BERING SEA FISHERMEN'S ASSOCIATION

Serving western Alaska small boat fisheries since 1980

Statement of

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before the

Committee on Commerce, Science, and Transportation
United States Senate

hearing on

The State of Our Salmon: A Review of the Science and Data Informing the Management of Alaska's Salmon Fisheries

October 20, 2018

Thank you, Chairman Thune, Senator Sullivan, and Members of the Committee, for organizing today's field hearing. My name is Karen Gillis. I am the Executive Director of Bering Sea Fishermen's Association (BSFA). I am honored to be here today to extend your awareness of the health of Alaska's salmon fisheries and share our opinions on the capability, or lack thereof, as it pertains to the current data and information necessary for maintaining healthy and sustainable salmon stocks in Alaska.

Ultimately, I recommend establishing a funding mechanism for the Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative which provides a Native, state and federal science-based partnership undertaking collaborative salmon research informing the rebuilding and management of declined western Alaskan salmon stocks. Our collaborative partnership has an extensive track record of applied research and restoration activities as presented herein.

NOT A TRADITIONAL FISHERMEN'S ASSOCIATION

Bering Sea Fishermen's Association was formed in 1979 with 150 fishermen from over 30 villages in western Alaska ranging from Bristol Bay to Kotzebue Sound. These fishermen united to become more involved in new fisheries that were developing directly off their coastline, and to build an organization that was concerned with helping local fishermen gain full economic benefits from Alaska's fisheries.

Commercial companies often fished in Alaska waters with short-sighted aggressiveness. As early as 1899, Alaska Natives appealed to the government to protect the salmon for those who relied on it for food.

For decades, foreign fleets scooped up fish and sailed away, while Alaska's own fishermen had no way to access these fisheries due to the lack of adequate venture capital, infrastructure, and local

expertise. BSFA initially set about assessing the viability of developing herring fisheries compatible with the rural Alaskan lifestyle.

We've grown and adapted as necessary in response to the fishery issues of most pressing need, focused on healthy and vibrant fishing communities, we foster greater capacity to access and develop fisheries in the Arctic, Yukon, Kuskokwim, and Bristol Bay (BBAYK) regions of Alaska. Within this area there are 128 communities and just over 120,000 residents.

We are committed to the sustainable management of Alaska's resources and serve as stewards of the extraordinary lifestyle and culture of Alaskans. We serve to **strengthen local communities, improve equitable access to fishery resources, support long-term ecological integrity, and stimulate robust economies.**

BSFA enjoys a long list of successes. We've played a significant role in the development of western Alaskan herring and halibut fisheries, succeeded to establish the Chinook salmon savings areas and other salmon bycatch reduction measures in the Bering Sea, constructed community fish plants and cold storage facilities, worked to eliminate high-seas driftnet interception, and foreign high-seas piracy activity in cooperation with the U.S. Coast Guard. We were the force behind the design and implementation of the Community Development Quota (CDQ) Program with Harold Sparck that launched the six CDQ corporations. We've guided and funded salmon research and monitoring efforts in the BBAYK as well as being an incubator for various fisheries research and coordinating programs and nonprofits some of which include:

- Yukon River Drainage Fisheries Association
  An association of subsistence and commercial fishers with a mission of protecting and promoting all wild fisheries and traditional cultures within the Yukon River drainage.

- Norton Sound Salmon Research and Restoration Program
  A forum to engage in a collaborative, regional and interagency-based approach to developing and implementing a comprehensive and strategic Norton Sound Salmon Research and Restoration Plan.

- Bristol Bay Buy-back Coalition
  A coalition of tribes, regional Alaska organizations and fishing companies formed and succeeded to influence the federal government to buy back $95M in oil and gas leases sold in October 1988 to offshore oil and gas companies interested in exploring in the North Aleutian Basin Planning Area encompassing Bristol Bay and the southeast Bering Sea.

- Arctic-Yukon-Kuskokwim Tribal Consortium
  Based on a Memorandum of Understanding, the AYKTC consists of the Association of Village Council Presidents, Tanana Chiefs Conference, and Kawerak, Inc. The Consortium utilizes BSFA to manage the Arctic-Yukon-Kuskokwim Tribal Research & Restoration Program to administer Pacific Coastal Salmon Recovery Funds to address a set of critical uncertainties and key factors limiting the productivity of Chinook salmon in the AYK region.

- Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative
  A science-based program working cooperatively to identify and address the critical salmon research needs facing the AYK region. The AYK SSI is the largest example of co-management of research funding within the Pacific Rim and one of the largest experiments in the co-management of fisheries and wildlife research in North America.

Most recently we've launched the Alaska Ocean Cluster Initiative to grow Alaska's vibrant, diversified, and resilient blue economy by encouraging and advancing innovators and entrepreneurs to create sustainable products and services from our vast and renewable ocean resources.

BSFA is a bridging organization, an entity which connects diverse groups for collaboration and learning. Our success lies in our ability to be nimble and willing to take on difficult issues quickly with efficient outcomes; both financially and timely. We build trust and achieve conflict resolution and we value supporting local organizations, creating linkages, increasing local influence on policy, and disseminating new visions and organizational innovations. Bridging organizations are central players in an emerging "multisectoral" development paradigm that is less subject to the flaws of the still-dominant market-led and state-led paradigms. Evidence from different natural resource management settings shows that bridging organizations can add value to governing processes by reducing the transaction costs of management.

BSFA acts as a platform for communication among residents and the wide-range of agencies that oversee and manage fisheries in western Alaska. More importantly, BSFA supports the capacity of residents to actively engage in the management and development of their own fisheries. BSFA does not "represent" the interests of our communities, we "serve" their interests by engaging and supporting residents to bring the ideas and needs of western Alaska to state, federal and international forums.

BSFA & FRESHWATER SALMON MONITORING

Among all the animals that serve as a source of food for humans, salmon are iconic. Their wide-ranging habit of migrating from freshwater to the ocean and back are indicators of ecological health. They play invaluable ecological, social, and cultural roles in Alaska and around the globe.

Salmon are highly valued culturally simply for their existence, socially as a source of food, and economically as a source of wealth through fisheries and tourism.

The well-being of humans and salmon are intimately linked in coastal communities. Indigenous peoples, resource managers, fishers, processors, businesses, and governments have demonstrated a need to understand what drives the variation we see in salmon abundance now and into a future with climate change.

Salmon abundance fluctuates on intra-annual to decadal scales and the causes of this variation have not yet found convincing explanations in any ocean.

In the summer of 1993, western Alaska experienced a failure in the chum salmon run on a scale never before seen. While some chum returns— particularly northern Norton Sound—had already been depressed, the region-wide poor returns led to sweeping subsistence and commercial fishery

restrictions, closures, and lack of adequate spawning escapements to most river systems throughout the AYK region of Alaska. One aspect that became apparent in the face of these disastrous returns was a need to increase monitoring of the salmon returns to improve fishery management. This may not be as important when runs are healthy, but when poor runs dominate, fishery managers must exercise even greater caution when faced with inadequate information.

Beginning in 1994, BSFA received funds from the Department of Interior for research and monitoring of salmon returns in the AYK region. After working with fishery managers to create cooperative efforts between state, federal, and local entities, BSFA passed-through over 80% of this funding to rural communities and regional Native organizations and created the most extensive collection of cooperative monitoring projects ever seen in Alaska. Western Alaskan residents were, for the first time, directly involved in gathering information to better understand and help manage their fisheries, and the fishery managers now had a greatly expanded set of information upon which to base management decisions.

Federal appropriations for this program continued through 2006 but ended abruptly. Without this information the data available to inform fishery managers has become increasingly limited, continued state budget cuts led to unprecedented levels of uncertainty in day-to-day decisions.

BSFA & MARINE RESEARCH

BSFA has been a long-time supporter of understanding the variability of marine ecology of Pacific salmon as it relates to their sustainability. We have fostered, funded and partnered with state, federal and regional organizations to investigate the ecological mechanisms regulating marine distribution and production of salmon populations, climate change impacts, retrospective analysis of key populations as indicators of conditions in North Pacific marine ecosystems, and implications of stock identification and model development for salmon management. Our Western Alaska Marine Salmon Studies (WAMSS) program maintains a strong relationship with the NOAA Fisheries, University of Alaska Fairbanks College of Fisheries and Ocean Sciences and the North Pacific Anadromous Fish Commission (NPAFC) to improve the understanding of the marine-life history state of salmon in the Bering Sea.

While WAMSS is suspended due to a lack of funding, international efforts to reengage in high-seas research is underway. On October 11, 2018 the NPFAC announced the International Year of the Salmon, a five-year initiative which includes a high-seas expedition to the central Gulf of Alaska.

Given the pace of change and the degree of uncertainty we need to effectively use the capacity of these multi-agency efforts to be efficient in our sharing of what we know, conducting research to address known gaps in our understanding, and to stand ready to effectively address surprises when they emerge.

Despite the investments, our ability to understand the relationship of salmon to our actions and the changing environment remains a challenge. Fishery managers continue to pursue a balance between commercial and subsistence fishing objectives while remaining mindful of Alaska's treaty obligations to Canada. Advocating for sustainable fisheries management practices and stewardship of Alaska's resources means BSFA will never tire of tracking decisions and activities that might threaten Alaska's fisheries, the resources upon which we depend, and the people who make up the history of this great land.

COMMUNITY-BASED SALMON HARVEST MONITORING on the Kuskokwim River

Data to inform Kuskokwim River salmon fishery management is very limited. Because subsistence harvests are not assessed until after the season, information on run timing, strength, and composition from the upper three quarters of the drainage is extremely limited to inform in-season management decisions. At the same time, communities have shown strong interest in participating in a community-based salmon monitoring program.

As a result of the 2012 Federal Fisheries Disaster Declaration and at the request of the Association of Village Council Presidents, BSFA developed a work-plan for an integrated set of community-based monitoring projects to address three objectives:

1. Inform an operative in-season fisheries management model with relevant additional data from across the watershed.
2. Build fisheries research capacity in community level organizations in the watershed.
3. Improve data transparency and ownership in the management decision process.

The Community-Based Salmon Harvest Monitoring program is designed to support the management of salmon throughout the watershed. This project involves harvest monitors in participating villages being selected, trained and mentored to collect data for in-season assessment, and to provide public outreach regarding the goals of management and assessment.

Data or sample collection varied by river location and management data needs but includes:

- Near real-time harvest reporting
- Drift gillnet catch per unit effort (CPUE) of Chinook salmon and other species to index run timing and strength
- Age, sex and length (ASL) data necessary to assess escapement quality
- Catch ratio of chum and sockeye to Chinook salmon
- Temperature monitoring in selected tributaries to assess thermal stress on Chinook salmon and other salmon species
- Other information that informs management of the fisheries

This data collection program bolsters engagement with fisheries management as well as builds fisheries research capacity within local institutions.

A central goal of the project is to provide fisheries research expertise to work with regional partner organizations to:

- Build capacity and train community-based monitors and harvest reporters.
- Assist with project design, start-up and implementation.
- Assist with data collection, reporting and in-season trouble shooting.
- Assist with communicating fisheries management decisions to community partners.

The project partners with a set of regional organizations across the watershed such as the Kuskokwim River Inter-Tribal Fish Commission, U.S. Fish & Wildlife Service (USFWS), Alaska Department of Fish & Game (ADFG), the Association of Village Council Presidents and other partner organizations.

In addition, several subprojects were funded as collaborative efforts to facilitate existing data collection efforts and fill data gaps, particularly in light of declining agency budgets and the need to provide data to support conservative fisheries management as Kuskokwim River Chinook salmon stocks recover.

All projects maximized the hire and training of local residents in the data collection and reporting process, with a goal of maximizing community fisheries capacity-building throughout the projects.

VOICES FROM THE REGION

Several years ago, a lengthy effort was undertaken to assess regional perceptions and observations, on the Yukon River, recording respondent's ideas for how to best manage salmon in difficult times (*Brown, C.L. and A. Godduhn, editors. 2015. Socioeconomic effects of declining salmon runs on the Yukon River. Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 398, Fairbanks.*).

The following bullets are derived from this research and are sentiments I've heard in all regions of Alaska:

- Eliminate Non-Essential Use [a reference to bycatch in the commercial pollock fishery in the Bering Sea]
- Eliminate All Use [a preferred alternative to risking the permanent loss of Chinook salmon from the Yukon River]
- Increase an Ecological Approach to Salmon Research Management [a call for a more holistic approach to research and management that includes all stages of salmon life cycles and all habitats occupied during those various life stages]
- Continue Public Outreach Programs and the Development of Communication Networks [an appreciation of collaboration to improve mutual knowledge by both explaining scientific methods and findings, and by listening to local concerns and observations]
- Make Subsistence Fishing More Efficient [short subsistence windows are inefficient]
- Continue to Improve Research Methods for Accurate Run Enumeration and Assessments [concerns regarding the accuracy of sonar-based assessments of salmon run strength and timing]
- Protect Subsistence Practices of Sharing, Barter, and Customary Trade [researchers, managers, policy-makers, and the public need to recognize customary trade as a complicated continuum of exchange practices and attend to this complication in policy development]
- Continue to Research the Effects of Gear [mixed comments but general concerns about what the most effective gear is for reducing effects on genetic composition and drop-out rates]
- Economic Mitigation of Salmon Disaster Effects [options and ideas were proposed to mitigate the economic effects of the Chinook salmon disaster]

The take-away from this research is that residents are willing to examine every possible avenue for addressing the declines of salmon, up to and including restricting themselves to protect our salmon resources; this has literally been put into practice in some areas when fishery managers announced fishing openers and residents stood down in protest because they knew there weren't enough fish in the river (Unalakleet River, 2000).

It would be naïve to pretend that illegal fishing doesn't happen in the BBAYK. It happens and may continue to happen while anger and resentment exists as they do. It is a reaction from individuals

seeing their way of life disregarded, their voices not heard, and questions not answered. It is a sign of desperation, deep suspicion, and insecurity. When people experience scarcity and are being managed by government, they, out of frustration, are sometimes inclined to do things that are often not in the long-term interest of sustaining resources.

STOCK STATUS & THREATS TO SUSTAINABILTY OF WESTERN ALASKA STOCKS

High subsistence dependence on salmon by Alaska Native Tribes combined with low incomes.
In the AYK Region, there are over 30,000 Alaska Natives from Athabascan, Inupiat, and Yup'ik cultural groups occupying 90 villages and three regional centers (Bethel, Fairbanks and Nome). The health and well-being of this region depends intensely on the annual harvests of wild salmon.

In virtually all of these communities, salmon constitute the largest category of wild foods harvest, providing about 167 lbs. of salmon per person annually in rural Alaska (*Fall, J.A. 2014. Subsistence in Alaska: a year 2012 update. Alaska Department of Fish and Game Division of Subsistence: Anchorage.* http://www.adfg.alaska.gov/static/home/subsistence/pdfs/subsistence_update_2012.pdf). Due to many cultural, nutritional, and logistical factors (such as favorable drying conditions during early summer), Chinook salmon remain the most important salmon species to many communities in the AYK watersheds.

The continued steep decline of AYK region Chinook salmon stocks has resulted in a failure to meet core subsistence needs, and in some years, a failure to meet both key escapement goals as and subsistence needs.
Chinook salmon stocks necessary for native subsistence fisheries have steeply declined, resulting in significantly reduced, or in some years, no subsistence harvests. Disastrous declines in Chinook salmon returns to western Alaska rivers within the AYK region beginning in the early 2000s resulted in the closure of commercial harvest of Chinook salmon for over a decade, numerous restrictions to subsistence fisheries, and a series of state and federal disaster declarations. AYK Chinook salmon populations are suffering a multi-year period of very low productivity and abundance.

Table 1. List of precipitous salmon population declines that have spurred multiple federal disaster declarations and the designations by State of Alaska as stocks of concern. A "Stock of Concern" designation under the State of Alaska's "Policy for the Management of Sustainable Salmon Fisheries," by the Alaska Board of Fisheries is a very important gauge of the conservation risks facing these populations.

Watershed	Year	Declaration Source	Declaration Type
Kuskokwim Region	1997	Federal	Commercial Fishery Failure
Kuskokwim River Watershed	1997	State of Alaska	Economic Fish Disaster
Yukon River Watershed	1997	State of Alaska	Economic Fish Disaster
Kuskokwim River Watershed	1998	State of Alaska	Economic Fish Disaster
Yukon River Watershed	1998	State of Alaska	Economic Fish Disaster
Yukon, Kuskokwim & Norton Sound	2000	Federal	Fisheries Disaster
Kuskokwim River Watershed	2000	State of Alaska	Economic Fish Disaster
Yukon River Watershed	2000	State of Alaska	Economic Fish Disaster
Norton Sound Watershed	2000	State of Alaska	Economic Fish Disaster
Kuskokwim River Watershed	2001	State of Alaska	Economic Fish Disaster
Yukon River Watershed	2001	State of Alaska	Economic Fish Disaster
Norton Sound Watershed	2001	State of Alaska	Economic Fish Disaster
Kuskokwim River Watershed	2002	State of Alaska	Economic Fish Disaster
Yukon River Watershed	2002	State of Alaska	Economic Fish Disaster
Norton Sound Watershed	2002	State of Alaska	Economic Fish Disaster
Yukon River Watershed	2008	Federal	Commercial Fishery Failure
Yukon River Watershed	2009	Federal	Commercial Fishery Failure
Yukon River Watershed	2010	Federal	Commercial Fishery Failure
Kuskokwim Region	2011	Federal	Commercial Fishery Failure
Yukon River Watershed	2011	Federal	Commercial Fishery Failure
Kuskokwim Region	2012	Federal	Commercial Fishery Failure
Yukon River Watershed	2012	Federal	Commercial Fishery Failure

As I discuss below there are multiple dimensions of the Chinook salmon decline. Specifically, the decline in the total number of returning adult salmon is exacerbated by two additional factors:

1) declining escapement quality, especially the shrinking size of female spawning salmon which results in fewer potential eggs in the gravel; and

2) smaller, currently less productive stocks in this period of decline are more vulnerable (Figure 1).

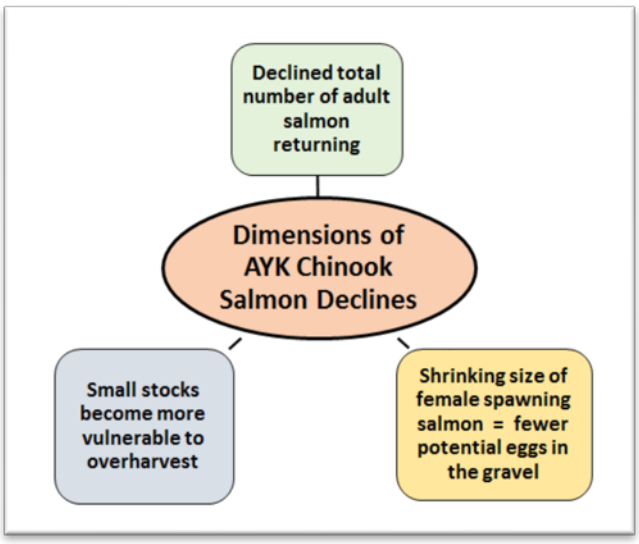


Figure 1: Multiple dimensions of the AYK Region Chinook Salmon declines

Yukon River Chinook Salmon Declines

During 1961 to 1997, the Yukon River Chinook salmon populations sustained an average combined subsistence and commercial harvest level of approximately 155,000 fish per year (Figure 2). The Alaska Board of Fisheries established in regulation the "amounts reasonably necessary for subsistence" (ANS) for Yukon River Chinook salmon as the range of 45,500-66,704 fish. Due to the recent declines and management actions striving to meet critical escapement needs, the ANS has not been met since 2010. The 2014 subsistence harvests of Chinook salmon were drastically curtailed to meet escapement goals, and rebuild the stocks, resulting in the lowest subsistence harvest on record.

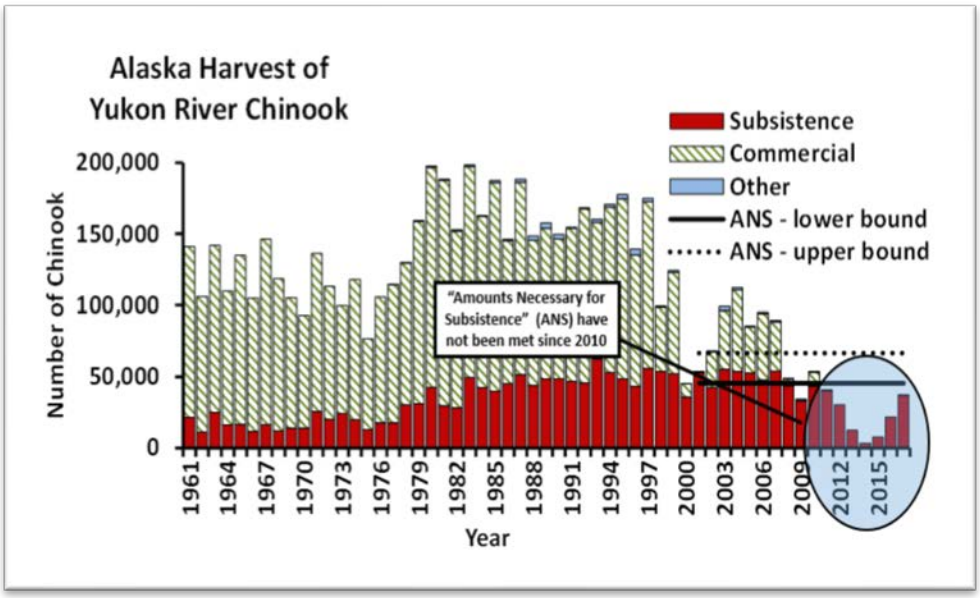


Figure 2. Alaska harvest of Chinook salmon, Yukon River, 1961–2017.
Source: Yukon River Joint Technical Committee 2017.

Kuskokwim River Chinook Salmon Declines

From 1985 to 2010, the Kuskokwim River supported the largest subsistence fishery for Chinook salmon in the world. Due to the recent declines, subsistence harvests have fallen well below the amount reasonably necessary for subsistence for each of the last eight years (Figure 3). The 2014 Chinook salmon subsistence harvest of 11,000 fish was the lowest on record and 56,000 short of the minimum of what is necessary for subsistence. Estimated Chinook salmon harvests in 2018, will be less than 45% of the minimum amount necessary for subsistence in the Kuskokwim River Watershed.

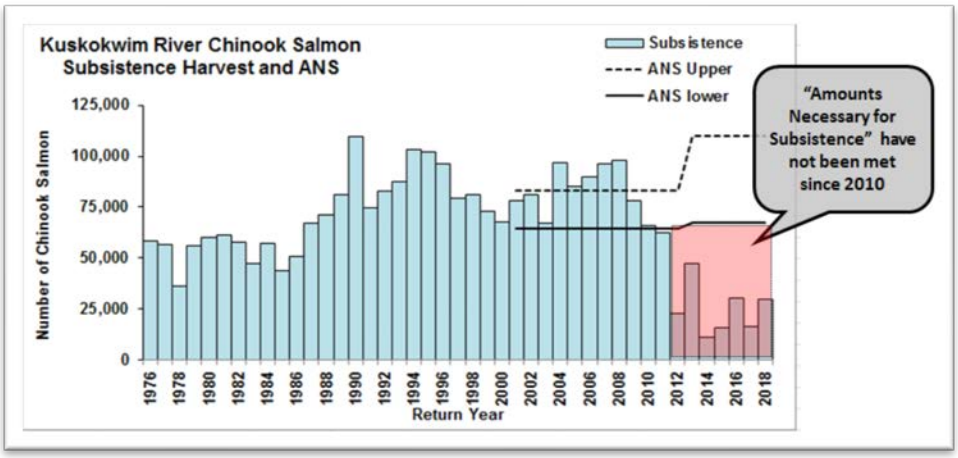


Figure 3. Kuskokwim River Chinook salmon subsistence harvests 1976-2018.*Source:* ADFG, Kuskokwim Region Data.

Norton Sound Chinook Salmon Declines

In the southern Norton Sound region, Chinook salmon subsistence harvests have decreased by more than 60% for the two watersheds which support important native subsistence fisheries, the Shaktoolik and Unalakleet rivers. Figure 4 presents the combined harvests from these watersheds, showing the steep decline and elimination of commercial harvests (1993-2000), followed by the steep sustained decline in subsistence harvests (2002-2011). This trend continues to the present.

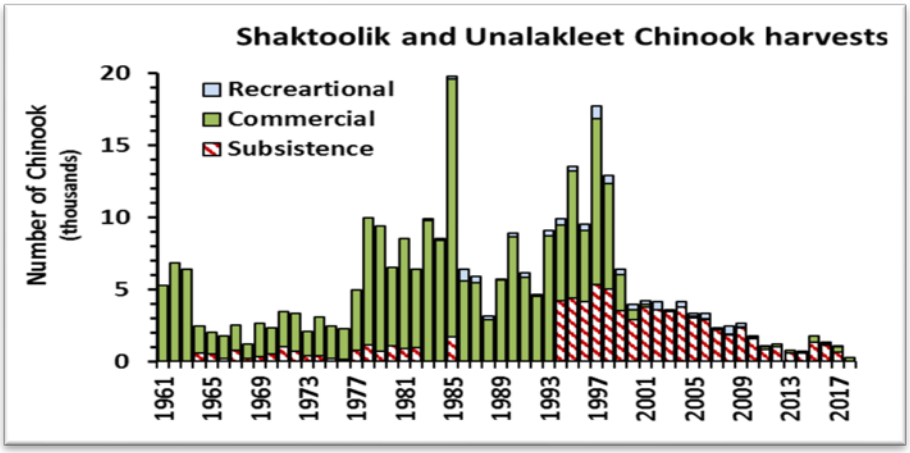


Figure 4. Norton Sound Subdistrict 5 (Shaktoolik River) and Subdistrict 6 (Unalakleet River) combined commercial and subsistence Chinook salmon harvests, 1961-2017. *Source:* ADFG, personal communication.

A key federal fisheries management metric demonstrating the collective magnitude and duration of the Chinook decline in the AYK region is the North Pacific Fisheries Management Council's "Three-System Index."
This index, based on the sum of estimated total returns of Chinook Salmon to the Upper Yukon, Kuskokwim, and Unalakleet rivers, was established by the North Pacific Fishery Management Council (Council) as a measure to reduce Bering Sea pollock fishery impacts after years of dramatically increasing bycatch of Chinook salmon.

A threshold of 250,000 Chinook salmon for the three-system index was implemented by the Council in 2016, meaning that if the total Chinook salmon returns in a year fall below the threshold – indicating declined and therefore more vulnerable Chinook salmon populations – more restrictive bycatch measures would be adopted for the next year's pollock fishery with the intent of reducing pollock fishery impacts on Chinook salmon rearing in the marine environment.

Using the May 2018 revised Kuskokwim River run reconstruction model, ADF&G presented revised total run estimates to the NPFMC indicating that the 3 System Index was less than the 250,000 fish threshold in each of the last three years (Figure 5)(*K. Howard, ADF&G, Memo to the NPFMC: "Updated Relationship of 3 System Inriver Total Run Index and Total Western Alaska AEQ", May 15, 2018*).

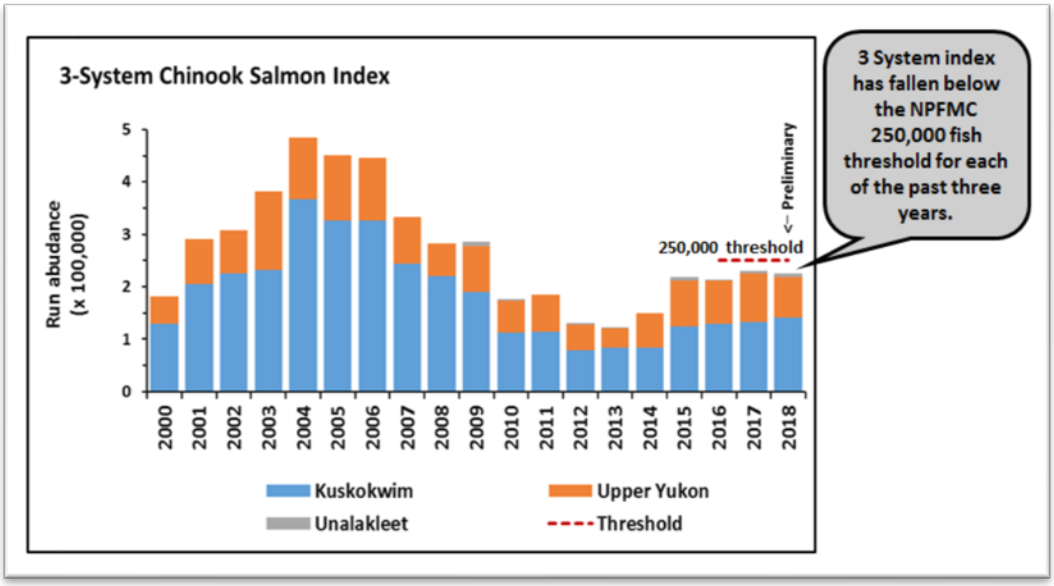


Figure 5: North Pacific Fisheries Management Council's "Three-System Index" based on the revised estimated total returns of Chinook Salmon to from the Kuskokwim River plus the Canadian Yukon and Unalakleet Rivers in relation to the Council's established threshold of 250,000 salmon. Source: (*K. Howard, ADF&G, Memo to the NPFMC: "Updated Relationship of 3 System Inriver Total Run Index and Total Western Alaska AEQ", May 15, 2018; Liller, Z. W., H. Hamazaki, G. Decossas, W. Bechtol, M. Catalano, and N. J. Smith. 2018. Kuskokwim River Chinook salmon run reconstruction model revision – executive summary. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A.18-04, Anchorage*).

Threats to salmon biodiversity: Declines now pose significant documented risks to small populations and potential loss of stock diversity/biocomplexity.
Chinook salmon stocks in the AYK region are composed of over 100 discrete spawning populations, many with unique phenotypes and life histories. These aggregate populations - salmon biocomplexity - play an important role in buffering interannual variability of the overall stock complex and provide resilience in the face of environmental change (*Hilborn, R., Quinn, T.P., Schindler, D.E., and Rogers, D.E. 2003. Biocomplexity and fisheries sustainability. Proc. Natl. Acad. Sci. U.S.A. 100(11): 6564–6568.*

doi:10.1073/pnas.1037274100. PMID:12743372.; *Schindler, D.E., Hilborn, R., Chasco, B., Boatright, C.P., Quinn, T.P., Rogers, L.A., and Webster, M.S. 2010. Population diversity and the portfolio effect in an exploited species. Nature 465:609-613.*).

This diversity in populations produces a stabilizing effect where less productive populations are compensated by the most productive populations, thereby stabilizing annual returns to the river (*Schindler et al. 2010*). AYK Chinook salmon stocks still retain much of this diversity that stabilizes annual returns (*Griffiths, J.R., D.E. Schindler, J.B.Armstrong, M.D. Scheuerell, D.C.Whited, R.A. Clark, R. Hilborn, C.A. Holt, S.T. Lindley, J.A. Stanford, and E.C. Volk. 2014. Performance of salmon fishery portfolios across western North America. Journal of Applied Ecology doi: 10.1111/1365-2664.12341*).

However, the challenges to management and conservation of population diversity is that in these large complex watersheds, highly productive populations are harvested together with low productivity or low abundance stocks, which are at risk of unsustainable exploitation or even extinction when part of such mixed-population fisheries. Loss of unproductive or small populations will erode the resilience of the overall system because these components of the population complex can become the productive or dominant producers in the future, under different prevailing environmental conditions (*Hilborn et al. 2003*).

Sustained productivity of salmon has been shown to be possible only if genetic diversity and population structure are maintained (*NRC (National Research Council). 1996. Upstream: salmon and society in the Pacific Northwest. National Academy Press, Washington, D.C.; Hilborn et al. 2003*). However, the effective population size of some small, currently less productive stocks in the Yukon, Kuskokwim, and Unalakleet River watersheds may be approaching a threshold of concern for long term loss of genetic diversity (*Olsen, J.B., Miller, S.J., Harper, K., and Wenburg, J.K. 2005. Effective population size of Chinook salmon in Yukon and Kuskokwim River tributaries. Arctic Yukon Kuskokwim Sustainable Salmon Initiative Final Report. Anchorage, Alaska.* http://www.aykssi.org/project/effective-population-size-of-chinook-salmon-in-yukon-and-kuskokwim-river-tributaries/) found that discrete populations may be at risk for long term loss of genetic diversity as populations fall below an "effective population size" (Ne) of ~500. Figure 6 illustrates the drainage-wide pattern of long term decline of monitored Chinook salmon populations.

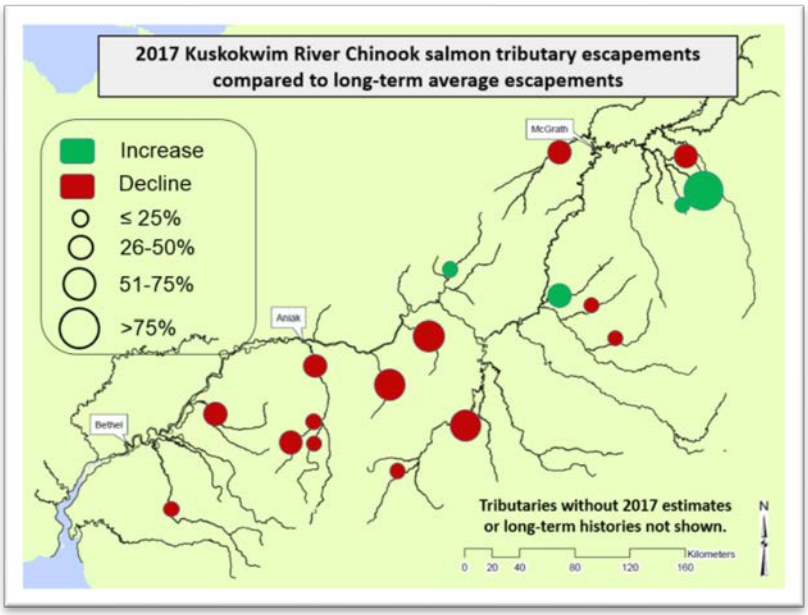


Figure 6. Kuskokwim Watershed with 2017 Kuskokwim River Chinook monitored salmon tributary escapements compared to long-term average escapements, illustrating the magnitude and widespread pattern of decline facing small or currently less productive stocks. This comparison shows that that 77% of the monitored tributaries remain declined compared to long-term average escapements, with 15% of the tributaries showing declines of greater than 50%. *Source:* ADFG, Commercial Fisheries Division.

Some monitored Chinook salmon spawning populations have steeply declined to near or potentially below the "minimum viable population size" applicable to many salmon populations. These potentially vulnerable including three Kuskokwim River Tributaries (Tuluksak, Tatlawiksuk, and Takotna Rivers). The ADFG counted a total of 94 Chinook salmon at the Takotna River weir monitoring site in 2013, down from a high of 721 in 2001.

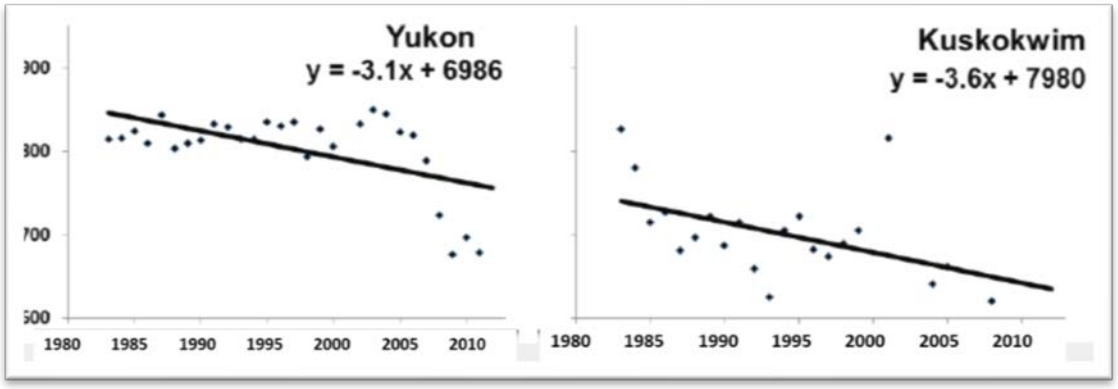


Figure 7: Linear regression of Chinook salmon mean annual length (mm) by year for the Yukon and Kuskokwim Rivers. (*Lewis B, Grant WS, Brenner RE, Hamazaki T (2015) Changes in Size and Age of Chinook Salmon Oncorhynchus tshawytscha Returning to Alaska. PLoS ONE 10(6): e0130184. doi:10.1371/journal.pone.0130184. pmid:26090990*)

Declining size of AYK Region Chinook salmon

The size-at-age of older Yukon and Kuskokwim River Chinook salmon has declined and the mean age of returning fish has declined since the early 1970s (*Lewis B, Grant WS, Brenner RE, Hamazaki T (2015) Changes in Size and Age of Chinook Salmon Oncorhynchus tshawytscha Returning to Alaska. PLoS ONE 10(6): e0130184. doi:10.1371/journal.pone.0130184. pmid:26090990*). Overall, a decreasing proportion of older fish and smaller sizes at a given age (Figure 7) have led to a reduction in the average size of returning females. This decline in the average size results in a reduction in the average number of eggs per spawning female, because fecundity increases with female body size.

CRITICAL AYK REGION SALMON RESEARCH & MONITORING DATA GAPS

The need for an integrated marine and freshwater research and monitoring to better understand the causes of Chinook salmon declines.

For most salmon populations the freshwater stages sustain over half of the total egg-to-adult mortality. Adult, embryonic, and juvenile stages are all vulnerable to changes in freshwater environmental conditions. Specifically, we need to better understand how changes in the suitability or productivity of freshwater habitat and changing ocean conditions (physical and biological) in the Bering Sea has caused reduced survival of Chinook salmon and contributed to the decline of AYK stocks.

The need to better understand the drivers and consequences of declining size of Western Alaska Chinook salmon

By directing research to understand the factors that altered the size, sex ratio, and composition of life history types in ways that have contributed to recent declines of AYK Chinook salmon. The large old female salmon that provided much of the reproductive potential of western Alaskan stocks are disappearing.

Key information gaps related to declining salmon size include:

- How has size- and age-at-maturity of returning adults changed among stocks, and drainage areas (Yukon and Kuskokwim rivers) and has this occurred synchronously with stocks elsewhere such as in Bristol Bay populations and coastwide?
- What is the relationship between size- and age-at-maturity of returning adults in stocks fished by gear selective for small fish versus gear selective for large fish?
- Which explanation, genetic selection or changes in environmental parameters (e.g., ocean conditions), better accounts for the observed changes in size- and age-at-maturity of returning adults in stocks? What is the relative contribution of anthropogenic and environmental variables as causal mechanisms for changes in size- and age-at-maturity?
- Are fewer eggs being deposited than in the past because the size- and age-at-maturity of returning adults in stocks has changed? What is the relative role of different variables affecting fecundity and egg deposition? Do stock-recruit relationships change if they are expressed in units of eggs rather than as aggregate spawning population numbers?
- How should management strategies change to accommodate the changes in reproductive potential of Chinook salmon? Which data are needed to monitor further changes, and which management strategies will be most robust to the inevitable uncertainties of the causes of the decline. Such analyses should be done by independent scientists outside the management agencies to ensure an objective assessment of the problem at hand.

The need to assess and proactively address risks to the most vulnerable Chinook Salmon stocks in the AYK region
We need applied research, monitoring and recovery actions for salmon stocks that address declined stocks to ensure that they do not become listed on the federal Endangered Species Act (ESA).

Considering the very large information gaps combined with steep declines there is an urgent need to address data gaps related to those salmon populations facing declining Viable Salmonid Population parameters that could potentially lead to ESA listing of stocks which are of greatest importance to subsistence fisheries. Each of the major western Alaska rivers support dozens of individual spawning stocks that, in aggregate, make up the runs to the Yukon, Kuskokwim, Nushagak and other large rivers. This collection of populations within each river provides stability to the overall runs but is also critical for producing fish for isolated villages throughout the watersheds.

Recovering and managing at-risk stocks requires an understanding of the genetic and demographic thresholds for population viability as well as the best approaches to risk management. Key information gaps for sustainable salmon management include:

1. Assessing the population viability of smaller currently less productive stocks in the region including assessing risk of overharvest and extinction;
2. Developing approaches to reduce these threats through the implementation of rebuilding actions and risk averse harvest strategies.

Addressing this information gap is critically important for a number of reasons:

- **Proactive measures to conserve small viable stocks are less costly and more effective** than later measures to address stocks at the brink of extinction.
- The AYK region Chinook salmon stocks overall are in a period of low productivity, driving some less productive stocks to new lows.

- Majority of harvest occurs in mixed stock fisheries where the productivity of strong stocks can mask proportionally greater impacts to weak or small stocks.
- Some stocks which are weak producers under one climate regime may emerge as major producers under another regime, highlighting the importance of conserving salmon biocomplexity for long term resilience (*Hilborn et al. 2003*).
- Although small stocks contribute to biodiversity and are most at risk from habitat change, these stocks represent as small proportion of the stocks receiving annual monitoring.
- The focus of management (due to funding shortages) has shifted from tributary escapement goals to a single drainage-wide escapement goal creating greater potential for weak stocks to be overharvested or extirpated without timely detection. A critical information gap is in understanding the consequences of management assuming that each river is a homogeneous collection of fish, when in fact, it is a collection of biologically diverse populations.

Research and monitoring to assess the impact of climate change on salmon and salmon habitat

Western Alaska is one of the fastest warming regions on Earth and recent trajectories of change are predicted to continue for at least the next century. With climate warming comes a loss of snowpack, increased winter flooding, increased erosion, and increased intensities of summer droughts and heat waves. All of these climate-induced changes threaten the productivity and suitability of salmon habitat in western Alaska rivers. Climate change will also alter the productivity of the nearshore ocean and the Bering Sea. In aggregate, changing climate will fundamentally change the nature of salmon habitat in western Alaska and produce changes in population abundance and productivity. New science and monitoring is required to understand the mechanisms and consequences of climate change on salmon and their habitat, and to successfully management these fish in a warmer future.

Particularly pressing science and information needs include:

- Monitoring of river flows and thermal regimes to understand how these change in response to changing air temperature and precipitation patterns. Currently there is almost no dedicated environmental monitoring throughout any of the major rivers in western Alaska
- Monitoring for temperature-mediated disease outbreaks that affect both juvenile fish during rearing and adult fish during migration and spawning
- Monitoring of physical and biological conditions in the nearshore ocean to understand how climate change is affecting early marine survival of salmon smolts
- Assessment of changes in migration timing of adults and smolts in response to changing environmental changes. What is the magnitude of these changes? How are changes in migration best monitored? How should in-season management of salmon adapt to changing migration timing?
- Quantifying the effects of changing climate on stock productivity and, therefore, management reference points for sustaining production from major rivers.
- Evaluation of alternative management strategies for providing the most robust approaches for managing fishery resources in a future with persistent and inevitable uncertainties about climate effects on fish populations.

Loss of key monitoring projects creates additional critical data gaps

For example, a number of critical long-term monitoring projects on the Kuskokwim River - over 60% of the high-quality salmon counting projects – have no secure funding from either state and federal agencies for 2019 forward (Figure 8).

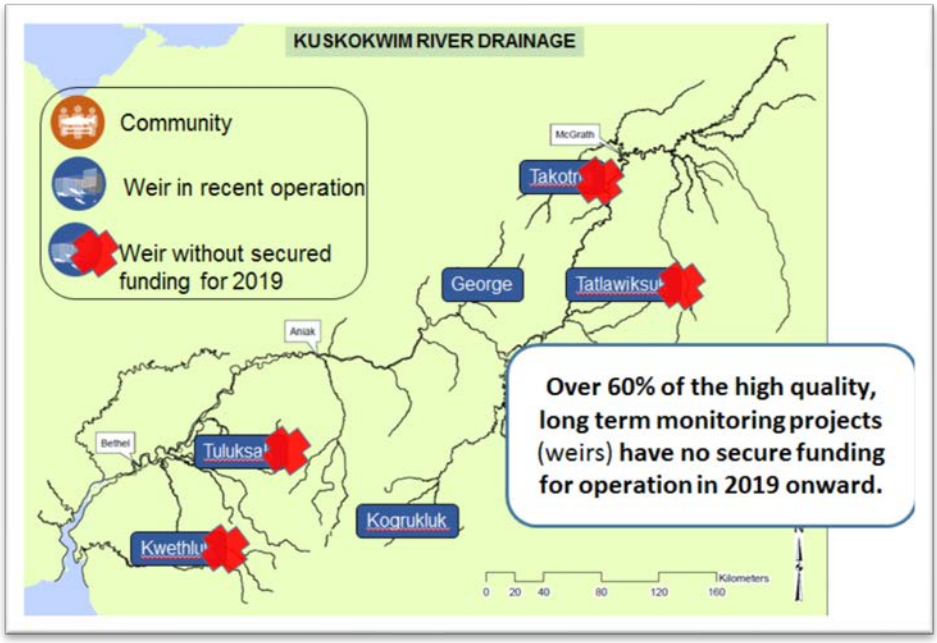


Figure 8: Map of Kuskokwim River salmon monitoring projects using weirs to count returning adult salmon showing long-term projects with & without funding for 2019 onward.

In rivers such as those in western Alaska, which are vast, complex and remote, there will always be substantial uncertainties about the status of the stocks, the causes of population changes, and the consequences of different management actions for achieving the multiple objectives of different stakeholders. It should be required that population models and agency management strategies are periodically and independently reviewed as it is not common practice for management agencies to perform thorough evaluations of how robust their management actions are to these uncertainties. Ongoing climate change will only add to uncertainties about the effectiveness of different management strategies for sustaining populations and allowing a safe level of harvest.

Addressing key information needs in the region is made more challenging by the steep decline in funding awards to Alaska state and tribes from an existing NOAA/NMFS program which has the potential to assist.

PROBLEM: Significant decline in funding to Alaska over the past decade under NOAA's Pacific Coastal Salmon Recovery Fund (PCSRF) Program

- The Pacific Coastal Salmon Recovery Fund (PCSRF) was established by Congress in 2000 to address and reverse the declines of Pacific salmon and steelhead by supporting conservation and recovery efforts in California, Oregon, Washington, Idaho, and Alaska.
- The priority of the program is to fund projects and activities that are "necessary for conservation of salmon and steelhead populations that are listed as threatened or endangered, or identified by a State as at-risk to be so-listed, for maintaining populations necessary for exercise of tribal treaty fishing rights or native subsistence fishing, or for conservation of Pacific coastal salmon and steelhead habitat." (emphasis added)

NOAA's PCSRF recipients in Alaska consist of:

- State of Alaska's Sustainable Salmon Fund
- Arctic-Yukon-Kuskokwim Tribal Consortium (consisting of the tribes represented by the Tanana Chief Conference, Association of Village Council Presidents and Kawerak Inc.)

Despite relative stability in congressional funding levels, the share of the funding allocated to Alaska's PCSRF recipients by NOAA administrators has dropped from 25% of the total in 2007 to ~ 7% in 2016 & 2017 since the competitive grants program began in 2007. (Figure 9)

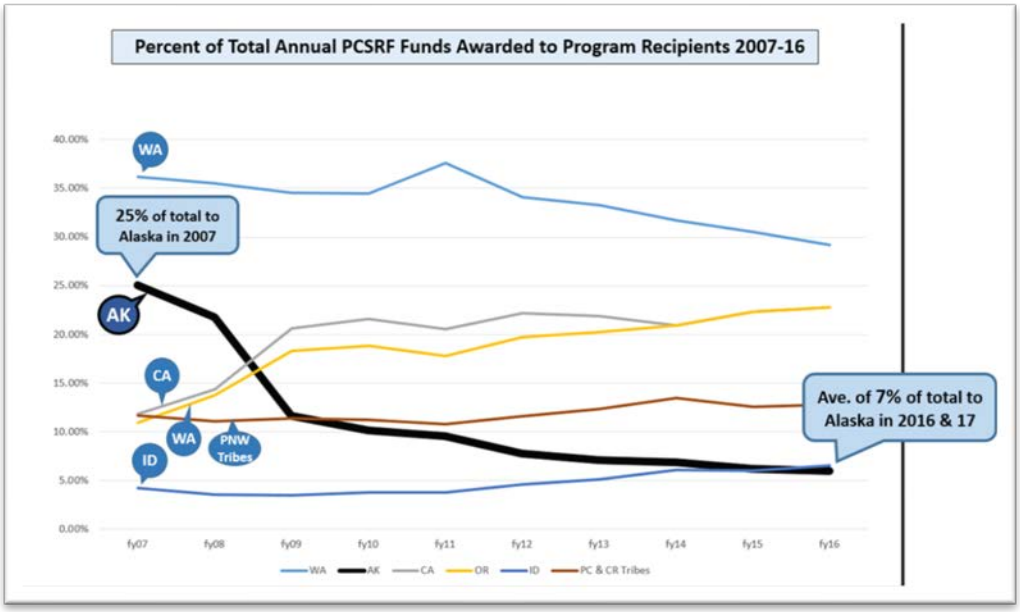


Figure 9: A clear trend of precipitously declined funding to Alaska over the past decade.

The PCSRF is almost exclusively focused on investing on ESA listed stocks. Clearly there is an imminent need for a program which proactively addresses salmon declines in advance of any potential or actual ESA listings.

AYK SSI: A SUCCESSFUL, UNIQUE, COLLABORATIVE SOLUTION

Salmon runs of the Arctic-Yukon-Kuskokwim (AYK) region have been critical to the survival of the people and wildlife for thousands of years. Over eighty communities in the region depend heavily on the harvest of salmon, which forms the foundation of their subsistence diet and their cultural identity. However, dramatic declines in salmon runs across the AYK region over the past two decades have led to restrictions on subsistence fishing and closure of many commercial fisheries. As a result, harvest restrictions have created tremendous hardships for the communities in a region with the highest subsistence dependence on salmon in the state, coupled with some of the lowest incomes in the state.

In response to these declines, BSFA and regional Native organizations invited state and federal agencies to create the Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYK SSI), a

proactive science-based program working cooperatively to identify and address the critical salmon research needs facing the AYK region.

Created via a Memorandum of Understanding in 2002, this innovative partnership includes BSFA, the AYK Tribal Consortium consisting of the Association of Village Council Presidents (AVCP), Tanana Chiefs Conference (TCC) and Kawerak, Inc., as well as ADF&G, National Oceanic and Atmospheric Administration (NOAA) Fisheries, and the USFWS.

The AYK SSI is governed by an eight-member Steering Committee (SC) and advised by a six-member Scientific Technical Committee (STC). Current roster of committee members:

Steering Committee	Scientific Technical Committee
Alaska Department of Fish and Game John Linderman, Commercial Fisheries Division Lisa Olsen, Division of Subsistence	**Christian Zimmerman, Ph.D., Chair** United States Geological Survey Alaska Science Center
Association of Village Council Presidents Jennifer Hooper	**Chuck Krueger, Ph.D., Vice-Chair** Michigan State University Center for Systems Integration and Sustainability
Bering Sea Fishermen's Association Karen Gillis, Chair	**Milo Adkison, Ph.D.** University of Alaska Fairbanks School of Fisheries and Ocean Sciences
Kawerak, Inc. Rose Atuk-Fosdick	**Caroline Brown, Ph.D.** Alaska Department of Fish and Game Division of Subsistence

NOAA Fisheries, Auke Bay Laboratories Peter Hagen **Tanana Chiefs Conference** Gale K. Vick **United States Fish & Wildlife Service** Aaron Martin, Vice-Chair	**Andrew Munro** Alaska Department of Fish and Game Commercial Fisheries Division **Daniel Schindler, Ph.D.** University of Washington School of Aquatic and Fishery Sciences

The AYK SSI is truly unique for Alaska and different from other approaches in several important ways.

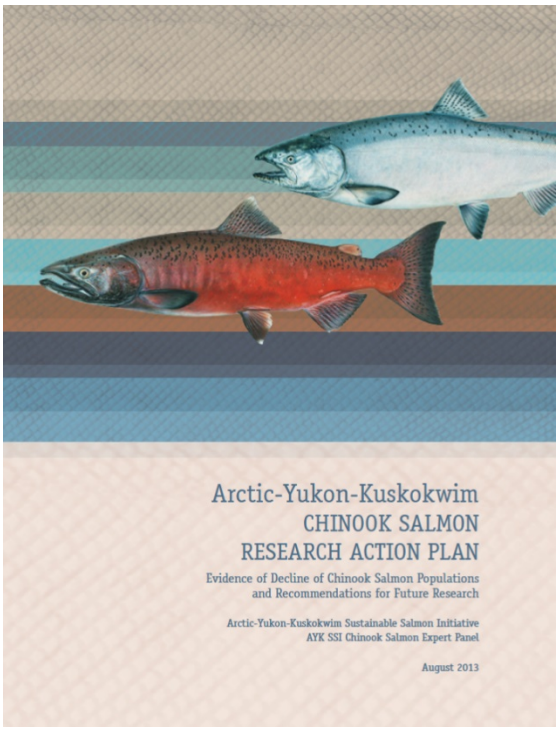
AYK SSI provides a cooperative forum for addressing research needs

The uniqueness of our program has been recognized as, potentially, the largest example of co-management of research funding addressing salmon within the Pacific Rim and is one of the largest successful experiments in the co-management of fisheries and wildlife research in North America.

AYK SSI provides coordination and avoids duplication of effort

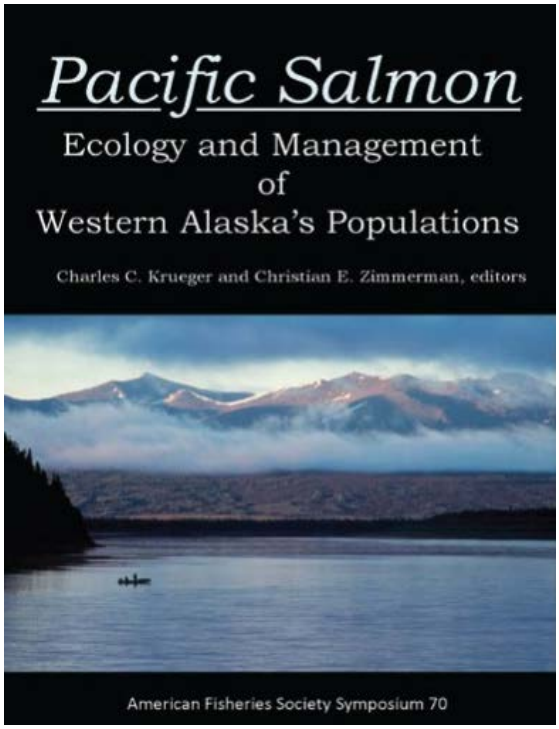
Projects funded through the AYK SSI address high priority hypotheses and critical uncertainties drawn from our **AYK SSI Salmon Research & Restoration Plan** (RRP). The aim of this long-range, strategic science plan is to identify the conceptual frameworks, research themes and research priorities needed to guide research funded through the AYK SSI. Development of the RRP helps to ensure that available funds are spent wisely and avoids duplication. The RRP draws on the best available science to identify effective ways to investigate and understand the complexity of marine and freshwater ecosystems which support these salmon stocks; identifies significant knowledge gaps, and establishes research and monitoring priorities that complement other relevant programs in the region without duplication of effort. In doing so, the RRP provides a science-based roadmap guiding the AYK SSI's current and future proposal solicitations and ensures that available funds target the highest priority issues and questions. *(Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYK SSI). 2006. Arctic-Yukon-Kuskokwim Salmon Research and Restoration Plan. Bering Sea Fishermen's Association, Anchorage, AK.)*

AYK SSI completes implementation-ready AYK CHINOOK SALMON RESEARCH ACTION PLAN to guide research in a coordinated, collaborative way



In 2013, responding to the disastrous decline of Chinook salmon in the AYK region, the specially appointed AYK SSI Chinook Salmon Expert Panel released its research blueprint for addressing failing Western Alaska salmon populations entitled: **"Arctic-Yukon-Kuskokwim Chinook Salmon Action Plan:** Evidence of Decline of Chinook Salmon Populations and Recommendations for Future Research.**"** Our expert panel members included scientists from two divisions within the Alaska Department of Fish and Game, NOAA Fisheries, US Geological Survey, US Forest Service and several universities. For each of the possible drivers of decline, the Chinook Salmon Action Plan provides a description, discussion of the biological plausibility, a summary of the evidence available, and a set of research themes and questions to guide future research. *(Schindler, D.E., Krueger, C., P. Bisson, M. Bradford, B. Clark, J. Conitz, K. Howard, M. Jones, J. Murphy, K. Myers, M. Scheuerell, E. Volk, and J. Winton. 2013. Arctic-Yukon-Kuskokwim Chinook Salmon Research Action Plan: Evidence of Decline of Chinook Salmon Populations and Recommendations for Future Research. Prepared for the AYK Sustainable Salmon Initiative Anchorage, AK). v + 70 pp. Available at https://www.aykssi.org/aykssi-chinook-salmon-research-action-plan-2013/)*

AYK SSI develops a state-of-the-art assessment of salmon stocks and management practices for the AYK region



Pacific Salmon: Ecology and Management of Western Alaska's Populations is a timely book, sponsored by the AYK SSI and published by the American Fisheries Society. It covers the freshwater, estuarine, and marine ecology and management of salmon and is the first-ever comprehensive appraisal of the region's salmon resources. Containing 61 chapters, the book assesses the ecological processes that cause changes in salmon populations; describes the effects of varying salmon runs on rural communities; reviews state, federal and international management of salmon fisheries in the region; and examines emerging themes at the nexus of salmon ecology and management in the AYK region.

The book includes special sections on the economic, social, and cultural significance of salmon, and on governance associated with salmon management. Reviews of several other fisheries such as those in

Washington and Oregon, provide lessons learned elsewhere conclude with recommendations for future research to promote a better understanding of the region's fisheries. *(Krueger, C. C., and C. E. Zimmerman, editors. 2009. Pacific salmon: ecology and management of western Alaska's populations. American Fisheries Society Symposium 70, Bethesda, Maryland.)*

The AYK SSI has created an important legacy of improved salmon science and conservation in an otherwise data-poor region with limited scientific capacity. Information from our high priority monitoring and applied research projects has contributed to:

- ✓ An improved understanding by management agencies of the complex relationships between salmon and their freshwater, nearshore and marine environments; and
- ✓ Improved management and recovery of declined salmon populations to better provide sustainable harvest opportunities for subsistence uses.

Our research addresses the full salmon life cycle; integrated marine and freshwater research

Gravel to gravel research focus, the AYK SSI has made important contributions by maintaining its focus on identifying and addressing drivers of decline throughout the entire salmon lifecycle. The AYK SSI is the only program in this large region focused on applied research, conservation, and restoration activities that span the freshwater - estuarine - marine habitats that salmon use throughout their life cycle.

Capacity-Building is a major goal of the AYK SSI's funded research

Our approach to conducting research includes an integrated program to expand the capacity of Native and rural organizations to participate in and lead the salmon research we fund. Principal investigators and their organizations are highly encouraged to demonstrate the ability to create and/or maintain effective relationships with local communities/organizations and a commitment to capacity-building.

We recommend establishing a funding mechanism for the AYK SSI which provides a Native, state and federal science-based partnership undertaking collaborative salmon research informing the rebuilding and management of declined stocks. Our collaborative partnership has an extensive track record of applied research and restoration activities.

I'm grateful for the opportunity to address you and I look forward to working with you to rebuild and maintain healthy and sustainable western Alaskan salmon stocks.

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