“Always taught not to waste”:
Traditional Knowledge and Norton Sound/Bering Strait Salmon Populations

2015 Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative Project 1333
Final Product

by:
Kawerak, Inc.
Brenden Raymond-Yakoubian and Julie Raymond-Yakoubian

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Kawerak, Inc.
Brenden Raymond-Yakoubian[2] and Julie Raymond-Yakoubian[3]

[2] Brenden Raymond-Yakoubian
PO Box 1628
Nome, AK 99762
(907) 434-1413
brenden@icybeard.com

[3] Julie Raymond-Yakoubian
Social Science Program
Kawerak, Inc.
PO Box 948
Nome, AK 99762
(907) 443-5231
socsci@kawerak.org

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ABSTRACT

Norton Sound and Bering Strait region residents have long depended on the resources of the land and water to sustain their traditional subsistence lifestyle. Because of their long-term, multi-generational observations and understandings of the region, local residents are familiar with changes in salmon harvest opportunities, escapement, colonization, climate and environmental changes, and other related topics. The research for this project was based on a recognition that a rich understanding of the ecology of the region, with a particular focus on salmon, could be obtained by recording, analyzing and presenting this knowledge in context. This report summarizes and analyzes data from research which engaged region residents on these topics and included interviews and workshops conducted with expert Traditional Knowledge (TK) holders and leaders in the Bering Strait/Norton Sound region communities of Brevig Mission, Diomede, Golovin, Koyuk, St. Michael, Unalakleet, Wales, and White Mountain.

This report completes work on Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYK SSI) Project # 1333, which was underpinned by work done for AYK SSI Project #601. These projects strove to gain a broad understanding of the ecology of the region and changes through time in it, specifically relating to salmon and the environment, that region residents have experienced and observed. The central question of the research can be stated as such: What is the current status and sociocultural significance of, the observed changes to, and the concerns about the salmon resources and environment in the Norton Sound/Bering Strait region as described by TK? The goals of the projects were to describe these changes to both salmon and the environment in a geographic context so that relevant information can be applied to aid in current fisheries challenges, including fisheries management and freshwater and marine ecosystem research, to augment ongoing and future biological research with social science as well as to contribute to social science research, and to increase the capacity of the local regional Native non-profit organization and local Tribes to become more meaningfully involved in both biological and social science research projects.

This report summarizes and analyzes the data collected from the above efforts. In it, data are presented from the eight communities noted above on salmon (king [Chinook], pink [humpy/humpback], silver [coho], red [sockeye], and chum [dog]) biology, behavior, population, distribution, harvest, and use. Additionally, data gathered on the broader regional ecosystem and changes within it are described and linked up with the data on salmon. Also presented are data on sociocultural processes associated with the above salmon and ecosystem-related processes. Discussions on current fisheries challenges, management processes, fisheries and ecosystem science and knowledge systems, community-input-driven recommendations (e.g. to managers, policymakers, researchers, and local entities), and the contributions of the data to existing bodies of ecosystem, management, and social science literature are presented.

Key Words:
Alaska Native, Bering Strait, Environment, Norton Sound, Salmon, Traditional Knowledge

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1 – INTRODUCTION

The study area for this research was the Norton Sound and Bering Strait region, which is located in Northwest Alaska. The region spans from Stebbins in the south to Shishmaref in the north, and includes Little Diomede Island and St. Lawrence Island (and other currently uninhabited islands as well). There are 15 year-round villages in the area outside of Nome (the region's 'hub' community, which has a population of 3598) (ADCCED 2015). The village populations range from 115 to 688 people in size, and the region's population is approximately 9492 people, a little over 75% of whom are Alaska Native or American Indian (*ibid.*). Three culturally distinct groups of Eskimo people have lived in the Bering Strait region as identifiable cultures for at least 3,000 years, although evidence of human habitation dates back at least 10,000 years (Hoffecker and Elias 2003). The Inupiat reside on the Seward Peninsula and Diomede Island. Yup'ik people primarily reside in the villages south of Unalakleet, although there are some Yup'ik people that live throughout the coastal margin of southern Norton Sound. St. Lawrence Island Yupik live in the communities of Gambell and Savoonga, and are most closely related culturally and linguistically to the Chukotka Native people of the Russian Far East. Generally, settlements in the Bering Strait region are concentrated along the coast and river systems, as the sea has historically been the principal focus of human activities, and subsistence hunting and fishing has long been the economic, cultural, nutritional and spiritual mainstay of the region. The uses and importance of salmon to region communities has been noted and documented by explorers, visitors, researchers and residents of the region for over a century (e.g. Nelson 1899, Zagoskin 1847 [1967], Oquilluk 1981, Ray 1983). Today, some hunters are able to support their families through subsistence activities alone, but most combine subsistence harvesting with cash employment or other income (e.g. Wolfe and Ellanna 1983, Wolfe et al. 1984, Magdanz et al. 2007). Subsistence harvests in many communities have also declined due to a variety of factors, including reduced availability of salmon (e.g. Magdanz et al. 1994, Magdanz et al. 2002b, Ahmasuk et al. 2008). This history of subsistence culture provides the opportunity to document changes to subsistence practices, and changes to the resources on which region residents have depended.

Because of their reliance on subsistence hunting and fishing, Norton Sound/Bering Strait residents must adapt to an ever-changing environment, and as they adapt to changes, their experiences are shared among generations within families and communities. This shared history and knowledge details long-term changes in the factors that affect resources and therefore harvest. This project focused on documenting and analyzing the traditional knowledge (TK) of region residents which pertain to the salmon resources and ecology of the region over time. The definition of TK which this project developed and utilizes is as follows:

> Traditional knowledge (TK) is a living body of knowledge that is acquired and utilized by indigenous communities and individuals in and through long-term resource use and environmental observation. It is transmitted intergenerationally. TK is a practically applicable body of knowledge, one that integrates personal experience with oral traditions. It provides perspectives applicable to an array of human and non-human phenomena. It is deeply rooted in history, time, and place, but is adaptable and dynamic in ways that keep it relevant and useful in contemporary life. This knowledge is part of, and used in, everyday life, and is inextricably intertwined with peoples' identity and cosmology. Tradition – and TK – does not preclude change, nor does it equal 'the past.' In fact, it inherently entails change (e.g. in adaptation processes).

TK has aspects which change, grow, and even disappear over time, and like all bodies of knowledge,

these processes are a topic of discussion inside the communities they exist within (e.g. the relationship of this body of knowledge to whatever the contemporary times are).

As this report will show, subsistence fisheries and TK about it show a complex and necessary interconnection between the environment, fisheries, and Alaska Native societies. Impacts to any and all are felt on a constant, daily basis at the social and individual levels. Subsistence fisheries are intimately connected in a strongly-felt, meaningful way with people's sense of self and with their daily well-being.

Documenting and analyzing this region's TK about salmon and the environment assists in advancing our understandings of the region's ecology, and facilitates interfacing TK with Western science hopefully to the benefit of communities, researchers in multiple fields, management, policymakers, and the ecosystem.

TK indicates that, starting in the mid-1960s and running up to the present, declines in salmon populations have affected the majority of summer-run salmon populations returning to spawn in the study region. However, this substantial decline is not uniform throughout the region for all salmon species. Northern Norton Sound salmon populations, especially those in the Nome Subdistrict, have experienced the greatest decline; the Nome Subdistrict has had the only Tier II salmon fishery in Alaska (Tier II regulations severely restrict subsistence fishing opportunity). Most locations in northern Norton Sound have experienced a closure at some point, and these closures have adversely affected the economy of those communities. However, healthy populations and even increases have also been noted for particular salmon species in some areas of the northern portion of the study region, including northern Norton Sound. Salmon fisheries along eastern and southern Norton Sound have not experienced a decline of the same magnitude as northern Norton Sound. However, especially somewhat more recently (i.e. the past 20-30 years), residents in these areas of Norton Sound have experienced significant declines in salmon returns (and have also experienced management restrictions), which may indicate a geographic progression of the declines that began in northern Norton Sound approximately five decades ago. It is possible that in general a progressive collapse in Norton Sound salmon populations has been occurring since the mid-1960s, beginning in the Nome Subdistrict and progressing east and south through the study region, albeit with variation with regards to particular species and locations. Fisheries that were once sustainable are now a cause for concern, suggesting progressive changes in the salmon resources of the region. The severity of the decline in salmon resources, the number of species affected, and other observed environmental and species-related changes may be related to geographic location in the Norton Sound/Bering Strait region. Increases in certain salmon populations in some parts of the study region are also being noted, including indications of an overall increase in salmon populations in the two most northerly communities in the project's study area (Diomede and Wales).

TK holders in the region have views on the possible causes of the declines in salmon populations. They also have knowledge about other environmental changes (which can also vary with regard to geographic location within the region), some of which may relate to fisheries. Changes have been noted, for example, in animal populations, ice development and extent, temperatures, snowfall, rainfall patterns, weather predictability, vegetation, and erosion, among other changes. In addition, some have noticed fish returning to rivers with more or different health problems than in the past. These are just a few of the myriad topics addressed through the collection and analysis of TK in the Norton Sound/Bering Strait region conducted for this project which can help to address some of the questions regarding fisheries and other resources in the region and provide guidance and direction for ongoing

and future management and research endeavors.

Norton Sound and Bering Strait region residents have long depended on the resources of the land and water to sustain their traditional subsistence lifestyle. Because of their long-term, multi-generational observations and understandings of the region, local residents are familiar with changes in salmon harvest opportunities, escapement, colonization, climate and environmental changes and other related topics. The research for this project was based on a recognition that a rich understanding of the ecology of the region, with a particular focus on salmon, could be obtained by recording, analyzing and presenting this knowledge in context. This report summarizes and analyzes data from research which engaged region residents on these topics and included interviews and workshops conducted with TK holders and leaders in the Bering Strait/Norton Sound region communities of Brevig Mission, Diomede, Golovin, Koyuk, St. Michael, Unalakleet, Wales, and White Mountain.

This report completes work on Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYK SSI) Project #1333, which was underpinned by work done for AYK SSI Project #601. Data collection for this research, conducted in collaboration with nine Bering Strait/Norton Sound region communities, was already been completed with the prior AYK SSI funding (project #601; J. Raymond-Yakoubian 2008, 2009b). The prior work for the research primarily entailed substantial semi-structured interviewing regarding TK in the villages of Brevig Mission, Diomede, Golovin, Koyuk, Savoonga, St. Michael, Unalakleet, Wales, and White Mountain. (Data from Savoonga are not included in this report. Greater detail on the methods used for this work, as well as information about Savoonga with regard to this report, are discussed further below in the Methods section.) That work was completed in 2009. Funds were later received in 2013 to complete the summary and analysis of this data (project #1333). Towards that end, workshops were held with interviewees and other experts and leaders from eight of the project communities (the above noted communities minus Savoonga) in order to review the data collected in 2009. It should be noted that the bulk of the data in this report, therefore, was based on information gathered in 2008 and 2009, though it was verified and to some extent updated during the workshops held in 2014. All dates and chronologies below reflect times from the present (e.g. something said to happen "last year" happened in 2014). The present report is the fulfillment of the task of presenting and analyzing the data collected from these research projects. (See the Methods section below for a more detailed timeline of these projects.)

These projects strove to gain a broad understanding of the ecology of the region and changes through time in it, specifically relating to salmon and the environment, that region residents have experienced and observed. The central question of the research can be stated as such: What is the current status and sociocultural significance of, the observed changes to, and the concerns about the salmon resources and environment in the Norton Sound/Bering Strait region as evidenced in traditional knowledge? The goals of the research was to describe these changes to both salmon and the environment in a geographic context so that relevant information can be applied to aid in current fisheries challenges, including fisheries management and freshwater and marine ecosystem research, to augment ongoing and future biological research with social science as well as to contribute to social science research, and to increase the capacity of the local regional Native non-profit organization and local Tribes to become more meaningfully involved in both biological and social science research projects.

This report summarizes and analyzes the data collected from the above efforts. In it, data are presented from the eight communities noted above on salmon biology, behavior, population, distribution, harvest, and use. (To be more precise, by "salmon" we are referring in this report to: king/Chinook salmon (*Oncorhynchus tshawytscha*), pink/humpback (or "humpy") salmon (*Oncorhynchus gorbuscha*),

chum/dog salmon (*Oncorhynchus keta*), silver/coho salmon (*Oncorhynchus kisutch*), and red/sockeye salmon (*Oncorhynchus nerka*)). Additionally, data gathered on the broader regional ecosystem and changes within it are described and linked up with the data on salmon. Also presented are data on sociocultural processes associated with the above salmon and ecosystem-related processes. Discussions on current fisheries challenges, management processes, fisheries and ecosystem science and knowledge systems, community-input-driven recommendations (e.g. to managers, policymakers, researchers, and local entities), and the contributions of the data to existing bodies of ecosystem, management, and social science literature are presented.

Some preliminary comments regarding the usage of the term "subsistence" in this report are in order. First, it is important for the reader to keep in mind that when using the term "subsistence" in this report, we refer to the local indigenous definitions of that term, not the State of Alaska's definition. Second, in terms of local fishing activities, this report focuses on subsistence fishing. However, local commercial fishing has connections to this subsistence fishing. For example, it is often the same people who are conducting both types of fishing, with the same equipment, on the same stocks, in the same waters, and so on. The vast majority of commercial salmon fishers in this project's communities also practice subsistence fishing. (However, not everyone who subsistence fishes participates in commercial harvest.) The money people earn from commercial fishing is also often used to help provide funds for their subsistence activities. Commercial fishing is important to the region and has a long history in the region dating back to the late 1800s. Regulation of this fishing only began in the middle part of the last century. Currently, commercial fishing activities are regulated by the State of Alaska. The small boat commercial fisheries of this region provide cash and employment to boat owners, crew members, and people who work in fish processing and other related jobs in the region.

This project addresses all 5 salmon species, including Chinook salmon, the AYK SSI 2013 species of special concern. Kawerak also previously completed a project (J. Raymond-Yakoubian 2009a; also in Myers et al. 2010) which focused on TK relating to Chinook salmon in three villages in the study region, and also discussed data pertaining to other salmon species, other animal and non-salmon fish species, and environmental and weather changes. That project was conducted concurrently with Kawerak's research for AYK SSI Project #601. The present project (AYK SSI project #1333) addresses aspects of all four selected research themes relating to Chinook salmon from AYK SSI's draft Chinook Salmon Research Action Plan. With regard to Theme 1 (Density-Dependent Effects and Overcompensation), TK can provide information about spawning area density and also information about whether or not extreme crowding exists on particular rivers and streams in the geographic area of this study. Regarding Theme 2 (Drivers of Freshwater and Marine Mortality), this study details various environmental changes that Norton Sound/Bering Strait residents have observed both over the long-term as well as in the recent past, including climate changes and changes in the food web. Additionally, it is worth noting that some of the information Kawerak has collected as part of this study's work which pertains to conditions in Norton Sound and Bering Strait rivers and streams is the only existing information on the conditions that Chinook and other salmon species are encountering in these places (e.g. changes in erosion, changes in water levels, etc.). With regard to Theme 3 (Anthropogenic Changes to Marine Ecological Processes), this study has collected data which pertains to anthropogenic changes that may be affecting all salmon species (e.g. marine pollution, use of boats with jet units, etc.). The study has collected many observations on climate change and its impacts (e.g. erosion, sedimentation, algae, etc.). Regarding the management of marine fisheries, the study has collected data from communities about their thoughts about current management regimes. With regard to Theme 4 (Escapement Quality), TK provides observations pertaining to the composition of stocks in various rivers and streams, as well as preferences for certain fish during harvest (e.g. harvesting

decisions which people make). The interviews which were conducted as part of the research for this project, and the follow-up workshops conducted afterwards, also provide information regarding changes in the size of returning salmon, and also about observations on the general health of returning fish.

This study also contributes to considerations of the high priority hypotheses from the AYK SSI Research and Restoration Plan. With regard to the high priority hypotheses pertaining to the "Salmon Life Cycle," Kawerak's project can help to address the following concerns, as well as others: changes in or maintenance of salmon migration routes from year to year, the prevalence of disease among stocks in particular drainages from year to year, and observations regarding changes in the maximum size and sex ratios of salmon. With regard to the high priority hypotheses relating to "Synthesis and Prediction," this project can provide observations about the loss of salmon stocks or the precarious status of some stocks, and information useful for determining escapement goals based on long-term observations of salmon population numbers over time.

On another note, the reader should keep in mind that an attempt was made in this report to use current US Geological Survey map names instead of local spellings and pronunciations for rivers and creeks, if there was a difference; this was done at the request of a number of the project's participants to assist the broader audience in reading the report.

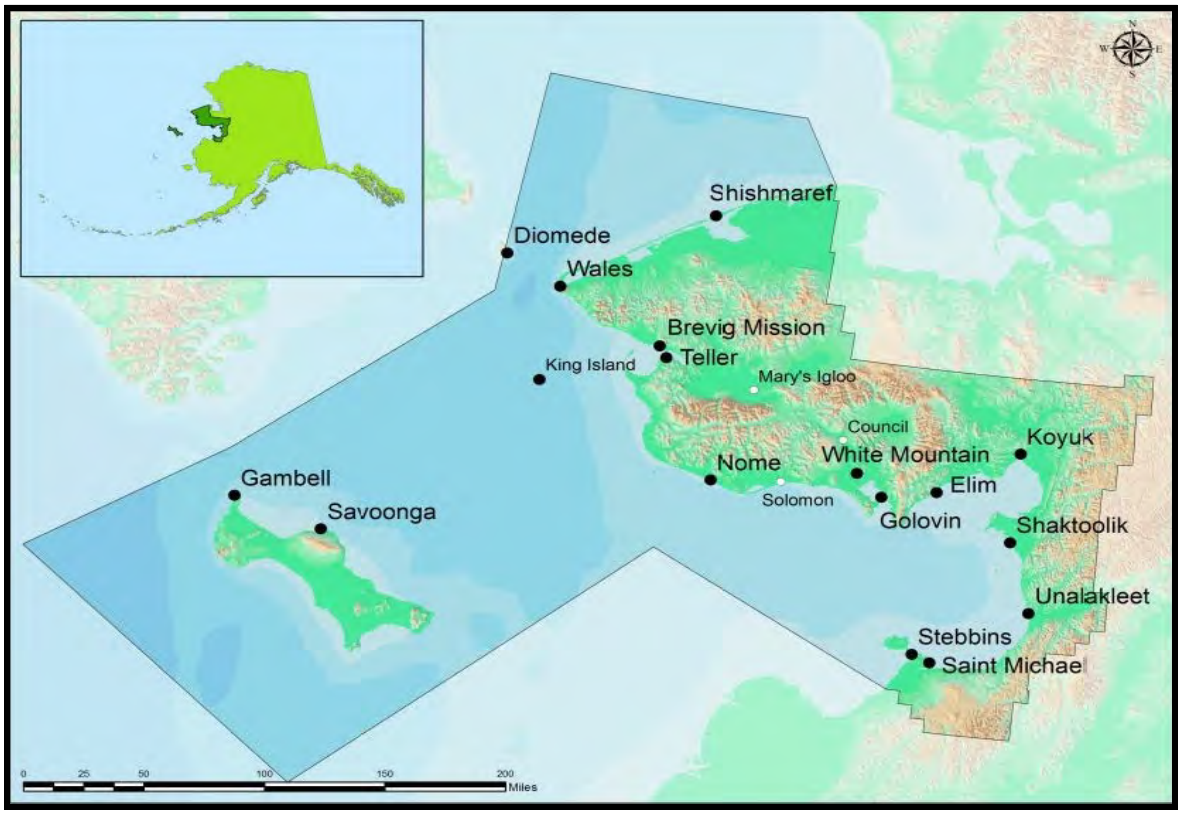

Figure 1: Map of the Norton Sound and Bering Strait Region (WHPacific, Inc., for Kawerak Community Planning and Development)

2 – OBJECTIVES

List of objectives

This project had three research objectives: 1) To describe the changes observed in a) salmon resources and b) the environment as related to the sustainability of salmon resources in this region; 2) To identify patterns regarding the location, timing, and characteristics of the variability of salmon resources in the Norton Sound/Bering Strait region related to the observed environmental changes; and 3) To increase local capacity and promote an understanding of fisheries research, harvest monitoring, traditional ecological knowledge, Alaska subsistence fisheries management, and career opportunities.

Results obtained from each objective

Information pertinent to both AYK SSI Project #1333 and the previous AYK SSI Project (#601) will be noted below.

Objective 1. To describe the changes observed in a) salmon resources and b) the environment as related to the sustainability of salmon resources in the region.

Results obtained towards meeting this objective began with compiling historic information and documenting TK. Current and historical information regarding environmental change and variation in salmon resources was obtained from information in the Eskimo Heritage Program archives, Alaska Department of Fish and Game (ADF&G) reports, other literature related to salmon and the environment, and from the photographic archives of the Carrie McLain Memorial Museum. This information was used to provide context to the interviewers during the course of the research. Local experts were interviewed in 9 region communities. Fifty three interviews with 58 people were conducted (5 married couples were interviewed in pairs). In this report, data from 45 interviews from 49 people in 8 communities are discussed. Tribal councils recommended which individuals should be interviewed in each community. A semi-structured interview protocol was used for all interviews. Kawerak Natural Resources Division staff, the Kawerak Elder's Advisory Committee, the Kawerak Natural Resources Committee, each participating tribal council, local assistants, and several fisheries biologists and social scientists in Nome and elsewhere reviewed and or contributed to the protocol. USGS 1:250,000 maps were used as prompts during virtually every interview as a reference point for local water bodies and landmarks. All local experts signed consent forms prior to being interviewed. Each of the interviews was digitally recorded. For each interview, the principal investigator and a local assistant were present. An intern was also present for interviews in Koyuk, White Mountain, and Wales. All interviews but one were conducted in homes; one was conducted in a tribal office. Each of the interviews (other than the Savoonga interviews; see Methods) has been transcribed and saved in .doc format, and are searchable by key word. All of the transcripts can be imported into social science data analysis programs such as Atlas.ti, which allows for more sophisticated searches and analyses.

Describing changes observed in a) salmon resources and b) the environment as related to the sustainability of salmon resources in this region, as is done in this report, provides information essential for addressing major research and management questions and will provide a means for gaining greater understanding and depth of research topics. Documenting and analyzing this region's TK about salmon and the environment assists in advancing our understandings of the region's ecology, and facilitates interfacing TK with Western science hopefully to the benefit of communities, researchers in multiple fields, management, and policymakers. The interfacing of social and biological science provides the

opportunity for a more comprehensive answer to research questions. Also, because TK encompasses all elements related to resources and environment, the knowledge is ecosystem-based.

The main benefit to the resource, and those dependent on the resource, is to provide indigenous perspectives on variability of fisheries resources and the environment in the Norton Sound/Bering Strait region, and to put that knowledge into a geographical context. Providing for interplay between TK and western scientific research results in a more complete understanding of variability, and of the factors that may influence fisheries resources and community access to, and use of, those resources. In addition, the inclusion of local residents in the research process facilitates their understanding of, and commitment to, the research and management process, and it will help to improve collaboration and communication between communities and other entities. This project will benefit local residents because they rely on salmon fishing for subsistence.

The primary objective of this project is to describe observed changes to salmon resources and the environment in a geographic context so that information can be applied to aid in current fisheries challenges, including fisheries management and freshwater and marine ecosystem research. The intent is to augment ongoing and new biological research with social science, as well as to contribute to social science research, to attain a more complete understanding of these changes and their impacts. This objective was successfully completed by documenting TK, placing it in context, and tying it into existing knowledge, which helps to offer a multidimensional understanding of the ecology of the region and, specifically, salmon populations over time. Steps leading to the accomplishment of this objective include the completion of the project interviews, participant observation, community meetings in the 9 original study communities, data analysis, follow-up community workshops with 8 communities, and report writeup. The dissemination of this report, as well as information contained within a related conference paper (B. Raymond-Yakoubian and J. Raymond-Yakoubian 2015) and a planned journal article, are the final markers of the successful accomplishment of this project objective.

Objective 2: To identify patterns regarding the location, timing, and characteristics of the variability of salmon resources in the Norton Sound/Bering Strait region related to the observed environmental changes.

TK interviews with local experts were conducted to discuss salmon and ecosystem processes in the region. As described above, 53 interviews in 9 communities were conducted on these topics (45 of which from 8 communities form the basis of the data presented in this report). Interviewees were asked about changes in salmon populations, vegetation, land and sea animals, and the environment and climate in general. Based on this data, patterns pertaining to variability in salmon resources in relation to observed changes throughout the region were identified, reviewed at community workshops in 2014, and then further analyzed. The presentation of this data and the analysis thereof are discussed in the Results section of this report.

Objective 3. To increase local capacity and promote an understanding of fisheries research, harvest monitoring, traditional ecological knowledge, Alaska subsistence fisheries management, and career opportunities.

One intern was hired specifically to participate in the project during 2008. Arlo Hannigan, from Nome, was hired and conducted archival research, learned about interview methods, participated in and helped conduct interviews in 3 communities (Koyuk, Wales and White Mountain), and transcribed interviews. Additionally, at the end of his internship, Hannigan gave a presentation to a meeting of the Kawerak

Natural Resources Committee (which was open to the public). A second intern, Meghan Topkok, worked for the Kawerak Social Science Program in 2013. As part of her job duties, she assisted with re-initiating this project with 8 of the original study communities, and with the proofing of transcripts. Additionally, a number of other Kawerak staff were involved in this project, expanding the exposure among the local workforce to social science, traditional knowledge, and ecosystems and fisheries research.

The original project for this research helped provide funding to initiate the creation of Kawerak's Social Science Program. This program has now been active for approximately 8 years, receiving numerous grants from a variety of sources and completing a number of projects relating to traditional knowledge in the Norton Sound/Bering Strait region (see the Program website for more information: http://www.kawerak.org/socialsci.html). The creation and development of this Program has greatly expanded the capacity of Kawerak to carry out community-initiated and community-based research.

Local residents were involved in the conduct of the research. This includes the employment and training of local assistants, the participation in the study of TK experts and tribal council members, as well as the internships completed as part of the study's activities. The dissemination of the reviewed and finalized report will also contribute to the educational and awareness aspects of this study, as has the presentation of data from this research at a recent conference on climate change and culture (B. Raymond-Yakoubian and J. Raymond-Yakoubian 2015), and the presentation of the data in a planned publication developing off of that work.

3 – METHODS

Overview

This project was conducted with the prior consent of region tribal councils and individual participants. A letter of informed consent was sent to tribal councils requesting permission to conduct the proposed research via tribal governing resolution. A resolution was received from each tribe. Participation in the research was completely voluntary; individuals were given the opportunity to decline participation with no negative consequences to them, or to decline to continue participation at any time in the research process.

The methods used to collect data for this project were semi-structured interviews with local experts, participant observation of salmon fishing and related activities, and data review workshops with local experts and tribal council members. The interview portion of the project focused on working with expert TK holders in each community. These experts were identified through consultation with the tribal council in each community. Each council provided a list of recommended experts to be interviewed. The methods used to carry out the semi-structured interviews are described below. The interview guide is included as an Appendix. Each interview participant signed a written consent form prior to participating in the project.

Project Timeline

This project was carried out over the course of more than seven years. A brief project timeline is necessary to understand the progression of the project and the time frames and context in which data was collected, analyzed, and synthesized into a final report.

Kawerak applied for initial project funding for this project from AYK SSI in December 2005. In May 2006, Kawerak was awarded funding for the project (under project #601). The initial project proposal was written by Kawerak, with the assistance of staff from the US Fish and Wildlife Service (USFWS). One of the intentions of Kawerak's proposal was to receive funding in order to hire a social scientist to carry out the work proposed in the grant. Once the project funding was received in 2006, Kawerak began to advertise for a social scientist. The project's principal investigator (Julie Raymond-Yakoubian) was hired in October of 2007 to conduct the work.

Work on this project was carried out from October 2007 through April 2009, which was the initial end date for the project award. Because the project work began almost a year and a half after the funding was received (due to the length of time it took to hire a social scientist), and because Kawerak was uncertain that AYK SSI would grant an extension beyond April 2009 to the project, Kawerak submitted a proposal to AYK SSI for additional funding in September 2008 to fund completion of the project as originally proposed. AYK SSI denied this funding request, which would have allowed the work to proceed and the project to be completed. Following this, and after discussions with AYKSSI staff, Kawerak submitted a formal request to AYK SSI in April 2009 to extend the project timeline and to maintain the funding already awarded to the project, so that all project activities could be carried out and a final report could be produced. AYK SSI also denied this request for an extension, and work on the project ended in April 2009. Kawerak was also required to return unspent funds to AYK SSI at this time (funds remained unspent because of the delay in project start-up).

After April 2009 Kawerak was not able to continue work on the project because no funding was

available to do so. In 2012, AYK SSI contacted Kawerak requesting that Kawerak complete the project. AYK SSI suggested that Kawerak would likely be successful in obtaining funding if Kawerak submitted a new proposal for funding at that time. In January 2013 Kawerak submitted a proposal to complete data analysis on the data previously collected and to complete a final report. Kawerak was awarded funding (under project #1333) for this in the fall of 2013.

This project experienced multiple setbacks during its operation. Kawerak initially developed this project and submitted a funding proposal prior to having a social scientist on staff. The intent was to hire someone as soon as funding was obtained, but this did not happen until over a year later. It can be difficult to find qualified individuals to fill such positions in rural locations such as Nome.

Also, as noted, the project had to cease activities in early 2009 because AYK SSI did not grant an extension of the deadline or allow Kawerak to continue to access already-awarded funding. Activities completed up to that time included interviews with salmon experts in nine communities (Brevig Mission, Diomede, Golovin, Koyuk, Savoonga, St. Michael, Unalakleet, Wales, and White Mountain). The majority of the interviews were also transcribed by this time, with one important exception. Interviews with experts in Savoonga were conducted primarily in Saint Lawrence Yupik, with brief English translations. Kawerak intended to hire a Saint Lawrence Yupik speaker to fully translate and transcribe these interviews so that they could be analyzed along with the data from other communities. Though several individuals were hired, these interviews were never fully translated or transcribed. The new funding awarded to Kawerak in 2013 was for analysis and report-writing based on the information from the eight communities where the transcription was complete (i.e. not including Savoonga). The original Savoonga materials are on file at Kawerak.

Another setback the project experienced was the unfortunate passing of multiple project participants between the time of the original interviews (2008-2009) and the re-initiation of the project in 2013. As a result, project staff were not able to, obviously, make followup inquiries with them about their data, nor could they participate in the more recent data review workshops and draft report review activities. The large gap between the original data collection in 2008-2009 and the re-initiation of project activities in 2013 presents a number of additional problematic issues as well. To name a few, there are potentially issues of recall introduced, the problems of new information from the interim period becoming part of the dataset as well as influencing newer participants' perspectives during reviews, and the problem of not only some original interviewees having passed away but also others having moved away and being unable to be reached. Issues such as these made the review process as well as data analysis a more complicated endeavor.

Work to complete this project (#1333) began in the fall of 2013. This work, described further below, included data analysis, community data review workshops, and the writing of the final report. All of this work took place from fall 2013 through summer 2015. Kawerak hired a contractor (Brenden Raymond-Yakoubian) to assist with these aspects of the project work, as the original principal investigator was engaged in other research activities at the time when Kawerak was encouraged to apply for funding to complete the project.

Study Design

The principal investigator (Julie Raymond-Yakoubian) requested that each tribal council provide a list of local experts to be interviewed for this project. The list provided by each tribal council was used to contact experts and ask for their participation in the project. Local experts were defined as individuals

who have lived in the area for an extended period of time and are intimately familiar with fishing for salmon. These are individuals who are considered to be experts by their peers. Each local expert was paid an honorarium for participating in an interview in recognition of their time and knowledge.

The principal investigator made an initial visit to each community to introduce the project in detail to the tribal councils and the community, and to answer questions about the project. Tribal councils had previously been asked to provide the names of potential local assistants to help conduct the study. Some interviews for the job of local assistant took place during these visits, while others were conducted over the telephone.

The principal investigator made an additional trip to each community to conduct interviews with local experts. These trips lasted approximately one week in duration, and some communities were visited more than once. The principal investigator also participated in fishing-related activities with community members. This participant observation provided an opportunity to engage with subsistence fishers during preparations to go fishing, the practice of fishing, preparing and storing fish, eating fish, and talking about fish. The principal investigator gained valuable insights and heard important perspectives on particular species, harvest methods, and other topics.

After re-initiating the project in 2013, and conducting preliminary data analysis, project staff also conducted a data review workshop in each community (described below). All local experts that participated in the project and the current tribal council members were invited to participate in these workshops. Some tribal councils also invited other community members that they thought had relevant knowledge or expertise to attend the workshop. Local assistants also attended the workshops.

Initial project meetings, expert interviews, and participant observation activities took place during 2008 and early 2009. Data analysis, community data review workshops, and report writing took place from fall 2013 through summer 2015.

Data Collection

The semi-structured interviews were conducted by the principal investigator. She was assisted, at various times, by a local assistant and/or an intern. Local assistants were hired in each community by Kawerak to assist with interviewing and to act as a local guide and liaison. The principal investigator trained each local assistant how to use the interview guide and operate recording equipment. Two interns were also hired over the course of the project to assist with interviewing, transcriptions, and other project activities. The purpose of the internships was to provide job experience to young adults with ties to the region and to introduce them to social science research and research methods. The internships were advertised through local tribal councils, schools, and other venues.

The interview guide was developed in collaboration with the tribal councils. One of the interns and the local assistants from each community also provided input for the interview guide. The interview guide covered a number of topics:

- Changes in salmon population numbers
- Changes in salmon species health
- Changes in salmon species distribution
- Current and previous salmon harvest locations
- Current and previous salmon harvest methods and strategies

- Processing, storage, and preparation methods for salmon
- Cultural, nutritional and economic importance of salmon
- Habitat preferences, spawning areas, and seasonal movements of salmon
- Observations about climate changes that may impact salmon species or the subsistence harvest of salmon species
- Changes in the environment/climate in and around each community over the lifetime of each interviewee (e.g. timing and character of spring ice break-up, water temperatures, wind patterns)

The principal investigator digitally recorded each interview (with permission of the interviewees). Individuals involved in conducting interviews were Julie Raymond-Yakoubian of Kawerak (who led all interviews), Arlo Hannigan (intern, Kawerak), Matilda Nayokpuk (local assistant, Brevig Mission), Arthur Ahkinga (local assistant, Diomede), Carol Oliver (local assistant, Golovin), Laverne Kimoktoak (local assistant, Koyuk), Rosina Lockwood (local assistant, Saint Michael), Michael Eakon (local assistant, Unalakleet), Christine Komonaseak (local assistant, Wales), and Mary Darlene Charles (local assistant, White Mountain). The interviews were transcribed by several individuals during the course of the project (Arlo Hannigan, Eva Menadelook, Blaire Okpealuk, Julie Raymond-Yakoubian, Erika (Eaton) Rhodes, Anahma (Saito) Shannon, and Meghan Topkok, all of Kawerak). Each local expert was provided an opportunity to review their transcript prior to it being finalized and archived by Kawerak. The Eskimo Heritage Program at Kawerak is the repository for the interview audio and transcripts. All project interviewees received an honorarium for their participation.

In 2014 Kawerak held data review workshops in seven of the eight communities (those noted above, minus Diomede). Brenden Raymond-Yakoubian (private contractor), Julie Raymond-Yakoubian (Kawerak), and Katya Wassillie (Kawerak) were involved in conducting these workshops for Kawerak. These workshops were an opportunity to review the data initially collected in each community in 2008 and 2009, to correct mistakes or misinterpretations and, minimally, to collect additional data. All salmon experts that were interviewed for the project were invited to participate, along with all current tribal council members in each community; some tribal councils also requested the participation of several other community members as well. Kawerak accepted all tribal council recommendations for individuals to participate in these workshops. Because the intent of these workshops was to review existing data, participation was limited to those groups just noted. (Community meetings to discuss the project, which were open to the public, were held at least once in each participating community during the project's original data collection efforts.) Prior to holding the workshops, a summary of the data from each community was created and organized by topic (similar to the interview guide) by Brenden Raymond-Yakoubian and Julie Raymond-Yakoubian. These data summaries were then used during the course of the workshops to structure discussions. Workshop participants were encouraged to keep the summaries and to contact Kawerak if they had additional comments about the information in the summaries after the workshops concluded. For the community of Diomede, a meeting was held in Nome with the one surviving Diomede local expert (who now lives in Nome) and his wife. The Diomede tribal council was sent the Diomede data summary, but did not comment on it. All data review workshop participants, as well as the Diomede meeting participants, received an honorarium for their participation in these events.

Data Analysis

Brenden Raymond-Yakoubian (private contractor) and Julie Raymond-Yakoubian (Kawerak) conducted the data analysis and report writeup for this project.

Atlas.ti qualitative data analysis software was used to code and organize the interview transcripts. The software was used to identify patterns and trends in the data through keyword, co-occurrence, and other queries. A list of codes was created (39 total) and applied to the interview data. This was an iterative process in which each transcript was reviewed multiple times during the coding process as codes were created, deleted, combined and otherwise revised (e.g. Friese 2012). The 39 codes were applied to approximately 1500 individual quotations. Quotations were organized by code, community, and other factors during the process of analysis to determine patterns, trends, and anomalies in the data.

During analysis, summaries of information for each salmon species and for each potential topic of interest (such as climate data, fish processing, etc.) were created for each village. After compiling these summaries, Kawerak worked with the tribal coordinator in each community to schedule data review workshops.

During the workshops, local experts, tribal council members, participating community members, and project staff reviewed and discussed the summaries. Kawerak staff also asked workshop participants specific questions about specific data points that needed clarification or elaboration. The summaries were left with workshop participants, and they were encouraged to review the material again and to report any changes or additions that were necessary to Kawerak. Each workshop participant was paid an honorarium for their time and participation. Kawerak also provided food for participants during the workshops as well as door prizes at the conclusion of the workshops.

Workshop participants signed consent forms (with one exception), and information and feedback provided by participants was incorporated into this report. Draft copies of this report have also been reviewed by project participants, workshop participants, tribal councils, and Kawerak Natural Resources Division and Administration staff.

4 – RESULTS

The results of this project are presented below, broken down by the communities within which the data was collected. The data collected from project interviewees and other participants is summarized below to present a summary of each community's perspectives on a wide variety of topics relating to the project's objectives. (In addition, interspersed throughout are topically-relevant quotations from project participants.) These topics include information about each of the following:

- The 5 salmon species (king, silver, pink, chum, red). This includes general information, information about biology and behavior, distribution, population, and harvest.
- Information about salmon in general. These include observations which speak to some (though not all) patterns relating to all 5 species but were not mentioned in the specific species' sections, observations about salmon which were not attributed specifically by interviewees to one particular species, and information which was not included in the specific species' sections for one reason or another.
- Information about the preparation and use of salmon. This includes information about the various uses for salmon and ways that salmon are "put away," a local term covering ways in which salmon are processed, cared for, stored, and prepared for their various uses (harvesting is also included within the concept of 'putting food away', though that information is presented in the harvest sections relating to salmon).
- A section on information about a variety of environmental observations and knowledge. The information in these sections paints a broad picture of TK about the environment, with a substantial amount of information which is relevant to salmon both directly and indirectly. Information which is also not necessarily connected with salmon but speaks to important trends and changes noted by local experts about the environment are also included as well.
- Information and discussion about broader social, cultural, technological and economic events and patterns which are related to salmon as well as the environment.
- Information and discussion about management, commercial fishing, sport fishing, science and TK, local difficulties and challenges related to salmon and the environment, and recommendations for a variety of audiences (including managers, policy makers, researchers, local entities (e.g. tribes), and other or general audiences). Regarding the recommendations, it is suggested that all audiences read the entirety of these recommendations, as even though a particular recommendation might lie outside the normal scope or interest of a particular audience (e.g. managers), it may provide that audience with valuable information towards understanding local concerns and contexts.

The information noted above is presented below by community in alphabetical order. The communities are: Brevig Mission, Diomede, Golovin, Koyuk, Saint Michael, Unalakleet, Wales, and White Mountain.

Due to the holistic nature of TK observations, it is difficult to adequately condense and present such knowledge in a format such as a report. The divisions below between sub-sections were created for analytical purposes only, and the reader is advised to keep in mind that information relevant across categories may be found in multiple areas.

A discussion of cross-community patterns amongst these data, this TK in light of existing social science and bioscience literature, and recommendations which are not community-specific are presented in the Discussions section which follows this Results section.

Brevig Mission

Brevig Mission is located approximately 65 miles northwest of Nome, on the north shore of Port Clarence, across from the neighboring village of Teller. Brevig Mission has no road access to Nome and must receive all goods by air or by barge in the summer. The 2010 US Census indicated that Brevig Mission has a total population of 388, of those 201 are male and 187 are female (ADCCED 2015). Approximately 91% of the population is American Indian or Alaska Native (*ibid.*), primarily Inupiat Eskimo.

Figure 2: Spring subsistence activities in Brevig Mission.

Regarding King (Chinook) Salmon

Comments about king salmon biology and behavior
Kings that are harvested in the Brevig area can vary in size.

Comments about king salmon distribution
While kings can be found in the Brevig area, they bypass the areas that Brevig people usually fish. Interviewees were not sure where kings are going to spawn.

Kings may be starting to come in under the ice, especially when there is a south wind.

It was noted that people who fish late in the season get jack kings. They come as a separate run.

It was reported that kings had recently gone up California Creek, which was unusual.

Comments about king salmon population
Kings are found in the Brevig area, but not in great numbers. It was reported that they have been in decline since the 1980s. Jack kings are also declining.

Comments about the harvest of king salmon
People like to eat kings, even if they are fatty. Also, jack kings were noted as a preferred fish.

Most Brevig people do not catch very many kings. Those that catch kings usually get them in Port Clarence or Grantley Harbor, not in the rivers. It was noted that a very good king day prior to the late 1980s would have netted 30 kings. Kings get caught in other nets, no one uses king-specific nets.

Regarding Silver (Coho) Salmon

General comments about silver salmon
Sores and worms are being seen on silvers. However, it was noted that they are seen on all fish, including tomcod and smelt as well. The worms are in the flesh, and are milky. Small worms are also seen sticking out of the flesh.

Comments about silver salmon distribution
It was noted that silver salmon spawn in rocky/gravelly areas.

It was noted that there are possibly two runs of silvers in the Brevig Mission area.

Silvers go up rivers, and some were noted as coming back down rivers as well.

Comments about silver salmon population
There is concern that after people started using jet units, silver salmon eggs would get washed away or disturbed, which decreased the number of silvers returning.

There was insufficient data to determine if there is a consensus on the status of silver populations in the Brevig Area compared to the past, and what that status is.

"Interviewer: Do you remember from when you were younger to now if you've seen the salmon populations go up or down? RR: That wasn't very noticeable. Because most times, in those days there was quite a bit of fish. That was before they come up with all these outboard motors and these jet units on the motors. They lower jet units on the motors when they go up river. Some fish are spawning among the rocks or something like that, and these lower jet units on the motors would wash them away or pick them up. And when that started happening they started getting fewer. Interviewer: Any particular species of salmon that that happened to? Chums or… RR: Mostly silvers that we catch along the American/Agiupuk River."
-Robert Rock, Sr.

Comments about the harvest of silver salmon
Silvers were noted as a preferred fish.

Silvers are harvested along the beach and in rivers. They are mostly caught along the American/Agiapuk River and on the beach; silvers are the predominant fish caught on the beach. This

is why people would prefer to set out nets from the shore in the form of a '7' (though current regulations require fishers to set nets straight out). One issue related to harvesting that was noted is that people stop fishing when it rains, and that is also when silvers arrive.

Regarding Pink (Humpy) Salmon

General comments about pink salmon

Worms and sores are being seen with all salmon species, and with other species of fish as well. Additionally, it may be the case that in the past 10 years or so more worms are being seen with pinks than before.

Spotted seals have been seen corralling pinks near the spit.

"Interviewer: Was there a particular salmon species that you use more than others of? HS: Mostly red salmon and we like to eat red salmon and humpies. We don't care too much for dog salmon but we still dry them."

-Helena Seetot

Comments about pink salmon biology and behavior

It was noted that the size of pinks is variable, which may explain why varying responses were given to questions about whether or not pinks have changed in size over time. Additionally, net size can impact the size of pinks that are harvested. It was also noted that Brevig doesn't see the long skinny pinks they used to anymore.

Pinks go further up rivers, by the silvers, to spawn.

It was noted that if it gets stormy enough, rough water can force the eggs out of their beds.

The pinks that arrive early are fatter.

Comments about pink salmon distribution

Commonly pinks can be seen migrating through the Brevig area in the early morning or late at night. It was also noted that they travel along the shore during the evenings.

Pinks cut across from Point Jackson to Teller in their migration route, but they can be caught along the beach as well.

There is some variation in what people are reporting for the spatial distribution of pink salmon. Pinks can be found almost anywhere in the Brevig area, especially down across Port Clarence bay. Pink salmon have started using California Creek in the past 20 or so years, which they did not do in the past. Hardly any pinks go into Sunset Creek now, though they did up until about three years ago; people used to get them there late in the year.

It was reported that Brevig used to get pinks every fall, but that they hardly get them anymore.

It was stated that pinks will spawn wherever high water takes them. High water can also wipe out egg populations; streams closer to saltwater may be impacted more by high water events.

"Last summer we didn't dry as much like we did the year before. We dried lots of humpies. I don't know why but the fishing was kind of different last summer. I think they were catching them more over there at Nook right across from Teller, more than here. I think they always cut across, you know, from Pt. Jackson to Teller. Right where they go into Grantley Harbor."
-Rita Olanna

Comments about pink salmon population
In general, an increase in pink populations was noted. This can, however, vary from year to year. It was stated that Brevig gets a lot of pinks in even years, and hardly any in odd years.

Jet units may be impacting pink salmon spawning areas by disturbing eggs.

Comments about the harvest of pink salmon
Pinks are preferred for harvesting because they dry fast and can be put away before rain usually arrives.

Fishers let the first pinks pass because they are oily, though not always. Pinks are good to harvest because they dry fast and are harvested before summer rains begin. Large pinks take longer to dry.

In some years, more pinks can be caught at Nook than at Brevig. Some people also seine for pinks in the fall on the Agiapuk River.

Some people catch a lot of pinks by setting their net along the shoreline.

Small mesh nets are good for harvesting pinks. They can also be harvested in dog salmon nets.

"I was kind of naive in that, OK I'll let the first salmon pass through, thinking that the red salmon would just continually make it. They do continually make it but they decrease numbers as end of July comes around and then goes into September you know you get different species. I seen quite a bit, number of pink salmon that kind of go through we see them on a common [typical] day early in the morning or late that night early in the morning passing through. And we just kind of let them go because we're not used to eating that oily fish right from the start. I heard in other places that they like it a lot, maybe like St. Lawrence Island that's kind of what they prefer, a fat and oily fish."
-Elmer Seetot, Jr.

Regarding Red (Sockeye) Salmon

General comments about red salmon
Some changes have been noted with the health of red salmon, particularly in appearance or an increase of sores, tapeworms, and scars. People have seen tapeworms in reds for several decades, but in the past 10 or so years there has been an increase. Some people remove the worms and keep the fish, and some only give these fish to dogs. It was also noted that with reds people will cut around worms because the reds are so tasty and are a preferred fish.

A gas-like taste was noted in red salmon bellies a few years ago, but only happened that one summer.

"Interviewer: Have you noticed any changes in the health of salmon? HS: Some of them always have like sores or round sores […] I don't know if it's from if they get snagged but those snagged ones always have long line and some of them the sores are like this, round circles. And I don't know about

the tapeworms, lots of them got lots. Interviewer: More than before? HS: Mmm hmm and in the meat. Lots of them always have. You always notice those have lots worms come out of them. I always just take them off. Especially if it's the red salmon."
-Helena Seetot

Comments about red salmon biology and behavior
The first red salmon that arrive are fatter.

Red salmon lose some of their fat as they travel through the river system. When they do that, the fish can get pretty soft.

Reds are smaller than they used to be. Brevig used to get some very large reds; some are still big, and some are smaller than they used to be, like they are not fully grown.

It was stated that reds are very fast swimmers and that they avoid nets.

"I've gone as far as up to Pilgrim River to try to catch sockeye red salmon because as they go through the river system they lose some of their fat and when they do that some of the fish is pretty soft when it dries out so it doesn't kind of get dried hard."
-Elmer Seetot, Jr.

Figure 3: Project workshop participants in Brevig Mission.

Comments about red salmon distribution
Reds are reported as passing by the Brevig area on their way up to Salmon Lake. Reds spawn on,

among other waterways, the Pilgrim River, and in Salmon Lake. They spawn in different areas than where silvers spawn.

It was noted that reds started showing up in Bering Creek a little over 20 years ago, and they had not been there previously.

The first few weeks of July is considered a good fishing time for reds, and sometimes as early as mid June. They start to decrease by the end of July, and by the time September comes around a different species is in the area. There is only one pulse of reds.

Reds were reported as mostly coming in with the current, following it in.

"The ones that are camped here across from Teller always tell me there were lot of red salmons but they were bypassing us here at Brevig so Henry and I went to Pt. Jackson and filled up my container. It's a 30 gallon container, just with red salmon bellies last summer. So we made it again this last year and I don't know what will happen next year."
-Rita Olanna

Comments about red salmon population
In 2008 it was reported that the population of reds can fluctuate, but in general they have increased over time. In 2014, however, it was reported that the population of reds is decreasing.

The Salmon Lake fertilization was reported as not resulting in increased harvests in Brevig, perhaps because of the path they take through the area. It was also stated, however, that people outside the community think Brevig gets a lot of red salmon, but really they don't. People noted that the Norton Sound Economic Development Corporation (NSEDC) is trying to get commercial fishing for reds started in the Brevig area; however, Brevig people estimated that there are only about 8900-9000 reds that come to the area.

Comments about the harvest of red salmon
Some people prefer and target reds. They may be considered the most preferred salmon species in Brevig. Reds are harvested by Brevig residents in a number of places, including Grantley Harbor, Tuksuk Channel, Point Jackson, in the Pilgrim and other area rivers, and on the north side of the spit. Most people don't harvest reds in the Kuzitrin. Some will get as many as they can as they go through the Brevig area or up to Nook so that they don't expend too much gas. Most red salmon are harvested along the north side of the spit. Red salmon seem to be taking a shortcut at the spit in their migration route rather than going along the shore. Reds are also now caught in the Agiapuk/American River, but weren't in the past.

Nets can be set out when the ice goes out. This can be done in mid-June.

Whether one gets reds, and whether they are male or female, is dependent on the mesh size of the net used (smaller nets get smaller fish and females, while larger nets get larger salmon but females get through).

People may let the first fish passing through go by because they aren't used to eating the oily fish found at the beginning of the run. Additionally, as reds go through the river system, they get leaner. People prefer less oily/fatty fish.

Early morning and late afternoon were identified as good times to harvest reds.

"Interviewer: What about rain, has that been an issue for you? ES: Most of them try to catch their fish June, July because later part in July that's when, you know, we get rainy season into August. When you keep them out too long and they're not completely dry they have a tendency to mold. Some of them you can just brush off, especially for our red salmon that we kind of target."
-Elmer Seetot, Jr.

Regarding Chum (Dog) Salmon

General comments about chum salmon
People focus on and know about certain salmon species more than others. For example, while some focus more on reds, others focus more on chums.

Comments about chum salmon distribution
Chums are found at Brevig and through the Agiapuk River system. Chums (along with pinks, and possibly some other fish as well), have started to be seen in creeks such as California Creek that are further down the coast, which had never been seen before; this development started about 20 years ago. Chums have also started spawning in Shelman Creek, which is a change; this may have started around 2000.

"Interviewer: Have you seen any changes in the, where the runs are happening? DS: Yes, I did. I saw dog salmons spawn in Shelman Creek. Behind the road over there, so that's unusual. Otherwise, trouts been always going there whenever they can I guess. Interviewer: When did you start noticing them spawning there? DS: 2000, around 2000. There was a trout and a dog salmon. And some of these like California Creek, downriver, they're getting more fish. Different species, what we never see. Interviewer: Do you know what they are? DS: Mostly dog salmon and humpies. Interviewer: And when did you start noticing that they were going into those creeks? DS: Within the last 10, 15 years."
-R. Delbert Seetot

Comments about the harvest of chum salmon
Some people prefer chums to kings because they are less fatty/oily.

It was noted that you can catch multiple types of salmon in nets designed for one type, but it is ideal to have a net that is designed for the appropriate salmon if you want to get that kind. For example, when using a chum net, you can also get pinks. It all depends on the mesh size.

"I think my parents preferred the [chum] salmon compared to the king salmon because there was just too much oil in that fish before they migrate up north or up the streams."
-Elmer Seetot, Jr.

Regarding Salmon in General

General comments about salmon in general
Several people felt that there had been little or no observed changes to fish health over time. One commonly observed change, when noted, was that more worms are being noticed starting between about 10 to 20 years ago. These worms are scraped off during processing, and the fish can still be

eaten. It was also noted that some fish are appearing which are deformed (for example, having parts of their anatomy missing). Other health-related problems being seen on some salmon included skin sores (a new development), cysts, and injuries from predators. Worms and sores are being seen with all salmon species, and with other species of fish as well.

There is a local preference for less oily/fatty fish. This is for reasons relating to ease of drying as well as taste preferences.

Of the salmon species, reds and pinks are probably the most preferred species for consumption.

Some people target and know more about certain species of salmon more than others while others target and know about different species instead; this varies from person to person and family to family.

It was stated that jet units can possibly impact salmon as well as other species, including those on land because it can be heard from so far away. It was noted that people in Brevig don't have boats with jet units because they cost too much money, and that those that have them are Nome people who come over to Brevig.

"Interviewer: Have you noticed any changes in the health of the salmon? DS: No, other than they got those little worms in them. Some of them got lots of them and some of them are, they've got a lot of marks from you know, animals out there. Interviewer: When did you start seeing those worms? DS: About, let me see…maybe around, I saw more of them maybe around 95. But you know they've been there ever since…but some of them have lots too. Interviewer: Do you use those fish when you catch them? DS: Yes, I do. You know they come out, they come out and then you pull them out."
-R. Delbert Seetot

Comments about the biology and behavior of salmon in general
There is a difference of opinion about whether there have been changes to the size of salmon over time. Some have noted they are getting larger, while others have not seen any changes to their size.

The first fish arriving of any species was noted to be more oily.

It was stated that silvers, pinks, and chums will eat other fish.

Comments about the distribution of salmon in general
In 2008, it was reported that the sequence of runs in the Brevig area was kings, then silvers and reds coming in at around the same time, then chums, and then pinks. However, in 2014 it was noted that kings come first, then reds and pinks come together, silvers come after the reds, and chums start coming in with the reds running as well. It was noted in 2014 that the timing and distribution of reds has changed a lot over the years, and that the perceived timing of the runs depends a lot on where one is fishing. The latter caveat may apply more broadly to the perception of more than just the timing of the reds run; one person gave this caveat while noting that in 2014 they got chums before a red that year.

Jack kings come later than regular kings. They are in effect a second run of kings.

Salmon may be ready to spawn earlier than they once were, and this may be related to warmer water. Species that return to the Agiapuk River may be ready to spawn before they reach the river. It was noted that it seems like salmon are making their runs earlier.

Run timing depends on when the ice goes out. Salmon always come right after breakup in the Grantley Harbor/Port Clarence area. Some felt that the run timing is the same as it's always been, while other felt it is earlier than it used to be. The length of the runs was also reported by some as lasting the same amount of time as in the past, or by others as shorter than in the past.

It was noted that Teller gets salmon first, before Brevig Mission.

Some observed that salmon are going all over the place now, including to places they hadn't been before such as small rivers and streams. Others, however, had not observed this. For example, chums and pinks now go into California Creek, which it was said they did not used to do.

As noted earlier, most red salmon take a shortcut across Port Clarence to get into Grantley Harbor rather than going along the shore. People are still able to catch reds and other salmon species along the shore, however.

"RO: [...] hardly any people go up to the place where we fish where they spawn, to Agiapuk River, to American River, they'll go, we saw lots of them passing last year from our cabin. We'll just look in the river and you'll see schools and schools of salmon just splashing but... Interviewer: And more people used to go up there to … RO: Yep, no more, hardly any even from Teller and Mary's Igloo. They used to just fish among each other, the villages, Teller, Brevig and Mary's Igloo, camping on the, along the river to seine and dry fish. Interviewer: So why aren't as many people going? RO: I think their tradition is dying down or something. You know young people don't try. They just want to do it the easy way, get it from maybe somebody. But I try to show my family how to, you know, work on the fish and put them away."
-Rita Olanna

"Interviewer: Do the runs start at the same time as they did when you were younger? RR: Pretty much, but one thing that I did notice was that when they start coming in to Port Clarence is when the ice goes out because I remember my dad told me to wait until about the end of June, for my sisters birthday, that's when he wanted to set the net out. I didn't say anything to him, but I notice that there was no more ice floating around from up here on the tundra. I notice that all the ice was gone, I went ahead and set the net, even though he told me to wait another week to week and a half, something like that. But soon as I set it out, we did catch fish. After that he don't tell me just when to set it. [laughs]"
-Robert Rock, Sr.

Comments about the population of salmon in general
There were varying opinions about whether there have been changes to salmon populations. These views ranged from: substantial decreases, to not many changes (mainly attributed to the lack of commercial fishing in the Brevig area, and the fact that Brevig people are conscientious about not leaving nets out), to increases.

A number of things were seen as impacting the size of salmon populations. It was stated that arguing can lead to lower salmon returns. Other factors noted include water temperature, predation, commercial fishing, sport fishing, and pollutants, among others. (It was also noted that Elders and others have instructed that if you stop harvesting animals, they will decrease in number; there was disagreement about whether or not this also applied to fish.)

"Try to make sure you don't argue about it very much. That's what I told the Norton Sound fishermen - 'I guess you guys argue about your fish so much that that resource is not there for you.'"
-Elmer Seetot, Jr.

Figure 4: Fish nets stored on a rack in Brevig Mission.

Comments about the harvest of salmon in general
It was reported that Brevig and Teller do not want commercial fishing; subsistence fishing is the priority. Brevig people reported that they were generally happy that there has been no commercial salmon fisheries in their area.

People from Teller and Brevig will communicate with each other about where fish are. For example, Teller residents once told Brevig people that the reds were bypassing Brevig, so some Brevig people went to Point Jackson and were able to successfully harvest them.

People like to get reds and humpies from around Nook, so they don't have to travel as far.

Some people conduct subsistence activities alone, while others work as a team.

Harvests have declined compared to, at least, times dating back all the way to the 1930s. Harvest declines may be connected to population declines, but are also related to decreased participation in salmon fishing. Also, people don't dry as many fish as they used to in the past because they don't use

dog teams for transportation like they did in the past.

It was noted that there have been a number of changes to fishing practices since people were younger. Among these are ADF&G regulations, including not allowing people to set their nets in a '7' shape (as opposed to setting them out in a straight line). People are now not able to get as many salmon as they once were. It was also noted that hardly anyone goes to where salmon spawn anymore in terms of people from Brevig, Teller, and Mary's Igloo. People used to camp, seine, and dry fish along the river, but this is done much less frequently today.

There are a variety of factors that impact participation in salmon fishing including jobs and age. With regard to the former, having wage employment can impact participation, as can whether or not the job is full or part time. With regard to the latter, older people tend to fish for salmon more than younger people today. Additionally, as will be discussed shortly, the number of areas people are fishing at for salmon has decreased, and is now more focused on areas closer to the village. Other important factors related to participation include young people not being taught how to fish and also not being interested in salmon fishing. A number of other factors which can impact participation in fishing and have been identified as factors which have led to a decrease in salmon fishing participation include weather conditions (including there being less calm weather now, shorter stretches of nice weather, and rainy weather making it difficult to put away fish and leading to more spoilage) and the replacement of dog teams with motorized transportation.

Other weather conditions can also impact salmon fishing. A south wind will negatively impact harvest activities, making it too rough to set one's net out. People especially make sure to pull their nets out when there is going to be a south wind. It was also noted that how a hunting season fares can impact plans for fishing. For example, a bad ugruk hunting season may lead people to head to fish camp instead, and lead to a heavier reliance on other resources like salmon.

Larger fish take longer to dry. In general, leaner/less oily salmon are preferred. However, people do like kings even if they are fatty.

One way that people time their harvests is to match up with the condition of the fish. For example, people who want less oily/leaner fish may not fish during the early part of a run, when fish are reported as being fatter. They may also travel to other locations such as the Agiapuk River, where fish tend to be leaner after their travels to that point.

It was noted that in the past, salmon fishing used to be done before berry picking.

It was reported that people used to be able to fill up racks in a day, but that it is hard now to do that.

Some Brevig fishers try to catch their fish in June and July (especially the first three weeks of July), as the rainy season comes in August, and if you keep the fish out too long they have a tendency to mold. Salmon may be running, and spawning, earlier. As stated earlier, it was noted that some salmon seem ready to spawn when people are fishing in July, even before they reach the Agiapuk River, and it was hypothesized that this may because of warming water, as people used to fish until September.

It was noted that it can be a good idea to do one's fishing in the late afternoon or into early mornings because you can see the wakes of fish that are passing through.

It was noted that salmon use the entire Imuruk Basin and its tributaries, and therefore people have always fished in these areas. There has been a contraction of salmon fishing to areas closer to Brevig Mission in more recent times, though. That is to say, the number of areas people are fishing at for salmon has decreased, and is now more focused on areas closer to the village. Frequently used areas for fishing now include in front of the village, the Agiapuk River and its mouth, and the spit. Areas such as the Kuzitrin River area are less frequently used.

People have been taught that they have to abide by the fishing regulations, even though this makes it difficult to harvest sufficient quantities of fish. Multiple people reported that they are told by ADF&G to keep their nets straight (and not set them in a '7' shape), which means they can't catch enough in time before a closure. Interviewees in general reported, as noted above, that there have been a lot of changes to the way people fish since they were younger.

It was felt that people shouldn't leave their nets out all the time when subsistence fishing, even on good days, and should pull it out some days. It was stated that if you catch too many fish, you won't know what to do with them.

"There's a time for everything and pretty much time to harvest. […] [E]verything got its own season and that's the way it's been with me."
-Elmer Seetot, Jr.

Regarding the Preparation and Use of Salmon

Salmon are used for a variety of things. They are caught for subsistence for human consumption, for trading, and for bartering for other subsistence foods. They are also used for dog food, though less now than in the past. Other than fish that is deemed not suitable for human consumption, chums are the species that would be mainly given to dogs. People used to get a lot of seal and salmon for dogs in the winter, as dogs used to be the main means of transportation. When dry dog food was available, it could be too expensive. Dogs are given dried fish, fish with dried backbones and the head on, and, as just noted, fish deemed unsuitable for human consumption (spoiled fish and fish with worms). Some people do eat fish that have worms (after they pull the worms out). Most said that fish with scars would be used for human consumption, though one person indicated they were given to dogs.

The oiliness of fish is a consideration for harvesting and putting away. The first reds that arrive are the most oily of the reds. Late summer chums dry fast. Pinks also dry fast and can be put away before the rain arrives.

People identified a number of means by which salmon are processed, cared for, and stored. This includes drying, half-drying, salting the bellies and then half-drying them, fresh freezing, eating fresh, and making fermented fish heads (fermenting fish eggs and heads in a box). Freezing is more common now than in times past, and it was noted that people vacuum pack their fish as well. It was noted that putting salmon away takes a lot of time and effort to ensure it's done properly. Some say that food tastes better when you harvest and process it yourself.

It was noted that people have to watch the weather and black flies when drying fish. Black flies have increased, and it can also be difficult on hot days to keep flies from laying eggs on the fish, and you have to make sure to clean, salt, and monitor the drying fish. If they are out too long when it is raining, the fish might get put away not fully dried which isn't the best, or they can spoil, get moldy, and turn

black. Spoiled fish would only be fed to dogs at that point (but since many do not have dogs anymore, such weather conditions have the net effect of discouraging people from fishing at all, since the fish won't be put away right). Some people try to catch their fish in June and early-mid July because late July and August is the rainy season.

People also have to be cautious when it is very hot out when they are drying fish, as overly sunny and hot weather can cook the fish on the racks. One approach to dealing with this is to put the fish in the shade when conditions become like this.

"Interviewer: Is looking at the weather something you spend a lot of time doing? DS: Yeah, yep. We've got to. We've got to if we want things to go right. You know like fishing. We want our fish to dry right. Bad weather we've got to think of something to make our fish good you know, instead of letting them spoil."
-R. Delbert Seetot

Regarding the Environment

Rain

It now rains in December and January, which it never used to do before about 30 years ago, which is when the change started to occur.

During the summer, August is the time when the rain comes in. 2014 was reported to have been good in this regard – less rain, that is – in that it was good for drying.

Too much rain is bad for fishing. It can cause berries to ripen early, forcing fishers to stop fishing to go get berries. Additionally, rain and moisture can also ruin drying fish, meaning they either have to be given to dogs or thrown away.

The rainy season can also lead to flooding.

"I was saying […] I hope we get good fishing season this time. Last year the berries got ripe too, the salmonberries, the cloudberries they got ripe early because of too much rain. So we had to quit fishing and try to pick salmonberries. I didn't put that much, we didn't put that much fish away. And it depends on the ocean too, too wavy or rain and got to watch your fish put away, those bugs, lots of black bugs got to clean them everyday or salt them, so."
-Helena Seetot

Snow

The snow used to melt quicker, but now it takes a long time to melt. Snow is locally present until July in some places. Snow can provide a useful and safe source of drinking water. There is less snow now in general than there used to be. It was noted that owing to the low-snow conditions, people aren't able to use snowmachines until late in the season now, and as such 4-wheelers are the main form of year-round transportation.

Wind

There were differences of opinion about whether there have been changes to the wind.

Multiple individuals reported that south wind was bad for salmon fishing. The south wind brings bad

weather, rain, and rough ocean conditions. People pull out their salmon nets when there is a south wind because then it often starts to rain. Also, if the ocean is rough, they may not be able to check their net from a small skiff because the south wind produces rough ocean conditions.

It was stated that you can tell when south wind is coming by looking at the clouds. Elders used to look at the stars (the flickering) as well to predict coming winds.

East wind was stated to always bring a lot of rain, and west wind can bring rain and waves to Grantley Harbor-side camps.

Wind impacts putting fish away, in that it can bring rain and bad weather. It was reported that some people who don't have dogs have been dissuaded from putting fish up because they may spoil if it rains and they don't have dogs to give spoiled fish to. If it rains, even if the fish doesn't end up spoiled or moldy, it might end up that it can't dry all the way before putting it away, producing a sub-par result.

A number of interviewees indicated that the weather changes more unpredictably and/or quickly now. For example, it was noted that it can change suddenly from nice to windy now. It was also noted that in the past 10 years it has been very frequently windy.

"We always just pull it [their net] out when we have south wind because then it starts to rain. That's the only difference we have here between the north wind and the south wind. The north wind brings sunshine and the south wind brings rain."
-Rita Olanna

Climate/Weather Unpredictability and Variability
Several people noted that the weather is less predictable now than it was in the past. It was also noted that the weather can change very suddenly. In the past, the weather used to be good and calm before it changed, but now the changes come rapidly. It was also noted that the weather used to be very nice all the time when current Elders were younger, or that at the least there used to be more long stretches of nice days in a row. Several people noted, however, that the unpredictability of the weather is not really impacting their salmon fishing activities.

Storms
Fall storms have become more destructive.

There used to be more thunderstorms than there are now.

Temperature
In general, temperatures seem to be increasing. The winters were reported to be significantly milder now, and the late winter and spring temperatures noticeably warmer than in the past, with hot spells even occurring in May. Water temperatures also may be rising, and changes in salmon spawning may be related to this. It was noted that water temperatures impact fish migration. Warmer temperatures and warmer water were stated to be a climate-related concern.

Other or General Comments about Climate and Weather
Most interviewees stated that the weather is different now. One noted that his parents had noticed the weather was changing. It was stated that people are seeing the effects of climate change.

The importance of watching and understanding the weather in order to do subsistence activities, such as drying fish, correctly, was noted. This includes understanding natural signs which can serve as weather predictors.

Weather considerations are a substantial factor not only in the harvest and putting away of salmon but also of other subsistence foods as well.

"The weather is so different now."
-Rita Olanna

Figure 5: Fish rack and fisher at Brevig Mission. Photo: Brenden Raymond-Yakoubian.

Ice

Freezeup occurs later than in the past, sometimes very late. Freezeup was stated to now occur sometime in November to December, whereas it used to occur starting in September to October. It was noted that in the last 15 years it has frozen up three times in December, and this in fact seems to be the pattern of the last 3-4 years.

There was some ambiguity, however, about changes with breakup. Some people stated that the ice breaks up earlier now in late May to early June, as opposed to mid June in times past. Others said it is different every year, or is breaking up faster than it used to, or is the same as it used to be (mid-late June) but difficult to predict. There was some consensus on the point that 30 years ago, breakup used to be slower, and now it is quick. The ice also used to go back and forth, but doesn't really do that

anymore. It was also stated that one has to follow the ice out, and go farther out to harvest marine mammals, and that game is not on the ice now.

It was noted that ice is not smooth like it used to be, and there are a lot of icebergs that pile up now. However, it was also noted that people used to see very tall icebergs in the past. It was noted that the characteristics of the ice in the bay depend on the wind; when it is windy, it piles up, when it is calm, the ice is flat. Ice also gets rotten because of the warmer temperatures now. It was noted that ice is not as thick as it used to be. Additionally, it was noted that the Port Clarence ice stays around longer than in the past, going around and around in the bay after it begins to break up. It was additionally noted that the ice between Point Riley and Point Jackson used to stay frozen, but now the ice forms a pressure ridge crack, and during high water it can open up.

Some consequences of changes in freezeup, breakup, and ice conditions in general were noted. First, changes in breakup/freezeup mean people can hunt a little longer now. Second, since the mid-1990s there is no more ice around during the whale migration which would block the whales, so now there aren't a lot of them in the area like there used to be, as they can migrate straight through or wherever they want. Third, more open water means being more prone to high water surges, whereas ice in place would provide more protection from that. Fourth, it was noted that there isn't ice to protect the banks, so people are seeing a lot of eroding banks now. Fifth, it was noted that in mid-October, people used to fish in Grantley Harbor for tomcod and smelt; now, however, those fish pass by before it freezes (when people would be able to go fishing for them). And finally, it was noted that rotten ice is dangerous to travel on, and additionally that a later freezeup is dangerous for snowmachine travel.

It was noted that because of permafrost melting, the ground is slumping in some areas.

"Interviewer: Have you notice if it's freezing up earlier or later? RO: Later. [...] We never had maybe till December last fall. Late freeze up. It used to really start freezing in October. Interviewer: How has that impacted people? RO: It's no good for us to you know, it could be dangerous to go to Teller in December with sno-gos so they always have to go around through Grantley Harbor to go. It's not freezing like it used to start freezing in October it start to freeze now in December."
-Rita Olanna

Erosion
Erosion in the Brevig area has been increasing. This is connected to storms and floods, and the lack of ice to protect the shores and banks from water. Mudslides have been noted lately after large storms, where permafrost slid down and collapsed.

Changes Regarding Other (Non-Salmon) Fish, or Fish in General
People noted sheefish as a recent new species to the area; it was stated that they show up with salmon. Pikes were also noted to be new to the area as well, perhaps showing up with whitefish. Pikes are very common in the river systems of the Imuruk Basin, but previously were rarely seen in the waters near the village. Pikes are felt to be on the increase, especially up near the mouth of the Kuzitrin River. The increase in pikes, which some felt were big increases, may be the reason for other fish decreasing.

In the last 20 or so years people may also be seeing other fish in creeks located down the coast, such as California Creek, in addition to chums and pinks.

There are less herring around now, and people aren't harvesting them anymore. Whitefish and trout

were said to be declining.

It was felt that fish might go further north because of warmer water or algal blooms.

It was noted that people will fish for other fish in addition to salmon while at fish camp, such as whitefish and tomcod. Tomcod used to be important for dog food.

"The sheefish have been showing up the last three years with the salmon. And the pikes, they're showing up right now with the whitefish."
-R. Delbert Seetot

Changes Noticed with Marine Animals
People noted impacts to belugas. They were said to be very sensitive to noise, and it was reported that at least for a while there were less of them around. It was noted that the LORAN (radar) site impacted belugas, and that after the Coast Guard tower was taken down, people saw a beluga at camp the next year, the first time anyone could remember seeing one there. VHF radio broadcasts and outboard motors are also stated to impact belugas. It was also noted that belugas eat a lot of fish.

Brevig people stated that there used to be a lot of whales in the area, but since the mid-1990s there is no ice to block them, so they can go anywhere (this observation pertains to whales of any kind).

Sick seals and skinny walruses have been observed, though since 2008 there are less sick seals being observed now. Some seals have been noted with no hair. Some also were noted to have red bubbly sores, something which had not been seen before. It was also noted that walrus used to be around longer in the past than they are now.

Sea lions were noted as moving north.

"[T]here used to be a lot of whales all over long ago. Now they've got no ice to block them, so they're just going straight."
-R. Delbert Seetot

Changes Noticed with Land Animals
In the past 15 years or so there have been more beavers observed. It was suggested that this may be because of warmer temperatures. There is a concern that they will contaminate the water supply. People are also starting to see more beaver dams. There was also a concern that beavers might end up passing diseases on to fish as well. There are also more muskox now. Caribou were noted as migrating closer to the community. There are also more wolves, as they are following the caribou in closer. There has been a large increase in bears, and starting about 5 years ago they have started to break into cabins. They are also living closer to town now. It was noted that people don't like the taste of beavers nor bears. There used to be a lot of squirrels, but they were killed by a recent storm that had high water. Additionally, it was noted that rabbits were formerly readily obtainable, but now not many are seen. Overall, it was noted that there is hardly any wild game close by the village anymore, and this may possibly be related to increased motorized noise from the community.

"Yep, a lot of changes are coming in. Start seeing beavers all over now."
-R. Delbert Seetot

Changes Noticed with Birds
There have been changes noticed regarding birds. It was noted that the area is getting different species of birds now than in the past. Some new birds that have been observed for the first time include small yellow-breasted birds. It was also noted that some birds, like cranes, seem to be showing up late now. Cranes are also taking a different route now than in the past, skipping the Brevig area and going closer to Koyuk and Buckland. People noted that they are seeing more seabirds now also.

Changes Noticed with Insects
One change noted with insects is that now there will be big swarms of mosquitoes. In addition to being more mosquitoes now, it was also reported that there are more warble flies, dragonflies, and black flies. It was also noted that spiders seem bigger in size now. Another change noted was that around 10 years ago there were wasps.

"Interviewer: Have you noticed any changes in bugs or other insects? DS: Oh yep, once in awhile there'll be a lot, there'll be a big swarm of mosquitoes. You go riding in the tundra. You stop, one minute later there's thousands of mosquitoes."
-R. Delbert Seetot

Vegetation
Changes to willows, such as them getting larger, having big leaves, and seeing a new species of willow have been observed.

Brushy shrubs have, in general, been observed as getting taller, particularly on the north side of Grantley Harbor. There are also now bushes on the tundra where there never were in the past. Some of this growth was attributed to reindeer 'fertilization'.

There are or may be more water weeds now than in the past. This was stated to have occurred in the time since the Salmon Lake salmon fertilization project began. An increase in algae in the water has been observed also. It was also noted that a lot of little fish can be seen swimming around algae mats.

Warming temperatures, including in the water, were noted as a possible cause for increases seen to vegetation.

It was noted that there are hardly any sourdock behind the mountains like there used to be; it was stated that muskox tramp them down and possibly are eating them as well. They apparently like the same vegetation as people do.

"Oh yeah, there's a lot of algae too growing now. Algae and maybe more of those long weeds."
-R. Delbert Seetot

Other, General, and Miscellaneous Comments about the Environment
Poor weather conditions can create interconnected problems. Bad ice conditions can keep hunters from going seal hunting, which can mean going to fish camp instead. But bad weather (like south wind, and too much rain) during the fishing period can be bad for fishing (e.g. necessitating people go for berries early, or because fish won't dry well). This all happened in 2007 at once, making that year an example of what a bad fishing year owing to environmental conditions (rain, south wind, and bad ice) looks like.

It was noted that water bodies have been drying up. Tundra ponds and some creeks and rivers have

been observed to have lower water levels. The river mouth/lagoon in front of the village store has dried up. Land back in the mountains is getting drier, and some greens have decreased. These changes started happening in the 1960s or 1970s.

Sinkholes have been observed.

Stronger currents have been experienced.

Some have noted that it is not unusual for people to go out to do subsistence activities and to come home empty-handed. It was said that this may be due to weather, or to animals moving to other places.

"We need to take care of the environment since that is home to the animals, and that is where they get their food from."
-Floyd Olanna

Regarding Culture, Society, and the Economy

Learning to Fish

Interviewees noted that they had been fishing for most of their lives, and learned starting when they were young. People learn how to fish and put away fish from their parents (mainly) and grandparents, as well as other Elders and community members. Watching, asking questions, and doing/participating are all important parts of learning.

The Importance of Salmon and Salmon Fishing

It was stated that salmon is still as important to Brevig people as it used to be. People still depend on it a lot, perhaps even as much in times past, for their diets as well as for sharing and trading. Salmon is considered to be good for people. People in Brevig Mission have staked out positions in opposition to certain things which also demonstrates the importance of fish resources in their lives. People have prioritized subsistence fishing heavily over commercial fishing. Brevig also opposed the Alaska Village Electric Cooperative (AVEC) intertie because of possible impacts on wildlife resources and fish.

There has been a decline in salmon harvests compared to times past. While it was stated that the "regulars" are still fishing, less people are fishing than in the past, and some who are fishing are doing so less than in the past. There has also been a decline in how much people harvest. People use salmon less for dogs because fewer people use dogs for transportation; therefore people don't need to catch as many fish for this purpose. People are also able to get their food elsewhere (i.e. at the store) which contributes to less fishing than in the past as well. (However, the current high prices of store food are also seen as another good reason to put away salmon.) Jobs also impact participation in fishing activities. Additionally, it was noted that younger people fish less now than in the past, and older people tend to fish more than younger people. It was felt that young people are not being taught how to fish, and also that they are not as interested in salmon fishing. Weather conditions (including there being less calm weather now, shorter stretches of nice weather, and rainy weather making it difficult to put away fish and leading to more spoilage) can also contribute to declines in participation in fishing activities.

"Fish is good for us."
-Helena Seetot

Figure 6: Fish camp on the shore of Port Clarence. Photo: Brenden Raymond-Yakoubian.

Transportation, Fuel, and Costs

As noted above, the use of dogs for transportation is historically connected to the importance of salmon. People had to catch more fish in order to feed their dogs. Also, if fish spoiled, because of bad weather for example, then people could still give that fish to dogs, whereas for people without dogs, it becomes a disincentive to fish if the weather is bad year after year, as in these cases the fish is just for human consumption. One interviewee noted that perhaps people don't need to catch as much fish because they have had snowmachines since the early 1960s but noted on the other hand gas and snowmachines are expensive, and perhaps someday in the future there will be a return to dog teams.

It was noted that commercial fishing permits are expensive, and that it is difficult to get loans.

Gas and equipment costs/ownership can be an issue – and a big issue for some – for fishing and subsistence in general. Some people noted they didn't go picking far upriver because they didn't have a motor/boat. Some will catch as many salmon as they can close by to the village so they don't expend too much gas. Some people pool resources owing to the high price of gas. People will, nonetheless, continue to try to get food even if they have not been successful. It was also noted that not being able to afford gas means that people don't travel around as much, and may not know as well as they did in the past where fish have moved to.

"Even though I miss having dogs all right, a team. A lot of work, but when you go one place they take you there, they take you back. Not like the snowmachines. You go travel alone by the snowmachine,

not like when you go alone by your dog team. You're stuck out in the country, your snowmachine or something goes wrong, well the dogs will bring you home no matter what. If it gets stormy on you while you're out there by dog team, then you just wait out the weather. Use your sled if you have a tarp with you in your sled. You can use it to protect you from the weather. Even put your dogs by it too if you want. Sometimes they just come around and curl up by you. Nowadays, you break down if you travel around, you gone two, three days. Sometimes they gotta wait for the weather to clear up. If it's not too stormy or too windy, then you can go home with your dogs. But if it's real bad, then you can, you know, stay up in the country with your dogs a day or two. If you catch game while they're out in the country, then you share that with your dogs."

-Robert Rock, Sr.

Jobs

Peoples' job situations factor into how much they fish. It can also impact whether or not people can make certain observations about patterns with fish over time. Less people go to fish camp now because of wage employment.

Sharing

Some individuals noted that they catch fish not only for themselves but also for other members of their family (including those who live outside of Brevig Mission). Some people do all the fishing for their family.

Sharing is an important value. People share salmon with family members, Elders, visitors, and people outside their community. Quite a few people engage in sharing. Because people share, impacts to harvests – including from management constraints – impact other people besides just the people getting the fish, such as family members in Brevig and in other communities with whom they are sharing. People don't just share salmon, they also share information. For example, people from Teller will tell Brevig people where reds are going.

It was also noted that some people share, while others don't. It was stated that some will even get rid of their food rather than give it away. Whether people share can depend on how much they catch. Some will try to harvest more specifically so they can share. It was noted that some people don't share as much, and some would rather sell than give food away, reflecting a trend towards greediness.

"Everything that my parents [taught] or what I learned from community members, I have tried at least to preserve in the old traditional way and then share my bounty with the Elders when the product is finished."

-Elmer Seetot, Jr.

Trading and Bartering

People barter and trade with fish. The State and Federal governments put limits on the dollar amount that can be earned by a household in the customary trade of fish for cash. People will barter fish for things they don't have, especially subsistence foods, including with people in other communities from this region all the way up towards the North Slope.

Commercial Fishing

In the past, people sold fish to the Teller Commercial Company.

Some people – perhaps most – in Brevig Mission are against commercial fishing in their area. People

stated that they do not want commercial fishing in the Brevig area. When a commercial fishery was tried in 2007 or 2008, no local people participated, and some people were concerned the commercial activity would impact subsistence fishing. Reasons people are opposed include the view that commercial fishing is just for money, that subsistence is peoples' priority, that no one owns the resource and the commercial people are trying to impose something on Brevig people, it does not allow for enough escapement, and concerns that it would affect subsistence. Brevig people reported that they were generally happy that there has been no commercial salmon fisheries in their area. Elders kept commercial fishing away from Brevig Mission when people who are adults today were young.

However, people would like more flexibility/a higher limit on household limits for customary trade of fish (for cash) to be able to trade chum dry and half-dry fish for cash. It would appear the extent of interest in commercial fishing would only extend to this, and not, for example, other salmon species. People wondered why it was that they could not sell dry fish. People wanted the current limit for the customary trade of fish raised, particularly for chum. It was noted that there is a high demand for dry fish. It was suggested however that this desire to have commercial fishing for chums reflected a shift in worldview. As it was noted, if there was commercial fishing, people would be out there, with the idea being that time is money; people never used to think like that, it was said.

"It was pretty much just all subsistence during my lifetime. I know that they did commercial fishing in other parts. Now they're trying to go after our resource. Not our resource. They pass through our back yard, it's anybody's resource, but they're trying to impose something that we're not familiar with. That is commercial fishing, that's one thing Teller and Brevig was saying, yeah we don't want commercial fishing because subsistence is our number one priority. Like I said before we start fighting over the resource, it's not gonna be there."
-Elmer Seetot, Jr.

Young People, and Knowledge Sharing
People reported learning from parents, Elders, and community members about fishing. It was noted that it is important to remember what your parents taught you, otherwise life will be difficult. It was also noted that it is important that young people learn about fishing early, even if they don't like fish, because they can still help so that others can be fed. Some people felt that younger people were still interested in learning about subsistence, and that they will help with fishing but simply have less perseverance doing it than older people do. Others felt that young people had the wrong attitudes – for example, that they are too lazy, don't want to get dirty, drink too much pop, think they can do anything, don't listen to older people, don't help themselves, watch too much television, don't want to try, and want to do things the easy way and get things from someone else. Others took a position somewhere in the middle, noting that kids are interested in hunting and fishing, and while some are doing it right, many are not taking the steps necessary for succeeding at it. It was stated that most learning is by doing, and it would also appear on the whole that young people are not fishing as much as in the past. Young people may be watching but they are not necessarily participating. It was noted that while some are trying to teach the younger generation about fishing, some felt that not enough was being passed on between the older and younger generations.

It was also stated that young people are more interested in rod and reeling now than in setting nets or seining.

It is felt that protecting and preserving resources for future generations is important.

Other Information on Human-Fish/Animal Relationships
It was noted that a traditional view still held by at least some people today is that when you stop hunting animals, they will decrease in number, and the more you hunt them, the more there will be. There was disagreement about whether or not this also applied to fish. It was also noted that if you don't respect animals, you will have lean years.

It was stated that young people's views about fish have changed compared to the past. The view that fish have feelings, and that sport fishing harms fishing was noted. It was also noted that no one owns the fish resources, but commercial interests try to push this view of things on Brevig Mission people. Another view that was noted was that too much talk and arguing can negatively impact salmon runs.

One person noted that they felt fish are smart, and have a way of sensing and communicating to other fish. They felt this is related to why ADF&G tells them not to use a 7 pattern for setting nets; the fish are able to see the net when it is set straight out, and will try to go around. It was also noted that Brevig's water is very clear, so fish are able to see the nets. However, not all participants were of the view that fish were intelligent.

"I've heard Elders say when you quit hunting animals or mammals, they'll just decrease in number. The more you hunt them they'll multiply. I've heard that before too, some other people when they talk about it like that."
-Rita Olanna

Change
It was noted that if a person is too involved with Western culture they won't be as observant about animals and the environment. It was stated that everything is changing, and the old people long ago said that that would happen. Changes to Brevig peoples' lives, to the environment, and to animals are all part of a connected larger process of change.

It was stated that people can lose the taste for certain foods if they don't eat them for a long time, such as fermented fish. It was also noted that the educational system is resulting in young people being less interested in Native foods; when people get school-aged, they slow down in terms of their usage of Native foods.

"Yep, we see a lot of change, a lot of changes coming. Warmness is coming, ice is going away quicker, different species are coming, both land and sea. And weather-wise too, but you know, people are seeing it too. Changes in our lifestyle. Pretty soon we're going to have maybe no more ice, who knows?"
-R. Delbert Seetot

Regarding Challenges, Commercial Fishing, Management, TK, and Recommendations

Difficulties and Challenges
Multiple individuals noted that ADF&G management rules can negatively impact harvest. One rule in particular which was noted on several occasions was the prohibition on setting nets in a 7 pattern (or a 'V' pattern), with the requirement to set them in a straight line, as being something which makes things harder to get enough fish.

Financial matters can make fishing difficult as well. Jobs can get in the way of having enough time to fish, and the monetary costs associated with fishing (e.g. for gas and equipment) can also make fishing

difficult to do.

Environmental conditions (wind, rain, and ocean conditions) can pose a challenge for harvesting and putting away fish.

Noise, turbidity, and contamination from barges and tugs is a concern. It was stated that barges are sitting on Brevig peoples' resources. People noted that tugs have been known to wash off their decks in the early hours of the morning while people are asleep; people have found vegetables, oranges, apples, and other things along the shore. In the past two years there has been an increase in tug and barge traffic, and this may be having an impact on salmon.

There is a concern about pollutants coming over from Russia in the winds, rain, and runoff.

The possibility of port development at Port Clarence, and possible gold dredging activities in Grantley Harbor, were also concerns people discussed.

There is concern about invasive species as well.

"DS: Ah, we got to go with the, you got to go with what they say, you know? We have hard time like trying to get our quota and they tell us not to fish certain way. We can't catch fish like that. Interviewer: The nets you mean? DS: Yep, the nets. They tell us to fish straight. We can't get nothing, the water's too clear. And what else. Oh other than that, we got to abide by these rules because they're put forth to us and, and we just got to go with the season. Other than that, you know, we may think it's bad you know the way they manage it, but we got no choice."
-R. Delbert Seetot

Commercial Fishing
It was noted that some people think the Norton Sound Economic Development Corporation (NSEDC; the regional Community Development Quota organization) does whatever it wants regardless of public input.

As noted further above, it was reported that Brevig does not want commercial fishing; subsistence fishing is the priority. However, people would like more flexibility/higher limit on customary trade of fish to be able to trade chum dry and half-dry fish for cash.

"We try, I at least try to respect the animal that I hunt because I have back in my head that if you take care of the resource it will be there for you. That's constantly in the back of my head whenever I try to harvest or take something then that will help me out through the season. That's how come I am kind of against commercial fishermen, because the commercial fishermen are going for the dollars […]."
-Elmer Seetot, Jr.

Other Notes Regarding TK of the Environment
As discussed in some sections above, people in Brevig Mission hold views about human-environment relationships which do not conform with Western views. For example, some which were noted are the view that the more one hunts for animals, the more they will be there, and the view that arguing and talking too much about resources like fish (e.g. at management meetings) will cause those particular resources to not be available. This different cosmology has implications for management and policy as well as understandings of various natural resources. It would be wise for those involved in natural

resources-related management, policy, and science to become aware of these differences and to incorporate the implications of this cultural diversity into their work.

On the other hand, it was also noted by one participant that TK of the environment (also known as Traditional Environmental, or Ecological, Knowledge, abbreviated as TEK) applies to everyone on the planet, and is how all people have survived. It was said to have non-Native correlates in western culture as well, such as the Bible, and words of wisdom. Key to TK of the environment, this individual stated, would be a view similar to 'waste not, want not.'

"After that I knew what the Elders were kind of talking about. And after that I kind of looked at TEK a little more in detail and what they said was pretty much true all around. You have you know the western culture where OK everything is determined, recruitment at least for caribou or moose. Recruitment rates you know they go through all of this, you have the biomass out there, stuff like that. We on the other hand, look at different things."
-Elmer Seetot, Jr.

Management
In 2008, there were mixed views of management. On the one hand it was noted by some that ADF&G restrictions in general have not been overly restrictive and that they are flexible with local people. Additionally, there is the view that Brevig people have an interest, aside from whether or not ADF&G's particular management practices are overly restrictive/problematic or not, in steps that protect resources. On the other hand, it was noted that people abide by the regulations so as to avoid running into problems, but that these rules make it difficult to get enough fish (and for some, they simply do not get enough fish as a result). The rationale, justification, and evidentiary basis for rule-making by managers was sometimes questioned. Of particular note is the prohibition on setting nets in a 7 or V pattern, which was felt to be particularly problematic. It was also clear that impacts to harvests – including management rules constraining harvest – impact not only people in Brevig harvesting resources and their local family members but also people who live outside the community as well because of the prevalence of sharing subsistence foods. By 2014, the view on management appeared to have become a bit more sour. Similar critiques as before were raised, notably the issues surrounding the ban on using a 7 pattern. One person noted they were threatened by ADF&G for using such a pattern. Another noted that every year people are threatened by managers. The view that ADF&G is restrictive now was stated, and it was also stated to be 'one-man rule,' and that people have had their nets sliced in enforcement actions. One individual stated enforcement likes to hurt local people because they won't give up their resources. A view was also forwarded that there is a social inequity occurring when the dietary mainstays of Alaska Native life are so heavily regulated in terms of harvest but the production of your average foods consumed by Western people (e.g. livestock) lack equivalent restrictions.

People noted that there is a lot of frustration regarding communication between agencies and Brevig Mission. It was also noted that the State does not take comments from rural residents seriously.

Regarding commercial fishing, as noted elsewhere, people in Brevig are opposed to it, and a previous attempt to institute it in the area was met with no participation and people's opposition due to concerns about impacts to subsistence fishing. Some felt that it would be best, at least as far as commercial fishing was concerned, for the communities to decide about things, as they are the caretakers of the resources.

Local or Traditional Rules of Management

A number of local or traditional rules of management and behavior were identified which pertain to salmon and other aspects of the non-human environment. These include:

- Don't talk too much or argue about salmon, it can negatively impact salmon runs.
- When you stop hunting animals, they will decrease in number, and the more you hunt them, the more there will be. There was disagreement about whether this also applied to fish.
- Respect and protect natural resources. If you don't respect animals, you will have lean years.
- Sport fishing harms fish.
- Subsistence is the priority.
- Fish need to be protected for subsistence.
- No one owns the fish resources. Commercial interests try to push an ownership mentality on Brevig Mission people.
- Protecting and preserving resources for future generations is important.
- A local salmon management technique is to make sure that nets are not left in the water all the time (which could result in catching more fish than people need/can use).
- If you catch a new species of fish you should use it, or release it when it is caught if you can't use it.
- People always used to fish using a 7 pattern, and they never ran out of fish in the past when people used it.
- When people who are adults today were young, there was no ADF&G presence, bag limits, and other regulations, and people would share and barter, and there was an abundance.
- Elders opposed commercial fishing and kept it out of the Brevig area, and this is thought to have been a good thing and that Brevig is better off for this having been the case.

"[R]espect the resource, that's my number one thing that I kind of remember. Respect the resource that you use, whether that be talking about it, or whether it be harvesting it, or however you go about it you know. […] Everything has its place in nature and we're just a small part. We got the brains, but sometimes we don't use them right or we don't think in the right way to help protect the resource or to make sure that is sustains itself so that future generations can use that. So it's pretty much how you see or how you grow up, I think that that was one of my main things in life was how I was taught or when I was growing up how I was taught to respect the animals, resources."

-Elmer Seetot, Jr.

Recommendations

The following recommendations can be gleaned from the data gathered in Brevig Mission:

- The restriction on setting out nets in a 7 or V pattern should be removed.
- There shouldn't be dates set for when people have to pull their nets out of the water. There should be no closed days.
- People felt that commercial fishing for salmon in the Brevig area should not be allowed. However, an exception to this noted by some was that there should be increased allowance for cash trade regarding chum dry and half-dry fish. It was expressed that people would like the dollar amount limit raised on customary trade of fish and/or for small-scale commercial harvesting of these fish for local people to sell. People don't have jobs, so need to sell dry fish.
- Local people should be the ones to make decisions about commercial fishing in their area, since they are the caretakers of the resources. There should be more community-based control and regulation relating to resources.
- Managers, policymakers, and scientists should equally value and incorporate TK into their

policy, actions, and research.

- The State should take rural comments seriously.
- There should be more investigation into the impact of beavers on fish and local water quality
- There should be job promotion activities conducted in Brevig.
- Bycatch from the pollock fishery should be decreased.
- Dredging or gold mining should not be allowed in the waters of Grantley Harbor. The proposed dredging sites are sites for fish (including salmon migratory routes), seaweeds and other elements of the ecosystem in the harbor, and the activity has the potential to impact the whole ecosystem. People are bothered that they have received no update about this proposed dredging, which makes them feel as though the State doesn't care about them.
- There were a number of port-related recommendations related to the potential for the construction of a deepwater port in Port Clarence. One was that studies on birds and other wildlife are needed to evaluate impacts of a potential port, another was that the US Corps of Engineers should just improve the Nome port, and a third was that port studies need to consider the impact on fish, as well as unintentional pollution, noise, and spills. It was noted, for example, that the area between Kotzebue, Port Clarence, and Nome, as well as the Imuruk Basin, are important staging areas for many animals, and that many endangered species go through that area.
- Communication between agencies and the community should be improved, as it is a source of great frustration in the community.
- Hearings should be held in communities, not just in hubs or in Anchorage.
- There should be more government-to-government consultation. It was stated that there has been a lot of talk about it, but that people haven't seen anything come of it.
- People feel like they should be listened to more by other entities e.g. commercial interests and others.

Diomede

The village of Diomede is located on the west side of Little Diomede Island, in the middle of the Bering Strait, approximately 135 miles northwest of Nome. Diomede is accessible by boat, helicopter, and by plane (during winters when ice conditions allow the construction of a runway on the sea ice). Most goods are delivered by air. The International Date Line runs between Little Diomede Island and Big Diomede Island. Big Diomede is approximately 2.5 miles to the west of Little Diomede. The 2010 US Census indicated that Diomede has a total population of 115, of those 61 are male and 54 are female (ADCCED 2015). Approximately 92% of the population is American Indian or Alaska Native (*ibid.*), primarily Inupiat Eskimo.

Regarding Salmon

Salmon have not been historically a very important food for most Diomede residents in terms of their overall contribution to the local diet. As a result, there was not much information gleaned about salmon from ethnographic interviews with local experts, and the data itself was somewhat thin (i.e. sometimes not corroborated by multiple interviewees).

Salmon run between Little and Big Diomede Islands between May and September. Silvers are most easily observable, as they jump while passing through the area (most notably in August), and may be the most prevalent of the salmon species found in the Diomede area. However, all five species of salmon were noted as probably passing through the area. It was reported that September 19th was the latest that salmon, most likely a late run of silvers, were seen running through the area. It was also reported that a salmon was caught in July once as well. Some people reported having seen seals eat salmon.

Little Diomede people are starting to see more salmon near the island. This increase was variably reported as starting in the 1980s or 1990s. However, it was reported that salmon were seen jumping between the islands in the 1960s and were heard of doing so even earlier than that. It was felt that people who used to live at the now-submerged old village site in front of Little Diomede used to fish for salmon.

While some salmon have been harvested since the 1990s, in general people do not try to harvest them for a variety of reasons. Two notable reasons were that 1) there are too many birds in the area for it, so setting nets for salmon will result in you getting potentially a lot of birds caught in the net, and 2) the currents around the island are too strong for salmon fishing (e.g. for setting and checking nets). Most peoples' involvement with salmon harvest seems to have involved trade and barter with people on the mainland (e.g. Kotzebue, Teller, and Nome) who have salmon (having dry fish for winter was particularly desirable), as well as some people from Diomede fished in the past at Cape York (near Wales); the Diomede Native Corporation owns land there.

"[W]e are not fishermen."
-Pat Omiak, Sr.

Regarding the Environment

As this project focused jointly on salmon and the environment, and given the relatively low importance of salmon to Diomede subsistence, information gathered on traditional knowledge of other aspects of

the environment was also correspondingly low in quantity and consistency. Conflicting responses from experts may also vary because of increased climate variability being seen by Diomede experts (see also e.g. B. Raymond-Yakoubian et al. 2015), as well as methodological issues (especially the fact that a number of interviewees had passed away between the time of the original interviews in 2008 and the data review workshop in 2014). Some key points which were gathered from the ethnographic interviews are presented below. However, far more substantial information was provided by Diomede residents in three recent Kawerak projects, one on traditional knowledge of ice seals and walrus in the Bering Strait region (Gadamus and Raymond-Yakoubian 2015, Oceana and Kawerak 2014, Kawerak 2013a, Kawerak 2013b, Kawerak 2013c, Gadamus 2013), one on traditional knowledge of ocean currents in the Bering Strait region (J. Raymond-Yakoubian et al. 2014), and one on Little Diomede traditional knowledge of walrus (B. Raymond-Yakoubian et. al. 2015).

Figure 7: A view of the village of Diomede from the helicopter pad.

Climate/Weather Variability and (Un)Predictability

It was noted that the weather changes faster now than it used to. Additionally, and likely related, is the fact that it is getting harder to predict the weather when one is out on the water doing subsistence activities. It was also noted that there used to be long stretches of good weather in the past, whereas now this is not the case, and there is more bad weather. People used to be able to stay out for hunting for days if needed in good weather until they got a large enough harvest, but now they are only able to stay out for less than a day. The weather now changes quicker than it did when interviewees were growing up, and it was noted that things taught to them by their ancestors do not always apply as a result. Interestingly, it was noted by interviewees that their Elders didn't discuss or predict changes to the environment and weather, and that this was because the changes were slower in their times.

Interviewees note that the environment in general, and climate and weather in particular, has changed

greatly in the Little Diomede area. There was concern over the potential impacts of this to subsistence activities.

This increased climatic unpredictability and variation – along with the unevenness it produces amongst residents in the timing and frequency of their subsistence activities – may be a considerable factor in the wide variation sometimes reported on the status of environmental conditions.

"Yeah it's [weather's] getting harder to predict when you're out hunting."
-Orville Ahkinga, Sr.

Temperature
Winters used to be colder than they are now, interviewees reported. It was also noted that there are no more days of deep sub-zero temperature like there used to be. It was also noted that the water temperature may be rising as well.

"We've been having warm weather nowadays when it's supposed to be cold."
-Pat Omiak, Sr.

Ice
Breakup is occurring earlier now. Ice breaks up earlier and melts faster than it used to. Interviewees recalled that the ice used to break up in mid to late June, and that breakup now is occurring between April and early June.

While freezeup between the islands was considered to be variable in timing, it is felt that it is freezing up later and not as quickly now as it did in the past. Additionally, it is freezing up differently than in the past. The ice now isn't freezing as thick, and the way the ice builds up between Little and Big Diomede Islands has changed in a way that is now more difficult to hunt on.

Additionally, there is no longer any more "old ice" (multi-year ice that is more than several years old, is thick and blue in color). These larger blocks of ice, which would become frozen into the other ice in front of the village during freezeup, were used for drinking water, but after it stopped appearing (the dates for this varied from as long ago as the 1960s to as recent as 20 years ago) people had to use snow instead. Very large icebergs are also no longer seen anymore. In the past, slush ice would appear first, and then the old ice came in. Now, it is young ice that is forming. The ice now takes longer to become shorefast. It has also been noted that the ice is moving up north at a faster rate every year. Diomede also builds an ice runway for airplanes on the sea ice in the winter, but it is noted that if the changes keep continuing to the ice as they have been, this may become a thing of the past in the relatively near future.

"No more old ice. No more real thick blue ice. It used to come here and really pile up high, way up."
-David Soolook, Sr.

Erosion
Owing to the general warming trend, changes in the land and permafrost have been noticed to be effecting buildings on the island. Additionally, people now believe this warming has caused an increase in rocks and boulders falling down the island's slopes.

"When the permafrost recedes all these boulders you see up here will be loosened up and probably

slide once in awhile."
-Orville Ahkinga, Sr.

Other Fish/Fishing
Other fish and crustaceans which Little Diomede residents reported in their area were herring, whitefish, blue cod, bullheads, crab (especially blue crab), and other bottom fish. Blue cod, bullheads and crab are the main fish species harvested at Diomede. There may be other fish going through the area that residents are not able to identify.

"Only thing we know is bull heads out there, the bottom fish and the blue cod, which is probably more abundant than others. But, we start seeing more salmon, let's put it that way."
-Orville Ahkinga, Sr.

Changes Noticed with Marine Mammals
It was felt in general that marine mammals migrate a little faster now than in the past, and that there are fewer animals around Diomede now because they are migrating away earlier each year.

Walrus migration routes vary over time. Currently it is felt that there are less in the Diomede area; they aren't as close by and are migrating through quicker than in the past. The relationship between the walrus population and environmental factors is a highly complex in the view of many Little Diomede residents (see B. Raymond-Yakoubian et al. 2015). People have to travel further than in the past to get walrus because they are so far away, the increased difficulty of which is compounded by the weather being worse and less stable than it was in the past. It was also noted that there have been changes to walrus health – there are skinny walruses now with few clams in their stomachs, and also mercury has been detected in their livers and cadmium in their kidneys.

A general trend towards the view that there have been increases in whale populations seems to run through the Diomede data. In particular, it appears that there are more belugas coming to the Diomede area than in the past. The data was less conclusive with regard to bowheads and gray whales on this matter.

"The walruses are migrating as early as February whereas they used to migrate in June. […] Because the ice is moving up, going up north at a faster rate every year."
-Arthur Ahkinga

Changes Noticed with Insects
Some changes with regard to insects were noted: the recent appearance of a small butterflies or moths that were rarely seen before, possibly more mosquitoes, and changes to fly populations.

Vegetation
People pick greens, Eskimo potatoes, and salmonberries on Little Diomede Island as they did in the past. However, some changes were noted: 1) people don't gather seaweed from the beach because of pollution from the village, and 2) there are hardly any salmonberries anymore compared to the past.

"Hardly any salmon berries out there anymore. Used to be lots."
-David Soolook, Sr.

Other Comments about the Environment
There is concern from some experts about pollution coming from the village and its impacts on the environment and aquatic life; the main sources of this pollution include trash and sewage (which are currently disposed of in the ocean) and leaking oil. There is also concern about pollution from vessel traffic in the area.

Regarding Culture, Society, and the Economy

Data related to culture, society and the economy for Diomede which pertain to salmon and the environment as elicited in interviews are discussed below.

The Importance of Salmon and Salmon Fishing
As one interviewee noted, "Other than that [one family fishing over at Cape York], those old people never talk about fishing, because we are not fishermen." Very few salmon are harvested by Diomede people, and other fish – bullheads and blue cods – are more important, though even those do not appear to be taken in great numbers either.

Transportation
Changing ice conditions have necessitated a greater use of motorized boats to procure subsistence resources, as sea mammals are migrating further and faster from Little Diomede. There are few jobs in Little Diomede, and gas is expensive, which makes subsistence difficult to do now, especially when compounded with changing environmental conditions.

"Like I said the walrus are [migrating] faster and get further over anywhere. So that's the changes, it's warming."
-Orville Ahkinga, Sr.

Young People, and Knowledge Sharing
There is a desire on the part of interviewed experts for the younger generation to continue the subsistence traditions of the past (e.g. hunting, not polluting the water, not wasting). Young people are interested in hunting, and they are taken hunting, but there is concern about the decrease in subsistence practices, the impacts of environmental changes on these practices and the transmission of information about them, and changes in social relationships between older and younger generations. It was felt that in general as time has gone on younger generations have less subsistence-related knowledge (including TK of the environment) than in the past.

Knowledge and awareness of one's surroundings, especially climatological factors (e.g. prediction of the weather), is integral to a subsistence way of life for Diomede residents. There is concern that the knowledge of past generations won't get passed on as a result of climate change, because this knowledge does not always apply now given the environmental changes. This in turn will effect the way which young people view older people. Additionally, new generations will have to learn more information about the environment themselves (instead of relying as heavily on knowledge from prior generations).

"So the things that our ancestors taught, some of it don't even apply now, because of the changing weather. The things that our ancestors taught us don't apply anymore. So we have to be aware of everything, climate wise."
-Arthur Ahkinga

Figure 8: Boardwalks in the village of Diomede.

Cultural, Social, and Economic Change

Major changes – often interlinked – which experts identified in the context of a consideration of peoples' subsistence practices and knowledge of animals and the environment, in no particular order, were: 1) decrease in the amount of trade in the summers with mainland people, 2) the introduction of the cash economy, 3) an overall decrease in subsistence practices, 4) the changes in hunting, clothing, transportation, lodging, and communication technology and material goods, 5) a decrease in the amount of assistance people give each other, 6) a dependence on the store for food, 7) a decrease in knowledge and transmission of traditional stories, 8) a decreased use and knowledge of their Iñupiaq language, 9) the increased importance of non-Native people's influences – from cultural (as also encapsulated already in some of the above comments) to legal/regulatory (i.e. non-Native people controlling the walrus harvest and also the International Date Line), 10) a changing dynamic between young and old people, 11) the increase in environmental changes and in the discussion about them compared to previous times, and 12) the disappearance of the *qagri*, a gathering place where, among other things, hunters discussed information about hunting and environmental conditions.

"[Advice to young people:] Be prepared to move faster, because you gonna be moving a lot faster than we do."
-Orville Ahkinga, Sr.

Regarding Challenges, Management, TK and Science, and Recommendations

Difficulties and Challenges

A number of key difficulties and challenges were identified by Diomede interviewees which pertain to subsistence and their relationship with the environment. Challenges related to money and climate change were the issues most stressed by interviewees. The challenges presented by the cash economy were noted repeatedly. A lack of jobs means people have little cash, and therefore little money to buy things like ammunition needed for subsistence. Additionally, the cost of store foods is seen as expensive. Changes to the climate are seen as playing an enormous role in the potential for the continuation of the subsistence way of life. Climate change is seen as having a very large potential effect to the environment and to animals depended on for subsistence. It was noted, for example, that shorefast ice doesn't last anymore, which has in turn made life more difficult in that harvesting ugruks (bearded seals) now requires people to go further from the Island. Climate change is also interconnected with issues relating to the cash economy. For example, changes in ice conditions are creating a greater reliance on boat travel to get ugruks, which means people are also more dependent on procuring expensive gasoline to power those boats, which is a hardship.

As knowledge of the environment is directly interconnected with practicing subsistence, environmental conditions, economic conditions, the status of animal resources in the environment, and social relationships (e.g. the transmission of knowledge between generations), impacts to one aspect of this social-ecological dynamic make impacts to all of these systems.

"It [whether subsistence way of life continues] all depends on the climate, because it's happening so rapidly, that we may not even, the younger generation now, when they grow older they may not be hunting walrus because they'll be all gone. They'll be no more ice for them. At the rate the ice is receding now."
-Arthur Ahkinga

TK and Western Science

As noted earlier, there is a substantial concern that environmental changes are degrading the applicability of traditional knowledge to contemporary conditions related to subsistence, and that this in turn is changing the social dynamic between generations.

People also noted relationships to western science as it pertains to problems related to subsistence resources. People take samples of unhealthy animals and send them to ADF&G. Additionally, scientific testing which has indicated contamination of subsistence resources (as in mercury being detected in walrus livers and cadmium in their kidneys) raises concerns about their consumption, though it is unclear to what extent these findings impact consumption practices.

Management

The substantial impact of non-native society's control over the harvest of subsistence resources (particularly walrus and whales) as well as over the International Date Line in contemporary times was noted by experts. This has substantial impacts on peoples' subsistence practices (as discussed elsewhere as well; see e.g. B. Raymond-Yakoubian et al. 2015) and social relationships. With regard to the latter, for example, people used to be able to hunt, trade, visit, and take shelter on different sides of the Date Line, but there have been changing rules about this over time which make for a difficult and potentially dangerous relationship to this invisible border.

"[T]he white man try to control it."
-David Soolook, Sr.

Local or Traditional Rules of Management

No comments were made specifically with regard to salmon, though a number of local or traditional rules were noted which pertain to the management and stewardship of subsistence resources and the environment, including not wasting sea mammals, not polluting the water, sharing, and putting food away properly. It is important to note with regard to the latter that sharing amongst people of subsistence resources is viewed in the traditional Eskimo cosmology as being directly related to the availability of these resources (e.g. Raymond-Yakoubian and Angnaboogok forthcoming, Fienup-Riordan 1994, 2000). For example, as one local expert noted, they were told by their grandparents that when you share subsistence food with others, those resources come back in greater quantities.

"Well, I would advise them [young people] don't let it [subsistence] die, keep it up. You have to use it, it's gonna be there, learn how to do it. Learn how to do it properly, not wastefully, my advice would be. Like our forefathers and grandfathers used to do. Don't waste the sea mammal. That was big no-no for it. Don't pollute the water; I would say that was a big no for them."
-Orville Ahkinga, Sr.

Recommendations

A number of recommendations can be made based on the information provided by Diomede local experts which have bearing on management and scientific practices. It is important to bear in mind the dynamic interconnections noted above in several places between all aspects of peoples' social and ecological relationships, as well as culturally-specific aspects of human-environment and human-animal relationships. When one does this, it is possible to see how some recommendations which to outsiders may not necessarily seem connected to management practices, actually are.

These recommendations, which have both internal and external relevance, are:

- The Iñupiaq language and subsistence practices should be taught to young people.
- Pollution issues coming from the village – e.g. leaking oil, trash, sewage – should be addressed, which would be beneficial to plant and animal life on and near the Island.
- Subsistence harvests should be controlled locally, by Little Diomede people.
- Steps should be taken to address climate change.
- Travel, trade, and hunting across the International Date Line should be less restrictive.
- Ship traffic and its impact to subsistence should be closely monitored and regulated. For example, vessels should not be present when people are conducting subsistence activities.
- Traditional rules about relationships to and knowledge of the environment and subsistence resources should be more closely followed.
- People should share more.
- It shouldn't take an inordinate amount of time for requested goods to arrive to the Island as it does now.

Golovin

Golovin is located approximately 70 miles east of Nome. Much of the village is located on a sandy spit that separates Golovnin Bay and Golovnin Lagoon. The community has no road access to Nome and must receive all of its goods by air or by barge in the summer. The 2010 US Census indicates Golovin has a total population of 156, of which 83 are male and 73 are female (ADCCED 2015). Approximately 93% of the population is American Indian or Alaska Native (*ibid.*.). The Iñupiaq name for the village is *Chinik*.

Regarding King (Chinook) Salmon

General comments about king salmon
Some people in Golovin target and prefer king salmon. People like to smoke kings.

Some kings harvested in the Golovin area were reported as having meat which looked like it had been eaten from the inside. Additionally, it was reported in 2014 that a number of kings had been caught with oily blood that needed to be cut out during processing.

"We like kings and silvers, you know, to put away."
-Robert Amarok

Comments about king salmon biology and behavior
Kings will eat small fish, and you can find them in their stomachs. It was stated that they feed on herrings, which is what makes them come in. Kings spawn in areas with gravel riffles where there is clean water, clean rocks, and gravel.

"Chums, pinks and king salmon spawn in clean riffle gravel waters where there's clean water, clean rocks, and gravel as far as I know. That's as far as I know from what I've read on Fish and Game reports."
-Thomas Punguk

Comments about king salmon distribution
Kings can be found on the coast and in the rivers. They are the first salmon run that comes in, before chums. (Trouts come in before kings.) Kings continue to show up during the chum run as well. The king run begins in mid-June and ends near the end of June. It was also noted though that you can occasionally catch small kings through the ice in November in the Kachauik River (pronounced locally as Kachavik). In general, king runs in the local area seem to be considered to be healthy, though some are concerned about their health and strength. Runs can be found in the Fish River drainage (mainly found in the Itchapak River), Niukluk drainage, Klokerblok River, and also the Kachauik River. People harvest them by seine or rod and reel in the Kachauik River. Jack kings also come to the Golovin area.

"Kings always seem like they arrive first, then chums, pinks, silvers will be, maybe first part of August, end of July, and that's when I'll set again. I'm almost ready to pull that king net out."
-Robert Amarok

Comments about king salmon population
King runs seem to be considered healthy in general, as noted above, though there is some concern about their strength and health. 2009 was one of the best years for kings; ten years prior in 1999 there

were also a lot of kings. In 2014 it was noted that kings had increased since 2009. However, it was also noted that the population varies as well.

"This year [2009] seems like there's more kings than maybe how many years ago, there was quite a bit. About ten years ago. This year I got maybe the second best year."
-Robert Amarok

Figure 9: One of the fish racks in Golovin.

Comments about the harvest of king salmon

People in Golovin harvest kings. For those who do, their catch can range from 1 on the low end to around 50 on the high end. Some people target kings, while others do not. Those who do target them can harvest a substantial amount. Some people get them as incidental catch while fishing for other salmon. In the past 15 years, people have targeted them for subsistence harvesting, and only just lately for commercial. In the past all kings were caught in the chum harvest, before people only recently started to target them; it used to be something like a treat when they were harvested before. The main place people targeting kings harvest them is down the coast, using a set net. Kings are harvested on the coast (set nets) and in the rivers (set nets, seines, rod and reel). 2009 was a good harvest year for kings, though 2008 was not.

"King salmon were rarely caught in my chum fishing nets because they were not, I was not targeting king salmon. But I have a brother and some other people in Golovin use king salmon nets at the beginning of the season to fish for king salmon and they do catch quite a substantial number of king salmon and they give us our share. […] I don't actually target king salmon by rod and reel. And I don't

target king salmon by net because I get my share from the king salmon fisherman, being an Elder now."
-Thomas Punguk

Regarding Silver (Coho) Salmon

General comments about silver salmon
Silvers are considered a good fish to eat; they are dried, salted, and frozen. There was a noticeable change in the health of silvers starting in around 2008; they had lumps or little bumps on their skin. This wasn't sea lice; it was just under the skin and didn't go into the meat. Some people were wary of this and didn't keep those silvers. ADF&G said they were a bug and were fine to consume. It was reported that these silvers tasted the same as ones without this issue. People reported in 2014 that they were still seeing this issue. Also, it was noted that silvers can have worms. It was considered to be a good idea to cut quickly after they are harvested, as the worms are coming out from the intestinal system.

"So, I never did really observe what the change was until last summer was it? Or, when we were starting to catch silvers, it was mostly the silvers we noticed that on the skin you see lumps, little bumps and so when my neighbors were leery of that, didn't want to keep the fish or if they caught fish they would let them go. They were afraid or didn't feel comfortable to hang them up for dry fish or freeze them for eating. So, I called Fish and Game and the biologist there Jim he sent me a letter of it explaining they were just the bug or whatever."
-Maggie Olson

Comments about silver salmon biology and behavior
It was reported that salmon stomachs are typically empty when they are traveling, but with silvers you will see little minnows in their stomachs. Silvers quickly move through Golovnin Bay and go right up in to the rivers, whereas chums and pinks mill around in the Bay while the river waters warm up. The river waters are already warm by the time the silvers arrive.

"The silver salmon zip right through the Bay then up the River they go. […] And by the time the silvers are running the rivers are warm and up they go, but their spawning cycle is such that they enter the river, spend a little time in brackish water and then they go to spawn quickly. Silver salmon spawn in brackish water, gravel bar."
-Thomas Punguk

Comments about silver salmon distribution
Silvers run after the kings, chums, and pinks. They will arrive at the end of July or beginning of August. They may be running later than they used to. One suggested cause of this was the more recent appearance of murky waters, which take a while to clear, and sediment might not be clearing out. Some reported them starting to run in late July and August, but others noted they used to run in August and September. There is some indication that something is amiss with the run timing, and that it varies. It was also noted that there are two pulses of silvers – the first around late July (which may be the larger pulse), and then a break, followed by one in August.

During the past 15-20 years, silver runs had increased in all of the Fish River tributaries, Kachauik River, Cheenik Creek, and McKinley Creek. Silvers are not found in substantial numbers in Cheenik Creek, and in the past were only found in that creek in smaller numbers. They stay below the beaver dams on the creek.

Comments about silver salmon population

There are a lot of silvers now coming to the Golovin area, but in the past there were not that many. It is not clear if there is any variation in the amount of silvers coming in. Some noted that there are a lot of silvers in some years, while others seemed to indicate that in general there simply are a lot of silvers now. The silver runs are healthy. As noted above, it was noted in 2009 that in the 10-15 preceding years, silver runs had increased in all of the Fish River tributaries, Kachauik River, Cheenik Creek, and McKinley Creek. The runs in Klokerblok, Fish, and Niukluk Rivers were also reported as being healthy. In 2014 it was noted that Golovin is indeed seeing improved silver runs in all spawning rivers. People also proffered some ideas about causes of these increases; one wondered whether it is part of a long cycle, and another wondered if the increase in silvers might be related to the decrease in chums providing less competition.

"We don't get that many but silvers are coming back, a lot of silvers now."
-Irene Aukongak

"So and then also during the past ten to fifteen years, I have seen the silver salmon runs increase over the years in all of the Fish River tributaries, Kachauik and even in Cheenik Creek and in McKinley Creek."
-Thomas Punguk

Comments about the harvest of silver salmon

Some people hardly get any silvers while others get more. People will salt, dry, or smoke silvers; some also put away their eggs. People wait until the end of July or the beginning of August to fish for silvers, which is when the run comes in. They are harvested with set nets, seines, and rod and reel.

In 1986 and 1987 ADF&G opened silvers to commercial fishing in the Niukluk River drainage. There was a commercial harvest that year, but not many people participated.

It was reported that in 2005 or 2006 Golovin's harvest for all salmon species except pinks was closed off by ADF&G because the Niukluk River didn't meet its escapement goal. This occurred despite the Fish River being on a completely different system than the waterways utilized more often by Golovin people. The silver harvest was among the closures, right when they were running.

"King salmon, silver salmon, smokes real good."
-Florence Doyle

"Most of the time those kids get their rods all tangled up and we end up working on them. […] [L]ast summer they did at Cheenik Creek for silvers, they caught some silvers."
-Irene Aukongak

"You know we like to put away silvers and they [Fish and Game] even closed that silver [two or three years ago], right when the silvers were running."
-Debbie Anungazuk

Regarding Pink (Humpy) Salmon

General comments about pink salmon

In times past, when families camped and fished together, people used to string harvested chums and

pinks on willow branches to help divide the catch between families. Pinks would be 10 males and 15 females per 'string'.

There have been one or two major unexplained events with pinks in recent years. One or possibly even two years between 2005 and 2008 a lot of pinks were lower down on the river and beach area and simply waited there and didn't come into the river, seemingly not knowing where to go. They had tapeworms – lots of them, and large ones – and deformed bodies (deformed cheeks) or sores. Some bad ones were mixed in with the good ones. It was concerning because it was unclear if whatever was wrong would spread. People did harvest these fish. Those which were not harvested ended up dying out in the Bay and washing up on the beaches. This event was thought to potentially be associated with other environmental changes, coming after beginnings of flooding, hot weather, and other climate change effects. Secondly, in 2005 and/or 2006 during one summer the waters and rivers were very polluted from some unknown cause, perhaps tundra or forest fires dumping ash into the rivers. The rivers looked like tea, and became brackish, so much so that the pinks couldn't go into the rivers. Every beach in Golovnin Bay was covered with dead pinks, and the entire Bay stunk. There were bears to be found everywhere in every creek getting fat off of the fish that couldn't get upriver to spawn.

Trout eat pink salmon eggs. They are found with eggs in their stomachs in locations where pink salmon spawn.

Drying is the major means of processing pink salmon by Golovin subsistence fishers. Pinks are preferred for drying. It takes less than a day to dry pinks which are harvested upriver, if the weather is good.

"That and when was it, couple years ago or more, what year was that. There was lot of humpies just like they didn't know where to go, there was some from, all the way down, I think down by McKinley and all the way up, all the way around to, yeah fish camp, this side of Nunanaghuq, they call and they were lot of humpies maybe from the beach. Just like they didn't know where to go and we were used to spend our time looking for fish up the river, push our little boats and wade in the water. Because we couldn't use motor sometimes because it was so shallow. And people would tell us "Oh we saw lot of fish down below your camp" at Kachauik, that mouth of that river. We saw lot of fish, I think they're gonna come in. We wait, nothing would show up, maybe they didn't know where to go, I think these were, what they call, hatchery fish. They didn't know where to go and they had like those big, what they call tapeworms and stuff and deformed faces, I mean deformed bodies and stuff."
-Irene Aukongak

Comments about pink salmon biology and behavior
It was noted that a lot of the female pink salmon are small. Pinks, as with chums and kings, were stated to spawn in clean riffle gravel waters where there's clean water, clean rocks and gravel.

Comments about pink salmon distribution
In some years the pink run is a little late. This may have to do with river water temperature. In 2009, the pinks were late.

While the order of salmon runs has not changed (pinks come after kings and chums but before silvers), there are some slight variations to the runs. Sometimes pinks will arrive starting from halfway through to the end of the chum run. Additionally, with the growth in the pink runs, they now last longer because there are more of them. And, as noted just above, they may arrive a little late sometimes.

It was reported that normally pinks will go into the rivers during their run, but for one or two years between 2005 and 2008, they stayed in the beach area and the lower portion of the river for some uncertain reason. These might have been related to some red substance possibly from fires causing the rivers to look like tea and become brackish, or from the river temperatures not being the right temperature (too warm) at the time.

Pinks, like chums, tend to mill around in the Bay before they enter the rivers when the rivers warm up.

It was stated that pinks don't go up Killamulvik Creek any more, or only in very small numbers, but other than that pretty much go up all the rest of the rivers and creeks. With this one exception, pinks are reported as going up the same rivers as they did in the past. More are going up Cheenik Creek in more recent times than they used to; they stay below the beaver dams on the creek.

"[...] humpies, right by my camp there, my cabin and right there you know where we seine too right there, they spawn. Humpies spawn around there, I could see them when the water gets low it, you could see those holes [nests]. […] So we know that they spawn there too and further up."
-Irene Aukongak

"Sometimes you notice that the humpbacks come with, towards the end of the [chum] salmon run or maybe halfway. You start catching humpbacks."
-Maggie Olson

Comments about pink salmon population
Pinks in the Golovin area have, now and historically, had strong and healthy population numbers. While some reported that in the past there were lower population years on odd years, others have noted that pinks have always been plentiful, and some have reported great growth in the pink runs. Additionally, most reported that the pink runs now are strong, and some noted particularly strong years. 2008 was reported as being the last really big year for pinks, and 2 or 3 years ago they did not do well.

It was also noted that 8 or 9 years ago when Fish and Game closed off salmon harvests because the Niukluk River escapement goals weren't met, the only salmon species not to get closed off was pinks.

The first commercial fishing arrived in the very early 1960s, and there was a strong chum run that first year. The commercial fishers let all the pinks escape that year. There were no buyers for pinks, and so they increased during this time. Pinks exploded in 1964 and 1965, and the cannery was practically overloaded. By that time the buyers had provided gear for harvesting pinks. Golovin continued to get heavy pink runs, including after local commercial fishing began to die out starting in 1978.

"Humpies always be plenty, plentiful."
-Irene Aukongak

"There was always plenty of fish [when I was small] but later on we start hearing this odd year where the humpbacks are low and even years and then there's lots. Last few years it seems when we have a humpback run there's so many. But one year when my daughter became a commercial fisher lady/woman or whatever and I think during her commercial fishing she caught only 8 in her net. It might be because some years the run of humpbacks is late. When you think there's not going to be too many just like a young couple up here, we were kind of giving up not to many humpbacks and they went

to Cheenik Creek and they hauled in 500. So some years the run is little late."
-Maggie Olson

Comments about the harvest of pink salmon
Pinks are the main salmon species that people in Golovin are targeting and harvesting. Some people will go far upriver to harvest pinks without fat on them. These are considered the best kind, especially good for drying. Salmon lose their fat as they go upriver. People also used to commercially fish for pinks near Golovin.

"Quite a ways up, when we want good humpies without the fat on 'em."
-Florence Doyle

"We mostly have pinks, they're good for drying, we dry few [chum] salmon but we'd rather have the pink, pink fish, pink salmon."
-Florence Doyle

Regarding Red (Sockeye) Salmon

General comments about red salmon
People feel that the False Pass commercial fishery, which targets reds and also take chums (as bycatch), resulted in declines in salmon populations up in the Golovin area.

"To me it [salmon] declined after the fisheries were through here and of course we hear about […] False Pass, where it was a big deal there for awhile. False Pass was the main reason why we were getting fewer fish, those. […] When they were fishing for reds and you know reds are a better choice and higher price. I really don't know what they did with the chums what they caught. You hear rumors but I can't really say what they really did."
-Maggie Olson

Comments about red salmon biology and behavior
It was stated that red salmon use the middle of the water column.

Comments about red salmon distribution
There are some indications that red salmon may go up Cheenik Creek and that their population is increasing in that creek.

Comments about red salmon population
In 2009 it was noted that in the preceding couple of years there had been increases in reds seen in the area. However, not many reds come to the Golovin area in general, now and in the past. In 2014 people still were of the view that there are a few reds to be found, but that it is rare for someone to catch one.

Comments about the harvest of red salmon
People in Golovin are not targeting reds for harvest, but will very occasionally catch some.

"Primarily for eating, we dried pink salmon and chums, dog salmon. And also incidental catches were a few king salmon and rarely a red salmon so that was the main, mainly we dried pink salmon, and dog salmon for human consumption. And we continue to do that today although to a lesser extent because

of the cash economy we get more groceries from the store."
-Thomas Punguk

Regarding Chum (Dog) Salmon

General comments about chum salmon
Some people refer to chum salmon simply as 'salmon'.

In times past, when families camped and fished together, people used to string harvested chums and pinks on willow branches to help divide the catch between families. Chums would be five males and three females per 'string'.

It bothers people that the pollock fishery is catching fish, such as chum salmon, as bycatch, and they are concerned that it is resulting in decreased populations for chums in their area.

Drying is the main method of putting pinks and chums away.

"[...] those are good eating salmon, dog salmon."
-Irene Aukongak

"[Regarding the pollock fishery's chum bycatch:] Now they're [chum salmon] very precious to us, we have to save every little thing and they make real good dried fish too."
-Irene Aukongak

Comments about chum salmon biology and behavior
Elders used to say that chums are bigger when the run is small, and when the run is heavy the chums are smaller. Hardly anything was noted as being inside chum stomachs. Chums and pinks tend to mill around in the Bay before they enter the rivers when the rivers warm up. Chums, like pinks and kings, spawn in clean riffle gravel waters where there's clean water, clean rocks, and gravel.

"My grandmother and my Elders when I was growing up they used to say the chums were bigger when the run was small and then when the run is heavy then the chums are smaller. This is by hearsay, what my Elders had said."
-Maggie Olson

Comments about chum salmon distribution
Chums are going into the same rivers they did in the past. They may be being found in fewer numbers in Cheenik Creek than in the past, which would appear to be the opposite of the overall trend for other populations of fish (i.e., silvers, pinks, and trout) for that waterway. They stay below the beaver dams on that creek.

Chums are the second salmon species to come in, after kings, and before pinks. It was reported that sometimes they show up at the same time as pinks, however. There is also a second chum run in August. The first chum run can very occasionally start as early as early June, but typically starts mid June; it would be considered late if it started in late June. The peak of the run is around July 4th. The chum runs have always been fast, lasting around two weeks, three at the most. There hasn't been much change in the timing or length of the two chum runs.

"[...] the chum runs has always been quick and fast, lasting about two weeks, three weeks at the most and then there's always a second chum run in August, what we used to call second run. And I don't think there has been much change in the timing or the length of those runs."
-Thomas Punguk

Comments about chum salmon population
When commercial fishing came to the Golovin area in the very early 1960s, there was a strong chum run. Some feel that chums were overfished, leading to a decrease in their population. It was reported that mismanagement by governmental agencies led to the overfishing of chums for the first twenty years or so of the commercial fishing. Others, however, do not feel that there was local overfishing of chums. Some other environmental changes happened around the same time and might have been related to impacts on chum populations: they started having very hot weather, floods, beavers that made dams and made the waters shallow, and more bears were present (which eat fish).

People reported that in 2006 or 2007, ADF&G closed off fishing for all salmon species except pinks because escapement goals were not met on the Niukluk River. This included not being able to keep chums. However, interviewees noted that the Kachauik River is not on the same system as the Fish River. It was noted that people fishing out of Council may be putting high pressure on their rivers' stock, as well as potentially damaging spawning habitat (eggs being blown out of the river bed) with jet units. This is felt to be having a negative management impact on Golovin's ability to fish.

There is disagreement about how chum populations are currently faring. These run the full range from 'seeing very little' to 'a lot'. Despite the decrease noted above which may have resulted from the original commercial (over)fishing for chums in the Golovin area, people noted that up until the late 1980s (e.g. 1988), people were still getting good chum runs. However, chums crashed in the late 1980s. Cumulatively, the decreases in chums are seen as being a result therefore of bad management and local overfishing in the Golovin area (though some do not agree with this), as well as fishing in Area M/False Pass (for reds) and the chum bycatch of the pollock trawling fleet. People noted that when Area M fishers took voluntary measures not setting nets for 5 days, larger returns were noticed in the Golovin area after that occurred.

Comments about the harvest of chum salmon
In the past, pinks and chums were the main salmon species targeted in Golovin for subsistence harvests. Some people currently prefer and target chums and pinks. The commercial fishing that came to the Golovin area fished mostly for chums. As noted above, after that started, the chum population and subsistence harvest dramatically decreased. Local people conducted commercial fishing as did foreign fishing vessels. The commercial fishing in Golovin steeply declined between the late 1970s and 1980s and is locally considered to be moribund now. When there was commercial fishing, the salmon (mainly chums) were being canned in the floating cannery. Some people from Golovin worked in the cannery.

People mainly harvest chums in Golovin by seining in rivers and creeks. There are varying opinions about chum population and harvest numbers now, since the decline of local commercial fishing. These views are not all necessarily mutually exclusive though do express a fairly wide range of sentiments, including that some people barely catch any which is a large decrease from the past, to the harvest having decreased but being still adequate, to a sense that the populations are rebuilding and healthy.

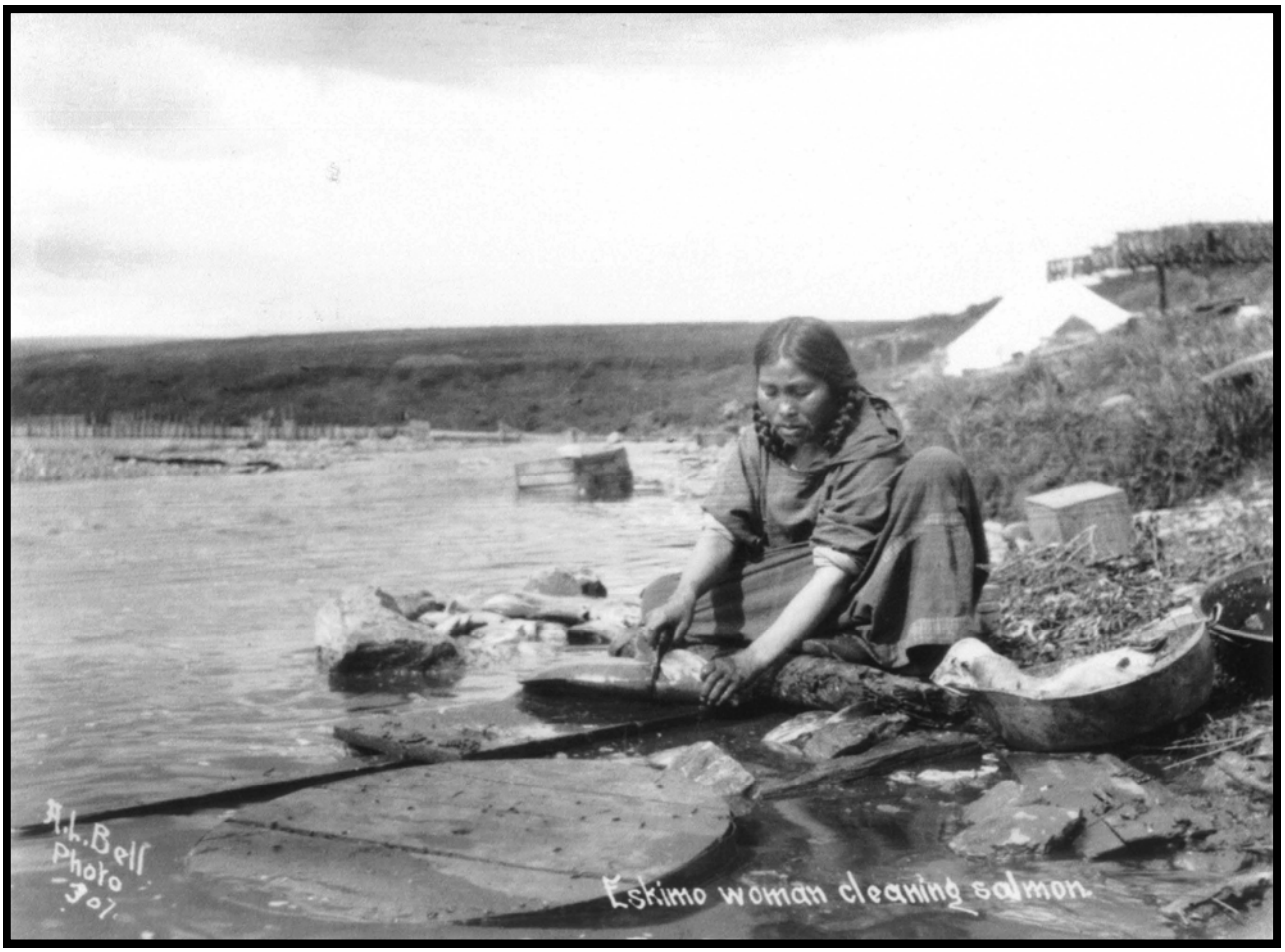

Figure 10: A woman cleaning salmon. Photo: Carrie M. McLain Memorial Museum, Nome, Alaska. Accession number Bell-N-61.

Regarding Salmon in General

General comments about salmon in general

People have different preferences for particular salmon species. Some reported preferring/targeting one or more of kings, silvers, chums, and pinks. As with all other food, and anything else that can be used, it is felt that salmon should not be wasted. Some also noted that failing to treat salmon or other animals properly will result in decreased success in future harvests.

While some people hadn't seen problems or changes in the health of fish, others have reported that some do not appear to be healthy. There is concern about the overall health and strength of the salmon runs, in general as well as for particular species (especially chums). There is also concern that increasing algae in the river bottoms will lead to problems with the health of fish and fish runs. People have seen lice, pin worms, and injuries from animal attacks; these were not very concerning to people. Also reported were some little lumps/bumps that had been seen on some salmon, especially silvers. People reported throwing back fish that seemed sick or unhealthy. Fish with small curly worms between the skin and fish meat were thrown back in because people were unsure how to properly dispose of them; these worms may be becoming more common. People have caught fish with tapeworms; it was noted that they used to just be found in the belly, but now are also seen going all the way through the meat into the skin, and there are also some indications that there are more tapeworms

in fish than in the past. Some fish had been caught with open sores, and thrown back in; these may also be increasing in frequency.

As noted in the section above on pink salmon, it was reported that for 1 or 2 years between 2005 and 2008 there were pinks that behaved in a confused manner and did not go up the rivers, instead milling around the beach and mouth of the rivers until they died out there. These fish also had many tapeworms, deformities, or sores. There was concern that this problem might spread amongst the fish. One interviewee suggested as an explanation for this event a sort of red smoky substance like fine dust which may be ash from tundra or forest fires that had been recently found going into the water and plants and making the rivers look like tea and become brackish; it was suggested that perhaps this had occurred to such an extent it had prevented the pinks from going into the rivers.

Comments about the biology and behavior of salmon in general

It was noted that when salmon move into freshwater they lose their fat. The further upriver they go, the less fat they will have. Fish with less fat are preferred for eating and drying for human consumption. However, some prefer fish from the Bay for dogs because it has a higher content of the nutritious oil.

It was reported that some *muloqcholq*s (which is the Eskimo word for salmon that have spawned out and are at the end of their lifespan and in poor shape) will try to get back out to saltwater, and if they do, they can be rejuvenated and come back years later.

"I was always taught that the further up you catch a fish, they won't be so fat. And when they're purple that they dry a lot quicker so that's the type of fish they prefer."
-Debbie Anungazuk

Comments about the distribution of salmon in general

There haven't been any real changes to the sequence of the salmon runs in Golovin. Kings come first, then chums (which also has a second run in August), pinks, and silvers. Sometimes pinks and chums show up at the same time. It appears in general that the runs are starting at the same time as the past. However, it was suggested that in more recent times the pinks may sometimes come late, and also that silvers may be coming late as well. There are also some occasional variations that do not seem to be part of a trend.

Approximately 21 years ago a very large amount of fish came to the Golovin area. They went up into lakes and every creek, including Cheenik Creek, which was the first time some people had seen fish go up that Creek.

It was reported that there used to be a lot of fish at Imaghuqchiaq, a place where people seined, but there are not any now.

"[...] kings always seem like they be here first, then chums, pinks, silvers [...]"
-Robert Amarok

Comments about the population of salmon in general

There appears to be some consensus that Golovin-area salmon populations – or at least for some of the salmon species – were negatively impacted by False Pass fishing, Golovin-area commercial fishing and co-op activities (though there is some disagreement over this issue in particular), bycatch from the current commercial fishing to the south, and possibly foreign fishing. However, there is substantial

disagreement about the status of Golovin-area fish populations today (with opinions ranging from not many, to less than the past but sufficient, to healthy). There is concern about the health and strength of salmon runs.

There is concern that Golovin-area fishing is being negatively impacted by a combination of poor fish returns in the Nome and White Mountain area coupled with poor fisheries management. Interviewees point to recent salmon harvest closures which were based on unmet escapement goals on the Niukluk River. Interviewees point out that Fish River systems are different from the Kachauik River, that there have never been studies of fish populations on Golovin-area waterways, and that Nome/Council and White Mountain fishers may be overfishing their rivers, damaging spawning habitat with jet units, and damaging the river with sewage outfall into the river from Council, but Golovin-area fishers are being penalized for it.

Golovin banned the use of jet units on the Kachauik River to protect the fishery (this protects the spawning area and egg nests from damage from the jet units).

Other factors or possible factors impacting fish and fish populations were also noted. For example, this includes river water levels at the time of spawning, snow cover levels in winter, climate change, water conditions, and ice conditions during the winter on salmon streams (e.g. it was noted that if a river freezes to the bottom during winter, this can negatively impact hatchery survival as demonstrated by future returns). Some other factors or possible factors are also noted in other sections of this report pertaining to Golovin, such as concerns about the impact of algae on salmon spawning.

"Gee, when we were growing up you can hear them fish all night, going up the river even in shallow places making all that noise."
-Florence Doyle

Comments about the harvest of salmon in general
People used to harvest and put away a lot of fish for dog teams before snowmachines were used. People need to harvest less fish now as a result of there not being dog teams anymore. Estimates of fish put away in total to meet all needs (e.g. for human consumption, for dogs, and for sharing) are as high as needing to process over 1000 fish (for one household).

Prior to commercial fishing, which started in the very early 1960s in the Golovin area, the chum and pink runs were healthy. People harvested them at the beginning of their runs using set nets in the bay at their spring camps on the beaches, and then at their fish camps on the Kachauik, Niukluk, and Fish Rivers as the runs began to enter the streams. As the pink and chum runs slowed, people shifted to harvesting berries and greens (which were then ready for harvest), as well as setting nets in the bay for silvers, which would be preserved by salting and smoking.

There is a general preference for harvesting salmon in the river as they lose their fat by going upriver in the fresh water. These are preferred for reasons relating to taste and drying.

It was reported that there are less people fishing now as compared to the past. There was practically a whole village's worth of people who would go out to fish camp in the past. There are very few families who now go out fishing and put away fish. This was attributed to a number of factors: more jobs, people getting groceries from the store with the cash economy, less people eating Native foods, people not wanting to participate or take the time to put away fish, and no dog teams to feed now.

Some people, at least in the past, go salmon fishing as soon as the ice goes out. Salmon fishing starts in June. Kings are the first run for those who fish for them. After that are chums, then pinks, and then silvers. There is also a second run of chums in August. Salmon fishing lasts into August or September. People reported that sometimes they are able to get all they need quickly while other times it takes a while. People fish and put fish away when the weather is nice, e.g. when there is no rain.

People will fish at fish camps and at other locations. One interviewee noted that subsistence resources are close by to Golovin, including fish. People learn about places to fish from their parents and grandparents. Before the use of motors, people pulled boats by dog team when they needed to. People mainly dry their fish at fish camp (the main fish being dried are pinks and chums). Some people spend all summer at fish camp. Kachauik River is the main area where people have fish camps. People will sometimes fish in different locations for different salmon species.

The main methods people use to fish for salmon now are seining, setting nets, and rod-and-reel. Both seining and setting nets are used in rivers and in the Bay, but it is most common that seines are used in rivers/creeks and nets in the Bay. Rod-and-reeling is also done on rivers and creeks. It is common that adults will fish by seining, and younger people and children will fish with rod and reel. People have used seining trails on the rivers. One person would stand on the shallow side of the river or creek and walk holding the net, while other people stood on the deep side walking with the net. Some of these trails have disappeared because of erosion.

It was reported that people used to fish for salmon farther upriver than they do nowadays. As noted above, the further upriver you fish, the less fat the salmon have on them, which is preferable for eating and drying. The shallowness of the waterways makes it too problematic to bring motorized boats up that far.

Some people reported that traditionally female salmon used to be thrown back in alive. This was seen as one of the reasons that fish kept coming back years ago – people knew what to do to keep the runs strong. However, some reported that people would mostly feed female fish to dogs.

It was stated that you need to give salmon enough time to dry, and that can be taken into account when you are catching them (e.g. how quickly you catch them).

Some people will share or exchange fishing resources – such as nets, fish rack space, labor for cutting, and so on. People will also help others put away fish at camp, e.g. by cutting.

Local commercial fishing in Golovin steeply declined between the late 1970s and 1980s and is locally considered to be moribund now. There are only a few people who commercial fish anymore. It used to be a significant source of income, but is not anymore for the most part. It was stated that people who used to rely on this income are hurting.

"They did all the cutting because I have a big rack and had the net. Because some of these people don't have a net or they don't have racks."
-Maggie Olson

"Seems like when we're younger or when they're younger [kids] they're really interested in seining, fishing, learning how to cut fish, put fish away and stuff, helping around, hang fish and then when they

get little older, then they lose that, just like they lose you know. Don't want to camp and so but I know they learn, they know, what they learn they never forget. Like I did, we don't forget what we learn. […] [I]t is very important [for them to learn those things] because you know some old folks used to tell us too that sometimes we'll go hungry and we have to know how to put fish away and put our Native foods away, stuff like that. We have to learn how to, instead of buying too much canned foods and stuff. 'Cause nowadays it's so expensive."
-Irene Aukongak

Regarding the Preparation and Use of Salmon

Salmon have a variety of uses. They are used for human consumption, sharing (with family members and others, such as friends, Elders, and those who help putting the fish away), trading (e.g. for other subsistence foods, or for gas to do subsistence activities), and food for dogs. People don't have dog teams now, which is one factor behind less fishing now compared to the past. The fish people gave dogs were dried. Dogs can be given the fattier/oilier fish; the oils are nutritious for them. People used to give dogs mostly female fish, cut but with the guts, eggs, and head still attached.

People identified a number of ways that salmon are processed, cared for, and stored: drying, smoking, salting, canning, freezing, boiling, soaking in seal oil, barbequing. People also noted frying salmon hearts, roasting fish skins over the fire to eat with or without seal oil, and boiling or fermenting salmon eggs. The main way that fish are put away is drying them on racks at fish camp. For the most part pinks and chums are dried. Silvers will get salted, dried, or smoked. Kings will be dried, smoked, or just cleaned and cut up for steaks and then frozen. People used to put salmon on willow strings to help divide them between families sharing the catch. This was also done because it was easier to cut and segregate males and females on the fish racks, and also because it made it easier to transport the fish on the small boats people used. One willow would have 5 male chums, or 5 females and 3 males if a lot had been harvested, and for pinks one willow would have 10 males and 15 females each. This practice was stated to have been utilized prior to commercial fishing, when everyone had a camp at Kachauik (thus prior to the early 1960s).

When putting fish away, health issues are examined before cutting, hanging, and drying the fish. For example, when a fish has lice, you can take the lice off and then dry the fish. Deformed fish, however, will be thrown away. Children will help with catching, hauling, washing, cutting and hanging fish. People also will pick berries at the same time as they are working at harvesting and drying fish. Some people share and exchange resources for putting fish away (e.g. exchanging labor cutting fish for using someone's fish rack, or exchanging fish for gas to go do subsistence activities). People will come to fish camp to help others cut fish.

Fish take about 4 days to dry. Rain makes it difficult to put away fish. Bugs can also be a problem when drying fish. Because of concerns with bugs, one has to monitor the fish a lot. Some people also use a smudge pot to help with bug concerns. The wind helps to dry fish.

"[...] the male humpies make good dried fish and soaked fish, seal oil. Any kind of fish taste good soaked in seal oil."
-Irene Aukongak

"Interviewer: What kinds of things did your Elders tell you about salmon and how they were supposed to be treated? TP: I don't remember nothing special about that. Other than don't waste. They put the

salmon eggs away, stinking eggs we call it. Salted bellies, silver salmon. And I was always taught not to waste anything. Don't shoot anything you don't eat, don't kill anything you don't eat. So it's just my way of life, other than that I don't know any treatment of fish special that I can remember. It goes the same for animals, do not waste any part of an animal."
-Thomas Punguk

Regarding the Environment

Rain

There is more rain now in Golovin than in the past. Rain can make it difficult to dry fish. Rain is now being seen in January; this is a recent change, but has become fairly consistent now.

It was noted that people are beginning to adapt to how seasonal changes are affecting their fish harvest. Some are fishing earlier to try to beat the rainy season.

Snow

In general people feel there is less snow now than in the past. There was a lot of snow in 2008-2009, but there hadn't been much snow for quite a while before that. It was the largest snowfall in 10-15 years. In 2014, the last heavy snow year was identified as being 2010. Ever since then, there has been a lot of open water everywhere each winter. A lack of snow cover is an important environmental change people are seeing. This leads to their being less insulation for river ice, less water in the rivers, and increased water temperatures. It was suggested that Golovin gets high pink numbers when this happens; one year pinks were spawning on the beach because of the temperature of water coming out of Cheenik Creek.

Low snowfalls also make it harder to get other resources such as caribou. It was suggested this may be resulting in greater pressure being applied to other resources such as fish. Higher snowfalls are good for seal and ugruk denning and also for berries. People depend on the snow because it gives plants water. It was noted that when Golovin's snow is melted one still might see snow in White Mountain, Koyuk, or Elim. On the Council side of Fish River there is more snow, but where the Fish River is flat it will be bare because of how windy it is there.

Wind

Some felt that there had not been changes to wind over their lifetimes, but others noted a number of changes. These changes included there being more wind than before; stronger wind than before; the presence of more hot, windy weather now; increased wind in the winters; increased wind causing large waves; and increased wind that is beneficial for drying fish.

Wind blowing in the summer will effect fishing because people are then unable to set out nets. It was noted that the wind is not predictable and regular. It was also noted that people have seen whirlwinds, and that these may be becoming more common. Dust devils were noted as becoming more common now.

Climate/Weather Unpredictability and Variability

While there were conflicting thoughts about the predictability of weather now as compared to the past, a number of people felt that the weather changes more suddenly now than it did in the past.

"The weather I know, always storm so quick now, all of a sudden. Long ago it used to come so slow,

maybe a day or couple days after it storm, when we know it's going to storm now, even during the night you wake up, that wind blowing and get up and look, storming. Yeah it changes so fast now, here we used to, we never had motors then but we drove across there, go berry picking, nice and calm. Stay across there, berry pick all day and come back rowing. Never blow that much when we were growing up. But now all of a sudden seem like it blows more, not grow but blow."
-Florence Doyle

Storms
Some felt that there are the same number of storms now as in the past, while others felt there were more now. It was also suggested that large storms used to occur at 20-30 year intervals, but now are much more frequent. Golovin gets most of its storms in the fall. Storms bring high waters and floods. With the fall storms, the water will come quite far inland. Every fall Golovin gets high water. There is some indication that Golovin is getting more floods than in the past. There was also some indication that storms are coming in quicker than in the past, and were representative of the weather changing faster than it used to.

"I think so [that there are more storms now], could be true yeah, could be. Lots of storms and floods, high waters. Water all over."
-Irene Aukongak

Temperature
It is felt that in general the temperatures are not as cold as they used to be. It used to be very cold in the winters, moreso than now. Additionally, there is more hot weather than there used to be. It is not clear when the new, very hot summer weather that people reported started to happen in Golovin, but the two time periods identified as candidates were the 1980s and 1990s, and prior to that the period around or after when commercial fishing started in Golovin (which was the early 1960s). Additionally, it was noted that a cluster of environmental conditions started to occur around the same time that commercial fishing began in the Golovin area: hotter weather, floods, and beaver dams making the waters shallow. The hotter weather was also accompanied by lakes and small sloughs drying up, and to willows growing larger.

Water temperatures were noted as playing a role in when fish come to the Golovin area and go into the rivers and creeks.

It was noted that when rivers freeze all the way to the bottom it kills fish fingerlings and eggs.

Other or General Comments about Climate and Weather
Climate change is felt to be having a big impact on everything.

People reported that Elders had stated that the weather was going to change, and that it used to be calm a long time ago.

People spoke of a time before gold was discovered in Nome when there were back to back winters; spring was coming, but winter came again instead. Fish came into the rivers like they usually do around June, but under the ice.

Poor weather can conspire with other issues like harvest closures to make subsistence difficult.

It was noted that climate change may be impacting fish and animal behavior.

It is felt that it is still important for children to learn traditional methods of weather forecasting; while the environmental signs used for this are not as effective anymore given climate change, it was noted that NOAA forecasts are not as effective now either.

Ice

According to participants, freezeup was consistently seen as considerably later now than in times past, and continues to get later. It used to be very cold in the past. Freezeup used to be in October (or perhaps as early as September), but now happens more around late October or November. The Bay has stayed open in recent times even until December. Later freezeup is making travel across the ice a more problematic proposition. On the other hand, there were significantly varying opinions about the timing and nature of breakup and whether there have been changes to it (some feel it is earlier while others feel it has not changed, and some feel it breaks up differently while some thought it varied year to year).

There have been other changes to the ice. It does not freeze up as it used to – there is more open area, certain areas are not safe to travel across, the ice is always moving, the edge of the ice is much closer to Golovin than it used to be, it doesn't pile up like it used to (which provided good drinking water), it freezes and then thaws out sometimes now, it is thinner than in the past and gets increasingly so in the Bay every year, there is less thick "winter ice" on the ocean, and overflows have become large and deep.

"Freezeup I've noticed, freezeup comes later than usual, much later sometimes. I have seen this Bay open until December [...]"
-Thomas Punguk

Erosion

There is a lot of erosion happening in the Golovin area. Erosion was noted as happening all along the beach as well as on the rivers (including far upriver). It is washing away edible vegetation, seining trails on the rivers, exposing permafrost, archaeological sites, and may be impacting fish. Banks are sloughing off gradually. It is seen as increasing in some places. 1992 and 2005 were seen as particularly bad years for erosion.

Additionally, it was noted that when barges come in to dock, they wash away the sand from Golovin's beaches.

"[T]here's lot of erosion here [...] up towards camp, up on those high banks like muddy, sandy banks and areas, you could see where the mud is going, even right across my camp too where the banks are folding in and sometimes if the banks wash off more we could see the […] permafrost [...]"
-Irene Aukongak

Changes Regarding Other (Non-Salmon) Fish, or Fish in General

People used to fish for herring along the beach in late September and early October, but after people started fishing for them in boats there was a decline, which started in the 1970s and 1980s; now, people do not catch that many of them.

Figure 11: Fish processing area on the beach in Golovin.

Trout were noted as fish that are now found in Cheenik Creek but didn't used to be there in the past. It was noted that trout sometimes have just-spawned salmon eggs in their stomachs (most likely pinks) as well as a lot of minnows and fingerlings (this is not a change from the past). It was reported that ADF&G told people they had never seen trouts with minnows and fingerlings in their stomachs. Small lesions have been observed on trout. Little bumps have also been observed on smaller trout, but hardly any on the larger ones; this is the first time people have seen this.

In 2009 people reported that since 4-5 years prior there had been a marked decrease in tomcods, such that it was getting harder to find good harvest areas. People used to harvest lots of them, including when they were used to feed dogs. It was also reported that some fish have lesions, like an infection, and part of the skin is off; this has been seen in particular on tomcods.

It was reported that eight or nine years ago someone caught a bright, fluorescent green colored fish. This had never been seen before, and people wondered if it came from a fish farm. People are seeing some different fish that some do not like to touch. Some, when you cut them open, have no color, and are pale like they have no blood (there is also concern these may be hatchery fish). Things like this were not seen long ago, it was reported. People felt they needed to be careful about these fish. Some fish were reported as being smaller, skinny, and having a large head. When they're skinny they tend to have big heads, slim bodies, are pale, and their skin doesn't appear to be healthy (not shiny, nice and firm).

Some people have reported seeing cysts on fish. Also, some people reported that when they got

deformed fish they always throw those away.

It was stated that changes and problems in fish health may be associated with environmental changes (hot weather, flooding, climate change, and the Exxon Valdez oil spill). At least some of these health changes and problems are viewed as having come after these environmental changes started.

It was noted that there are a lot of different kinds of fish in the lagoon before they head out to the ocean. This is a reason why mining is a concern.

"We tried to tomcod fish, seem like there was hardly any, there used to be a lot of tomcods long time ago, right during first freezeup, and now when we go out there, catch one or two or nothing at all. I don't know what's going on."
-Debbie Anungazuk

"Yes, there's less tomcods too now, ever since how many years ago now. About four, five years ago. They were getting less and less and then even last year we were having hard time finding the good patch, you know, good school of fish. And their getting to be few, they have to look to try and find tomcods. Whereas long time ago when I first came, people used to even come from White Mountain, like elderly people and we even used to go across there too, across over this way and even around here. Some people used to go home with lots of tomcods, some people used to even like sled load."
-Irene Aukongak

Changes Noticed with Marine Mammals
Many belugas used to be found in the Golovin area, but the running of a noisy light plant generator was blamed for them no longer showing up.

In the late 1960s, there were many seals (up to thousands) in the young ice every day, but recently there are a couple hundred at most.

Changes Noticed with Land and Other Animals
It was reported that a long time ago, there used to be a lot of caribou in the Golovin area, which were from Cape Darby and which people hunted, but then one year, about 130 years ago, they disappeared. This was part of a famine on the Seward Peninsula where there were also no fish and no other game. A lot of people on the coast were able to stay alive by eating tomcods and crabs. A flu epidemic also happened that year, devastating the villages. Caribou came back for one or a few years in the 2000s, the same year some young people were lost and search crews were looking for the missing youth, and then after that they retreated about 30 miles inland. People do harvest caribou now.

It was reported that some people used to have reindeer herds, and that there used to be thousands of reindeer.

It was noted that a lot of animals moved towards the Golovin area after the large fires in the interior part of the State in the early 1960s. This included beavers, bears, and moose. Some of these animals stayed. Some people feel that the bear population is having a large impact on the moose population. It was noted that there didn't used to be many bears around Golovin, but that now there are a lot, and people feel their numbers are increasing. They are considered a nuisance because they can cause problems at fish camp, in terms of concerns about safety, and because they are starting to come into the village, and seem to have lost their fear of humans. There are also more beavers now than there used to

be, and there are concerns that there are too many beavers. There is concern about beavers contaminating river and creek waters. One resident has tested water for contamination. One area that is now a pond used to have good water but is now highly contaminated. The presence of beavers has dissuaded people from drinking creek water. There is also concern that beavers will effect fish because of building dams, particularly on the Kachauik River, because there are many dams there. Beavers were also noted as making the waters shallower as a result of their dams. People have tried to break up some dams, but they were either too difficult to break up or the beavers simply rebuilt them.

"After that big fire they had around Fairbanks, lots of animals moved up this way like bears, beavers, moose, all kinds of animals came up this way."
-Irene Aukongak

"And we were real happy the caribou just stayed across there, I guess they, I don't know, God put em there for, to help feed the people that were searching out there. I always think like that, 'cause after they got through searching, the caribou left. Now you have to go way out there."
-Florence Doyle

Changes Noticed with Birds
While some interviewees stated they had not seen any different birds arriving that were new to the Golovin area, or any other changes with birds, some had seen new birds they hadn't seen in the past. Some people felt there were a lot less migratory birds than there used to be. It was stated that there was a decline in brandts migrating through the area, though it was unclear if this was caused by a quicker migration or a population decline. There was concern among some that it was only a matter of time before avian flu turns up in birds that come to the Golovin area. It was stated that there are more eagles now in the area, that they were coming back after a period when they had been absent. Swans were noted as increasing in numbers. It was reported that there was a great decline in the migration of pintails/sprigs starting after 1962, though along with that mallards became plentiful in Golovnin Bay in the summer.

There were reports of birds with deformed beaks.

Changes Noticed with Insects
Some people reported new insects in the Golovin area in recent times, including: grasshoppers (there are a lot of these), large black flying beetles, very large black spiders (some of which were new, and were possibly introduced with freight), horseflies, small black butterflies, small swallow-tailed butterflies, and some kind of very small black insect.

Vegetation
Having a lot of snow was seen as a good indicator for having a good berry season. Too much rain can cause flooding in the rivers and flats, which can lead to logs and seaweed being deposited on greens; however, with too little rain, berries will dry out. Poor weather conditions were identified as a cause of greens not growing, as was frost (as for berries as well). In general people felt that greens were growing in the same areas as they used to and in the same amounts, though some changes were noted. Lakes are drying up, which can have an impact on greens. Also, the erosion of river banks can lead to plants (e.g. berries, wild rhubarbs) being washed away.

While some felt that vegetation in the Golovin area overall was the same as in the past, others noted some changes. Some felt that willows are growing in more places and growing bigger than they used

to; they were noted as growing particularly fast in the hills. Willows were reported as also taking over berry areas. It was also noted that people are seeing different kinds of willows as well, not just more of them. Spruce trees were noted as growing in abundance in areas that they weren't found before. Wild rhubarbs were also noted as growing in areas they did not used to grow.

There has also been a great increase in sea grass at the bottom of Golovnin Bay, which can cause problems for outboard motors. Additionally, it was noted that when barges come in, it can cut up sea grass, which will then float into fishing nets, causing problems. Additionally, there has been an increase in algae in the rivers and the Bay recently. (There is also more silt being noted in Kachauik River as well.) This algae can get into fish nets and decrease the effectiveness of the nets because it makes the nets more visible to fish. There is also a concern the algal growth will effect fish. It was also stated that lakes are also filling up with algae now as well. It was also reported that people are seeing a green slimy mush which hasn't been seen before.

It was noted that some people do not collect greens as much as they used to in the past. Some interviewees discussed the health benefits of various kinds of vegetation, including those with medicinal uses such as red willow (alder), ayuu tea, bumblebee flower roots, and stinkweed.

"My Momma used to take me out when she's up there picking. Ugly looking greens, flowers, she put away flowers, roots and stuff. Tell me what they're for, I forget most of it. But my wife knows a few, she has a few herbs put away for her own use, and they work for her. I never try it yet. For instance she has a cough, smokers cough when it's bad she'll chew a little tiny piece of that ____. And we know what them great big plants, they have a root, big root down there. Her, she used to dry em, her Momma used to dry em and whenever they get a bad cold or bad cough they chew that root. It works. There is also them bumble bee flowers, have a root. My Momma used to put them away. I don't know what for. She had her own reason. Schargigruaq, stink weed. My Momma used to make a tea out of that stink weed, bad tasting tea. But she had TB before and when it got bad she'd brew a cup, little cup, drain her lungs out I guess, Florence. And stink weed is also used as a poultice. Something about, I've heard somewhere, where scientists are studying stinkweed cancer curing properties. Amazing."
-Thomas Punguk

Other, General, and Miscellaneous Comments about the Environment
Currents around Golovnin Bay were noted as having gotten a lot stronger.

It was noted that lakes and sloughs are drying up, and some have already dried up.

There has been more flooding in Golovin in more recent times. It is felt that it may result in temporary contamination of the river waters such that they would be unfit for drinking.

It was reported that there is a lot of sediment in the rivers now.

The tides were reported as being different now, staying higher longer.

It was stated that environmental changes were gradual at first, but that many of them are a big problem now. Additionally, it was noted that changes in the environment may lead to a food security problem.

"TA: I think the thing I noticed last two years is that the things coming up from the ground. And if it's real calm that, I think you could smell it now. Interviewer: Is that in the inner Lagoon or out in the

Bay? TA: Where it's not deep, when we get high water you could see it coming up through the old airport because the old airport I think is part of the ponds are on that airport. When we had very high water we had to move the boats. That you could see stuff bubbling up. Not just letting a bubble up. Interviewer: Like continuous? TA: Yeah. And I think that problem will get worse. You could see the banks, are dropping off. Slowly or whatever they call that."
-Toby Anungazuk, Jr.

Regarding Culture, Society, and the Economy

Learning to Fish

People mainly learned to fish from parents and grandparents about how to fish and put fish away. At fish camp, children help with seining, hauling, washing, cutting, and hanging fish. They also help with babysitting younger siblings at camp. People learn about fishing by watching, participating, and by doing it themselves.

"I was told by my grandpa where to fish for certain species with rod-and-reel or in the winters through the ice. Lot of what I learned is traditional Eskimo knowledge from my grandpa."
-Thomas Punguk

The Importance of Salmon and Salmon Fishing

For some families salmon remains as important as it used to be. Overall, salmon are seen as very important by Golovin experts.

One way the importance of salmon and salmon fishing can be seen is the serious concern about restrictions on salmon fishing. There is a significant concern about the cultural impacts of restrictions being placed on the local harvest of salmon in terms of how it has taken life opportunities from generations of young people in Golovin.

In terms of frequency and quantity, salmon and salmon fishing has declined significantly in importance compared to the past, but it is still seen as needed. While a handful of families put away fish in significant amounts, one does not see almost the whole village at fish camp during the summer as used to be the case. Not as many people go out fishing as in the past, and not as many go to fish camp. This was attributed to a number of factors: more jobs, people getting groceries from the store with the cash economy, less people eating Native foods, people not want to participate or take the time to put away fish, and no dog teams to feed now.

Salmon are still very important in other respects. They are still used for human (and to a much lesser extent, dog) consumption, as well as for sharing and trading. Also, in general, salmon is seen as culturally important. Additionally, people who were raised eating Native foods like to eat them very much. A lot of people in Golovin depend on salmon, especially Elders. Fish also helps people stretch their budgets because of the cost of store food. Additionally, salmon are seen as being healthy and an important part of peoples' diets.

"A lot of the people depend on it [salmon] here, especially the Elders. And one thing my mom always told me was how […] Kachauik River was black with fish a long time ago, and now they don't see it that way."
-Debbie Anungazuk

Transportation, Fuel, and Costs
As noted earlier, dog teams have been replaced by the use of snowmachines and four-wheelers, and boats now have powerful outboard motors. Fuel prices effect subsistence activities. Some people don't have the money to get gas to do subsistence activities. Some are pooling resources to deal with this issue (e.g. relatives with gas take people out, or people will go out together). Others are donating gas to people in need to go do subsistence, or trading for it. It is not clear if the price of fuel, however, is resulting in decreased fishing harvest. One interviewee noted, for example, that you can get subsistence resources very close by to the village. Another interviewee, however, noted that it had definitely made an impact and prevented people from doing as much fishing as they would want to. It was noted that when fish are close by it is a lucky thing because of fish prices. Some commercial fishers are also staying closer to town to save on gas.

Jobs
People noted both positives and negatives related to employment. People worked in commercial fishing and the cannery in the past. Commercial fishing was a significant source of income for some people, and without it now they are hurting financially. It was noted that one potential benefit of fish counting studies being conducted in the Golovin area in the future (there have never been any) could be employment for local people. People also noted, however, that jobs are partially responsible for people fishing less now than they used to.

Bartering
People barter salmon with other people in Golovin and in other villages for other subsistence foods such as muktuk, as well as for gas to go out and do subsistence activities.

Sharing
It was pointed out that people don't just barter subsistence food items with each other, they also <u>give</u> them to each other as well.

Sharing is valued, and people still practice sharing today. People share salmon with Elders, family, friends, people who helped cut fish, and with people who can't do subsistence activities. People share with others within Golovin and outside the community as well. People not only share foods, but also other resources, such as fishing nets. It was stated that nothing has changed with regard to sharing.

"It's our way to share. Not only knowledge but food, share everything. Share your life."
-Thomas Punguk

Commercial Fishing
Much of the history of commercial fishing in Golovin has been noted above. It began in the very early 1960s with chum fishing, and according to some, owing to poor management, chums were overfished leading to a decrease in the population. Pinks were allowed to escape during this initial period of chum harvesting. There was a floating cannery in the Golovin area which people sold fish to. There were very strong pink runs after the decrease in chums, and when the gear became available for processing them, people also began to heavily harvest pinks commercially as well. While the fish plant was in the Golovin area, there was a lot of commercial fishing. The commercial harvest for salmon was dictated by the fish buyers, whose harvest was set by the Alaska Department of Fish and Game. Local commercial fishing steeply declined between the late 1970s and 1980s and is locally considered to be moribund now. The loss of commercial fishing has significantly impacted some people financially.

In addition to the effects of poor management and overfishing of the local commercial industry that some feel occurred, commercial fishing outside of the Golovin area has also contributed to a negative impact on fish runs, particularly chums. Foreign fishing, as well as bycatch (particularly of chums) in the Area M and pollock trawling fisheries are seen as significant contributors to the crash of the chum population in the Norton Sound area in the late 1980s.

While there is still some commercial fishing done locally, there is not much. In terms of fishing, Golovin people are subsistence and small scale commercial fishers. People sometimes pass along their permits to relatives. There are concerns as noted above with regard to the challenges associated with commercial fishing for Golovin people. Past commercial fishing closures have hurt people financially. Additionally, commercial fishing is an expensive activity, and the permit system is felt to be onerous. Some people feel that something needs to be done to create economic opportunities for people in the community based on the harvest of not only salmon but other fish as well. It was suggested in this regard the development of a local economic development program, as well as self-regulation and management of the fish resources by Golovin.

Concern was raised over unfair and unequal treatment in terms of subsistence and commercial fishing activities. It was noted that in times of fisheries declines, subsistence fishers bear the burden of conservation and in cases of formally declared fisheries disasters do not receive assistance, whereas commercial fishers do receive assistance during these times.

Young People, and Knowledge Sharing

People learn about fishing and putting fish away when they are young. They learn by getting instruction, watching, and participating. While some kids lose interest and don't want to go to fish camp when they are a little older, and some mostly have their needs provided for by others, it was noted that in general kids, especially when they are younger, like to learn about fishing. They are very interested in the range of fishing and fish camp-related activities, and while they may lose interest when they get a little older, they never forget what they learn. However, someone must be willing to teach them and take them out on a regular basis, and it was noted that a lot of kids would like to learn but are hardly ever taken to fish camp.

It was felt that kids should learn a number of things. They should learn how to do subsistence fishing as well as other subsistence activities such as how to collect plants, how to put food away, and how to survive out in the country. It was stated that adults need to let young people know that there is a 'store outside your door.' People try to teach young people to conserve and not to waste. It was taught by Elders not to waste, and that wasting something will lead to it not coming back as it used to. Disrespect towards any kind of animal, fish, or plant will lead to it not being plentiful. These kinds of things are felt as necessary to teach to the younger generation lest there be too much disrespect for the land, animals, and fish. Not wasting is a very important theme. If young people can't eat all they catch, they should save it and give it to Elders or someone who needs food. It was noted that kids today still do bring their hunting and fishing catches to Elders first, which is considered to be a good thing.

Subsistence was described as a continuation of a lifestyle of survival which carries over from generation to generation. It was stated to be important for young people to learn subsistence because people can go hungry, because store foods are expensive, and because it is good for them to eat natural foods and not to buy too many canned foods and things like that. There is concern that young people won't make it in times of great hunger if they do not know about subsistence. It was also noted that sharing with Elders repays itself, as when you are older, young people will share with you.

"Interviewer: And when you are teaching those things to kids do you think they're interested or are they learning, are they absorbing that? DA: It's kind of hard to say unless you let them participate and be a part of it. And the only problem I'm having right now in passing that on is we do this during the summer and they'll be there camping for a day or two or whoever wants to, usually I have a lot of, I used to have a lot of young kids with me and teach them. But they need to practice that with their families. Every summer, not just one time. And a lot of the kids really like to learn but they're hardly ever taken to fish camp. Interviewer: Do you think there is any way to change that? DA: I always dream, thinking I'm gonna probably have a summer camp or outdoors school and teach them. And I even promise those younger ones that, I'll take you for a day or two this summer and try to teach them because we don't only do our fish during the summer we also collect plants."
-Debbie Anungazuk

Other Information on Human-Fish, Human-Animal, and Human-Environment Relationships
One person felt as though God had put the caribou close during the time when the caribou returned to the Golovin area after a long absence (during the search for missing youth) so that they could be used as food for the rescue crews.

It was stated that people can communicate with animals, or at least have in the past.

It was stated that fish can sense and know things (e.g. if a net is in front of them, they can see it).

It was stated that moose give themselves to hunter.

A number of views on the proper treatment of animals were noted. Many which related to animals in general, the environmental in general, or fish in particular are noted further below in the section on Local or Traditional Rules of Management. One rule which was particular to just one other species was that people should leave killer whales alone according to one interviewee; they are the "human beings of the ocean." As will be discussed in greater detail below in Local or Traditional Rules of Management, there is also the view that wasting resources results in those resources not coming back in the future. The reasons offered for this are that everything in the ecosystem has a spirit, there is a higher power, animals communicate with each other, and everything in the ecosystem is connected. People traditionally use every part of a resource that is usable.

Cultural, Social, and Economic Change
Some of the key changes that were identified which related to salmon and broader sociocultural and economic changes can be stated as such: everything has become commercialized, everything costs money; not as many people go fishing and to fish camp as in the past; people don't need to get salmon for dogs like they once did as no one uses dog teams now (having been replaced by snowmachines, four-wheelers, and outboard motors); fish is still an important part of some peoples' diets though not as much for others; more jobs, less people eating Native foods, no dog teams to feed, and a cash economy with store groceries available are important factors in why people fish less now; the beginning and end of commercial fishing were significant events locally; people do not make their own subsistence gear (e.g. nets, boats) as they did in the past; some of the traditional ways of putting away subsistence foods are no longer practiced; and people now have to get licenses to practice subsistence fishing whereas in the past they did not.

"Primarily for eating, we dried pink salmon and chums, dog salmon. And also incidental catches were

a few king salmon and rarely a red salmon so that was the main, mainly we dried pink salmon, and dog salmon for human consumption. And we continue to do that today although to a lesser extent because of the cash economy we get more groceries from the store. But my family still relies heavily on subsistence foods. And fish is a main part, I think, of our traditional diet, always have been. Although over the years I've become a moose hunter, a bear hunter, a caribou hunter, so we've always had enough to eat because we're not... We're proud to be putting away our native food for human consumption because it's healthier food. And I even see the difference where people that have relied on can food don't live as long as some of us people who rely on native food. Including seal oil and greens and meat, fish preserved with seal oil. I think it's one of the best things that we have ever learned from our heritage."

-Thomas Punguk

Figure 12: Workshop in Golovin. Photo: Donna Katchatag.

Salmon Fishing and Family – Other Considerations

In addition to that which has been noted elsewhere, the following observations were made with regard to salmon fishing and family. In the past it was very common for multiple families to fish together and divide the catch. Pink and chum salmon would be strung on willow branches to assist in dividing the catch, as noted further above. People today fish either with family or by themselves. People will fish for themselves as well as for others (e.g. other family members, Elders, friends, people who help them put fish away). Some people fish mainly for their household, and some fish for multiple households. People often inherit fishing-related items from their parents, such as sites for fishing, nets, and commercial fishing permits.

Regarding Challenges, Management, Commercial Fishing, TK, and Recommendations

Difficulties, Challenges, and Concerns

A very general concern which people have but which speaks to many other areas noted below is that people are concerned with changes that are happening with regard to fish, the climate, and other aspects of the environment.

People are concerned with the way fisheries in the Golovin area are being managed and the way regulations are policed, and feel that it is done in a way which needlessly creates difficulties for local people; see Management, further below, for more information. There is a concern that restrictions on fishing are severely impacting opportunities for generations of people in Golovin.

People are concerned and upset about the impacts of bycatch in commercial fisheries elsewhere – particularly in Area M and in the pollock trawling fleet – on salmon populations returning to Golovin.

There is also concern with regard to the impact of neighboring communities on Golovin's fishing activities. One concern is that the status of the Nome, Council, and White Mountain fisheries are used as a basis for determining the regulation of the Golovin fishery, which is felt to be both unscientific and unfair. Another concern is that jet units are damaging spawning habitats. It is felt that this has occurred on the Fish River. Golovin banned jet units on the Kachauik River to protect the fisheries.

Some people feel that there are less fish now than in the past, and that makes subsistence fishing more difficult. For example, people do not know why the tomcod populations have decreased so dramatically. There is also concern about environmental changes impacting salmon as well as fish and fishing in general (e.g. increasing algae in river bottoms, stronger winds, beaver dams, and waterway shallowness).

People get concerned about fish that look unhealthy. There is concern about health problems in fish spreading to other fish, with unhealthy fish making people sick, and with understanding what is happening in particular cases of unhealthy fish/abnormal occurrences with fish. There are also concerns about hatchery fish.

There is concern about kids not getting involved in fishing activities either because they are not taught about fishing when they are young or because they lose interest when they grow older.

One concern and challenge are rising bear populations. In addition to increased populations, they are now found in areas near camps and the town, and can eat fish and damage cabins at camps. It was suggested that sports hunting of bears is contributing to the problem in that they are taking the biggest bears, who would otherwise control the population.

The cost of fuel may be negatively impacting the subsistence activities of some people.

There is a concern that the contamination of peoples' subsistence foods has increased. There is concern also about the effect of plastics in the environment, about uranium, about mining activity in general in the area, regarding Fukushima, about contaminants from the abandoned dump, about ocean contaminants impacting sea mammals, and about beavers contaminating drinking water sources. Cheenik Creek provides drinking water; there are concerns about contamination resulting from beavers and from the abandoned dump, particularly during high water events.

People are concerned and challenged by the lack of economic opportunities in Golovin.

Commercial Fishing
As noted above, some feel that the commercial fisheries in the Golovin area were mismanaged by governmental agencies, causing an overfishing of the chum population (some disagree with the view that there was overfishing, however) which led to a decrease in chum population (which some think is recovering in the absence of commercial fishing, and some perhaps do not), but also an increase in pinks. Very few if any people do commercial fishing any more in the Golovin area. People who relied on that income are hurting. It is possible that commercial fishing could be restarted in Golovin and some suggested this. One interviewee thought that it should be opened up again, for herring and for salmon.

False Pass fishing is seen as a major reason that for Golovin area decreases in fish populations.

People do not like that the pollock fisheries are having salmon bycatch and wasting the fish.

Also, as described above, there is concern about the inequity between subsistence fisheries and commercial fisheries activities, wherein subsistence fishers bear the burden of conservation in a number of ways (e.g. having their harvest activities significantly regulated and enforced), while commercial fisheries do not seem to bear such a burden equally (one extreme example of this may even be seen as the case of commercial fishers receiving assistance during times of formally-declared fisheries disasters whereas subsistence fishers do not).

"They close it too much now for our fishing, commercial fishermen and those people that rely on the income are hurt. They have no other income but that during the summer and nothing during the winter so, they need it."
-Debbie Anungazuk

TK of the Environment
It was stated that traditional knowledge is a very important source of information about fish and the environment and about subsistence activities related to them.

Local people communicate with biologists about salmon behavior and read biological reports.

Management
People have interactions with the ADF&G for a variety of reasons. People interact with ADF&G to get fishing permits, tally and report their harvests to them, and send fish or write letters to them when they notice something different with the fish they are harvesting. Local concerns about boat traffic disturbing or destroying spawning nests on the river bed was communicated to ADF&G also. Additionally, the schedule for opening the season for commercial fishing was set by ADF&G.

In general there was a strong sense that there have been large failures of government-run management of fisheries historically and currently which have had serious negative impacts on people in Golovin. These have effected people financially and culturally, and in terms of both subsistence and commercial fishing.

It is felt that the decreases in chum salmon are a result of a combination of Area M fishing, pollock

trawlers, and bad management – overall and (historically) in the Golovin area.

People feel that ADF&G may not be making sound decisions about harvest closures in the Golovin area. First, there have never been any studies of salmon populations in Golovin area waterways. Included in this is the fact that there are not now, nor have there been in the past, counting towers in the Golovin area. Secondly, people reported that ADF&G makes decisions regarding Golovin waterways based on Nome, Council, and White Mountain fish populations (e.g. Fish and Niukluk Rivers). It would appear the fish populations in those other areas may be in trouble from overfishing by sport fishers and damage to the river habitats by boats with jet units and maybe by sewage outfall from Council. But Golovin feels they are also being penalized for this even though they had nothing to do with it, and additionally (and thirdly), because the status of runs on the Nome, Council, and White Mountain fishing waterways may not be relevant to the runs in Golovin's waterways.

People do not want to see their area have salmon harvest closures. When people were interviewed in 2009, they were very upset over Fish and Game having in the recent past closed all salmon harvests (except pinks) because the Niukluk River failed to meet its escapement goal. This action was felt to be very hurtful towards Golovin. It was also stated, as noted earlier above, that restrictions on subsistence have severely impacted the opportunities for generations of people in Golovin.

Some people are also afraid or very wary of Fish and Game and wildlife troopers. Overzealous enforcement officers are also a concern for Golovin people. There is additionally a concern about inequity in regulations and enforcement. Some examples were given of this. In one example, it was noted that there was a picture in the paper of a kid holding a silver salmon, presumably from sport fishing, after Golovin's fishing had been closed; while Golovin was being cut off from fishing, others are playing with their food. The inequality of permits between Area M and the Golovin area was also noted. In general, it would appear that people hold management as equally if not more responsible for current fisheries and harvest related problems as they do large-scale commercial fishing. Another example of inequitable regulation was the fact that people from Nome can cross the river in their vehicles at Council but people in Golovin are forbidden from riding their 4-wheelers across a creek near town. People also noted how the bycatch of king salmon was being allowed by commercial fisheries but people in the Yukon-Kuskokwim delta region were having their subsistence harvests of salmon being closed. It was felt that Native people will go to jail for regulatory infractions but that non-Native people and commercial interests suffer no consequences for destroying fisheries resources. Native people are left having to take the brunt of conservation.

People had a variety of thoughts about the issue of fish counting. As noted earlier, there are no fish counting towers in Golovin waterways. Additionally, people feel that ADF&G makes decisions regarding Golovin harvest closures based on information they have on escapement for waterways that are seen as unrelated to the condition of the Golovin waterways. As was noted, ADF&G states it uses the 'best science available', but people felt that it isn't really doing good science or using relevant data. There is a sense that the estimates have been little more than guesses. There have been requests for counting towers in Golovin area in the past. The three priorities would be Cheenik, McKinley, and Kachauik if a sense of the health of the local fishery were to be most accurately attained. Some positives of counting towers were noted – first, people would know the numbers, and second, it would be a source of good jobs for locals. However, some negatives were also noted: tower counting is not considered to be necessarily accurate, knowing the towers and numbers might not do much since the runs/species of concern are already known, they might help with the severity of the problem but will not solve it, the results can be interpreted differently by different parties, and they can be used as

simply another tool to further regulate local peoples' activities.

A number of other management-related concerns and critiques were noted by Golovin project participants, including:

- As noted above, there is concern that there is too much sport fishing in some areas.
- ADF&G doesn't take local peoples' concerns about fish health seriously.
- There is concern about people not being able to assert their water rights anymore.
- There is a concern about the State relaxing mining regulations and permitting mining in area waterways.
- There are concerns about the design of the regulatory, management, and policy processes. Local people don't have the money to go to Anchorage for meetings where decisions are made, and when they do only get a few minutes to testify. And even then, the subsistence interests are vastly outnumbered by what the commercial interests are able to bring to these meetings.
- Too many agencies come in to the area and attempt to dictate what they are going to do and what they want, and have a take-it-or-leave it attitude.
- People are concerned about the amount of hatchery fish in the ocean. They are concerned they may be seeing hatchery fish that are strange and, and concerned that these fish may be related to the diseases people are seeing in fish.
- It was noted that on holidays, Nome-area hunters and fishers come in large numbers and compete with people in Golovin and White Mountain for resources.
- There is concern about the number of fishers on the Council River, and on people crossing it and ripping up the bottom of the river.

It was stated that if Golovin people managed their own fish, things would be better than they are now.

"Fisheries managers, which include the NPFMC [North Pacific Fishery Management Council], are working hard to protect their commercial fishing interests, with bycatch levels set so high that the customary and traditional users are taking the brunt of conservation measures; in areas of this State they are being made criminals in the eyes of Western society."
-Toby Anungazuk, Jr.

"And I'm not sure of what kind of impact, I think if they have problems in Nome area, also could hurt this area. There's so many people out of Nome fishing. They need to close it to protect their runs but it shouldn't affect like Kachauik River where it's, you know salmon that go up that river, that probably originated from there."
-Toby Anungazuk, Jr.

"What I don't like is having to have a fishing license. I was here before the State of Alaska was the State of Alaska."
-Toby Anungazuk, Jr.

Local or Traditional Rules of Management
People in Golovin identified a wide variety of local or traditional rules of management and proper behavior with regard to salmon and other aspects of the non-human environment.

One overarching principle which was repeated in a number of ways was that of respect. It was stated that people should be in relationships of respect with animals and the environment and that they need to co-exist together. People stated that you should respect fish, animals and the ocean and treat them with

such respect. It is considered important to teach and instill in the younger generation respect for nature. Some interviewees reported that if you do not treat fish, plants, or animals properly (e.g. with respect), they won't be as plentiful in the future and/or you will have decreased success harvesting them in the future and they will not come to you. As one interviewee (Thomas Punguk) stated, like with anything one does "treat anything right and you'll be repaid richly."

One key aspect of proper relationships with natural resources, one that was taught by Elders, is not wasting. It was stated that people should not waste – fish, animals, or plants. One should also not kill anything that you do not need or cannot eat. Some felt that there were consequences to proper or improper treatment of animals, such as proper treatment leading to their fellow animals coming back to feed you while failing to treat them with respect leading them to avoid you. Another key aspect of proper relationships with natural resources is not playing with fish and animals. As with wasting, it is felt that if you play with fish or animals you may have a more difficult time harvesting them in the future.

People in Golovin don't do catch-and-release fishing like sportsfishers. They cook, freeze, or dry what they catch.

It was stated that there is a need for responsible management of salmon populations as well as the ecosystem as a whole to allow salmon to endure.

It was noted that Golovin has its own land use policies and procedures.

There is local concern, as noted earlier, with regard to large boats and boats with jet units churning up the river bottom when they hit it and damaging spawning nests and minnows, as well as causing large waves when they pass by. Golovin banned boats with jet units on Kachauik River to protect the fisheries from the damage these units do to habitat, salmon eggs and minnows.

It was stated that one of these years in the future Golovin is going to have to limit access to their river (Kachauik).

There was some indication that people may have traditionally thrown back female fish when they were seining – alive – and only kept the males, and this was cited as a reason fish always came back years ago, that people knew what to do to ensure the perpetuation of the salmon runs.

"They [Elders] always say if you waste something it's not gonna come back like how it used to. If you disrespect any kind of animal, fish, plant it'll come back and it won't be plentiful. And those kind of things need to be taught to our younger generation before there is too much disrespect for land and animals and fish."
-Debbie Anungazuk

"And I was always taught not to waste anything. Don't shoot anything you don't eat, don't kill anything you don't eat. So it's just my way of life, other than that I don't know any treatment of fish special that I can remember. It goes the same for animals, do not waste any part of an animal. And when I catch a seal, I return the head into the ocean, it is the Eskimo way. Throw the head out to the Ocean, say goodbye, come back when you grow up. They do, I believe that. […] I think the thinking about that [consequences for not following rules about proper treatment of animals] is, if you treat an animal with respect his brothers and his sisters will come back to feed you, if you do not treat these animals with

respect the rest of his family will avoid you. You will be a poor hunter then. I'm always a good hunter because I respect what I hunt. That's the way I was raised. […] It's not the people that are punishing these people, it's the higher power, it's nature."
-Thomas Punguk

Recommendations

The following recommendations can be gleaned from the data collected in Golovin:

- Greater local control of fisheries (and hunting) management for the Tribes. A lot of the problems in fisheries are felt to be related to mismanagement by the State and Federal government.
- There are conflicting sentiments about how Fish and Game should better manage and interact with Golovin regarding salmon population numbers and harvests. On the one hand there is a concern that Fish and Game is basing their closure decisions for Golovin on areas that are not relevant to their runs, i.e. on Nome/Council/White Mountain fishing areas and activities. Additionally, population studies could create employment for Golovin people. On the other hand there is skepticism that counting studies would be helpful now because they never had any before to compare to, and also there is a general distrust of Fish and Game so any added involvement in the Golovin region may be unwelcome regardless of its intent. In any event, one clear recommendation is that Fish and Game should recognize the difference between the waterways Golovin fishes in and those that Nome/Council/White Mountain fish in, and should not simply base closure decisions for Golovin areas based on problems meeting escapement goals in the other areas' waterways whose numbers may not be accurate or relevant for the Golovin area.
- ADF&G should improve its relationship with Golovin in other ways as well, including equitable enforcement of regulations, taking local concerns about fish health seriously, and taking other steps to address the criticisms outlined in the Management section further above.
- Something should be done to stop salmon bycatch in the Area M fishery and the commercial pollock fishing operations to the south.
- Steps should be taken to ensure that the burden of conserving salmon should not fall inequitably to Alaska Native subsistence users in times of fisheries collapses. Commercial users are not equally burdened and even in particular cases receive assistance, while subsistence users are not assisted and have strict and punitive regulations and enforcement placed on their harvest.
- The various meetings which are held in Anchorage for setting fisheries-related policies should find a way to be more inclusive of the concerns of Golovin residents and more aware of the difficulties of such residents to attend those meetings. Attending these meetings is very expensive, and financially out of reach for many village residents; there is a concern that their lack of attendance may give policymakers and managers the impression that local people don't care, but nothing could be further from the truth. It was additionally recommended that local organizations take steps to support sending village residents to such meetings. It was also felt that more funding should be made available for Golovin people to attend important fisheries-related meetings. People are currently placed in a difficult position to decide whether they will eat, work, or try to go to a (expensive) meeting to try and make sure their children and grandchildren will have fish.
- It was suggested also that sport fishers give the fish to the poor who need something to eat, because Native people don't waste food.
- Communities should work together to find common ground amongst themselves to find out what to protect.
- Boats with jet units should stay out of the Golovin waterways. Additionally, signs should be

erected at fish camp which state the local policy of banning jet units on the Kachauik River.

- Restarting commercial fishing and taking steps to make conducting it more feasible in the Golovin area should be considered. As noted further above, some people feel that something needs to be done to create economic opportunities for people in the community based on the harvest of not only salmon but other fish as well. Some suggestions in this regard include better management in terms of closures and also permits, the development of a local economic development program, and the self-regulation and management of the fish resources by Golovin.
- Agencies, commercial interests, and others should respect local land use policies.
- Let local people sell bear parts
- Put additional protections put in place for the rivers before they are contaminated and fish killed.
- The abandoned dump should be remediated. People are concerned about toxins leaching out.
- Increased testing and studies of/for the following (and the dissemination of the results to Golovin):
    - Water temperature
    - Water quality and fish health should be tested on a regular basis for concerns regarding contaminants (from beavers, radioactivity, the abandoned dump, and other toxins).
    - The effects of Nome fishers and of jet units on the health of the Fish River and its fisheries.
    - Boat traffic in the waterways, and vessel traffic in the region
    - More baseline studies on their rivers – fish, vegetation, etc. More studies about the health of the rivers are felt to be needed so people can protect them.
    - A comparison of the benefits of wild foods versus the risks from contaminants.
    - Research into the effects of algae on salmon spawning sites in streams, and whether a plan can be enacted to remove that algae to prevent any negative impacts it may be causing.
    - Looking into the protective shading effects of larger willows on salmon streams, especially in light of predicted increasing warmer water temperatures, and how these can be protected.
- A water quality workshop should be held to inform people in Golovin more about contaminants.
- When a mining company plans to do something, they normally say they will work with the community, but actually just end up doing the minimum required. They should do more, and meaningfully engage the community.
- Promoting youth going into traditional and non-traditional fields of study, and taking steps to ensure they are hired and progress through the professional ranks. This includes promoting students to major in biology and fisheries fields.
- Steps should be taken to reduce the beaver population in the area.
- Something should be done to address the problems associated with the increased bear population. This may include stopping the sport hunting of bears (which may be eliminating the largest bears), among other things.
- The bilingual/bicultural work in the schools needs to be increased and receive better support from the school district.
- More funding, support, and projects related to traditional knowledge, stories, values, and subsistence that create products that can be used in the village. This is seen as urgent, as Elders are passing away.

"Who will fight for our ability to continue to put safe foods on our tables? We may have to fight our

own State government so we don't become really 'poor'.”
-Toby Anungazuk, Jr.

“For too long, villages that have always relied on dried, smoked or frozen fish are taking the brunt of all the conservation measures. We are frustrated and tired of the fisheries managers taking only the traditional gatherers that put traditional food on their tables to court, giving them a criminal record in the Western society's eyes, and openly calling them criminals – it is just not fair to the Alaska Native people.”
-Toby Anungazuk, Jr.

"With the greater importance now that we place on all kinds of fish,salmon especially maybe, we need to responsibly manage one commercial harvest, also the management of our whole ecosystem so that these salmon can continue to spawn and perform their natural life cycles. Because if we damage one part of our ecosystem that damage will snow ball into damage to other things. Where eventually maybe the salmon healthiness will be effected. It’s the same with anything you do, treat anything right and you’ll be repaid richly. It’s the same thing with nature, animals, fish even my relationship with you. Treat ourselves with respect and I’ll never, I always say, make a friend not an enemy. Do the same with nature, keep nature your friend. Nature depends on you, you depend on nature. We need to co-exist together. Whether you do it intentionally or not, we need to exist together. The whole world needs to exist together. And being a responsible person, we are a part of a whole theme of nature. We’re not, I’m not here getting rich off nature. I hope nature will benefit from me in the long run so that the richness of our nature and our culture will always be there to sustain our people. Amen."
-Thomas Punguk

Koyuk

Koyuk is located approximately 90 miles northeast of Nome at the mouth of the Koyuk River in Norton Bay. The community has no road access to Nome and receives most of its goods by air or by barge in the summer. The 2010 US Census indicates that Koyuk has a total population of 332, of those 183 are male and 149 are female (ADCCED 2015). Approximately 89% of the population is American Indian or Alaska Native (*ibid.*), primarily Inupiat Eskimo. Koyuk is a checkpoint on the Iditarod Trail.

Figure 13: Half-dried salmon from Koyuk.

Regarding King (Chinook) Salmon

Comments about king salmon biology and behavior

The king salmon which come to the Koyuk area were noted as being smaller than those which are found on the Yukon River.

Comments about king salmon distribution
More and more pinks, chums, and kings were reported as going into Mukluktulik River, which they had not been doing because of beaver dams. The dams were reported to be gone in 2009, and fish were thusly able to go upriver. In 2014, it was reported that there were dams on the river, but fish were still noted as going up the river.

Comments about king salmon population
Most people felt that kings are at lower numbers (and possibly still declining) than in the past, though there was some concern about inaccurate fish counting. Kings may have decreased more than the other salmon species in the Koyuk area.

Comments about the harvest of king salmon
People set nets for kings in the ocean. It was reported that there are a lot more people fishing for kings in order to make king strips than there used to be. The summer of 2008 was a noticeably low salmon harvest year. People reported in 2008 that in the preceding 5 years, they were not getting kings where their traditional set net spots were, and were having to experiment to find the kings, which never seemed to be in the same place. It was also reported that there had been a bright green algae in the water which gets into nets and makes harvesting kings difficult because they can see the net as a result, though it was unclear to what degree if any this was a change from times past. There were some commercial attempts to get kings but it did not result in anything.

"This year [2008] has been really, really bad for us. I think we only got seven kings, and before that we used to get thirty."
-Georgianne Anasogak

Regarding Silver (Coho) Salmon

Comments about silver salmon biology and behavior
Silvers change color when they get into the river (from the bay) and their meat changes in taste.

"[W]e also try and get silvers every summer, for the freezer. From out in the bay, I mean we try to get them before they get close to the river where they're colored, because you could notice the taste, like the silvers in the river are kind of, you can tell the difference. We like them when they're not colored. Catch them from in the bay."
-Ramona Nassuk

Comments about silver salmon distribution
Silvers are traditionally speaking the last salmon run. However, as noted further below, it has been suggested that the salmon runs are starting to blend together in recent times. People also noted that occasionally you can see or even harvest a silver through the ice.

Comments about the harvest of silver salmon
People will harvest silvers predominantly using set nets and beach seines. While some people regularly target silvers (for subsistence or commercial fishing), some do not and target different species instead. The upper range of subsistence harvest for silvers reported was up to 20 silvers a year. People noted that they get a lot of silvers while commercial fishing. When silvers were first being commercially fished, the commercial buyers didn't pick them up on time or there were too many fish, and they paid very low amounts for them.

Regarding Pink (Humpy) Salmon

Comments about pink salmon biology and behavior
Male pinks are larger than females; they have a bigger 'hump'.

Pinks are on a two-year cycle. 2008 was an even year for them in terms of their cycle.

Comments about pink salmon distribution
As noted above, more and more pinks, chums, and kings were reported as going into Mukluktulik River, which they had not been doing because of beaver dams. The dams were reported to be gone in 2009, and fish were thusly able to go upriver. In 2014, it was reported that there were dams on the river, but fish were still noted as going up the river.

It was noted that once in a while Koyuk won't get pinks at all.

"I know humpies, once in a while we don't get them at all. But [chum] salmon seem to come all the time. Regardless of the weather, you know?"
-Grace Morris

Comments about pink salmon population
Some people felt that 2008 was a plentiful year for pinks.

Comments about the harvest of pink salmon
People will use either seines or set nets to get pinks. They are harvested in the rivers. People primarily make dry fish out of pink salmon.

"We always had lot of fish in Ungalik, there always be lots. One seine, when we seine once for humpies, over 600 humpies in one scoop, so I was really busy cutting [that] one time."
-Nina Nanouk

Regarding Red (Sockeye) Salmon

Reds are not common in the Koyuk area; not many come to the area now or in the past. They may in fact be a fairly recent arrival to the Koyuk area. People harvest reds by setting nets on the beach or upriver, as well as incidentally catching them when set netting for whitefish. However, they are not a fish that Koyuk people have traditionally harvested or ate. It was not clear in the data at what time of year reds are found in the Koyuk area.

"[Reds are] new and it's something we traditionally never fished for or put away and never ate for that matter."
-Georgianne Anasogak

Regarding Chum (Dog) Salmon

General comments about chum salmon
Some people simply use the word "salmon" to describe chum salmon.

Some people had noticed in 2008 a few salmon with marks from nets, e.g. trawlers, mostly on chums in

the preceding few years.

Comments about chum salmon biology and behavior
It seems that chums are larger now than they used to be in the past in this area. Some people harvested very large chums, similar in size to a small king salmon.

"[S]ometimes we get huge chum. Huge. I mean they're big, like small kings. We got a couple of those this year."
-Ruby Nassuk

"They [chums] seem a lot bigger. The [chum] salmon, they appear to be bigger."
-Georgianne Anasogak

Comments about chum salmon distribution
As noted above, more and more pinks, chums, and kings were reported as going into Mukluktulik River, which they had not been doing because of beaver dams. The dams were reported to be gone in 2009, and fish were thusly able to go upriver. In 2014, it was reported that there were dams on the river, but fish were still noted as going up the river.

It was reported that chums can be harvested in almost all of the local rivers.

There are multiple runs of chum salmon. The fish in the final run are referred as "fall fish."

Comments about chum salmon population
It was felt that in 2008, the chums must either have been slow or coming in smaller numbers than pinks, because people were getting less of them than pinks. Some felt that this was the first change they had ever noticed with chums. In the previous year, however, there were lots of 'fall fish.' The female chums in this run spawned early; it was the first time they had been seen spawning along the coast instead of upriver. It is felt that in general the chum populations are doing well now.

Comments about the harvest of chum salmon
People seine for chums on river shores. People also set nets for chums, doing this in early June. It was noted that a pink salmon net can also be used to catch chums. Chums are harvested for subsistence and commercial purposes.

Regarding Salmon in General

General comments about salmon in general
People try to put away their salmon before the rainy season (e.g. dry fish, king strips).

There is concern about climate change, pollock fishing, and False Pass fishing as causally linked to problems for salmon and the changes that have been seen locally.

People have seen salmon with marks or scars from pikes, seals, and eels. People reported that pike will eat salmon. The eel marks were noted as being something which is increasing over time and that never used to happen.

Figure 14: Salmon drying outside a home in Koyuk. Salmon are frequently processed by drying or half-drying and can be hung to dry in a variety of locations including on racks out at camp, racks in villages, drying poles attached to homes or other outbuildings and even, occasionally, inside of homes or other structures.

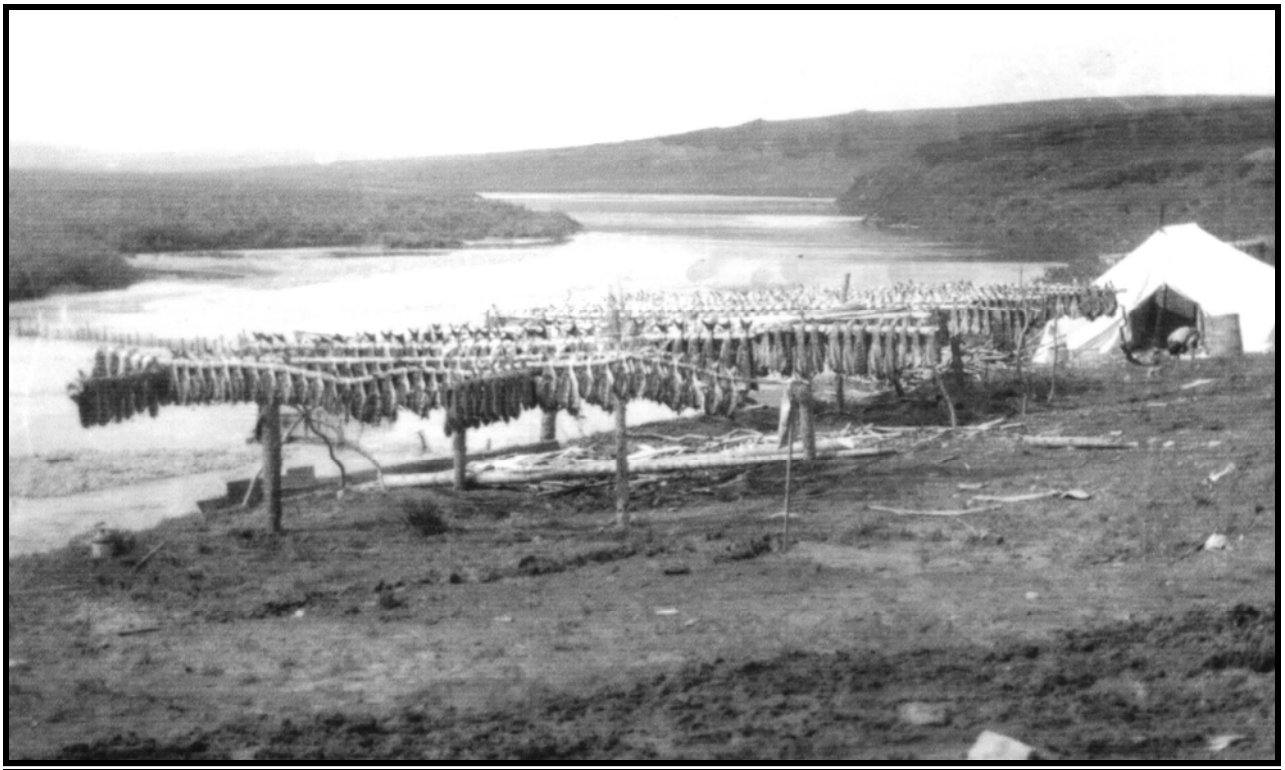

Figure 15: Fish drying on racks at a camp (date unknown). Photo: Carrie M. McLain Memorial Museum, Nome, AK. Accession number Bell-N-76.

People noted that the quality of salmon flesh had not changed, and still appeared to be good quality. It seemed to people that most of the salmon they caught were in good health. However, starting about 17 years ago, people started to notice that there were a lot more worms in salmon. Most people will simply remove the tapeworms, and, if they are just in the stomach, feel the meat is still acceptable to eat; people noted that they can't afford to throw away fish. Years ago, people noted, there were very little if any worms in their salmon. People also noted in 2008 having seen salmon as well as tomcod with black spots of varying sizes starting a couple of years prior; they did not know what these spots were, and would not keep fish if they had such spots. Also within that time period people would once in a while harvest salmon that had lumps on them which appeared to produce pus when cut open, like cysts. These salmon were kept, and the cysts removed. In 2007 some fish that had not spawned were noted to be floating dead in the Inglutalik River, and it was not known what the cause was. Additionally, people have noticed salmon that are dead and floating in the water up East Fork; this was considered (in 2008) to be a recent change, and was occurring for no discernible reason. It was noted, however, that East Fork used to have very cold water, but that it had recently been warming up. Salmon go up that tributary to spawn, and there was concern that the warmer water temperatures were killing fish.

"RN: I've noticed like if we go up East Fork we'll see salmon that died for no apparent reason. Some floating here and there and we'll pick them up sometimes, they got no scars, nothing on them, they just died. Interviewee: Do you ever see them on the beach around here? RN: The dead fish? No, they're mostly floating, I've never seen them on the beach. Interviewee: Is that something that's recent too, I mean them floating? RN: I would say so, yeah. Was kind of, 'cause there's a lot of fish that go up East Fork too and you hear about global warming and that affects their spawning. We were up East Fork about a week or so ago and East Fork is warm, warm water. I remember it used to be cold, colder. But it was warm and it was maybe 10, 11 at night and I kind of going in the water saying, geez the water's really warm, I hope those fish don't die. 'Cause it's a really shallow river, I mean tributary of Koyuk River, and they go really far up to spawn. Or not really far maybe few bends up. So hopefully they'll live to spawn."
-Ruby Nassuk

Comments about the biology and behavior of salmon in general
People reported that the flesh of salmon is the same as it was in times past.

Comments about the distribution of salmon in general
The normal order of runs in the Koyuk area is as follows: kings, chums (which have multiple runs), pinks, and silvers (as noted above, it was not clear in the data at what time of year reds are found in the Koyuk area). It appeared that perhaps the normal order of salmon runs coming into the Koyuk area had recently changed as of 2008, such that the species were starting to come in together. The cause of this was not known, but it was suggested that perhaps this was caused by the ice taking longer to go out, warming water, or something impacting fish neurology. It appears that in general run timing is the same as in the past, though there was not consensus on this point in the data.

It was reported in general that salmon are returning to the same places they have always gone. However, it was noted that salmon are also moving further north because of climate change. It was noted that years ago, someone had set a net across Mukluktulik River, and that this had resulted in noticeably less salmon going up that water body in subsequent years. As noted several times above, more and more pinks, chums, and kings were reported as now going into Mukluktulik River, which they had largely not been able to do because of beaver dams. The dams were reported to be gone in

2009, and fish were thusly able to go upriver. In 2014, it was reported that there were dams on the river, but fish were still noted as going up the river.

Comments about the population of salmon in general

Koyuk experts have observed declines in all salmon species, except possibly reds, starting most likely in the late 1980s, though the cause for declines is unknown. Also, when taking into account 2008, it was also felt that kings had declined more than others because of their poor run that year. It is not entirely clear how different factors are influencing population number changes for chums, pinks, and kings. It was felt that trawling might be having an impact on salmon populations, and it was noted that when trawling was occurring the runs coming into the bay and rivers had decreased. The ADF&G does a yearly trawl survey in Norton Sound.

Comments about the harvest of salmon in general

People used to harvest a lot of fish to provide enough food for people and dogs to make it through the winter. Almost everyone felt that in general people in Koyuk now are fishing less than in the past (though this may be picking up recently). It was also noted that people used to be at fish camp all summer, every summer; now, they go to fish camp less. Peoples' diets have changed as well, and some no longer depend on fish for food, barter, or dog food now. Young people were felt to be fishing less now than in the past as well. There are some families who consume a lot of fish, and these are the families spending the most time fishing. Some people fish for multiple families. There was a small amount of concern expressed in Koyuk about local overfishing and the use of poor techniques, such as people fishing wherever they want.

Some people prefer fish harvested in the river as opposed to the ocean. When fish are in the ocean, they are fattier, whereas river fish have lost a lot of their fat and are much better for drying. People primarily use seines and set nets to harvest fish (other noted techniques include rod and reel and throwing/radius nets). In the past, everyone used seines. Some prefer set nets because, while seines get more fish, they are considered to be harder work to haul in, and require more people. Others prefer seines because they don't like to have to check nets and untangle fish from the mesh; they get all their fish at once and can spend the rest of the day cleaning and cutting. People use set nets in the ocean, and seines in the river (i.e. beach seining near the mouth of the river); usually set nets are not used for catching fish in the rivers.

It is seen as good practice to fish right away when the fish come, so as to beat the rain. If people are unable to get enough of one species they will often focus on another species to try and make up for that.

High gas prices are considered to have a substantial impact on subsistence activities as people are unable to make as many trips out as they would otherwise. The weather (especially rain and wind) can be a challenge for salmon fishing as well.

People in Koyuk fish both for subsistence and commercial reasons. These activities are conducted separately from each other.

"Interviewer: What kind of changes have you seen in the salmon over your lifetime? EK: Seems like there used to be lots of fish in fish camps, lots of fish. Because they only get them by seining. Right now they're using their own nets, individual nets to set out and fish, yeah."
-Esther Kimoktoak

Figure 16: Grace Morris of Koyuk preparing a net for fishing.

Regarding the Preparation and Use of Salmon

Fish are used for a variety of things. This includes being used for human consumption, sharing, trading at the store in the past, bartering, and for feeding dog teams in the past.

When putting away fish, people look for signs of their health. People identified a number of ways that salmon are processed, cared for, and stored: fermenting, making 'stink' (fermented) eggs, drying, half-drying and freezing, boiling, preserving in seal oil, making strips, salting, freezing, aging underground, smoking, baking, cooking inside a campfire, and canning. People also discussed the variety of ways fish were put away in the past (e.g. in seal pokes, barrels, fermenting pits, and caches). Everyone uses freezers now. Melting permafrost has made underground methods of storage and fermentation more difficult; the increase in bears also has worked against the use of fermenting pits. Some people prefer fish to be leaner or not too fat. As a result, fish that are in the rivers are preferred to when they are in the ocean. They are considered better for both drying and eating. Fish can get rancid when drying if they are too large or fat. Additionally, there are a number of post-harvest techniques people use to prevent spoilage (e.g. spacing fish far apart for drying, using smoke when it is rainy, etc.). People noted that there are more flies now than there used to be, and that people have to take steps to ensure the flies do not ruin the fish. People will also cut their fish as soon as possible to prevent it from getting soft. Additionally, it should be noted that there are now drying racks in front of the village, whereas in the past they were only at fish camp.

"I like salmon that's not too fat. You know when you dry them [salmon that are too big/fat] because they always get rancid when they dry, you know the salmon fat. Kind of strong."
-Lily Mayland

Regarding the Environment

Rain

Rain was stated to impact fish-related activities; it can make drying fish difficult, and along with wind can prevent people from going out to fish. It was felt that it is raining more when people are trying to dry fish. By the time people are now getting leaner fish, the rain has started.

The El Niño of 1998 may have marked a significant historical point for environmental conditions. Since this event, it was noted that it will seemingly rain at any time, rather than at more regularly predictable or patterned times. At a more general level, one participant stated that after El Niño everything in a broad environmental sense changed.

It was also noted that Koyuk is getting rain now in December and January, something which never used to happen. This rain, along with the fact that Koyuk is not getting snow until later in the season than it used to, and periods of melting after getting snow, are all adding up to make conducting subsistence activities difficult.

"[We]'re seeing a lot of rain now even in December and January where we never saw rain before."
-Georgianne Anasogak

Snow

Snowfall can impact subsistence, because snow during the winters is relevant to berry growth; without enough snow or rain berries don't grow well. Low snowcover can also make overland travel by snowmachine difficult. In general people felt that Koyuk gets less snow it did in the past.

Wind

It was felt that wind directionality has stayed the same over time, and there were varying opinions about whether there were changes to the strength and frequency of winds when comparing now to times past. Each of the seasons seems to have its own normal, characteristic wind directions. As noted above, rain and wind together can make conducting fishing difficult. However, a light wind without rain (e.g. 10-15 miles per hour) is seen as good for drying fish (it helps in drying and keeps the bugs away).

"EK: It used to be kind of nice for long time, dry fishing time. Dry fishing time kind of stay good all summer. But it gets kind of windy in August, starting August, rain, rain and windy in August. And September too but we have real nice calm days in September, too. Right now the wind change real easily. Interviewer: Quickly? EK: Quickly, but we had south wind for long time now. [laughs] For long time. Interviewer: Do you think in general that the wind can or that the weather can change real quick now? EK: Yeah. Interviewer: Was it like that when you were younger? EK: No. We have a real long, good days long ago. And it'll stay bad for a few days and get good again. Yep."
-Esther Kimoktoak

Climate/Weather Unpredictability and Variability

Most people noted that the weather is less predictable now than it used to be. The weather changes

easily and quickly now, doesn't hold for long periods like it used to, is less amenable to forecasting by reading environmental signs, and has increased variability. In the past, Elders were weather predictors; some still have this knowledge today as well (this is something which is seen as good to pass along to young people, too).

"[I]t's [the weather] unpredictable now. Years ago, he [husband] was really good about predicting the weather. He'd go out in the morning and look all around the landmarks. What kind of clouds were over there, he'd look and he'd say it's gonna rain, or it's gonna blow, or something's gonna happen. And sure enough it would always do it. And nowadays it's, you can't pretty much do that anymore. And when it blowed, it blowed and blowed and blowed for days at a time. And then when it calmed down, it stayed calm for days and days. Now it, you could wake up to calm weather, by afternoon it's windy. Interviewer: So things change really quickly. GA: Yep, really quickly now. Versus long time ago where it seemed to take time to change."
-Georgianne Anasogak

"Interviewer: So would you say that you think the weather is more or less predictable than it used to be? NN: Yeah, it's different. It don't stay the same."
-Nina Nanouk

Figure 17: Boats anchored in front of Koyuk.

Storms

While there was disagreement about whether Koyuk had more or less storms now than in the past, people did note that storms now are stronger than they used to be (fall storms were also particularly singled out in this regard), that floods are getting worse (as well as more frequent), and that storms are coming later. It was noted that storms are pushing ice up on shore and ruining berry areas.

Temperature
Water temperatures are warmer than they used to be. This change has been noted in spawning areas as well. This may lead to salmon mortality.

Other or General Comments about Climate and Weather
Climate change is seen as a significant concern in terms of its impacts on salmon.

Ice
Interviewees felt that freezeup is occurring later now than in the past, with some saying it can occur as late as November. Freezeup used to occur in mid October or earlier. It is also freezing up slower than it used to, and sometimes it will freeze and then breakup and stay warm for a while. It was suggested that later freezeup is good for beluga hunting, but also that it has eliminated some ice fishing opportunities (because some fish are passing by before it freezes up and people are able to fish for them through the ice). These changes to freezeup also make travel over ice more difficult if not impossible in certain situations, and more dangerous. Ice in front of the village used to be 8-10 feet thick in March, but now it only gets to 5-6 feet thick by that time of year.

Permafrost melting is also occurring, which creates significant problems for traditional means of cold storage. In the past it never used to melt out, but that is no longer the case.

There was a considerable variety in responses regarding breakup timing now as compared to the past, though most have observed that it breaks up earlier than in the past. People seemed to agree more firmly on the view that breakup is happening in a different way than it used to. The ice used to go out quicker on the Koyuk River – the river current would push the ice out, it was noisy, and there would be ice jams. Now, it simply melts in place and gently and quietly goes out, with no big ice chunks as part of the breakup. While it was stated that this can make the ice go out slowly, it was also noted that this is not necessarily always the case. It was suggested that the change in how breakup occurs might be because of the weather, with it being warmer now. The length of time it takes to breakup may be connected to the timing of salmon runs; for example, the lateness of ice breakup in 2008 was seen as potentially connected to late fish runs that year.

"Springtime, we used to have, boy that break up used to be real strong years ago, when I was growing up. Even the ice would come up, you know, make lots of noise but last these years, it's kind of quiet. Seems like it just melt away then go away. […] It used to start going out, you know but real noisy you know when it break up you can hear it when it break up. Real noisy, real strong current, but now seems like it just melt. Interviewer: Just sits there? LM: Melt away, real quiet, almost like that. Interviewer: Why do you think that is? LM: Maybe the weather, ah? Too warm."
-Lily Mayland

Erosion
There is a significant amount of erosion happening along the coastline, rivers, and creeks in the Koyuk area. Erosion is making the rivers and creeks wider. Erosion has changed where people can fish and has additionally ruined a lot of berry grounds. When Koyuk gets high water it can be destructive because of the erosion. It was noted that roots and other detritus can get into peoples' nets because of eroding river banks. Climate change is suggested to be the cause of this erosion.

Changes Regarding Other (Non-Salmon) Fish, or Fish in General
While some interviewees indicated they had not seen any new or unusual fish in recent times, others

had seen or heard of new fish in the area.

The black spots that are now being seen on tomcod, as noted above, were stated by project participants in 2014 to have become more common now.

The pike population is considered to be rapidly increasing, and some people think there are too many of them.

"[N]ow there's more pike than before. And that's not good I don't think. […] They eat up all the other [fish] trying to come up."
-Nina Nanouk

Changes Noticed with Marine Mammals
The major consistent change people noted about marine mammals was that there are less belugas, or that they aren't coming around like they used to (which was much more). Ocean trawlers, belugas getting smarter and hiding from hunters, and too much noise in the ocean (e.g. from commercial fishing; it was noted belugas stopped coming around when the fish buyers arrived) were all blamed as possible causes for this change.

It was also noted that in 2008 there were almost no seals around; the cause for this was unknown.

Regarding other marine life, it was noted that in the late 1990s there were a lot of large jellyfish observed in the ocean, which was a strange occurrence.

Changes Noticed with Land Animals
There are more bears around now, and it is felt that they are becoming a problem. Moose on the other hand are declining, and people are having to go further out to get them. It was also suggested that they appear to know when hunting season opens, disappearing from the area when it begins. From around 50-60 years ago at least, caribou had not been close to the Koyuk area until around 2005 when many of them came back close to and even within Koyuk, but after that they moved away again. Beavers are a problem; there are a lot of them, and their numbers are increasing on certain waterways. Beaver dams in waterways can interfere with salmon returns.

"When I was growing up, we never see bear, never see bear even we walk long ways, we don't see bear. People never talk about bears long ago. They, one summer we saw only one. Right now you, every time we go up we see a bear on the river. Or from camp we saw one right across the river. […] Lots of bears now."
-Esther Kimoktoak

Changes Noticed with Birds
Some changes to bird populations were noted. There used to be eiders and cormorants found around Isaac's Point, but not anymore. Additionally, there used to be a lot of mallards in the Koyuk area, but now there are few. In the past few years, there have been a lot less swallows. There are more eagles now; in the 1960s and 1970s, there were hardly any, but starting in the late 1980s to 1990s there was an increase in both bald and golden eagles. It was also reported that there are not as many ducks on the mudflats as there used to be. It was reported that crane migratory patterns appear to have changed; they don't come through the Koyuk area as much as they once did. Some people also reported seeing some birds that were new to the area.

Changes Noticed with Insects
Some experts have observed changes with regard to insect populations, including an increase in spiders in the summer of 2008, the presence of a variety of beetles, lots of caterpillars, large grasshoppers, more flies now than in the past (which can be a problem for drying fish), monarchs coming in the late 1990s along with spruce beetles, more ants, and larger bumblebees and wasps.

Figure 18: Near the mouth of the Koyuk River.

Vegetation
Most people had not noticed any changes in greens.

Some people noted the presence of a bright green algae in the water which gets into peoples' nets and can make harvesting kings more difficult because they can see the nets. People are also having to set their nets in different places because of the algae. It was also noted that the algae growth is coming earlier now – it used to arrive in the fall, but now is arriving in the spring – and people can't keep their nets out all night as a result of the algae collecting in them. There has been a notable increase in the growth of algae and plants in the mudflats. Warmer waters are seen as being related to the increased growth in plant life in rivers.

Willows are growing bigger and thicker now, though are not growing in new places; this change may be owed to an increase in the length of the growing season.

Other, General, and Miscellaneous Comments about the Environment
Environmental change is seen as a significant concern, alongside commercial fishing, in terms of impacts to fish.

Regarding Culture, Society, and the Economy

Learning to Fish

People noted learning to fish from parents, spouses, and other relatives. People learned, which they felt was a fun process, by watching, being shown and told what to do, and by doing it hands-on themselves. People reported having cut their first salmon between approximately 6 and 13 years of age. When people made mistakes with cutting when they were first learning, those fish were given to the dogs. Interviewees reported camping and fishing being an important part of their lives growing up, all summer every year.

The Importance of Salmon and Salmon Fishing

As noted earlier, almost everyone felt that in general people in Koyuk now are fishing less than in the past (though there is some indication of a recent upswing), people spend less time at fish camp than in the past, and peoples' diets (as well as ways of life in general) have changed with some no longer depending on fish. There has also been a decrease in the use of dogs for dog teams, which has resulted in people fishing less. Additionally it was also noted that public assistance may lead to people fishing less as well. Fishing appears to be less important to young people nowadays, and they are less interested and less knowledgeable about what to do than in times past. Some feel that people are also fishing in different ways than before, and that there has been a change in mindset and attitude trending towards a more western way of thinking, with a disregard for the future and a feeling that people can fish wherever and however they want.

On the other hand, salmon – and fish as well as subsistence foods in general – are still seen as very important for people in Koyuk. Salmon is considered to be a preferred food, as well as an important component of Koyuk's food security. Subsistence in general is seen as important. People noted that subsistence foods make you feel less poor, that they are important because food is expensive at the store, and that fish provides food for the winter. People noted that fish and other subsistence foods are good and healthy for people. People also still identify going to fish camp with their way of life, and link their identity to the country. For some people their memories of conducting subsistence are some of their best memories. Subsistence is seen as important as well because things are getting harder for people in general, things are getting more expensive, many things are changing and uncertain, and subsistence is seen as important for survival.

"With subsistence food, it's a better feeling to have, like you're not so poor."
-Ramona Nassuk

"And whatever they [her children] decide to do, I hope subsistence will be instilled in their hearts."
-Ramona Nassuk

Transportation, Fuel, and Costs

The cost of fuel, which people felt would get worse in the future, can play a role in subsistence activities. Additionally, some motors are inefficient with their use of gas, compounding the problem for some people. People may not be able to go out when they otherwise would have, or stay at camp longer instead of going back and forth. High costs may mean people can not make exploratory trips to find where the fish are if they are not showing up in the usual places. Additionally, the cost of gas can make it difficult to save enough money to get to camp before the rainy season, but not getting to camp before then can impact whether one is able to put fish away. It can seem to be a no-win situation,

where people cannot go out as much and question whether it's worth it when they do, yet at the same time can't afford not to go and harvest food. People have various techniques to try and cope with the cost of fuel. They will try to buy gas before the price goes up, will share rides, will carefully monitor their decision-making about when to go out for subsistence, will help others by getting gas for them, and will work together with others to harvest food. The environmental changes which are occurring also make a larger impact on people who participate in subsistence activities, and make travel more difficult, especially when compounded with gas prices. In addition to the cost of fuel, people noted that everything is expensive now, including heating oil, groceries, and bills in general.

"Now would be a good time [as an estimate of the normal start of the king run] but, I don't know, with gas prices being really high too, we can't make as many trips as we used to to try and find where they're at, so."
-Grace Morris

Wage Employment
A few thoughts were expressed by participants about jobs. It was noted that jobs can get in the way of spending time at camp. Some saw jobs as an even bigger issue than the price of fuel, because people need money to buy gas, and there were hardly any jobs when people were being interviewed in 2008.

Commercial Fishing
In the 1950s and 1960s, there was commercial fishing in the Koyuk area that wiped out the fish for a while. There is commercial fishing today in the Koyuk area as well. Some people need the money from commercial fishing to keep their family going.

People have concerns about trawling and salmon bycatch. There is concern about the vast amounts of discarded bycaught salmon in the pollock industry. Additionally, one person wondered whether something could be done with these bycaught fish instead of throwing them away.

Young People, and Knowledge Sharing
As noted above, it is felt that not many young people fish now, and that they are less interested in and knowledgeable about fishing than in the past. A number of people bring their children and grandchildren to camp with them. Some, however, note that they want to take their children to camp with them but their children don't want to go and would rather stay home, which makes people sad. It was also noted though that people do not feel that it is kids' fault. It was stated that young kids need mentors. People feel it is important for children to learn to practice subsistence and to put subsistence foods away for a variety of reasons (for its own inherent value, because it is hard to live off of the store, because it promotes self-sufficiency, and because it is important for survival). It is a source of pride when young people practice subsistence and love subsistence foods. Some people give subsistence foods away to children so that they will become familiar with it and love it. Some participants noted the need for having a balance in life, and subsistence would be a part of that.

"Interviewer: If you could say something to young people in Koyuk what would you tell them? EK: Try to stay on subsistence lifestyle and learn how to live with it."
-Esther Kimoktoak

Figure 19: Esther Kimoktoak and her granddaughter at a family fish rack.

Changes

Sharing still occurs in Koyuk, but is less common, and is usually restricted within the family unit, whereas it used to be community-wide. The influence of television, conflicts with western ways, the cash economy, and economic costs are seen as influencing factors relating to this shift. The spread of Native language loss is also seen as an area of change that is concerning. There is in general a concern with the problem of western influences on Native communities.

"We need a two-month power outage."
-Johnny Anasogak

Regarding Challenges, Management, Commercial Fishing, and Recommendations

Difficulties and Challenges

As discussed earlier, high fuel prices, the high cost of goods and services, environmental conditions (particularly changing conditions), and lack of youth interest in fishing can pose difficulties, concerns and challenges in peoples' lives.

Some people are concerned about fishing and that something needs to be done to come up with a way to ensure that fish (as well as birds and animals) are here for future generations. Some feel that it may be such that people will only be able to go out to harvest at certain times and not just whenever they want.

Some people feel that commercial fishing activities (e.g. trawling, False Pass fishing, and local fishing), as well as environmental changes, have caused or have the potential to cause problems for fish.

Commercial Fishing

There are varying opinions about commercial fishing. Some note its importance for providing income, though it was also pointed out that Koyuk was not ready for this like Elim and Shaktoolik were. However, others feel that commercial fishing has been connected with decreased fish runs. They also noted that Unalakleet and Shaktoolik experience subsistence closures potentially arising from overfishing. Additionally, it was noted that perhaps the reason people still have fish in Koyuk is because they did not have a commercial buyer for many years.

"[C]ommercial fishing [is] a way that you can earn money for the winter. There are pros and there are cons for commercial fishing. You don't commercial fish, maybe you don't get the money that you need to buy your groceries for the winter. And if you don't commercial fish you don't get it. But the plus side is there'll be more escapement, or fish returning to the rivers, that might have not gotten there. So there are some good things and there are some bad things you just have to kind of, I wish that there was a way that you could even it out and know exactly when you reach that even mark. Because you have to have some give and some take. You just have to know when to draw the line. Unfortunately in rivers like these you can't very well do that unless Fish and Game [ADF&G] have a way of doing it. Unfortunately a lot of our subsistence way of life is being governed by the Fish and Game. Sometimes Fish and Game doesn't know the patterns of our Native foods. The Native people know more about our Native foods than the people in Juneau, or where ever the Fish and Game board comes from. They're the ones that are making the decisions that are affecting our lives, on our land."
-Georgianne Anasogak

Management

In 2008, people in general seemed happy that they hadn't been impacted much by harvest restrictions and regulations from the Alaska Department of Fish and Game, and felt that Fish and Game was not overly involved in their fishing activities. Some wondered if their impacts were less because Koyuk has so many rivers which they can fish. Some felt that regulations were going to be coming (e.g. due to changes that are happening, or to preserve subsistence lifeways). In 2014, however, people had a much more negative view of ADF&G management. It was noted how in the past, people didn't have to worry about ADF&G. By 2014, however, ADF&G management was considered on the whole to be a substantial problem for people. One concern was the over-regulation of local activities, such as in the need to get a license simply to go rod-and-reeling. A more significant concern is uneven (e.g. lack of enforcement in some areas and too much in others) and inequitable enforcement. For example, when guides are reported for violations by people from the village, little is done and the burden of proof is very high, but ADF&G will act forcefully on simply a phone call regarding allegations of Native people violating rules. In general it is also felt that guides are not being monitored adequately at all by ADF&G. Additionally, there was a concern about the lack of communication from ADF&G to people in Koyuk. Regarding a recent closure, they did not come to talk with people in the village and get

input, but rather simply faxed over documents. It is felt that they also do not have enough data behind their closure decisions. There was also a general sense that the people who are making decisions at the management and policy levels do not understand what subsistence means, and that their perception of subsistence is different from what people in Koyuk's perception is.

People in Koyuk are concerned about the effects of nearby mining, nearby contaminated sites, offshore drilling, vessel traffic, acidification, global warming, Fukushima, trawling and salmon bycatch, and problematic management by the ADF&G.

There is a general philosophical debate that is particularly salient with people who participated in the project in Koyuk relating to the issue of external management. Discussions with participants highlighted the bind that local people feel they are in. Local people were able to adequately manage natural resources on their own without external influence for thousands of years, and there is a sentiment that they are more than capable of still doing this today, but instead are regulated by people from the outside. People were able to manage resources on their own perfectly well, and if they had power they would be allowed to do this management even today. However, in the past there weren't things like commercial trawling and other large-scale external activities whose effect on resources are a great concern to local people and for which local people can see a value in regulating. This seems to illustrate the bind that local people have. They are capable of self-regulating their own activities, but the presence of external activities which are far more destructive of resources requires external regulation. However, once regimes of external regulation come into place, instead of focusing where it should (on large external forces), it is used inequitably against local people, who lack political power, while external forces are allowed to get away with an astonishing range of environmentally stressful and destructive activities.

Local or Traditional Management

Most people still follow the practice of giving their first harvested food away, especially to Elders.

Some people feel that there is a problem with overharvesting of eggs on corporation lands by people on snowmachines and 4-wheelers that is decimating the bird populations on those lands. There is also a concern about the use of snowmachines on corporation lands and the lack of enforcement on land use, and a concern about the general impacts of motorized vehicles on the land.

People highlighted how they have a long-standing tradition of good management. People were good managers of the land long ago, and it was noted that the old people managed fish better than the ADF&G can do now. People also feel that they are able to self-regulate their use of natural resources. Some concern was also expressed however, including in terms of its ramifications on the use of resources such as fish, about the problem of the westernization of local peoples' behaviors and attitudes.

"In order for us to continue our subsistence lifestyle, I'm almost certain some regulations have to be put somewhere, but I don't know where. I don't know if outside, people from the outside coming in will have an impact on the fish we do have in our rivers. I would hate to say, to tell them, 'Don't come.' Because the old folks I grew up hearing, that if you restrict the food that's in your land, the fish, the birds, the berries, if you restrict the foods that are growing, on your land, the time will come when that's wiped up, or almost wiped out. Our culture is you need to share, just because my land claim is here, doesn't give me the right to say you can't come and put your net there. Just because his land, my husband's land claim is there, that doesn't mean that nobody can come and fish or hunt there. God

intended this land to be used by everyone. And I think that when people begin to put restrictions on land that's when trouble begins. I've seen it in some areas when people say you can't come pick berries, that's my ground, you can't pick berries. Over the next several years, the berries have stopped growing. So you need to share. The land is there for you to share with everyone. Having said that, with the fish, I don't know how we're going to keep the fish coming into our rivers as they are now. It has been good for the last few years since the commercial fishing hasn't, we haven't had any commercial fishing, but this year it's been open for awhile, the commercial fishing in this area. I don't know if that's gonna have an impact. In the next few years in the rivers especially in the Ungalik River and the Inglutalik River, I'm not sure. Time will tell."
-Georgianne Anasogak

Figure 20: Koyuk residents preparing for fishing.

Recommendations
As intimated above, there is a strong sense when talking with people in Koyuk regarding the binds they are in terms of their traditional abilities to manage and self-regulate their use of resources with the realities of modernity (e.g. the presence of external management forces, large-scale commercial interests, participation in the cash economy, westernization of local behaviors and attitudes, etc.).

The following recommendations could be gleaned from the data:

- Greater awareness should be spread at the local level about the use of motorized vehicles on the landscape in terms of its effects on the land as well as in their use for the harvest of bird eggs.
- Management and policy regarding natural resources should more adequately deal with the binds local people are placed in regarding their traditions of resource stewardship and the strong

external forces impacting their ways of life today. Additionally, managers and policymakers should gain a better and more accurate understanding of what subsistence means, should increase the communication flow with people in the village regarding decisions (e.g. talking with people before making closures and explaining the decision, about how managers come up with their numbers, etc.), should enforce regulations evenly and equitably, and should recognize the long-standing traditions of fish resource stewardship in Koyuk. In the ideal world things would be returned to the way it used to be, without large-scale commercial trawling, and where local people made their own decisions about resource use.

- Measures should be taken to protect the local watershed.
- Basic water testing is needed so as to be able to monitor any changes.
- An expert should be brought to Koyuk to demonstrate techniques for repairing nets.
- Different nets required for commercial and subsistence fisheries are overly expensive and local people should be allowed to use whatever they have.
- The increasing growth in algae should be studied.
- A culture camp would be a good way for young people to learn to put away fish and would be good for the community, and steps should be taken to make this a reality.
- Increased efforts to determine to what extent the salmon bycatch in the pollock industry represents salmon that were headed for local waters.
- A subsistence priority should be recognized in the State Constitution.
- More Koyuk people should be sent to key meetings which pertain to fish resources and regulations which impact the local area, in particular the North Pacific Council and the Board of Fisheries.
- Extending the boundaries out further from 3 miles for salmon management.

Saint Michael

St. Michael approximately 125 miles southeast of Nome, on the east side of St. Michael Island, in Norton Sound. The community has no road access to Nome and receives most goods by air or by barge in the summer. There is a 9-mile long road connecting St. Michael and the village of Stebbins. The 2010 US Census indicates that St. Michael has a total population of 401, of those 211 are male and 190 are female (ADCCED 2015). Approximately 92% of the population is American Indian or Alaska Native (*ibid.*), primarily Yup'ik Eskimo.

Regarding King (Chinook) Salmon

People in Saint Michael reported that kings are smaller now than they used to be. They also take longer to come in now than they used to. Kings come in right after herrings spawn, usually in late May or very early June, just after breakup. One place that kings were noted as no longer spawning is Klikitarik River, because it is very small now, having largely dried up; people used to catch a lot of kings in that river.

People in Saint Michael use set nets to harvest king salmon. More generally speaking, people reported that they used to be able to harvest a lot of kings, but that they get much less now. Some reported getting hundreds a day when they were young, but it was noted that some people are lucky if they catch just one king now. People also used to get large kings in the past as compared to now.

"It seemed to be less fish coming in [compared to the past]. It takes a while now for kings and salmons to hit like they used to hit long time ago."
-Monica Oyoumick

Regarding Silver (Coho) Salmon

People in Saint Michael harvest silvers in August. Silvers arrive in the area at that time; they are the last run (other than the second chum run), coming after pink salmon, which come in July.

Regarding Pink (Humpy) Salmon

As noted above, pinks usually come to the Saint Michael area in July, which is when they are harvested. They are the second to the last run, coming before silvers. It was reported that pinks may be smaller than they used to be.

Regarding Red (Sockeye) Salmon

Red salmon were noted as being a fish mainly found in Bristol Bay, though it was noted that they do come to the Saint Michael region as well.

Regarding Chum (Dog) Salmon

Chum salmon, which are harvested by Saint Michael people, were noted as taking longer to arrive than they used to, similar to kings.

Regarding Salmon in General

It was reported that while usually salmon eggs that people get are large, some are getting to be small now. These smaller eggs were reported as being the same color as usual. People reported a variety of health-related problems with salmon, including: 1) salmon with worms (these fish are fed to dogs), 2) sores (these fish are fed to dogs), 3) the gut fused to the stomach lining, 4) yellow pus that was tunneled into the skin, 5) marks from animal attacks (e.g. bears), and 6) strange skin. Strange skin was a key

marker of unhealthy fish; for example, fish with white spots on the flesh were not considered acceptable for human consumption (these are fed to dogs). However, some felt that in general the health of salmon is pretty good.

Interviewees were of the view that salmon are coming in later now than they used to, some saying they come later and later every year. In terms of the order of runs, herrings come first, then whitefish, then kings (in late May or very early June), then one or two weeks after kings come the chums and reds come, then pinks come in July, and then silvers in August. Chums also have a second run in the fall, and are mixed in with the silvers for about a week. Chums are the only fish that have a second run.

Most interviewees reported that salmon populations were down (some also extended this to other subsistence resources as well). However, some disagreed, arguing that there are less people fishing now, and that people are fishing less heavily now than they used to, all of which was variously attributed to being tied to jobs, lack of equipment, and/or governmental assistance disincentivizing practicing subsistence.

Additionally, it is felt that people are harvesting much less salmon now than in the past; people used to get a lot, but not anymore. People mainly fish between June and August. People mainly use set nets (designed for specific species of salmon) for fishing, but also will use rod and reel. Seining is not often practiced nowadays, but was something people did in the past as well.

"Yeah, fish swim <u>everywhere</u>. Keep fishing. Keep your net clean, check your net three times a day and you're good."
-Luci Washington

Figure 21: Luci Washington of St. Michael rinsing a salmon before hanging it to dry.

Regarding the Preparation and Use of Salmon

People 'put away' (i.e. process, store, etc.) salmon in the following ways: drying, half-drying, smoking, salting, as strips, boiling, baking, eating the heads, freezing, in seal oil, and with salmonberries in a seal poke. People are smoking fish now more than they did in the past. People do not store things away in the ground anymore owing to the melting permafrost; storage holes simply fill up with water and so cannot be used. Fish may also be stored in wooden barrels.

People put away fish for human consumption, sharing, bartering, trading (e.g. dry fish), and, moreso in the past, for dog consumption. People will barter fish with other people in a large extended geographical range, often for other subsistence products such as whale, beluga, berries, and native artwork.

Fish that have sores, worms, other health problems or simply aren't good quality are hung and dried separately and fed to dogs by some people; it has not been seen to have deleterious effects on the dogs. Other people instead throw unhealthy fish back into the water. Salmon that have spawned out and are barely alive are also not eaten. Rainy, damp weather can make putting away fish difficult; smoking fish can help with this problem. It was been more rainy in the summers than it used to be.

Avoiding being wasteful is a strongly held value (e.g. putting away everything one catches, or utilizing fish that are poorly prepared by children who are learning).

"We can't waste food."
-Christine Washington

Regarding the Environment

General Comments about Climate and Weather

It was noted on a number of occasions by interviewees that the weather has changed substantially from earlier times. Commonly noted differences included the feeling that the weather used to be nicer more often in the past, and that there has been an increase in storminess and rain in more recent times. One interviewee noted that things are not as they used to be a long time ago where whatever people needed was there, and that perhaps climate change has to do with this change.

Climate/Weather Unpredictability and Variability

The weather is seen as being less predictable and more variable now than it was in the past. This includes both during the summers and winters. For example, large temperature changes in the winters happen suddenly now, and the weather in the summer will change from nice to rainy quickly. It was noted that the weather used to be nice almost all of the time in the past.

"We'll have sudden nice weather and next thing you know it's raining. Just unpredictable. Never know."
-Monica Oyoumick

Rain

Interviewees reported that summers have seen an increase in rain and dampness when it normally wouldn't be; for example, June is damp as well as cold, when it never used to be, it used to be a dry month that was good for fishing and drying fish. July has also become rainier than in the past. The weather also changes from nice to rainy very quickly and unpredictably now. There is overall an

increase in rain and storminess, including noticeably high winds with rain during silver runs.

"[...] just rain when it's not supposed to be raining, damp when it's not supposed to be damp. Too hot. Sometimes it gets too hot. But that's good."
-Luci Washington

Snow
There is less snow than there used to be; this trend started in the 1970s or 1980s, and there seems to be less every year. The snow is also coming later than it used to, and when it comes, it will melt and then freeze now.

"Yeah, there used to be lots of snow long ago [...]"
-Irene Lockwood

Figure 22: St. Michael fisher sharing a salmon.

Wind
Winds were reported as now changing in strength unpredictably. Additionally, it was reported that the fall has started to get high winds in more recent times.

Storms
People use signs such as observations about the clouds to help predict the weather. The weather was

noted as being different now than in the past. They used to generally get good weather, including in the winter, with only occasional storms. Now, however, it is a lot stormier, with more rain and wind. Some felt that this change had occurred fairly recently as well.

"It's getting different. Not that long ago, we used to have good weather all the time."
-Irene Lockwood

Temperature
There were varying opinions about changes in summer temperatures. Some interviewees noted heating trends, e.g. that it is sometimes too hot in the summer, while others noted that some summer months have become colder, as well as rainier and damper than in the past. It is possible that these are reconcilable views, in that summers may be getting rainier overall which lends to a sense that it is colder than in the past, while a general warming trend at the same time leads to periods of noticeably more intense heat than in the past. Additionally, in line with observations about increased environmental variability, one interviewee noted that in terms of summer temperatures, it seems to be changing all the time.

Warmer water temperatures than in the past were identified as one possible contributor to lower salmon harvests in current times.

Fall and winter are regarded as being warmer than they used to be. It does not freeze up as early as it used to, and winter does not get very cold, only getting cold weather once in a while. Winter is seen as arriving later now as well.

Ice
In general people indicated that breakup is happening at roughly the same time as in the past, with perhaps slight variation, though some felt it goes out earlier now than in the past. The ice goes out in May and June, with some variation. People felt that how breakup occurs may have changed. A number of people felt that the ice now simply rots/melts in place, and then goes out all at once with a strong current, as opposed to breakups in the past where the breaking ice would go back and forth and go out in pieces.

Freezeup occurs later now than in the past. In the past, it used to freeze up in September, October, and November, whereas now it occurs in November, December, and January. Late freezeup can impact subsistence negatively. For example, this can prevent people from being able to go tomcod fishing through the ice, or being able to travel over the ice to go moose hunting.

It was also noted that open water is far closer than it used to be in the wintertime, and additionally that it used to be safe, even in the spring, to go out and hunt on the ice, whereas now it is too thin and always moving.

"Yeah but that ocean, it can't keep still, just like me and you, we gotta walk around move from place, yeah."
-Elias Akaran

Erosion
People noted that there has been a lot of erosion. It was reported that the erosion has been widespread, and also that rivers are wider now than they used to be, and that a lot of ground has disappeared.

Significant erosion has occurred all along the shoreline. Ten or eleven years ago high water caused the worst of this erosion, though interviewees felt that it seemed like every year the fall storm season is eating up the ground. The melting permafrost was cited as a potential related factor in increased erosion as well.

"[…] eroding all over here and there."
-Luci Washington

Figure 23: Salmon fishers checking their net in St. Michael.

Fish and Fishing in General, and Notes on Other Non-Salmon Fish

With regard to non-salmon fish, herring were reported as being less than in the past, with people harvesting few in recent times. It was also reported that they do not spawn now as they used to, no longer spawning in St. Michael Bay. Additionally, in 2006 and 2007, an unknown eel-like creature was reported to have appeared. It was also reported that there are more flounder, devil fish, and wolf fish now than in the past. Finally, it was noted that whitefish are reported to have gotten smaller since the flooding which occurred 12-14 years ago.

With regard to fish and fishing in general, some comments can be made. The only place noted where fish had abandoned was Klikitarik River, which has mostly dried up now. Additionally, people noted that there used to be a lot of salmon, herring, seals, and whales as compared to now, and people also used to catch a lot of fish as compared to now. Some people felt that they were not getting fish like they used to, and that fish were diminishing in number and arriving slower and later.

"I know they [salmon] used to do it [spawn] in Klikitarik, but not anymore, the river's dry. It's just a small little river now. That's where we used to go camp for king salmon and herrings, fish. We used to catch lots of fish there."
-Luci Washington

Changes Noticed with Marine Mammals
A few changes with regard to marine mammals were noted. First, there have been recent sightings of polar bears in the area, which was seen as a new development. It was reported that in the past there used to be lots of seals and whales. However, it was also noted that currently there are many minke whales, but the cause of this was unknown.

Changes Noticed with Land Animals
A number of changes were noted with land animals. People noted that there are no longer any martens or minks anymore. People have started to see more foxes, wolves, and moose; moose never used to be seen long ago. As of 7 years ago, caribou had not been coming down to the St. Michael area in years, perhaps because it is not freezing enough for them to cross waterbodies now. Additionally, as of 7 years ago reindeer had been considered to have been coming close. Reindeer meat used to be very fat long ago, but that has changed in more recent times. Bears are starting to come closer to St. Michael, but long ago they were never seen close by.

"Never used to see bears long ago, nothing. No bears, nothing."
-Irene Lockwood

Changes Noticed with Birds
Puffins were the only bird reported to have been a regular bird for the area which are no longer seen anymore. One interviewee reported that small black birds had started to be seen just in the past few years.

Changes Noticed with Insects
People felt that starting around 11-12 years ago, there were less mosquitoes in the spring than there used to be. There are also less flies than there used to be. People have been seeing some very large bumblebees more recently, and there may be more bumblebees than normal around now.

Vegetation
It was felt that grasses are growing much faster than they used to in the past. People felt that berries are found less frequently in large numbers than in the past. People harvest cranberries, blueberries, blackberries, raspberries, strawberries, and salmonberries. While berries, which usually get ripe in July, normally are ready in a certain order, sometimes this happens irregularly. There are areas where berries used to be that they are not anymore, which was seen as most likely due to changes in weather and the environment. It was noted that the increased rain and dampness which is seen now in June and July has negatively impacted peoples' abilities to harvest berries. Some other plants which used to be harvested in larger numbers are less available now as well, including wild spinach and 'mouse food'. People noted that plants are growing/blooming slower and later now (e.g. willows, sourdocks, and Labrador tea). Some greens have also quit growing entirely, which was thought to perhaps be related to there being less snow now than in the past as well as drier ground conditions being found in the summertime now than in the past (regarding the latter, people have noted that it has started to become very dry as compared to the past).

"I love looking for berries, no matter how my back aches. Then we enjoy them in the winter. That's what subsistence is all about."
-Luci Washington

Other, General, and Miscellaneous Comments about the Environment
People noted that some lakes are drying up. People also noted that there have been a number of high water/flooding events in recent times in the St. Michael area, and that it didn't used to flood like it does now. Water levels in the ocean were also reported as seeming to be higher now than in the past; the morning high tide is higher and seems to be getting higher every year. However, it was also noted that long ago they used to get large high tides in the fall, pushing the ice up, which doesn't happen anymore.

Regarding Culture, Society, and the Economy

Data related to culture, society and the economy for St. Michael which pertain to salmon and the environment as elicited in interviews are discussed below.

Learning to Fish
Interviewees noted that they learned how to fish and put away fish (e.g. cutting fish) from their parents, grandparents, aunts, and older people in general. When younger, people learned about how to make nets, fish, clean fish, cut fish, dry fish, and smoke fish, all mainly by watching and helping. People generally started going to fish camp with their parents when they were young, with most learning to cut fish when they were around 9 or 10, though some did not learn until later in life (e.g. their 20s). At fish camp people were also engaged in other activities such as taking care of children and cleaning up around camp.

"Learning how to put food away is a great joy for my family."
-Luci Washington

The Importance of Salmon and Salmon Fishing
Many people used to fish during the summer, but now less people are fishing. People are also not getting as much fish as they used to in the past. Numerous reasons were postulated as to why this was the case, including lack of interest, increasing dependence on store food (which all but a very few are dependent on now instead of subsistence) and associated changes in taste preferences, various forms of public assistance (e.g. food stamps, welfare), the negative impacts of the government historically on local people, greater difficulty in getting fish now owing to people lacking the means (e.g. boats, nets, gas), other social changes (increases in drug and alcohol use, the demands of jobs, and the influence of television and other 'modern' technologies), and decreases in fish populations. However, with regard to the latter, some felt that there are still sufficient fish for people, but what is happening now is that less people are fishing and people are fishing less. A number of interviewees expressed views that fish and fishing are important, and that harvesting fish is something that children should be taught.

"Can't be lazy to put food away. Especially if you have a big family. Lazy is not in our culture!"
-Luci Washington

Sharing
People share fish with Elders, family members, people in other villages, and people who help them process their fish. Additionally, sometimes people are given fish by others who have harvested fish but

do not want to process their own fish.

People will help family members with fishing activities if it is needed.

Trading and Bartering
For some people, bartering or trading fish (e.g. dry fish) with others (e.g. for whale, beluga, berries, native artwork, or cash) is important, though some families do not engage in these activities.

Commercial Fishing
There used to be commercial fishing for herring in the St. Michael area. However, it is felt that the commercial herring fishery in the bay harmed fish stocks.

Young People, and Knowledge Sharing
It was stated that peoples' ancestors once predicted that young people would not help their parents and engage in hunting practices in the future, and it is felt that younger generations now are less interested in subsistence activities. While it is felt that it is important for younger people to learn how to do subsistence activities, it was also felt that you don't see a lot of young people fishing now as compared to the past. It is felt that television has had a substantial impact in instilling amongst young people a disinterest in engaging in activities nowadays. One interviewee noted that everyone learns about subsistence at home, first through parents, and that if it is not stressed to their children then they will not do it.

"There's too much TV, too much what not, make young kids don't want to do things anymore."
-Monica Oyoumick

Other Information on Human-Fish, Human-Animal, and Human-Environment Relationships
It was stated that people should be respectful of the fact that salmon provides for their sustenance. Not wasting fish is a commonly held value.

Regarding Challenges, Management, Commercial Fishing, and Recommendations

Difficulties and Challenges
A number of difficulties and challenges associated with fishing were identified by interviewees. These include, in no particular order: 1) a decrease in fish stocks and other subsistence resources from the sea as compared to the past, 2) the increased rain and dampness in the summer which makes putting away fish more difficult, 3) a lack of boats and nets for some and an increase in gas prices, and 4) the conflict of working at jobs with engaging in subsistence activities.

Commercial Fishing
As noted earlier, it is felt locally that the commercial herring fishing activities in the past contributed to a loss of fish (including salmon) in the bay.

Management
It was felt that there is really no place for ADF&G to be coming around St. Michael at all since no commercial activities are conducted there, and they should not be involved in subsistence fishing at all.

ADF&G's rules pertaining to king salmon were seen as particularly irritating. It was felt that the rule directing that kings which are incidentally caught must be thrown back in was particularly nonsensical.

It was also felt that ADF&G's dictate that people not fish for kings was unwelcome when people not from the local area were allowed to come to the area and fish.

Figure 24: Community gathering in St. Michael.

Local or Traditional Rules of Management

The primary rule and value associated with the local management of fish which was stressed by project participants was the importance of not wasting.

Recommendations

A number of recommendations were made by project participants which would be of value to the community. In no particular order, these are: 1) canning classes being taught in the village, 2) commercial smokers and vacuum sealers would be helpful for people in the village, 3) instituting something, facilitated by the Tribal Council, such as a camp away from town where knowledge can be passed on to younger people, 4) assistance in repairing camps that are washed away by storms, and 5) increased assistance with reindeer herding.

Unalakleet

Unalakleet is located approximately 147 miles southeast of Nome at the mouth of the Unalakleet River in Norton Sound. The community has no road access to Nome and receives all of its goods by air or by barge in the summer. Unalakleet is a sub-regional hub community with more air access options than other villages (e.g. more daily flights to Anchorage). The 2010 US Census indicates Unalakleet has a total population of 688, of those 371 are male and 317 are female (ADCCED 2015). Approximately 77 percent of the total population is American Indian or Alaska Native (*ibid.*). Unalakleet has been a trade center for generations because of its location near an important portage into Interior Alaska.

Regarding King (Chinook) Salmon

"[…] I want to see numbers like what I saw when I was growing up with kings. It was amazing! I think back on those times and I think man, it's unbelievable because those days are gone and it was like, was it real what I seen with my own eyes? Just massive massive amounts of king salmon, big ones, big bright beautiful kings."
-A. Shane Johnson

Comments about king salmon biology and behavior
The king salmon which are returning to the Unalakleet area are smaller than those which returned in the past.

People reported that now a significant portion of the king harvest are jack kings.

It was also noted that kings swim with pollock, and that the pollock fishery is taking a lot of kings as bycatch, including many which would be returning to western Alaska.

A number of observations were made about the king salmon diet. They are noted to eat herring, and have been seen to have small fish in their stomachs as well. Some have reported harvesting kings which had empty stomachs.

"MK: It seems like we used to get all different size, but right now it seems like we're getting the same size, which are small. DK: Jack kings. MK: Yeah, mostly jack kings."
-Mildred and David Katongan

Comments about king salmon distribution
Kings are the first salmon species to arrive in Unalakleet. When their runs begin is at least in part dependent on the weather and the ice conditions. When there is more ice, they come later. Kings arrive after herring, whose run timing also depends on the weather. In general, kings arrive around the first of June. When the weather is warm, one might get a king in May.

People noted in late 2014 that they were not seeing kings with the whitish tip on their noses anymore.

Comments about king salmon population
There used to be many kings coming to the Unalakleet area, but there are far less now. People started observing declines as early as the 1980s; the declines were definitely noticeable by the late 1980s and early 1990s. Additionally, the kings that are coming now are smaller in size than in the past (60-80 pounds on average in the past, compared to 15-25 pounds now). A number of causes for this decline

were identified, the main ones being, in no particular order: predation by trout, False Pass fishing, foreign fishing 'pirates', pollock fishing bycatch, changes in the weather, and, possibly, changes to habitat and estuaries from anthropogenic and non-anthropogenic causes. The decline in the king population is taken very seriously and is disconcerting for community members. Many feel that preserving the king populations should be a significant priority.

'[O]ur kings were pretty big then, 60 to 80 pounds, now they range from 15 to 25 pounds."
-Jerry Ivanoff

Figure 25: Mae and Oscar Koutchak of Unalakleet.

Comments about the harvest of king salmon

In the words of one interviewee, "[c]ommercial fishing for kings is dead." Commercial fishing for kings in any significant quantity hasn't occurred for a long time due to the depleted kings population. Some people do not even fish for kings at all anymore, either because it is not worth the effort or due to participation in a voluntary moratorium because of the low population numbers. Some only fish for them in very small quantities. Regardless of reason, the harvest of kings is very low compared to times past.

People noted substantial restrictions that have been implemented regarding king harvests due to the population crash. Alaska Department of Fish and Game enforces closures on king harvests during the season. Additionally, a number of people in Unalakleet have self-imposed restrictions on their harvest of varying levels (including not fishing for them at all) to ensure the preservation of the king runs.

The first kings are harvested around the middle of May and usually by June. They are perhaps arriving a little later lately as compared to more towards May in the past. They arrive after herring, whose run timing also depends on the weather. People fish for kings in the ocean (using set nets) and in the rivers. Some, however, do not have the gear (including boats) for conducting ocean fishing.

"Interviewer: So do you still try to catch kings for subsistence now? ASJ: No. Maybe we might get one or two just so we can eat fresh king in the beginning of the year, but we try to not even, I don't even target those because they're so few."
-A. Shane Johnson

Regarding Silver (Coho) Salmon

General comments about silver salmon
While the flesh of silver salmon was reported in 2009 as being the same as in the past, some negative changes to their health were reported as being seen in recent times. This included silvers being caught that did not have noses, silvers with a deformity where the upper half of their snout was shorter than the bottom, and more silvers appearing that have scabs on the skin forming something akin to sores. In 2014, it was noted that silvers without noses and with the deformity noted above were no longer being seen, but that latter problem (something like sores) was still present, and was now being described as being like acne or boils.

"We've seen, we're starting to see more and more like scabs on the skins of the fish. Which even though they're, even before they go upriver, while they're still out in the ocean, you can see the scabs are just like forming on them like sores. And that doesn't usually happen when they're young silvers."
-Benjamin Eakon

Comments about silver salmon biology and behavior
Silvers, as with reds (which are only seen rarely), will spawn up the Unalakleet River.

Comments about silver salmon distribution
Silvers are the last salmon run; the only major fish harvest occurring after them is ice fishing for trout. Some reported that there are two runs of silvers. The first is usually small, and then they get bigger. The second run is bigger, stronger, and there are more of them than in the first run. Fish during the first run weigh around 7 pounds, and in the second, 10-16 pounds. The second silver run comes after people have stopped fishing in September, and is also after the second run of chums. However, it was also suggested that possibly these are all simply one run with fish of varying characteristics during its duration. The 'fall fish' – those that come later – were reported as not having red meat. The early silvers are typically vacuum packed and frozen, while the later ones are dried. It was noted that the fish which have spawned out make good dry fish.

In 2009, it was reported that silvers are now coming in from the north most of the time. However, in 2014 it was reported that they are not coming from the north now, and that people from south were getting more for the past few years.

Comments about silver salmon population
Silver populations were reported as being good and pretty consistent. In 2009 there was some concern that, after having experienced the crashes of first kings and then chums, that silvers would come next. It was noted that they were being caught in significant numbers in the Area M catch as well as the pollock fishery's bycatch, and it was also suggested that they were being overfished at the local level as well.

"Interviewer: Do you see yourself continuing to commercial fish into the future? ASJ: No, I think the silvers are going to decline and dry up and I think we are going to go belly up because nobody is doing

anything right."
-A. Shane Johnson

Comments about the harvest of silver salmon
In 2009 silvers were reported as being the main commercial fish for Unalakleet. They were also an important subsistence fish as well. People seine for silvers in the rivers as well as rod and reeling for them. Occasionally people are able to harvest silvers through the ice as well. The commercial fishing for silvers is done in the ocean, while the subsistence harvest is done in the rivers. Fishing for "fall fish" - the later silvers – is not done in the ocean but rather in the rivers. It was also noted that problems with jellyfish were more a concern for the commercial fishing of silvers.

It was noted with concern that the Area M fishery is now harvesting even more silvers than they were in the 1960s.

"[A]s a coho fisherman, we make most of our money off of coho now. If we lose our coho commercial fishing, there's gonna be a lot of people hungry."
-Jerry Ivanoff

Regarding Pink (Humpy) Salmon

General comments about pink salmon
Some people are starting to see more worms now in pinks than earlier times.

It has been noticed that trout will have pink salmon eggs, fry, and smolt in their stomachs.

The flesh of pinks caught upriver is considered superior to that caught elsewhere; it is considered a white flesh.

"[T]he trouts are always eating the humpback baits or whatever baits they could have […]."
-Mildred Katongan

Comments about pink salmon biology and behavior
No change to the size of pink salmon was noted as having occurred over time.

A number of interviewees reported that pinks were the only salmon species that they have seen dead before they have spawned out. Some felt that this was likely a result of catch and release fishing.

Male pinks were noted as having larger humps than females, and as being less oily than females as well.

Comments about pink salmon distribution
Pinks are the second to last salmon species to arrive in Unalakleet.

Comments about pink salmon population
People felt that there are a lot of pinks now as well as in the past, though there was some concern that the runs might be decreasing.

Comments about the harvest of pink salmon
Pinks are harvested in subsistence and commercial fishing. Pinks are and were a significant portion of many people's subsistence harvests now and in the past. However, it was felt that it is a noticeable trend that less people are putting away pinks compared to 10-20 years ago. They are highly sought after for making dry fish. People harvest pinks primarily by seining for them in the rivers. A preference was noted for male pinks over females as they are not as oily as the females and thus dry better, have more meat, and taste better. People will use chum nets to get pinks so as to catch the males but let the females through. Some people, however, like eating both males and female pinks.

"[W]e like to dry the males more than the females."
-Leila Eakon

Regarding Red (Sockeye) Salmon

General comments about red salmon
One interviewee noted having seen abscesses with white pus in some harvested reds, and stopped harvesting them as a result. This condition is considered to be the same as that which was noted above which is effecting some silvers (something akin to acne, boils, or sores).

Comments about red salmon biology and behavior
Silvers and maybe reds will spawn up the Unalakleet River in areas with very little current (though only rarely do people see reds).

Comments about red salmon distribution, population, and harvest
People reported that there are few reds coming to, and getting harvested at, Unalakleet. People will harvest a few – or sometimes as many as ten (which would be considered a lot). However, they are starting to see more come around, though they are still considered to be a rare occurrence and are not a key fish in the local diet. People are starting to see more reds towards August when the silvers are coming in. It was reported that the later people fish, the more reds they would catch. It was also reported that there is a later run of reds that occurs after fishing closes in early September, though others felt that perhaps there were not two runs, but rather one continuous run that people would harvest at different times.

"I know one species [that] is starting to come around, [and] that is the red salmon. That's occasionally."
-Oscar Koutchak

Regarding Chum (Dog) Salmon

General comments about chum salmon
The flesh of chums was reported as being the same as in the past.

Comments about chum salmon biology and behavior
No change in the size of chums had been noticed over time. The early chums were reported to be fat.

Comments about chum salmon distribution
Chums come after kings in the sequence of salmon runs at Unalakleet.

Comments about chum salmon population

Most interviewees in 2009 felt that the main historical feature of chum populations was a notable decline. Chum populations were seen as being good until the early to mid 1990s, and then they declined (some say crashed). Trout consumption of chum eggs, fry, and smolt, as well as False Pass fishery in the 1980s and 1990s, the current pollock fishery's bycatch, and possibly local overfishing were all identified as the main culprits behind this significant decline (for both chums and kings). The chum decline is seen as happening after the kings decline started. In 2014, participants felt that the chum population had revived in the previous few years, and people had harvested more in recent years.

"[W]hen the dog teams started disappearing, the trouts multiplied, and every time the chums or kings spawn they mill around them and eat the eggs that are coming out of the females."
-Benjamin Eakon

Comments about the harvest of chum salmon

Chums are harvested commercially as well as for subsistence. On the whole, in 2009 it was reported that chums are no longer a mainstay of the Unalakleet salmon harvest, owing largely to the substantial decline in their population starting in the 1990s. Some fishers no longer even targeted chums for harvest. However, in 2014 a revival of sorts of the chum population had been reported for recent years, and it was noted that people had been recently harvesting more.

"The chums, we used to have way way waaay more chums."
-A. Shane Johnson (2009)

Regarding Salmon in General

General comments about salmon in general

A number of health issues were noted relating to salmon in general. People noted having seen some salmon with deformities. Additionally, some have seen fish with marks or cuts on their skin, perhaps from motors or predators such as seals. Starting around 7-8 years ago, some salmon as well as tomcod were noted as having sores or purple-ish marks on them. People would either remove that part and eat the rest (salmon) or avoid the fish entirely (tomcod). Some people who check salmon stomachs noticed that in the summer of 2008 the stomachs were pretty much empty, indicating a lack of food. It was noted that usually in king stomachs people will find some shrimp, but as of 2009 in the preceding several years the stomachs were empty, with only a yellowish liquid in them. Some salmon have been noted as having something like bumps, pimples, bubbles or boils; this was stated to be occurring at the same rate as in the past (i.e. once in a while). It was noted that people have seen worms in all fish in both recent times and in the past. There are different kinds of worms as well. There was some debate about whether the amount of tapeworms being seen more recently are to be considered an increase or the same as in the past.

The ocean floor, and keeping it healthy, is seen as important to salmon.

Seagulls and arctic terns were noted as feeding on salmon when they go into the rivers.

"[T]his last summer I noticed that their stomachs were just, pretty much all of them were empty, and that's like there's no food out there, like they're not eating. […] There was just nothing in there just maybe a little fluid […]."
-Leila Eakon

Comments about the biology and behavior of salmon in general
It was noted that in general salmon used to be larger, and there used to be more of them.

Comments about the distribution of salmon in general
The overall order of runs in Unalakleet, which has not changed from the past, is as follows: herring, kings, chums, pinks, and then silvers. People then later do ice fishing for trout. Salmon are seen as coming around the same time as in the past, towards the end of May or early June.

When runs begin is dependent at least in part on the weather and ice conditions. When there is more ice, the fish run later.

Trout runs are seen as importantly linked with salmon runs as well. After herring come in, trout come out of the rivers to feed after the ice leaves. Then kings arrive, and the trouts then follow the kings to eat. Trouts will also follow silvers as well to eat. Trouts will feed all summer.

Salmon were noted as traveling to the same waterbodies as in the past.

"Interviewer: What's the sequence of runs here at Unalakleet? […] MK: The herring and then the kings, dogs, humpies, then silvers. […] DK: and the last kind, ice fishing we do, is trout fishing."
-Mildred and David Katongan

Figure 26: Salmon drying.

Comments about the population of salmon in general
People noted that in 2008 there were a large number of jellyfish, a peculiar occurrence. It was thought

that they may have kept some of the fish away, especially silvers. They were also a nuisance to fishers because they would get caught in nets, and nets would need to be frequently cleaned.

Traditionally, people noted that they did not have a problem with stocks, and caught what they wanted and never wasted. However, as noted above, most people have observed in general a decline amongst salmon populations. Kings and then chums are seen as having had notable crashes. Silvers are being commercially fished, and pinks are seen as coming still in good numbers. The main causes of the crashes are seen as having occurred after the 1950s and involving a variety of commercial forces (foreign pirates, pollock bycatch, Area M fishing, and local commercial fishing), trout predation, and improper management. Trout predation is seen as being related to the high numbers of trout present now as compared to the past when people would harvest large numbers of them during fall seining to be used for dog teams; trout are noted as eating a lot of salmon eggs, fry and smolt.

"Every one [king salmon] has become vital or valuable. It's a beautiful fish, I would be really heartbroken if my kid's children were not able to catch them."
-Jerry Ivanoff

Comments about the harvest of salmon in general
People will harvest salmon from May to October.

As was noted earlier, subsistence and commercial fishing occurs in Unalakleet. People are harvesting far less kings and chums now given the low numbers of both populations. It was noted that there isn't enough fish to go around for sharing now, which is felt to be stressful.

Kings, chums, pinks and silvers have a history of being commercially harvested in Unalakleet (though silvers are the main commercial fish now). Some people reported harvesting more of the non-king species now that the king populations are down.

People currently harvest fish using seines, set nets, and rod and reel. It was suggested that the main method for harvesting has changed over time, and that now more gill nets are used than beach seines as compared to the past. Fishing for salmon takes place in both the ocean and the rivers. The current regulations limiting subsistence fishing allow for longer fishing times in the oceans rather than the rivers/creeks, which may have pushed a number of people into fishing for salmon more in the ocean than the rivers and creeks than in the past.

Some people are unable to get their nets out of the water because of inclement weather. This has some tie-in to recommendations as well (see further below) which entail timing closures to periods of rough weather. It was also noted in general that rain is a significant impairing condition for harvesting; some people, though not all, will not fish in the rain.

Regarding the Preparation and Use of Salmon

People identified a number of means by which salmon are processed, cared for, and stored: drying, half drying, smoking, turning into strips, processing in the fish plant, salting, freezing, canning, storing in seal oil, baking, boiling. Eggs are also prepared in a number of ways. Less oily fish are preferred for drying. For dry fish, pinks are preferred to kings. With the decline in fish, people are interested in preserving fish in any way they can.

Fish is used in a variety of ways. This includes for human consumption; for sharing, trading and bartering; for dog food; and using salmon eggs as bait for trout. Additionally, people will use the heads, innards, and bones for garden fertilizer. Fish which are deemed unacceptable for human consumption such as those with strange meat, strange smells, abnormalities, worms, sores, and cysts may still be dried and given to dogs.

"Every time people get their first king salmon, they share with everybody, a piece here, a piece there. That's what we do, because everybody likes to have a taste."
-Theresa Nanouk

Regarding the Environment

Rain

People felt that an environmental change that has been experienced is that there is more rain now, which is leading to difficulty in drying fish, which has resulted in spoilage or even prevented putting away fish at all. It was suggested that traditional knowledge could be of assistance in adapting to this by figuring how to dry fish when it rains. It was also noted that too much rain in the river can disrupt spawning.

"Interviewer: What kind of changes in the weather [have you seen in your lifetime]? MK: It's always … DK: Rough in the ocean. MK: Rough, even in the springtime and sometimes it rains too much, hard to dry our fish and summers we're very lucky if we could fill our fish rack before it really starts raining. But it's the rain and the ocean that doesn't ice no more like the way it used to."
-Mildred and David Katongan

Snow

People stated that there is less snow now than there used to be in the past, and also that the snow is coming later on in the year. It was additionally noted that decreased snowfall is leading to rivers freezing all the way down to their beds, which may be another source of fish mortality. It was also noted, however, that now with increasing temperatures, there is not as much freezeup happening anyway. One participant noted how in the past the night used to be as bright as the day because of the snow they would get, and it used to be calm, with less wind.

Wind

Some interviewees felt that the wind hasn't changed much over their lifetimes, while others felt that it had, including increased wind, stronger wind, and changing wind patterns.

Climate/Weather Unpredictability and Variability

The weather now changes quicker than in the past, and is less predictable than it used to be. This has a significant impact on peoples' subsistence activities. It was also noted that there aren't long stretches of the same weather conditions during both winter and summer like there used to be. People also started noticing in the 1960s a change towards increased roughness on the ocean during the fishing season, compared to the past when it used to be much calmer. Additionally, it was felt that the weather used to be more consistent than it is now, and that summers were better in the past than they are now.

"The weather changes real quick nowadays, huh?"
-Laura Paniptchuk

Storms
People identified a variety of problems associated with fall storms. There are more of them now, the waves are coming higher because of higher water levels, they are causing substantial erosion, and they are stretching into the winter season and leading to increased breaking up of the ice, which typically protects the shoreline.

It was noted that Unalakleet is not getting the prolonged winter blizzards that they used to get.

"The tides are a little bit higher maybe on account of more ice melting up north or, and the storms are a little more, the waves are bigger, you know fall time when we have fall storms."
-Benjamin Eakon

Temperature
Most people felt there was a trend towards warmer winters now than in the past. However, some felt that this was not the case. The summers are felt to have gotten colder as well as more variable than they were in the past. River water temperatures are noted to be warming.

Ice
In 2009, there were a variety of conflicting opinions about when breakup occurs and if it has changed compared to the past (some felt earlier, some later, some the same). In 2014, participants also had varying opinions, but in general there was something of a consensus that breakup occurs at about the same time as in the past. There was more consistency however on the point that how the ice breaks up is different now than in the past. Breakup used to be quite loud, dramatic, and more violent, but now the ice simply melts in place and gradually drifts out. There may be a connection between this change and decreases in snowfall or the thickness of the ice.

With regard to freezeup, however, almost everyone felt that freezeup is happening later. In the past freezeup occurred between late September and mid October, but now it occurs between mid October and November.

It was noted that the ice extent has dramatically decreased over peoples' lifetimes. It used to stretch in the winters as far as people could see, but there is less and less every year now. Additionally, it is thinner now, and open water areas are noticeable. People have to be more careful when atop the ice. The icebergs that people saw used to be very tall, but they aren't as big now as they used to be.

"We used to have ice all the way where we can't even see water all winter long."
-Mae Koutchak

Erosion
There has been noticeable (and ongoing) erosion on the rivers and the coastline near Unalakleet. Higher tides are causing more beach erosion, and a seawall had to be erected as a result. Melting permafrost is leading to changes in the course of the Unalakleet River as well. Additionally, people are losing fish camps due to erosion.

Changes Regarding Other (Non-Salmon) Fish, or Fish in General
As noted earlier, because of the decline in usage of dog teams, people are harvesting far less trout than the used to, which has resulted in an increase in the trout population. People in Unalakleet feel this is a significant contributor to decreased king salmon populations. They have noticed salmon eggs, fry and

smolt in their stomachs, including in substantial numbers, when opening them. Trout wait out in the ocean for kings to move upriver and then follow them upriver to predate.

People have noted an increase in jellyfish populations. These can impact fish harvests, as they get into the nets.

"[W]hen you cut them open those trouts in fall time, every one of their bellies are full of little salmons […]. [...] The dog mushers long time ago used to take care of that fall time, they'd get 40-50 sacks for each musher, and that way they'd keep the trout down low, but they don't hardly do that anymore."
-A. Shane Johnson

Other Comments about Fish/Fishing in General
It was noted that there are pinks, chums, kings, silvers, trout, grayling and some other fish species which remain year-round in the Unalakleet area.

Crab populations have increased since commercial crab fishing started; it was conjectured that this is related to increased productivity owing to increased ocean temperatures.

Figure 27: Project workshop participants in Unakakleet. Photo: Reneé Cooper.

Changes Noticed with Marine Mammals
The decrease in sea ice which is occurring ever year has been linked to increased difficulty in harvesting seals.

Changes Noticed with Land Animals
There are a lot of brown bears now in the Unalakleet area, more than there used to be. They are also coming closer to town than they used to. Additionally, while there were no moose a long time ago in this area, they arrived in more recent times. However, even more recently this moose population has been declining, potentially as a result of increased wolf populations, overhunting, and an extended period since the last fire in the river valley. Caribou populations have declined in recent years. In 2009, people were seeing more ptarmigans than in the past. Regarding beavers, people reported in 2009 they were seeing less beavers upriver. In 2014, people commented that there are a lot of beavers, and most felt that they are causing problems with salmon spawning and harvesting (because of dams), though one participant felt that silvers and reds will spawn in the dam areas and for that reason thought dams were not a concern.

"There's so many bears down the coast now. So many of them."
-Mildred Katongan

Changes Noticed with Birds
Cranes have changed their flight pattern starting 11-16 years ago because of the increased northwest wind driving them to take shortcuts. It was noted that cranes don't migrate until the end of September now, which is a big change of about two weeks from the past.

There were some indications of climate-related changes to birds, including arriving earlier and leaving later, and a possible increased presence of southern birds.

Seagulls can now be seen in November and December, which is also a change from the past.

Vegetation
People have noticed more tree growth on the tundra – evergreens, "never grow trees," tamaracks, and willows.

There have been less berries recently with the decrease in snow and the melting of permafrost. The increase in large storms with high water events which spill over onto the tundra is having an effect on berries as well because of the saline water.

Other, General, and Miscellaneous Comments about the Environment
A number of interviewees reported that they do not remember their Elders talking about environmental change.

There was a concern that increasing temperatures will go hand-in-hand with increased vessel traffic in the region which will be detrimental to the environment and the resources that people depend upon.

A number of interviewees spoke positively about the currently available technological and scientific developments in meteorology. It was noted that it can be useful for helping in the conduct of subsistence activities. Traditional means of using environmental signs for making weather and other predictions were also noted as being useful (e.g. predictions based on observations of conditions around Besboro Island).

"Interviewer: Do you remember your Elders ever telling you stories about changes they had seen in their lifetimes? BE: I was born in 1950, you know, maybe that's when the winters were normal, when I

was growing up, but now they're not normal. But they never really talked about the weather, my grandparents, or anything because when I was younger it was the same since they were born too. But now I probably say from the 1970s to present time, the weather patterns have changed, the temperatures have changed, the ocean has changed a little bit, the water level has come higher you know. And you're seeing more erosion especially on the ocean side, on the beach side. A lot of the, quite a few of the, banks along the, are starting to wash [away] when we have storms come. You can see the erosion along the beach side. "
-Benjamin Eakon

Regarding Culture, Society, and the Economy

Learning to Fish
People learned to fish by watching and participating in fishing-related activities, such as hanging fish, washing fish, feeding dogs, harvesting fish, and doing other camp duties. Many learned to cut fish when they were around 7 to 10 years of age. Learning the entire process involved in working with subsistence resources – e.g. including processing fish – is seen as a successful means by which to get young people involved and interested in subsistence activities.

The Importance of Salmon and Salmon Fishing
Salmon are seen as intimately connected with people's sense of selves, as a healthy food that is connected to physical well-being, as something which people have a taste for, and as something that is loved and felt to be important. People feel salmon is also important for financial reasons as well, be it for their cash value from commercial fishing (which is substantial to the livelihood of many people) or their ability to replace store bought food (which is expensive) in the local diet. People did note in general, however, that there has been a decrease in fishing and increased use of store foods. As one person noted, for example, when a fish rack upriver falls down or gets eroded into the river, it doesn't go back up. People have also noted the significant impact of decreased salmon populations on peoples' lives.

"[F]or me and our family subsistence is the most important, more than commercial fishing, even though commercial fishing has the economy money for that. For me it's more important that we have it for subsistence use to live, to live on, to eat, have something to eat that we're used to eating every year."
-Leila Eakon

Transportation, Fuel, and Costs
The cost of fuel, which has increased substantially, has a significant impact on both subsistence and commercial fishing. It is one of the main costs involved in these activities. People have to be watchful and conservative in how much they travel for subsistence activities. Some people stay closer to town for their subsistence activities in order to conserve fuel. This can make fishing even more difficult, as being successful can often depend upon having sufficient distance from others who are also fishing. Some stay at fish camp longer and do not go back and forth between camp and town so as to not use a lot of fuel. Some people have gotten more efficient motors to save gas. Some have curtailed or entirely stopped doing subsistence activities as a result of the increased prices, which leads to greater dependence on store foods. Some, however, have not been effected by higher fuel prices. In addition to the cost of fuel, the cost of equipment (e.g. motors, boats, etc.) itself is very difficult for some people to afford.

"Interviewer: How have the fuel prices effected you? LE: Very, very much because the price is so high, like you can't go very far on one tank of gas so we have to really conserve and pretty much stay close to the town so that we can go as many times as we can to get what's close by. Yeah, the prices really effected everybody I think."
-Leila Eakon

Jobs
Jobs are a double-edged sword for subsistence practitioners. While they provide cash necessary to make purchases people need to conduct subsistence activities (e.g. fuel, ammunition, etc.), they also significantly restrict the ability of people to go out to do these activities when and as often as they would like to.

Sharing
People share fish with others, particularly relatives and older people. People will share their first catch, young people share their catches with older people, and people will share their first king with everybody in small pieces. There is some indication that there is less sharing now than there was in the past; the decreases in fish populations and harvests contribute to this.

Commercial Fishing
People in Unalakleet do commercial and subsistence fishing for salmon. People also work in the fish plant. People commercial and subsistence fish both in the ocean and in the rivers/creeks. As noted earlier, the main commercial fishing now is for silvers. Large declines in kings and chums have affected their harvests, particularly in the case of kings.

Taste and Preferences
Less oily fish are preferred for drying. For pinks, this means males as compared to females. Chums which have already spawned are also preferable in this regard.

Young People, and Knowledge Sharing
There were conflicting opinions about the participation of youth in subsistence activities. More people indicated that youth are less involved in subsistence activities than in the past, though not all felt that way. People felt that it was up to parents to teach their children about subsistence activities and also to introduce them to the taste of subsistence foods, which is seen as important. There is a concern about how to get young people to enjoy and appreciate doing subsistence, to learn about what is available to them in this regard, and to learn how to do subsistence themselves as well. Many young people do not have a way to go out to do subsistence activities; additionally, some young people are not even familiar with the taste of subsistence foods. It was stated a number of times that once you are able to get young people involved in subsistence – participating in subsistence activities, eating subsistence foods, etc. - that they enjoy it and want to be involved more.

"Interviewer: Do you think that young people today are interested in learning how to fish? MK: I'm sure, like I work in bilingual/bicultural and there's some students that would love to learn. And some parents don't do it, that's the problem too. And one of the local staff teachers does subsistence, puts away subsistence food with his class and my co-worker and in the fall time we help him with butchering seal with the class. There's some students that love to do it. But they're just not taught at home."
-Mildred Katongan

Other Information on Human-Fish, Human-Animal, and Human-Environment Relationships
It was reported that Elders taught that fish and all animals should be respected. This includes not playing with fish, killing the fish immediately after removing it from a hook, respecting those who taught you how to take care of fish, never wasting, taking care of the food, and saving everything. People were also taught to only catch what you can take care of and can eat, to make use of everything you catch, and not to kill something for fun or sport. Some also expressed sentiments against the commercialization of fish.

"Just don't waste anything."
-Jerry Ivanoff

Cultural, Social, and Economic Change
Modernity-related social problems, such as problems with alcohol, crime, hunger, poverty, and the control of government, were a notable concern of a number of interviewees. Subsistence has also played a decreased role in peoples' everyday lives and people have become increasingly reliant on store-bought foods. Another major change is that people don't use fish for dog teams nearly as much anymore, which many feel is one factor negatively effecting king populations (as the decreased harvest of trout is leading to their increased predation of king salmon eggs, fry, and smolt).

"I'm telling you what I think the problem is, but do we have a solution? I don't see it. And that scares me 'cause I'm a hunter and I'm a fisherman first. I like my job here, I like what I do. Put people to work, provide scholarships, provide training, but the thing I'm most proud of is what my dad taught me. I'm a hunter, I'm a fisherman. In our lifestyle, it's not the person with the biggest pile of money, it was always the hunter that was able to catch and share. You know that was the measure of success. My dad taught me how to be a damn good hunter, and he taught me how to be a damn good fisherman and I'm proud of what I learned and that I'm able to pass that on. I just wish that these powers that be, whether it's international government and the national government, the state government, even the local folks, not waste our fish so that our kids can have the same things that we had."
-Jerry Ivanoff

Regarding Challenges, Management, Commercial Fishing, Sport Fishing, TK and Science, and Recommendations

Difficulties and Challenges
The following difficulties and challenges were noted by participants, in no particular order: the decline in salmon populations (particularly kings and chums, though people expressed concerns about the future of silvers); harvest closures and regulations; the limited entry system for commercial salmon and crab harvests; the price of fuel and subsistence-related equipment (e.g. motors, boats, etc.); the impact of jobs on limiting the how much and when people can do subsistence; rainier summers than in times past; the high number of commercial permits; the commercialization of fish in general (e.g. salmon bycatch in the pollock fishery, Area M/False Pass, foreign pirates); the increase in jellyfish; sport fishing activities; and mismanagement of fish in the Unalakleet area (e.g. fisheries remaining open during rough weather/water periods, too many permits being given out, etc.). Harvest opportunities have been hampered in multiple ways over the past several generations for a variety of reasons, e.g. because of changes in weather patterns, increased regulatory and enforcement activities, lower returns, etc. Additionally, as one participant noted, a number of factors which can be associated with modern society – particular forms of technology, the impacts of climate change, pollution, development, increased vessel traffic, the increased ability of outside people and interests to access local peoples'

traditional foods – are all of a great concern to local people for the security of their subsistence resources.

"Interviewer: Do you think salmon is still as important to people today as it has been in the past? LE: Yeah, I think even more so it seems. But subsistence living is becoming, has become so hard to even get by on with regulations, restrictions and the cost of store food is way, way extremely high out in rural Alaska and at same time it's also harder to gather because of the fuel prices also or just harder to get to where you need to go gather food and fish and I've seen, notice that change."
-Leila Eakon

Figure 28: Unalakleet salmon expert Theresa Nanouk and her daughter, Tribal Council member Jolene Nanouk.

Commercial Fishing

People in Unalakleet have a complex relationship with commercial fishing. On the one hand, there is significant concern about the negative effects of the commercialization of fish on fish resources. As noted elsewhere above, these forces have contributed to huge declines in king and chum salmon fish returns. Additionally, there is concern that while subsistence should be the harvest priority, it takes the brunt of regulation when there is a problem, as opposed to commercial fishing. On the other hand, the commercialization of fish provides an important source of income for many people in Unalakleet (mainly through commercial fishing but also through the fish plant as well as membership benefits

from the local CDQ organization). Some draw a distinction between large and small scale commercial fishing, with the former being a much greater area of concern. A number of people identified subsistence fishing as being the priority over commercial fishing, though it was also noted that without the income, subsistence fishing is more difficult, which places people in a bind.

"I think subsistence fishing is the most important thing and commercial is a distant second."
-A. Shane Johnson

"Outside forces are more interested in harvesting all marketable resources with the least amount of expense to the extractor. We live in, around, atop and with these resources – our interest is in their health viability and extent into future generations – just like our Elders, forefathers, ancestors and Creator has guided us to do for as long as we live – we are one part of the circle of life."
-Frances Degnan

TK and Western Science

Additionally, people also have a complex relationship with western science. On the one hand, it was noted that science has acted in collaboration with commercial interests and the law to take fish for commercial activities that were once just used for subsistence. It is thus complicit in the process of depleted stocks. However, others feel that western science holds the key to figuring out declining stocks, e.g. through genetic stock studies. Others point to the limits of science and management, noting that managers and scientists really don't know what's going on. There is also skepticism about the value of a number of studies that have been done, and concern that the studies are not translating into anything of practical value in terms of protecting fish stocks. People also point out that locals are an important source of knowledge (e.g. TK of the environment) given their experience in the natural environment.

People felt as well that there needs to be a greater collaboration and sharing of data between the state and the federal government in regards to salmon fisheries. It was suggested that there be a central place for information from state, federal, international, subsistence, and other data sources, all of which needs to be understood together to provide a whole picture of fisheries issues.

"[I]f we're not going to be fishermen, they're killing that particular source of life, then we'll be scientists. Local knowledge, like I told my Dad I have a degree from Stanford University, anybody can get that with 16 years of concentrated education. […] I told him the knowledge that you have is far more valuable than anything that I have gained in 16 years of education, as his knowledge is not written in any books. He possessed the oral tradition, knowledge passed down through generations, in our own language. I cannot speak my own language, so the oral tradition may be severed."
-Jerry Ivanoff

Management

In general there is concern, expressed in a variety of ways, about fish management in Unalakleet. Interviewees recognized a need for measures to be taken to help improve salmon returns – especially king – and to ensure the continuation of subsistence fishing into the future. The impacts of management measures – such as closures, permits, disparities between openings for ocean versus river fishing, and other regulations – were noted as being highly discontinuous with the fishing of the past. This system of management and regulation is seen by some as having a large social cost through decreasing or preventing entirely the participation of some people in harvest activities. Additionally, there was substantial concern about poor management. For example, people felt that closures should

take into account other relevant environmental factors, should appreciate the need for flexibility when it comes to subsistence, and should truly reflect a subsistence priority. Some examples of better management in these regards would include taking into account the inability to put fish away on rainy days (which are increasing in number), days with rough weather and ocean conditions, and days with high populations of jellyfish; the issuance of too many permits; and the seemingly non-existent enforcement of the activities of sport fishers. There was a sense that fishing could be managed better in ways that would benefit people's lives.

"[...] the fish counting is great, but what good is it if you're counting them until there's none, you know?"
-A. Shane Johnson

"Subsistence is a priority use of resources and the user must not be penalized/criminalized to put food on the table."
-Frances Degnan

Sport Fishing
Many people had problems with, or at least concerns about, sport fishing. The practice of catch and release was described as playing with fish and hurting fish. A number of people noted that catch and release kills fish, and thus is wasteful, including those who felt sport fishing was not as big a problem as others thought it was. People have seen evidence of this, as well as evidence of sport fishers not following rules and regulations (e.g. throwing salmon away into the brush). There is also a sense of uncertainty about just how many fish the sport fishers are catching. It was additionally noted that the sport fishers take the good spots for fishing, which forces local people to have to go elsewhere. Sport fishers (there are a few lodges nearby) are felt by some to enjoy special privileges, being able to fish more than locals and also not suffering the consequences of violating rules and regulations, even when they are reported to ADF&G by locals. The problem of special treatment becomes even more difficult to tolerate when taken in light of the fact that local people are punished for violations but sport fishers seem to not have enforcement of their actions.

Local or Traditional Rules of Management
A number of traditional practices are seen as being beneficial to fish resources. These include the harvest of trout for dog teams (which kept the trout population low, decreasing trout predation on king and chum eggs), not playing with or wasting fish and instead using them for food for humans and dogs, not taking more than is needed and using everything you catch, and not selling fish. Sharing and giving food to others is also a traditional practice, one which is still practiced today, is seen as central to traditional culture, and has strong connections to management ethics. For example, if people have more than they need, they will share or give it to others.

Some people have also implemented other forms of self-regulation in addition to those noted above. At a more community-wide level, many people have enforced restrictions on their own harvest of kings (including some people not harvesting any at all) in order to help king returns. Additionally, some also take care not to disturb salmon eggs with their boating activities.

"[A]t heart I think the whole town realizes that it needs to be done, everybody wants to save and preserve and grow what's lessened. We need to make it get back to what it used to be, so I think that's the feeling of most of the town, you can sacrifice, everybody take a part and sacrifice some of this so we can get more in return, and I think that's the general feeling and it doesn't bother me either, I share

that feeling too. Because I'd like to see before it's all gone or extinct, that we would lose ourselves, becoming a little extinct like that."
-Leila Eakon

Recommendations

The following recommendations can be derived from the collected data:

- Remedying the problems with declining fish stocks – particularly kings – should be considered of great importance by management bodies.
- There should be a true subsistence priority. It is felt that there is not a true priority in practice. Subsistence users rather than commercial interests are the first to feel the brunt when there is a problem.
- Salmon bycatch should be stopped.
- Better management practices are needed. Some important elements of this would be incorporating information about environmental factors as well as the need for flexibility when it comes to subsistence harvests into management decisions. For example, closing the fishery when the weather and water conditions are rough, and then opening them at another time when it is calm. This will help ensure people can get fish, not increase the overall open time, and will prevent waste when nets are left in the water during storms. Other examples include taking into account the presence of jellyfish in the water (which can make fishing impossible) as well as rainy conditions which can make putting away fish difficult or impossible.
- ADF&G should get a tighter grip on the actions of sport fishers. Also, many people have concerns about, and do not approve of, catch-and-release fishing. Additionally, it was the view that when one type of fishing for a species is closed, all should be closed. Currently, sport fishing is allowed to continue when subsistence and commercial fishing is closed, and this is seen as problematic.
- Greater collaboration between agencies is needed to deal with the problems of the commercialization of fish in order to bring the king populations back up.
- The pollock fishers should be paying for the hatcheries and studies via substantial fines on bycatch.
- Steps should be taken to address fishing piracy in international waters.
- Steps should be taken to decrease the negative impacts of the Area M fishery on fish returns for this region.
- This region should remain closed to bottom trawling.
- Steps should be taken to prevent negative impacts on the environment and subsistence resources resulting from increased vessel traffic in the region.
- ADF&G should support research into if and how changes to habitat and estuaries (both anthropogenic and non-anthropogenic) might be contributing to declines in salmon populations.
- There should be a central gathering point for all of the data pertaining to fisheries issues from the variety of interests involved in its use, e.g. traditional knowledge holders, various agencies, etc.
- The results of scientific studies – including previous studies – need to be returned to the tribes and communities they involved and affect.
- Scientists should consult with the Tribe on projects.
- Genetic stock studies of kings should be conducted.
- The impacts of icebreakers on the winter sea environment should be thoroughly researched and considered as something potentially important.
- Less wasting and smarter harvesting behavior by local people (e.g. taking in nets during rough

weather)
- More trout should be caught to help the chum and king stocks.
- People should receive training to do things other than commercial fish, in order to protect fish for subsistence.

Some people were also concerned about the activities of NSEDC, the regional CDQ, particularly in regard to their participation in the pollock fishery, with the export of local fish outside the region in exchange for what may be perceived as a small amount of money, and in the sense that people felt NSEDC should talk with the tribe when they are doing projects.

Wales

Wales is located approximately 110 miles northwest of Nome on the westernmost point of land on the Seward Peninsula, and is the westernmost city on the North American mainland. Wales has no road access to Nome and receives goods by air or by barge in the summer. The 2010 US Census indicates that Wales has a total population of 145, of those 82 are male and 63 are female (ADCCED 2015). Approximately 85% of the population is American Indian or Alaska Native (*ibid.*), primarily Inupiat Eskimo. Wales was formerly one of the largest villages in the region prior to contact with Euro-Americans.

Regarding King (Chinook) Salmon

People in Wales hardly see any kings in their area. The kings that people are getting – which are few – may be smaller now than in times past.

Regarding Silver (Coho) Salmon

Silver runs are happening earlier than in the past. Silvers now start to run around mid-July, but in the past they used to start from the end of July running through to the end of August.

"The kings and the chum and the reds are the first to come, then humpies; the last are the silvers, that is about mid-July now."
-Kelly Anungazuk

Regarding Pink (Humpy) Salmon

In 2008, a large number of pinks went up Village Creek, and also spawned in the creek, traveling all the way up to the head of the creek. This was reported by a number of people as being the first time that pinks had gone into that creek, at least in the lifetimes of interviewees, though some noted that in the past some other fish (other than pinks) had gone up the creek in small numbers. Pinks have not used that creek again between 2008 and 2014. There were originally concerns that the 2008 run would affect the drinking water, and people reported that the water smelled fishy, but it did not end up being a problem. People, including children, harvested pinks that summer using rod and reel. Pinks are also reported as regularly going up the York River. Most people get their pink salmon, however, by setting nets off the beach in front of the village.

"And then first time in my life humpies went into the creek [Village Creek]."
-Faye Ongtowasruk

Regarding Red (Sockeye) Salmon

Wales gets very few red salmon coming through the area and also harvests very few.

Regarding Chum (Dog) Salmon

In 2008 people reported that not many chums come to the Wales area, and that they did not harvest many. In 2014, though, people noted that chums, silvers and pinks were the main salmon species harvested in Wales. However, it was not noted that there were greater harvests of them than in the past,

so it is difficult to say if harvests of chums have increased, or if this simply reflects the very low amount of kings and reds which migrate through – and are harvested in – Wales. One participant noted that in the past, only smaller mesh size nets were available, and only recently are larger mesh size nets available; this may help account for an increase in chum harvests if there has been one.

Figure 29: The shoreline in front of Wales.

Regarding Salmon in General

General comments about salmon in general

People reported in 2008 that they had not seen unhealthy fish, any changes to the health of fish, fish with lesions or sores, fish with net marks or damaged fins, and only very rarely a dead salmon on the beach was reported as being seen. A few salmon were noted as having tapeworms, but it was stated that these can be pulled out and the fish still dried. The only out of the ordinary thing which was reported with regard to salmon was that in 2008 pinks went into Village Creek, as noted earlier. However, in 2014 some people noted that they were seeing more parasites coming out of the fish they were catching. One person also noted that some of their fish have skin missing in spots.

Comments about the biology and behavior of salmon in general

In 2008, people reported that the size of salmon seems to be the same as it had been in the past. However, in 2014 it was noted that this was true of all salmon species except for kings, which were noted as being smaller than in the past.

Comments about the population of salmon in general

All five species of salmon visit Wales. However, on the whole not many salmon come to the Wales

area. Most interviewees stated that there were more salmon in the Wales area now than when they were younger, though not all participants agreed, and it does not appear to hold steady for all different species of salmon. One Elder reported that getting salmon at all at Wales was a change from times past. Some people bought fish, at least in the past, from people in Teller, because Wales itself doesn't get many fish.

"I think they [salmon populations] have gone up a little bit than when we were growing up 'cause we can share, you know, to people who don't have fish net."
-Lenora Sereadlook

Comments about the distribution of salmon in general
The sequence of salmon runs in Wales is as follows: kings, chums, reds, pinks, silvers. Twenty to thirty years ago, the first salmon would arrive in the Wales area around July 4th, but now they arrive around June 20th or a little after. It was noted that not only do salmon spawn at Rocky Island, Anikovik River, Grouse Creek, and York River, but that there have also been more salmon at these locations starting around 10 years ago. As noted previously, in 2008 pinks went up Village Creek, and this was reported as the first time salmon had ever been in that creek in the lifetimes of interviewees. Other than that, fish have not been seen moving into any new creeks.

Comments about the harvest of salmon in general
Comparatively speaking, fewer people fish for salmon in Wales compared with many of the other communities involved in this project. The amount of harvest amongst fishers ranges fairly widely as well, from a dozen to several hundred. For some people whose main subsistence activities lie elsewhere, they will only fish when they get the available time. People now start harvesting salmon a little after June 20th in accordance with the earlier run timing (noted above). People restrict their setting of nets to times when the weather is not rough. People used nets of varying length. People used the same net for all species of salmon. As mentioned further above, one participant noted that in the past only smaller mesh size nets were available, whereas only recently larger mesh size nets have become available to people. People will switch to a smaller mesh net at the end of August for harvesting whitefish. In general people do not go to fish camp so much as setting a net and checking on it. In addition to set nets, people also fish by rod and reel. Chums, silvers, and pinks are the main salmon species harvested by people in Wales.

"Only about maybe five or six [families] did the fishing during the summertime when I was growing up, but there's more now."
-Kelly Anungazuk

Regarding the Preparation and Use of Salmon

People in Wales identified the following ways of putting away and preparing salmon: drying, half-drying, boiling, frying, freezing (including eating frozen, with or without seal oil).

Some felt that it is quite difficult to dry fish in Wales due to an abundance of rain and wind-blown sand. People use drying racks for drying fish; some have fish racks in town, while others have them at camp.

Fish are used for a variety of things. The first is for direct consumption by the fisher and their family, such as being put away for use in the winter, or for consumption while at camp. Additionally, people share fish with others, such as Elders, people who don't have a net, and others in need. People also

trade or barter for fish with people in villages that have higher harvests. In the past some people used to use fish for feeding their dog teams (dog teams were also fed using other wild meat). People reported not eating or feeding to dogs fish that looked skinny because that was a sign they were unhealthy, and it was felt it would make them or their dogs sick.

"We put away half-dried fish. But I don't like to dry them real much, I like to eat them half-dried or frozen or cooked, you know boiled. Quaq 'em, frozen, eat 'em frozen with seal oil."
-Lenora Sereadlook

Regarding the Environment

Rain

People reported during the 2008 interviews that several times in the recently preceding years they had started to get rain and sleet in January. The phenomena of increasing rainfall events in the winter as opposed to times past was again noted in 2014 as being an ongoing issue. It was also reported that it is difficult to dry fish in Wales owing to the abundance of rain they receive (in addition to wind-blown sand). Too much rain was also noted to be bad for berries as well.

"See, we had a few times we had rain in January for past few years that's one thing I notice, January, sleet."
-Clyde Ongtowasruk, Sr.

Snow

Snowfall amounts and timing were reported to be variable from year to year. However, a number of project participants noted that snow banks used to be much higher in the village in times past than they are now, and that snowfalls are too low, at least in more recent times.

Wind

People had differing opinions about the strength of the wind. Some felt that it was stronger now than it used to be in the past, while others hadn't noticed a change in wind strength over time. In terms of wind directionality, it was felt that the wind is still coming from the same directions as it had in the past. North and northeast winds were identified as being the most favorable wind conditions for setting nets for fishing.

"Got to be north wind to set up our nets up there on the shoreline."
-Faye Ongtowasruk

Storms

There was some indication that there are more storms now in the Wales area than there used to be in the past, though the data are inconclusive on this.

Climate/Weather Unpredictability and Variability

Interviewees noted that there is a greater degree of variability and/or unpredictability in the weather now than there was in the past. One notable aspect of this change is that the weather does not hold steady as it used to, and it changes more quickly than in the past. The impacts of this are seen and felt in a number of ways, such as in decreased windows for walrus hunting and increased danger during hunting activities, decreased ability to predict the weather as Elders did in the past, and more frequent changes to wind conditions and concomitantly ice conditions. Interestingly, while the changes outlined

in this section were noted by interviewees in 2008 (as well as in 2014), in 2014 workshop participants also noted increased weather unpredictability and variability (including speed of change), noting that a marked shift had occurred somewhere around 2008-2010, thus potentially indicating an increased rate of changes being seen on these fronts.

"Lot of weather doesn't stay steady too much. You know? Doesn't stay steady too much anymore."
-Clyde Ongtowasruk, Sr.

Temperature
The vast majority of those commenting on the matter felt that winters are warmer now than they used to be when they were growing up. It was also noted that the water temperature of the ocean and creeks is warmer than it used to be.

Other or General Comments about Climate and Weather
It was noted that the weather has changed significantly since times past. People felt that the weather now is worse than it used to be when they were younger.

Ice
Interviewees felt that breakup is occurring earlier than it used to. In recent times, breakup has been occurring at the end of May or the first part of June, but it used to occur around mid June, about 1-2 weeks before salmon started coming in. It was noted that breakup will come early if the ice is weak. It was also noted that the inland creeks are breaking up earlier as well. Another recent change noted was that breakup is occurring quicker than in the past; the increasing occurrence of pack ice leaving soon after breakup, rather than taking a longer period to pass by compared to the past, was noted.

There was not enough information in the 2008 interviews to indicate whether there has been a changing trend with regard to freezeup. However, in 2014 it was indicated that since around 2006-2008 there had been a noticeable trend towards significantly later freezeups. One interviewee noted that freezeup should be occurring in October, but now seems to be occurring instead at the end of December or in January. In the winter of 2014-2015 there was open water and no ice very late at the time of this project's workshop on December 11, and open ice was noted in front of Wales even in January 2015. It was noted that the ice used to be very thick in the winter in the past, but that it is now thinner than it used to be, and seems to be getting thinner every year, and is not as solid now. People have also noted increased periods of mid-winter thaws; grass was even noticed growing in January of 2013.

Several participants noted that the salt content of the ice is decreasing as well, which is leading to quicker melting of the ice as well as a lower buoyancy.

A number of people noted that some currents are stronger now than in the past as well. One consequence of this is that combined with high winds, the ice can be taken out easier.

"In the past couple of years it [breakup] has been about first part of June or end of May."
-Kelly Anungazuk

Erosion and Water Levels
Interviewees noted that there has been a substantial amount of erosion in the Wales area during their lifetimes. This is resulting in changes to the shoreline (some of which is concerning during high water events in the fall) as well as to ponds, creeks, rivers, and the lagoon. The water is coming higher and

higher each year, closer to structures in town (particularly during storms and other high water events), which may be a result of both erosion as well as higher ocean water levels than in the past. It was noted that there is also erosion of the mountain which sits behind Wales; for example, it was stated that in one mountainous area near Wales it has been recently noticed that the thawing ground is allowing the water to drain away, and with this greens are no longer able to grow there as a result. Additionally, the permafrost melted in a nearby lake and it completely dried out approximately 7 years ago.

"Too much erosion, that's one thing I can say about everywhere."
-Clyde Ongtowasruk, Sr.

Figure 30: Wales drummers practicing.

Changes Regarding Other (Non-Salmon) Fish, or Fish in General

In general, it is felt that there are overall less fish now than there used to be; in particular, this is felt to be the case with whitefish and possibly also pink salmon. However, recently people have started to see more cigarfish, which hadn't been seen in a while, and there are indications, as noted above, that overall salmon may be higher in population than in the past (though not all agree with this), at least for particular species. Flounder and halibut populations might also be increasing as well.

Other Comments about Fish/Fishing in General

For a number of fishers, a significant amount of their catch is non-salmon fish. At certain locations and also at certain times of the year, people will focus on other fish. For example, some will switch to fishing whitefish after August from salmon fishing. Others focus on other fish besides salmon, such as

trout, dolly varden, flounder, tomcod, and whitefish (e.g. because this is what they fish for when camping, or because of the time of year they fish).

In comparison to a number of other villages involved in this project, there are not many fish being harvested in Wales. Some people in Wales will obtain fish from Teller, where people get more fish in general.

It was noted that no one in Wales goes crabbing anymore, which they used to do in the past.

Changes Noticed with Marine Mammals

People reported there being less polar bears around now – and less being harvested as well – than there used to be. Another changed that was noted was that people are starting to see sea lions, which they didn't used to see in the past. Unhealthy seals (including some being found with an oily substance on them) and walruses have also been reported being found recently.

"This year there's hardly any polar bear. First time in my life, you know."
-Faye Ongtowasruk

Changes Noticed with Land Animals

There are more brown bears now near Wales than there used to be. This has impacted some people – some people are concerned about going to camp as a result, and some have had cabins damaged by the bears. In general people in Wales don't hunt brown bears. There are more caribou coming to the area as well, particularly starting within the past 17 years. People noted that there are more squirrels in town than there used to be. Additionally, it was noted that muskox didn't used to come around in the past, but now there are a lot of them nearby.

"Then we got more squirrels in town. More than before. Too many."
-Pete Sereadlook

Changes Noticed with Birds

A decline in phalaropes was reported. This decline might also be resulting in an increase in mosquitoes. One interviewee felt that there was a general decline in birds, such as snipes, northern phalaropes, sparrows, and snowbirds, and suggested that ravens might be to blame (eating the eggs). Ravens are felt to be increasing, which is seen as potentially problematic (e.g. they eat or spoil hanging meat). People reported seeing unusual birds in more recent times as well.

"There are some [birds that haven't seen before] but, our birds are getting less. There's hardly any snipes and northern phalaropes, and the sparrows, snowbirds, they're not like before, I'm blaming the ravens, might be the blame."
-Faye Ongtowasruk

Vegetation

People harvest a wide variety of vegetation. This includes, for example, salmonberries, blackberries, blueberries, sourdock, wild onions, wild potatoes, and a number of different kinds of roots and greens. People are also starting to see willows coming into the area more and growing more densely and taller as well. In 2014 it was noted that edible greens are starting to grow larger than they used to in the past, and it was also noted that berries had decreased in abundance.

Other, General, and Miscellaneous Comments about the Environment
There is a concern in Wales about uranium (naturally occurring) in the water supply. People have also noticed loose debris (e.g. nets, buoys, empty bottles, nets, and trash) coming ashore from Russia, China, and Japan, significant amounts from the former two places. There was also a concern over whether Russians are dumping radioactive waste into the ocean.

Regarding Culture, Society, and the Economy

Learning to Fish
People reported learning to fish by watching and doing, and most, but not all, learned as a child from their parents.

"[I] learn[ed] how to [fish] by doing it, seeing people, my dad what he's doing."
-Kelly Anugazuk

The Importance of Salmon and Salmon Fishing
There is disagreement about the numbers of people and the frequency of their fishing, including any associated changes regarding this, within the lifetimes of participants. There aren't many fish in the Wales area comparatively speaking. The data is fairly inconclusive on whether people feel in general there are more fish – and salmon – now than in the past. Subsistence foods in general were felt to be very important and necessary. Some reasons that subsistence foods were felt to be crucial included the low income in the area as well as their importance in the event of starvation times. It was stated that people enjoy fish and it was clearly an important food for some residents. On the other hand, it was also noted that many people now rely on store-bought foods for a substantial portion of their diet, in particular the younger generations; some younger people also do not like the taste of subsistence foods.

"That's our living, subsistence, you know. We can't go without our Native food. That's how I am, my life."
-Faye Ontgowasruk

Transportation, Fuel, and Costs
Gas prices are high now. The cost of fuel is an impact to some peoples' fishing and subsistence activities, but not others. For those who noted its impact, however, the impact was felt to be substantial. Additionally, it was noted that fish nets also are quite expensive, and some people aren't able to fish because they do not own a net. The cost of store food is also very high. People noted that income is low in Wales and there is high unemployment, and people are also short on subsistence equipment in general, which makes obtaining subsistence foods difficult.

"Gas is outrageous right now and fuel is getting up too. Gas, it hurts, you know?"
-Lenora Sereadlook

Sharing
Sharing is something that was of traditional importance in Wales and is also still practiced today, and is considered to be a community value. People share with each other, and in particular with Elders and those who are in need. It was also noted that people from other communities share fish with people in Wales as well. Some people in Wales will help each other and pool resources and effort when fishing and distribute the products of their effort amongst each other.

"I like to share my food with anybody who's hungry."
-Lenora Sereadlook

Trading and Bartering

Some people in Wales will barter (e.g. using reindeer) or trade for fish from people in other communities. Dry fish are the most common fish bought from elsewhere, and most is from Brevig Mission and Teller. When people in Wales obtain sufficient fish, such as dry fish, for trading or bartering, they may also barter it with other communities which do not have many fish for other subsistence foods.

Figure 31: Lenora and Pete Sereadlook at a project workshop meeting in Wales. Photo: Joanne Keyes.

Young People, and Knowledge Sharing

It was felt that young people are not participating in subsistence activities, as well as related activities (e.g. helping Elders), as much as they did in the past. Modern technology, a lower number of Elders in Wales at the present, the prevalence of store-bought prepackaged food, and the role of bad weather were seen as some of the contributing factors to this. Nonetheless, it was felt that it is important that young people learn how to participate in subsistence activities, as well as other locally-valued activities (e.g. Eskimo dancing, carving, sewing and knitting, etc.). It was noted that if children are introduced to subsistence foods at an early age they will always enjoy those foods. However, it was also noted that more and more young people have not acquired a taste for these foods. There is a concern that young people do not want to learn about subsistence. Subsistence-related themes were prevalent in the advice people would give to youth if they could, such as sharing food, showing respect, eating Native foods, helping Elders, putting away as much as one can, and not overhunting.

"They've [young people] got to learn how to [practice subsistence]."
-Faye Ongtowasruk

Cultural, Social, and Economic Change
A number of subsistence-related cultural, social, and economic changes were noted by interviewees, including: 1) people no longer repair their nets, 2) there is now a lot of childhood obesity, 3) children do not play outside as much as they used to, 4) there are not as many group-oriented activities as in the past, though reindeer corralling is something people are still interested in, 5) food and gas prices are high now, 6) dog teams are no longer used, 7) skin boats have not been used in Wales for quite a while, 8) diets, and dietary preferences for some, have changed significantly, shifting more towards store-bought foods, 9) the younger generation does not have as much knowledge about subsistence-related and self-reliance issues as in the past, 10) there are less Elders now than there used to be, which has negative social effects, 11) money has become very influential in peoples' lives, too much so in the views of some.

"My younger days was lot better than now. 'Cause of there was more Elders and they tell you what to do and what not to do."
-Lenora Sereadlook

Regarding Challenges, Management, and Recommendations

Difficulties and Challenges
The price of gas, food, and equipment (e.g. nets), the deleterious impact of external game management, increased ocean vessel traffic and dumping, and the negative changes in the weather were identified as major difficulties and challenges for peoples' subsistence activities and lifeways in Wales. Residents are also concerned about the possibility of increased commercial fishing activities in the area. They have observed what appear to be commercial fishing vessels offshore (these may be fishing vessels that have been conducting trawl research).

Management
There is a general sense of unease surrounding external management of subsistence resources in Wales. One interviewee noted that they hoped ADF&G didn't start in the future to apply its regulations to their area for fishing, particularly those regarding specific times for allowing harvest, given the very weather-dependent nature of when people can set nets in Wales. Additionally, people are wary of conducting subsistence activities for marine mammals because of the enforcement activities of the US Fish and Wildlife Service, which some noted as being ignorant of the safety concerns people have in light of changing environmental conditions during hunting.

"Hunger knows no law."
-Gilbert Oxereok

Local or Traditional Rules of Management
It was felt that people in Wales are able to sufficiently self-regulate themselves with regard to subsistence activities and get what they need. While "hunger knows no law," as one workshop participant noted, people also understand the need to conserve. People stated that they get what they need but that they do not overharvest. Additionally, sharing was noted as an important local practice. For example, it was stated that people need fish to get through to the next fishing season, and if they do

get a lot of fish, they will give it away to others.

"I share my food a lot with people that don't have fish net."
-Lenora Sereadlook

Figure 32: A fish net in Wales.

Recommendations

Greater local sovereignty over managing subsistence activities, external management that is better informed on the realities of hunting (including safety concerns and environmental factors), greater presence of local advisors and observers to and of management bodies and their meetings, managers allocating time during their meetings specifically to tribal concerns are some general management-related recommendations which could be taken from the gathered data. An end to what is perceived as excessive oversight of walrus harvesting in the community is also desired.

There is a desire for greater and easier access by locals to the information produced in scientific and management meetings. Additionally, it is preferred that managers and policymakers do very thorough research before making decisions which impact subsistence activities.

People were concerned about the activities of research vessels, especially being wary of commerce being undertaken under the guise of research. One important recommendation then would be for greater collaboration between researchers and the community, a strict division of commercial goals and interests from research-related activities, observers being placed on research vessels, and a greater verifiable documentation of the activities which are conducted on these vessels.

There are concerns about commercial fishing in the region, and as such, any changes to commercial fishing activities which would impact the Wales area should take into account the concerns of Wales people.

There is a concern about introduced species. It was noted that introduced species, such as reindeer and muskox, are the most environmentally destructive, and it was recommended that there not be any further introduction of large game animals to the area.

The activities of vessel traffic passing through the area should be strictly monitored and regulated, for example to prevent destructive and illegal dumping. There is also a concern about debris that washes up on shore in Wales. Steps should be taken to document the sources of this debris and to minimize and mitigate it and its environmental impacts.

A greater effort should be made to have Native teachers in the schools, and steps should be taken to encourage a greater integration of learning about aspects of Native culture and lifeways in the local school. There was also a desire to see a greater inclusion of young people in meetings being held in the village which pertain to subsistence activities and resources.

People felt that there would be a value in a community workshop where a knowledgeable person or people instruct people how to smoke fish and also how to repair subsistence-related items such as fish nets.

There is concern about farmed fish. Any proposed introductions of hatchery fish to the area should be heavily studied and involve strong consultation with the community.

More research on recently observed sick and oiled marine mammals was seen as important.

White Mountain

White Mountain is located approximately 65 miles east of Nome on the Fish River. The community has no road access to Nome and receives goods by air or by barge in the summer. The 2010 US Census indicates that White Mountain has a total population of 190, of those109 are male and 81 are female (ADCCED 2015). Approximately 82% of the population is American Indian or Alaska Native (*ibid.*), primarily Inupiat Eskimo. Gold mining in the early 1900s influenced White Mountain and other nearby communities.

Regarding King (Chinook) Salmon

General comments about king salmon

The Tribe in White Mountain currently has a State grant for king salmon rehabilitation work. This involves planting eggs up the river to see if they result in returns. This past year they planted silver eggs because they weren't able to get female kings to produce king eggs. NSEDC is working with the Tribe on the undertaking. People would welcome higher king returns on the Fish River; the majority of people on the Tribal Council, when asked (by NSEDC) what fish they would prefer to have more of, chose kings, with silvers as a second choice. People are hoping to eventually get an incubator in the village to incubate eggs.

Comments about king salmon distribution

Kings will go up Fish River. King salmon numbers may have started noticeably increasing about 10 years ago. They are typically mixed in with the chums during their run. People usually only get one or two in a season, but it seems like every summer people are getting more.

Comments about king salmon population

The king population in the Fish River area is small, and while there is variability, it is slowly increasing as time goes on. People did report catching them in very small numbers at least as far back as the 1950s.

It was noted that in 2013 while the Yukon River was low on kings, in White Mountain and Elim they got more than usual.

People have been seeing jack kings since around 2005. They are seen once in a while.

Comments about the harvest of king salmon

People will often only catch a few kings per season; some people have never caught a king. Despite this, people have observed that there are more kings in the river than when they were younger.

"WA: We are getting more king salmon. […] So seems like every summer we're getting more. The ones we have here in the river aren't as big as they get in Anchorage but they're still king salmon. Interviewer: Are kings something that people try and catch, or is it just if you happen to catch one then that's good? WA: Yeah if we happen to catch one, my son will go out and use rod and reel and aim for king salmon. Some summers we're just getting more king salmon in the river."
-Willa Ashenfelter

Regarding Silver (Coho) Salmon

General comments about silver salmon
Silvers are a popular and preferred fish.

There is a concern about catch-and-release sport fishing of silvers causing them to die.

White Mountain selected silvers this past year as the focus for a rehabilitation project.

Figure 33: The village of White Mountain.

Comments about silver salmon distribution
Silvers are in the White Mountain area in July. They are coming earlier than in the past – arriving at the end of July instead of August. It was also noted that silvers are found in the White Mountain area when berries are ripe. There is some indication that they seem to come at different times every year, sometimes early, sometimes late, and that this may be related to environmental changes.

Silvers will go up the Fish River as well as into the small streams that are tributaries of that river. Beavers can clog those up, and are cutting off some of the spawning areas. Silvers can go up multiple creeks, and don't necessarily stay in the same area when they go up a river. It was stated that they can be found in any of the tributaries. It was also noted that with recent high water, silvers have been going further upriver than they would otherwise.

"And every year, too, the silvers come at a different time it seems like. Some early some years other

years none."
-Rita Buck

Comments about silver salmon population
The silver population appears to change every year, but overall seems to be doing acceptably well. In general it is felt that there are not a lot of silvers that come to the area.

Comments about the harvest of silver salmon
Silvers may not be available for harvest at upriver camps until August. They can be harvested in other locations earlier (see distribution, above). People by and large harvest silvers in August.

Some people will go to rod-and-reel for silvers up the Klokerblok River in August.

It was noted that once in a while someone will catch a silver through the ice, but that this is rare.

In 2008 it was reported that regulations on silver harvest have been imposed by ADF&G in certain years, which has made it less appealing to fish for them (i.e. not worth the effort in some peoples' opinions). By 2014 however people felt that they were getting enough silvers to make it worth harvesting them.

"Yeah, well I don't notice any change in their [silver] population. It usually seems like every fall about this time we get about the same amount of silvers."
-Robert Lincoln

Regarding Pink (Humpy) Salmon

General comments about pink salmon
People throw the pinks they get that have worms back into the river or throw them away. In the summer of 2008 there may have been more issues with worms for pinks then in the past, as well as a white pus coming out of some backbones when they were opened up.

A variability to pinks has been noted as a more recent characteristic for the species. The run timing, run populations, and places they can be found for harvest were noted as now being variable.

"Interviewer: Do you think that the health of the salmon has changed at all over your lifetime? RB: I think so. There could be changes yeah but this summer seems like there was more. We went up first of July to go fish and a lot of pinks had tapeworms in them. I don't know, maybe in one sitting when we were cutting fish we threw away like five because they had worms. I mean you don't just see worms, you open the backbone and then there's just white stuff coming out. That was kind of different. Interviewer: Like full of pus? RB: Mmm hmm, I never saw that before. I mean, there used to always be tapeworms, we'd throw those back in or throw them away. But there was more this time with white milky stuff in the back."
-Rita Buck

Comments about pink salmon biology and behavior
It was reported that pinks are on an even/odd year cycle. Some years you will get mostly pinks, some years chums. 2008 was reported to be a strange year for pinks: they were very silver in color when they first arrived, and people expected them to be very fat because the first ones are always very oily

when you dry them. However, they weren't that fat. It then started to rain and many of the pinks that came in were very purple in color, and the meat was white; when pinks get big, they look very purple. They are less fatty and they dry very quickly.

One interviewee reported that her mother had told her you can tell the first run of pinks are coming in because you can grab them by their tails; during the second run, the tails are thinner and they slip through when you try to grab them. The second run consists of smaller-sized fish.

It was stated that pinks lay their eggs in swift, shallow spots of the river.

"[B]when I used to camp with my mother in-law here at Nilqlipaq, she used to always say you know the first pinks when they come their tails you can grasp them real easy. But the second run their tails are thinner and every time you try to grab them they just slip right through."
-Rita Buck

Comments about pink salmon distribution
The timing of the pink run used to be very predictable, to the day, but this is no longer the case. It is much less predictable now. Additionally, some people have difficulty finding pinks in some years, and have had to dry different spots along the river.

There are two pink runs, the only salmon species coming to White Mountain with multiple pulses. It was reported that the first run can now start as early as late June. In the past, it used to start in either early or mid July. The second run used to be in late July, but is now between the middle and end of August.

Pinks were late in 2013. It then started to rain, and people weren't able to catch much once they arrived.

It was also noted that usually the run sequence is pinks then chums, but in 2007 and 2008 they came together, and it seemed as of 2009 that they were becoming just one run now, and there weren't as many pinks as before. In 2014 it was also reported that the runs used to be distinct but that they are now appearing to be more mixed together. They are found in the river at the same time and you have to look for where to seine to get what you want. However, this is not necessarily the case every year.

"[U]sually the humpies come first, then the [chum] salmon. […] But now, it seems like they're just one run now. Yep, and not as many."
-Robert Lincoln

Comments about pink salmon population
Some say the pink population has remained steady, some say it has been very variable, and some say it has increased during certain years. For example, in 2008, some reported that there were 'too many' pinks; at other times there have been very few. In 2014 the variability of the run populations was also still highlighted.

"I'm mostly concerned about the inconsistency of the times they come in. And the amount, like we have too many this year, it seems like. Now there are times when we hardly see any. But there hasn't, I've seen one or two years where we've hardly seen any humpies […]."
-Karl Ashenfelter

Comments about the harvest of pink salmon
Pink salmon is a preferred food for White Mountain people and they are considered to be good fish for drying. They are preferred for drying, and if there are not enough of them, people will harvest chums (which are not preferred because they are large and very oily, making them difficult to dry). It was noted however that this was simply a preference, and that other communities prefer oily fish.

Run timing is inconsistent, in general, but has also been happening earlier in some years (see above). Upriver fishing for pinks is often the most successful. Sometimes people with camps further downriver have to go upriver to catch their pinks; this occurs occasionally, but was done more in the past.

As noted above, the pink and chum runs are now often mixed together. As they are found in the river at the same time, people have to look for where to seine to get what they want. This is not the case every year, however.

It was noted that some people will put live female pinks back in the river when there are too many in their harvest. One should cut pinks very quickly before they get soft. Some people will throw females back in because they are small anyway, also in the hopes that they will go upriver and spawn and ensure more will return in the future. Then people will just focus on the males. People who do this will only throw back those that are alive, so that there is no waste.

"Interviewer: Is there any particular salmon species that you target? KA: Yeah, humpies, I like, most of us like dried humpies. They taste so much better. And ah, dog salmon, that's why they call them dog salmon I guess, feed them to the dogs. They're alright. When you're starving for dried fish they're good."
-Karl Ashenfelter

"Well, we prefer the pink salmon for drying. And if there's no pink salmon, then we go after dogs [chums]. And the dogs are a lot harder to dry, they're big and some of them get real oily. And you never know how they're going to turn out, you just have to take good care of them. Hope it's not rainy."
-Rita Buck

Regarding Red (Sockeye) Salmon

The White Mountain area does not get many red salmon. It is rare to see them in Fish River, and correspondingly, people rarely catch them. People eat red salmon fresh because they get so few of them. People wish they had more reds because they think they taste good.

"[O]nce in a while we catch red salmon, it's not very often. Last year I think we got, we must've got about four or five. I didn't notice any this year."
-Robert Lincoln

Regarding Chum (Dog) Salmon

General comments about chum salmon
Some participants discussed hearing stories about a major climatic even related to salmon. It was stated that one time that there was once two winters in a row. During this time, people were catching chums through the ice up on the Fish River because it didn't thaw. It was reported that this might have

been in the 1800s.

Some people refer to chum salmon simply as 'salmon'.

"Papa Punguk was from Golovin and said his parents told him that there was a time when they had two winters in a row. Up on the Fish River people were catching dog salmon through the ice because it didn't thaw."
-Rita Buck

Comments about chum salmon biology and behavior
It was reported that some years you will get mostly pinks, some years chums. It was also noted that one possible pattern with chums is that the more there are in the run, the smaller they are (and the reverse), and that this has something to do with the amount of food the fish have available to eat.

Comments about chum salmon distribution
Chums go up the Fish River, the Niukluk River, and Cache Creek.

As noted in the section on Pink salmon, normally the order of the runs is pinks then chums, but it was reported that in 2007 and 2008 they came together, appearing to be like one run now. In 2014 it was also reported that the runs used to be distinct but that they are now appearing to be more mixed together. They are found in the river at the same time and you have to look for where to seine to get what you want. However, this is not necessarily the case every year.

It was noted that by the time silvers arrive, chums are getting old.

Comments about chum salmon population
As noted above, people reported a cyclical nature to salmon returns, with some years having mostly pinks and others mostly chums.

There are varying opinions about whether the chum population has stayed the same, increased, or decreased over time. It was also noted that this is somewhat hard to tell as well because people aren't targeting them as much as they used to because of the decline in the use of dogs, and are currently targeting pinks more.

"Interviewer: Do you think that the number of the different kinds of salmon has changed, if there's more or less than when you were growing up? RB: I think the dog salmon might be less. Back then there was lots, even pink salmon. Ever year seems like the dogs are getting less. Maybe not so much the pinks, I don't know, it's just different every other year. There was one year there was no pinks at all and you know it's kind of tough because nobody likes to dry dog salmon, they're so, they're too big. Interviewer: Was there a particular time when you started to notice there were maybe less of them? RB: Probably late 70s."
-Rita Buck

Comments about the harvest of chum salmon
As noted above, the chum and pink runs are now often mixed together. As they are found in the river at the same time, people have to look for where to seine to get what they want. This is not the case every year, however.

People look at the weather to predict when it will rain, so they are not out harvesting fish when it rains given the difficulty it presents for drying fish. This is particularly relevant for harvesting chums, because they are difficult to dry anyway, particularly if it rains, and people do not want to waste fish.

People put away a lot fewer chums now in the past, mostly because they no longer need them for dog teams. People used to harvest a lot of chums for dog food. Compared to pinks they are not a preferred food for human consumption, though they are used for that now and were in the past; they also have a long history as a food for dogs. Also, people would eat the good chums and feed the ones that had turned bad to the dogs. Restrictions on chum harvests have, in accordance with the above factors, not really impacted White Mountain, particularly because they have had plenty of pinks.

"Right across from the camp is where they used to seine, they always caught dog salmon. If they wanted pinks they had to go farther upriver and back, but they didn't have the gas to go looking for it, so we always seined right across, and the majority of the fish were dog salmon, and they were huge."
-Rita Buck

Figure 34: A fish camp at the mouth of the Niukluk River. Photo: Carrie M. McLain Memorial Museum, Nome, Alaska. Accession number Swanberg-860.

Regarding Salmon in General

General comments about salmon in general
Interviewees have noticed salmon with tapeworms as well as salmon with pus (in bumps, as well as

inside the fish). Some appeared to feel these were becoming an increasing problem in more recent times, with the pus problem first being observed around 20 years ago and the tapeworms being found in possibly larger amounts in more recent times as compared to when people were growing up. The milky white substance some have noted in salmon may be associated with tapeworms. People also notice lesions on fish as well as scars from nets and other animals, but these were not noted as health problems. Fish with a lot of worms are thrown back into the river. Fish with lesions are also usually thrown back in. There is some concern about whether throwing back fish with worms will lead to other fish getting worms as well.

The two most important salmon species for White Mountain are pinks and chums. Pinks are preferred for drying because they are smaller and less oily. Historically chums were preferred for dog food. However, people will eat either kind.

In terms of the changes noticed with salmon populations, people identified two time periods as being significant markers in this history for when changes occurred – one is when commercial fishing began to have impacts, and the other is in the 1980s (the latter of course also being likely related to the impacts of commercial fishing at least in part as well).

Comments about the biology and behavior of salmon in general

Salmon sizes do not appear to have changed over time. The color and texture of fish meat hasn't changed either.

Less fatty/oily fish dry quicker. The first fish that come in are generally fattier/oilier.

Comments about the distribution of salmon in general

The main trend in the data seemed to indicate the view that runs are beginning earlier, and have become inconsistent in their timing as compared to the past. It was stated that in general they are coming in early, though sometimes late, and that inconsistency has become more commonplace. This inconsistency is seen as historically abnormal; one used to be able to predict to the day when a particular species would arrive. The sequence of runs is now also inconsistent. For example, there was some indication in 2008 that the pink and chum runs had recently begun to run together. It was postulated that the run timing may be inconsistent because salmon depend on the temperature of the water, and when it is right they will come up, so changes in temperature could change the run timing.

It was also noted that in some years it seems like the salmon are hard to find, and this is a change form times past. A long time ago there were lots of fish and there were always fish.

Salmon will spawn along most if not all of the Fish River. They will spawn far up the Fish River and its tributaries. They lay their eggs in the swift, shallow spots of the river. Beavers may be a problem in spawning locations.

Salmon can be found on the Fish, Niukluk, Klokerblok, Council, and maybe Fox Rivers. They do not appear to be going into new areas that they haven't used to in the past. Some interviewees indicated that when salmon were not found in their usual places, they might be found by going upriver or downriver. It was also noted that salmon don't necessarily stay up the same river that they go up, they may travel to other areas also.

"HL: And we have another river over here, Klokerblok, we have fish go up there but nobody goes over

there and does fish counting or anything. […] There's fish that go up that river. Pretty soon people will go up there and fish for, rod and reel for silver salmon when they get a little thick or make a run."
-Howard Lincoln

Comments about the population of salmon in general

There is a difference of opinion about salmon populations over time. Several people indicated there are less fish now as well as greater variability in runs from year to year, and one person indicated that it seemed like other than kings (which are coming in greater numbers now), the population of the salmon species seemed to be about the same as in times past. In general however people feel there are less salmon now than in the past. As one participant noted, when growing up at camp, people never had to worry, there were always fish there, and the boat was always full; there were no high or low years, the fish were just always there. The inconsistency in run timing and size may be due to water temperatures and the impacts of commercial fishing elsewhere (e.g. False Pass and the pollock trawling fishery). Until 2014 there was only a fish counting station on the Niukluk River, but not the Fish River; in 2014 this station was moved to the Fish River. There are no fish counting stations on the Klokerblok River.

When some of the experts interviewed were young, there were so many fish in the river that it would run black. After the fish went upriver and spawned, all of the dead fish would come downriver and get caught in the bends, piling up in White Mountain because there was no current to wash them out.

It was noted that even if it's a good year with high salmon returns, the weather might not cooperate. Additionally, it is difficult to plan around work when trying to take into account the weather.

There were some other factors which were identified that could be having an impact on fish populations. Beavers may be a problem where fish spawn. Far up past Cache Creek there are a lot of beaver lodges. It was felt that ADF&G has not assessed beaver impacts to salmon spawning. Another potential impact identified (though only by one interviewee) was that of boats with jet units and the possibility that they have an effect on eggs and spawning in shallow waters.

"[A]t the time [when he was a boy at fish camp], there was so much fish the river was just running, running black. And after the fish go upriver and spawn all the dead fish would come downriver and kind of, kind of bury themselves around the bends. But usually they would pile up right in the village of White Mountain because there's no current there to wash them out. I remember one summer just to go to our boat we had to pack along a shovel just to clear the way down to the boat."
-Robert Lincoln

Comments about the harvest of salmon in general

Salmon run timing has changed, and accordingly so has salmon harvest timing. People have to be careful not to wait lest they lose out on harvest opportunities. July 4th was a marker date for many people as when many would start salmon fishing. Salmon can now be harvested in June. They often come earlier than they used to (though this is not necessarily consistent), starting about 25 years ago.

Feeding one's dogs used to be a big factor driving how many salmon people put away. However, it does not play a large role now with the prevalence of snowmachines. In the past a family would get thousands of salmon a year, but now a total harvest of about 200 salmon for each family is a fair estimate of what people are getting each year, but with rain and other challenges sometimes people don't meet that number. If they get more, they would share a good deal.

Some people target certain salmon species, and some do not target any species and just take whatever gets caught in their nets. Pinks and chums are the main salmon targeted for harvest in White Mountain, with a preference for pinks. Sometimes people will move from their main fish camp to another camp or area just to fish for a particular species for a while.

Rain can impact people's salmon fishing activities negatively. People only go seining on days that they are know are good drying days.

Some people use fish camps that they have been to their whole lives, while some move on to other fish camps later in life. Many old fish camp sites have been abandoned. People used to do subsistence fishing on Cache Creek, but people don't fish there anymore. Local experts noted that if people wanted to, they could get enough salmon from in front of White Mountain to last through the winter. Some families used to fish for salmon right in front of White Mountain and dry the fish there as well. There used to be 4 or 5 nets in the river right in front of the village. In the past, the goal at fish camp was to get enough fish to last through the winter, for people and for dogs. People used to spend a lot more time at fish camp and harvest more in general in the past than they do today. There also aren't as many families going to fish camp anymore. Fish camp use to be a normal and regular part of life. Almost everyone used to leave the village in the summers to go to camp. Now, however, it is common to see more people in the village in the summer. People will sometimes get help at fish camp in the summer from others – relatives or other people they know – cutting fish.

Almost every house used to have a cache for storing fish, but now there's only one in all of White Mountain.

The price of fuel impacts some people's decisions about where to fish.

Sometimes people have to look around for all the fish they put away.

"Interviewer: How many do you think your family would put away in a summer? RB: Because we had dogs back then, over 1000, I would think. Because there would be a whole boat load when we'd go back up to bundle them and bring them back down."
-Rita Buck

Regarding the Preparation and Use of Salmon

Salmon are used for a variety of things. Their primary use is as food for people. They were used heavily for dog food in the past, though with the introduction of snowmachines, this particular usage of fish has decreased dramatically. Fish seen as unfit for human consumption in the past were also often fed to dogs. Fish are also used for trading, for example for foods that are less available, such as muktuk. Some people also sell and buy fish, but other people do not do that. People will share salmon that they harvest, for example with people who helped them cut fish, people who were not able to go to fish camp because of work, or at gatherings.

A number of methods for processing, caring for, and storing salmon were identified. This includes drying, freezing, making 'stinkheads', salting silver salmon, pickling silvers, cooking salmon stomachs and heads, boiling, frying, baking, and half-drying and then boiling or baking. For drying fish, it was noted that you need a period of rain-free weather to do this, at least 3-4 days of sunshine. Very hot weather can also be a hindrance for drying fish; people won't dry fish on very hot days because it will

cook the fish. To make 'stinkheads', people put the fish heads and eggs in a fermentation hole (the precise method by which this is done is very important to ensure people do not get sick). Fish are inspected for problems before and during processing to determine whether they should be kept for human consumption. Fish with worms are thrown back in the river or thrown away, fish with pus or sores are thrown away, and fish with large scars or lesions are thrown back in but if they aren't too large they will be kept.

Tasks at fish camp for people, including children, include cutting up and hanging fish, taking care of fish (e.g. when it rains), bundling up fish, feeding dogs, carrying water, chopping wood, and helping with seining and hauling fish. Men and women are involved in catching and cutting up fish. Women are often more involved in cutting up fish than men. There used to be a technique used for putting fish away that entailed stringing fish on a willow branch in order to count and keep track so as to divide them up equally. As part of this process, they were also cut up in a special way. It was also noted that people used fish caches more in the past than they do now.

It was stated that there are techniques used for keeping flies away from your fish when they are on a fish rack. Two examples given were: 1) starting a fire under the rack to use the smoke to get rid of the flies, and 2) getting a large cookie sheet and putting a little water with some dish soap in it, and putting a rack over that with some fish guts on it; the flies will die in the water.

"You gotta remember we had about seven or eight dogs. They ate about half a fish day, we fed them half a fish a day, plus a piece of blubber. So during the winter, you're talking about from September, October, November, December, January, February, March, April, May, June. How many months is that ten months? See, I don't count, we fed them fish, you know fish heads at fish camp, cooked them all the bones, put them in a big tub and cooked also my dad throw some cornmeal in there and, we cooked dog food, during those periods where there was fish in the river. And the rest of the time we fed them, if it's dog salmon its half a fish a day. And we had to water them and feed them every day. Plus we ate fish, in the winter time, maybe two three times a week."
-Karl Ashenfelter

Regarding the Environment

Rain

Rain can prevent the successful harvest of salmon. You need 3 or 4 days of good sunshine and weather for fish to dry. This was never really a problem in the past, but it can be now. In the past, even if it rained during the fishing season, there would still be enough good weather to harvest and dry salmon. There were never problems of having it be so rainy during the summer that one wasn't able to dry any fish, but this happens now. It was also noted that when putting away chums, you never know how they will turn out, as they are harder to dry; you just have to take good care of them, and hope that it isn't too rainy. People will look at the forecast before going to fish to see if rain is coming. It was noted that August used to be a rainy month, but now it is hot in August, and July is now when most of the rain occurs. Additionally, it was noted that in the summer it rains a lot harder now than in the past. The weather has changed, is more inconsistent, and less predictable. The warm weather brings more inconsistencies, including perhaps more rain. Some people reported that there are also now periods where rain will melt away the snow during the winter, which is a change from the past. It was also noted that too much rain (or wind) at the beginning of a season can prevent salmonberries from growing well.

"You gotta have at least three or four days of good sunshine and weather for them to dry."
-Karl Ashenfelter

Figure 35: A fish rack under repair before the start of salmon runs on the banks of the Fish River near White Mountain at Willa Ashenfelter's camp.

Snow

Most participants felt that there is less snow now than there used to be. A greater inconsistency was also noted. White Mountain started to get less snow in the 1950s. They also don't have as many snowstorms and blizzards now as before; this change started perhaps a little over 15 years ago. Another change is that sometimes now there will not be any snow until December. Also, it was noted that in recent times, winter storms are coming from different directions than what was usual.

It was noted that Fish River water levels are different from year to year, depending on how much snow is received. In some years there is barely any snow, and the river is very low.

"You know when I was younger we used to have lot of snow. We used to have big snow banks. […] I was born in 1930, 31. In the 40s, we had a lot of snow in the 40s. But a few years later, like in the 50s seem like we started getting less and less snow."
-Howard Lincoln

Wind

Most people were of the view that south winds are the winds which usually bring bad weather. West winds bring good weather, east and south winds bring rain, and north winds bring cold.

Almost everyone felt that the strength of the winds has stayed the same. Wind patterns were also felt to be the same as in the past.

Climate/Weather Unpredictability and Variability
Most interviewees agreed that climate conditions are, in general, less predictable than in the past. Winter temperatures are more inconsistent. There used to be a lot more snow in the past, but now it is more unpredictable. There is some indication that the winds associated with particular weather patterns may also have more variability now.

It was also noted that people can't predict whether it will be a good year for salmon. Even if it's a good year in terms of returns, the weather might not cooperate. Compounded with the modern reality of having wage jobs, it is difficult to pick the right time to go fishing because of the difficulty of predicting the weather. Sometimes people will share food with those who have job situations such as those.

"Our weather patterns were more consistent back in our days, when I was kid, they were more predictable and more, you could almost ah, count on it. Well, you did, you counted on it. Now it's like a miracle, you know all those years when we were kids, when we were making dried fish, and we had it every year, and never wondered about it. Now it's a wonder. Kind of, I think things are generally more inconsistent. You could say that about the weather for sure."
-Karl Ashenfelter

Storms
Storms don't seem to last as long as they once did.

The weather can change quickly, even overnight. It can be good one day, and storm the next, and then nice again the day after. This is a change from times past.

Temperature
Some have noted that summer temperatures have impacted fishing, the way the rivers melt, the water level getting lower, and not enough snow.

There is some data from interviewees indicating that some places/some times of the year are getting colder than they used to be.

People agreed that water temperatures are rising.

It was reported that it used to get colder in the winter than it does now. It used to get to 40 or 50 degrees below zero (Fahrenheit) in December and January. The ice froze very well for ugruk hunting and crabbing. This is not occurring now. People miss weather that provided better conditions; the changing temperatures significantly impact hunting, and create dangerous conditions for people. It was also noted that as it used to get so cold in the past, the character of the snow on the ground was different than it is now. It used to be hard, but now you will sink through. In the 1970s and 1980s it started to get noticeably warmer.

Other or General Comments about Climate and Weather
People are noting changes in the climate and weather, though the changes observed aren't consistently noted by each interviewee. Two fairly consistent observations seem to be that: 1) The weather seems to

be more unpredictable and diverging from historical norms. 2) The winter/frozen season appears to be shorter than usual, and warmer than it used to be. Other changes and any patterns regarding them which pertain to snow, wind, rain, ice, etc. are noted in those sections separately above.

Ice

There were varying opinions about freezeup, breakup, and other ice conditions. Most people indicated that there has been some change – either in freezeup or breakup times, or consistency of these times, or in the stability of ice conditions – but there was not a consistent view about these changes in the interview data. Regarding freezeup, it was reported to be either the same as the past, later than in the past, or more inconsistent starting around 30 years ago. Early to mid October were suggested as the normal historical timeframe for freezeup but there was disagreement about if it is occurring later now compared to the past (and if so, by how much). Breakup was reported to be inconsistent starting around 30 years ago as well, and the way the ice goes out on the river now was stated to be both different than in the past and inconsistent. There was disagreement about when breakup occurs now and in comparison to the past, though variability in timing was an agreed-upon feature. Some noted that the ice conditions are changing and becoming dangerous, noting that the ice melts earlier, quicker, and is more 'rotten'.

It was noted that at particular camps and areas along the waterways where snow or ice was previously seen in July it is no longer seen at that time of year, because it already melted.

Ice and snow conditions make a significant impact on subsistence activities. For example, if there is insufficient ice or snow in the fall, people aren't able to get out in the country or the river to go caribou hunting. Overly quick melting during breakup also negatively impacts the opportunities for bear hunting. If the ice goes out early, it also changes the way brandts are hunted. And it is noted that spring ugruk (bearded seal) hunting is dependent on the ice; in the past people used to go in February and March, but now they are harvesting these animals in April and May.

It was noted that the river changes every year, owing to where the ice is when it moves, carving into the channels. It was also noted that people used to get ice from permafrost along the river bank for drinking water, but now they get it from the river.

"As long as there's ice down here, they'll have brandt, but sometimes the ice goes out early and they have to hunt brandt a different way. Not the way they're used to."
-Rita Buck

Erosion

It was reported that erosion is likely happening along the whole Fish River, and that it is even impacting camp structures. It was also thought that melting permafrost is contributing erosion processes along the rivers. It was unclear what impacts erosion might be having on fish.

"[W]e've lost a lot [of ground at fish camp due to erosion]. Every year we've lost a lot of ground. […] It's just every year and we're having to move everything back."
-Willa Ashenfelter

Changes Regarding Other (Non-Salmon) Fish, or Fish in General

The problems with inconsistency in runs that are happening with salmon are also happening with herring. Additionally, it was noted that herring, tomcod, whitefish, skipjack and trout numbers have

substantially declined. The area has lost a substantial amount of fish populations over the years. The substantial impacts and changes to fisheries noted here and in other sections have occurred rapidly as well, not even just within the lifetime of project participants but even more precisely within a relatively recent period of those lifetimes.

Pus has been seen in harvested graylings.

"[A]nd people don't, the state governor, she doesn't even know what, there's a high a low year that's normal. That isn't normal! They need to know that isn't normal! The fisheries. 'Oh we had a low year this year, and ah, next year we'll have a high year, and that's normal.' That isn't normal. That's not a healthy fishery. And we didn't get there by accident. We were regulated into that, and we were represented into that, by the state and feds. You know, and we had no say so about how it happened. We can't even blame ourselves."
-Karl Ashenfelter

Changes Noticed with Marine Animals
Crab populations have declined. Commercial crabbing depleted the populations.

Belugas used to be found in the inner bay, but not anymore. There used to be a lot of tomcod and herring where belugas would go to feed, but there isn't anymore. Hunters now have to go to the ocean across White Mountain (on the ocean side).

White Mountain is getting less and less seals than they used to.

People started noticing small black porpoises out in the bay about 15 years ago, but it was stated that they may always have been there.

People used to go hunting for ugruk (bearded seals) in February and March, but because of changes in ice conditions, now they seem to be getting them later in April and May.

Changes Noticed with Land Animals
Moose being found in the White Mountain area is a new thing, happening in the past 60-65 years.

It was reported that beavers didn't used to be in the White Mountain area in the past either, or that there are more of them than in the past. They may be a problem where fish spawn. They have now dammed up every little creek. This has resulted in fish not being extant in some waterways anymore, for example whitefish in Steamboat Slough. Beavers are also a problem because they contaminate the water, making it unsafe to drink where people used to have their water source. It was stated that no one hunts or traps beaver anymore, so they're running amok, and there are too many of them. People felt that they smell bad and aren't good food.

There are more bears around now. People used to see them when they were at camp, but they have become more bothersome lately. They take fish from racks (and potentially in large numbers as well), so people have to stay at camp and watch their fish. Bears really started showing up in greater numbers about 25-30 years ago.

It was reported that there used to be a lot of muskrats, but they are hardly seen anymore.

It was reported that caribou used to be close to the White Mountain area long ago, and then went away for a long period of time, and then started to return in the 1980s or 1990s. People usually go about 65 miles north to hunt them, and they are usually in that area.

"And another thing that we got a few years later maybe, maybe 10 years later they had another big fire in Fairbanks. The next year we get beaver. They come up to Fish River and then when the ice, we had ice go. Here comes a beaver right behind there. Now we got lots of beavers, beaver houses all over."
-Howard Lincoln

Changes Noticed with Birds
Most interviewees who commented on the matter noted that there were changes to bird populations; however, varying information was provided as to what those changes have been. Some of the changes noted by interviewees include the following:

- Songbirds and woodpeckers are found in the area now and didn't used to be.
- Swallows are leaving earlier and earlier than before, and coming earlier in the spring.
- Bald eagles only used to be in the area once in a while, but now they are seen every year and their numbers have continued to increase.
- Duck populations are declining.
- Brandts, generally a preferred food bird in White Mountain, used to be harvested by the hundreds, but the population has declined dramatically. Additionally, they are arriving later than before, though this varies. The changes happened within the past 15 years ago or so. People also are not harvesting as many brandts because less people are hunting them.
- Crane populations are declining. Additionally, they used to be seen heading north for about a week, but now the migratory flyby lasts just 3-4 days. People used to see large flocks of them. There used to be a lot of cranes in the 1950s and 1960s.
- Swans have come back. There are also a lot now, and there didn't used to be many.
- Warm-weather birds are coming to the area as a result of climate change.
- There used to be a lot of smaller black birds years ago which would clean the fish (eating the worms off), but they haven't been seen for a little over 15 years.

Changes Noticed with Insects
Some interviewees noted beetle infestations as a new development which started around 10 years ago. However, the large numbers of tree beetles which had been seen in the recent past have declined between 5 years ago and now.

It was reported that there have been some insects seen in the White Mountain area in more recent times that weren't found there before. It is thought that warm-weather insects are arriving as a result of the warming climate.

Vegetation
The following comments can be made with regard to changes associated with vegetation:

- Changes in water temperature were noticeable as a result of there being more algae and grass in the rivers; it was noticeable that there was more starting approximately a little over 25 years ago. There is a lot more algae in the rivers and the bay now than in the past.
- There are a lot more weeds upriver now.
- There are now very few salmonberries, fewer than before. It was noted that salmonberries are very sensitive to environmental conditions. If it gets windy in July, for example, the berry

flowers will blow away.

- The tundra is a lot warmer than it used to be.
- There is a lot of new tree growth.
- There are varying opinions about whether willows are growing faster than they used to or not.
- Bark beetles are attacking trees. This started happening around 15 years ago. People used to have to go 6 miles outside of town to get firewood, but only have to go 1-2 miles now because the beetles are killing the spruce.
- There are differing opinions on whether there have or have not been changes to greens.

"Interviewer: Have you noticed changes in the water temperature yourself? KA: Yeah, you can see the algae, there's more algae in the rivers, because, even right down in front here. […] And even in the bays, in the bottom of the bays, there's more algae."
-Karl Ashenfelter

Figure 36: Bundle of dry fish at a White Mountain fish camp.

Other, General, and Miscellaneous Comments about the Environment

There seems to be a fairly even split in views on whether river water levels are getting shallower or have stayed the same.

Most people have not noticed tundra ponds having different water levels than in the past.

Regarding Culture, Society, and the Economy

Learning to Fish

For interviewees, when they grew up, fishing and going to fish camp was a normal part of life. Fishing itself was a way of life. People at camp, including children, used to cut up fish, hang fish, take care of fish (e.g. when it rained), bundle up fish, feed dogs, carry water, chop wood, and help with seining and hauling the fish. Children learned how to fish and prepare fish (especially cutting fish) at camp mainly from parents, and also with help from older siblings. Learning came from watching, instruction, and from hands-on activities. People learned how to fish and cut fish in general in the few years before becoming a teenager, if not earlier in some cases. It was stated that it is good to get children involved helping with fishing and cutting up fish. For example, it is good to teach children to cut fish when they are young. While they may waste fish while trying to learn, it was noted that it is the only way they will learn. People reported enjoying the time they spent at camp when they were younger and were glad they did it, and felt lucky to have been able to.

It was noted that currently twice a year there is a program to take kids out to pick berries, fish, and do similar activities.

"Interviewer: What were you're jobs at camp when you were growing up? KA: Me and my brother we did it all, my mom and I think my older sister, they cut fish. But we cut the heads and hung the fish, took care of the fish, we moved the fish. When it got rainy out we had to put them underneath the fish rack where there's no rain, and bundle them up, feed the dogs every day and carry water, chop wood, whatever needed to be done, we did it."
-Karl Ashenfelter

The Importance of Salmon and Salmon Fishing

There is a good deal of variety in the data from White Mountain about how important salmon and salmon fishing is to the people of the community, in what ways, and how things are different or the same as the past.

In terms of frequency and quantity, there has been a decrease in the usage of salmon in peoples' lives. While it is still a mainstay of some peoples' diets and many still depend on it for food, there are others for whom it is not a main component of their diets. In the past people could not afford much food from the store, and while store food remains expensive, people are able to afford to buy it to some degree, and the use of store-bought foods has increased. The ease of buying store-bought foods has had a significant impact on the importance of fish to people. In the past, fish was a large part of peoples' diets, and was also necessary for all people to make it through the winter, whereas that is not the case for everyone now. With the introduction of snowmachines, the use of fish for dog food has decreased dramatically, which has led to a decrease in the amount needed to be harvested by people. There are not as many families going to fish camp as there used to be, and people spend less time at camp and doing harvesting activities than they used to. So as a whole people are catching and eating less fish now than in times past. Young people are also less involved with fish and fishing than they used to be. They are less interested than before, and some don't even like to eat it, and prefer store food. Young people also often do not have boats or seines and some lack interest in fishing. Some experts also feel that as a whole fishing is less important to people than it was before.

However, salmon and salmon fishing are still very important, and some feel they are just as important

as they were in the past. They are seen as socially and culturally important to White Mountain, as being a part of peoples' lives, and as being an integral part of local culture and tradition. This importance is held to be the case even though people do less subsistence activities now than in the past. People felt lucky that they still have fish, unlike some on the Yukon who are struggling in this regard. It is noted also that when fish come, everyone wants to get fresh fish. Additionally, it was pointed out that it feels good to see all the fish that come in. Fish are seen as still being a large part of peoples' health, and as being the best food people have. Some people still stress the importance of fish as a food to make it through the winter, and also as a way to counter expensive store-bought food prices. Some people do indeed heavily depend on the fisheries as well. It is also important to note that there is a sense that the current lack of participation by young people in fishing related activities is seen as regrettable, which is also a telling illustration of the continued importance of fishing to peoples' lives, well-being, and sense of themselves.

"Interviewer: Do you think that salmon is still as important to people around here as it was when you were growing up? RB: I think so. Even though lot of people don't go subsistencing I think it still is, you know when the first salmon come everybody wants to go get some fresh fish. So yeah, more so with some families than others. It's a part of some people's lives. You know it's their, not only their culture and tradition, but for the winter they need that food too. Things cost too much in the store."
-Rita Buck

Transportation, Fuel, and Costs
It was stated that the costs associated with fishing can be prohibitive. The price of fuel can impact peoples' decision-making about subsistence activities such as fishing and can be prohibitive.

The cheaper cost of items from the store in current times is seen as a factor pushing people away from doing as much subsistence as in the past.

People will help each other and pool resources to help deal with the cost of fishing. This was practiced in the past as well.

"We just barely do subsistence. It's too expensive to go out and go fish right now, we can't even pay for the gas to go up and do the fishing […]."
-Karl Ashenfelter

Jobs
It was reported that salmon populations, weather, and jobs can all be very hard to manage together to make a successful fishing season. With jobs, it can be difficult to plan when to take time off, because people don't know when the weather will be good. If one doesn't get their harvest, it can be painful, because subsistence is a mainstay for some people.

"Interviewer: Is there any way to predict or any way to guess whether or not a run is going to be good at the beginning of the season? RB: No, Fish & Game always say it's going to be a good year you know, [laughter] even year or odd year, I don't always believe them because even if it is a good year, for us the weather doesn't cooperate either. So I don't know. Well this spring the Fish & Game guy told us there would be lot of fish and there is. And you know it is hard to plan like for me I work and I plan my leave like 3 months in advance because there's of us that have to take turns. It's hard to pick the right time 'cause you never know when the fish are going to be here, never know how the weather's going to be – plays a real big part. And it's real painful when it doesn't work out. Because that's our

mainstay, you know, subsistence."
-Rita Buck

Sharing
In the past, multiple families would sometimes work together at fish camp, and would divide the catch amongst themselves. Today, people also share fish with other people and families who helped them cut fish. People also share fish with other people as well. They share, for example, at gatherings (e.g. potlucks and large dinners), with those who are not able to fish (e.g. because of work), and others. Sharing is considered a value. It was noted that it's always best to share, and that when one eats with more people it seems like the food tastes better. Additionally, the more you give away, the more you get back.

It is felt that while people do still share, traditional sharing is slowing down, and that there is a need to carry on the traditional ways more than is occurring. It was noted that it used to be unheard of for people to sell Native food, whereas this occurs now. It was also noted that for potlucks, instead of bringing food from home to share, you will now hear of people expecting food to be bought from the store to be prepared. However, these views were tempered with statements that not everyone sells Native food, and that there still is a lot of sharing going on.

"Interviewer: How many people would you say are going to eat this salmon [drying outside on racks]? How many people are you going to share it with? WA: How many families? MC: Four households? WA: Maybe four households. MC: Maybe four households. Uncle, Auntie, Uncle. WA: Luann, you. MC: Oh five, me. WA: And Carol. MC: About seven households. Mom, Luann, me, Uncle Howard, Uncle Hunnik. WA: Auntie Bon. MC: Auntie Bon and then split between teachers like Kim and Eric and Holly. WA: Holly and Andy. MC: Haviland. Interviewer: And do those people come to camp too and help? WA: They come to help us cut fish. They don't ask for very much but I really appreciate their company and having them helping. Helping us cut fish."
-Willa Ashenfelter and Mary Darlene Charles

Trading and Bartering
People will barter fish with other people, e.g. for food that they don't get themselves, such as muktuk. By and large it appears that people do not engage in cash trading with subsistence foods.

Young People, and Knowledge Sharing
It is felt that letting young people help during subsistence activities is the best way to encourage them. Jobs that were noted for young people at camps included hanging fish, cutting fish, helping with seining, and (moreso in the past) cooking dog food. It was stated that many people don't do subsistence today, and that in these cases, parents aren't encouraging them. Some young people don't get the opportunity to go to fish camp at all. Others noted that it seems like it is difficult to tell young people how to live or to explain to them how older people lived. There was overall a sense of unhappiness with young peoples' current relationship with subsistence. It was stated that there is a need to teach people what it takes to do subsistence even before you get into the boat to go fishing, and that kids today don't have the skills to know what is needed to go out and fish. Young people also do not have the attachment to the land that people once had. The subsistence activities people did in the past were not optional then but now are something that young people don't do and don't have to do; this is seen as a sad turn of events. It was noted that young people, around 30 years old and younger, have different priorities that are markedly different from older generations, and that there are also other social ills and underlying issues which they confront which are very problematic. It was noted that young people can

learn to do fishing activities despite having different priorities, but it was also noted that it would be good to teach them different priorities as well. Many young people don't own the necessary equipment for fishing activities such as boats and seines. It was also stated that young people are not interested in subsistence and depend on Elders for subsistence foods rather than helping them get these foods in many cases; Elders are having to do all the work. It was also noted that this appears to be a broader trend in general beyond just young people, with less people doing subsistence and more people depending on someone else.

"Most of the kids I knew in high school, they're just about all of them are gone. And uh, along with it, the attachment to the land as we know it, as we knew it back then. It's not the same, the kids don't know, hardly any of them go do the things that we did back when we were kids. When we were kids we had to fish, it was not an option, we had to go pick berries, that was not an option, because that's what we ate during the winter time. But it's not that way anymore, we don't have to go out berry picking, we don't have to go out make dried fish. You know ah, it's sad to see all that go away […]."
-Karl Ashenfelter

Figure 37: A fish camp on the banks of the Fish River (L-R: Robert Lincoln, Arlo Hannigan, Dean Pushruk).

Other Information on Human-Fish, Human-Animal, and Human-Environment Relationships
It was stated that in the past, there were never dirty fish camps. It was felt that young people should keep fish camps clean, lead healthy lives, clean the river, and have clean water. People have been cleaning up Fish River over the last couple of years, and it is felt that this will provide for a clean river, lots of fish, and health.

Cultural, Social, and Economic Change
A number of highly fish-related comments were made by interviewees about significant cultural, social, and economic changes that had been experienced in White Mountain.

There have been large-scale changes to peoples' way of life, and changes resulting from impacts to fishing (e.g. poor regulation of commercial fisheries) is an important part of that. These changes have been devastating and systemic. Some of these changes include loss of language, loss of wisdom with death of Elders, loss of traditional dancing, people not doing subsistence, prohibitive costs associated with subsistence, among other things. Some feel as though traditional culture is not a part of many peoples' lives anymore in White Mountain. These changes are painful to people. Less people participate in subsistence activities. People are also significantly impacted by the historical legacy of the trauma from cultural contact which resulted in the decimation of Native populations and many other changes including losses of traditional culture. Other contributors of historical trauma were reported in the tuberculosis epidemic, as well as the boarding schools. With regard to the latter, it was stated that people came home and didn't know how to put Eskimo food away. It was also noted that there has been a change from a community-oriented society to an individually-oriented society in White Mountain. The church was stated to be a big part of this shift, and it was compounded by the introduction of televisions and telephones (the latter two leading to people not visiting with each other as much as in the past).

Other significant contributors to large scale social and cultural change have come from the loss of cultural traditions associated with Elders passing away, and the presence of certain forms of social welfare. With regard to the latter, it was noted that this contributes to people not doing subsistence in the summer to prepare for the winter because these things are being given to them. Another important historical fact of sociocultural importance that was noted is that fishing did not used to be regulated.

The school system is better now than in the past in terms of its attitude towards Eskimo traditional culture. It was felt that the school should be encouraged to continue incorporating Native culture more into the curriculum. It was noted that there hadn't been a bilingual/bicultural teacher in White Mountain for many years.

People discussed a number of changes they have seen associated with fish camp. People used to get their boats to upriver fish camps before the use of boat motors by using poling and pulling by dog team. Boat motors arrived in the late 1940s. At fish camp, there used to be a lot of tent frames, but those are not used anymore, having been replaced by cabins. Not as many people go to fish camp as in the past. Everyone in the village used to be at fish camp during the summer for the entire summer. People ate substantial amounts of fish while at camp as well. Additionally, more people used to fish right out of White Mountain in the past than they do currently. Many people used to go far upriver to fish camp even without boat motors. However, now there are only three fish camps located up there. Some people do not currently even have a fish camp site. Experts also noted that when they were younger, they used to eat more fish, especially when they were at fish camp. People also used to speak their Native language at fish camp in the past; today, while some still know the Iñupiaq words for fish, not many people use them anymore.

As noted further above, snowmachines were a big driver behind changes to fishing. Snowmachines arrived in 1961 and 1962 and took over everything in terms of winter transportation (though some did not adopt them until later). A significant result of that was that people needed less fish because they didn't need as much for feeding dog teams. Getting enough fish for dog food was a significant driver

behind the volume of subsistence fishing people used to do, and the decline in amount of subsistence fishing now is partly a result of not needing fish for this purpose.

White Mountain people have no choice but to adapt to the environmental changes they are confronted with. This is considered to be a difficult task now and will continue to be so in the future. It was also noted that changes to the environment which may lead to it being more unpredictable can undermine the utility of traditional knowledge about subsistence and the environment.

"You know, we're less of a community. We don't do as many things, they were a lot more get-togethers back then because they had to be, there wasn't much choice. Nowadays you can kind of be isolated, in a way that the rest of the world or the western culture. You have yours and I have mine and that's it. It's getting to be more and more like that. And uh, mostly because you have to, it's survival of the fittest. And before in order to survive it had to be more of a community thing and they died as a community also."
-Karl Ashenfelter

Regarding Challenges, Management, Commercial Fishing, Sport Fishing, and Recommendations

Difficulties and Challenges
The main fishing-related difficulties and challenges people identified were as follows:

- Impacts from commercial fishing and their management.
- ADF&G management in general. It was noted that people didn't have many problems before statehood, when their interactions with the government were mostly just with BIA. Regulations on subsistence fishing are a significant aspect of the problems associated with ADF&G management.
- Costs such as the price of fuel and other costs of getting to fish camp. A lot of people do not have the resources to go out. People will help each other and pool resources to help deal with the cost of fishing (this was practiced in the past as well).
- Certain environmental conditions like weather (especially rain) and flies, are a challenge for fishing and putting away fish. Changes to the environment create a whole new set of problems as well as amplifying existing challenges.
- Not getting enough help from others, such as relatives and young people, for doing subsistence activities
- Jobs are a challenge for doing subsistence fishing. It can be difficult to plan when to take time off, especially in the face of uncertain weather and uncertain salmon runs and returns.
- People from Nome (and to an extent Council) can cause problems for White Mountain people. They are reported to leave fire rings and trash around that White Mountain people have to clean up, are not respectful of locals, and to overcrowd fishing areas (e.g. they come down to rod-and-reel for silvers right where White Mountain people want to seine and refuse to move).
- It is difficult for White Mountain to get federal funds because there are few federal lands near them.
- Young people are not as involved in and knowledgeable about fishing as they used to be. Many of them also eat a lot of processed foods today. Additionally, store food is expensive and not healthy, and people are having health problems now that they never used to have.

"Interviewer: What are your thoughts or your opinions on how salmon is being managed around here? RB: You know a couple years ago when we couldn't catch pinks and there was a limit on dog salmon we were angry. 'Cause we couldn't catch fish. There was no pinks and we couldn't catch dogs. It was

kind of painful knowing we weren't going to make any dry fish, but we have to follow their rules I guess. There was one year we just barely had enough fish just to go little ways through the winter because we couldn't cut them."
-Rita Buck

"[Y]ou asked me about the culture, what culture? It's been taken away."
-Karl Ashenfelter

Management, and Commercial Fishing
People keep tallies of their salmon harvest for ADF&G.

People (though not all) expressed significant concerns about, and problems with, management. These include the following:

- ADF&G, and management/regulation forces in general, have brought a lot of problems to subsistence fishing. The commercial fishing interests are not adequately regulated, allowing them to destroy the fisheries to the detriment of subsistence users. Then they come and heavily regulate the subsistence users. Management and regulation entities are not protecting the fisheries or the interests of subsistence users, and are favoring commercial interests. It was further noted that this poor regulation and management, especially when combined with poor salmon returns, uncooperative weather, and other changes occurring inside the community, have an enormous cultural impact that is devastating, systemic, and painful for people.
- In addition to the problems of management and commercial fisheries to the south, there is concern that the scenario by which things were ruined down south is going to be repeated, that these forces are coming further north and will ruin things in this area as well (even more), particularly with the fisheries moving northwards because of climate and water temperature changes.
- Contrary to what fisheries managers and politicians say, the poor and inconsistent returns and runs (i.e. fluctuating good and bad years for salmon returns, and inconsistent/irregular run timing) are not normal.
- Subsistence users are not adequately represented, and do not have sufficient influence, in the management, regulatory, and political processes related to subsistence resources. Local people also feel that no one listens to them, and that what they say is not valued as being useful or important. People are not selfish either, taking the view that fisheries should be protected for everyone.
- ADF&G has not had a complete picture of salmon populations because they were not counting in all the places they should be counting, and are basing their decisions on incomplete – and probably representationally inaccurate – data. It was noted, however, that the tower on the Niukluk River was just recently moved down to the Fish River before the rivers split. The tower is now getting numbers relevant to multiple rivers, so this is a good development. It was noted however that high water has meant counting towers can't operate, so weather has an impact on their effectiveness.
- There is inadequate enforcement of the fishing activities of those coming from Nome and Council. People coming to fish from those directions have been seen catching far more than they are allowed and getting away with it.
- The variety of regulations – over commercial fishing, subsistence, and water rights – is a lot for local people to have to deal with.
- The conflicts between State and federal regulations are seen as problematic.
- ADF&G is not adequately addressing the bear problem.

Large-scale commercial fishing is seen as having enormous impacts to the fisheries and, as such, to local peoples' lives. It was noted that they only appear to be regulated by greed. The sheer tonnage of fish they are taking out of the ocean every year is seen as staggering, and the problems of management (e.g. local people not having any weight or given any consideration, jurisdictional problems regarding bycatch between the State and the federal government, etc.) are seen as highly impactful. The comparison between commercial activities and subsistence fishing activities is particularly bothersome – e.g. how much more fish commercial interests take compared to all the subsistence fishers, how commercial interests seem to want no limits but subsistence gets limited, and how subsistence fishers make more sacrifices than commercial fishers.

"Down that way, they talk about millions of tons of fish, you know, which is kind of a joke. And then they come up here after they get whatever their quota is, however it's regulated, and I don't think that's regulated; I think its regulated by greed. We need the, all the rivers and all, if there were no people here, the rivers and the streams and the waters, should be represented on the State level to protect their own, to protect the fisheries. We don't ah, they need to stop that, they need to stop. The fisheries need to be healthy. And I don't, and then I get my share, I won't have to worry about getting cut off, you know, we've had periods of years where they cut off our silvers. We like to eat silvers just like anybody else, they're a good food fish. Humpies we need those for the dry fish, but you know for the silvers, we value that because it is a good fish. And when we don't get that we're kind of ah ... we feel like ... I don't know what to say about that because there's so many things that they hurt when they do that. They hurt our people, they hurt how we feel about our country, about ourselves. When we have no control over things that are happening in our very rivers the rivers that we owned in the beginning, that we never had to worry about when we were kids, we never had to worry about whether somebody's gonna cut us off from, because there was always enough fish. But, in this very short time, in my lifespan it's a very short time, they ruined the fisheries. You know they're out there ruining the crab industry. They're out there the commercial fisheries, we used to get, go out there in the coast and get crab, by as many as you want. Now there are years when we don't get any. They're not there. And they overdo this and then they ask, "What happened?" like they don't know? If they don't know they shouldn't be here. They should know. They get an education they act like they went to stupid university. Where do they get these ideas? About escapement and all that, and they're supposed to know. And they always act like they know but they don't know, they're stupid. They really are."
-Karl Ashenfelter

"They [commercial fishers] need to let the fish escape to these rivers and to the streams to the degree that it protects them and also protects us. If they don't get the escapement up here, that injures their own fisheries. [...] There's still fish in the rivers, and it needs to be to the degree where, they get their fish, and we get ours. It shouldn't be us against them; the fisheries need to be healthy. For us and for them. And if they protect the fisheries to the degree that it's healthy for them, we'd get our fish and they'd get theirs. But I think there's a tendency for them to regulate it to the degree that it hurts the fisheries. The commercial fisheries have representation, we don't have any representation on the boards of fisheries. There's none, no representation for the people here and for the fish in the rivers. And uh, there lies the problem, you know. They're regulated by greed generally, I'd say. We're to the point where we have to no say-so, we've never had any say-so, only just like now for instance. This is long past overdue."
-Karl Ashenfelter

"[I]f it was regulated properly, we would get the fisheries up here and they [commercial fishers] would

get theirs."
-Karl Ashenfelter

Sport Fishing

There are varying opinions about sportsmen's activities – whether it is something that people should be concerned about, especially given the other damaging activities sport fishers do, or whether it is not a big enough activity (e.g. in terms of impact and numbers of fishers) compared to commercial fishing to warrant concern at this time. In terms of the former view, it was noted that sport fishing might be something to look into regarding management, because the big game hunters love big fish, and people have seen dead silvers on the sandbars, and wondered if it's because of the hunters and sport fishers (e.g. doing catch and release). It was noted that there also doesn't seem to be oversight of their activities. It was additionally noted that guided activities are tearing up the land.

"I always wonder about sport fishing. These big game hunters they love these big, beautiful fish and I think it was last year, I don't know how many times we saw dead silvers along the sandbars. And made me wonder if it was sport fisherman, you know they let them go but then they don't really come alive they just die. So, that's one thing I'm concerned about."
-Rita Buck

"Interviewer: Do you think that sport fishing in this area is a problem? KA: No, sport fishing, you know. The bulk of the fisheries are taken by commercial fishing, you know, you're talking about millions of tons, we're talking about a few fish here."
-Karl Ashenfelter

Local or Traditional Rules of Management

People do not want to see fish wasted and take steps not to waste.

Reusing and recycling everything is seen as a local and traditional value. Elders practiced this, and reused everything until it couldn't be used anymore (though this is not occurring as much among people now as in the past). People are also taking an active role in cleaning up the environment, such as in cleaning up the Fish River, and trying to get rid of e-waste and keeping the landfill and community clean. Employees of the Native Village have been very proactive in disposing of non-biodegradable waste. It was noted that White Mountain has a very well-managed landfill.

Sharing is also an important subsistence-related community value. It is viewed as an activity of giving which also results in people receiving more.

Recommendations

The following recommendations can be discerned from the collected data:

- Fisheries should be protected. Regulations and management should ensure this. Regulations are needed now to ensure healthy fisheries, and the people involved in enforcement, policy, regulations, and management should know what needs to be done and do it. Fisheries should be managed such that there is sufficient harvest for subsistence. Commercial fishing should not be allowed to destroy or limit subsistence fisheries as they have done. Commercial interests and fish managers need to let the fish escape to the rivers. Doing that protects subsistence and commercial interests.
- Alaska Native subsistence users should be given better representation and more influence in

resources (e.g. fisheries) decision-making processes. Native people are not represented at the regulatory, State, and Federal levels, while commercial interests are represented; fish are not represented either, and rural areas are inadequately represented. People feel they need to be heard, particularly with regard to the need to protect fisheries, and that their views should be valued and considered important.

- The inequitable application of the force of management and regulation on subsistence users over commercial users should be remedied.
- There should be harvest-related enforcement on the road back to Nome. When people are headed back into town from the river, someone should be there to check their coolers. This would help to keep pressure off the villages. People have been seen taking far more than they are allowed.
- Regulations surrounding subsistence harvest should not only take into account population but also weather conditions, which also impact harvest.
- ADF&G should have counting towers on the rivers where fish are going, or at least placed in the most optimal positions possible (which in the past they were not, though recent developments have been positive in this regard), and should base their decisions on this more complete information, rather than the incomplete information they have based it on in the past (in fact they may have based decisions on populations of salmon in a river in which salmon are not even going in the greatest quantity).
- ADF&G should consult with the community about bag limits, and before subsistence closures.
- Managers and scientists should look into the impacts of beavers on subsistence and environmental resources. Beavers are a problem that need to be addressed. A beaver bounty was suggested as a possible idea that might be effective. They should also consider steps to curb the growth of bear populations. There should be a higher allowable take for bear hunting. There are not enough people to hunt bears, but bears have become a problem that needs to be addressed.
- Something should be done about environmental changes such as climate change. They have had an effect on subsistence and will potentially have a profound effect on subsistence and the White Mountain community in the future.
- Managers, scientists, and politicians should recognize the value of Alaska Native subsistence as well as their environmental knowledge.
- Managers, scientists, and politicians should recognize that the poor and inconsistent salmon returns are not normal. They should also recognize that the environmental changes going on are anthropogenic (i.e. human caused), and should do something about it.
- The school in White Mountain should be encouraged to continue to incorporate Native culture into the curriculum.

"As natives, we are indigenous, and there should be a lot more respect and a lot more ... for lack of a better word, representation. In my whole lifetime, I have never felt like I've been represented in the federal government or in the state government, never. There are periods of time where we do get good representation but that disappears pretty fast. [...] The state of Alaska should make sure that the whole state is represented on the State Board of Fisheries. That needs to be looked at. In that sense there's a lack of representation, how do they pick these people. [...] [W]e need representation, not necessarily local control, because we ... we would have local control if we were properly represented. But there needs to be ... we don't have any say so over what goes on with the fisheries, we don't! Never have. [...] But there needs to be regulation, I know that, we can't go unregulated, we can't protect the fisheries without regulation."

-Karl Ashenfelter

5 – DISCUSSION

The Discussion section below analyzes the Results presented above in further contribution towards meeting the study's goals and objectives as outlined in the Introduction and Objectives sections at the beginning of this report.

This Discussion section is broken into three main areas. The first is a summary and analysis of results from a cross-community perspective. The second is a discussion of the project's results pertaining to TK in light of pertinent western science literature (e.g. social science, ecosystem science, etc.). And the third section is a set of recommendations derived from the community results (especially their recommendations) noted further above which had wide applicability; these recommendations are directed at policymakers and managers, researchers, local organizations, and broader audiences (and are organized as such).

Cross-Community Results Summary & Analysis

Here we would like to highlight some of the more striking results, patterns, and contrasts across those community-by-community results discussed further above, as well as some other points of potential analytic value. The results related to the topic of recommendations (e.g. for managers, policymakers, community entities, etc.) will be discussed more in the subsection below on Recommendations.

A fairly consistent preference was noted for less oily/fatty salmon. Part of this was attributed to taste, but perhaps an even larger part to the greater ease of drying. People have taken note of health problems observed in fish, and there does appear overall to be a sense of an uptick in concerns, especially regarding worms and pus-y substances. There was variability between villages in terms of which communities saw multiple pulses of which fish.

In terms of population numbers, an interesting trend was that while there were a variety of responses regarding whether particular salmon species were up, down, or unchanged, all communities in the project but one, and possibly two others, identified an overall decrease in salmon populations. Diomede, which does not get very many salmon, was one of these exceptions to the majority trend, indicating an increase. Wales was a possible exception to the trend, though there was some disagreement on this point; Wales too does not get many salmon, relatively speaking. Golovin was also a possible exception, giving indications of healthy populations or increases in four of the five salmon species, though at the same time presenting data with internal disagreement regarding the status of salmon populations in general now, and also indicating significant concerns with regard to salmon populations and some consensus that populations had been negatively impacted by a number of factors. Taken together this may point to a trend towards increased salmon populations in the northernmost portion of the study area; this would also be taken in concert with the decreased overall salmon populations in the rest of the study area (which is located further to the south and east of Diomede and Wales), albeit with some variation with regards to particular species and locations. Reds are in general found in low numbers in the project communities except for Brevig Mission where it is a preferred fish. Population numbers for reds in general seemed to be holding steady or increasing across communities except for Brevig, where there are indications of decreased and variable populations. Silver salmon overall appear to be faring well from a population perspective. Chums are in general reported to be lower than in the past population-wise across the project communities. Kings have definitely declined in the southernmost portion of the study region (i.e. around Unalakleet and also further south), and the parts of the study area outside that southernmost portion had varying reports about king populations

over time (some indicating higher, some lower). Pink salmon were overall seen as doing well population-wise, though were variable.

Harvests of salmon were reported in general as being down across the region. This owes in part to declines in salmon populations, to management practices, and also to declines in participation in subsistence activities (which have a variety of causes). A number of problems were identified as being associated with lower salmon returns and harvests. Some of the more common ones were: declines in stocks, impacts of large-scale commercialization of fisheries (locally or, in most cases, further to the south outside the region), the increased impacts of higher population numbers of trout predating salmon, the impacts of beavers, climate change, poor management, and social and cultural changes in the communities resulting often in declining interest in participation in subsistence activities. Shifts were not infrequently noted in the technology used to harvest salmon, though the nature of the shifts was not consistent across the communities. A concern regarding the impact of boat motors on spawning habitat was noted on a number of occasions. In terms of the preparation of fish, drying is the most important means of food preservation and preparation, and freezers have grown in importance considerably compared to times past. The most common use of fish was for human consumption; consumption as dog food is a noted use but dramatically decreased from times past; sharing is a major use for salmon, and bartering and trading salmon, particularly for other subsistence foods that people are unable to get, is a common practice as well.

The data show a wide scope of knowledge pertaining to the environment, with much of the data showing strong, complex, and interesting interlinkages between fisheries, social factors (e.g. fishing activities, management activities, local traditions, etc.), and a breadth of environmental factors, conditions, and changes.

In general people noted that there is more rain than in times past, in both the summer as well as the winter. The increased summer rain has presented problems for drying fish. Overall there is less snow than in the past, and more unpredictable weather as well as weather that changes quicker than it used to. Winters were largely reported as being warmer. Water temperatures were also reported as being warmer, and the possibility of this altering salmon migration and causing mortality events were noted. There was some indication of colder summers for some areas. Erosion was reported to be widespread and ongoing, having significant impacts to subsistence harvests and resources. Winter ice is reported to be at thinner levels than in the past. Freezeups are later. In some cases later freezeups are resulting in people missing fishing opportunities because fish pass by before they can be fished through the ice as they were traditionally. Breakups (and whether there are changes to them) appear to be more variable. People noted changes to how breakup occurs. A pattern of earlier freezeups but variable and overall similar breakup times would appear to be consistent with a model of an overall climate warming trend, as breakup has a wider number of factors involved in its timing. Even warming itself may not make ice break up quicker; for example, ice could now melt in place and go out slower than in the past.

Concern was expressed in a number of communities about predator fish, particularly trout and their impact on salmon eggs, fry, and smolt; pike was also a predator fish of concern. Declines or concerns about declines were noted in most fish species – salmon and otherwise – that had received heavy commercial attention at some point in history, either directly or indirectly (e.g. bycatch), locally or not locally. There is a sense that commercial harvests have the potential to (or indeed have already) significantly impact(ed) fish populations. A dramatic increase in beaver populations in the region was also noted, and people were highly concerned about their impacts to salmon spawning, as there was evidence beavers had blocked numerous waterways and also at least in some cases prevented upstream

movement of fish. Significant increases in bear populations were also noted. This also has ramifications for subsistence harvests of fish, as people noted an increased wariness when out in the country, as well as bears coming into fish camps and damaging cabins and taking fish from racks. Substantial growth in certain forms of vegetation were noted, particularly willows as well as algae. In a number of places it was noted that belugas had moved away. Increases in warmer-climate birds were noted, as were increases in flies and tree beetles.

Similar patterns in learning how to fish were noted across communities. A complex picture was painted of the importance of salmon to communities, highlighting both decreased harvest activities (lower harvests, lower interest by certain segments of society, and decreased fishing activities) coupled with strong statements of the continued importance of fish in cultural, nutritional, and economic terms. Young people were reported as being overall far less involved in fishing activities than in times past. Sharing of fish, though indicated as having decreased in some areas, was reported to be a strong value in region communities and one that endures and is crucially important. It is clear that sharing, a community and social activity, has been and can continue to be an important factor in individual and community resiliency in the face of environmental changes (e.g. increases in poor weather conditions for drying fish), socioeconomic changes (e.g. the requirements of wage labor jobs), and poor and/or unjust fisheries management practices, regulations, policies, and politics. It is a testament to the ways in which social bonds and cultural values can provide a substantial adaptive benefit in the face of environmental and social changes and challenges.

Common challenges, difficulties, and concerns included concerns about high gas prices and the cost of fishing equipment, and the challenges posed by jobs. Jobs posed a unique challenge in that, while people need money to participate in subsistence, jobs provide this money but can keep people from doing subsistence. The case of jobs also provides a good example of the interconnected, ecosystemic nature of people's involvement with fisheries and the variety of socio-environmental factors and changes they confront. The historical pressures necessitating participation in the cash economy, climate changes leading to unpredictable and sub-optimal weather conditions (e.g. increased summer rain), the requirements of wage labor jobs, changes to fisheries (e.g. unpredictable run sizes and timing), and the necessities of planning associated with fishing all can conspire to work against an individual attempting to harvest fish for subsistence. This is a good illustration as well of the analytic difficulty of providing condensed information on TK of the environment given its complex interconnections with so many social, cultural, historical, and environmental factors.

Another common thread found in the data was the complex relationship people have to navigate when dealing with the market economy. The issues of jobs, gas prices, and equipment costs were already noted above. The relationship with commercial fishing is a significant aspect of this as well. In general people are very concerned and troubled by the negative impacts of large-scale commercial fishing on fisheries and the environment. The problem of the impact of commercial fisheries on the fisheries as a whole and its relationship to politics, regulation, and management also puts people in difficult binds as will be discussed shortly. On the other hand, small-scale commercial fishing is an important and needed source of income for many families in the region.

Environmental changes, State and Federal management practices, and large-scale commercial fishing were seen as the three biggest threats and sources of damage to fisheries, the environment fisheries are interlinked with, and local peoples' abilities to harvest fish. Some of the commonly noted environmental changes affecting fish and fishing have already been noted just above (e.g. increased populations of beavers, trout, and bears, algal growth, and increased rain), and these pose significant

challenges to fish and fishing according to experts who participated in this project. Other environment-related natural resource policies and politics, and other activities, such as mining, pollution, vessel traffic, and other pressures on the local environment and resources from external pressures were also significant concerns.

Problems with fisheries management was a common theme in the data. People feel that fisheries are often managed poorly in a variety of ways, at the local level and outside the local region (e.g. in the poor management of large-scale commercial fishing to the south that has impacts on fish returning to the Norton Sound/Bering Strait region). Additionally, people feel as though fisheries are managed inequitably. Many instances were highlighted which illustrate a pattern whereby non-subsistence, non-village and non-Native activities exploiting fisheries, sometimes in egregious manners (e.g. chum bycatch in the pollock fishery), are either permitted or simply ignored, while a heavy hand of enforcement and the burden of conservation is regularly shifted to people who should be least expected to carry it (given their long-standing history of stewardship of fisheries resources, the fact that they are in fact not damaging fisheries, and their socioeconomic status) – e.g., the Native subsistence users and communities who participated in this project.

A strong sense of an exploitative and colonial relationship on the part of management and commerce was communicated in a number of instances. People feel as though they have little power and voice in the processes associated with fisheries policies and regulations, and also feel that their observations about fisheries (e.g. about changes to fish health, causes of fisheries declines, and so on) are not heard or valued by managers. Local people are also placed in a philosophical bind not of their making. On the one hand they are inclined towards supporting local control and policies of self-regulation, but on the other hand they recognize the presence of forces outside their control (e.g. large-scale commercial fisheries to the south) which have significant impacts on their resources and which require some form of external control. However, it is clear that once mechanisms of control are in place they are used inequitably. Sport fishers are perceived as being allowed to get away with almost anything (e.g. wasting fish, fishing during closures, overharvest and illegal taking, pushing local users out of fishing areas, and a type of fishing that is often regarded as 'playing with fish') and seem to be unenforced upon in terms of regulations and seem to have the benefit of an almost impossible-to-meet burden of proof applied in inquiries into their reported misdeeds. Area M fishers and pollock trawlers are ravaging fisheries e.g. through bycatch, while village residents trying to feed their families with small scale harvests find the heavy hand of regulation and enforcement easily, swiftly, and constantly applied to their lives. There is a strong sense of injustice, of enforcement born of convenience at best, and of colonialism, racism, and the privilege of wealth being applied at worst.

A strong ethic of sharing, respecting resources, and not wasting as local rules and traditions of management and behavior regarding fisheries (and other natural resources) permeated the discussions that were part of this research. People have a strong desire to protect natural resources in general and, in terms of this project, salmon fisheries in particular.

General recommendations, including those which were collected that were not community-specific or particular, will be discussed separately, just below in the Recommendations subsection.

Norton Sound/Bering Strait Salmon and Environment TK and Western Science

This research's engagement with region TK aims to make a number of contributions. Among these are a discussion of western science and region TK pertaining to salmon and the environment in light of

each other. In these respects on a number of fronts the available TK supports particular existing scientific data points, contradicts others, and points to new potential avenues for policy, management, and research. Examples of these will be discussed further below. It is important to bear in mind that TK is based on long-term *in situ* observations of salmon and the environment, set within different contextual frameworks, which offers uniquely valuable understandings of the world. This report also examines specific social and cultural effects of changes involving salmon (e.g. salmon returns and harvests) and ecological processes for this region, documentation of which is greatly needed (e.g. Wolfe and Spaeder 2009: 372).

Calls for increased documentation and use of TK in regional fisheries research is not new (e.g. National Research Council 2005: 125-130), nor are calls for 'integrating' TK and western fisheries science. Moller et al. note the potential benefits of using a joint scheme of traditional management and scientific monitoring towards effective (sustainable) and mutually-beneficial outcomes (2004). In addition to salmon-specific work in western Alaska, a variety of other relevant traditional knowledge and community-based documentation projects have take place in recent years in western and western-interior Alaska. These include Andersen et al. (2004), Brown et al. (2005), Georgette and Shiedt (2005), Jones (2006), Moncrieff (2007), Ray et al. (2010), Andersen et al. (2013), J. Raymond-Yakoubian (2013), Carothers et al. (2014), J. Raymond-Yakoubian et al. (2014), and B. Raymond-Yakoubian et al. (2014). These works each explored some facet of subsistence and traditional knowledge in western Alaska communities, as well as provided recommendations for resource managers and policy makers working with communities.

It is important to consider the dangers and pitfalls of documenting TK that is designed to interface with research, management, and policy interests. As Schreiber and Newell have noted, communicating distilled TK as bits of information "unencumbered by history and political context" to solve natural resource conflicts is inherently incomplete, especially so without the context of that information (2006: 82, 99). To the extent possible, this report has sought to contextualize and accompany TK statements with locally-generated discourses on natural, sociocultural, and political histories. Additionally, Schreiber and Newell (following Bavington) highlight the problems associated with documenting and sharing TK in light of a landscape where "resource managers are waking up to the notion that nature is highly variable and uncontrollable, [and with this] the managerial ethos has shifted towards controlling and managing people and knowledge;" indeed, the "difficulties in managing nature have set up TEK as a new target for managerial control" (*ibid.*: 94-95). This creates the danger wherein continuing to provide TEK before the key relationships involved remain unresolved – e.g. between Tribes and fisheries managers, the State of Alaska, and so on – may "disguise" existing power imbalances as well as undermine the case of those with less power (*ibid.*: 96). Further, as Nadasdy notes, "knowledge-integration" projects involving TEK serve to "concentrate power in administrative centers, rather than in the hands of aboriginal people;" while these endeavors may result in some positive results, they do not change the fact that decision-making power is still left in the hands of predominantly non-indigenous managers not personally dependent on the resource for sustenance or cultural survival (1999: 15, 1).

Kawerak is extremely concerned about these problematics. While such problems have in no way been resolved or obviated, Kawerak's Social Science Program, which conducted the TK research for this study, has attempted to mitigate their impacts in a number of ways. In terms of broader social impacts, the program has pushed strongly – and effectively – for injecting meaningful standards of tribal consultation processes into federal fisheries decision-making processes (see e.g. J. Raymond-Yakoubian 2012). (Additionally, it should be noted that this report, and ones like it, should not be seen

as a substitute for direct consultation with Tribes when it comes to specific decision-making, planning, etc. regarding fisheries, land use, and environmental issues.) Additionally, in the conduct of this study, Kawerak has integrated rigorous community data review processes and dialogue in the crafting of the final report, and has worked with the study communities to outline detailed, contextualizing information in the report as well as recommendations to a wide variety of audiences of epistemic, policy, and regulatory import.

The TK as discussed in this report interfaces well with some western science work on variation in salmon populations, including consideration of variables impacting those populations. As McPhee et al.'s (2009) and Moss et al.'s (2009) work implies, there are very large gaps in western science's knowledge about Pacific salmon; the former note that the "causes of spatial and temporal variation in Pacific salmon abundance are poorly understood" (2009: 1177). There is also likely a great deal of complexity to these issues as well; Krueger et al.'s work, for example, notes that there are likely stock-specific variables influencing the abundance of various salmon returns to the Arctic-Yukon-Kuskokwim (AYK) region (2009: 4). The TK in this report provides an abundance of information about salmon distribution, population, harvest, biology, and behavior over time in regard to many different variables in eight community areas, offering a wealth of data for scientists interested in pursuing broader or more geographically-specific studies of variation in stocks.

Participants in this project placed a much greater stress on the negative impacts of large-scale commercial fishing on salmon populations and see it as a much higher priority for something to be resolved than it would appear to be in the scientific literature and policy/management arenas. The 2009 Bering Sea Chinook bycatch Environmental Impact Statement, for example, stated that "[a]lthough there are many factors potentially contributing to the reductions in historic run strength, measures to minimize Chinook salmon losses to the trawl fishery **could** allow more Chinook salmon to remain in the ocean and return to in-river systems" (NPFMC 2009: ES-5; [emphasis added])." It is further noted that the impact of direct and bycatch marine commercial fisheries' takings of Chinook are "under debate," with some of the view that these "removals do not greatly impact" returns while others "believe that marine catches are the only human activity that we can directly control and, therefore, need to be controlled to mitigate the impacts of declining runs due to the changing environment" (*ibid.*: ES-42). Others, however, have expressed views which strike closer to the concern of region TK experts. Myers et al., for example, notes that certain life-history traits of AYK Chinook make them "more susceptible than other AYK salmon species to bycatch in winter BSAI [Bering Sea and Aleutian Islands] trawl fisheries," and further that,

> We concluded that the low abundance of some populations of AYK Chinook makes them vulnerable to adverse changes in climate-ocean conditions and fisheries. Relationships among climate, fishery, and other factors affecting growth and survival of AYK Chinook in both marine and freshwater habitats are complex and point to critical needs for additional research, management, and restoration actions to ensure sustainability of this valuable natural resource. (2010: i)

Even in the face of a lack of precision about the impacts of bycatch to salmon stocks, the extremely high bycatch of chum and Chinook in the pollock fishery (topping out at over 705,000 and 121,000, respectively, and showing significant increases from earlier times in the early to mid 2000s), especially in regard to the great importance of salmon stocks to people in the Norton Sound and Bering Strait region, should have, one would think, warranted at the very least concern enough for dramatic action in the face of its potential to "affect the recovery, on-going fisheries, and long-term sustainability of the resource" (Robbins Gisclair 2009: 801, 804, NMFS 2015a, 2015b). Indeed it is noteworthy that in 2015 the North Pacific Fishery Management Council (NPFMC) did take additional action to further

effect reductions in Chinook bycatch when poor run sizes are indicated by an assessment index. The EIS process for chum bycatch in the pollock fishery is currently ongoing.

TK holders noted the interconnections of other environmental variables on salmon as well. Collie has noted that "environmental changes taking place over decades have a greater effect on these stocks [AYK chum] than year-to-year changes in recruits-per-spawner" (2010: 12). Concern over the effects of environmental change – including climate change and land use (e.g. resource development) – on the health of salmon stocks was noted by a number of TK holders in the region. Existing and significant projected effects of climate change and land use changes have been noted in the literature (Alessa et al. 2008, Smoker 2010, Schindler and Rogers 2009, Mantua 2009); for example, Alessa et al. note that "[o]n the Seward Peninsula, salmon provide a singularly important food source, and both broad-scale changes in climate and local changes in land use will affect not only the distribution of the five salmon species present in the area, but also subsequent spawning and recruitment success" (2008: 265). Alessa et al.'s work also outlined the ways in which climate and landscape changes could lead to a suite of fisheries "vulnerabilities and opportunities" (*ibid.*), a number of which have been intimated in the TK elicited in this research. This includes increased salmon mortality in waterways owing to higher water temperatures, impacts from expanding algal growth, and concern regarding the "compounding" effects of mining on streams. Another aspect of climate change which has had impacts on fish harvests has been the overall increase that people have seen in weather unpredictability and variability. Weatherhead et al. (2010) has described "changes in weather persistence" in northern Canada similar to what participants in this study have experienced and described (i.e., regarding unpredictability and variability), as have a number of contributors to a now-well-known volume on indigenous observations of climate change (Krupnik and Jolly 2002). Royer and Grosch postulated that salmon will move "pole-ward" owing to future ecosystem-scale regime shifts (2009: 342); TK holders in this report noted indications that such a northward shift of salmon resources is already underway (see also e.g. Carothers 2013).

The importance of both freshwater and marine water conditions and habitat on salmon species have also been noted in the literature, including in particular water temperatures (see e.g. Lawson et al. 2004, Beuchamp 2009, Farley et al. 2009, Farley 2010, Ruggerone 2010, and Svejkovsky 2010); TK holders have also noted the importance of water conditions on the salmon lifecycle, including observations of negative impacts of increased water temperatures on salmon. TK holders have also stressed the importance of considerations of other fish and animals to salmon population health. For example, the negative effects of large amounts of jellyfish on salmon harvests were noted in Unalakleet (see also J. Raymond-Yakoubian 2009a); Robinson et al. have noted the potential connections of jellyfish blooms to climate change, as well as competitive and predatory behavior towards salmon (2014).

Concerns about the spreading impact on salmon (and water quality) of growing beaver populations and beaver dams in the region were noted by a number of this study's TK holders. Some in the literature have problematically downplayed some of these concerns in certain situations (Nemeth et al. 2009 regarding coho salmon). The observation and concerns regarding impacts from beavers is one area where a number of region residents have expressed concerns that they are regularly dismissed or ignored by western biologists. This highlights, among other things, a greater need for fisheries research to properly conceive TK – e.g. not as anecdotal, but rather based on long-term *in-situ* observations of the environment and resource behavior – as well as to properly document it. On the other hand, some research has affirmed negative impacts to salmon from beaver dams (Kroeker 2006 showed negative effects for chum migration past dams and showed coho migration was dependent on sufficient precipitation; Magdanz et al. 2003: 40 noted concerns amongst some White Mountain residents about

the effects of beaver dams on salmon populations) or at least the need to further research the matter (Andersen and Fleener 2001, whose work was on whitefish in the Yukon Flats, and Wolfe and Spaeder 2009). As the TK for this research demonstrates, experts have not declared that beaver dams are closing off streams to upriver salmon migration in all cases, but rather that they present a concern that they are a general impediment (among other concerns about water quality) to upstream migration of salmon. Evidence of particular streams with beaver dams no longer supporting spawning or demonstrating clearly impaired upstream salmon migration further supports this assertion.

Expert TK from this project has also noted concerns about trout predation of salmon, smolt, fry, and eggs, having backed up the concerns with observations of *in-situ* trout behavior and analysis of stomach contents all amid a backdrop of concerns over dropping salmon populations and dramatically increasing trout populations after local people switching from dog teams to snowmachines took harvest pressure off of trout. This last broader ecosystematic linkage is an interesting example of a connection between changing social patterns (decreased harvest of trout owing to decreased usage of dog teams, which they were used to feed) and changing impacts on salmon (increased predation owing to increases in trout from decreased harvest). A number of TK holders, however, felt this concern regarding trout has been treated dismissively by the members of the scientific and management community with whom they had interacted. Wipfli has noted that there is much that is unknown about the salmonid diet, so all new information about their food resources needs to be carefully considered and incorporated into management (2009: 49), which would provide support for carefully considering this TK observation.

The TK documented in this study demonstrates a holistic interplay of a variety of factors relating to the health of salmon and their habitats, including a wide variety of other environmental variables and interconnections. Some examples of elements of this knowledge has been outlined above. Before moving on to a discussion of social and cultural ramifications of salmon and ecological processes and variation in light of the interface between region TK and the scientific literature, one type of observation noted in this study provides an interesting segue, as it speaks well to both the previous and the subsequent section for discussion. Moncrieff et al. (2009) describe the use of "natural indicators" by indigenous fishers along the middle and lower stretches of the Yukon River. These environmental observations are used by communities and individuals to plan for salmon fishing. Indicators can provide information about both what kind of run to expect (e.g. strong, weak, etc.) as well as when certain runs are expected to arrive. Similar data on indicators has been documented for the Bering Strait/Norton Sound region for non-salmon fish (J. Raymond-Yakoubian 2013). Correlative indicators were also noted in this project, such as in Golovin one interviewee noted in a discussion of the seasonal round prior to the introduction of commercial fishing that the ending of the pink and chum run signaled the move towards gathering greens and berries as well as harvesting silver salmon.

The most frequent kind of salmon research in the study area are harvest surveys (most often conducted by ADF&G, and sometimes in conjunction with Kawerak in the past). While these are useful for harvest estimates, and often include a "comments" section aimed at obtaining qualitative data about salmon, they are not as useful in comparison to in-depth ethnographic interviews in terms of obtaining detailed information about the reasons for changes through time, other information regarding the environment and social factors that bear upon fishing, information about TK, values, and beliefs relating to salmon, and so on. This project's data collection was primarily based on such in-depth ethnographic interviews with local experts, and did not include harvest surveys, instead focusing on other knowledge about salmon and the environment than that which is typically collected during those surveys. This is thus a different approach than much of the salmon-related community research that has taken place in the past in the Norton Sound and Bering Strait region, which as just noted has

focused more heavily on harvest numbers rather than TK, values, and beliefs about salmon. While harvest numbers are also necessary for managers and policymakers, this research aimed to delve deeper into fishers' knowledge on the other just-noted topics which are typically un- or under-examined.

Some information in this report about salmon, from the communities of Brevig Mission, Golovin, and Unalakleet, was previously described by J. Raymond-Yakoubian (2009a, Myers et al. 2010). Other work in the Bering Strait/Norton Sound region on topics related to community use of salmon and traditional knowledge includes research conducted by the ADF&G Division of Subsistence, and annual management reports from the Division of Commercial Fisheries. Some of this work has included research summarizing participation in subsistence activities, including salmon fishing (Magdanz 1981, Wolfe et al. 1986, Olanna Conger and Magdanz 1990, Magdanz 1992, Magdanz et al. 2002b, Ahmasuk et al. 2008), discussion of the impact of subsistence harvest regulations on the community of Nome and other area communities (Magdanz et al. 2003), and more recently, detailed research on customary trade and barter of salmon and other subsistence foods (Magdanz et al. 2007; see also Reedy-Maschner 2009).

Each community that participated in this study has their own particular set of traditions, practices, and knowledge related to salmon and the environment. As Wolfe has noted, these "localized systems of food production and distribution" represent "relatively unique combinations of ecology, community, culture and economy" (2004: 2). This is true across the state of Alaska, as well as within a smaller region such as the Norton Sound/Bering Strait region. At the same time, cross-community patterns exist with strongly shared cultural features. Salmon was a very important resource for all but one study community, and important in both similar and unique ways. As evidenced in this report, salmon is regarded as highly important to people of the study region. As Alessa et al. noted for the Seward Peninsula, "salmon provide a singularly important food source" for the study region (2008: 265). As Condon et al. (1995) showed in their work in Canada, subsistence has significance socially and psychologically, and, as this report demonstrated, the level of involvement in subsistence is not what matters but rather what subsistence itself means to people. Salmon and subsistence salmon fishing are a part of peoples' identity and a tangible link to their heritage.

Subsistence (and thus TK about it) is a complex socioecological system tied inextricably to individual and social identity, practice, and history. Effects in any one part of this system can – and often are – felt in other parts of the system as well. While this system is thus highly adaptive and resilient, it is also by the same token highly vulnerable. As described in this report, and as Moerlein and Carothers (2012) have argued, communities in northwest Alaska are experiencing changes in social, economic, environmental, and other systems. Multiple social and environmental changes, some broadly similar to what was documented in this study, were also discussed in Carothers (2013) and Carothers et al.'s (2014) work on fishing in north, northwest, and interior communities. Many participants in Kawerak's salmon project described a variety of challenges that they and their communities face – all discuss a convergence of multiple factors that impact their subsistence activities, and their salmon fishing and processing activities, in particular. Additionally, Huntington and Fox have noted that changes in any one "climate variable" can disproportionately affect subsistence harvesters (2005: 74). A good example of this are the substantial and intricately linked effects changes in rain patterns can have on subsistence fishers as described in the results of this report.

Any discussion of social and cultural ramifications of salmon and ecological processes and variation in light of the interface between region TK and the scientific literature (as with what follows) should not, however, simply focus on 'effects' to local people but also highlight the ways in which local people are

active in participating and defining the systems in question themselves. In that vein, not only will changes, impacts, and effects of salmon and environmental variation on region communities be discussed below (and this is a substantial contribution of this report; see e.g. Wolfe and Spaeder, who noted the need for documenting the specific cultural effects of declining salmon harvests [2009: 372]), but so also will ways within which local people operate within the systems related to this variation, including through recommendations made in this report. It is also worth noting again the highly adaptive nature of TK and of Alaska Native cultures in the face of environmental variation. The utility of this cultural value and characteristic was seen, for example, in this report in the ways in which the traditional practice and value of sharing could provide a buffer against the 'conspiring' effects of changing weather patterns, cash employment obligations, and changes to salmon runs which together can make harvest opportunities problematic.

The literature details the past two decades experiencing harvest declines in the study area (e.g. Magdanz et al. 2005, Wolfe and Spaeder 2009, Magdanz et al. 2009, Magdanz 2010). Decreased harvests over time were noted as occurring for a variety of reasons in a number of the study area's communities in this research. Magdanz et al.'s work noted for a recent ten year period that while escapement and harvest declines both occurred during that period, escapement data wasn't a good predictor of subsistence harvest (2009). Nonetheless, decreased returns were noted as impacting harvests by study participants. They also have triggered management measures which have resulted in further changes to harvests as well. For example, they have resulted in closures and other regulation for both subsistence and commercial fisheries, which have had a number of effects, such as dis-incentivizing harvest, making it more difficult to get and dry fish in time, and displacing Nome-area fishers to adjacent areas where they end up competing with village fishers (in the Port Clarence and Fish/Niukluk River areas) (see Menard 2009 for discussion of some of these factors).

There are currently three salmon 'stocks of concern' in the study area: Chinook in the Norton Sound sub-districts 5 and 6, chum in Norton Sound sub-districts 2 and 3, and chum in Norton Sound sub-district 1 (ADF&G 2015). As Olsen notes, “Norton Sound has suffered a progressive collapse in salmon populations since the mid-1960s that greatly affected the lifestyle and culture of most residents” (2010: 69).

There has been concern about the salmon populations of the region since at least the 1970s, particularly in the Nome area. Commercial fishing began in the region in 1961. An increasing amount of regulation was imposed on the subsistence fisheries of the Nome area starting in the 1960s. A federal fisheries disaster was declared in 1999 due to low returns in the Norton Sound area, and in that year a Tier II subsistence chum fishery was established as well (later dropped in 2006), the only Tier II subsistence fishery ever established in Alaska. Additionally, around this time several stocks of concern were designated (see just above). It was discovered, however, that an effect of these fishing restrictions was to 'displace' harvest to nearby areas, which in turn prompted restrictions on adjacent areas as well (Menard et al. 2009, Menard et al. 2013: 1-12).

Some of the problematic approaches to such events can be seen in the management interpretation of them as well. For example, Menard et al. argue that

> [T]he reduced use of chum salmon caused by low run sizes and restricted harvest may have changed cultural values toward the species. A shift in values in the subsistence fishery seems to have occurred over the past decade away from chum salmon on to coho and pink salmon, and beginning in 2003, to sockeye salmon in response to record Pilgrim River runs. […] We speculate that a decade-long limited harvest of chum salmon due to

> management actions had altered human behavior, fishing practices, and preferences for salmon species. […] We believe that harvest regulations allowed many more salmon to reach the spawning grounds and helped to restore salmon populations and their fisheries. However, the restrictions affected not only the fish but also those who fished and caused changes in fishing patterns in time and space and potentially cultural values. (2009: 647-648)

When considered alongside the authors' assessment that managers (ADF&G, at least) have little control over many of the factors involved in salmon restoration, but they do have control over managing harvests and can also try to manage and improve stream habitat (*ibid*.: 649), one can see in these statements the rhetorical warning signs of the problems of the control imperative of management (discussed further above in its relationship to TK). Additionally, it should be noted that a meaningful consideration of TK with regard to fisheries, as illustrated in this report, can also serve as a bulwark as regards such problematic analyses. For example, such a consideration would provide a caution regarding the utilization or overextension of a view that shifting harvest targets as a result of diminished harvest opportunities results in changing cultural values towards fish. Analysis of the TK data from the present study does not show changed cultural values towards chum salmon stemming from diminished harvest opportunities related to decreased runs and increased regulation. It would be a mistake to characterize, pertaining to this study's research population as a whole, changing harvest targets in light of diminished harvest opportunities as changed cultural values. Chum remain a valued fish, and the chum crash has greatly impacted people in the region. A major shift to speak of in the last half-century or so with regard to chum salmon that could be said to relate to cultural values would be that which was associated with the diminished use of chums as food for dog teams. As this report illustrates, chum and pink salmon have a long-standing role as being primary salmon of harvest interest, with chums being used in many communities as primarily, though not exclusively, for feeding dog teams; a diminished use of them pertains, according to region residents, to the replacement of dog teams by snowmachines. (Wolfe and Spaeder's [2009: 366-367] work on the Yukon suggests diminished chum runs as a causal factor in declining use of dog teams there; there may be a connection in this project's study area as well, though this is not how region residents portray the history, and it is more likely that in this region, the chum crash was less causal with regard to the declining use of dog teams. Additionally, it is worth noting that the social impact of the massive declines occurring in chum returns since the 1980s (and occurring earlier at least in the case of Golovin) may have been partially blunted by sheer historical luck in that the main traditional use for these fish – feeding dogs on dog teams – has dramatically decreased as a use for the fish with the introduction of the snowmachine. That is not to say that the chum crash has not greatly impacted people in the region, because, as noted above, it has.)

Reedy-Maschner's work (2009) has argued against a dichotomization of the commercial-subsistence division as well as a recognition that cash is part of the subsistence economy now. Many commercial fishers are also subsistence fishers, and commercial fishing income provides funds to support subsistence fishing activities (Howe and Martin 2009: 457; see also Buklis 1999: 45). Knapp has forwarded that "[l]ow salmon runs have been the most important factor contributing to the decline in value and participation in AYK commercial salmon fisheries" (2009: 484). Cash trade, as well as barter for other goods (e.g. subsistence foods), is also found throughout the region, and the cash trade is a regulated activity (see Magdanz et al. 2007). As discussed in this report, a number of study participants have noted concerns about the declines and prohibitions associated with commercial fishing in their area as well as in some cases the limits on cash trade of some salmon.

Variations in salmon and the environment do not just impact region residents directly, they also impact

them in other ways. One significant way is via the processes of policy and management which attend these resources and which are often heightened in times of problems (e.g. salmon stock depletion). Study participants identified numerous ways in which salmon policy and management impacted their lives, most of which were negative, e.g. feelings of pain, feelings of powerlessness, a sense of inequity and discrimination, and so on.

TK holders in this study discussed at length the problems with fisheries policy and management which gave them with a sense of being left outside the process, largely powerless, and inequitably treated. The recommendations throughout this report (including in this section) contain many examples of avenues suggested by the data whereby these problems could begin to be remedied. Some of the recommendations noted include ideas such as these: 1) Development of processes to incorporate TK of salmon and the environment into policy, regulation, management, enforcement, and research; 2) Increased meaningful participation of local people in salmon management and regulation processes, e.g. through greater local control over management and regulation of fisheries, greater communication, better access to fisheries-related meetings, and better representation at various levels; 3) An end to inequitable policy, regulation, management, and enforcement; 4) The development of regulations and regulatory structures which prioritize protecting fish and fisheries as well as the importance of subsistence fishing; and 5) Conducting research designed to protect habitat and remedy current problems associated with fisheries.

West and Ross (2012) examined "local institutions" (such as indigenous resource management strategies) used by communities in the Yukon-Kuskokwim region. Their results are similar to findings in this study, in that government regulations on subsistence activities (including bag limits, limits on trading for cash, restrictions on harvest timing, and so on) interfered with local strategies that have been successfully practiced for generations. Colding and Folke call these institutions "informal institutions," and concluded that

> many RHTs ["resource and habitat taboos"] have functions similar to those of formal institutions for nature conservation in contemporary society but have not been sufficiently recognized in this capacity. We suggest that designs for conservation of biological diversity and its sustainable use in developing countries focus more on informal institutions, like social taboos, because they may offer several advantages compared to conventional measures. (2001: 584)

Bering Strait tribes have expressed a strong desire to be involved in fisheries management decisions, particularly when such management has the potential to impact subsistence salmon fisheries (J. Raymond-Yakoubian 2012).

There is a substantial body of literature which elaborates the virtues and necessities of involving local indigenous resource users in management processes, something which the results of this research also called for as well. As Benjamin et al. (1996) argue, there are a number of good reasons for managers to involve local people in conservation activities, including social justice reasons, the long history of locals' interaction with and knowledge about resources, and the consideration that local buy-in and participation in conservation strategies increases chances of preventing loss of biodiversity. Bue et al. (2009) have noted that fisheries management in other areas of the AYK region, for example on the Yukon, have acknowledged that subsistence user involvement is critical to effective management (as is rapid information sharing). Hanna (2009) advocates for collaborative management (i.e. co-management) of AYK salmon fisheries (AYK SSI has also talked about co-management in the context of capacity building [2006]). Cubitt et al. have called for "fair representation" of rural/subsistence

fishers in the management process to reduce tension within the AYK region's fishery (2009: 1222). Thornton and Scheer advocate for "collaborative" work in terms of research, management, and conservation related to the marine environment, and for a "management infrastructure that is embracive of modern science and LTK [local traditional knowledge] and practices in the marine environments" (2012: 1). Additionally, Moller et al. note that

> Combining scientific and traditional monitoring methods can not only build partnership and community consensus, but also, and more importantly, allow indigenous wildlife users to critically evaluate scientific predictions on their own terms and test sustainability using their own forms of adaptive management. (2004: 1)

Moller et al. also point out the need to attend to some of the practical difficulties associated with conducting such collaborative research, which can be substantial. Brelsford (2009) has also noted that Alaskan communities have a desire for their TK to be used in management practices. However, there are institutional (bureaucratic), economic, epistemological, and other barriers which attend this. These barriers can seep into the management-related research as well. For example, Burr's (2009) work argues that it is important to maintain sport fishing opportunities as sport fishing is valued by sport fishers, provides economic benefits, and promotes conservation of salmon and protection of their habitat; as such, Burr notes that "[a] primary goal of management of sport fisheries will continue to be to maintain a reliable level of fishing opportunity so that anglers and the businesses that provide services to them can plan to participate in the fisheries" (*ibid*.: 538). While noting an indigenous traditional view regarding proper treatment towards animals which is violated by catch-and-release practices – the view that "[i]f animals are treated with respect, they will continue to make themselves available for human use" – Burr shortly thereafter states flatly that "[s]almon sport fisheries in the AYK region are small and in nearly all locations, have little impact on salmon runs or on achievement of escapement goals" (*ibid*: 537, 538). Burr acknowledges the "social friction" between visiting and local fishers, attributing much of it to "cultural differences concerning the sport fishing practice of catch-and-release fishing;" the concern about sport fishing practices on the part of local indigenous people is stated as being "based on traditional ethics" (*ibid*.: 537). Burr notes that "[s]ome rural residents find catch-and-release incomprehensible; it violates their belief concerning the proper manner in which animals should be treated" (*ibid*.). Burr suggests measures for sport fishers to take – "understand[ing] and respect[ing] [the] traditional values of local residents towards catch-and-release fishing and resource use," "adopt[ing] an attitude of being guests that have been granted the privilege of fishing the unique waters of Alaska" – and also states that educating these anglers "will become increasingly important to help foster understanding between anglers and local rural Alaska residents" (*ibid.*: 537-538). TK research can provide a valuable tool to counter problematic analyses such as these, as well as to demonstrate the barriers to TK and TK holders in management practice as evidenced by management discourse. For example, it should first be noted that TK holders in this study find catch-and-release to be perfectly comprehensible, yet unethical. It should also be noted that a variety of other issues are attendant to this conflict, such as, for example, sport fishers competing with locals for fishing spots (which Burr notes), and the inequity in enforcement and management regarding sport fishers compared to local indigenous fishers that has been discussed elsewhere in this report. Additionally, Burr's work demonstrates the problem that even when TK is acknowledged, it often does not make a substantive difference in terms of impacting management rationality or practice. The possible veracity of a traditional view regarding the treatment of animals and its impact on salmon populations is dismissed. Additionally, the suggested measures for changing sport fishing in Burr's piece are either incomplete or appearance-based in nature. The possibility that such practices be stopped or substantially altered does not appear to enter into the equation. Rather, the economic and other benefits of a recreation activity are stressed whilst subsistence communities face economic disasters. The consideration of TK holders' views without the possibility for meaningful change is faux consideration.

It is also important to look at the process of research itself in terms of its interface with communities as pertains to fisheries, to which we will now briefly turn. Another factor, in addition to those discussed above, associated with salmon variation which impacts region residents' lives is the conduct of research associated with this variation. It is a fact of the modern world that scientific research is conducted extensively on natural resources topics, particularly in cases of problems with these resources. Research on salmon in the study area has substantial impacts felt at various levels. For example, it generates income, takes up peoples' time, sometimes creates a way in which people can participate in and even shape policy and research processes, but can also mask power inequalities and further contribute to the use of extracted information from TK holders for goals which are not in the best interests of their communities (as discussed further above). An example of the problems associated with research is as follows. Region tribes and organizations have long argued for the need for more accurate fish counts around the region to better inform in-session fisheries management decisions. For several decades, Kawerak and other regional organizations have led and participated in fish counting research to support that goal (e.g. Dunmall 2008). However, there are also local concerns and hesitancy accompanying the previously-mentioned sentiments. For example, as TK experts in this study noted, a number of problems can be associated with fish counting. For example, they may be done in a way which produces little value (e.g. if there was insufficient baseline data to begin with), they may simply act as a futile exercise to document a problem without fixing it, and they may in the end simply function as little more than a new tool for managers to further regulate and restrict local harvests. A number of research recommendations are made as part of this project in the hopes that this will improve these processes such that they function to most effectively better the lives of people in the region.

Recommendations

The following are recommendations derived from the community recommendations noted in the Results section above. This section, however, only focuses on broader recommendations that have applicability to more than one community.

Recommendations for fisheries and natural resource managers and policymakers:

- Keep the northern Bering Sea closed to bottom trawling.
- Develop a very specific process that is fair to TK holders whereby TK is incorporated into decision-making, management, policy, and research. This is specifically needed for the Board of Fisheries and the NPFMC. In addition to the many recommendations which follow below, some additional considerations for such a process would be as follows: the development of the process itself in collaboration with TK holders; the process itself would include true tribal consultation (e.g. as discussed in J. Raymond-Yakoubian 2012); the institutionalization of TK on equal grounds with western science, management, and policy; TK should be brought into scientific, policy and decision-making processes to a significant degree (e.g. by involving TK holders, social scientists working with TK holders, etc.); and TK holders should be involved in the implementation of this process, e.g. as voting members of the NPFMC and the Board of Fisheries and with seats on their various committees and panels.
- Improve communication with communities.
- Increase government to government consultation.
- Establish a true priority for subsistence – and the resources on which it depends (above other interests, e.g. commercial interests).
- Implement fair regulations to protect waterways and fisheries resources.

- Take local concerns (e.g. about fish health, fish predation, etc.) seriously.
- Acknowledge and respect, at various levels (including legislative, policymaking, and management), the traditions, knowledge, and lifeways of Alaska Native people and the necessity of ensuring their continued customary and traditional use of natural resources.
- Value TK and local input and concerns, and take it into account in management decisions, policy decisions, and setting research priorities.
- Give greater local control over fisheries, natural resources management, and regulations to communities and tribes.
- Do not make decisions about commercial fishing in the local area that go against communities' concerns and views.
- Provide truly equitable enforcement of regulations (e.g. with regard to sport and non-rural fishers, commercial fishers, etc., and in terms of how regulations are enforced on locals in comparison to those other groups).
- Increase and improve collaboration between agencies and governments to solve problems relating to the management of fisheries and problems with fish stocks.
- Do not shift the burden of conservation onto local people.
- Take steps to make policymaking a more representative and accessible process that gives Alaska Natives a true voice, equitable participation, and real access, power, and influence.
- Smarter management (e.g. taking into account the effects of weather on harvest activities when establishing closures, basing closure decisions on good data, etc.).
- Increase monitoring and regulation of vessel traffic, especially with regard to protecting the environment and subsistence.
- Enable small-scale commercial fishing activities and/or increases in limits on cash trade of particular fish in areas where locals feel it is appropriate.
- Take regulatory/management steps to facilitate managing species that are causing problems for fisheries and fishing activities, e.g. beavers, bears, and trout (where appropriate).
- Put an end to salmon bycatch, and exert stricter control over the harvests of the large-scale commercial fishing interests to the south (e.g. Area M and pollock trawlers).
- Take steps to address foreign fishing piracy.
- Prioritize the remedying of problems causing declining fish stocks, and the overall protection of the fisheries.
- Any attempts to introduce hatchery fish should be heavily studied and entail consultation with affected communities.
- More steps should be taken at all policy levels to address climate change.
- Policy, regulation, and management should take a more holistic approach and make the necessary structural adjustments to achieve this. This includes taking an ecosystem approach to policy, regulation, and management, as well as better coordination and integration of policy, regulation, and management between various institutions charged with oversight such that management of the entire fisheries systems can be done effectively and justly.

Recommendations for researchers:

- Work with communities to address concerns related to fisheries and environmental changes through research. This also includes working closely with tribes in the development of projects that pertain to their communities or resources, and also sending information to the communities upon completion of research.
- Take TK seriously and incorporate it into research.
- It is recommended that research funders also take note of the recommendations noted above

which were directed at managers and policymakers to develop a very specific process that is fair to TK holders whereby TK is incorporated into decision-making, research, and so on. It is recommended that funders develop an understanding of the ways TK is best interfaced with, and for this understanding to carry weight in the review of funding applications as well as research review.
- It is recommended that there be increased local control over the conduct and objectives of research carried out in the region.
- Conduct more research into the impacts of high seas fishing on salmon stocks returning to the region.
- Explore the impacts of trout predation on salmon spawning, including increased predation in communities where populations of trout have risen.
- Collect results from other studies on the impacts of jet units to river and spawning habitat and disseminate to interested local parties.
- Explore the impacts of beaver activities on Norton Sound area waterways to determine the extent of impacts to salmon upstream migration and spawning.
- Increase applied research regarding the impacts of environmental and climate change on Norton Sound and Bering Strait region communities.
- Increased testing of region waterways to gather information about, and establish baseline data on, water quality, water temperatures, contaminants, vegetation (e.g. algae, willows), and impacts to fish from these factors and also changes to these factors. Additionally, increase such testing for ocean water temperatures as well as ice size and thickness.
- Research should be conducted which assesses the impacts of existing infrastructure (e.g. roads) that impact waterways used by salmon.
- Continued research into the causes of, and solutions to address, the various declines in salmon populations that have been seen in different parts of the region.

Recommendations for local organizations (e.g. tribes, regional non-profits, etc.):
- Take steps (e.g. pursuing funding) to send local people to fisheries policy meetings.
- Make concerted efforts to get young people involved in subsistence activities.
- Investigate ways communities can efficiently and effectively pool resources to maximize subsistence opportunities in the face of the high cost of fuel and fishing-related equipment (e.g. nets, boats, smokers, vacuum sealers, etc.).
- Take all necessary steps at the local level to ensure the health of nearby natural resources, including waterways (e.g. controlling pollution within the community).
- Develop stronger inter-community collaboration to protect resources.
- Develop local strategies to address problematic species such as beavers, bears, and trout.
- Enact measures to protect local resources, e.g. watersheds, fisheries, etc., and increasing awareness of those measures inside and outside the community.
- Hold workshops with experts to provide expertise to local people on how to do particular things that may not be common practice in the community but is desired knowledge (e.g. how to smoke fish, how to repair nets, canning, etc.).
- NSEDC should be more aware of the concerns of local residents in terms of the projects and activities it pursues.
- Local schools should incorporate Alaska Native culture into their curricula.

Recommendations for other or broader audiences than that which was noted above:
- Greater respect on the part of sport fishers towards locals (e.g. in terms of not wasting, not

overharvesting, not crowding locals out of their fishing areas, respecting local land use policies, abiding by fisheries regulations, and ending catch-and-release practices).

- Commercial natural resource interests (e.g. large-scale commercial fisheries, mining interests, etc.) should stop abusing natural resources and as such harming resources such as fisheries and the rural communities that depend upon them.
- For all people from outside particular communities to respect the local use policies regarding land and waterways established by that particular community.

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DELIVERABLES

Three Seminannual Progress Reports were submitted for this project, on January 30, 2014, July 25, 2014, and January 31, 2015. Additionally, a Project Update was submitted on September 29, 2014.

This document is the Final Report for this project.

The data from this project is being stored at Kawerak's Eskimo Heritage Program archive in Nome, Alaska. See the Project Data section below for more information.

An oral presentation was made at the May 2015 Climate Change in Culture Conference held in Charlottetown, Prince Edward Island, Canada (B. Raymond-Yakoubian and J. Raymond-Yakoubian 2015). A journal paper based in part on this oral presentation is in preparation.

The Final Report for this project has been distributed to all project participants as well as all 20 Kawerak-region Tribal Councils and schools. The Final Report is available to the public via Kawerak's Social Science Program webpage (http://www.kawerak.org/socialsci.html).

PROJECT DATA

Project 1333 Project Data Summary:

- *Name of people who generated the dataset.*
  Julie Raymond-Yakoubian and other project staff

- *Organization/Institution name.*
  Kawerak, Inc.

- *Description of dataset.*
  The dataset contains a series of interview audio files (in .mp3 format) and transcripts (in Microsoft Word .doc format) from interviews conducted with traditional knowledge experts on salmon and the environment in 2008-2009 in Brevig Mission, Diomede, Golovin, Koyuk, Saint Michael, Unalakleet, Wales, and White Mountain. The dataset also contains a number of image files (in .jpg format) from photographs taken during the data collection activities.

- *A summary of the intentions with which the dataset was developed.*
  The dataset was generated to document information about region residents' traditional knowledge of salmon and the environment.

- *Additional information not covered elsewhere and/or important information.*
  The dataset, which consists of interview audio files, transcripts of interviews, and image files, is stored at the Kawerak Eskimo Heritage Program Archives. Project participants retain intellectual property rights over the information shared during the course of interviews. Participants have agreed to have the interview audio, interview transcripts, and image files stored at and accessed from the Eskimo Heritage Program archives.

- *Short description of where the data were collected.*
  The data was collected from local experts in the Alaskan communities of Brevig Mission, Diomede, Golovin, Koyuk, Saint Michael, Unalakleet, Wales, and White Mountain.

- *Key Words.*
  Key Word 1: Alaska Native
  Key Word 2: Norton Sound
  Key Word 3: Bering Strait
  Key Word 4: Traditional Knowledge
  Key Word 5: Salmon
  Key Word 6: Environment

- *Regional and specific references.*
  Place Name 1: Norton Sound
  Place Name 2: Bering Strait
  Place Name 3: Brevig Mission
  Place Name 4: Diomede
  Place Name 5: Golovin
  Place Name 6: Koyuk

Place Name 7: Saint Michael
Place Name 8: Unalakleet
Place Name 9: Wales
Place Name 10: White Mountain

- *Taxonomic information of the primary species studied.*
  Kingdom: Animalia
  Phylum: Chordata
  Class: Osteichthyes
  Order: Salmoniformes
  Family: Salmonidae
  Genus: Oncorhynchus
  Species: tshawytscha, gorbuscha, keta, kisutch, nerka

- *Accessibility, restrictions, and citational requirements regarding this dataset.*
  Dataset is accessible through the Kawerak Eskimo Heritage Program Archives. Researchers must contact or visit the Eskimo Heritage Program Archive, sign a user agreement, and request specific files. Must cite originator if used in publications, reports, presentations, etc.

- *Description of the dataset in the producer's processing environment.*
  The dataset is a series of interview audio files created using a Maranz PMD 660 digital recorder, interview transcripts created in Microsoft Word and also available in Adobe .pdf format, and image files in .jpg format created using a digital camera. The dataset contains files for 45 interviews.

- *Describe the accuracy of your data in terms of process or observation error and how these errors were calculated.*
  Not applicable.

- *Did you check for bad values and conditions?*
  Not applicable.

- *Identification of data omitted from the data set that might normally be expected, as well as the reason for the exclusion.*
  None.

- *Detailed summary of the information contained in the dataset.*
  The dataset contains information from interviews with experts on the topics of salmon and the environment in the Alaska communities of Brevig Mission, Diomede, Golovin, Koyuk, Saint Michael, Unalakeet, Wales, and White Mountain.

- *References to literature and/or website where more information on this general research topic can be obtained.*
  See References section contained within this Final Report.
  http://www.kawerak.org/socialsci.html
  http://www.kawerak.org/ehp.html

PRESS RELEASE

This project strove to gain a broad understanding of the ecology of the Bering Strait and Norton Sound region and changes through time in it, specifically relating to salmon and the environment, that region residents have experienced and observed. This report summarizes and analyzes data from research which engaged Norton Sound and Bering Strait region residents on these topics and included interviews and workshops conducted with traditional knowledge (TK) holders and leaders in the Bering Strait/Norton Sound region communities of Brevig Mission, Diomede, Golovin, Koyuk, St. Michael, Unalakleet, Wales, and White Mountain. The central question of the research can be stated as such: What is the current status and sociocultural significance of, the observed changes to, and the concerns about the salmon resources and environment in the Norton Sound/Bering Strait region as evidenced in TK? The goals of the project included describing these changes to both salmon and the environment in a geographic context so that relevant information can be applied to aid in current fisheries challenges, including fisheries management and freshwater and marine ecosystem research, and augmenting ongoing and future biological research with social science as well as contributing to social science research.

In this report, data are presented from the eight communities noted above on salmon (king [chinook], pink [humpy/humpback], silver [coho], red [sockeye], and chum [dog]) biology, behavior, population, distribution, harvest, and use. Additionally, data gathered on the broader regional ecosystem and changes within it are described and linked-up with the data on salmon. Also presented are data on sociocultural processes associated with the above salmon- and ecosystem-related processes. Discussions on current fisheries challenges, management processes, fisheries and ecosystem science and knowledge systems, community-input-driven recommendations (e.g. to managers, policymakers, researchers, and local entities), and the contributions of the data to existing bodies of ecosystem, management, and social science literature are presented.

Some of the key results and potential applications of this research are as follows. There was an uptick in concerns about fish health compared to the past. Overall, participants noted decreases in salmon populations, though there was variation regarding this, including the two most northerly communities giving indications of increases. Harvests are down overall. A number of environmental changes were noted, e.g. more rain, less snow, more unpredictable weather, warmer winters, warmer water temperatures, widespread erosion, thinner winter ice, later freezeups, and more variable breakups. Concerns were noted about the effects on salmon populations of predator fish (especially trout), commercial harvests, and dramatic increases in beaver populations. Environmental changes, management practices, and large-scale commercial fishing activities are seen as the three biggest threats and sources of harm to fish populations, fisheries, fish environments, and abilities for local harvest. Significant concern was expressed by participants for the health of fisheries and natural resources in general. A complex picture also emerged of the importance of salmon to communities, coupling decreased harvest activities with continued importance in cultural, nutritional, and economic terms. Numerous recommendations were made by participants having relevance for management, policymakers, researchers, and study-region residents and entities.

APPENDIX

Interview guide used for project interviews conducted in 2008 and 2009.

Traditional Knowledge and Norton Sound/Bering Strait Salmon Variability project Interview Guide

NOTE: "Salmon" refers to dog salmon, king salmon, red salmon, humpies/pink salmon, and silver salmon.

- Who taught you to fish for salmon?
- What is your earliest **memory** of salmon fishing?
- How long have you been fishing for salmon?

For the following questions, where relevant: What was this change; where did it happen; when did it happen; why did it happen?:

- Have you seen any significant **changes in salmon** populations in your lifetime?
  - What do you think **causes** year-to-year changes in the salmon returns?

- Have you seen any significant changes in salmon **behavior** in your lifetime?
- Have you seen any significant changes in salmon **migrations/movement** patterns in your lifetime?
- Have you seen any significant changes in salmon **health** in your lifetime?
  - Have you noticed a change in the **quality of salmon flesh** (soft/skinny/smelly/harder to preserve, etc.)?
  - Have you seen lamprey scars, sea lice, **worms**, cysts or sores?

- Have you ever seen **dead salmon** (not spawners) washed up on beaches? What species, where, when?
- Have you noticed changes in the **size, shape** of salmon?
  - Do you think these changes are related to changes in the climate or ocean environment (e.g. temperature, wind, cloud cover, sea ice, salinity, currents, availability of food)?
  - Do you think changes in body size of salmon are related to ocean fishing? Why?

- What salmon species have you used in the past?
- What species do you use now?
- If different, why has this changed?
- Has the **gear** you use to catch salmon changed?
  - What kind of boat (type and size) and what kind of motor (type and size) do you use to fish for salmon?

- Do changes in the climate or the ocean environment impact salmon returns? How?
- Does **ocean fishing** affect salmon returns? (trawlers)
  - Which has a bigger impact on salmon returns? Why?

- Do you ever fish in the **ocean**? What kind of fish are you trying to catch?
  - Have you ever caught a salmon in the ocean? What species? Where?

- If salmon, how did you catch the salmon (type of boat, fishing gear)? When you catch a salmon in the ocean do you know what river it is from? How?

- Do you know other people who fish for salmon in the ocean? Who?
  - What species, where, when? How did they catch the salmon (type of boat, fishing gear)?

- Have you ever caught salmon in the ocean or in a river with **net marks** from ocean fishing?
- Other than fishing, have you ever seen salmon in the ocean? For example, have you ever seen salmon **jumping** out of the water in the ocean?
- Have you ever seen eagles, seabirds, marine fish, or marine mammals eating salmon in the ocean?
- Have you ever seen salmon in the ocean near **sea ice**?
- Have you ever seen salmon **feeding** in the ocean? Do you know what species? Where? When?
- Have you ever seen salmon **interacting** with other animals in the ocean (e.g. other fish, birds, whales, etc.)?

- Can **declines** of one species tell you about the future of another?
- Have you encountered any **salmon** species that **haven't been here** before?
- Have you encountered any **other fish species** that you haven't seen before?
- Do you catch any of the new species of fish that have arrived in this area?
- Are particular species that were here, **no longer present**?
- Have salmon species **moved into new streams** that they haven't used before or that only other salmon species used in the past?
- Do you know where each species **spawns**?
- Do salmon spawn in different areas than they used to?

- **Where** do you catch each species of salmon? Map
- Why is your **camp located** where it is?
- Are there other places where you have found artifacts or something that indicated that people had **fished there long ago**?
- Are these the same areas that you fished in the past?
  - If not, why not?

- Are there **more or less** of each species of salmon?
- When did you begin to see these changes in population numbers?
- Where have you seen these changes (what creeks or rivers)?
- Approximately how many fish per set of your net do you get? Is this different than in the past?

- Can you tell me about the **runs** for each salmon species – when and where they take place?
  - Reds (sockeye); Pink (humpies); Coho (silvers); Chum (dogs); Chinook (kings)

- Are these **runs different** than in the past?
- Are they **larger or smaller** in size?
- Do they begin **earlier or later**?
- Do they **last as long** or are they shorter?

- Are the runs more or less **predictable** than in the past?
  - Is this related to climate?
  - Is this related to ocean fishing? How do you know?

- Is there any way to tell, at the beginning of a run/season, if a run will be strong or not? What are the main things that **impact** how many salmon there are every year?

- What does each salmon species **eat** (in freshwater or the ocean)?
  - Have you seen a change in the amount or type of **food in the stomachs** of salmon caught in freshwater or the ocean?

- Can you remember any particularly **good or bad** years for salmon?
- Can you describe what made it bad or good and where it happened?
- Did you ever hear **stories** from your parents or anyone else about how salmon fishing was in the past?

- Can you talk about **climate changes** or environmental changes that you have seen in your lifetime?
- When did you start to notice these changes?
- Where did you start to notice these changes?
- What do you attribute that change to?
- Do you think it has affected salmon in any way?

- Have you noticed any changes associated with **freeze-up**?
- Have you noticed any changes associated with **break-up**?
- Have you noticed any other changes related to **sea ice**?
- Do you think any of these changes have affected salmon in any way? How?

- Is the climate/weather more or less **predictable**, or just as predictable, as it was in the past?
  - In what ways?
- Have you noticed changes in **water levels** in ponds or rivers?
- Have you noticed changes in **water temperatures**?
  - **Ocean currents**?
  - **Plankton blooms**?

- Have you noticed changes in **wind** patterns or wind strength?
- Have you noticed changes in **vegetation** (land or aquatic)?
- Have you seen new **insects**, or changes in insects?
- Have you seen new species of **birds**, or have some disappeared?
- Do you see more **bears** than in the past?

- What do you think is responsible for any or all of these environmental changes?
- Do you think the changes have affected salmon?

- How have people here **adapted** to the changes you have described (environmental or salmon

related)?
- Have you noticed any changes in **other animal** populations?
- Do you think they are being affected by the same factors/causes as salmon?

- Have people begun to replace one species of salmon with another, in terms of what they are catching?
- Do you spend more or less **time salmon fishing** than in the past?
- What about others people in the community?
- Are there more or less **people salmon fishing** now than in the past?
- Did you depend more on salmon in the past than you do now?
- Why has that changed?

- Have **fuel prices** impacted subsistence fishing?

- Have you, or people in general, changed their **attitudes** about salmon?
- Are there certain ways that they used to be treated or handled, but aren't any more? (Prohibitions)
- What do you think about the relationship between people and salmon?
  - How has this changed in your lifetime?
  - How did your parents or grandparents think about the relationship between people and salmon?

- Why are **salmon important** to people? Has this changed over time?
- What is the relationship of fish to the community? Has this changed over time?

- What do you think **causes** year-to-year changes in the salmon returns?

Iñupiaq/Yup'ik/St. Lawrence Yupik names for salmon species

- Is there anything else that you would like to say about salmon?
- Is there anything else that you would like to say about the environment?
- Is there anything that you would like to say about how salmon are managed?
- Do you have any recommendations about how salmon should be managed?