figure A31 shows the subsistence harvest composition for communities in YRITFC Territory 4 for which comprehensive subsistence harvest data are available. Territory 4 communities include Ruby (data year 2010), Galena (1985, 2010), Nulato (2010), and Kaltag (2018). Territory 4 residents depend on salmon for 62.5% of the overall subsistence economy, including 47.35% chum salmon. Summer chum salmon contributed 36.23%, which is the largest proportion of the total subsistence harvest, followed by large land mammals (24.49%), Chinook salmon (13.21%), fall chum salmon (11.09%), and non-salmon fishes (8.93%).

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 4 tribal communities in 1990-2023.

Figure A32 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence. Fall chum salmon and Chinook salmon dominate the subsistence uses of salmon in YRITFC Territory 4 representing an average of 38% fall chum and 24% Chinook salmon during 1990-1994, an average of 35% fall chum and 30% Chinook salmon in 1995-1999, an average of 20% fall chum and 49% Chinook salmon in 2000-2004, an

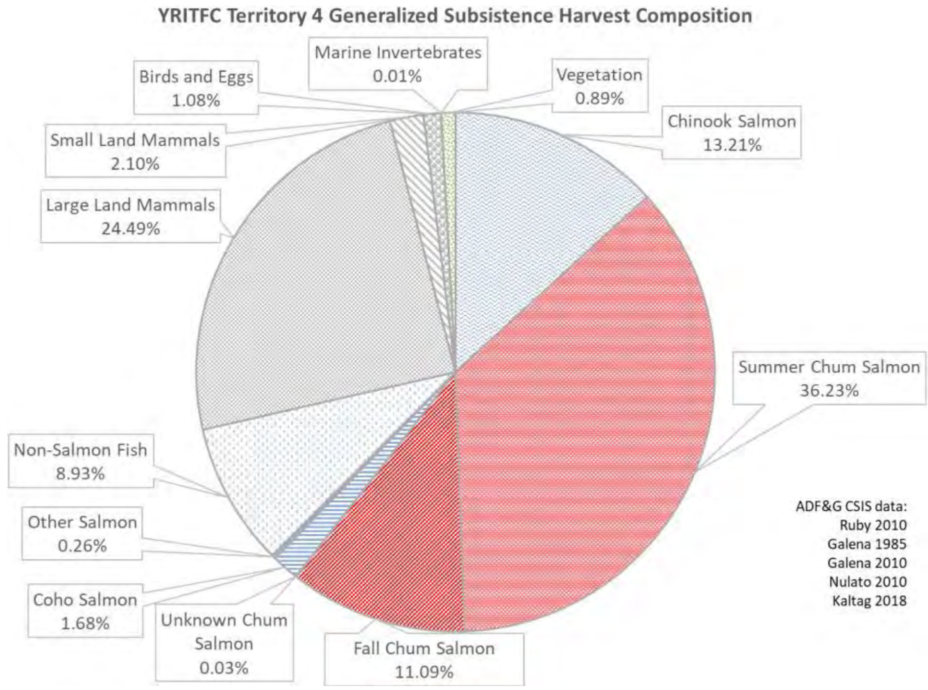

Figure A31. YRITFC Territory 4 generalized subsistence harvest composition (in edible pounds).

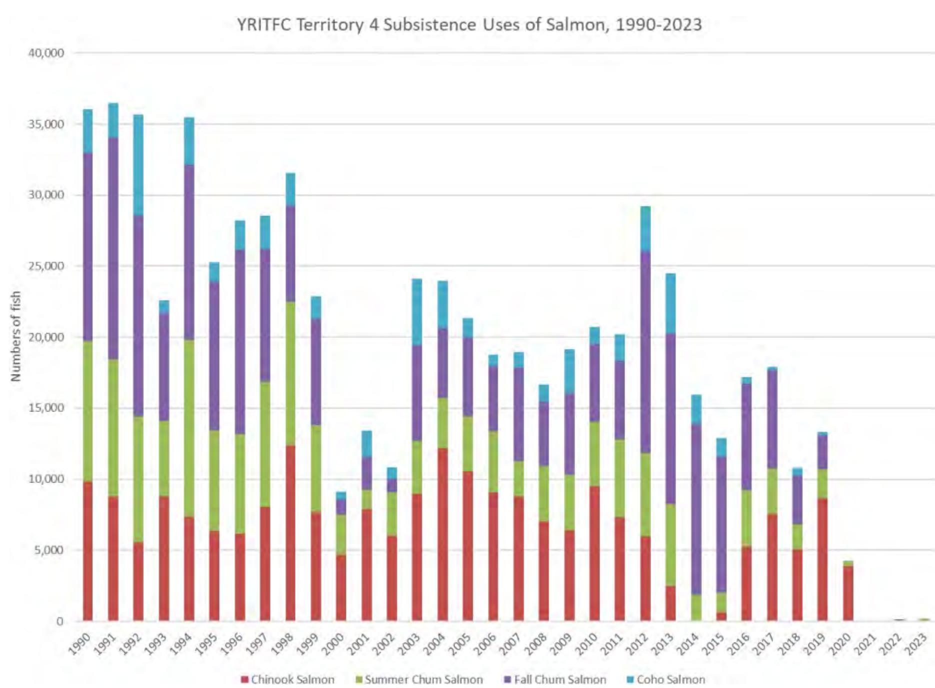

Figure A32. YRITFC Territory 4 subsistence uses of salmon, 1990-2023.

average of 29% fall chum salmon and 44% Chinook salmon in 2005-2009, an average of 45% fall chum salmon and 23% Chinook salmon in 2010-2014, and an average of 41% fall chum salmon and 38% Chinook salmon in 2015-2019.

During 2020-2023, an average of 2% of Territory 4 subsistence uses were of fall chum salmon, 35% summer chum salmon, 63% Chinook salmon, and less than 1% coho salmon. The proportion of total subsistence uses of salmon contributed by fall chum salmon ranged from highs of 75% in 2014 and 74% in 2015 to lows of zero in 2021-2023. Excluding 2020 when the Chinook salmon proportion of total subsistence use of salmon was 91%, the proportion of Chinook salmon ranged from highs of 65% in 2019 and 59% in 2001 to lows of 0.43% in 2014 and 5% in 2015.

The proportion of total subsistence salmon uses contributed by summer chum salmon in Territory 4 ranged from a high of 35% in 1994, excluding 2022 (39% summer chum) and 2023 (79% summer chum), to lows of 8% in 2020 and 11% in 2001, 2014, and 2015. The average proportion of total salmon uses contributed by summer chum salmon was 28% and 29% in the 1990-1994 and 1995-1999 periods, respectively, followed by a 2000-2004 average of 18% summer chum, a 2005-2009 average of 19% summer chum, a 2010-2014 average of 21%, and a 2015-2019 average of 17%. In 2020-2023, summer chum contributed 8%, 12%, 39%, and 79% of total subsistence salmon uses, respectively.

Figure A33 represents Territory 4 subsistence uses of summer chum salmon and Figure A34 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series. The number of summer chum salmon used in YRITFC Territory 4 ranged from a high of 12,481 fish in 1994 to a low of 2 fish in 2021, which was the worst year on record

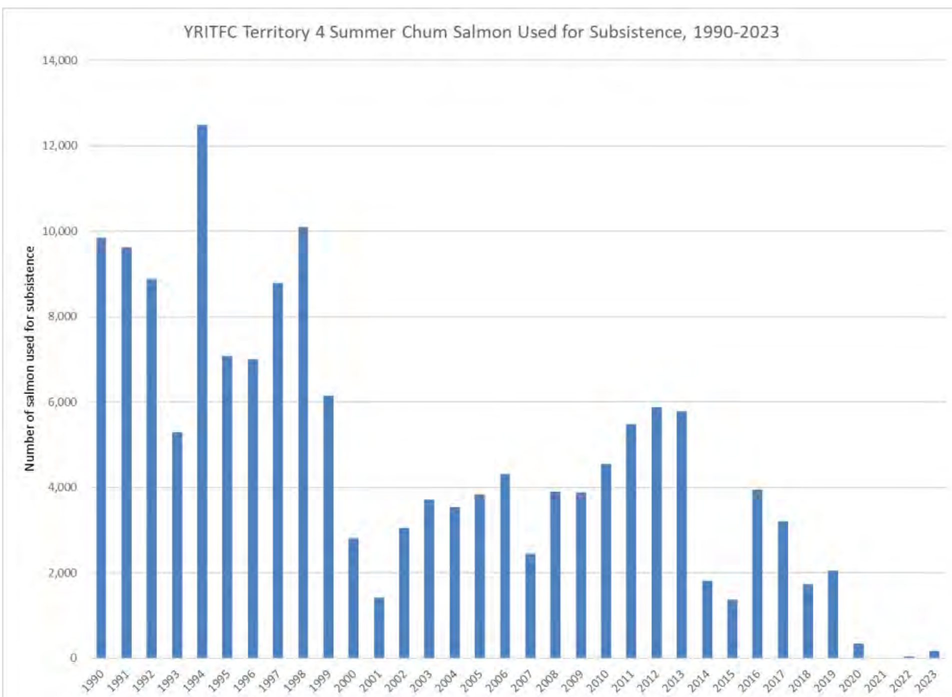

Figure A33. YRITFC Territory 4 subsistence uses of summer chum salmon, 1990-2023.

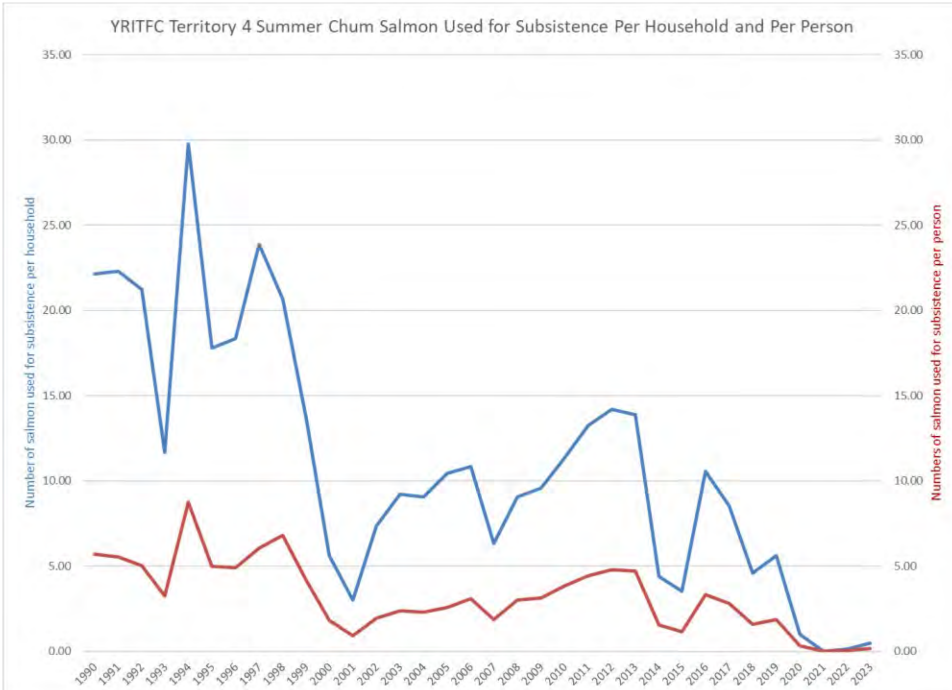

Figure A34. YRITFC Territory 4 subsistence uses of summer chum salmon per household and per person, 1990-2023.

for summer chum salmon uses. The 1990-2023 average number of summer chum salmon annually used for subsistence was 4,544 fish in Territory 4, representing an average of 5% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence was 9,224 fish, followed by 7,822 summer chum salmon in 1995-1999, and average of 2,902 and 3,674 fish in 2000-2004 and 2005-2009, respectively. The 2010-2014 average number of summer chum salmon used in Territory 4 was 4,703 fish, followed by 2,461 fish in 2015-2019. In 2020-2023, 349, 2, 47, and 165 summer chum salmon were used for subsistence.

Territory 4 household use rates of summer chum salmon averaged 21.43 fish per household in 1990-1994, 18.87 fish per household in 1995-1999, 6.86 fish per household in 2000-2004, 9.26 fish per household in 2005-2009, 11.42 fish per household in 2010-2014, and 6.57 fish per household in 2015-2019. Household use rates fell to 1.01 summer chum salmon per household in 2020, 0.01 fish per household in 2021, 0.14 fish per household in 2022, and 0.46 fish per household in 2023. The number of summer chum salmon used per Territory 4 households exceeded 20 fish per household in the 1990s, except in 1993 (11.67 fish per household), 1995 (17.79 fish per household), 1996 (18.35 fish per household), and 1999 (13.64 fish per household). In the 2000s, household use rates of summer chum salmon fell below 10 fish per household, except in 2005 (10.44 fish per household) and 2006 (10.86 fish per household). In the 2010s, the number of summer chum salmon used per household exceeded 10 fish, except in 2014 (4.41 fish per household), 2015 (3.52 fish per household), 2017 (8.54 fish per household), 2018 (4.60 fish per household), and 2019 (5.63 fish per household). In 2020-2023, Territory 4 household uses of summer chum salmon fell below 1 fish per household, except in 2020 (see above).

Territory 4 per capita uses of summer chum salmon averaged 5.66 fish per person in 1990-1994, 5.38 fish per person in 1995-1999, 1.88 fish per person in 2000-2004, 2.74 fish per person in 2005-2009, 3.87 fish per person in 2010-2014, and 2.15 fish per person in 2015-2019. In 2020-2023, per capita uses of summer chum salmon were 0.32, zero, 0.05, and 0.16 fish per person, respectively. The number of summer chum salmon used per person for subsistence exceeded 4 fish in the 1990s, except for 1993 with only 3.25 fish used per person. Per capita uses of summer chum salmon exceeded 1 fish per person in the 2000s and 2010s, except in 2001 (0.92 fish per person).

Figure A35 represents Territory 4 subsistence uses of fall chum salmon and Figure A36 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. The number of fall chum salmon used in YRITFC Territory 4 ranged from a high of 15,613 in 1991 to a low of zero fish in 2021 and 2023. Figure A35 demonstrates a declining trend in the number of fall chum salmon used for subsistence in Territory 4 from the historic high numbers used in 1991 and 1992 down to the lows of the early 2000s, which were the lowest uses of fall chum salmon until the most recent chum salmon crash began in 2020. Territory 4 fall chum salmon uses between 2003 and 2011 demonstrated a partial recovery in fall chum salmon uses ranging from approximately 4,500 – 6,500 fish. In 2012, subsistence uses of fall chum salmon once again exceeded 14,000 fish, followed by another declining trend in uses leading up to the current collapse in chum salmon returns to the Yukon River that began in 2020.

The 1990-2023 average number of fall chum salmon annually used for subsistence was 6,837 fish in Territory 4, representing an average of 9.5% of the total uses among all territories. The 1990-1994 five-year average number of fall chum salmon used for subsistence in Territory 4 was 12,602 fish, followed by 9,423 fall chum salmon in 1995-1999, 3,200 fall chum salmon in 2000-

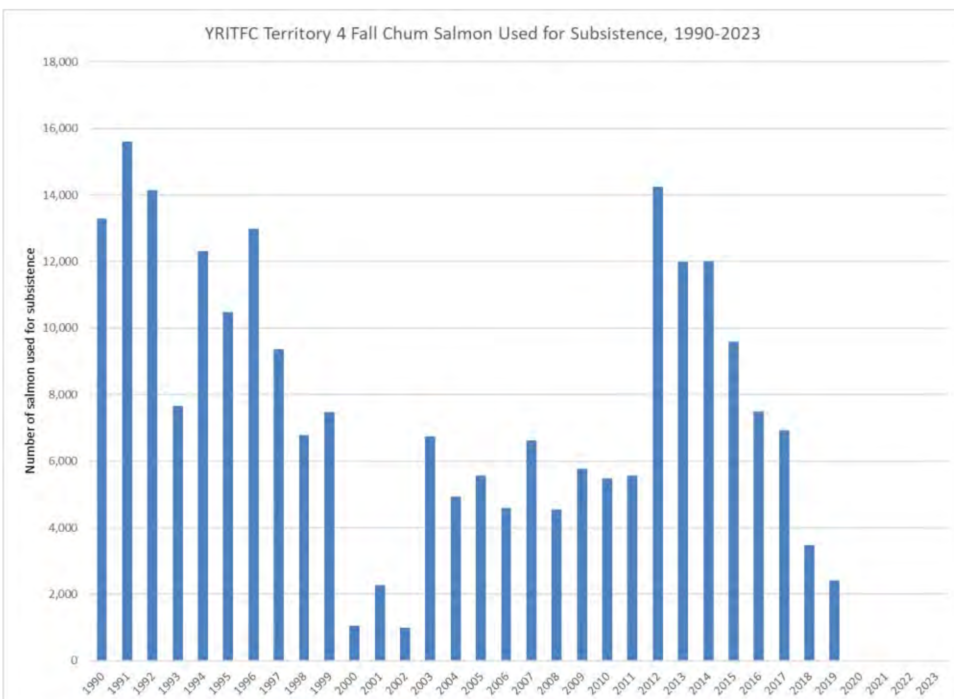

Figure A35. YRITFC Territory 4 subsistence uses of fall chum salmon, 1990-2023.

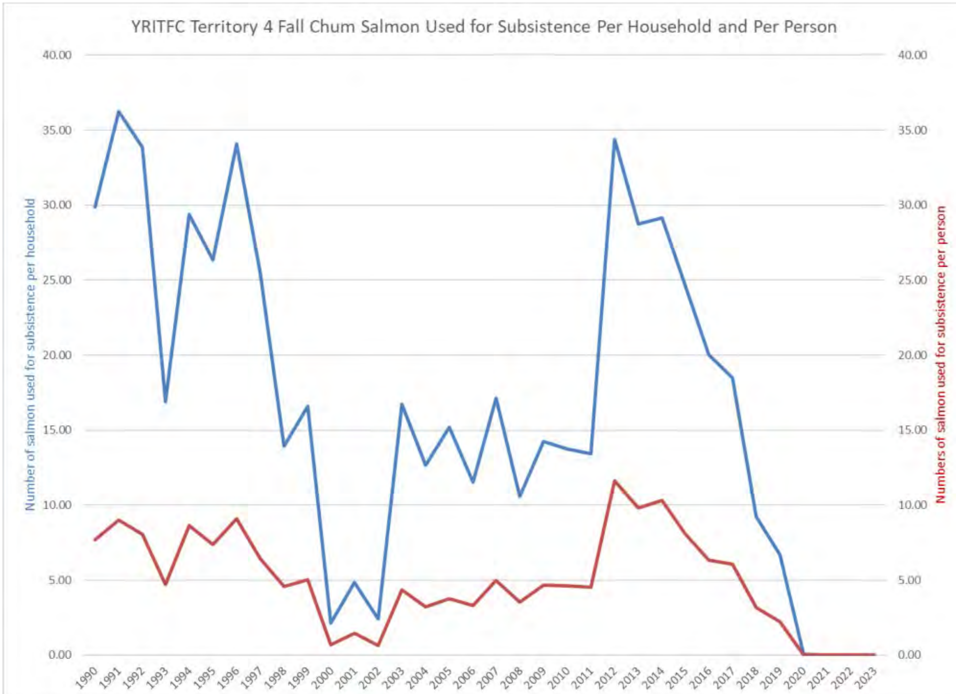

Figure A36. YRITFC Territory 4 subsistence uses of fall chum salmon per household and per person, 1990-2023.

2004, 5,415 fall chum salmon in 2005-2009, and an average of 9,861 fall chum salmon in 2010-2014, and 5,984 fish in 2015-2019. In 2020, 19 fall chum salmon were used for subsistence, followed by zero fish in 2021, 10 fish in 2022, and zero fall chum salmon used in 2023. Territory 4 subsistence uses of fall chum salmon exceeded 10,000 fish in the 1990s, except in 1993 (7,667 fish), 1997 (9,358 fish), 1998 (6,791 fish), and 1999 (7,485 fish). In the 2000s, the number of fall chum salmon used for subsistence in Territory 4 exceeded 4,000 fish, except in 2000-2002 with only 1,057, 2,276, and 996 fall chum salmon used. In the 2010s, the fall chum salmon uses exceeded 5,000 fish, except in 2018 and 2019 with 3,473 and 2,423 fish, respectively.

Territory 4 household use rates of fall chum salmon varied considerably throughout the 1990-2023 time series from a high of 36.23 fish per household in 1991 to a historic low of zero fish per household in 2021 and 2023. The number of fall chum salmon used per household averaged 29.23 fish in 1990-1994, an average of 23.28 fish per household in 1995-1999, 7.75 fish per household in in 2000-2004, 13.73 fish per household in 2005-2009, 23.90 fish per household in 2010-2014, and 15.81 fish per household in 2015-2019. Household use rates fell to 0.06 fall chum salmon per household in 2020, zero fish per household in 2021, 0.03 fish per household in 2022, and zero fish per household in 2023. Territory 4 household use rates of fall chum salmon exceeded 20 fish per household in the 1990s, except in 1993 (16.89 fish per household), 1998 (13.92 fish per household), and 1999 (16.60 fish per household). Territory 4 household rates of use of fall chum salmon exceeded 10 fish during the 2000s and 2010s, except in 2000-2002 (2.12, 4.84, and 2.41 fish per household, respectively) and 2018-2019 (9.21 and 6.67 fall chum used per household, respectively).

Territory 4 per capita uses of Yukon River fall chum salmon ranged from a high of 11.62 fish per person in 2012 to a low of zero fish per person in 2021 and 2023. The 1990-1994 average per capita rates of fall chum salmon use were 7.62 fish per person, an average of 6.51 fish per person in 1995-1999, 2.07 fish per person in 2000-2004, 4.04 fish per person in 2005-2009, 8.18 and 5.18 fish per person in 2010-2014 and 2015-2019, respectively. The number of fall chum salmon used per person in Territory 4 exceeded 6 fish per person in the 1990s, except in 1993 (4.70 fish per person), 1998 (4.58 fish per person), and 1999 (5.05 fish per person). In the 2000s, the number of fall chum salmon used in Territory 4 fell below 2 fish per person in 2000-2002 (0.69, 1.47, and 0.64 fish per person, respectively), but otherwise exceeded 3 fish per person in 2003-2009). In the 2010s, per capita uses of fall chum salmon exceeded 4 fish, except in 2018 and 2019 with 3.18 and 2.23 fish per person, respectively. Notably, during 2012-2015, fall chum per capita uses exceeded 8 fish per person. In 2020, the number of fall chum salmon used per person in Territory 4 fell to 0.02 fish per person, followed by zero fish in 2021, 0.01 fish per person in 2022, and zero fish per person in 2023.

Territory 5

Figure A37 shows the subsistence harvest composition for communities in YRITFC Territory 5 within the Koyukuk River drainage for which comprehensive subsistence harvest data are available. Territory 5 communities include Bettles/Evansville (data years 1982, 1983, 1984), Bettles (2011), Evansville (2011), Allakaket/Alatna (1982, 1983, 1984), Alatna (2011), Allakaket (2011), Hughes (1982, 2014), and Huslia (1983). Territory 5 residents depend upon salmon for 55.34% of their total subsistence harvests, including 50.95% chum salmon (29.67% summer chum salmon, 3.48% fall chum salmon, and 17.80% unknown chum salmon). After salmon, the

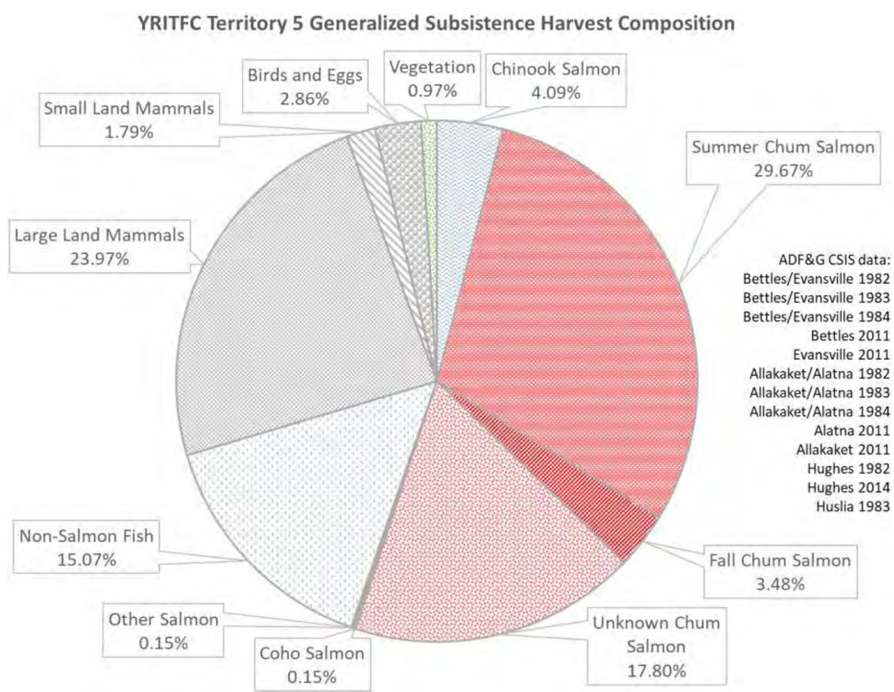

Figure A37. YRITFC Territory 5 generalized subsistence harvest composition (in edible pounds).

next largest contributors to the Territory 5 overall subsistence economy are large land mammals (23.97%), non-salmon fishes (15.07%), and Chinook salmon (4.09%).

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 5 tribal communities in 1990-2023.

Figure A38 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence in Territory 5. Summer chum salmon dominates the subsistence uses of salmon in YRITFC Territory 5 representing an average of 85% summer chum salmon during 1990-1994, 82% summer chum salmon in 1995-1999, an average of 78% summer chum salmon in 2000-2004, 2005-2009, and 2010-2014, and an average of 77% summer chum salmon in 2015-2019. The proportion of total subsistence uses of salmon contributed by summer chum salmon ranged from highs of 94% in 1994, 93% in 2002, 92% in 2011, and 91% in 1993 to a low of 60% in 2019, excluding 2022 when 50% of the 292 salmon used in Territory 5 were summer chum salmon. During 2020-2023, an average of 79% of Territory 5 subsistence uses were of summer chum salmon.

The proportion of total subsistence salmon uses contributed by fall chum salmon in Territory 5 ranged from highs of 24% in 2019, 23% in 2014, and 22% in 1990 and 2005 to lows of zero percent in 2021 and less than 1% in 1994 and 2002. In Territory 5, the average proportion of total salmon uses contributed by fall chum salmon was 10% in the 1990-1994 and 1995-1999 periods, followed by a 2000-2004 average of 11% fall chum, a 2005-2009 average of 13% fall chum, and

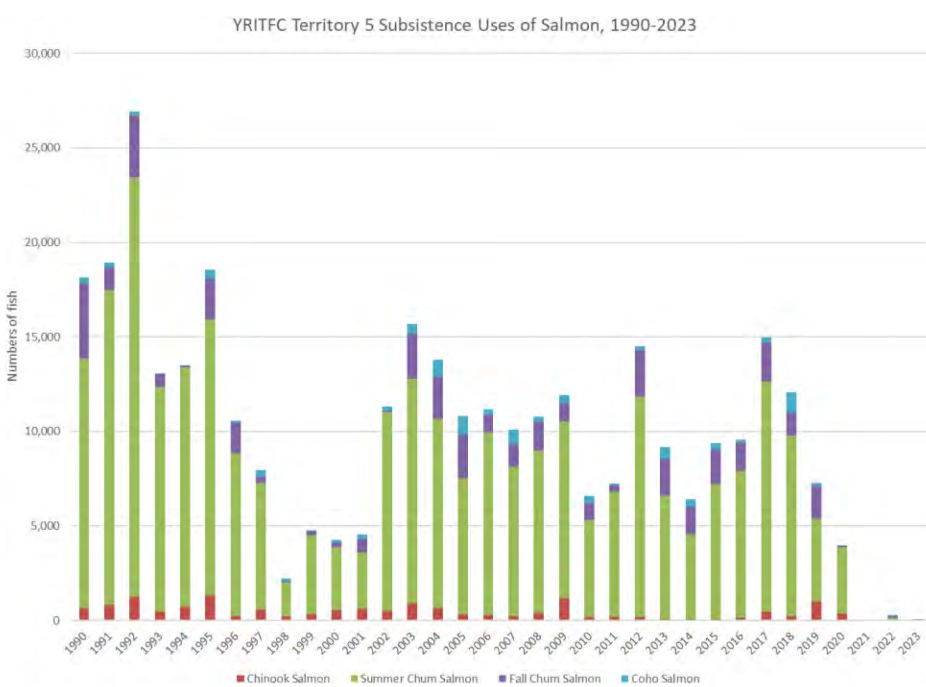

Figure A38. YRITFC Territory 5 subsistence uses of salmon, 1990-2023.

averages of 16% fall chum in 2010-2014 and 2015-2019. In 2020-2023, fall chum contributed 2%, zero percent, 21%, and 9% of total subsistence salmon uses, respectively.

The proportion of Chinook salmon used in Territory 5 ranged from highs of 14% in 2019 and 13% in 2001 to lows of zero percent in 2021 and 2022 and less than 1% in 2013-2015. The proportion of total salmon uses contributed by coho salmon ranged from highs of 9% in 2005 and 2018 to lows of zero percent in 2021 and less than 1% in 1992-1994.

Figure A39 represents Territory 5 subsistence uses of summer chum salmon and Figure A40 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series. The number of summer chum salmon used in YRITFC Territory 5 ranged from a high of 22,190 fish in 1992 to lows of 2 fish in 2021, 45 fish in 2023, 146 fish in 2022, and 1,779 fish in 1998. The 1990-2023 average number of summer chum salmon annually used for subsistence was 8,040 fish in Territory 1, representing an average of 9% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence was 15,339 fish, followed by 7,190 summer chum salmon in 1995-1999, and average of 7,758 and 8,553 fish in 2000-2004 and 2005-2009, respectively. The 2010-2014 average number of summer chum salmon used in Territory 5 was 6,889 fish, followed by 8,202 fish in 2015-2019. In 2020-2023, 3,509, 2, 146, and 45 summer chum salmon were used for subsistence, respectively.

Territory 5 household use rates of summer chum salmon ranged from highs of 127.04 fish per household in 1992, 97.52 fish per household in 1991, and 79.20 fish per household in 1995 to a low of 8.01 fish per household in 1998, if 2021-2023 are excluded. The number of summer chum salmon used per household averaged 84.09 fish per household in 1990-1994, 37.43 fish per

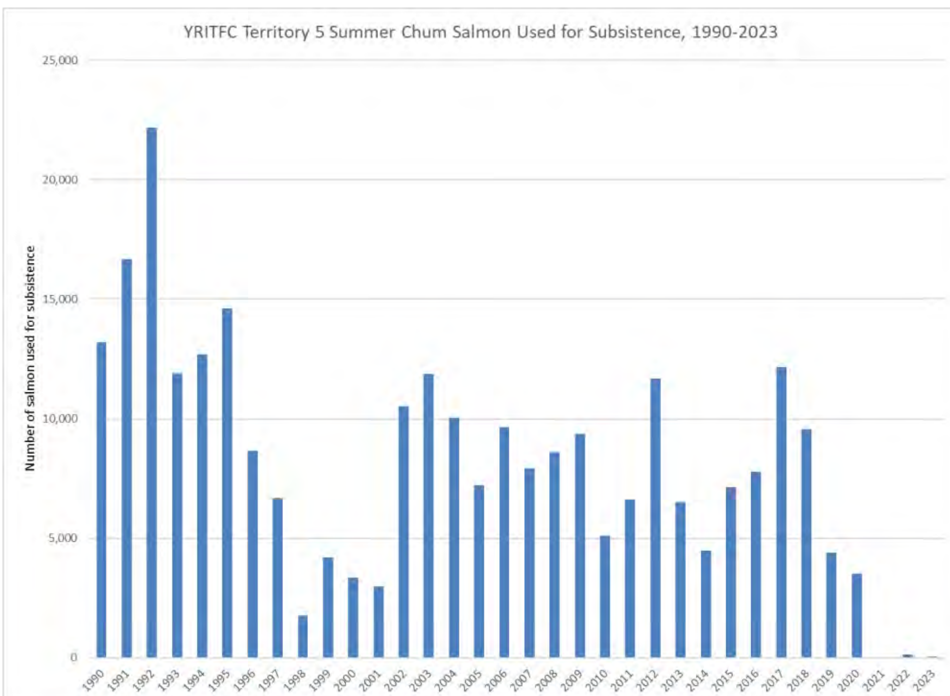

Figure A39. YRITFC Territory 5 subsistence uses of summer chum salmon, 1990-2023.

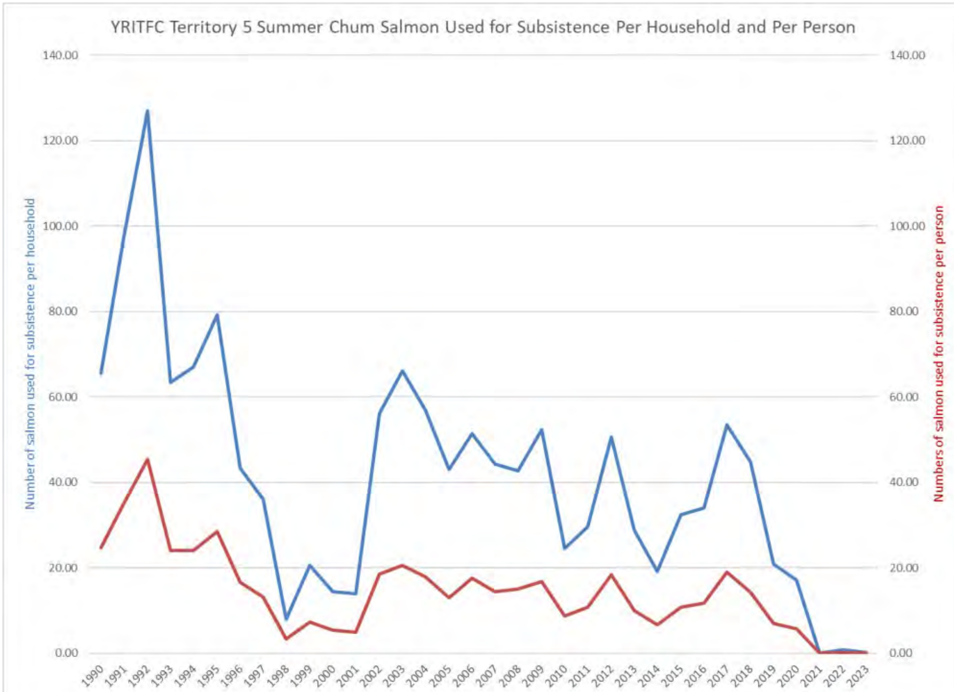

Figure A40. YRITFC Territory 5 subsistence uses of summer chum salmon per household and per person, 1990-2023.

household in 1995-1999, 41.51 fish per household in 2000-2004, 46.77 fish per household in 2005-2009, 30.55 fish per household in 2010-2014, and 37.15 fish per household in 2015-2019. Household use rates fell to 17.12 summer chum salmon per household in 2020, 0.01 fish per household in 2021, 0.78 fish per household in 2022, and 0.22 fish per household in 2023. The number of summer chum salmon used per Territory 5 household exceeded 60 fish per household in the 1990s, except in 1996-1999 (43.39, 36.02, 8.01, and 20.54 fish per household, respectively). In the 2000s, household use rates of summer chum salmon exceeded 40 fish per household, except in 2000 (14.48 fish per household) and 2001 (13.90 fish per household). In the 2010s, the number of summer chum salmon used per household exceeded 20 fish, except in 2014 (19.24 fish per household).

Territory 5 per capita uses of summer chum salmon averaged 30.70 fish per person in 1990-1994, 13.81 fish per person in 1995-1999, 13.52 fish per person in 2000-2004, 15.38 fish per person in 2005-2009, 10.93 fish per person in 2010-2014, and 12.59 fish per person in 2015-2019. In 2020-2023, per capita uses of summer chum salmon were 5.70, zero, 0.24, and 0.07 fish per person, respectively. The number of summer chum salmon used per person for subsistence exceeded 24 fish in the 1990s, except for 1996-1999 (16.62, 13.09, 3.39, and 7.39 fish per person, respectively). Per capita uses of summer chum salmon exceeded 10 fish per person in the 2000s and 2010s, except in 2000 (5.48 fish per person), 2001 (4.99 fish per person), 2010 (8.71 fish per person), 2014 (6.74 fish per person), and 2019 (6.95 fish per person).

Figure A41 represents Territory 5 subsistence uses of fall chum salmon and Figure A42 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. The number of fall chum salmon used in YRITFC Territory 5 ranged from highs of 3,966 in 1990, 3,204 fall chum in 1992, and 2,437 fish in 2012 to lows of 55 fish in 1994, 71 fish in 1998, and 100 fish in 2002, excluding the years 2020-2023. Figure A41 demonstrates considerable inter-annual variation in fall chum salmon use during the 1990-2023 time series.

The 1990-2023 average number of fall chum salmon annually used for subsistence was 1,225 fish in Territory 5, representing an average of 2% of the total uses among all territories. The 1990-1994 five-year average number of fall chum salmon used for subsistence in Territory 5 was 1,816 fish, followed by 864 fall chum salmon in 1995-1999, 1,134 fish in 2000-2004, 1,396 fall chum salmon in 2005-2009, and an average of 1,423 fall chum salmon in 2010-2014, and 1,667 fish in 2015-2019. In 2020, 70 fall chum were used in Territory 5, followed by zero fish in 2021, 62 fish in 2022, and 5 fall chum salmon used in 2023. Territory 5 subsistence uses of fall chum salmon exceeded 1,000 fish in the 1990s, except in 1993 (662 fish), 1994 (55 fish), 1997 (331 fish), 1998 (71 fish), and 1999 (193 fish). In the 2000s, the number of fall chum salmon used for subsistence in Territory 5 exceeded 900 fish, except in 2000-2002 (243, 733, and 100 fall chum salmon used, respectively) and 2006 and 2009 (946 fish each). In the 2010s, fall chum salmon uses exceeded 1,000 fish, except in 2010 (924 fish) and 2011 (339 fish).

Territory 5 household use rates of fall chum salmon varied considerably throughout the 1990-2023 time series from highs of 19.63 fish per household in 1990, 18.34 fish per household in 1992, and 13.94 fish per household in 2005 to lows of 0.29 fish per household in 1994, 0.32 fish per household in 1998, 0.53 fish per household in 2002, and 0.94 fish per household in 1999, excluding the years 2020-2023. The number of fall chum salmon used per household averaged 9.75 fish in 1990-1994, an average of 4.52 fish per household in 1995-1999, 6.15 fish per household in in 2000-2004, 7.74 fish per household in 2005-2009, 6.28 fish per household in 2010-2014, and 7.58 fish per household in 2015-2019. Territory 5 household use rates fell to 0.34

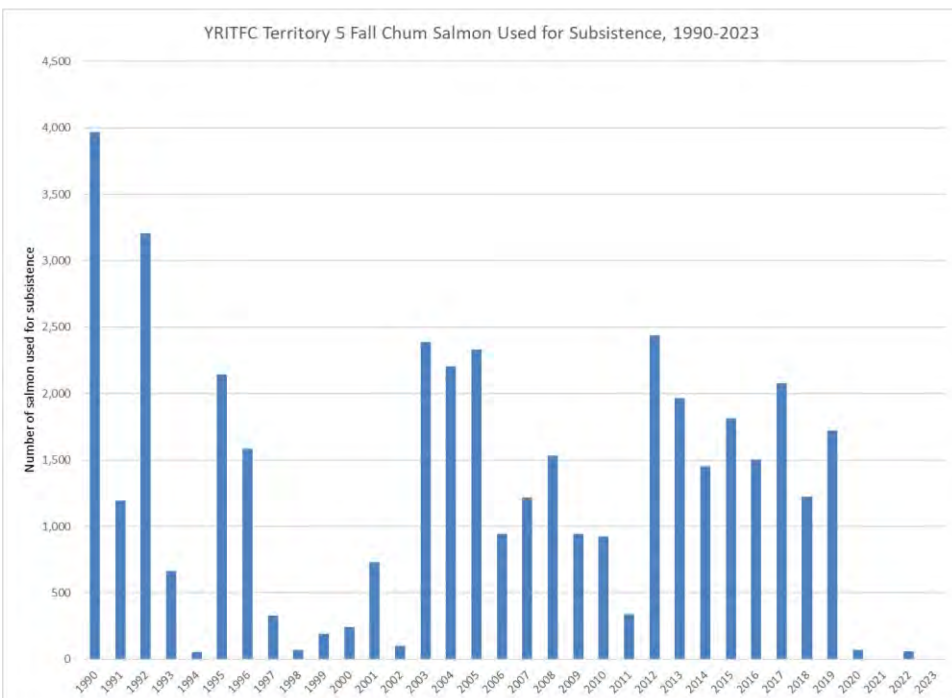

Figure A41. YRITFC Territory 5 subsistence uses of fall chum salmon, 1990-2023.

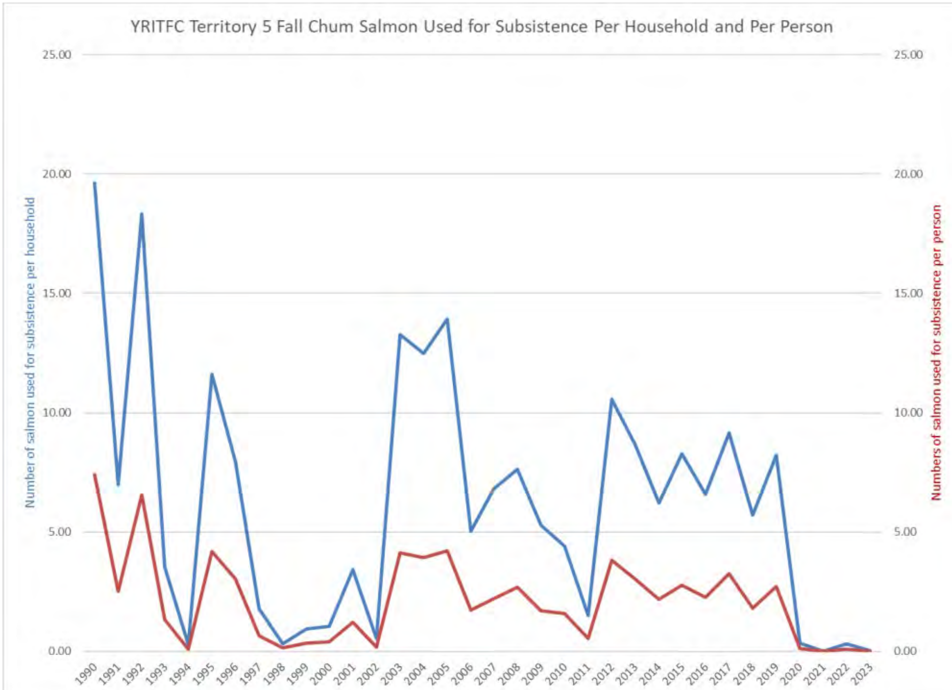

Figure A42. YRITFC Territory 5 subsistence uses of fall chum salmon per household and per person, 1990-2023.

fall chum salmon per household in 2020, zero fish per household in 2021, 0.33 fish per household in 2022, and 0.02 fish per household in 2023. Territory 5 household use rates of fall chum salmon ranged from 0.29 fish per household to 19.63 fish per household in the 1990s, exceeding 10 fish per household only in 1990 (19.63 fish per household), 1992 (18.34 fish per household), and 1995 (11.61 fish per household). Household use rates in the 2000s ranged from 0.53 fall chum salmon in 2002 to 13.94 fish per household in 2005, exceeding 10 fish per household only in 2003-2005 (13.28, 12.49, and 13.94 fish per household, respectively. In the 2010s, Territory 5 household rates of use of fall chum salmon ranged from 1.51 fish per household in 2011 to 10.57 fish per household in 2012, the only year in the 2010s where uses of fall chum salmon exceeded 10 fish per household.

Territory 5 per capita uses of Yukon River fall chum salmon ranged from highs of 7.40 fish per person in 1990 and 6.57 fish per person in 1992 to lows of 0.10 fish per person in 1994, 0.14 fish per person in 1998, and 0.18 fish per person in 2002, excluding the years 2020-2023. The 1990-1994 average per capita rates of fall chum salmon use were 3.58 fish per person, an average of 1.67 fish per person in 1995-1999, 1.97 fish per person in 2000-2004, 2.51 fish per person in 2005-2009, 2.23 and 2.57 fish per person in 2010-2014 and 2015-2019, respectively. In 2020, per capita uses of fall chum salmon in Territory 5 were 0.11 fish per person, followed by zero fish per person in 2021, 0.10 fish per person in 2022, and 0.01 fish per person in 2023.

Territory 6

Figure A43 shows the subsistence harvest composition for communities in YRITFC Territory 6 for which comprehensive subsistence harvest data are available. Territory 6

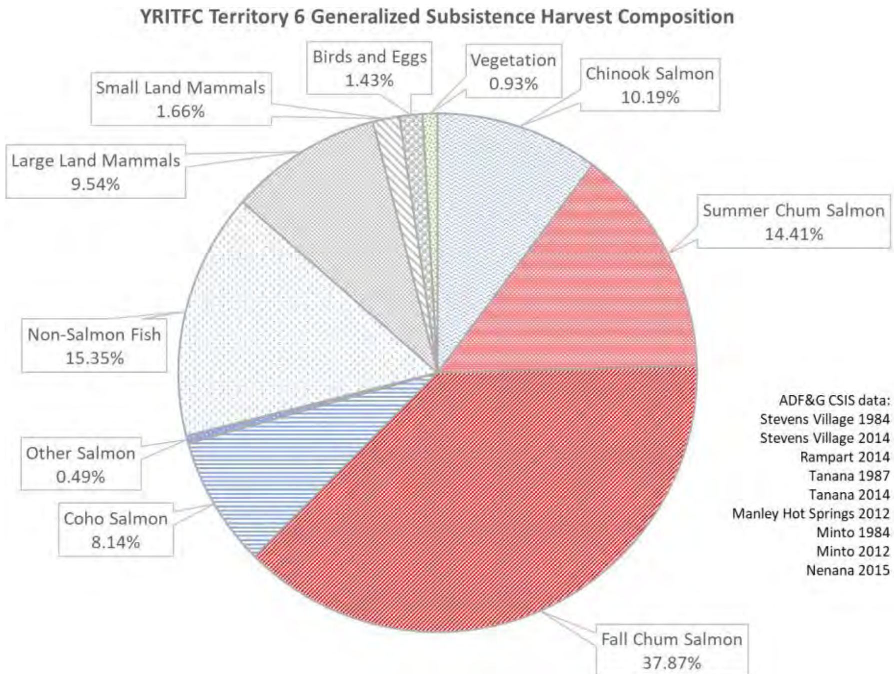

Figure A43. YRITFC Territory 6 generalized subsistence harvest composition (in edible pounds).

communities include Stevens Village (data years 1984, 2014), Rampart (2014), Tanana (1987, 2014), Manley Hot Springs (2012), Minto (1984, 2012), and Nenana (2015). Territory 6 residents depend upon salmon for 71.10% of their total subsistence harvests, including 52.28% chum salmon (14.41% summer chum salmon and 37.87% fall chum salmon), 10.19% Chinook salmon, 8.14% coho salmon, and 0.49% other salmon. After salmon, the next largest contributions to the overall subsistence economy in Territory 6 communities is non-salmon fishes (15.35%) and large land mammals (9.54%).

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 6 tribal communities in 1990-2023.

Figure A44 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence in Territory 6. Figure A44 demonstrates an overall declining trend in the number of salmon used for subsistence in Territory 6. Yukon River fall chum salmon dominates the subsistence uses of salmon in YRITFC Territory 6 representing an average of 60% fall chum salmon during 1990-1994 and 1995-1999, 46% fall chum salmon in 2000-2004, 62% fall chum salmon in 2005-2009, 68% fall chum salmon in 2010-2014, and an average of 70% fall chum salmon in 2015-2019. The proportion of total subsistence uses of salmon contributed by fall chum salmon in Territory 6 ranged from a high of 75% in 2014 to lows of 33% in 2001 and 2002 and 35% in 2000, excluding the years 2020-2023. During 2020-2023, an average of 26% of Territory 6 subsistence uses were of fall chum salmon, including 27% in 2020, 24% in 2021, 12% in 2022, and 41% in 2023.

The proportion of total subsistence salmon uses contributed by summer chum salmon in Territory 6 ranged from highs of 20% in 1993 and 2013 to lows of 4% in 2019, 5% in 2001 and 2010, and

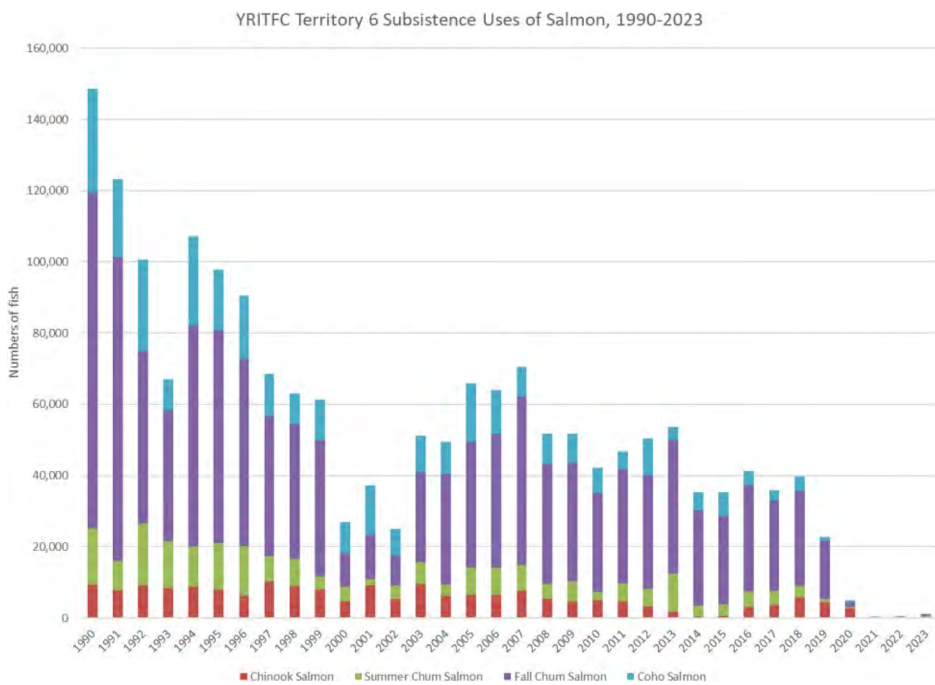

Figure A44. YRITFC Territory 6 subsistence uses of salmon, 1990-2023.

6% in 1999 and 2004. In Territory 6, the average proportion of total salmon uses contributed by summer chum salmon was 12% in the 1990-1994 and 1995-1999 periods, followed by a 2000-2004 average of 10%, an average of 11% summer chum salmon in 2005-2009 and 2010-2014, and 9% summer chum salmon in 2015-2019. The proportion of Territory 6 total subsistence uses of salmon contributed by summer chum salmon in 2020-2023 averaged 14%.

Excluding the years 2020-2023, the proportion of Chinook salmon used in Territory 6 ranged from highs of 25% in 2001 and 22% in 2002 to lows of <1% in 2014, 2% in 2015, and 3% in 2013. In 2020-2023, Chinook salmon represented an average of 47% of total subsistence uses of salmon in Territory 6. The proportion of total salmon uses contributed by coho salmon ranged from a high of 37% in 2001 to lows of 3% in 2023, 4% in 2019, and 7% in 2013.

Figure A45 represents Territory 6 subsistence uses of summer chum salmon and Figure A46 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series. Figure A45 demonstrates an overall declining trend in summer chum salmon uses for subsistence with considerable interannual variation with low levels of uses in the early 2000s and early 2020s. Excluding 2020-2023, the number of summer chum salmon used in YRITFC Territory 6 ranged from a high of 17,354 fish in 1992 to lows of 942 summer chum salmon in 2019, 1,783 fish in 2001, and 2,240 fish in 2010. The 1990-2023 average number of summer chum salmon annually used for subsistence was 6,014 fish in Territory 6, representing an average of 7% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence was 13,151 fish, followed by 9,031 summer chum salmon in 1995-1999, an average of 3,752 and 6,410 fish in 2000-2004 and 2005-2009, respectively. The 2010-2014 average number of summer chum salmon used in Territory 6 was 5,250 fish, followed by 3,149 fish in 2015-2019. In 2020, 372 summer chum salmon were used in Territory 6, followed by 23 in 2021, 39 in 2022, and 306 in 2023.

Territory 6 household use rates of summer chum salmon ranged from highs of 38.75 fish per household in 1992, 35.23 fish per household in 1990, and 33.54 fish per household in 1996 to lows of 1.07 fish per household in 2019, 3.72 fish per household in 2018, and 4.05 fish per household in 2001, if 2021-2023 are excluded. The number of summer chum salmon used per household averaged 29.33 fish per household in 1990-1994, 21.56 fish per household in 1995-1999, 8.87 fish per household in 2000-2004, 16.10 fish per household in 2005-2009, 12.12 fish per household in 2010-2014, and 4.37 fish per household in 2015-2019. Household use rates fell to 0.45 summer chum salmon per household in 2020, 0.03 fish per household in 2021, 0.05 fish per household in 2022, and 0.38 fish per household in 2023. During the 1990s, the number of summer chum salmon used per Territory 6 household exceeded 30 fish per household in 1990, 1992, 1995, and 1997 and exceeded 20 fish per household in 1993 and 1994. In the 2000s, household use rates of summer chum salmon exceeded 10 fish per household in 2003 and 2005-2009, otherwise reflected low rates of use coinciding with the poor chum salmon returns of the early 2000s (e.g., 8.54 fish per household in 2000, 4.05 in 2001, 9.03 in 2002, and 7.98 summer chum salmon per household in 2004). In the 2010s, the number of summer chum salmon used per household exceeded 10 fish only in 2011-2013, otherwise, household rates of summer chum salmon use for subsistence were some of the lowest on record declining annually from 7.69 fish per household in 2014 to 0.03 fish per household in 2021.

Territory 6 per capita uses of summer chum salmon averaged 10.76 fish per person in 1990-1994,

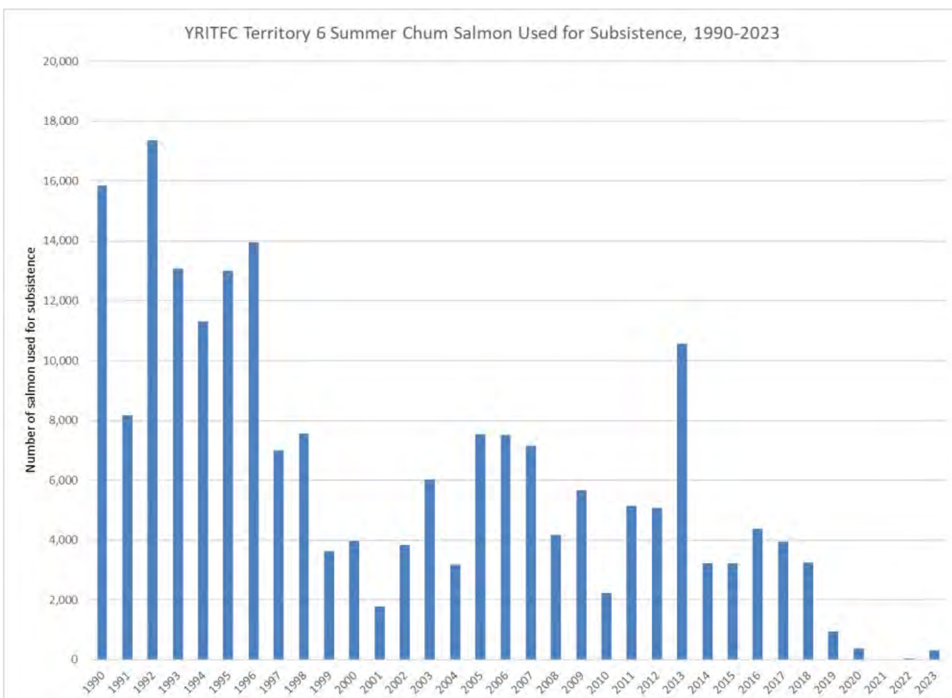

Figure A45. YRITFC Territory 6 subsistence uses of summer chum salmon, 1990-2023.

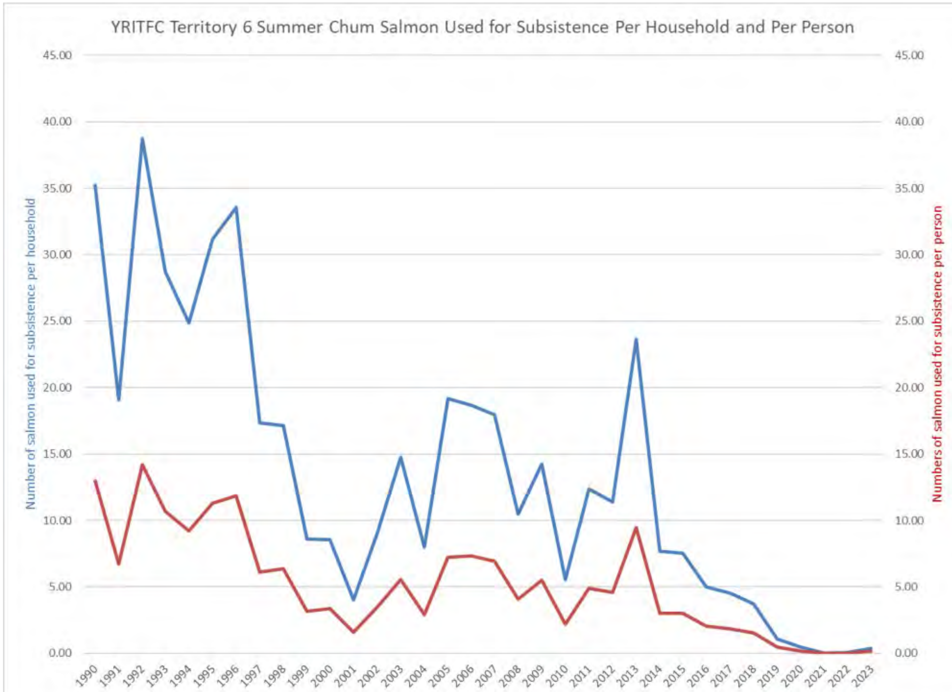

Figure A46. YRITFC Territory 6 subsistence uses of summer chum salmon per household and per person, 1990-2023.

7.77 fish per person in 1995-1999, 3.38 fish per person in 2000-2004, 6.22 fish per person in 2005-2009, 4.84 fish per person in 2010-2014, and 1.78 fish per person in 2015-2019. In 2020-2023, per capita uses of summer chum salmon were 0.19, 0.01, 0.02, and 0.16 fish per person, respectively. The number of summer chum salmon used per person for subsistence exceeded 10 fish in the 1990s, except for 1991 (6.74 fish per person), 1994 (9.19 fish per person), and 1997-1999 (6.11, 6.37, and 3.18 fish per person, respectively). Per capita uses of summer chum salmon exceeded 2 fish per person in the 2000s and 2010s, except in 2001 (1.61 fish per person) and 2017-2019 (1.86, 1.55, and 0.45 fish per person, respectively).

Figure A47 represents Territory 6 subsistence uses of fall chum salmon and Figure A48 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. Figure A47 demonstrates an overall declining trend in fall chum salmon uses for subsistence with low levels of uses in the early 2000s and early 2020s. The number of fall chum salmon used in YRITFC Territory 6 ranged from highs of 94,453 fish in 1990, 85,601 fish used in 1991, and 62,075 fish in 1994 to lows of 8,372 fall chum salmon used in 2002, 9,404 fish in 2000, 12,462 fish in 2001, and 16,408 fish used in 2019, excluding the years 2020-2023.

The 1990-2023 average number of fall chum salmon annually used for subsistence was 32,654 fish in Territory 6, representing an average of 45% of the total uses among all territories. The 1990-1994 five-year average of number of fall chum salmon used for subsistence in Territory 6 was 65,461 fish, followed by 45,545 fall chum salmon in 1995-1999, 17,331 fish in 2000-2004, 37,451 fall chum salmon in 2005-2009, an average of 31,253 fall chum salmon in 2010-2014, and 24,623 fish in 2015-2019. Territory 6 subsistence uses of fall chum salmon exceeded 40,000 fish in the 1990s, except in 1993 (36,682 fish), 1997 (39,336 fish), 1998 (37,829 fish), and 1999 (38,222 fish). In the 2000s, the number of fall chum salmon used for subsistence in Territory 6 exceeded 30,000 fish, except in 2000-2003 (9,404, 12,462, 8,372, and 25,348 fall chum salmon used, respectively). In the 2010s, fall chum salmon uses exceeded 25,000 fish, except in 2015 (24,801 fish) and 2019 (16,408 fish). In 2020, 1,369 fall chum were used in Territory 6, followed by 80 fish in 2021, 52 fish in 2022, and 401 fall chum salmon were used in 2023.

Territory 6 household use rates of fall chum salmon varied considerably throughout the 1990-2023 time series from highs of 209.90 fish per household in 1990, 200.29 fish per household in 1991, and 136.45 fish per household in 1994 to lows of 18.68 fish per household in 2019, 19.77 fish per household in 2002, and 20.27 fish per household in 2000, excluding the years 2020-2023. The number of fall chum salmon used per household averaged 147.09 fish in 1990-1994, an average of 108.65 fish per household in 1995-1999, 41.70 fish per household in in 2000-2004, 94.05 fish per household in 2005-2009, 73.14 fish per household in 2010-2014, and 34.06 fish per household in 2015-2019. Territory 6 household use rates fell to 1.64 fall chum salmon per household in 2020, 0.10 fish per household in 2021, 0.07 fish per household in 2022, and 0.50 fish per household in 2023. Territory 6 household use rates of fall chum salmon ranged from 80.56 fish per household to 209.90 fish per household in the 1990s and exceeded 90 fish per household except in 1993 and 1998 with 80.56 and 85.86 fish per household, respectively. Household use rates in the 2000s ranged from 19.77 fall chum salmon in 2002 to 119.04 fish per household in 2007, exceeding 60 fish per household except in 2000-2002 (20.27, 28.29, and 19.77 fish per household, respectively). In the 2010s, Territory 6 household rates of use of fall chum salmon ranged from 18.68 fish per household in 2019 to 84.36 fish per household in 2013 and exceeded 50 fish per household except in 2016-2019 (33.98, 29.29, 30.58, and 18.68 fish per household, respectively).

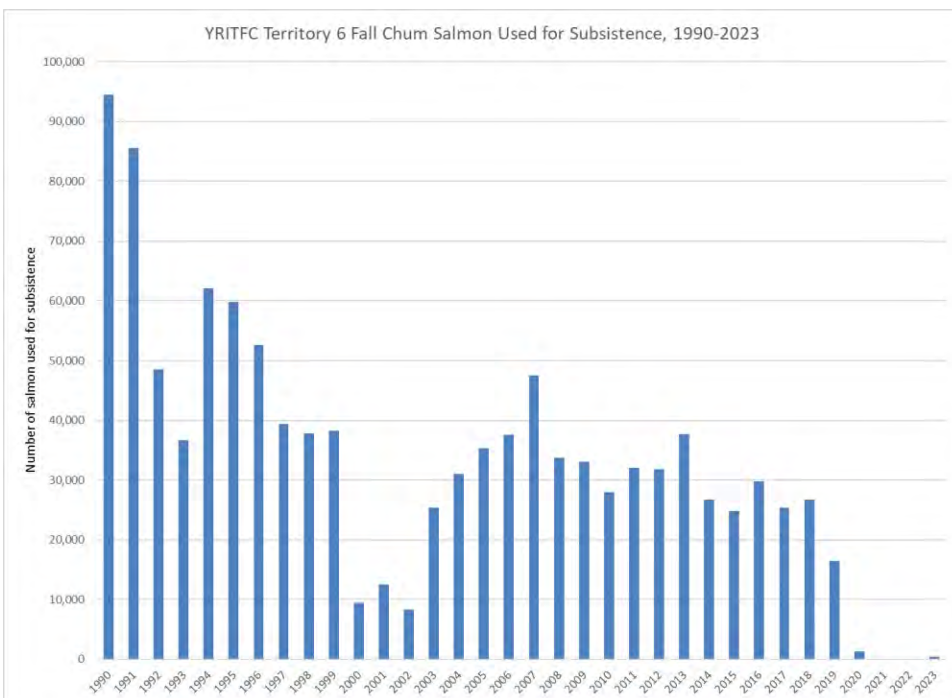

Figure A47. YRITFC Territory 6 subsistence uses of fall chum salmon, 1990-2023.

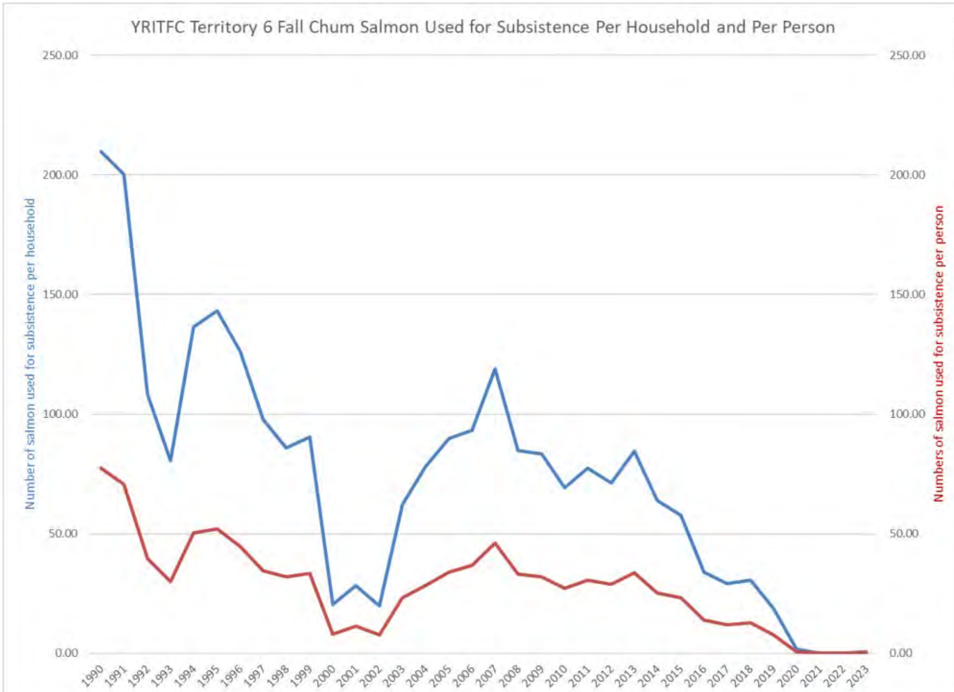

Figure A48. YRITFC Territory 6 subsistence uses of fall chum salmon per household and per person, 1990-2023.

Territory 6 per capita uses of Yukon River fall chum salmon ranged from highs of 77.29 fish per person in 1990 and 70.74 fish per person in 1991 to lows of 7.60 fish per person in 2002, 7.75 fish per person in 2019, 7.60 fish per person in 2002, and 8.02 fish per person in 2000, excluding the years 2020-2023. The 1990-1994 average per capita rates of fall chum salmon use were 53.65 fish per person, an average of 39.27 fish per person in 1995-1999, 15.72 fish per person in 2000-2004, 36.38 fish per person in 2005-2009, 29.14 fish per person in 2010-2014, and 13.92 fish per person in 2015-2019. In 2020, per capita uses of fall chum salmon in Territory 6 were 0.69 fish per person, followed by 0.04 fish per person in 2021, 0.03 fish per person in 2022, and 0.22 fish per person in 2023.

Territory 7

Figure A49 shows the subsistence harvest composition for communities in YRITFC Territory 7 for which comprehensive subsistence harvest data are available. Territory 7 communities include Birch Creek (data year 2018), Fort Yukon (1987, 2017), Beaver (1985, 2011), and Venetie (2009). Territory 7 residents depend upon salmon for 57.82% of their total subsistence harvests, including 35.03% chum salmon (12.62% summer chum salmon, 20.77 fall chum salmon, and 1.64% unknown chum salmon) and 22.50% Chinook salmon. After salmon, the next largest contributions to the overall subsistence economy in Territory 7 are large land mammals (23.71%), non-salmon fishes (10.24%), and birds and eggs (4.13%).

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 7 tribal communities in 1990-2023.

Figure A50 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence in Territory 7. Figure A50 demonstrates considerable variability in salmon uses during the 1990-2023 time series, but generally represents an overall declining trend in the number of salmon used for subsistence in Territory 7. Yukon River fall chum salmon dominates the subsistence uses of salmon in YRITFC Territory 7, representing an average of 48% fall chum salmon during 1990-1994, 70% fall chum in 1995-1999, an average of 51% fall chum salmon in 2000-2004, 61% fall chum salmon in 2005-2009, 81% fall chum salmon in 2010-2014, and an average of 72% fall chum salmon in 2015-2019. The proportion of total subsistence uses of salmon contributed by fall chum salmon in Territory 7 ranged from highs of 96% in 2014, 91% in 2013 and 2015, and 87% in 2016 to lows of 23% and 25% in 2000 and 1991, respectively, excluding the years 2020-2023. During 2020-2023, an average of 56% of Territory 7 subsistence uses were of fall chum salmon, including 14% in 2020, 23% in 2021, 98% in 2022, and 89% in 2023.

The proportion of total subsistence salmon uses contributed by summer chum salmon in Territory 7 ranged from highs of 54% in 1991 and 21% in 2006 to lows of <1% in 1998, 2005, 2012-2017, and 2019-2023. In Territory 7, the average proportion of total salmon uses contributed by summer chum salmon was 22% in the 1990-1994, an average of 3% summer chum salmon in 1995-1999, followed by a 2000-2004 average of 11% summer chum, 8% summer chum salmon in 2005-2009, an average of 4% in 2010-2014, dropping to an average of 0.58% summer chum salmon in 2015-2019. The proportion of Territory 7 total subsistence uses of salmon contributed by summer chum salmon in 2020-2023 averaged 0.29%.

Excluding the years 2020-2023, the proportion of Chinook salmon used in Territory 7 ranged from highs of 64% in 2000, 46% in 2018, and 40% in 1992 and 1993 to lows of 1% in 2014, 8%

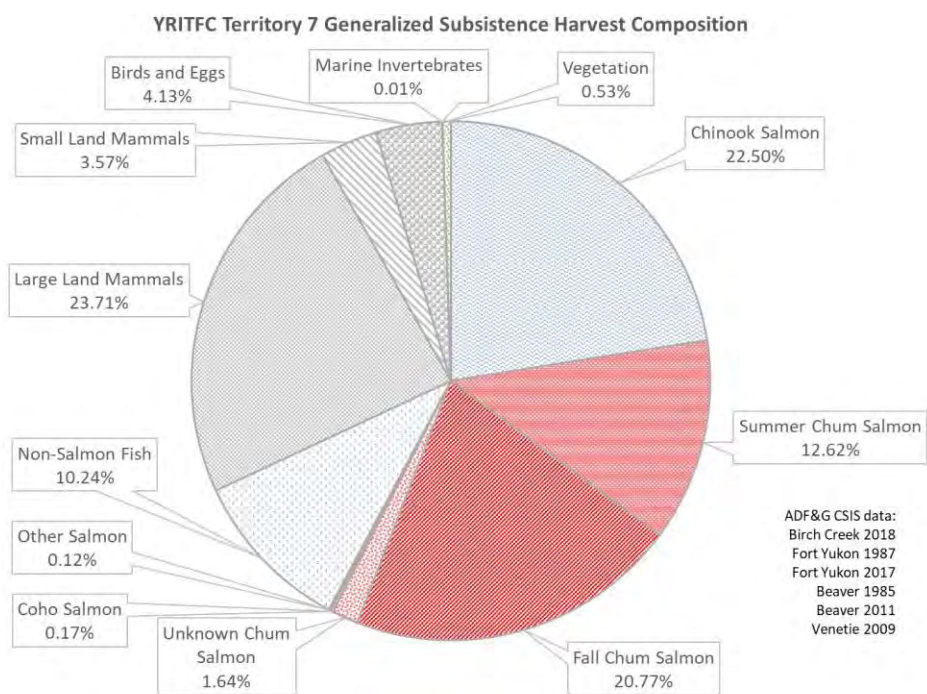

Figure A49. YRITFC Territory 7 generalized subsistence harvest composition (in edible pounds).

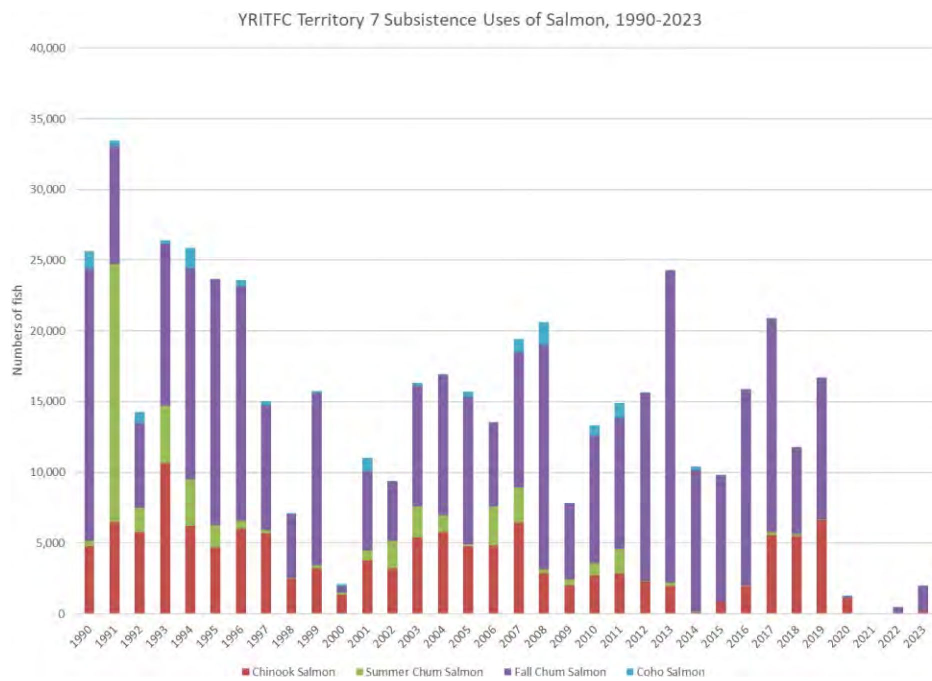

Figure A50. YRITFC Territory 7 subsistence uses of salmon, 1990-2023.

in 2013, and 9% in 2015. In 2020-2023, Chinook salmon represented an average of 43% of total subsistence uses of salmon in Territory 7 (i.e. 85% in 2020, 77% in 2021, <1% in 2022, and 9% Chinook salmon in 2023). The proportion of total salmon uses contributed by coho salmon ranged from highs of 9% in 2001 and 8% in 2008 to lows of 1% or less in 1991, 1993, 1995, 1998-1999, 2002, 2004, 2006, 2009, 2012-2013, 2015-2023.

Figure A51 represents Territory 7 subsistence uses of summer chum salmon and Figure A52 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series. Figure A51 demonstrates the relative lack of use of summer chum salmon in Territory 7 in the past decade with higher levels of use in the 1990s and 2000s, particularly in 1991 when 54% of subsistence salmon uses were of summer chum salmon. Excluding 2020-2023, the number of summer chum salmon used in YRITFC Territory 7 ranged from a 1991 high of 18,222 fish to lows of zero summer chum salmon in 2015, 27 fish in 2012, 35 fish in 2014 and 2016, 39 fish in 2019, and 45 fish in 1998. The 1990-2023 average number of summer chum salmon annually used for subsistence was 1,354 fish in Territory 7, representing an average of 1.5% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence in Territory 7 was 5,530 fish, followed by an average of 540 summer chum salmon in 1995-1999, 1,234 fish in 2000-2004, 1,236 fish in 2005-2009, 574 fish in 2010-2014, and an average of 87 summer chum salmon fish in 2015-2019. In 2020, zero summer chum salmon were used in Territory 7, followed by zero in 2021, 4 fish in 2022, and 7 fish in 2023.

Territory 7 household use rates of summer chum salmon ranged from a high of 49.92 fish per household in 1991 to lows less than one summer chum salmon per household in 1990, 1997-2000, 2005, 2008, and 2012-2023. The number of summer chum salmon used per household averaged 15.10 fish per household in 1990-1994, 1.57 fish per household in 1995-1999, 4.49 fish per household in 2000-2004, 4.43 fish per household in 2005-2009, 1.60 fish per household in 2010-2014, and 0.25 fish per household in 2015-2019. Household use rates of summer chum salmon exceeded 10 fish per household only in 1991, 1993, and 2006.

Territory 7 per capita uses of summer chum salmon averaged 5.31 fish per person in 1990-1994, 0.52 fish per person in 1995-1999, 1.28 fish per person in 2000-2004, 1.29 fish per person in 2005-2009, 0.61 fish per person in 2010-2014, and 0.10 fish per person in 2015-2019. Territory 7 per capita uses of summer chum salmon were zero in 2020-2022 and 0.01 fish per person in 2023. Territory 7 per capita uses of summer chum salmon exceeded 2 fish per person only in 1991 (17.74 fish per person), 1993 (3.73 fish per person), 1994 (3.10 fish per person), 2003 (2.32 fish per person), 2006 (2.88 fish per person), and 2007 (2.63 fish per person).

Figure A53 represents Territory 7 subsistence uses of fall chum salmon and Figure A54 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. Figure A53 demonstrates considerable interannual variation in fall chum salmon uses. The number of fall chum salmon used in YRITFC Territory 7 ranged from highs of 22,063 fish in 2013, 19,251 fish used in 1990, 17,357 fish in 1995, 16,578 fish in 1996, and 15,858 fish in 2008 to lows of 485 fish in 2000, 4,208 fish in 2002, and 4,535 fish in 1998, excluding the years 2020-2023.

The 1990-2023 average number of fall chum salmon annually used for subsistence was 9,275 fish in Territory 7, representing an average of 13% of the total uses among all territories. The 1990-1994 five-year average of number of fall chum salmon used for subsistence in Territory 7 was

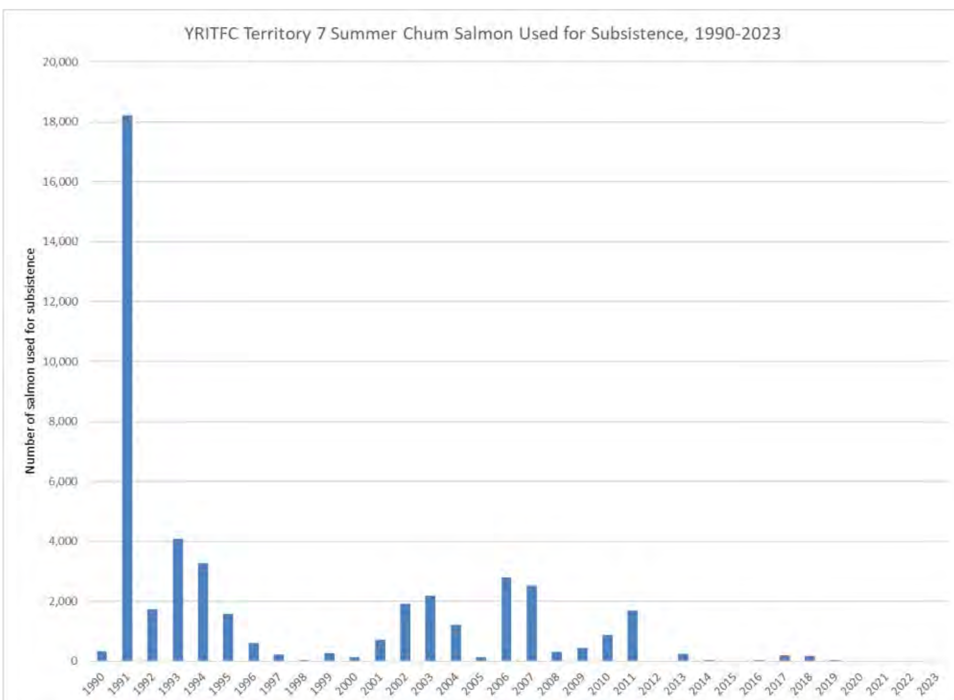

Figure A51. YRITFC Territory 7 subsistence uses of summer chum salmon, 1990-2023.

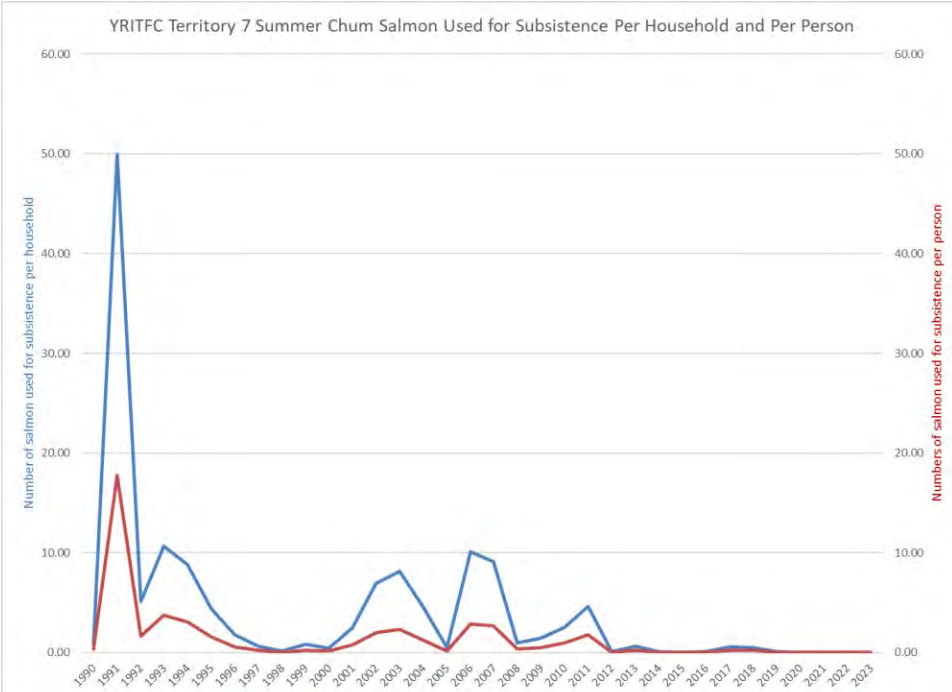

Figure A52. YRITFC Territory 7 subsistence uses of summer chum salmon per household and per person, 1990-2023.

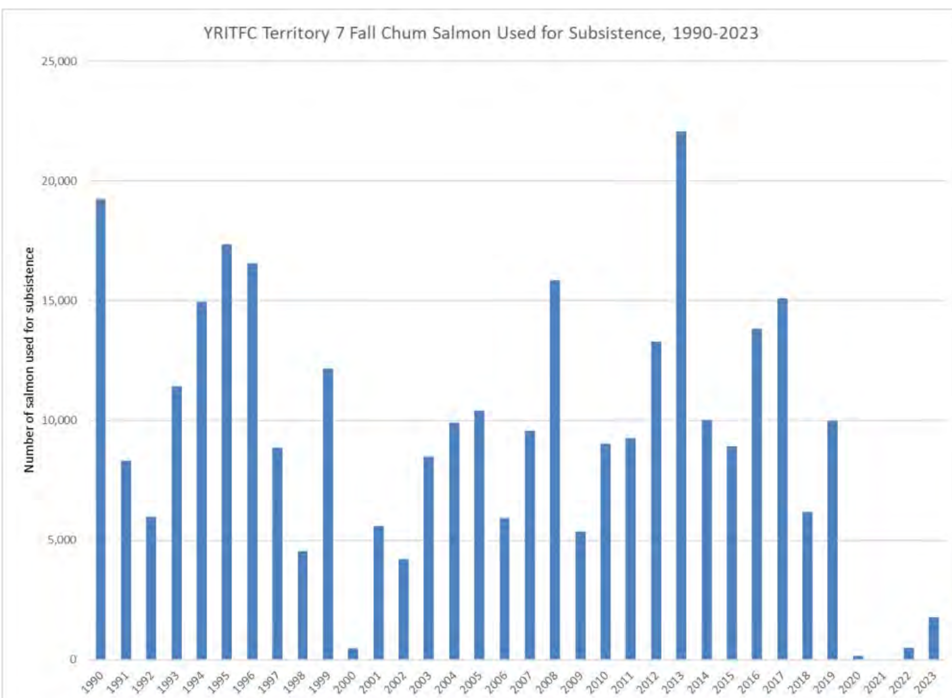

Figure A53. YRITFC Territory 7 subsistence uses of fall chum salmon, 1990-2023.

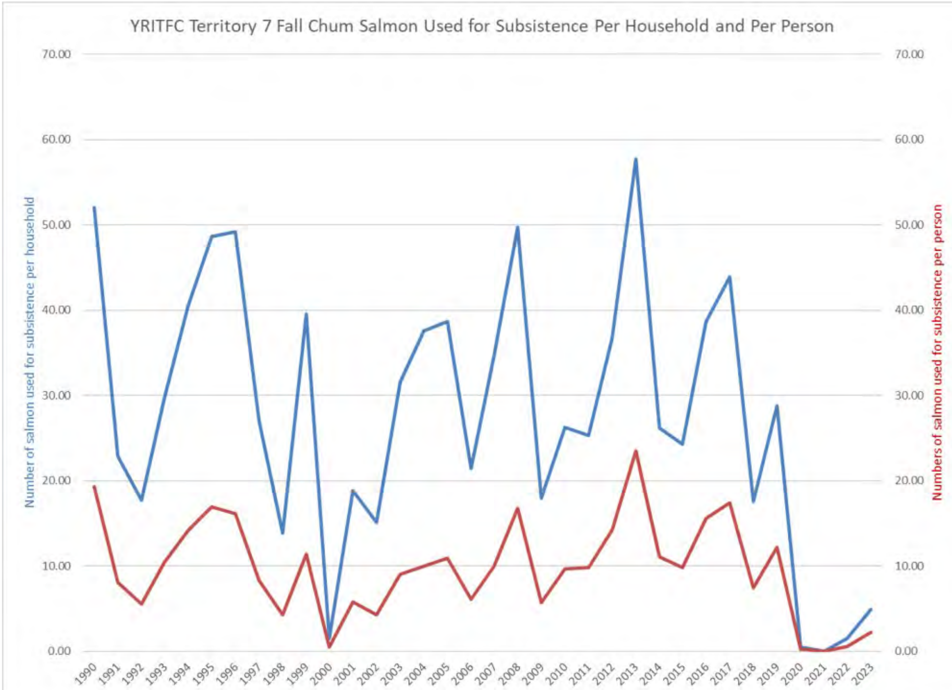

Figure A54. YRITFC Territory 7 subsistence uses of fall chum salmon per household and per person, 1990-2023.

11,989 fish, followed by 11,901 fall chum salmon in 1995-1999, 5,738 fish in 2000-2004, 9,419 fish in 2005-2009, an average of 12,729 fall chum salmon in 2010-2014, and 10,802 fish in 2015-2019. Territory 7 subsistence uses of fall chum salmon exceeded 10,000 fish in the 1990s, except in 1991 (8,332 fish), 1992 (5,985 fish), 1997 (8,862 fish), and 1998 (4,535 fish). In the 2000s, the number of fall chum salmon used for subsistence in Territory 7 exceeded 10,000 fish only in 2005 (10,405 fish) and 2008 (15,858 fish), otherwise exceeded 5,000 fall chum salmon in all years except in 2000 (485 fish) and 2002 (4,208 fish). In the 2010s, fall chum salmon uses exceeded 10,000 fish in 2012-2014 (13,290 fish, 22,063 fish, and 10,011 fish, respectively), otherwise exceeded 8,000 fish in all years except 2018 (6,172 fish). In 2020, 176 fall chum were used in Territory 7, followed by 7 fish in 2021, 497 fish in 2022, and 1,781 fish in 2023.

Territory 7 household use rates of fall chum salmon varied considerably throughout the 1990-2023 time series from highs of 57.76 fish per household in 2013 and 52.03 fish per household in 1990 to lows of 1.51 fish per household in 2000, 13.83 fish per household in 1998, and 15.14 fish per household in 2002, excluding the years 2020-2023. The number of fall chum salmon used per household averaged 32.58 fish in 1990-1994, an average of 35.63 fish per household in 1995-1999, 20.92 fish per household in in 2000-2004, 32.47 fish per household in 2005-2009, 34.47 fish per household in 2010-2014, and 30.64 fish per household in 2015-2019. Territory 7 household use rates fell to 0.51 fall chum salmon per household in 2020, 0.02 fish per household in 2021, 1.52 fish per household in 2022, and 4.89 fish per household in 2023.

Territory 7 household use rates of fall chum salmon ranged from 13.83 fish per household to 52.03 fish per household in the 1990s and exceeded 20 fish per household except in 1992 and 1998 with 17.76 and 13.83 fish per household, respectively. Territory 7 household use rates of fall chum salmon during the

2000s ranged from 1.51 to 49.71 fish per household and exceeded 30 fish per household in 2003-2005 and 2007-2008, otherwise fall chum household uses exceeded 15 fish per household in the 2010s except 2000. Household use rates in the 2010s ranged from 17.58 fall chum salmon in 2018 to 57.76 fish per household in 2013, exceeding 25 fish per household in all years except 2015 (24.26 fish per household) and 2018 (17.58 fish per household).

Territory 7 per capita uses of Yukon River fall chum salmon ranged from highs of 23.50 fish per person in 2013 and 19.31 fish per person in 1990 to lows of 0.49 fish per person in 2000, 4.32 fish per person in 1998 and 2002, excluding the years 2020-2023. The 1990-1994 average per capita rates of fall chum salmon use in Territory 7 were 11.52 fish per person, an average of 11.43 fish per person in 1995-1999, 5.92 fish per person in 2000-2004, 9.90 fish per person in 2005-2009, 13.66 fish per person in 2010-2014, and 12.49 fish per person in 2015-2019. In 2020, per capita uses of fall chum salmon were 0.23 fish per person, followed by 0.01 fish per person in 2021, 0.60 fish per person in 2022, and 2.20 fish per person in 2023.

Territory 8

Figure A55 shows the subsistence harvest composition for communities in YRITFC Territory 8 for which comprehensive subsistence harvest data are available. Territory 8 communities include Dot Lake (data years 1987, 2011), Tanacross (1987), Tetlin (1987), and Northway (1987, 2014). ADF&G comprehensive subsistence research demonstrates that harvest of non-salmon fishes contributes the most to the overall subsistence economy of Territory 8 at 42.82%, followed by large land mammals (32.19%), salmon (9.41%), and small land mammals (7.10%). Documented salmon harvests in Territory 8 include other salmon (5.10%) most of which

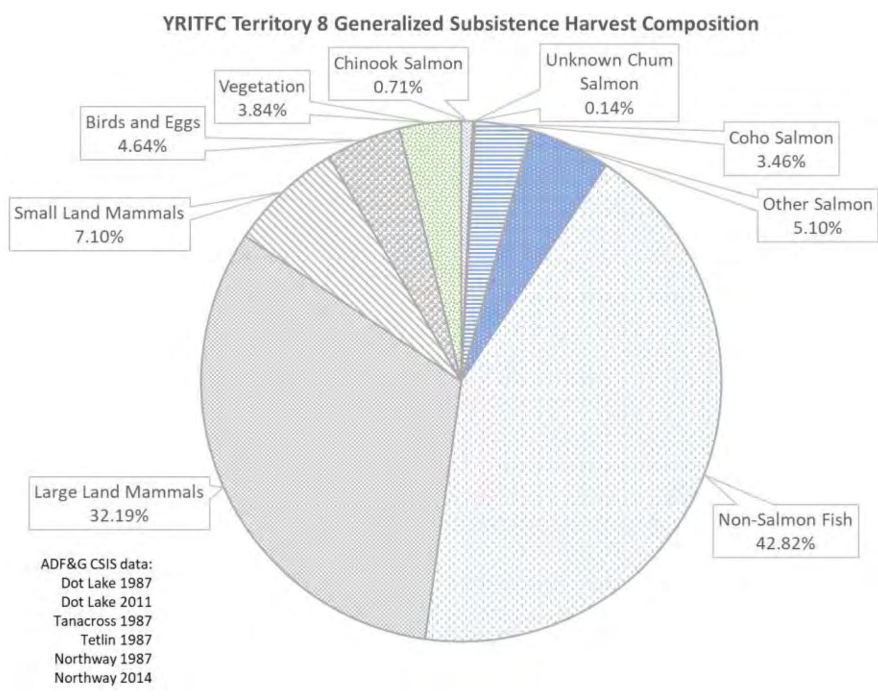

Figure A55. YRITFC Territory 8 generalized subsistence harvest composition (in edible pounds).

are Copper River sockeye salmon, coho salmon (3.46%), Chinook salmon (0.71%), and unknown chum salmon (0.14%).

Territory 8 residents of the Upper Tanana River drainage generally do not have abundant local salmon populations upon which they depend for subsistence, but instead travel elsewhere such as the Copper River, lower Tanana River, or at least formerly to the Yukon River at Eagle to harvest salmon for subsistence uses. Given the relative lack of salmon in the Upper Tanana River region, Territory 8 communities are not part of the Yukon Fisheries Management Area subsistence salmon post-season salmon household harvest survey or harvest calendar program, such that harvest and use data on salmon is very limited. Since Territory 8 is not well represented in the Yukon River subsistence salmon use data, Territory 8 is not further represented in this report.

Territory 9

Figure A56 shows the subsistence harvest composition for communities in YRITFC Territory 9 for which comprehensive subsistence harvest data are available. Territory 9 communities include Circle (data year 2017) and Eagle (2017), the only Alaskan member tribes of the territory for which data are readily available. Territory 9 residents depend upon salmon for 85.92% of their total subsistence harvests, including fall chum salmon (74.24%), Chinook salmon (11.57%), and other salmon (0.11%). After salmon, the next largest contributions to the overall subsistence economy in Territory 9 are large land mammals (10.33%) and non-salmon fishes (1.41%). Given that Figure 21 reflects only subsistence harvest patterns in 2017 for both Eagle and Circle, undoubtedly Chinook salmon would otherwise contribute more to the subsistence

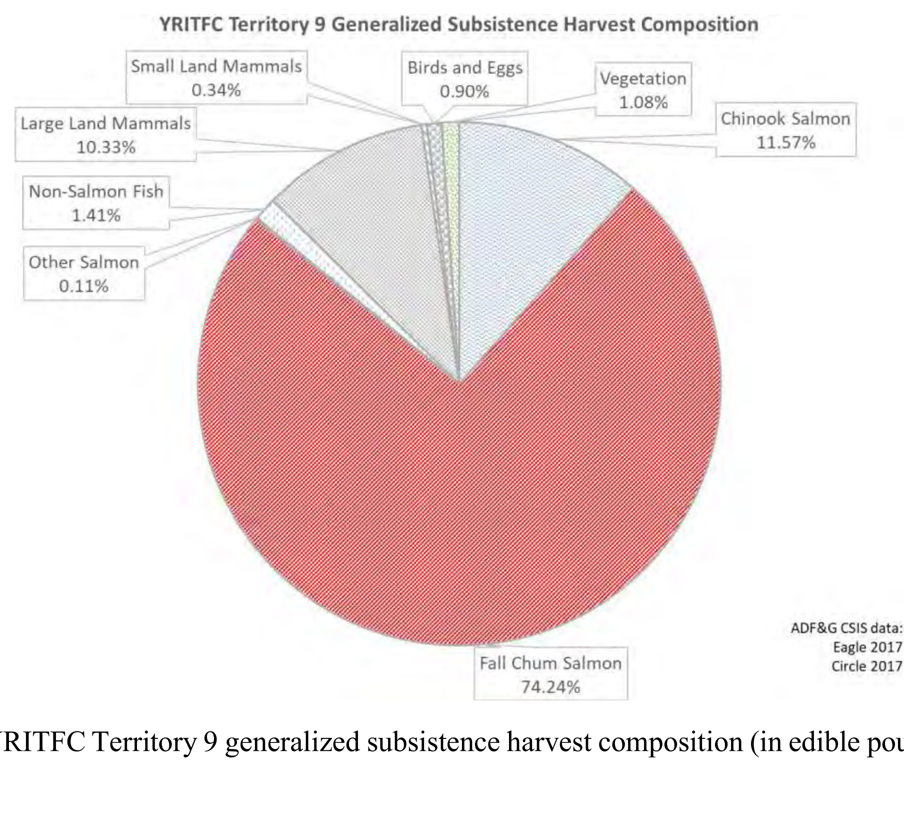

Figure A56. YRITFC Territory 9 generalized subsistence harvest composition (in edible pounds).

economy of Territory 9 if it were not for the many years of conservation concern associated with Yukon River Chinook salmon.

ADF&G post-season household surveys document subsistence salmon harvests, the number of salmon received from in-season test fisheries for subsistence uses, and the number of salmon retained from commercial fishing efforts among all Territory 9 tribal communities in 1990-2023.

Figure A57 illustrates the number of Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon used for subsistence in Territory 9. Figure A57 demonstrates variability in salmon uses during the 1990-2023 time series, but generally represents an overall stability in the number of salmon used for subsistence punctuated by significant declines in 1993, 1998, and the early 2000s, and most recently in 2020-2023. Yukon River fall chum salmon dominates the subsistence uses of salmon in YRITFC Territory 9, representing an average of 77% fall chum salmon during 1990-1994, 81% fall chum in 1995-1999, an average of 55% fall chum salmon in 2000-2004, 86% fall chum salmon in 2005-2009, 96% fall chum salmon in 2010-2014, and an average of 93% fall chum salmon in 2015-2019. The proportion of total subsistence uses of salmon contributed by fall chum salmon in Territory 9 ranged from highs of 99.59% in 2014, 98% in 2012, and 97% in 2013 and 2015 to lows of 2% in 2000, 11% in 2002, and 15% in 1998, excluding the years 2020-2023. In 2020, the proportion of subsistence salmon uses was 2% fall chum salmon and 98% Chinook salmon, recognizing that only 464 salmon were used for subsistence in 2020. In 2021, a total of 43 salmon were used in Territory 9, which were 100% Chinook salmon. In 2022, a total of 93 salmon were used with 56% Chinook salmon and 44% fall chum salmon. In 2023, no salmon were used in Territory 9.

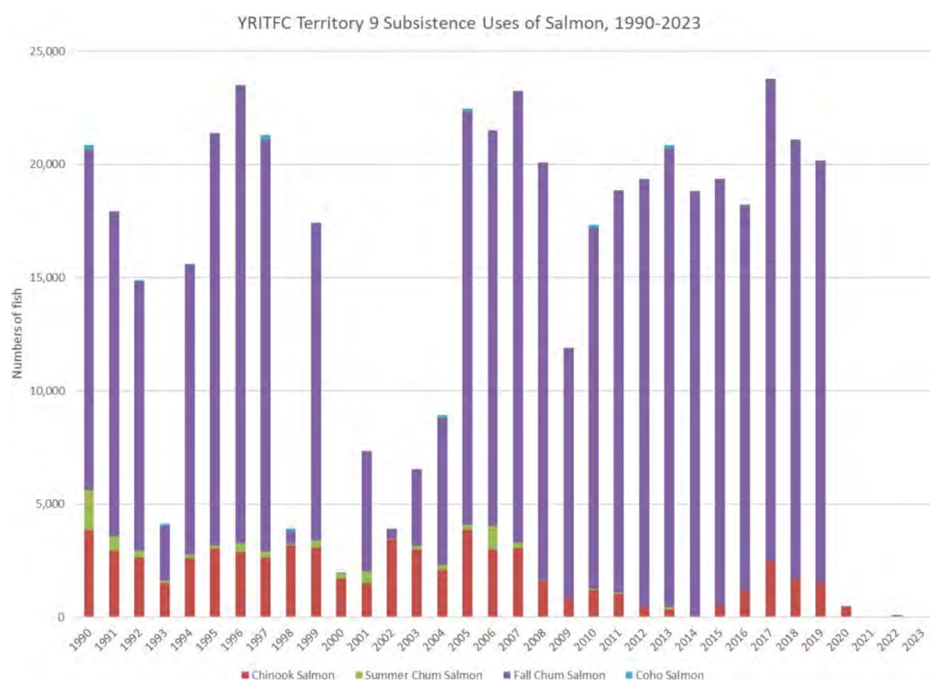

Figure A57. YRITFC Territory 9 subsistence uses of salmon, 1990-2023.

The proportion of total subsistence salmon uses contributed by summer chum salmon in Territory 9 ranged from highs of 12% in 2000 and 8% in 1990 and 2001 to lows of <1% or zero in 1994, 2002, and 2007-2023. In Territory 9, the average proportion of total salmon uses contributed by summer chum salmon was 4% in the 1990-1994, an average of 1% summer chum salmon in 1995-1999, followed by a

2000-2004 average of 4% summer chum, 2% summer chum salmon in 2005-2009, an average of 0.24% in 2010-2014, and zero percent from 2014-2023.

Excluding the years 2020-2023, the proportion of Chinook salmon used in Territory 9 ranged from highs of 89% in 2002, 87% in 2000, and 81% in 1998 to lows <1% in 2014, 2% in 2012 and 2013, and 3% in 2015. The proportion of total salmon uses contributed by coho salmon ranged from a high of 3% in 1998 to <1% or zero in all other years except 1990 (1%), 1993 (2%), and 2004 (1%).

Figure A58 represents Territory 9 subsistence uses of summer chum salmon and Figure A59 reflects the number of summer chum salmon used per household and per person during the 1990-2023 time series. Figure A58 demonstrates the relative lack of use of summer chum salmon in Territory 9 in the past decade with higher levels of use in the 1990s and 2000s. The number of summer chum salmon used in YRITFC Territory 9 ranged from a 1990 high of 1,755 fish to lows of zero summer chum salmon in 2009, 2012, 2014-2023. The 1990-2023 average number of summer chum salmon annually used for subsistence was 208 fish in Territory 9, representing an average of 0.2% of the total uses among all territories. The 1990-1994 five-year average number of summer chum salmon used for subsistence in Territory 9 was 590 fish, followed by an average of 232 summer chum salmon in 1995-1999, 246 fish in 2000-2004, 301 fish in 2005-2009, 46 fish in 2010-2014, and zero summer chum salmon in 2015-2019.

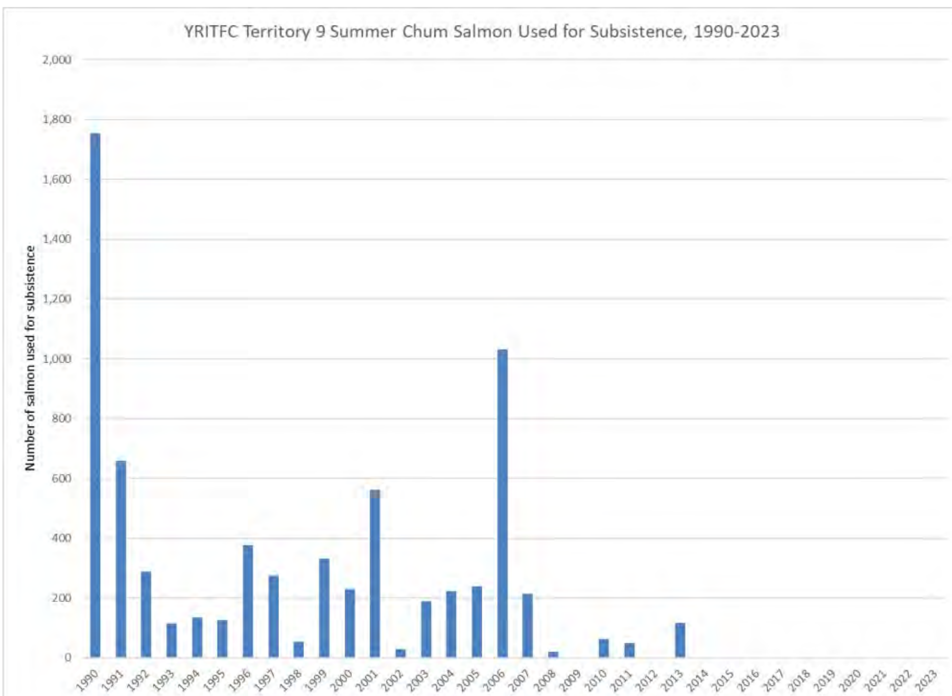

Figure A58. YRITFC Territory 9 subsistence uses of summer chum salmon, 1990-2023.

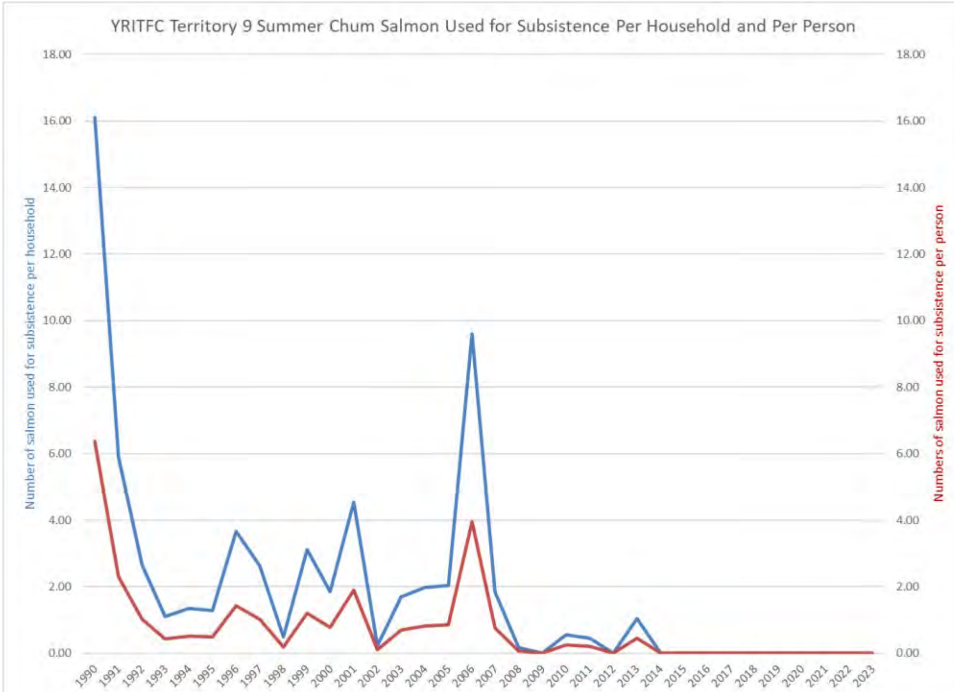

Figure A59. YRITFC Territory 9 subsistence uses of summer chum salmon per household and per person, 1990-2023.

Territory 9 household use rates of summer chum salmon ranged from a high of 16.10 fish per household in 1990 to lows less than one or zero summer chum salmon per household in 1998, 2002, 2008-2012, and 2014-2023. The number of summer chum salmon used per household averaged 5.42 fish per household in 1990-1994, 2.24 fish per household in 1995-1999, 2.05 fish per household in 2000-2004, 2.73 fish per household in 2005-2009, 0.41 fish per household in 2010-2014, and zero per household in 2015-2019 and 2020-2023. Household use rates of summer chum salmon exceeded 10 fish per household only in 1990 and exceeded 2 fish per household only in 1991 (5.89 fish per household), 1992 (2.64 fish per household), 1996 (3.66 fish per household), 1997 (2.62 fish per household, 1999 (3.12 fish per household), 2001 (4.53 fish per household), 2005 (2.04 fish per household), and 2006 (9.59 fish per household).

Territory 9 per capita uses of summer chum salmon ranged from highs of 6.36 fish per person in 1990 and 3.95 fish per person in 2006 to lows of less than one or zero fish per person in 1993-1995, 1998, 2000, 2002-2005, and 2007-2023. The number of summer chum use per person in Territory 9 averaged 2.13 fish per person in 1990-1994, 0.87 fish per person in 1995-1999, 0.86 fish per person in 2000-2004, 1.13 fish per person in 2005-2009, 0.18 fish per person in 2010-2014, and zero fish per person in 2015-2019, and 2020-2023. Territory 9 per capita uses of summer chum salmon exceeded 2 fish per person only in 1990 (6.36 fish per person), 1991 (2.30 fish per person), and 2006 (3.95 fish per person).

Figure A60 represents Territory 9 subsistence uses of fall chum salmon and Figure A61 reflects the number of fall chum salmon used per household and per person during the 1990-2023 time series. Figure A60 demonstrates considerable interannual variation in fall chum salmon uses in the 1990s and early 2000s. Territory 9 uses of fall chum salmon exceeded 15,000 fish annually in 2005-2019, except in 2009 with only 11,051 fall chum salmon used that year. Fall chum salmon uses during this time were comparable to 1995-1997 when the number of fish used were 18,217, 20,224, and 18,195 fish, respectively. The number of fall chum salmon used in YRITFC Territory 9 ranged from highs of 21,308 fish in 2017, 20,268 in 2013, and 20,224 fish used in 1996 to lows of 32 fish in 2000, 413 fish in 2002, and 580 fish in 1998, excluding the years 2020-2023.

The 1990-2023 average number of fall chum salmon annually used for subsistence was 12,222 fish in Territory 9, representing an average of 17% of the total uses among all territories. The 1990-1994 five-year average of number of fall chum salmon used for subsistence in Territory 9 was 11,305 fish, followed by 14,246 fall chum salmon in 1995-1999, 3,124 fish in 2000-2004, 17,044 fish in 2005-2009, an average of 18,315 fall chum salmon in 2010-2014, and 19,062 fish in 2015-2019. Territory 9 subsistence uses of fall chum salmon exceeded 10,000 fish in the 1990s, except in 1993 (2,419 fish) and 1998 (580 fish). The number of fall chum salmon used for subsistence in Territory 9 exceeded 10,000 fish in 2005-2019. In 2020, 9 fall chum were used in Territory 9, followed by zero fish in 2021, 41 fish in 2022, and zero fish in 2023.

Territory 9 household use rates of fall chum salmon varied considerably throughout the 1990-2023 time series from highs of 197.04 fish per household in 1996, 184.96 fish per household in 1995, and 181.97 fish per household in 2013 to lows of 0.26 fish per household in 2000, 3.37 fish per household in 2002, and 5.39 fish per household in 1998, excluding the years 2020-2023. The number of fall chum salmon used per household averaged 105.16 fish in 1990-1994, an average of 138.69 fish per household in 1995-1999, 26.77 fish per household in in 2000-2004, 149.98 fish per household in 2005-2009, 160.14 fish per household in 2010-2014, and 137.90 fish per household in 2015-2019. Territory 9 household use rates fell to 0.06 fall chum salmon per

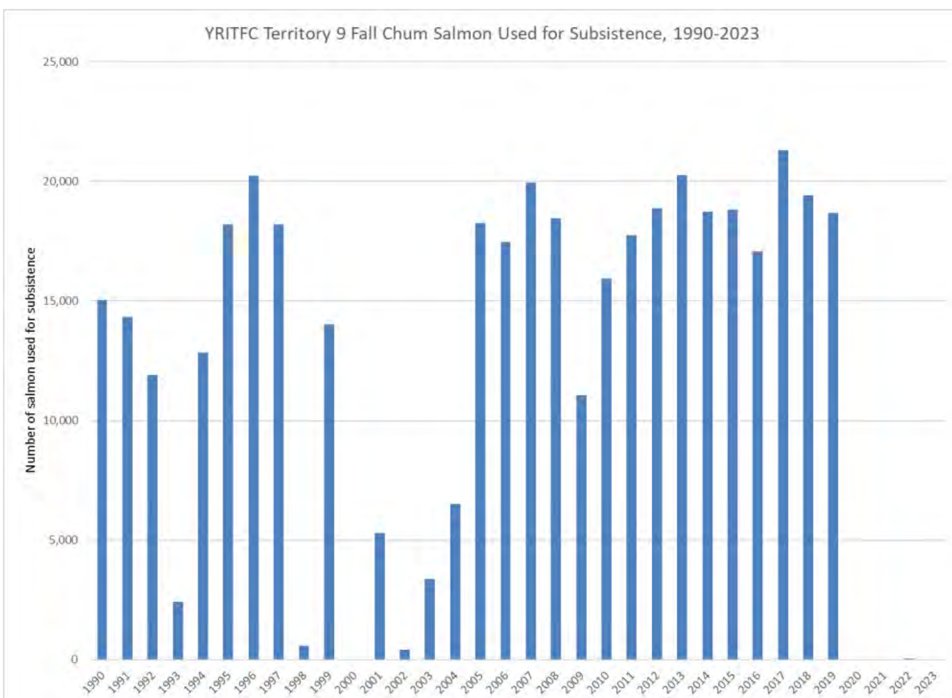

Figure A60. YRITFC Territory 9 subsistence uses of fall chum salmon, 1990-2023.

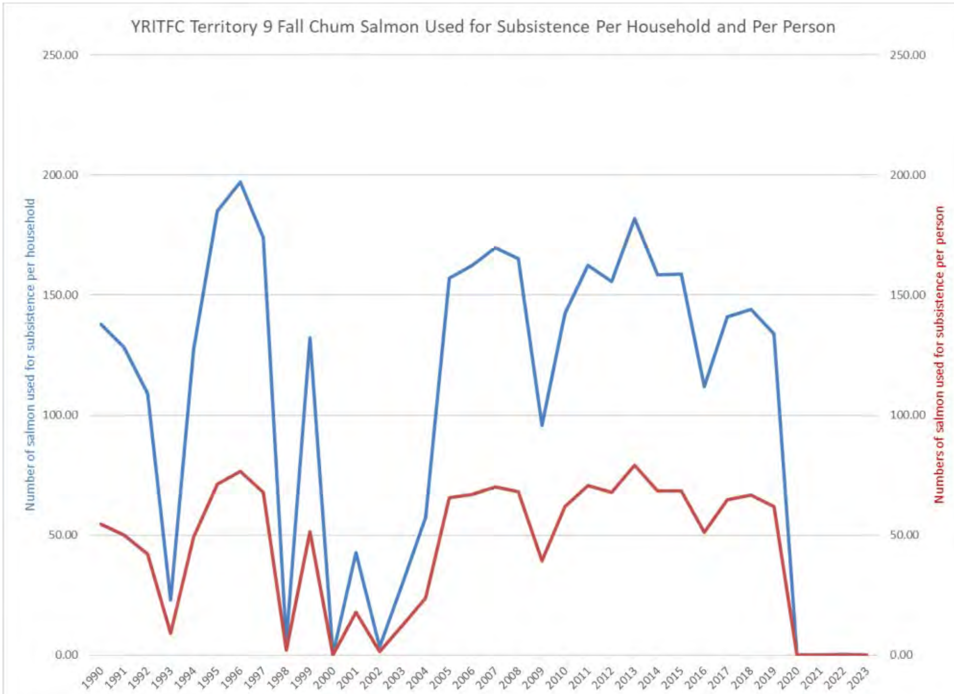

Figure A61. YRITFC Territory 9 subsistence uses of fall chum salmon per household and per person, 1990-2023.

household in 2020, zero fish per household in 2021 and 2023, and 0.28 fish per household in 2022.

Territory 9 household use rates of fall chum salmon ranged from 5.39 fish per household to 197.04 fish per household in the 1990s and exceeded 125 fish per household except in 1993 and 1998 with 23.02 and 5.39 fish per household, respectively. Territory 9 household use rates of fall chum salmon during the 2000s ranged from 0.26 to 169.81 fish per household and exceeded 125 fish per household only 2005-2008, otherwise fall chum household uses fell below 50 fish per household in 2000-2003. Household use rates in the 2010s ranged from 111.76 fall chum salmon in 2016 to 181.97 fish per household in 2013, exceeding 130 fish per household in all years except 2016.

Territory 9 per capita uses of Yukon River fall chum salmon ranged from highs of 79.17 fish per person in 2013 and 76.61 fish per person in 1996 to lows of 0.11 fish per person in 2000, 1.42 fish per person in 2002, and 2.10 fish per person in 1998, excluding the years 2020-2023. The 1990-1994 average per capita rates of fall chum salmon use in Territory 7 were 40.99 fish per person, an average of 53.82 fish per person in 1995-1999, 11.13 fish per person in 2000-2004, 61.99 fish per person in 2005-2009, 69.59 fish per person in 2010-2014, and 62.62 fish per person in 2015-2019. In 2020, per capita uses of fall chum salmon were 0.03 fish per person, followed by zero fish per person in 2021 and 2023, and 0.15 fish per person in 2022.

CONCLUSION

This technical report serves to describe and characterize the role of Yukon River chum salmon stocks in the subsistence economies of tribal communities within the Alaskan portion of the Yukon River watershed by tribal territories established by the member tribes of the Yukon River Inter-Tribal Fish Commission. This report serves as reference material for the Tanana Chiefs Conference Tribal Resource Stewardship

Division staff to support development of NPFMC Chum Bycatch EIS cooperating agency contributions and comments.

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Our Vision

Healthy, Strong, Unified Tribes

Our Mission

Tanana Chiefs Conference provides a unified voice in advancing sovereign tribal governments through the promotion of physical and mental wellness, education, socioeconomic development, and culture of the Interior Alaska Native people.

Tanana Chiefs Conference

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YUKON RIVER INTER-TRIBAL FISH COMMISSION

Appendix 8-4: Discrete Spawning Populations and Conservation of Chum Salmon in the Yukon River

November 1, 2024

Krystal Lapp, Natural Resource Policy Analyst, Tribal Resource Stewardship Division

Eva Burk, Science and Policy Consultant, Yukon Inter-Tribal Fish Commission

Cooperating Agency for the Environmental Impact Statement Bering Sea Chum Salmon Bycatch Management

Acknowledgement

Tanana Chiefs Conference acknowledges that many other Alaska Native and First Nations communities face similarly complex and profound challenges related to the decline of chum salmon. These struggles include not only economic hardships but also the disruption of cultural practices, food security, and the erosion of long-standing traditions that are intimately tied to the health of salmon populations. This report is not intended to serve as an all-encompassing overview of the unique and multifaceted experiences of each region or Nation, but rather as a contribution to the broader dialogue that recognizes and respects the diverse impacts felt across different communities.

1. Introduction

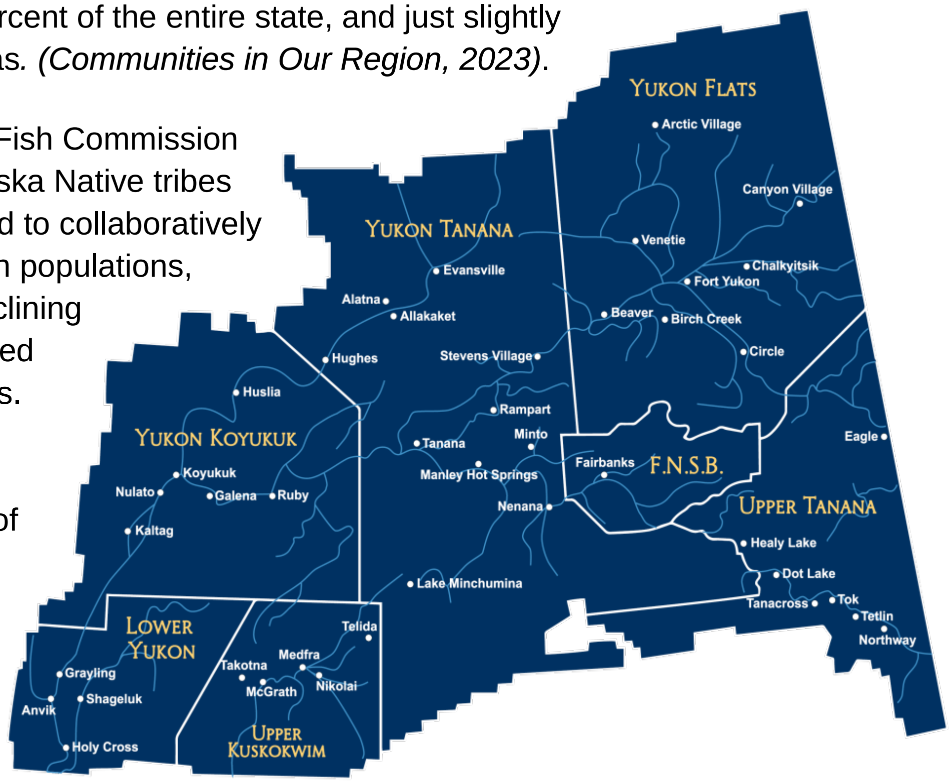
The Yukon River, one of North America's largest river systems, flows over 3,190 kilometers from its origins in British Columbia through Alaska, eventually reaching the Bering Sea. Encompassing various landscapes, including mountain ranges, boreal forests, and tundra, the Yukon supports diverse ecosystems with fish species such as grayling, whitefish, and multiple salmon species. The river's vast watershed and complex hydrology make it a crucial ecological and cultural resource across Canada and the United States, serving as both a habitat and a migration corridor for various species. Among these, chum salmon (Oncorhynchus keta) hold particular ecological, cultural, and economic importance.

The unique migratory behavior of Yukon River salmon, particularly their distinct spawning patterns, contributes to genetic diversity, enabling adaptation to local environments. Chum salmon, in particular, display discrete spawning populations, with different groups migrating and spawning in specific river sections. Understanding these populations is essential for managing salmon conservation amid environmental and economic challenges facing the Yukon River.

1.1 Overview of Tanana Chiefs Conference and Yukon River Inter-Tribal Fish Commission

Tanana Chiefs Conference (TCC) is an Alaska Native non-profit corporation, also organized as Dena' Nena' Henash or "Our Land Speaks", which is made up of 42 members, including 39 villages and 37 federally recognized Tribes. We strive to address the health and social service needs of Tribal members and beneficiaries across our region. The TCC region covers an area of 235,000 square miles in interior Alaska, which is equal to about 37 percent of the entire state, and just slightly smaller than the state of Texas*. (Communities in Our Region, 2023)*.

The Yukon River Inter-Tribal Fish Commission (YRITFC) is a coalition of Alaska Native tribes along the Yukon River, formed to collaboratively manage and conserve salmon populations, particularly in response to declining salmon runs and the associated cultural and economic impacts. Established by tribal governments, the YRITFC operates within a framework of Traditional Ecological Knowledge (TEK) and scientific research, aiming to protect salmon resources vital to the cultural heritage, subsistence, and economies of the Yukon River communities.



"We, the Tribes/First Nations of the Yukon River and its tributaries, proclaim that our fisheries are essential to our cultural, nutritional, economic and spiritual well-being and way of life. We recognize our responsibility and authority to exercise our tribal rights as stewards to our traditional territories and resources. Since time immemorial, we have properly cared for the fisheries of the Yukon River and its tributaries, but for the past 100 years US, Canadian, and State of Alaska have usurped management with no deference to tribal governments. We commit, to conserve, restore and provide for tribal use of fisheries based on indigenous knowledge systems, and scientific principles. Founded on tribal unity, we form the Yukon River Inter-Tribal Fish Commission for the health and wellbeing of our tribal members, our future generations, and all Alaskans and Canadians who rely upon the health of the fisheries." Yukon River Inter-Tribal Fish Commission Preamble [9]

2. Life Cycle of Chum Salmon

The life cycle of chum salmon consists of several stages that each play a role in their development, adaptation, and eventual contribution to the ecosystem. This cycle not only reflects the complex demands of their habitat but also highlights the need for specific environmental conditions crucial for their survival.

2.1 Egg and Alevin Stages

Chum salmon eggs are laid in gravel nests, known as redds, typically located in riverbed areas with stable flow, cold temperatures, and high oxygen levels. These conditions support embryo development, although disruptions like sediment buildup and temperature fluctuations can endanger egg survival. After hatching, the young fish, called alevins, remain hidden in the gravel to avoid predation, feeding on nutrients from their yolk sacs until they grow strong enough to emerge.

2.2 Fry and Juvenile Migration

Unlike other Pacific salmon species, chum salmon fry do not spend extensive time in freshwater. Shortly after emerging in early spring, fry begin migrating downstream toward estuaries, where they find abundant food sources and encounter fewer predators. This early migration stage is crucial, as it allows young salmon to develop in saltwater environments quickly and adapt to the marine ecosystem.

2.3 Ocean and Marine Phase

In the ocean, chum salmon undergo significant growth, feeding primarily on fish, squid, and krill. This diet supports rapid development, enabling them to reach considerable sizes—up to 10 kilograms—before returning to freshwater to spawn after approximately 2 to 5 years. Their time at sea also introduces them to various survival challenges, including avoiding predators and adapting to oceanic temperature and food availability fluctuations.

[9] Yukon River Inter-Tribal Fish Commission, 2022

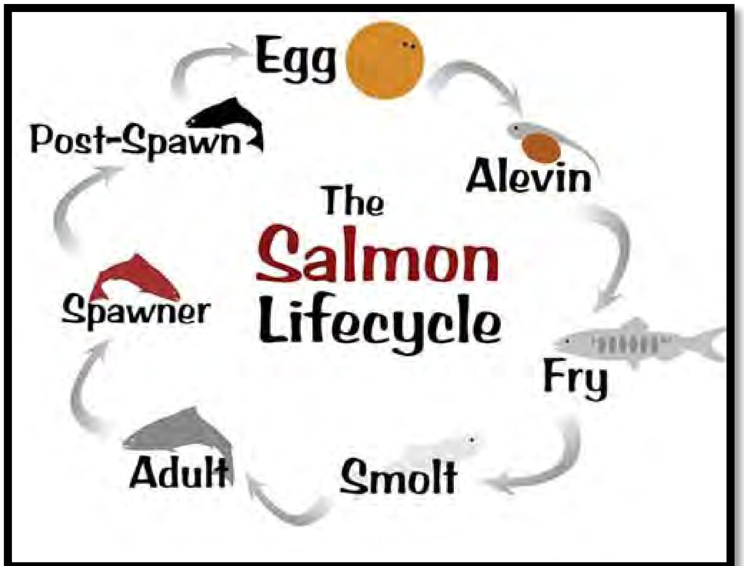


Figure 4 Salmon life cycle. Wildlife Notebook Series. Salmon life cycle. Wildlife Notebook Series.

2.4 Spawning Migration and Death

Once mature, chum salmon migrate up to 3,200 kilometers upstream to reach their natal spawning grounds. This journey demands significant energy, leading them to cease feeding and rely entirely on stored body fat. Upon arrival, they exhibit distinct physical changes, including color alterations and morphological adaptations for spawning competition. After spawning, both males and females die, leaving nutrient-rich carcasses that fertilize the river ecosystem, benefiting numerous species and reinforcing the nutrient cycle.

3. Discrete Spawning Populations

Chum salmon in the Yukon River are divided into discrete spawning populations, with distinct groups returning to specific tributaries, like the East Fork Andreafsky for summer chum and the Chandalar River for fall chum. Genetic studies, geographic sampling, and behavioral observations confirm that upper and lower river populations have adapted to different environmental conditions, thus minimizing inter-population competition and enhancing the resilience of the overall salmon population.

Research on salmon populations has shown that genetic studies, geographic sampling, and behavioral observations indicate distinct local adaptations in response to environmental conditions in upper and lower river segments. (Adkison, 1995) These adaptations, driven by environmental factors like water temperature, flow rate, and food availability, help to minimize competition among populations and enhance overall population resilience. For example, population differentiation in salmon has been linked to environmental selection pressures, which drive unique physiological and behavioral traits suited to specific habitats, thereby reducing inter-population competition. Studies confirm that geographic isolation and environmental diversity lead to distinct adaptations even across short distances within the same river system, increasing the species' ability to withstand environmental changes and reinforcing the resilience of the overall salmon population.

Summer and fall Chum Salmon in the Yukon River system have distinct spawning tributaries and environmental requirements that are essential for successful reproduction. The East Fork Andreafsky and Anvik Rivers are primary tributaries for summer Chum, with established escapement goals to ensure population sustainability. These regions require specific water temperature ranges and flow characteristics conducive to spawning, though recent fluctuations in water levels have complicated escapement monitoring and accuracy. Fall Chum Salmon, on the other hand, spawn in tributaries like the Teedriinjik (Chandalar) and Delta Rivers within U.S. drainage areas, while Canadian-origin Chum populations rely on the upper Yukon River and Fishing Branch River. These spawning sites demand stable water flows and low sediment levels, yet challenges such as unmet Canadian escapement goals in recent years highlight the growing pressures from environmental and migratory factors affecting these populations. (Federal Subsistence Board, 2024).

4. Decline in Yukon River Salmon Fisheries

The commercial decline in Yukon River salmon fisheries has had a significant socioeconomic impact on local communities. Since 2001, reduced salmon runs have led to the closure of commercial fisheries, causing annual revenue declines of 65% in the lower Yukon gillnet fishery and 85% in the upper Yukon fish wheel fishery. This income loss disrupts subsistence practices and reduces funds for essential fishing supplies, leading to economic hardships and migration from traditional fish camps. Additionally, poor salmon returns increase food insecurity, forcing residents to seek alternative income sources while abandoning cultural practices tied to fish camps and dog sledding.

Since 2001, declining salmon populations have drastically reduced income for commercial fisheries in the Yukon River region. Annual earnings have dropped by 65% in the lower Yukon gillnet fishery, 97% in the upper Yukon gillnet fishery, and 85% in the upper Yukon fish wheel fishery, affecting village economies by cutting funds needed for subsistence gear, fuel, and essentials (Federal Subsistence Board, 2024). This economic decline has led to significant food insecurity, as poor salmon returns and commercial fishery closures have limited resources for subsistence fishing. While disaster relief funds have offered temporary support, many residents await further aid to mitigate these economic impacts.

In addition to financial hardship, cultural traditions are impacted as declining commercial fishing opportunities have led to fish camp abandonment—a critical aspect of local economic and cultural life. (Wolfe & Spaeder 2009). Many residents have had to seek alternative work, often leaving behind traditional fish camps. Historically, commercial fishing provided essential cash flow for rural economies, supporting subsistence practices and even cultural customs like dog mushing. The reduction in salmon, a key dog food source, contributed to a 39% decrease in dog populations used in sled teams between 1992 and 2002, particularly affecting communities along the Yukon River.

As incomes from fishing dwindled, many families shifted to other employment opportunities, often through regional government roles or community development programs. This shift has also led to some out-migration, as individuals move to regional centers such as Bethel and Nome, or even larger urban areas like Fairbanks and Anchorage, seeking economic stability. This migration and shift threaten the continuity of traditional village life, and while some families adapt by harvesting other wild resources, success varies based on local availability. Coastal communities generally have access to more diverse resources, whereas inland villages face more difficulty maintaining subsistence without salmon.

5. Subsistence Harvests and Escapement Goals

Subsistence fishing, which has been the backbone of Yukon River communities, faces similar declines. From 1990 to 2000, summer chum harvests fell by over 50%, while fall chum harvests decreased by nearly 89% (Federal Subsistence Board, 2024), These declines jeopardize food security, particularly in remote communities with limited access to alternative food sources. Canadian-origin populations struggle due to environmental and migratory pressures, highlighting the binational management challenge under the Yukon River Salmon Agreement.

Since the 1990s, subsistence harvests of summer Chum salmon in the Yukon have declined significantly, from 115,609 fish in 1990 to 58,385 fish by 2001. Fall Chum salmon harvests have seen an even sharper decline, dropping 89% from 167,900 in 1990 to just 19,306 in 2000 (Federal Subsistence Board, 2024). In 2023, the Federal in-season manager approved limited harvests for summer Chum, as projections indicated the run would meet escapement goals. Early fall Chum harvests were also allowed, as they largely consisted of genetically summer Chum salmon. However, due to low abundance of Canadian-origin fall Chum salmon, mainstem fishing was subsequently closed for the rest of the fall season to protect these populations. To meet the subsistence needs of Yukon-Northern Area communities, the Alaska Board of Fisheries has set target amounts at 83,500–142,192 fish for summer Chum and 89,500–167,100 fish for fall Chum annually

Canadian-origin fall Chum populations, tracked via the Eagle Sonar, have consistently fallen short of escapement goals since 2019 due to significant declines in these stocks (Federal Subsistence Board, 2024). Monitoring efforts for Chinook, summer and fall Chum, and Coho Salmon rely on sonar stations at Pilot Station and Eagle Sonar.

However, differences in sonar counts—potentially influenced by environmental conditions or in-river mortality—have introduced challenges in accurately projecting run sizes, sometimes leading to missed escapement targets. U.S. and Canadian fishery managers collaborate under the Yukon River Salmon Agreement to align escapement goals and assess run sizes, but severe declines in runs since 2020 have constrained fishing opportunities, impacting subsistence, commercial, and cultural practices along the Yukon River.

Both summer and fall chum populations have drastically declined. Summer chum salmon subsistence needs have gone unmet since 2018, and 2021 witnessed the lowest recorded runs. In 2023, counts at Pilot Station for summer chum were down by 92%, with major tributaries like the Anvik River showing similar reductions. Fall chum salmon faced similar declines, with border passage goals unmet since 2020 and substantial reductions documented at monitoring points such as Eagle and Porcupine Rivers. (Yukon River Inter-Tribal Fish Commission. 2023).

6. Significance of Each Salmon Return

Each spawning salmon plays a critical role in supporting both the ecosystem and Alaska Native cultural practices. The nutrient contributions from salmon carcasses benefit plants, animals, and future salmon generations by enriching food webs in rivers and streams. Culturally, salmon remain central to the subsistence and traditions of Alaska Native communities, enabling knowledge transfer across generations. Economically, reduced salmon returns and fishery closures threaten the livelihoods of many local fishers, underscoring the need for sustainable salmon management.

Each salmon that returns to spawn brings vital nutrients from the ocean into freshwater ecosystems, enriching rivers and streams and supporting a wide range of plants, animals, and the next generation of salmon. These nutrients are fundamental to maintaining food webs and overall ecosystem health (Schoen et al., 2023). For Alaska Native communities, spawning salmon hold immense cultural and subsistence significance, providing not only food but also a deep connection to traditional practices and generational knowledge transfer. Declines in salmon populations disrupt these cultural practices and compromise food security, impacting the community’s way of life.

Economically, individual salmon contribute to both subsistence and commercial fishing. Declines in salmon runs can result in restrictive fishing regulations or complete fishery closures, leading to substantial income losses for local fishers and narrowing economic opportunities. Additionally, each salmon’s reproductive success is critical for population stability. Decreases in average body size have led to lower reproductive output, making each spawner essential for sustaining population levels and preserving ecosystem balance (Schoen et al., 2023).

7. Conservation and Management Challenges

7.1 Threats to Salmon Populations

Environmental changes and human activities pose significant risks to the Yukon River salmon. Rising temperatures disrupt river flows and temperature stability, which are essential for successful spawning. Offshore commercial fishing intercepts Yukon-bound salmon before they reach their spawning grounds, reducing population returns. Habitat degradation from land use changes and bycatch in groundfish fisheries further stress salmon stocks, affecting long-term survival.

Human activities like bycatch, the unintended capture of non-target species during commercial fishing, has become a critical issue impacting Yukon River salmon populations, particularly Chinook and chum salmon. (Yukon River Inter-Tribal Fish Commission. 2023). Bycatch in the Bering Sea, particularly from large trawl fisheries targeting species like pollock, has led to substantial incidental captures of salmon. In 2023 alone, approximately 198,700 chum salmon and 14,300 Chinook salmon were caught as bycatch, which is significant given the severe restrictions on subsistence and commercial salmon fishing along the Yukon River due to declining stock. Yukon River communities depend heavily on Chinook and chum salmon for subsistence. However, as bycatch reduces the number of salmon reaching spawning grounds, it exacerbates population declines, impacting food security and traditional practices for these communities. The removal of salmon in marine fisheries means fewer fish survive the journey back to the Yukon River, contributing to the multi-year collapse in salmon returns, which has led to significant gaps in meeting escapement and subsistence needs.

7.2 Conflicting Management Approaches

Management challenges often stem from conflicting state and federal regulations, differences in priorities, and limited Alaska Native involvement in decision-making. For example, while federal management aims to mirror state actions, this approach does not fully address the subsistence needs of Yukon River communities. The result is often frustration among Alaska Native leaders, who advocate for prioritizing subsistence rights over commercial interests until escapement goals are achieved.

The management and monitoring of Yukon River salmon populations face significant challenges, with poor oversight and trawling practices intensifying the threats to these already vulnerable stocks. Climate change has shifted water temperatures and flows in the Yukon River, disrupting salmon migration and spawning conditions, while inconsistent water levels add further complexity to escapement targets. Offshore commercial fishing, particularly around the Alaska Peninsula, intensifies the problem by intercepting Yukon-bound salmon, both through direct harvest and substantial bycatch in trawl fisheries targeting groundfish in the Bering Sea and Aleutian Islands. Bycatch rates, averaging 37,819 Chinook and 69,332 chum salmon annually, have reduced adult returns, as most bycaught fish are juveniles that would have otherwise contributed to future spawning populations. This indirect harvest weakens key salmon populations like those of the Yukon River and disrupts traditional and subsistence fishing practices in Alaska Native communities.

Inadequate management practices further compound these issues. Seasonal openings in lower Yukon commercial fisheries often coincide with key migration periods, prioritizing commercial over subsistence needs and preventing enough fish from reaching upstream spawning areas. Measures like the Salmon Savings Areas—designed to protect salmon by closing trawl fisheries during peak migration—have had limited success due to the overlap of trawl operations with critical salmon seasons (Witherell, Ackley, & Coon 2002). Poor alignment between fishery timing, regulatory enforcement, and conservation priorities has led to missed escapement goals and weakened resilience among distinct salmon populations, putting both the ecosystem and cultural practices reliant on salmon at risk.

Conflicting management approaches to Yukon River salmon populations arise due to discrepancies between State and Federal regulations, priorities, and practices, frequently resulting in negative impacts on salmon runs and escapement achievements.

Federal in-season managers have, at times, adopted approaches aligned with those of the State of Alaska, which does not prioritize rural subsistence as a primary management objective. This alignment often fails to address the specific subsistence needs of local Yukon River communities, leading to dissatisfaction among residents who rely on salmon as a primary food source

Managing Yukon River Chinook and fall Chum salmon is complex due to the seasonal overlap of stocks with distinct geographic origins (U.S. and Canada). Canadian-origin fall Chum stocks exhibit lower abundance compared to U.S. stocks, complicating management efforts that aim to allow domestic harvest while also meeting obligations under international agreements to protect Canadian-origin populations. This misalignment in management objectives presents a significant challenge in balancing harvest opportunities with conservation goals.

Federal and State management authorities employ sonar data from different points along the river, with the Pilot Station sonar on the lower river typically recording higher run estimates than the Eagle sonar station near the U.S.-Canada border. These discrepancies can result in inflated estimates of fish availability for Alaska's harvest, ultimately causing shortfalls in meeting Canadian escapement targets. This data misalignment highlights the need for coordinated monitoring to achieve accurate population assessments.

Alaska Native leaders and stakeholders argue that State-level management does not adequately integrate their subsistence and cultural requirements into decision-making processes. Many advocate for restricting commercial fishing until escapement goals are met, stressing the importance of enhanced coordination and increased Tribal involvement to ensure management practices align with subsistence and cultural values integral to the region. These conflicts underscore the necessity of synchronized management practices and a more inclusive approach that accommodates both conservation priorities and local subsistence needs.

The North Pacific Fishery Management Council (NPFMC) and Alaska state fisheries have struggled to balance commercial fishing demands with conservation needs for salmon populations bound for the Yukon River. While some management measures, such as bycatch caps and voluntary rolling hot-spot closures, are in place to reduce bycatch, they have been insufficient to fully protect Yukon-bound salmon. Advocacy for stricter bycatch limits, particularly for high-salmon-return areas like Area M, continues as a strategy to address this issue. (Yukon River Inter-Tribal Fish Commission. 2023).

7.3 Traditional Ecological Knowledge

Integrating Alaska Native knowledge with scientific practices is essential to effective chum salmon management, leveraging deep-rooted Traditional Ecological Knowledge (TEK) alongside modern research. Alaska Native communities, for whom salmon are a critical cultural, spiritual, and nutritional resource, have long developed sustainable practices for managing salmon populations. These practices include nuanced insights into salmon behaviors, migration patterns, and habitat requirements, all of which have been passed down through generations. Working collaboratively with Alaska Native communities fosters a management approach that is more inclusive, flexible, and context-sensitive.

Alaska Native TEK aligns with scientific principles in several key ways. Seasonal Fishing Practices: Alaska Native fishing practices often include timing restrictions and selective harvesting methods that promote successful spawning. These align with scientific seasonal closures, both ensuring that salmon populations have the necessary conditions to reproduce and replenish. Selective Fishing Techniques: Alaska Native methods, such as fish wheels and dip nets, are designed to reduce bycatch and limit harm to non-target species, aligning with sustainable, low-impact fishing practices that preserve ecosystem health. Local Habitat Stewardship: Alaska Native communities' extensive knowledge of local habitats—including water temperatures, flow rates, and other environmental cues critical for salmon spawning—supports habitat conservation efforts, ensuring the protection of essential spawning and rearing areas. These collaborative approaches integrate both Alaska Native and scientific insights to create a holistic and sustainable framework for chum salmon conservation.

Traditional Ecological Knowledge (TEK) is invaluable in managing salmon populations effectively, as it provides insights that span generations, capturing long-term observations of salmon behavior, migration, and habitat needs. TEK encompasses a deep understanding of ecological patterns, which Alaska Native communities have used to sustain salmon populations through culturally embedded practices such as timing seasonal harvests, applying selective fishing methods, and stewarding critical habitat areas. These practices align closely with conservation principles, often minimizing environmental impact and allowing salmon populations to thrive. Integrating TEK with modern scientific management allows for more adaptive and sustainable strategies, as it brings both precise local knowledge and cultural stewardship into the decision-making process.

7.4 Recommendations for Policy and Management Reform

The North Pacific Fisheries Management Council (NPFMC) holds a pivotal role in shaping sustainable fisheries practices and can implement several key strategies to help preserve Yukon River salmon populations while supporting the subsistence needs of Alaska Native communities:

- **Implement Stricter Bycatch Limits in Salmon Migration Areas**: The NPFMC can introduce more rigorous bycatch limits specifically targeting trawl fisheries operating in the Bering Sea, where incidental salmon catches have put additional pressure on Yukon River chum salmon populations. By setting stricter seasonal bycatch caps and implementing real-time monitoring, the Council could help prevent large-scale salmon losses and reduce competition for salmon resources vital to Alaska Native subsistence fishing.

- **Enhance Co-Management with Alaska Native Tribes**: The NPFMC can establish formal co-management agreements with Alaska Native tribes, granting them a greater role in the decision-making process for managing salmon and other critical species. Through these agreements, Alaska Native knowledge would be directly incorporated into fisheries management practices, creating policies that respect cultural practices while also enhancing ecological sustainability. This collaboration would align federal fisheries policy with Alaska Native stewardship values, prioritizing salmon conservation and ensuring that management strategies address the needs of Alaska Native communities.

- **Develop a Tribal Advisory Council within the NPFMC**: Establishing a Tribal Advisory Council within the NPFMC would provide a dedicated platform for Alaska Native representatives to voice their concerns, contribute traditional ecological knowledge, and advocate for policies that support subsistence rights. This advisory council could play an integral role in shaping salmon conservation measures, ensuring that Alaska Native perspectives are considered alongside commercial and recreational interests in all Council decisions.

- **Prioritize Subsistence Access During Salmon Shortages**: In times of low salmon returns, the NPFMC could adopt policies that prioritize Alaska Native subsistence needs over commercial and recreational fishing. By enacting emergency measures that limit commercial fishing during critical shortages, the Council could help secure access to salmon stocks for Alaska Native communities that rely on these resources for food security, cultural practices, and economic stability.

- **Promote Habitat Conservation Initiatives**: Recognizing the link between healthy habitats and salmon survival, the NPFMC can advocate for conservation projects that restore and protect spawning and rearing habitats along the Yukon River. By supporting initiatives that improve water quality, restore riparian zones, and reduce industrial impacts on the river ecosystem, the Council could contribute to long-term salmon population recovery, benefiting both the species and the Alaska Native communities that depend on it.

- **Increase Transparency and Accountability through Monitoring Programs**: The NPFMC can strengthen accountability by mandating comprehensive monitoring and reporting systems for all fisheries with potential impacts on salmon populations. Enhanced data collection on bycatch, fishing locations, and seasonal salmon movements would allow for more adaptive management practices and provide the Council with clearer insights into areas where further conservation efforts are needed. Transparency in monitoring would also help build trust between the NPFMC and Alaska Native communities, fostering collaboration toward shared conservation goals.

8. Conclusion

The conservation of Yukon River chum salmon is essential not only for preserving ecological diversity but also for maintaining the cultural practices and economic stability of Alaska Native communities that rely on these fish. A crucial aspect of this conservation effort involves recognizing and protecting the unique, discrete spawning populations of chum salmon. These distinct groups, adapted to specific segments of the Yukon River and its tributaries, play a critical role in the river's ecological resilience, enabling the species to endure environmental fluctuations such as changes in water temperature, flow patterns, and food availability.

Discrete spawning populations are finely attuned to the unique characteristics of their spawning grounds, with adaptations that include precise timing of migration, temperature tolerance, and spawning behaviors specific to localized habitats. This diversity within the species is a natural buffer against environmental shifts; as climate change and habitat degradation introduce more uncertainty into the river ecosystem, these distinct populations provide a resilience that allows the broader salmon population to survive, even as certain spawning areas may become temporarily or permanently unsuitable. The loss of any one of these spawning populations, however, could weaken the salmon's overall resilience, reducing genetic diversity and adaptive capacity across the species.

To address the challenges of climate change, habitat degradation, and conflicting resource management approaches, future policies must prioritize both the preservation of these discrete populations and the ecosystems that sustain them. Incorporating Alaska Native knowledge, which includes generations of understanding about salmon behaviors, river health, and sustainable fishing practices, is essential in crafting conservation strategies that align with the ecological rhythms of the Yukon River. Alaska Native communities have long observed the nuanced adaptations of salmon populations to various parts of the river, and this knowledge can guide the identification and protection of critical habitats necessary for the survival of each spawning group.

Sustainable practices, such as habitat restoration, reduced bycatch, and controlled industrial impacts near sensitive spawning grounds, are vital to protecting these populations. Policy frameworks that promote co-management with Alaska Native communities can further enhance conservation efforts, as Alaska Native leadership is integral to ensuring that resource management decisions honor the relationship between salmon and the cultural heritage of river communities. The protection of discrete spawning populations thus represents not only an environmental priority but also a pathway toward achieving environmental justice for Alaska Native communities who depend on the Yukon River's resilience.

In prioritizing the conservation of discrete spawning populations, future efforts can support a sustainable balance between ecological health and cultural preservation. By respecting the diverse adaptations within salmon populations, embracing Alaska Native knowledge, and committing to policies that address the root causes of habitat loss and climate impacts, it is possible to secure a future where Yukon River chum salmon continue to thrive, nourishing both the land and the communities along its banks for generations to come.

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Our Vision

Healthy, Strong, Unified Tribes

Our Mission

Tanana Chiefs Conference provides a unified voice in advancing sovereign tribal governments through the promotion of physical and mental wellness, education, socioeconomic development, and culture of the Interior Alaska Native people.

Tanana Chiefs Conference

Tanana Chiefs Conference

Appendix 8-5:

Environmental Justice for the Tanana Chiefs Conference Region

November 1, 2024

This report was compiled with Traditional Knowledge contributions from the Tribes within the Tanana Chiefs Conference Region.

Krystal Lapp, Natural Resource Policy Analyst, Tribal Resource Stewardship Division

Cooperating Agency for the Environmental Impact Statement Bering Sea Chum Salmon Bycatch Management Salmon Bycatch Management

Acknowledgement

Tanana Chiefs Conference acknowledges that many other Alaska Native and First Nations communities face similarly complex and profound challenges related to the decline of chum salmon. These struggles include not only economic hardships but also the disruption of cultural practices, food security, and the erosion of long-standing traditions that are intimately tied to the health of salmon populations. This report is not intended to serve as an all-encompassing overview of the unique and multifaceted experiences of each region or Nation, but rather as a contribution to the broader dialogue that recognizes and respects the diverse impacts felt across different communities.

1. Introduction

1.1 Overview of Tanana Chiefs Conference (TCC) and the Yukon River Region

The Tanana Chiefs Conference (TCC), also known by its name in the Athabascan language, Dena' Nena' Henash, or "Our Land Speaks," is an Alaska Native non-profit organization dedicated to serving the health and social needs of Tribal members across a vast region in interior Alaska. This region, spanning approximately 235,000 square miles—nearly 37% of the entire state and comparable in size to Texas—comprises 42 TCC member organizations, including 39 villages and 37 federally recognized Tribes.

For the Alaska Native communities of the TCC region, the Yukon River and its tributaries are integral both to survival and to cultural identity. These waterways are essential sources of chum salmon, a fish that serves as a primary food source and is at the heart of the communities' cultural practices and seasonal traditions. However, recent years have seen a drastic decline in chum salmon populations, severely impacting the Alaska Native peoples who rely on them. Beyond threatening food security, the salmon collapse also threatens the cultural and spiritual practices that are rooted in salmon fishing, from communal gatherings to the transmission of traditional knowledge.

1.2 Importance of Environmental Justice for Alaska Native Communities Affected by the Salmon Crisis

The crisis surrounding the chum salmon population is not only an environmental issue but also one of environmental justice. Environmental justice in this context involves equitable management of natural resources, protection of Alaska Native cultural practices, and genuine inclusion of Alaska Native voices in conservation and policy efforts. This principle advocates for Alaska Native communities' right to clean water, accessible land, and resources to sustain their traditional ways of life. The concept is evident in the sacrifices many Alaska Native communities along the Yukon River have made, voluntarily restricting or even ceasing their salmon fishing in an attempt to aid population recovery. However, this burden of conservation is not equally shared; commercial fishers and other non-Alaska Native groups have not faced the same restrictions, creating an unjust scenario that disproportionately affects Alaska Native communities.

> ***"We didn't fish for two years voluntarily because we want to help the salmon stocks rebuild. It is a difficult decision, but one we know is necessary for the survival of our culture and way of life." - Vicky Josie, Old Crow, Yukon Territory.***[10]

1.3 Purpose and Scope of the Paper

The primary focus of this paper is to analyze the environmental injustices tied to the chum salmon decline, emphasizing how these injustices impact the Alaska Native communities of the TCC region. This analysis will examine the interconnected factors contributing to the salmon crisis—including climate change, overfishing, habitat degradation, and pollution—and will propose pathways to achieve environmental justice. By outlining these factors and exploring solutions rooted in shared conservation responsibility and respect for Alaska Native stewardship, this paper advocates for a more inclusive and equitable approach to natural resource management that upholds the cultural and subsistence rights of Alaska Native communities along the Yukon River.

2. Background: The Cultural and Ecological Significance of Chum Salmon

For centuries, salmon have been a foundational element of life for Alaska Native communities along the Yukon River, including the Athabascan, Gwich'in, and other Alaska Native tribes. The chum salmon, in particular, is a staple food source, providing essential nutrients and sustaining people through the long, harsh Alaskan winters. Beyond their practical value as food, salmon are deeply woven into the cultural and spiritual fabric of these communities. Fishing for salmon follows seasonal cycles that align with the natural rhythms of the river, and this practice holds profound spiritual significance, reinforcing a connection to the land and to ancestral traditions.

Chum salmon fishing also fosters social cohesion within these communities. Families and neighbors gather at fish camps, where fishing, processing, and preserving salmon become communal activities. These gatherings serve as vital opportunities for intergenerational knowledge transmission, with elders passing down fishing techniques, stories, and cultural wisdom to younger generations. The communal harvest of salmon strengthens family bonds and fosters unity, while also reinforcing traditional ecological knowledge and the values of respect and stewardship for the natural world.

> **"The tribes along the Yukon have completely shouldered all of the ramifications of the salmon collapse, yet they were not the cause of it" – Chief Chairman, Brian Ridley, Tanana Chiefs Conference**[11]

[10] Yukon Fisheries News, *Yukon Fisheries*, Yukon River Drainage Fisheries Association, Spring 2008, https://www.yukonsalmon.org/wp-content/uploads/spring08.pdf.
[11] (Ridley, *The Impact of the Historic Salmon Declines on the Health and Well-Being of Alaska Native Communities along Arctic, Yukon, and Kuskokwim Rivers*, U.S. Senate Committee on Indian Affairs, 2023) (CHRG-118shrg54782).

However, the recent drastic decline in chum salmon populations has threatened not only food security but also these cultural practices. Without adequate salmon runs, communities face not only nutritional hardships but also a loss of cultural identity. The salmon crisis thus highlights a broader environmental justice issue; as Alaska Native communities struggle to preserve their cultural heritage amid declining resources largely impacted by external forces beyond their control.

2.2 Ecological Role of Chum Salmon

Chum salmon play a vital role in the health of both riverine and marine ecosystems, functioning as a keystone species whose presence supports broader biodiversity. In their life cycle, chum salmon contribute to ecological balance in both their freshwater spawning grounds and the ocean. When adult salmon return to the Yukon River to spawn, they bring with them essential nutrients accumulated during their years in the ocean. After spawning, the salmon die, and their decomposing bodies release nitrogen, phosphorus, and other nutrients into the water and surrounding soil. This nutrient input fuels primary productivity in the river ecosystem, benefiting a range of organisms—from aquatic insects and plant life to larger predators, including bears, eagles, and other fish species.

In the ocean, salmon contribute to the food web at multiple levels, serving as prey for a variety of marine animals, including larger fish, marine mammals, and seabirds. By connecting marine and freshwater ecosystems, chum salmon play a unique and irreplaceable role in nutrient cycling, supporting biodiversity in both environments. Their decline disrupts this balance, reducing nutrient availability in rivers and affecting the productivity of entire ecosystems.

The loss of chum salmon thus has cascading ecological effects, weakening ecosystem resilience and impacting biodiversity far beyond the salmon themselves. As these changes ripple through both marine and freshwater habitats, they highlight the interconnectedness of ecological health and the importance of protecting keystone species like chum salmon. The decline of salmon populations underscores the need for sustainable resource management practices that recognize and protect the intricate relationships within these ecosystems, not only for the sake of biodiversity but also for the Alaska Native communities whose cultures and livelihoods are intimately tied to these natural cycles.

3. Factors Contributing to the Chum Salmon Crash

3.1 Bycatch and Overfishing in Commercial Fisheries

Commercial fishing in both U.S. and international waters has significantly increased pressure on salmon populations. While Alaska Native subsistence fishing is tightly regulated, commercial fisheries in the Bering Sea have historically caught large numbers of salmon as bycatch, unintentionally contributing to salmon stock depletion and further straining the resources vital to Alaska Native communities that rely on these salmon for both food and cultural practices.

In Alaska's groundfish fisheries, trawl operations account for more than 99% of salmon bycatch, primarily in the walleye pollock fishery, the largest and most economically significant in the region (Witherell, Ackley, & Coon, 2002). To a lesser extent, bycatch also occurs in trawl fisheries for Pacific cod, flatfish, and rockfish. Between 1990 and 2001, the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries caught an average of 69,332 chum salmon annually as bycatch, primarily in pollock trawl fisheries. In 2001 alone, the Bering Sea pollock fishery recorded 52,690 chum salmon bycatch, with chum salmon making up roughly 95% of all non-chinook salmon caught incidentally. By comparison, the Gulf of Alaska (GOA) saw lower bycatch numbers, averaging 20,496 chum salmon annually over the same period.

Chum salmon bycatch typically follows a seasonal pattern, peaking between July and October in the Bering Sea. In an attempt to limit bycatch, the Chum Salmon Savings Area (CSSA) was created as a designated zone in the eastern Bering Sea. This area closes to trawl fishing in August, with the closure extending through mid-October if the bycatch exceeds 42,000 fish during this period. Despite exceeding annual bycatch limits from 1995 to 2001, closures were not triggered as the designated period limits were not reached.

Estimates indicate that BSAI groundfish trawl fisheries catch around 60,000 chum salmon annually as bycatch, with approximately 27% of these fish originating from western Alaska, including the Yukon River. This implies that about 16,200 salmon from western Alaska stocks are caught incidentally each year, and an estimated 13,120 of these fish that would have returned to natal rivers, including the Yukon, are lost. While this represents less than 0.2% of the total annual run size, any additional mortality like this compounds stress on already declining populations.

The cumulative impact of chum salmon bycatch over decades has deeply affected population dynamics. Salmon have complex life cycles, spending several years in the ocean before returning to spawn, and bycatch consistently reduces the number of adults reaching spawning grounds. A small percentage of spawner loss each year accumulates over time, especially over decades. For example, if 13,000 to 15,000 chum salmon from the Yukon River are lost annually, it translates to approximately 130,000 to 150,000 fewer spawning fish over a decade. This sustained reduction decreases reproductive potential, leading to fewer eggs laid and juveniles hatched, making it increasingly challenging to recover the population without particularly strong spawning years.

Genetic diversity is another critical factor. Sustained bycatch losses can lead to genetic bottlenecks, with fewer individuals contributing to the gene pool. Reduced genetic diversity weakens the population's adaptability to environmental changes, such as temperature fluctuations and shifts in food availability. For Yukon River chum salmon, the gradual loss of genetically diverse spawners diminishes the resilience of the stock, making recovery from external threats like climate change and habitat loss increasingly difficult.

Chum salmon also play a crucial ecological role by contributing nutrients that support entire riverine ecosystems. After spawning, their decomposing bodies release essential nutrients into the water and soil, fueling aquatic life and benefitting species like aquatic insects, bears, and eagles. Fewer returning spawners due to bycatch decreases nutrient inputs, which gradually reduces habitat productivity and impacts future salmon generations and other species reliant on these nutrient cycles.

Bycatch’s cumulative effects further impact stock recruitment relationships—the balance between spawners and surviving juveniles. When significant numbers of potential spawners are removed annually, stock productivity declines, and populations struggle to maintain sustainable levels. Low recruitment in already stressed populations can trigger further declines, creating a downward spiral in productivity. Over time, the stock may reach a threshold where there are too few spawners to support healthy recruitment, putting the population at risk of collapse, even in years with favorable conditions.

3.2 Climate Change

Rising global temperatures have disrupted both freshwater and marine ecosystems. In the Yukon River and its tributaries, warming waters impact salmon spawning, while ocean acidification and altered ocean currents affect their food sources and migration patterns. Salmon require cold, oxygen-rich water to thrive, and these climate shifts have become increasingly detrimental to their survival. Chum salmon, like other Pacific salmon species, are especially sensitive to water temperature changes, relying on cold, well-oxygenated freshwater environments for successful spawning.

Due to climate change, warmer water temperatures have significantly affected chum salmon, particularly during migration and spawning. High water temperatures can lead to thermal stress, reduced spawning success, and higher mortality rates among salmon. Warmer temperatures in both rivers and oceans also disrupt food availability in marine ecosystems, negatively impacting salmon growth and survival at sea.

In 2019, for example, large numbers of adult summer chum salmon died prematurely en route to their spawning grounds on the Koyukuk River, most likely due to extreme temperatures, low dissolved oxygen levels, and temperature-driven pathogen growth. Mortality rates in these conditions were often size-selective, disproportionately affecting larger fish (Westley, 2020).

Changes in stream flow, water levels, and discharge, linked to melting glaciers and changing precipitation patterns, can also disrupt salmon migration. High water discharge can wash away salmon eggs or prevent salmon from reaching their spawning grounds, while low water levels can create barriers to migration, reducing suitable spawning habitats (Nieminen & Gilbey, 2014).

3.3 Habitat Degradation

Habitat degradation is a major threat to chum salmon populations in both their freshwater spawning grounds and marine environments. This degradation arises from various activities, such as pollution, deforestation, water diversion, and infrastructure projects like dam construction, all of which disrupt the essential conditions salmon need to complete their life cycle. Chum salmon (*Oncorhynchus keta*) rely heavily on healthy freshwater systems for spawning and early development, making them especially vulnerable to habitat changes that can seriously affect their survival and reproductive success.

Riparian zones—the vegetated areas along river and stream banks—are essential for maintaining water quality, temperature, and cover for juvenile salmon. However, the destruction of these zones through deforestation, agriculture, and urban development removes the shade that helps keep stream temperatures cool. Without the shading provided by trees and plants, water temperatures rise, causing thermal stress and lowering oxygen levels, which hinders salmon egg development and juvenile growth. Additionally, riparian vegetation stabilizes stream banks and prevents erosion; when these areas are degraded, soil erosion leads to sedimentation in streams. This sediment covers the gravel beds salmon use for spawning, reducing oxygen flow to their eggs and increasing mortality rates. High levels of fine sediment in spawning habitats can further reduce egg hatching success and the survival of young salmon, known as alevins.

Mining activities, particularly placer mining, hard rock mining, and coal mining, pose additional direct and indirect threats to chum salmon by contaminating rivers, altering stream flows, and destroying crucial spawning and rearing habitats. Mining often releases harmful substances—such as mercury, arsenic, lead, cadmium, and copper—into nearby waters. These heavy metals, toxic to salmon at all life stages, can impair development, cause physiological stress, and disrupt critical functions like gill and nervous system activity, reducing both juvenile and adult salmon survival. Copper is particularly harmful; even at low concentrations, it can interfere with salmon's ability to detect chemical cues in the water, impairing their capacity to avoid predators, locate food, and navigate to spawning grounds (Gore, 2022).

Certain types of mining, especially hard rock and coal mining, expose sulfide minerals which, when exposed to air and water, produce acid mine drainage (AMD). This acidic runoff leaches metals from rocks, further degrading water quality. AMD significantly lowers the pH of rivers and streams, creating acidic conditions that can either kill salmon outright or severely stress them, greatly reducing their chances of survival (Foldvik, Holthe, Bremset, & Solem, 2022).

One of the greatest challenges with habitat degradation is the cumulative effect of multiple stressors over time. Combined factors like pollution, climate change, damming, water diversion, and deforestation create increasingly hostile conditions for chum salmon. Already-stressed populations are less resilient to additional pressures, such as ocean warming or increased predation, making it harder for salmon to recover after poor spawning seasons or high juvenile mortality rates. Habitat degradation, both in freshwater and marine environments, hampers salmon's ability to spawn successfully, leading to reduced recruitment of new populations. Over time, fewer juvenile salmon survive to adulthood and return to spawn, driving population declines.

Overall, habitat degradation poses severe risks to the long-term survival of chum salmon. In freshwater systems, riparian destruction, pollution, migration barriers, and water diversion diminish suitable spawning and rearing habitats. In the ocean, rising temperatures, acidification, and pollution threaten salmon's ability to find food, grow, and return to spawn. These cumulative changes lead to declining chum salmon resilience and productivity, elevating the risk of long-term population decreases.

3.4 Environmental Pollution and Oceanic Changes

The conditions in the Bering Sea and Pacific Ocean, where chum salmon spend most of their lives before returning to spawn, have undergone significant changes in recent years. Warmer waters and decreased availability of prey, such as zooplankton, have made it increasingly difficult for juvenile salmon to survive in these marine environments. Oceanic changes profoundly impact the life cycle and survival of chum salmon, affecting growth, migration, and reproductive success. As chum salmon spend most of their lives in the ocean, they are highly sensitive to such changes in ocean conditions.

Rising ocean temperatures amplify the long-term effects of bycatch on salmon populations. Chum salmon, which remain in the ocean for several years before returning to spawn, face heightened survival risks as their food sources, like zooplankton and small fish, decline in warmer waters. This reduction in food supply can lead to lower body condition and survival rates. When salmon are already weakened by poor ocean conditions, additional stress from bycatch intensifies their struggle to recover, increasing the risk of population crashes, especially in years with adverse environmental conditions.

The Bering Sea and Gulf of Alaska, crucial feeding grounds for chum salmon, have seen declines in zooplankton populations due to rising sea surface temperatures, reducing available food and harming salmon health overall. Additionally, the ocean's absorption of carbon dioxide has increased acidity levels, which primarily impacts calcium carbonate-dependent organisms like shellfish, small crustaceans, and plankton—key components of the salmon food chain. This acidification weakens these organisms' calcification processes, leading to potential declines in their populations and affecting the salmon that rely on them for food. Moreover, acidic ocean waters can directly impair salmon's physiology, including their sense of smell, which is vital for navigation and predator avoidance, ultimately disrupting their ability to efficiently find food and migrate (FISHBIO, 2021).

Pollution in the ocean, ranging from plastics and heavy metals to chemical pollutants and oil spills, presents additional threats to chum salmon populations. As salmon spend much of their life cycle in the ocean, they are especially vulnerable to widespread contamination. Studies show that microplastics have been found in the digestive systems of numerous fish species, including salmon. While immediate lethal effects may be minimal, long-term ingestion of microplastics can impact overall health and resilience to other stressors like climate change and habitat degradation. Ingested plastic particles can block the digestive tract, reduce feeding efficiency, and cause malnutrition by creating a false sense of fullness, ultimately impairing growth and body condition, leaving salmon more vulnerable to predation (Alberghini, Truant, Santonicola, Colavita, & Giaccone, 2022).

Persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs), dioxins, and DDT, are another category of pollutants that enter the ocean through industrial discharge, agricultural runoff, and atmospheric deposition. These pollutants accumulate in the fatty tissues of fish and can disrupt salmon growth, immune function, and reproductive success over the long term. Prolonged exposure can also cause hormonal imbalances, affecting salmon's ability to reproduce and survive during their return to spawning streams. In places like Prince William Sound and the Gulf of Alaska, elevated levels of mercury and PCBs have been detected in chum salmon, posing risks not only to the fish but also to their predators, including seals, bears, and humans (Adams, von Hippel, Hungate, & Buck, 2019).

Overall, ocean pollution in its various forms—from microplastics and chemical pollutants to oil spills—has significant negative effects on chum salmon populations. While some effects, such as reduced growth and reproductive success, may appear gradually, severe pollution events like oil spills can have immediate, catastrophic impacts. Over time, pollutants build up in marine ecosystems, weakening salmon populations and making them increasingly susceptible to stressors like climate change, overfishing, and habitat degradation. Effective pollution control measures, such as reducing plastic waste, regulating industrial discharge, and cleaning up marine debris, are essential to protect chum salmon and ensure the long-term sustainability of their populations.

4. Impacts on Alaska Native Communities: An Environmental Justice Perspective

4.1 Food Security and Health Consequences

The decline of chum salmon has had a significant impact on food security for Alaska Native communities along the Yukon River, where subsistence fishing has traditionally provided both sustenance and economic stability. As salmon stocks dwindle, many Alaska Native families are forced to rely more heavily on store-bought foods, which are often both expensive and nutritionally inferior to traditional diets centered around salmon. This shift has not only increased economic strain but also introduced health consequences, as non-traditional foods lack the nutritional benefits of salmon and are often high in processed ingredients that contribute to dietary-related health issues within these communities.

The loss of salmon as a primary food source creates a cascading effect of food insecurity, especially in remote areas where subsistence fishing has long been the foundation of both diet and identity. The economic burden of purchasing alternative food sources is compounded by limited access to fresh, affordable options. As a result, Alaska Native households face increased vulnerability to food insecurity and a dependency on costly, less nutritious food options that diverge from traditional diets. This shift threatens not only the physical health of community members but also the cultural integrity tied to subsistence practices.

4.2 Cultural and Social Consequences

Beyond the immediate impacts on food security, the salmon crisis deeply affects the cultural and social fabric of Alaska Native communities. For generations, salmon fishing has been more than a means of sustenance; it is a vital cultural practice that reinforces family and community bonds, as well as traditional knowledge transmission. Annual salmon runs structure seasonal gatherings at fish camps, where elders pass down fishing techniques, environmental knowledge, and cultural values to younger generations. The collapse of salmon stocks interrupts these intergenerational practices, weakening community bonds and jeopardizing the cultural heritage that sustains the community's identity.

The absence of salmon disrupts these cultural practices, leaving younger generations with fewer opportunities to learn and participate in traditional fishing practices. This disruption erodes communal ties and diminishes the sense of shared identity that is integral to the community. The cultural knowledge and environmental stewardship historically passed down at fish camps are at risk of being lost, as the absence of salmon limits the continuation of these communal practices, traditions, and teachings.

4.3 Legal and Political Challenges

Alaska Native communities face systemic exclusion from meaningful participation in resource management and environmental policy decisions that affect their lands and resources. Legal structures, particularly the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National Interest Lands Conservation Act (ANILCA), have introduced complex legal restrictions that complicate Alaska Native subsistence rights. Although ANCSA transferred land ownership to Alaska Native corporations, it did not adequately address subsistence rights, leaving many Alaska Native communities vulnerable to restrictive state and federal regulations that prioritize commercial interests over Alaska Native subsistence needs.

Under ANILCA, while Title VIII was designed to protect rural subsistence rights, conflicts between federal and state laws have limited its effectiveness. The Alaska state constitution mandates resource use for "common use," which has conflicted with ANILCA's preference for rural subsistence. This legal contradiction has led to court rulings that weaken ANILCA's subsistence protections, making it difficult for Alaska Native communities to access traditional fishing grounds even on federal land. Additionally, limited Alaska Native representation in decision-making bodies like the Federal Subsistence Board restricts the ability of Alaska Native communities to advocate for subsistence protections and fair resource management, compounding the environmental injustices faced by these communities.

These legal and political challenges reinforce systemic barriers that limit Alaska Native communities' access to resources that are not only essential for survival but also for the maintenance of cultural practices and traditions. Addressing these barriers requires reforming these policies to recognize and uphold Alaska Native subsistence rights and support the inclusion of Alaska Native voices in managing natural resources critical to their communities.

> ***"While conservation of our salmon should not rely solely on our Native people, it is important that we continue to be trusted stewards of our lands and resources. TCC continues to testify and advocate at the State and Federal levels to ensure that we do everything we can to protect our salmon." - Chief Chairman, Brian Ridley, Tanana Chiefs Conference***[12]

The TCC tribes face significant injustices due to their exclusion from decision-making processes in fisheries management and conservation. Although Alaska Native communities possess extensive knowledge of salmon ecosystems and sustainable fishing practices, their input is frequently marginalized in favor of industrial fishing interests or state-led management priorities. In the Yukon River region, Alaska Native leaders and fishermen have consistently advocated for stronger protections of salmon populations and stricter bycatch regulations in Bering Sea commercial fisheries, which heavily impact salmon stocks. However, despite these efforts, their calls are often overlooked, leaving Alaska Native communities feeling disenfranchised from resource management decisions that directly affect their livelihoods and cultural practices (Tanana Chiefs Conference, 2024).

5. Historical Context of Marginalization in Resource Management

5.1 Colonialism and Loss of Alaska Native Land Rights

The legacy of land dispossession among Alaska Native communities in Alaska, including the Tanana Chiefs Conference (TCC) region, stems from colonial practices that prioritized settler expansion and resource extraction. Before the United States purchased Alaska from Russia in 1867, Alaska Native groups managed their lands with long-established stewardship practices, maintaining sustainable use of natural resources that supported subsistence-based lifestyles. However, the transfer of Alaska to U.S. jurisdiction marked the beginning of widespread land claims by the federal government, often disregarding Alaska Native land ownership and rights. This led to significant displacements and a gradual loss of control over traditional lands as government policies encouraged settlement and industrial activities such as mining, logging, and fishing, which reshaped the land to prioritize non-Alaska Native interests.

The early 20th century saw further dispossession of Alaska Native lands as homesteading and resource development intensified. The Alaska Native Allotment Act of 1906 allowed individual Alaska Natives to apply for small parcels of land, yet it did not recognize communal ownership, leaving large areas of traditional land open for settlement and resource extraction. This process fragmented Alaska Native territories,

[12] Tanana Chiefs Conference. (2024, June 20). Protecting our salmon for future generations. https://www.tananachiefs.org/protecting-our-salmon-for-future-generations/

creating conflicts between traditional subsistence activities and encroaching commercial enterprises. The loss of these lands has had enduring impacts, limiting the ability of Alaska Native communities to manage resources, access traditional hunting and fishing grounds, and sustain their cultural practices.

5.2 Legal Frameworks Limiting Alaska Native Sovereignty

Over the years, federal and state policies have further restricted Alaska Native sovereignty, limiting the ability of Alaska Native communities to govern and protect their lands and resources. The Alaska Native Claims Settlement Act (ANCSA) of 1971 was a landmark policy, as it extinguished Alaska Native claims to traditional lands in exchange for monetary compensation and title to a portion of Alaska's land, distributed among Native corporations rather than tribes. ANCSA effectively transformed Alaska Native land stewardship into corporate ownership, where lands were managed primarily by regional and village corporations that are legally structured as for-profit entities. Although ANCSA allocated 44 million acres to Alaska Native corporations, the corporate framework often conflicted with traditional subsistence priorities, as corporate interests emphasized economic development over sustainable resource use, leaving many Alaska Native communities unable to prioritize cultural and environmental preservation on their lands.

In 1980, the Alaska National Interest Lands Conservation Act (ANILCA) aimed to address the subsistence needs of rural Alaskans, including Alaska Natives, by granting them priority for subsistence activities on federal public lands. Title VIII of ANILCA was specifically intended to protect subsistence rights for Alaska Native communities, recognizing the central role of subsistence activities in sustaining Alaska Native culture and economic independence. However, state and federal conflicts have restricted ANILCA's protections. The Alaska state constitution requires natural resources to be used for the "common use" of all citizens, creating legal challenges that often undermine subsistence preferences outlined by ANILCA. For instance, in the 1989 *McDowell v. Alaska* decision, the Alaska Supreme Court ruled that the state's subsistence priority for rural residents violated the state constitution's "equal access" clause, which reduced the effectiveness of ANILCA's protections and made it harder for Alaska Native communities to exercise their subsistence rights on federal lands.

These limitations have left Alaska Native communities with restricted access to critical resources like salmon and caribou, often prioritizing commercial or recreational interests over Alaska Native subsistence needs. Further complicating matters, Alaska Native communities have limited representation within state and federal resource management bodies, such as the Federal Subsistence Board. The board oversees subsistence uses on federal lands, but its jurisdiction does not extend to state-controlled waters and lands that are essential for subsistence fishing and hunting. The Katie John case underscored this jurisdictional limitation when Alaska Native elder Katie John fought for subsistence fishing rights on navigable waters adjacent to federal land. The legal battle eventually extended federal subsistence protections to some navigable waters, but significant portions of Alaska's river systems remain under state control, limiting Alaska Native rights to traditional fishing and hunting grounds.

5.3 Continuing Challenges and Environmental Justice

The combined effects of colonial land dispossession and restrictive legal frameworks have left Alaska Native communities marginalized in managing the resources that are essential to their cultural and economic survival. Without full sovereignty or equal decision-making power, many Alaska Native communities lack the authority to enforce sustainable practices and protect the resources on which they rely. State and federal regulations often prioritize non-Alaska Native economic interests, such as commercial fishing and industrial development, over the subsistence rights of Alaska Native communities, perpetuating a cycle of disenfranchisement and environmental injustice.

Addressing these challenges requires legal reforms that recognize and protect Alaska Native subsistence rights, ensuring Alaska Native voices are included in decision-making processes regarding natural resource management. By restructuring policies like ANCSA and ANILCA to prioritize Alaska Native sovereignty and resource access, Alaska Native communities would gain the agency needed to protect their traditional lands and cultural practices, moving toward a more equitable and sustainable approach to resource management in Alaska.

5. Historical Context of Marginalization in Resource Management

5.1 Strengthening Sovereignty and Self-Determination

Achieving environmental justice for Alaska Native communities requires redressing historical inequities by expanding Alaska Native control over natural resources. Strengthening sovereignty enables Alaska Native tribes to govern their lands and resources in alignment with their customs and laws, creating pathways to manage natural resources sustainably. Greater control over resource management is essential for Alaska Native tribes to preserve their lands and waters from destructive practices like mining, logging, and commercial fishing. Legislative initiatives can help prioritize Alaska Native subsistence rights, recognizing the importance of Alaska Native sovereignty in shaping policies that align with long-term conservation and cultural protection goals.

Expanding co-management models also represents a valuable pathway to enhancing Alaska Native governance. Such frameworks allow Alaska Native tribes to partner directly with federal and state agencies in the management of fish stocks, wildlife, and water resources critical to subsistence and cultural practices. For instance, the Alaska Eskimo Whaling Commission (AEWC) collaborates with the federal government to manage bowhead whale hunting, incorporating Alaska Native knowledge into regulatory decisions while respecting traditional practices. Expanding co-management practices to include salmon fisheries and other key resources would help balance economic development with environmental preservation, ensuring Alaska Native input in management decisions that affect their communities and lands.

5.2 Restoring Land and Water Rights

Restoring land and water rights is fundamental for sustaining Alaska Native access to traditional food sources and cultural practices. Many Alaska Native communities continue to seek the restoration of land and water rights lost through the Alaska Native Claims Settlement Act (ANCSA) and other policies that transferred land ownership to state or corporate entities, limiting Alaska Native access to traditional hunting and fishing grounds. Reclaiming these rights involves strengthening protections under laws like the Alaska National Interest Lands Conservation Act (ANILCA), particularly Title VIII, to give Alaska Natives priority access to fish and game in times of scarcity over commercial and recreational interests.

Expanding subsistence protections on both federal and state lands would ensure that Alaska Native communities have consistent access to vital resources, allowing them to maintain their traditional practices and cultural identity. Legislative amendments that prioritize subsistence rights over commercial exploitation are essential for preserving the cultural, spiritual, and economic sustainability of Alaska Native communities.

5.3 Incorporating Traditional Ecological Knowledge (TEK) in Conservation

Traditional Ecological Knowledge (TEK), developed over generations by Alaska Native communities, provides invaluable insights into ecosystem management and conservation. Integrating TEK into state and federal resource management practices can enhance ecosystem sustainability, as TEK emphasizes a holistic, long-term approach to natural resource stewardship. This perspective is particularly valuable in addressing challenges like climate change, biodiversity loss, and habitat degradation, which require adaptive and sustainable practices.

Collaborative management models that integrate TEK, like those used by the Alaska Eskimo Whaling Commission (AEWC), demonstrate the benefits of including Alaska

Native knowledge in conservation practices. (Alaska Eskimo Whaling Commission. (n.d.). Alaska Eskimo Whaling Commission. https://www.aewc-alaska.org/co-management By incorporating TEK in salmon fisheries, water resources, and broader land use policies, government agencies can support effective conservation practices that align with Alaska Native stewardship values. TEK's focus on balance and respect for natural cycles is essential for creating sustainable management practices that honor Alaska Native expertise and contribute to ecological resilience across Alaska Native lands.

5.4 Stronger Environmental Regulations on Industrial Activities

Achieving environmental justice for Alaska Native communities necessitates legal and policy reforms that actively mitigate the environmental impacts of industrial activities like mining, oil extraction, logging, and commercial fishing. These industries have long contributed to habitat degradation, pollution, and resource depletion on Alaska Native lands and waters, affecting the ecosystems that Alaska Native communities rely on for subsistence and cultural practices. Stronger environmental regulations can protect these critical resources and ensure that industrial development does not come at the expense of Alaska Native health, cultural practices, or environmental integrity.

One crucial area for reform is the reduction of bycatch in commercial fisheries. Incidental catches of salmon and other species in large-scale trawl fisheries disrupt salmon populations, impacting subsistence fishing practices that are central to Alaska Native communities. Strict bycatch limits, effective monitoring systems, and designated conservation zones—such as the Chum Salmon Savings Area in the Bering Sea—are essential steps toward reducing incidental catches. Expanding such conservation areas and enhancing enforcement mechanisms could significantly lessen the unintended impacts of commercial fishing on Alaska Native food security and cultural practices.

Additionally, policy reforms that target habitat destruction from resource extraction are needed to protect the ecosystems surrounding Alaska Native lands. Mining, oil drilling, and logging operations often degrade watersheds, disturb wildlife habitats, and contaminate soil and water with pollutants like heavy metals and petroleum byproducts. Enforcing stricter environmental impact assessments (EIAs) and requiring comprehensive restoration plans before, during, and after industrial projects could help minimize the long-term environmental consequences of these industries. EIAs should also integrate Alaska Native input and Traditional Ecological Knowledge (TEK) to ensure that assessments reflect the full impact on local ecosystems and Alaska Native communities.

Regulations that address pollution specifically from oil spills, mining runoff, and deforestation are also crucial for protecting salmon spawning grounds, forests, and water systems. For instance, tighter restrictions on pollutants and better infrastructure to contain and clean up potential spills could help preserve water quality and aquatic life in key rivers and tributaries. Implementing buffer zones around Alaska Native lands and waterways can protect these areas from industrial encroachment, ensuring that Alaska Native lands remain viable for subsistence activities.

Furthermore, mandating regular environmental audits for corporations operating on or near Alaska Native lands can hold companies accountable for adhering to environmental standards and penalize those that fail to comply. Such audits, in combination with consistent monitoring by independent organizations, can enhance transparency and reduce the likelihood of unreported violations. Financial incentives for sustainable practices, coupled with penalties for non-compliance, could encourage industries to adopt methods that prioritize environmental health and community well-being.

Ultimately, stricter environmental regulations that encompass all stages of industrial activity—from permitting and operation to restoration—are vital to achieving environmental justice. These reforms can help preserve the ecosystems that Alaska Native communities depend on, empowering them to continue traditional practices while ensuring that industrial development respects and protects Alaska Native rights and the natural environment.

5. Conclusion

The decline of chum salmon populations along the Yukon River has highlighted significant environmental injustices faced by the Alaska Native communities of the Tanana Chiefs Conference (TCC) region. For these communities, the loss of salmon threatens far more than food security; it endangers a way of life rooted in cultural practices, subsistence traditions, and a deep connection to the land and waterways. The impacts on Alaska Native communities have been disproportionate, underscoring the need for a more inclusive and equitable approach to environmental management—one that respects and incorporates the perspectives, knowledge, and rights of Alaska Native peoples.

Addressing these challenges requires a transformative shift toward centering Alaska Native leadership in resource management and conservation. Alaska Native communities possess generations of Traditional Ecological Knowledge (TEK) that can inform sustainable practices in habitat restoration and species conservation. By integrating this knowledge, conservation efforts can become more adaptive, culturally respectful, and effective in restoring and sustaining salmon populations. Additionally, recognizing and upholding Alaska Native sovereignty in environmental policies ensures that communities have control over the natural resources they depend on, fostering resilience against industrial and environmental pressures.

A commitment to environmental justice for Alaska Native communities along the Yukon River means implementing policies that protect their subsistence rights, such as strengthening protections under the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National Interest Lands Conservation Act (ANILCA). These measures, along with co-management frameworks that allow Alaska Native communities to work directly with state and federal agencies, can create a collaborative foundation for managing fish stocks, protecting water quality, and ensuring the sustainable use of land and resources.

Through collaboration, regulatory reform, and respect for Alaska Native sovereignty, a path to environmental justice can emerge for the Alaska Native peoples of the Yukon River. Sustainable resource management practices, equitable policies, and partnerships that recognize Alaska Native expertise are essential to restoring the ecosystems on which these communities depend. By prioritizing the rights, knowledge, and cultural practices of Alaska Native peoples, there is a meaningful opportunity to build a future where both the salmon populations and the cultural heritage of the Yukon River are preserved for generations to come.

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Our Vision

Healthy, Strong, Unified Tribes

Our Mission

Tanana Chiefs Conference provides a unified voice in advancing sovereign tribal governments through the promotion of physical and mental wellness, education, socioeconomic development, and culture of the Interior Alaska Native people.

Tanana Chiefs Conference

Appendix 9: Original Submissions from Cooperating Agencies

This appendix provides the four original, complete chapters co-developed by the Tanana Chiefs Conference (TCC) and Kuskokwim River Inter-Tribal Fish Commission (KRITFC) as cooperating agencies to this Environmental Impact Statement (EIS) process. Because parts of these sections were modified or removed from the draft EIS after their submission on October 4, 2024, TCC and KRITFC wish to include them as an appendix for context and reference to ensure the visibility and consideration of our contributions, particularly those grounded in Traditional Knowledge (TK).

As cooperating agencies, TCC and KRITFC were tasked with providing information as recognized special experts in local knowledge, TK, and Western scientific data. Our focus centers on the ecosystem-wide status of chum salmon stocks of the Kuskokwim and Yukon River systems and the wide-ranging social, economic, environmental, and health impacts that chum salmon declines and harvest restrictions have posed on our Tribes. This appendix reflects TCC and KRITFC's responsibility to represent the voices and experiences of our member Tribal Nations in the EIS process while ensuring that decisions are informed by a holistic understanding of the challenges affecting Indigenous ways of life, including the ecosystems and economies our Tribes depend upon.

Original Submission: Section 4.4: Importance of Chum Salmon for Indigenous Peoples in the Yukon and Kuskokwim Regions

To be read in partnership with DEIS Section 4.3.3.2 and all sub-sections.

This section was co-authored by KRITFC and TCC as cooperating agencies to this analysis. Additional information about the importance of subsistence in rural WIAK can be found in Section 4.3.5 of the April 2024 Social Impact Analysis.

4.4.1 Indigenous Peoples of the Kuskokwim and Yukon

Over 27,800 Indigenous Alaska Native people reside in the Yukon and Kuskokwim regions of Alaska (Alaska Department of Labor 2023), home to 98 federally recognized Tribal nations, named in Appendices 6 (contributed by KRITFC) and 7 (contributed by TCC). All of the citizens of these Tribes are Salmon People, and traditional ways of life, including salmon fishing, are continually practiced to support the health, well-being, and identity of these people.

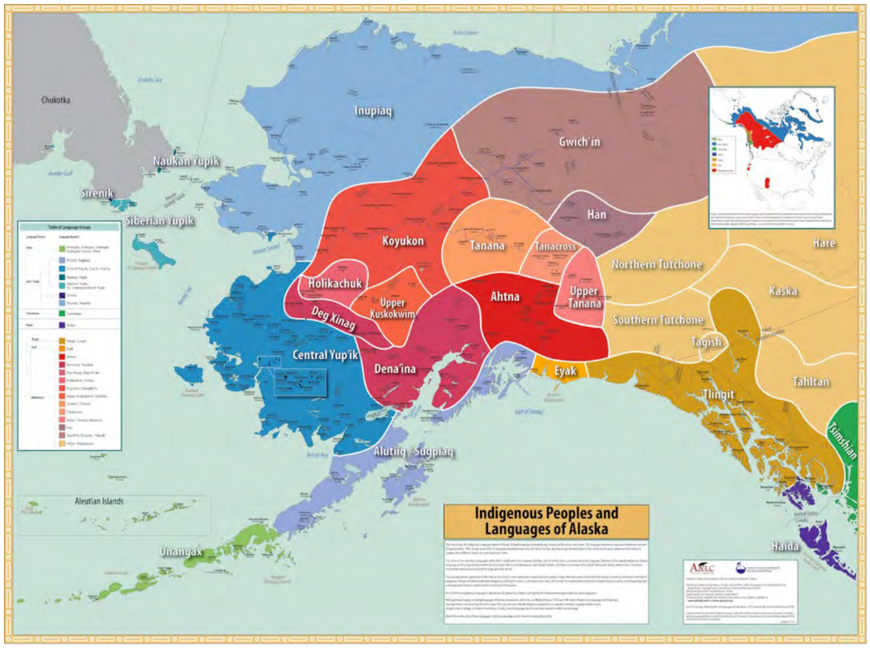

Figure 4-23. Indigenous Peoples and Languages of Alaska. From Krauss et al. 2021, the Alaska Native Language Center and UAA Institute of Social and Economic Research.

Figure 4-23 depicts the traditional ethnolinguistic groups of Alaska. At least 12 traditional languages are spoken within the Yukon-Kuskokwim region of Alaska: Dinjii Zhuh K'yaa (Gwich'in), Hän, Benhti Kokhwt'ana Kenaga' (Lower Tanana), Sahcheeg Xut'een Xneege' (Middle Tanana), Nee'aanèegn' (Upper Tanana), Dihthaad Xt'een Iin Aandeeg' (Tanacross), Dena'inaq', Dinak'i (Upper Kuskokwim), Denaakk'e (Koyukon), Holikachuk, Deg Xinag, Cup'ig (Nunivak Island Yupik), and Yugtun/Cugtun (Central Yup'ik) (ANLPAC 2024). Words and phrases in each of these languages express the centrality of salmon in the lives of their language-bearers. For instance, *neqa* is the Yugtun word for both "fish" (typically referring to salmon) and "food," and *Khii Zhrii*, the Gwich'in word for the month of August, literally translated means "Month of Chum Salmon."

It is important to the co-authors—whose special expertise resides in the Yukon-Kuskokwim region of Alaska—that we note there are other watersheds, Tribal Nations, traditional language speakers, and Nations people who are both affected by recent chum salmon declines and impacted by this action. These include the Bristol Bay region, Norton Sound/Bering Strait Region, and Kotzebue Sound regions of Alaska, and First Nations peoples in Canada. Information and knowledge from these regions are not explicitly included in this section, though this section may apply to these regions and people. Additionally, some communities within our regions are experiencing intensified impacts of chum salmon declines (e.g., the Koyukuk River region); these are further detailed in Appendices 6 and 7.

4.4.2 Traditional and Modern Salmon Fishing

Traditional chum salmon fishing methods practiced by Indigenous peoples along the Yukon River, Kuskokwim River, and their tributaries are deeply intertwined with cultural, spiritual, and subsistence traditions, honed over centuries in harmony with the environment. These customary practices reflect the deep connection between Indigenous communities and the natural world.

Indigenous communities along the Yukon River developed sustainable fishing methods that have endured for generations. Practicing selective fishing techniques to maintain salmon populations across generations, rather than overharvesting or indiscriminately catching fish, Indigenous salmon harvesters used methods such as weirs, traps, and hand-held nets, allowing them to target specific species, sizes, and age classes of salmon. These techniques often focused on harvesting fewer mature fish, ensuring that sufficient numbers could continue upriver to spawn. This selective approach prevented the depletion of salmon populations, maintaining the ecological balance within the river systems. Apart from the lower stretches of the river, Yukon fishers traditionally harvested salmon in terminal fisheries, meaning salmon were harvested as they approached or reached their tributary spawning grounds at the end of their life cycle. By focusing on sustainable harvest methods, ancestral Indigenous fishers of the Yukon River and its tributaries were able to adapt their practices according to the seasonal abundance of different salmon species. For example, some communities would harvest certain species only during peak runs or only after other species had already successfully spawned, allowing fish stocks to naturally replenish. This level of selectivity was based on an intimate understanding of the salmon life cycle and the river ecosystems.

In the Kuskokwim region, numerous traditional methods for harvesting chum salmon exist, including drift and set gillnets, once hand-woven from materials like cotton, sinew, or tree bark; fish traps and fences; spears; and hook-and-line gear. Historically, as on the Yukon, these tools were mainly employed in terminal subsistence fisheries rather than in the main channel of the Kuskokwim, except for the lower stretch of the river where few salmon-bearing tributaries exist. Most contemporary Kuskokwim fishers, when permitted by regulations, use drift and set gillnets made of nylon for both commercial and subsistence chum salmon fishing. In recent years, dipnets have gained popularity in the lower Kuskokwim, largely due to fishing restrictions that allow their 24/7 use for selective fishing, enabling the release of salmon species of concern, such as chum, while retaining others, like sockeye. There has also been a noticeable shift toward fishing in the main channel of the Kuskokwim, influenced by commercial practices and recent regulations that close subsistence fishing in salmon-bearing tributaries.

For Indigenous communities along the Yukon River, Kuskokwim River, and their tributaries, chum salmon have long been a crucial subsistence resource, providing essential nutrients for the long winter months, as well as material for clothing and fueling dog teams. The harvest of chum salmon holds deep cultural significance and helps communities pass down traditions across generations. Subsistence fishing offsets high food costs in remote areas, where access to store-bought food is limited or prohibitively expensive, and also supports local barter systems, trading salmon for other essential goods such as moose meat and berries.

Salmon fishing plays a central role in cultural practices in the region, with ceremonies and rituals honoring the fish and fostering community bonds. Salmon is often shared within the community, especially with Elders, reinforcing collective well-being. TK guides sustainable harvesting practices, which account for not only human consumption needs but also the needs of the non-human relatives that rely on salmon, ensuring the long-term health of salmon populations and sustaining ecological biodiversity. Fishers monitor salmon runs closely, adjusting their harvest to protect the species during lean years. This reciprocal relationship with nature emphasizes environmental stewardship, where only what is needed is taken, ensuring future generations can continue the subsistence way of life. Sustainable management of chum salmon is vital for food security, cultural continuity, and local economies along these rivers.

However, the arrival of European settlers and the imposition of colonial fishery management systems disrupted these long-standing Indigenous management practices. Colonization introduced commercial fishing, new technologies, hatchery programs, indiscriminate targeting of fish, and a market-driven approach to resource extraction, which often prioritizes short-term economic gain over long-term sustainability. Indigenous communities were excluded from decision-making processes regarding the management of their traditional fishing grounds, and their knowledge systems were often devalued or entirely dismissed by colonial authorities.

Furthermore, modern fishery management approaches, based on Western scientific models, often employ a one-size-fits-all regulatory framework that does not account for the unique ecological conditions of different river systems or the traditional practices of Indigenous communities. For example, seasonal fishing closures or quotas imposed by government agencies frequently conflicted with Indigenous fishing seasons and cultural practices, leading to tensions and further marginalizing Indigenous fishers from participating in the stewardship of their own lands and waters.

Since 2020, subsistence users along both the Yukon and Kuskokwim rivers have faced severe, if not total, restrictions on chum salmon fishing due to declining stocks. Any discussion of modern fishing in these regions must acknowledge the profound disruption of these vital salmon-human relationships and the traditional seasonal harvest cycles that have sustained these communities for generations.

4.4.3 Chum Salmon Support Holistic Well-Being of Indigenous People

Chum salmon play a vital role in the individual, communal, and ecological well-being of Indigenous peoples in the Kuskokwim and Yukon regions (KRITFC 2024). This discussion explores how chum salmon contribute to Tribal communities by supporting physical health (including food security), emotional and mental well-being, cultural integrity, family structures, local economies, livelihoods, and ecosystems.

4.4.3.1 Physical, Mental, and Emotional Health

Chum salmon—and all salmon species—are cornerstones of the physical health in the Yukon and Kuskokwim regions as a primary source of regional food security and nutrition. Food security is defined by the U.S. Department of Agriculture (USDA) as “access by all people at all times to enough food for an active, healthy life.” Food security has multiple dimensions, including food production, processing capacity, distribution systems, price, food quality, among others (Hanna et al. 2012). The Inuit Circumpolar Council (ICC 2015: 14, 34-35) prepared a conceptual framework for food security which emphasizes: availability; culture; decision-making power and management; health and wellness; stability, and accessibility. Compared to other U.S. states, Alaska faces unique food security challenges because of its remoteness, limited agricultural production, and high reliance on both locally harvested wild foods and imported foods; therefore, subsistence plays a greater role in supporting food security in the state (Fall 2018; ICC 2015).

Food security, specifically through the lens of subsistence harvests, can be affected by myriad factors, including time spent harvesting, a lack of harvest effort, resources being less available to harvest, and changes in household composition (Ahmasuk, Trigg, Magdanz, & Robbins 2008; Fall & Kostick 2018). Wolfe et al.'s (2012) research in Yukon River communities found five factors to be significantly related to household salmon production: cost of fishing fuel; whether the household had the necessary gear; number of harvesters; number of households eating salmon; and the number of people eating salmon.

The nutritional profile of chum salmon makes it an invaluable food source, particularly in Alaska's harsh and remote environments. Chum salmon is a complete protein, offering 20 grams of protein per 100 grams of fish, as well as the B vitamins, potassium, phosphorus, selenium, and omega-3 fatty acids (Chief Andrew Isaac Health Center 2024). The availability and nutrient-density make salmon a dietary staple for many, as it can be harvested, preserved (through smoking, drying, or freezing), and stored for extended periods—crucial during months when fresh food is limited. A diet rich in chum salmon and other traditional foods supports the health of Indigenous Alaskans, who face elevated rates of lifestyle-related conditions like heart disease, diabetes, and stroke (ANTHC 2021a,b). The essential nutrients in salmon play a key role in mitigating these risks. Additionally, chum salmon's high protein-to-energy ratio, low energy density, and low insulinogenic load make it key to a healthy, sustainable diet (Chief Andrew Isaac Health Center 2024).

Chum salmon play a unique dietary role across the Yukon and Kuskokwim regions and are consistently named as a primary food source in Alaska Native communities (ANHB 2004). They are considered "like medicine" to many Elders (Fienup-Riordan et al. 2020:76) because they are less oily and fatty than other species (e.g., Chinook salmon) and thus can feed Elders, people with open wounds or who cannot digest oil-rich salmon, and those who prefer their taste (KRITFC 2021; Moncrieff, Brown & Sill 2009). In addition, the low oil content makes chum salmon an easier resource for processing and drying (Raymond-Yakoubian and Raymond-Yakoubian 2015), which is vital for long-term storage through the winter, as well as for preparing traditional delicacies such as *eggamarrluk* (half-dried, half-smoked salmon) (KRITFC 2021).

In addition, the acts of fishing (e.g., pulling nets, walking along riverbanks) and harvesting (eg., cutting and hanging fish, maintaining fires) are energy intensive, providing exercise which can minimize the consequences of chronic diet related diseases. The benefits extend beyond physical health as well—both the strenuous activity and the cultural connection cultivated by subsistence practices have been found to reduce depression, substance abuse, and other mental health diseases that are increasingly prevalent in Indigenous communities in Alaska (ANTHC 2021b). Chum salmon thus supports mental and emotional health in Indigenous communities of the Yukon and Kuskokwim rivers. As stated by TCC to the Senate Committee on Indian Affairs:

> *"The act of going to fish camp, preparing camp, fishing, and processing fish is hard, physical activity. From dusk to dawn, families are working. [This] helps families stay busy and maintain focus in the present moment, which is ideal for mental health" (U.S. Senate 2023:18).*

Over the last 10 years, the salmon crisis has contributed to the number of diabetic and pre-diabetic patients due to increased food insecurity and lifestyle changes. Since 2019, TCC has found that the number of diabetic and prediabetic patients in its region has increased by 24.6% and 70%, respectively. This can be directly linked with declines in salmon abundance, harvesting, and consumption (Chief Andrew Isaac Health Center 2024).

4.4.3.2 Culture, Identity, and Family

Through fostering physical, emotional, and mental health, salmon and salmon fishing ground Indigenous residents of the Yukon River, Kuskokwim River, and their tributaries in our identities, cultures, and places.

The relationship between Alaskan Natives and chum salmon has deep historical and cultural roots. The early Paleoindians in Alaska, traditionally thought of as big-game hunters, likely relied heavily on chum salmon as part of a diverse subsistence strategy that included fishing, hunting, and gathering. Evidence from the Upward Sun River site in the Yukon region of Alaska reveals that Alaskan Natives have been exploiting chum salmon as far back as 11,500 years ago (Halffman et al. 2015). Chum salmon were particularly important because of their predictable seasonal abundance and their suitability for preservation due to their lower oil content than other salmon species, supporting survival during long winter months. Additionally, the historical importance of chum salmon for Alaskan Natives underscores the rich biodiversity of the Beringia region and suggests that riverine resources were crucial to the economy and diet of these early inhabitants, even during the challenging post-Ice Age environment.

Fishing for salmon as a primary food is a means of practicing cultural values and a source for building and maintaining relationships, which shape and form identity (Raymond-Yakoubian 2019). In this way, salmon may be considered as a "cultural keystone species": a "culturally salient species that shape in a major way the cultural identity of a people, as reflected in the fundamental roles these species have in diet, materials, medicine and/or spiritual practices" (Garibaldi & Turner 2004). Moreover, salmon are considered kin to the Indigenous Peoples of the Yukon and Kuskokwim regions, meaning both salmon and humans have a responsibility to support the well-being of the other.

Many Indigenous peoples across the Yukon and Kuskokwim regions believe that humans and salmon share a mutual awareness. Salmon "are considered sentient creatures possessing intelligence and memory. Like all animals, they are aware of what people think and say about them" (Fienup-Riordan 2020: 11). Therefore, there are protocols for proper behavior and treatment of fish, and salmon are only caught when they willingly gift themselves to fishermen (Fienup-Riordan 2020 et al.; Voinot-Baron 2021). In the Yupiaq worldview, if this reciprocal relationship is not respected, the salmon will not return, meaning that sharing and avoiding waste is crucial (Fienup-Riordan 2020:25). Maintaining cultural connections amongst humans, and between humans and salmon, depends on humans maintaining these reciprocal relationships.

Avoiding waste is perhaps the pinnacle teaching and example of proper behavior and respect toward salmon. Checking set nets and fish wheels often, not catching more fish than can be processed in a timely manner (i.e., before spoilage), avoiding cutting during the hottest parts of the day, fishing during ideal weather, and proper cutting to use all parts of the salmon are all ways to avoid waste (Fienup-Riordan 2020; Ikuta et al. 2013; Moncrieff 2017; Raymond-

Yakoubian and Raymond-Yakoubian 2015). Additionally, parts of the salmon that are not eaten, like bones and fins, must be properly disposed of, often through burial, burning, or return to the river, depending on the culture and family; and harvest gear and fish-cutting spaces must be kept clean (Fienup-Riordan et al. 2020). Failure to abide by these teachings, and thus disrespecting salmon, contributes to salmon declines (Fienup-Riordan et al. 2020: 78, 107).

Sharing resources is another hallmark teaching of proper behavior toward fish, and it is widely understood that sharing salmon leads to an increase in its abundance (Fienup-Riordan et al. 2020); builds strong connections between households within and across communities (Ikuta et al. 2016); and provides many benefits to individuals, households, and communities across the state including increased well-being, food security, food diversity, heritage, and cultural identity (Carothers 2021). Sharing is vital to social responsibility as well, as salmon are given to Elders and those who do not have access to fish, which further reinforces social and communal ties. Finally, sharing extends beyond simply exchanging resources to include cooperation in harvesting, processing, and sharing of equipment and knowledge.

It is at fish camp that these teachings, values, and kinship relationships with salmon are passed down to Alaska Native youth of the Yukon and Kuskokwim regions. Summer fish camps have long been a primary place for Indigenous families to gather, heal, learn from Elders, and foment traditional ways of life, and many families have maintained the same fish camp sites for generations (KRITFC 2024). Each person is given age-appropriate chores at fish camp (e.g., young children haul water, older adults supervise smokehouses), and the shared work both fosters responsibility and purpose as well as family unity, continuity, and belonging.

Chum salmon hold a special role at Yukon and Kuskokwim fish camps. They are often the first salmon on which young women will practice heading, gutting, and cutting fish. As shared by an Elder from the Kuskokwim:

> *"When they started bringing in chum salmon, I would try cleaning and cutting… When she handed me a fish to work on, I'd be very happy… That was how we girls learned about caring for fish, and each girl did the same" (Nastasia Larson, quoted in Fienup-Riordan et al. 2020:69).*

Young men, on the other hand, are taught purpose in becoming providers for their families through fishing. Contemporary salmon declines and fishing restrictions are preventing youth from fulfilling a core part of who they are, and Alaska Native youth who are disconnected from cultural practices have reported suffering suicidality and identity and mental health crises (Skewes et al. 2020; Voinot-Baron 2022). Cultural well-being is thus vital to mental and emotional health of regional Indigenous peoples.

Fish camp traditions are changing with declines in salmon abundance and fishing opportunities, increasing fuel prices, a greater dependence on store-bought food, and ties to full-time, year-round work, and many families are moving their fish camp sites and activities to their villages, closer to home (Johnson et al. 2009; KRITFC 2024). In general, fewer families are migrating to fish camps for any extended period, let alone for an entire summer fishing season. As said by one Kuskokwim Elder:

> *"I'm one of the fish campers...but I don't go to fish camp because of the fish closures. There's only maybe 5 in Tunt [who use their] fish camp right now. No, that's not that many." — Adolph Lupie, Tuntutuliak, as quoted in KRITFC (2021:7)*

Subsistence fishing restrictions are especially impacting the core of fish camp; whereas in days of abundance, parents and grandparents could spend the summer teaching youth our ways of life, contemporary restrictions mean Indigenous youth "are having to learn core components of our way of life and how to be Real People in 12-hour [fishing] windows" (J. Samuelson, personal communication, September 25, 2024). Many families admit not permitting young children to practice cutting salmon because the few fish harvested are too precious to allow for mistakes.

While it is important to note that the practice of traditional cultures on the Yukon and Kuskokwim is alive and strong today, Alaska Native practitioners are being forced to adapt these traditions, particularly due to declines in traditional foods, climate change, and ongoing legacies of colonization. Drastic changes to or loss of fish camps, as well as heightened anxiety to meet subsistence salmon needs in short windows, are impacting families' abilities to gather, reconcile grievances, and instruct children (KRITFC 2024; Voinot-Baron 2022). Elders on the Kuskokwim have noted that a "root cause of the decline of fish is that young people are no longer instructed," and "along with lack of instruction, the decline of fish is believed to be a product of discord and lack of consensus among people" (Fienup-Riordan et al. 2020:109). Decreases in salmon have also affected families' abilities to share salmon without worry for winter food stores (Brown and Godduhn 2015; Ikuta et al. 2016). The absence of salmon and resulting effects to Indigenous families' abilities to embody millennia-old values and traditions is a leading contributor to social crises in WIAK families and communities. These effects also likely contribute to out-migration of families and population loss in rural regions as families pursue new forms of food security and identity in urban areas (Wolfe et al. 2010:14-15).

Furthermore, colonization has had profound and lasting impacts on Alaska Natives' traditional ways of life, including their relationship with salmon. The arrival of Euro-American settlers and the imposition of Western governance systems led to widespread disruptions in Indigenous communities and human-salmon relationships, including through forced assimilation and boarding school attendance, commercialized resource extraction, and the criminalization of traditional practices, leading to declined populations and increased vulnerabilities (Atlas 2020).

Indigenous peoples had long-standing systems for managing salmon populations, which were deeply intertwined with their spiritual and cultural practices and based on respect, reciprocity, and sustainability. Colonization replaced these systems with state and federal management practices established without Indigenous knowledge and stewardship principles, leading to the ongoing marginalization of Indigenous voices in resource management. The imposition of Western laws criminalized many traditional fishing and hunting practices, forcing Alaska Natives to hide their activities or face legal penalties (Stevens and Black 2019; Voinot-Baron 2020, 2022). This has caused significant hardship, as salmon and other resources were vital not only for sustenance but also for maintaining cultural and spiritual practices. Over time, privatization and commodification of commercial fishing rights dispossessed many Alaska Natives of access to salmon fisheries. Indigenous communities, which had depended on salmon for thousands of years, found themselves excluded from the very resources that formed the foundation of their culture and economy.

The loss of access to salmon and the criminalization of traditional practices have contributed to social issues within Indigenous communities, such as depression, anxiety, and the breakdown of cultural knowledge transmission. Younger generations have faced barriers in continuing the fishing traditions of their ancestors, disconnecting them from their heritage and cultural identity. To begin to address these deep social and cultural losses, Indigenous leaders continue to advocate for the recognition of their rights and the restoration of their traditional stewardship roles (Carothers et al. 2021).

4.4.3.4 Economies and Livelihoods

Contemporary subsistence uses in rural Alaska occur within a mixed economy, which includes both a subsistence fishing and hunting component and a cash component. Commercial fishing has long played an important role in mixed economies for rural and Alaska Native communities across Alaska (Wolfe 1982; Reedy 2009). Wolfe & Spaeder (2009: 350) describe the connections between subsistence and commercial fishing across Western Alaska (Norton Sound, Kuskokwim, and Yukon areas), emphasizing that commercial fishing uses the same skills and equipment as subsistence fishing and serves to reinforce subsistence practices through providing an additional source of income that can help purchase subsistence gear (e.g., nets, motors, fuel). Fishermen also often retain some salmon from their commercial harvests for subsistence purposes (Brown et al. 2023). With no commercial opportunities for Chinook in the Yukon since 2008, recent commercial opportunities have centered on summer and fall chum salmon, though those too have ceased since 2020.

The combination of money from paid employment and subsistence food production characterizes the mixed subsistence economies in many areas of rural Alaska (Fall 2018). Subsistence food production is directed toward meeting the needs of families and communities, not market sale as in commercial production. In this way, families (or households and communities) will engage economic strategies that use household income (e.g., from commercial fisheries, fur trapping, wage employment, seasonal jobs, and dividends) to support subsistence activities and invest in efficient harvest technologies for subsistence use.

In many Indigenous Yukon and Kuskokwim communities, sled dogs have played an important role in mixed economies and culture as a means of transportation, hauling goods, subsistence hunting, fishing, and trapping, and racing (Andersen 1992). Chum salmon has long been a primary food source for dogs, and fishing for a dog team was a large portion of the annual subsistence harvest for many communities (Duffy et al. 2013; Native Village of Georgetown 2021). As a primary means of transportation and work, it was critical that dog teams were fed good "fuel," primarily chum salmon. Though the number of sled dogs in rural Alaska communities has declined since the arrival of snow machines in the late 1960s and early 1970s (Ikuta et al. 2013), sled dogs, the caretaking that they require, and mushing are activities that continue to the present and provide a means for intergenerational relationships to form and for knowledge about one's culture and environment to be shared (LaVine 2010). The decline in salmon, and particularly chum salmon, on the Yukon and Kuskokwim has been a significant shock to many sled dog kennels, whose owners now must find other food sources for their dogs, ranging from Northern pike to expensive manufactured dog food.

During recent chum salmon declines, TCC has facilitated the distribution of fish to Tribal communities along the Yukon River that are unable to engage in subsistence fishing. This is a significant issue that extends beyond economics, involving cultural, legal, and logistical complexities. On average, the cost to distribute fish, both donated and purchased, to replace foregone subsistence harvests in the TCC region has totaled approximately $1,968,506.82 annually since 2020: TCC has spent an average of $713,866.44 per year to purchase salmon for its Tribal Citizens, and collectively, the Tribes in the TCC region have spent an additional $1,254,640.38 annually on fish distribution.[1] In 2024, for the second summer in a row, all TCC communities have received fish by the end of the season.[2]

In addition, Tribal citizens have incurred higher expenses in recent years from the maintenance of fish camps, especially when unused and facing increased environmental exposure. Without regular in-season maintenance, repair costs have escalated due to the need for significant rebuilding, including high expenses for materials, labor, and transportation to remote locations. Economically, the cost of restoring these camps after long periods of disuse is substantial, ranging from $20,000 to $50,000, depending on their condition and size. This cost includes replacing damaged structures like drying racks, cabins, and access roads. Logistical costs for transporting materials to remote Yukon River areas can add 10-30% to the total expense. Additionally, with fewer locals skilled in traditional construction, communities often need to hire external labor at rates of $35 to $70 per hour, further increasing restoration costs.

Fish camps along the Yukon River face increasing rehabilitation costs as they go unused, with the potential for rebuilding expenses to far exceed initial estimates. Beyond monetary concerns, the cultural and social costs are significant. The loss of TK and reduced engagement in subsistence activities weaken Alaska Native communities' economic resilience and increase reliance on external food sources. The decline in subsistence fishing has led to unattended camps, making them vulnerable to trespassing, vandalism, and environmental damage. Repairing this damage adds to already high maintenance costs, while the cultural significance of these camps makes their loss emotionally impactful for the communities. Proactive investment is needed to restore the camps and revive subsistence practices.

4.4.3.5 Ecosystems & Biodiversity

Alaska Native people in the Yukon and Kuskokwim regions are deeply interconnected with regional ecosystems and cannot be separated from them; the health of the people is reflected in that of the ecosystem, and vice versa (Samuelson 2023). As salmon declines are deeply felt in families, cultural exchanges, and economies in the Yukon and Kuskokwim regions, so too are they felt across the ecosystem.

[1] These figures do not include additional costs for specific TCC programs, such as the Elder Nutrition program, and costs of staff labor and benefits to distribute fish. Additionally, many Tribes' distribution program costs have been partially offset by grants, and they face the risk of no longer being able to supplement fish supplies beyond what TCC can provide once this funding ends.

[2] The process of ordering fish begins in late March or early April, with the goal of having fish available by May and completing distribution by August. TCC staff spend 2-4 months per year preparing for the distribution, and when it comes time to distribute the fish, it requires 4-6 staff members working 25-40 hours per week to coordinate all the logistics.

Salmon play a keystone role in ecosystems across Alaska, including within the Kuskokwim River and Yukon River. The biodiversity impacts of the chum salmon crash affect the entire food web, as salmon act as a nutrient vector between marine and freshwater environments. When salmon return to spawn and die, their carcasses provide a critical influx of marine-derived nutrients to river ecosystems, supporting a wide array of species—from aquatic insects to large predators (Cederholm et al. 1999; Walsh et al. 2020). The crash in chum salmon populations disrupts this nutrient cycle, leading to nutrient-poor conditions in rivers and streams, which can affect the entire aquatic food web and reduce biodiversity at multiple trophic levels.

A reduction in chum salmon populations directly affects predators in the Yukon and Kuskokwim regions that rely on salmon as a food source, like bears, eagles, and wolves. The decline in chum salmon means these predators face food shortages, particularly as they head into winter. This can result in lower survival rates, diminished population sizes, and migration to areas with higher food density, including human villages and towns. This has cascading effects throughout the ecosystem, as these top predators also play a role in regulating prey populations and maintaining balance within their habitats. As stated by one Kuskokwim TK holder:

> *"When the chum returns were good, it was just stink, and fish were everywhere.* ***I*** *don't think people realize the importance they have to the ecosystem. The river's health, the plants. I think of all the bears, and if they have no fish, they're eating berries; but that's not going to hold them off, so they have to eat more baby moose; and then we get back to where we are still: trying to conserve moose up here." (Whitworth et al. 2023, in Siddon 2023:133).*

Salmon also contribute to the structure of river and stream ecosystems by digging redds (nests) for their eggs. This process of digging and reshaping gravel beds creates habitat for many other species, such as aquatic insects, other fish species, and amphibians. The reduction of chum salmon reduces the frequency of this natural process, leading to more stable and compacted riverbeds, which may reduce habitat diversity. In the long term, this can result in less suitable spawning habitat for other fish species, further exacerbating declines in overall aquatic biodiversity.

Juvenile chum salmon feed on aquatic insects and small forage fish in the river. Chum salmon population declines can therefore lead to an overabundance of certain prey species, which disrupts the balance of predator-prey relationships in the river. The absence of salmon also alters the ecosystem dynamics for other fish species that either depend on the same food sources or depend on chum salmon as prey. This can lead to imbalances in the river's ecosystem and affect the long-term sustainability of forage fish populations, which are in turn vital to the diet of other species. For instance, at the Henshaw Creek weir project in the Yukon drainage, the 2021 summer chum salmon escapement of 3,729 fish represented only 2.5% of the annual average escapement from 2000 to 2019. Over this same period, changes in longnose sucker and Northern pike abundance were also noted, highlighted the interdependence of salmon and other species (McKenna 2022).

Chum salmon body sizes have declined 2.4% since pre-1990 levels (Oke et al. 2020). This not only decreases fecundity with long-term consequences for salmon population productivity and recovery, but also shrinks the level of marine-derived nutrients that can be transported to river systems, impacting the productivity of riparian ecosystems and reducing nutrient availability for other organisms that depend on these salmon-driven nutrient inputs.

Additionally, shrinking body sizes of chum salmon has reduced the caloric value of subsistence harvests, with smaller salmon providing approximately 26% fewer meals per fish (Oke et al. 2020). The reduction of chum salmon sizes and numbers has forced human communities to find alternative food sources. This has been a particular challenge for many families, as chum salmon especially have been one of the most reliable, abundant salmon species for annual food stores during recent declines of other traditional food sources, like Chinook salmon, caribou, moose, and waterfowl (Godduhn et al. 2020; KRITFC 2021). Over time, species substitutions may lead to accidental overharvesting and further reductions in biodiversity, as observed by one Kuskokwim TK holder:

> *"There just weren't any [chum salmon in 2021]. I was having to harvest a lot more reds than I normally would for all of that other stuff…I think a lot more people were just getting a lot more reds. So, then that makes me concerned about the red numbers. If we have to keep doing this and hitting them hard, then maybe, is that going to negatively impact what's spawning, what comes back…? And that was the talk, too, a couple of years ago. I remember as we were having to harvest more chum, people were like, 'Well, you guys are going to have to start watching the chum numbers.' Same with whitefish, people were bringing that up. If we're having to harvest more whitefish, we're going to have to start thinking about watching those species. I guess it all has a ripple effect." (Megan Leary, quoted in KRITFC 2021:7).*

Chum salmon are thus of critical importance to Indigenous people and ways of life in the Yukon and Kuskokwim regions of Alaska, where physical, cultural, economic, social, and ecosystem health and well-being are intricately woven together.

Original Submission: Section 4.5: Environmental Factors and Traditional Knowledge Related to Chum Salmon Declines

To be read in partnership with DEIS Section 3.2.3.1.1.1.

4.5.1 Environmental Factors Related to Chum Salmon Declines[3]

While overall salmon abundance is known to be variable, consistent declines have been observed across WIAK including by in-river subsistence fishermen (Brown et al., 2020; KRITFC, 2021; KRITFC, 2023; Mikow et al., 2019).

Figure 3-8 below shows the life history stages of salmon in the various environments encountered throughout their life cycle as well as the life history stage encountered in the marine environment by the pollock fishery as bycatch. The following sections describe the environmental stressors encountered at various salmon life stages as depicted in Figure 1.

[3] KRITFC and TCC restructured and augmented Section 4.5.1 from the April 2024 preliminary DEIS into this Section 4.5.1. Section 4.5.2 is entirely new and original, drafted by KRITFC and TCC for this December 2024 DEIS.

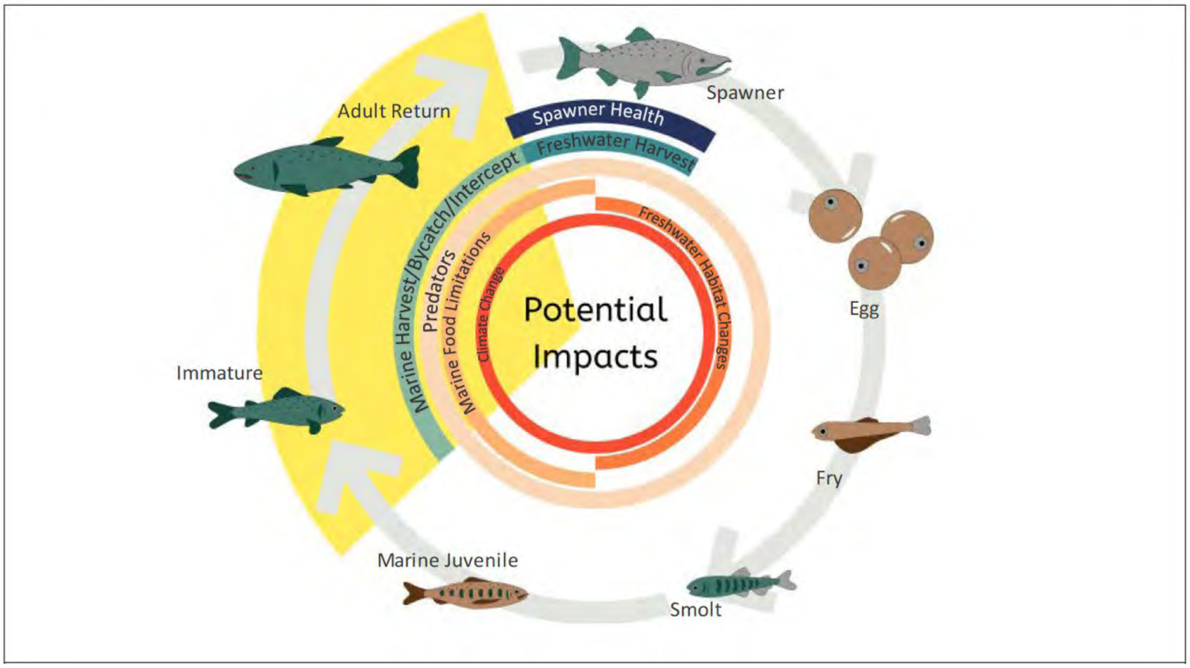

Figure 3-8. Life history cycle of chum salmon (modified from the draft Alaska Salmon Research Taskforce October 2023 report) with yellow shading indicating the ages encountered as bycatch in the pollock fishery.

WIAK chum salmon eggs, fry, and smolt are susceptible to freshwater climate and environmental changes. Changes in stream discharge, oxygen levels, turbidity and flow, and bank erosion can affect survival of eggs and young chum salmon during outmigration (Bash et al., 2001; Beechie et al., 2022; Carey et al., 2021). The timing of ice break-up has been correlated to juvenile salmon outmigration and may result in a mismatch in prey availability during early marine life (Trainor et al., 2019).

Chum salmon originating from WIAK river systems use the Bering Sea as habitat in their first summer before migrating to the Gulf of Alaska for their first winter. The early marine phase is a critical time for juvenile salmon, as they need to grow quickly to escape predation and build energy reserves to survive their first winter at sea (Beamish and Mahnken 2001, Farley 2007). Early marine survival is frequently positively associated with adult returns (Healey, 1982; Kondzela et al., 2016; Murphy et al., 2019; Farley Jr et al., 2020). However, this positive association between early marine survival (as measured by juvenile abundance) and adult returns disappeared for fall chum salmon starting in 2016, which coincided with the start of marine heatwaves in both the Bering Sea and Gulf of Alaska ecosystems.

Marine heatwaves in the Bering Sea and Gulf of Alaska negatively affect chum salmon by increasing metabolic rate while also destabilizing the base of the food web and thus altering chum salmon diets. Juvenile chum salmon energy condition and stomach fullness decreased concomitantly with the start of the marine heatwaves in the Bering Sea, likely due to decreased prey availability, increased metabolisms, and lower quality prey items (e.g., eating more jellyfish as lipid rich prey items are unavailable; Farley et al, 2024, Deeg et al., 2022; Mustonen & Van Dam, 2021; Murphy et al. 2016; Myers et al., 2016; Urawa et al., 2016;). Additionally, WAK chum salmon are negatively affected by increases in pink salmon and Asian-origin hatchery chum salmon both during early marine life and while foraging during summer in the Bering Sea (Minicucci, 2018; Ruggerone & Agler, 2008). This competition for resources in conjunction with warming water temperatures may have increased reliance on low-quality prey items such as gelatinous zooplankton. Prolonged reliance on prey with low nutrient densities can affect growth, susceptibility to disease and pathogens, reproduction, and mortality. In addition, even with a diet high in plasticity, competition for resources can affect growth.

Climate change impacts in the Pacific Ocean thus affect maturing chum salmon. Sea surface temperature is found to be correlated with the average size of chum at maturity, as well as with both early and late marine growth during first and last marine occupancy seasons (Oke et al., (2020). In addition, changes to marine ecosystems, such as variation in temperature regimes and salinity, may result in a decrease in suitable marine environments (i.e. habitat loss) for chum salmon and therefore contribute to population declines (Azumaya et al., 2007; Kaeriyama et al., 2012, 2014; Urawa et al., 2018). WAK chum salmon had high marine mortality in years with unusually cold sea surface temperature (SST); however, growth rates also declined when SST increased by 2ºC above the warmest SST during studies offshore of the Yukon and Kuskokwim rivers during 2002 – 2007 (Farley, 2009). Nonstationarity in SST has been associated with declines in chum salmon productivity in the North Pacific region when comparing pre-and post-1988/89 eras (Litzow et al., 2019). Malick & Cox (2016) found weak evidence of declines in chum salmon stocks in Alaska with relatively stable productivity from 1980-2000, followed by a steep decline from 2000-2007. Though some variability in productivity trends was observed in Alaska chum salmon stocks, but widespread declines were more evident than with pink salmon (Malick & Cox, 2016).

Consistently, WIAK chum salmon caught as bycatch tend to be between ages 3-5 (Berry et al., 2023; Appendix 4). Bycatch and intercept in the South Alaska Peninsula affect WIAK chum salmon at their marine and immature juvenile and adult returner life stages, and the extent to which they are affected is discussed elsewhere in this analysis (Section 4.3.4.2).

Additional factors contributing to declines during the immature juvenile life stage that can be broadly attributed to climate change include changes in predator density, increased pathogen load, and more frequent interactions with hatchery fish across the North Pacific due to increased hatchery releases (Ahmasuk & Trigg, 2007; Atlas et al., 2022; Barbeaux et al., 2020; Braem et al., 2017; Carey et al., 2021; Cheung & Frölicher, 2020; Crozier et al., 2021; Deeg et al., 2022; Fall et al., 2013; Godduhn et al., 2020; Gorgoglione et al., 2020; KRITFC, 2023; Malick & Cox, 2016; Mikow et al., 2019; Moncrieff et al., 2009; Ruggerone et al., 2010; Suryan et al., 2021; Trainor et al., 2019).

WIAK chum salmon again face freshwater climate and environmental changes when they return to river systems as adult spawners. Water above or below the optimal range can alter metabolic needs and spawning success (Carey et al., 2021). Changes in stream discharge and oxygen levels can also negatively affect survival of migrating adults (Carey et al., 2021). A large spawning migration mortality event due to warm stream temperatures, hypoxia, and pathogen infections was documented for summer run chum in the Koyukuk River in 2019, largely affecting pre-spawn migrating fish (Westley 2020). Low water levels, warm temperatures, significant algae blooms, and a large quantity of chum salmon migrating decreased dissolved oxygen in the water, resulting in a significant die-off in the Kobuk River drainage in 2014 (Braem et al., 2018). The presence of parasites, such as *Ichthyophonus*, has been linked to mortality in Yukon River Chinook salmon, and likely has similar effects on chum salmon, especially when environmental conditions favor parasite outbreaks. Warmer waters and changing ecological interactions due to climate change are likely contributing to increased disease prevalence (Zuray et al., 2012).

Many other environmental changes have been observed in WAK, although it is not clear how these broader environmental changes may impact WAK chum salmon abundance. For example, communities across Western and Interior Alaska have experienced warmer winter temperatures, increased precipitation, decreased ice thickness, delayed freeze-up, less predictable break-up timing, thawing permafrost, algae blooms, an increase in beaver dam prevalence, increased Northern pike populations and increased bear populations (Ahmasuk & Trigg, 2007; Braem et al., 2018; Carothers et al., 2019; Carothers et al., 2021; Fall et al., 2013; Godduhn et al., 2020; Mikow et al., 2019; Moncrieff et al., 2009; Mustonen & Van Dam, 2021; Peirce et al., 2013; Raymond-Yakoubian & Raymond-Yakoubian, 2015; Trainor et al., 2019).

4.5.2 Traditional Knowledge of Chum Salmon Declines

The following section was prepared by TCC and KRITFC in their cooperating agency roles. It specifically covers the Yukon and Kuskokwim regions in which TCC and KRITFC respectively have special expertise, though information may also be relevant to other regions of Western and Interior Alaska dependent upon chum salmon and impacted by this action.

TK held by residents of the Yukon and Kuskokwim regions also provides information on factors leading to chum salmon declines.

For instance, Yup'ik TK holders share that traditional foods are sentient and respond to the behaviors and needs of people. When an animal or plant appears to a person, it is willingly offering itself to be taken and used for food, medicine, clothing, or other materials. To not take the being when it appears offends it, and it might not return to that person or place again because it feels is no longer needed. In the words of Kuskokwim Elders:

> *"You know in the old days, the uses [of chum salmon] were multifold. We ate them and our dogs ate them. In the old days, they were used a lot. And I still think of what the old people say: you use them, they will come back in numbers. It's just like I see the muskrats now. We quit hunting them and they're disappearing." – Robert Lekander, July 2023, KRITFC archives*

Contemporary subsistence salmon fishery management restrictions, effected with the intent of conserving salmon spawners, dictate when, where, and how people can fish. These contradict Indigenous stewardship principles in which, with guidance from Elders, people take only what was needed at the time it was meant to be taken and without wasting it. To not be able to take salmon when salmon are in the river—when it is time to take salmon—not only threatens food and cultural security but also offends the salmon so that they may not return. Thus contemporary conservation-based management restrictions, though intended to allow spawners to pass through, conflict with traditional stewardship practices (Voinot-Baron 2019).

TK says salmon, once harvested, must be attentively monitored while drying and smoking to ensure it dries properly without flies/maggots or rot. Workspaces for processing fish must be cleaned so as to respect fish to come, and bones and scraps are to be properly disposed of; in Yup'ik communities of the lower Kuskokwim, traditional disposal is burial in the ground (Fienup-Riordan et al. 2020). The failure to adhere to these practices of care, and instead to disrespect and waste salmon, contributes to salmon declines. As noted in Fienup-Riordan et al. 2020:

> *Such careless treatment [of bones, scraps, and food], many believe, will cause the animals and plants to dwindle. Annie [Nelson] (March 2017:66) concluded: 'Because food is stepped on, some fish are declining in numbers…'" (Fienup-Riordan et al. 2020:78).*

TK holders additionally hold that salmon bycatch, as a form of wasteful and careless treatment of salmon—as a spiritual and physical offense to these fish—contributes to chum salmon declines. Similarly, TK holders from the Kuskokwim have expressed that catch-and-release sport fishing also disrespects salmon by playing with food, thus contributing to salmon declines.

Declines in salmon and criminalization of fishers have disrupted the spiritual relationship of salmon and people (Stevens and Black 2019), as well as the Elder-youth interactions that often occurred at fish camp (see Section 4.4.3.2). The dissolution of these relationships has also contributed to salmon declines: "The root cause of the decline of fish is that young people are no longer instructed… Along with lack of instruction, the decline of fish is believed to be a product of discord and lack of consensus among people" (Fienup-Riordan 2020:109).

Furthermore, though the Indigenous people of the Yukon and Kuskokwim regions have been stewards of these fisheries for thousands of years, they have been largely excluded from state and federal fishery management decision-making and policy-setting. Contrary to traditional fishery stewardship—which is guided by Elders' TK, and centered around the values of sharing, avoiding waste, taking only what is needed in the season it appears, and carefully attending to fish from gravel to table—state and federal fishery management aims toward principles like Maximum Sustainable Yield, with the intent to maximize harvest to maximize profit. After over 11,000 years of careful traditional stewardship of chum salmon that kept stock abundance and harvests in balance, chum salmon populations have declined to a historic low under Western fishery management regimes developed without the influence and inclusion of TK and in operation for fewer than 150 years (Carothers et al. 2021).

TK from the Kuskokwim region holds that in additional to the environmental factors described in Section 3.2.3.1.1, these anthropogenic factors accumulate over time such that effects of an action (or inaction) that took place in previous decades may manifest only now. For instance, many TK holders understand that non-Indigenous agencies justified the removal of too many chum salmon in in-river commercial fisheries with mathematical models based on Western principles that prioritize harvest for profit. Over time, this mismanagement has contributed to chum salmon declines. Yukon and Kuskokwim TK holders understand a similar situation has unfolded in the Bering Sea trawl fisheries and South Alaska Peninsula (Area M) fisheries over recent decades (KRITFC 2021). The systematic exclusion of TK and traditional stewardship/values from salmon management, coupled with inattention to conservation-based stewardship during states of decline, has contributed to the depleted populations seen today.

Original Submission: Section 6.1.1.1: Ecosystem and Community Impacts Under Recent Declines

To be read in partnership with DEIS Sections 4.4.1.1 and 4.4.5.3.2

This section was co-written by cooperating agencies KRITFC and TCC. The areas where the co-authors refer specifically to the Yukon and Kuskokwim regions, in which their special expertise lies, may be applicable to the WAK region as a whole.

While the analysts cannot calculate a concrete AEQ analysis or impact rate for WIAK chum salmon, nor are the genetic groupings refined enough to provide these region-by-region were they available, we can infer probably impacts to Yukon and Kuskokwim communities and ecosystems should the Council opt for Alternative 1. Additionally, it should be noted that AEQ analyses and impact rates are mathematical models that reduce the value of a single fish for population viability and community well-being. It is also possible to estimate the number of WAK chum salmon annually removed through bycatch (see Table 3-12), and it is reasonable to assume some number of these would have returned to WAK as adult spawners, potentially supporting stock abundance.

The return of a single chum salmon can support the viability of discrete spawning populations: tributary stocks with significant spatial separation such that they may be genetically distinct. Yukon and Kuskokwim salmon populations vary in their productivity, carrying capacity, and life history characteristics. This variation contributes to their sustainability as a result of portfolio effects, and it is especially important for climate resilience of chum salmon stocks. Sustained levels of chum salmon removals (including through bycatch and intercept) likely have greater negative impacts to viability of discrete spawning populations at times of low abundance (e.g., in 2020–2023) compared to periods of high abundance. In other words, as chum salmon decline, every salmon that returns becomes biologically more important for the sustainability of its discreet spawning population as well as overall stock abundance.

Figure 1 illustrates this point through three scenarios of varying (e.g., low, medium, high) chum salmon removals. It is crucial to keep in mind the potential impacts to discrete spawning populations under Alternative 1 and status quo removals when considering this alternative.

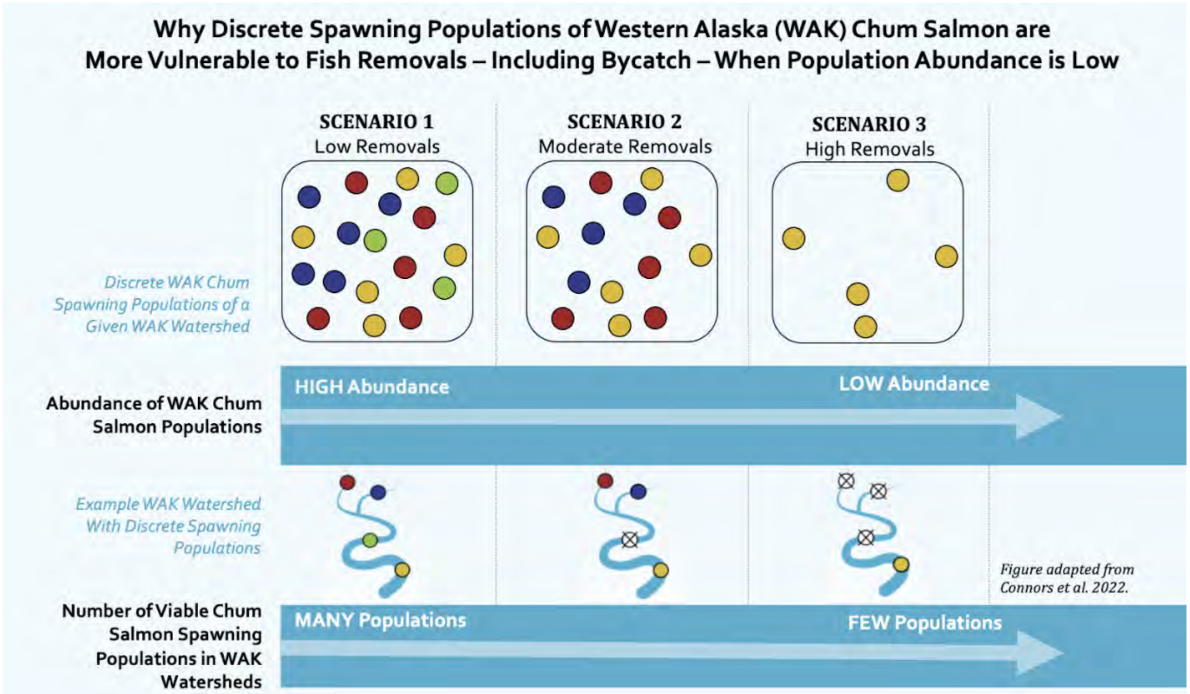

Figure 1. Schematic showing why discrete spawning populations of WAK chum salmon are more vulnerable to overharvest when populations are low, as adapted from Connors et al. 2022. Different color circles represent discrete spawning populations within chum salmon stocks of a WAK river. Moving from left to right: (1) When fish removals (e.g., from fisheries, predation, bycatch, etc.) are low, abundance of all populations is likely to remain high. The impact on genetic diversity within the watershed is low, and genetic diversity of discreet spawning populations remains high. (2) When fish removals are moderate, abundance of a population(s) may decrease, and the risk for losing genetic diversity of a discreet spawning population(s) increases moderately. (3) When fish removals are high, abundance of most populations may decrease, and the risk for losing genetic diversity of most discrete spawning populations may increase significantly.

Under status quo conditions, it is likely that Yukon and Kuskokwim region chum salmon abundance will remain low as in years since 2020. While chum salmon returns are cyclical, cumulative impacts of new climate regimes and chum salmon depletions over time have a strong potential to maintain low chum salmon abundance compared to historical levels. TK holders have also noted that chum salmon abundance cycles are decreasing in span; whereas a significant collapse in chum salmon abundance used to occur every 30 years, it now occurs every 20 years (E. Burk, personal communication, September 23, 2024).

Sustained low chum salmon abundance on the Yukon River, Kuskokwim River, and their tributaries represents a biodiversity crisis with profound ecological, cultural, and socio-economic consequences. The loss of salmon not only threatens the species itself but also impacts the entire river ecosystem, the genetic diversity within salmon populations, and the food security of Indigenous communities. Within the Yukon-Kuskokwim region, low chum salmon returns will likely lead to low subsistence harvests with resounding implications for Alaska Native and rural communities' ways of life and well-being in the region (see Section 4.3.3.2). Additionally, status quo conditions would allow chum salmon removals at or near their current levels, giving stocks minimal opportunity to recover from current record-low abundance.

Chum salmon declines have imbalanced regional freshwater ecosystems and caused people (and non-human harvesters, such as bears) to seek other sources of nutrition to fill gaps in food security (see section 4.3.3.2.3). With the potential for continued low chum salmon abundance under status quo operations, increased harvest of non-chum salmon species—both by human and non-human harvesters—is likely to continue, with compounding effects felt throughout WIAK freshwater ecosystems.

For Indigenous communities, the loss of chum salmon threatens food sovereignty—the ability to access traditional, culturally significant foods in a sustainable and self-determined way. Continued declines in chum salmon abundance reduces the availability of a key food source, forcing communities to turn to less culturally significant and less nutritious store-bought foods, which are often more expensive and less accessible in remote areas. This trend not only threatens the physical health of these communities but also erodes their cultural connections to the land and water, where salmon fishing has long been a central practice.

Indigenous food security, particularly for salmon species, is tightly linked to biodiversity. A decline in species diversity, including chum salmon, reduces the stability and temporal access to harvest cycles. Communities with access to a wider diversity of species (and populations within species) tend to experience more stable catches and longer seasons, making biodiversity conservation critical for food security (Nesbitt & Moore 2016). Because ecosystems and subsistence Indigenous communities are innately interconnected, ecosystem impacts filter to community level, affecting their health and well-being:

> *"It is key to understand that the health and well-being of our Alaska Native communities on the Kuskokwim is intrinsically linked to the health of our salmon, ecosystems, and economies. When our salmon are healthy, our people, our land, our river, and our non-human relatives are healthy. These health benefits mutually reinforce one another; they are interconnected." (Samuelson 2023:2)*

Conversely, when salmon are unhealthy—in low abundance, riddled with diseases, subject to harvest restrictions—so too are Yukon and Kuskokwim region Indigenous communities and the wider ecosystem upon which these communities depend. With the potential for continued low chum salmon abundance under status quo operations, this reciprocal ecosystem-community well-being will likely continue to be disrupted.

It is also plausible that status quo operations will impact marine food webs by driving low chum salmon abundance, reducing chum salmon genetic diversity, or altering habitat. A reduction in WAK chum salmon abundance in the North Pacific would likely affect chum salmon-reliant predators such as killer whales, Stellar sea lions (including populations in the Gulf of Alaska), and Northern fur seals, some of whose populations are depleted. Additionally, the no action alternative will maintain current trawl operations, with continued impacts to seafloor habitat and bottom-up drivers of trophic ecology.

Original Submission: Section 6.1.2.1: Benefits of this Proposed Action to Yukon and Kuskokwim Indigenous Ways of Life

To be read in partnership with DEIS Section 4.4.5.5.3.

This section was co-written by cooperating agencies KRITFC and TCC. The areas where the co-authors refer specifically to the Yukon and Kuskokwim regions, in which their special expertise lies, may be applicable to the WAK region as a whole.

A meaningful reduction in chum salmon bycatch through one or more of the action alternatives could lead to an increase in WAK chum salmon abundance. Over time, this would allow for increased harvest opportunities, a higher likelihood of attaining harvest goals, and a restoration of the human-salmon-ecosystem relationships on the Yukon and Kuskokwim rivers (see Section 4.3.3.2), as well as elsewhere in the WAK region.

It is difficult to overemphasize the potential benefit that even a single chum salmon returning to river systems offers Yukon and Kuskokwim communities and ecosystems. Female chum salmon typically lay 2,400 to 3,100 eggs, with some carrying as many as 4,000 eggs (Buklis 2024). One successful spawning event may procreate thousands of future spawners, thus contributing to the rebuilding and sustainability of these stocks, including discrete spawning populations (see section 4.4.5.3.3 and Appendix 7, Section 5.A.). These effects in turn contribute to the viability of future chum salmon fisheries, as well as to the integrity of Yukon and Kuskokwim Indigenous communities and ecosystems as a whole. Each individual chum salmon spawner is particularly vital given current population declines and climate conditions; each salmon that returns and successfully spawns not only helps rebuild populations but also imbues climate resilience into the genetics of future chum salmon.

Indigenous communities in the Yukon and Kuskokwim regions would be positively affected in a profound way should chum salmon abundance recover to historical or near historical levels. Abundant chum salmon populations would increase both the opportunities for harvest and the amount of chum salmon harvested, restoring communities' unique relationships with salmon and their holistic well-being that is so dependent upon salmon and salmon fishing (see section 4.3.3.2). Though other factors affect traditional ways of life in the region (e.g. increased use of technology, climate change, legacies of colonization) and contemporary subsistence communities will always represent a synthesis between traditional and modern ways of life, subsistence fishing restrictions have inarguably affected Indigenous people's ability to embrace and share traditional practices. Increased abundance leading to increased harvest opportunities would provide the option for younger generations to learn these practices and would encourage families to continue fish camps that foster important intergenerational exchanges and learning.

In addition, subsistence harvest of salmon is vital to health in the region—from nutritional value to the exercise fishing and processing provides to the mental and spiritual well-being engendered by learning these traditional practices from Elders in the community (KRITFC 2024; see also section 4.3.3.2). Chum salmon also support regional ecosystem health and provide for resilient populations of other traditional foods, directly linking salmon abundance with ecosystem health and community well-being (see section 4.4.5.3.2). Therefore, an action alternative that meaningfully reduces chum salmon bycatch would engender a variety of substantive benefits for Salmon People and ecosystems.

Appendix 10 Magnuson-Stevens Act and FMP Considerations

Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). In recommending a preferred alternative at final action, the Council must consider how to balance the national standards.

A brief discussion of this action with respect to each National Standard will be prepare for final action.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be; (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirements of National Standard 2, in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

National Standard 9 — Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP or FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (a) participants in the fisheries and fishing communities affected by the plan amendment; (b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and (c) the safety of human life at sea,

Council's Ecosystem Vision Statement

In February 2014, the Council adopted, as Council policy, the following:

Ecosystem Approach for the North Pacific Fishery Management Council

> ***Value Statement***
>
> The Gulf of Alaska, Bering Sea, and Aleutian Islands are some of the most biologically productive and unique marine ecosystems in the world, supporting globally significant populations of marine mammals, seabirds, fish, and shellfish. This region produces over half the nation's seafood and supports robust fishing communities, recreational fisheries, and a subsistence way of life. The Arctic ecosystem is a dynamic environment that is experiencing an unprecedented rate of loss of sea ice and other effects of climate change, resulting in elevated levels of risk and uncertainty. The North Pacific Fishery Management Council has an important stewardship responsibility for these resources, their productivity, and their sustainability for future generations.
>
> ***Vision Statement***
>
> The Council envisions sustainable fisheries that provide benefits for harvesters, processors, recreational and subsistence users, and fishing communities, which (1) are maintained by healthy, productive, biodiverse, resilient marine ecosystems that support a range of services; (2) support robust populations of marine species at all trophic levels, including marine mammals and seabirds; and (3) are managed using a precautionary, transparent, and inclusive process that allows for analyses of tradeoffs, accounts for changing conditions, and mitigates threats.
>
> ***Implementation Strategy***
>
> The Council intends that fishery management explicitly take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, fluctuations in productivity for managed species and associated ecosystem components, such as habitats and non-managed species, and relationships between marine species. Implementation will be responsive to changes in the ecosystem and our understanding of those dynamics, incorporate the best available science (including local and traditional knowledge), and engage scientists, managers, and the public.
>
> The vision statement shall be given effect through all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management.

In considering this action, the Council is being consistent with its ecosystem approach policy. At final action, the analysts will provide rationale on how the proposed action is aligned with the Council's Ecosystem Vision Statement