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Life Without Ice: Climate Change and the Subsistence Communities of St. Lawrence Island

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Abstract

The Bering Strait region is undergoing rapid environmental change linked to the loss of sea ice. The goal of this study was to assess the impacts that environmental change and loss of sea ice have had on marine subsistence resources and resource users in the communities of St. Lawrence Island (SLI). Twenty-four stakeholders from SLI participated in ethnographic discussions held over three weeks in May 2019. Five main themes were explored: 1) key marine resources, 2) changes in key resources, 3) community responses to change, 4) community attitudes towards oil and gas development in the region, and 5) perceptions about the future of the subsistence way of life in these communities. Discussions were transcribed and uploaded into MAXQDA software to code themes. The four most discussed marine resources were Pacific walruses (*Odobenus rosmarus divergens*), seals, crabs, and fish. The most significant resource changes identified by stakeholders included decreased walrus harvests and limited access with increased hunting effort; increased abundance of Hanasaki crab (*Paralithodes brevipes;* also known as spiny king crab); limited crab harvests due to lack of shorefast ice; and increased abundance of walleye pollock (*Gadus chalcogrammus*) and Pacific cod (*Gadus macrocephalus*). Oil and gas development was identified as the most concerning human activity in the region. Two-thirds of stakeholders indicated that they would not support oil and gas development near SLI due to the impacts it would have on marine animals either via disturbance or contamination. SLI residents utilize all edible marine flora and fauna and, at times, eat less preferred prey items. Lastly, most of the stakeholders who addressed the future of subsistence activities felt that the next generations would harvest and consume fewer subsistence resources. Due to environmental changes and, most specifically, loss of sea ice, SLI communities may have to diversify the species they hunt and consume to continue their maritime subsistence practices. Alternatively, stakeholders may turn to terrestrial wild and domestic resources such as reindeer (*Rangifer tarandus*).

Introduction

The eastern Bering Sea supports some of the greatest benthic biomass densities in the world (Grebmeier et al. 2006). This rich benthos underpins large commercial fisheries and a food web that supports approximately 33 crab species (Byersdorfer & Watson 2010), 34 avifaunal bird species that nest along the Bering Strait coastline and islands (Drury 1980), and nearly 30 marine mammal species that reside in the Bering Sea seasonally or year-round (Ray et al. 2014). St. Lawrence Island (SLI), the largest island in the Bering Sea, is home to Gambell and Savoonga, two of the largest villages in the Bering Strait region, each with approximately 700 people (Figure 1). The majority of SLI residents (Gambell 95.6%; Savoonga 94.5%) are of Alaska Native descent (2010 U.S. Census). Inhabitants of SLI are Siberian Yupik (Yupik), and they rely heavily on marine resources as part of their daily dietary needs (Ahmasuk et al. 2008), cultural identity, and social cohesion. Like other northern and Arctic inhabitants, Alaska Native communities in the Bering Strait rely on a mixed subsistence economy (Krupnik 1993, Robards 2008). On SLI, marine mammals, terrestrial plants, reindeer, store-bought food, and federal aid make up the main components of this economy (Robards 2008), as jobs are scarce in the villages.

SLI is in the Bureau of Ocean Energy Management (BOEM) Alaska Outer Continental Shelf (OCS) planning area (Figure 2). This qualitative study was conducted in 2019 to further information on the communities in the region by documenting changes in availability and use of marine resources and documenting SLI stakeholder perspectives regarding oil and gas development.

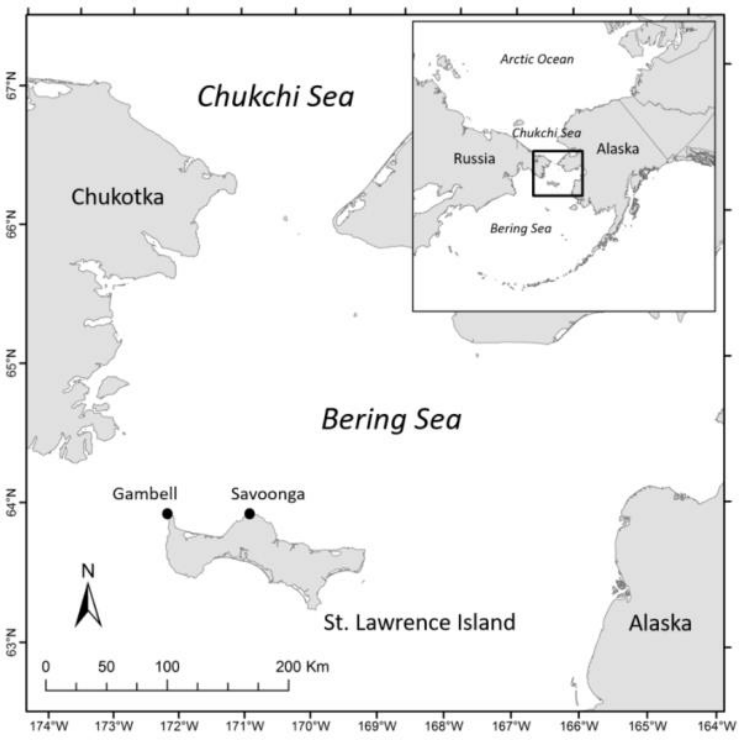

Figure 1. Study sites on St. Lawrence Island, Alaska.

Figure *2*. Bureau of Ocean Energy Management planning area (BOEM 2020).

Rapid reductions in sea ice and increases in air and seawater temperatures have been well documented in the Arctic in recent decades (Comiso 2012, Hamilton & Stroeve 2016, Polyak et al. 2010, Steele et al. 2008, Stroeve et al. 2007, 2012, Stroeve & Notz 2015). While the effects of climate change are variable across species and regions, research in the Bering Sea has documented the following changes in association with environmental changes: marked shifts in the zooplankton community structure (Coyle 2008, Coyle et al. 2011), shifts in run timing of salmon (Myers et al. 2010), changes in the diets of walleye pollock (*Gadus chalcogrammus*), as well as pink (*Oncorhynchus gorbuscha),* chum (*Oncorhynchus keta)* and sockeye salmon (*Oncorhynchus nerka,* Coyle et al. 2011), observations of baleen whales overwintering further north than previously recorded (Moore et al. 2006, Moore & Huntington 2008) and alterations in movements of marine mammals in response to changes in sea ice extent (Huntington et al. 2016). For the first time, data from a recent National Oceanic and Atmospheric Administration (NOAA) trawl survey in the southeastern Bering Sea showed the absence of the "cold pool," a thermal barrier that isolates many fish and some invertebrate species from transiting between the northern and southern Bering Sea (Stebeno et al. 2019). This change may have widespread impacts on productivity (Coyle et al. 2011) and predators that feed on benthic prey such as Pacific walruses (*Odobenus rosmarus divergens*), bearded seals (*Erignathus barbatus*) and grey whales (*Eschrichtius robustus*), as well as top trophic level predators such as polar bears (*Ursus maritimus*) and killer whales (*Orcinus orca*), some of which make up key components of protein in the diets of SLI residents (Ahmasuk et al. 2008). While ecosystem changes have been documented, there is a paucity of research on the effects of ecosystem changes on subsistence-based communities in this region.

The total number of walruses harvested across Bering Sea communities has plummeted in recent years (Krupnik & Benter 2016). SLI hunters have reported earlier and quicker ice-break up in the spring (Metcalf & Krupnik 2003). NOAA declared an Unusual Mortality Event (UME) during 2011-2016 for Alaska pinnipeds in the Bering and Chukchi Seas that exhibited lesions, hair loss, and stranding both live and dead. More than 600 seals and walruses were reported infected (www.fisheries.noaa.gov, *a*). Another Alaska ice seal UME was declared in the Bering Sea as of June 2018 and was ongoing at the time of this report (www.fisheries.noaa.gov, *b*). Additional concerns have included high levels of domoic acid and saxitoxin in Alaskan marine mammals due to harmful algal blooms, with high concentrations reported in stomach contents from walrus (Lefebvre et al. 2016). These toxins may affect the health and behavior of walruses and are a concern for SLI residents as bivalves from walrus stomachs are a subsistence resource. These recent changes have led to concerns about food security and safety and overall environmental changes in the Bering Strait region.

The primary aim of this research was to document *local* truths, rather than regional trends, about marine harvested subsistence foods and attitudes towards gas and oil development. A qualitative research approach was employed to determine 1) the key marine resources for SLI communities, 2) changes in key marine resource harvests and use, 3) community responses to ecosystem change, 4) perceptions about the future of the subsistence way of life in these communities, and 5) community opinions about oil and gas development in the region.

Methods

Methodology and approval

The fieldwork for this project was carried out in the communities of Gambell and Savoonga on St. Lawrence Island (Figure 1) in April and May 2019 using the techniques of Rapid Qualitative Inquiry (RQI; Beebe 2014). The RQI technique is defined by three basic concepts: 1) it is focused on obtaining insider/inhabitant perspectives, 2) data collection involves multiple sources of data and is conducted by a team of two or more researchers, and 3) data analysis is an iterative process conducted by a team (Beebe 2014). This type of research is appropriate for identifying variables that cannot be easily measured or numerically quantified and is useful to "hear silenced voices" (Creswell 2013) at a local scale.

The Native Villages of Gambell and Savoonga were included in project development and permitted this research to be conducted in their communities (letters of support in Appendix 1). Other Alaska Native Organizations in the region were informed of the project, including the Eskimo Walrus Commission, the Alaska Eskimo Whaling Commission, the Bering Sea Elders Group, and Kawerak Inc. The University of Alaska Fairbanks Institutional Review Board approved the study (protocol number 1321844-3; Appendix 2). Participant identity and personal information were kept confidential.

Stakeholder selection and study design

Purposive sampling (Creswell 2013) was used for stakeholder selection to incorporate two groups: expert key informants and household community members. Stakeholders were identified as expert marine resource users based on experience with hunting, harvesting, and/or preparing indigenous foods. This group of key informants included elders, whaling and walrus boat captains and crew members, fishermen, and family food preparers. The second group of stakeholders had more generalized knowledge of marine subsistence resources and contributed household-level information. A balanced design was sought based on age, gender, and geography (physical location of the stakeholder's residence). Stakeholder residences were plotted using a map and overlaying grid created using Google Maps imagery. Since housing locations varied by income and age, this information was useful for obtaining a sample representative of the population. For example, in Gambell, the Old Village site is closest to the ocean and typically houses elders or older individuals while newer homes are being built closer to the school.

A team of two researchers conducted ethnographic discussions (discussions). One researcher had an established rapport with community members through prior research activities. The second researcher, an Alaska Native from the Bering Strait region, used personal knowledge of indigenous food preparation, harvesting, and preferences to engage stakeholders. Discussions were modified with each stakeholder to explore their expertise. Discussions were initially conducted by both researchers to standardize the protocol. St. Lawrence Island Yupik is the primary language among adults aged 40 and over; however, all ages fluently speak and write English, so all discussions were conducted in English. With the participant's permission, conversations were recorded using a Zoom H4nPro Handy Audio Recorder (2016 Zoom Corporation). Written notes were taken if stakeholders were not comfortable being recorded.

Responses from expert key informants and household community members were combined in the final data analysis. The two groups were similar; all participants were long-term residents of SLI who indicated that they participated in subsistence activities and consumed indigenous foods weekly or daily. "Participation" was defined as hunting animals, collecting plants or beachcast seafoods, preparing indigenous foods, and consuming indigenous foods. The term "subsistence," defined as "customary and traditional uses of fish and wildlife," has been used in surveys conducted by the State of Alaska (www.adfg.alaska.gov). However, some stakeholders expressed dislike for the term and preferred the use of "indigenous foods." For this reason, the terms are used interchangeably in this study report.

Data analysis

Discussions were transcribed into Microsoft Word and imported into MAXQDA 2020 Analytics Pro software (VERBI software GmbH 2020) to code themes, create frequency charts, and assess connections between themes. The transcription of audio recordings followed the exact

flow of the conversation and, when audio recordings were not available, notes and photos were compiled and organized into the Word format.

Results

Characteristics of participants

Twenty-three discussions were conducted with 24 stakeholders (in one instance, two stakeholders met together). Researchers recruited more in Gambell because personal connections existed in the community from previous research. Table 1 shows participant demographics.

Table 1. Participating stakeholders by age and gender.

Participants		Participant Ages		Participant Genders	
Gambell	16	20-39	5	Gambell Female	10
Savoonga	8	40-59	8	Gambell Male `	6
		60-79	9	Savoonga Female	2
		Ages 79+	1	Savoonga Male	6
		Age unknown	1		

As reported by study participants, the median number of people per household was six. The median number of people employed per household was one (full, part-time, or seasonal), and the median amount estimated as spent on groceries per month was $200 per person. Spending fluctuated with income and family size, and several men said that they spend more at the store when they have money and rely more on subsistence harvest when they do not. Stakeholders agreed that store prices have significantly increased in the last 25 years. Most stakeholders also said store prices have increased in the previous 10 years, but four felt that prices had not changed. Participants felt they had no control over store prices, and many said that high store prices led them to rely even more on subsistence foods. One Savoonga resident articulated:

> *"…the cost of goods is outrageous, you know, I'd rather eat a steak of walrus than a steak from the store, that's like 30 gallons of fuel right there for one steak. Or close to it, you know? Fifty-something dollars for a steak that's quite a bit of fuel I could be using for subsistence foods. A lot of times, it comes down to - should I get fuel, or should I go to store and buy groceries, or should I pay for this bill or that bill, you know? A lot of times, we will choose not to go to the store because of lack of income." (Savoonga, age 54).*

Key marine resources

The importance of specific marine resources was determined by quantifying the number of times stakeholders referenced a species or group of animals in proportion to the number of times other species were referenced (Figure 2). Frequency identified what stakeholders most wanted to talk about, so these resources were considered most culturally important even if they were not the most consumed. All species listed are consumed except for killer whales, which are considered sacred to SLI inhabitants. For this study, walruses, seals, fish, and crabs were

identified as *key resources*. These species are also undergoing the most change according to stakeholder knowledge. While seals were the second-most discussed resource, the category included all four species of ice-seals harvested on SLI: ringed (*Phoca hispida*), ribbon (*Phoca fasciata*), bearded (*Erignathus barbatus*), and spotted seals (*Phoca largha*). Stakeholders discussed similar changes concerning ice-seals and walrus were, so they are addressed together in this report.

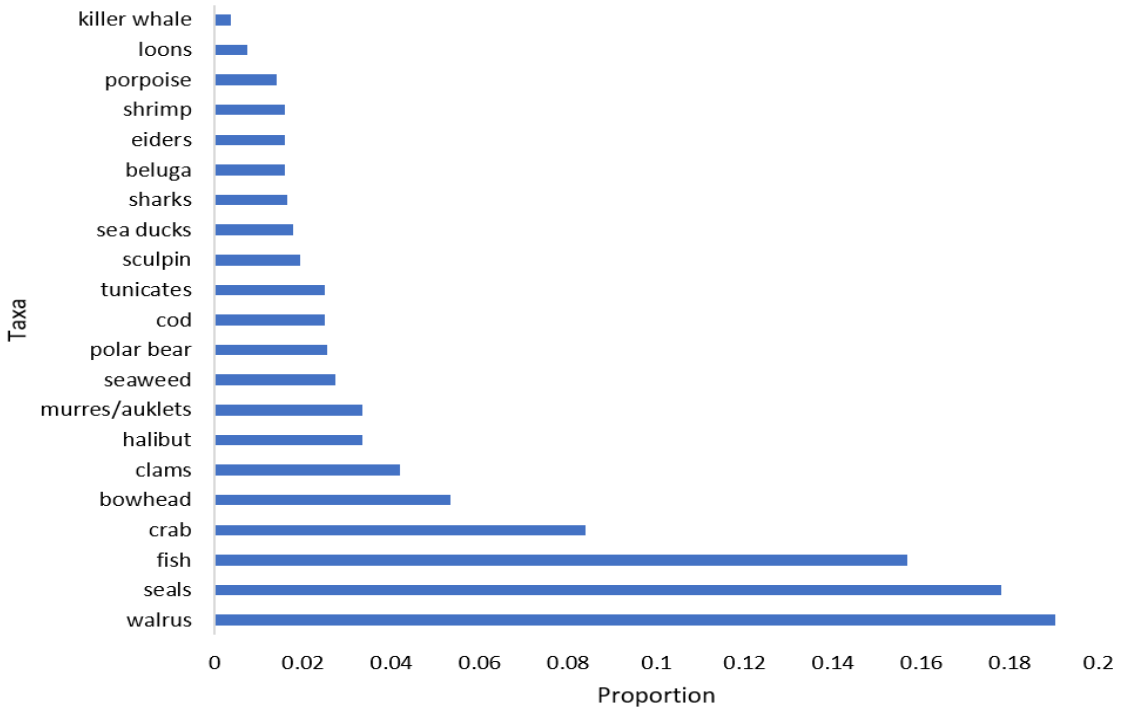

Figure 3. The proportion of times resources were referenced in discussions. Resources at the bottom of the chart were referenced most often in discussions of cultural and dietary importance of resources and changes occurring to the harvest, health, or abundance of resources.

Changes in key resources

Walruses and seals

Walruses were the most mentioned resource in all discussions (Figure 3). As stated by a Savoonga stakeholder, the relationship that SLI residents have with walruses goes beyond food for the table; it has been their lifeline to survival.

> *"I would say that our most powerful ally in our survival has been the walrus…the walrus provided for us—their tusks for harpoon hits, tools, sewing needles, and the skin for skin boats, and also the skin for summer homes…the summer houses are logs and covered with walrus skin…without the walrus, I think we would have had a very hard time. So the walrus gave us everything that we need, needed for hunting equipment, tools, building homes." (Savoonga, age 60).*

The main changes stakeholders reported were reduced access and overall catch of walrus, increased hunting effort, and concerns about their reproductive success without ice. Stakeholders identified decreasing sea ice, climate change, and bad weather as the drivers limiting access to walrus herds. As one stakeholder noted: *"…because the ice re-routing somewhere, our hunting season has been real bad, like we haven't seen or caught any baby walrus or female walruses because of climate change." (Gambell, age 63).* Most hunters have witnessed this change during the last two decades. When asked about recent catches, one stakeholder stated: *"It has dramatically dropped… we're harvesting probably less than half we used to harvest ten years ago." (Savoonga, age 60).* Seals were also mentioned in all discussions, and several hunters reported that, like walrus, seals are becoming harder to access. Bearded seals, in particular, were reported as being difficult to access due to declining sea ice.

Stakeholders indicated that "bad weather" (characterized by high winds) has been occurring more frequently than in the past and has reduced the number of days hunters can go out for walrus, seals, and whales. Hunters and nonhunters alike reported a shrinking hunting window. Historically the walrus harvest would last from April through June; now, it has been condensed into May.

When calm conditions allow, hunters are traveling further by boat than in previous decades. Hunters also reported that without ice cover, boats are taking on larger swells. Several stakeholders reported going 80-100 miles away in search of walrus. The youngest stakeholder in the study noticed a considerable difference during her lifetime. Referring to a specific hunting spot she noted:

> *"It's 83 miles away from this island and that's the farthest I've had to go out before to harvest walrus. And a long time ago, when I first started, we used to have to go 5-10 miles out, so that's a huge difference from there." (Savoonga, age 20).*

Consequently, a shorter hunting window and more bad weather days have made planning hunting trips near impossible. With changing conditions and small sections of ice moving by quickly, the hunting style has become more "opportunistic." As one stakeholder explained:

> *"It's more of an opportunistic hunting now… we're starting to push the envelope of safety a little bit more because of open water. And lack of sea ice, you know, that's factoring into the way we're hunting. It's more of an opportunistic technique we're doing now…Combat hunting. We go out real fast and come back…Like spur of the moment hunting…In the past, we used to plan it out carefully, you know? Make sure we had everything. But now…everything is getting faster. Opportunistic hunting style, yeah." (Savoonga, age 54).*

In addition to low harvests, access to reproductively active female walruses was a concern. SLI residents have long targeted females with calves as fermented baby walrus and fermented lactating mammary glands of females are a regional delicacy. These dishes were

historically aged in underground food caches. While food caches are no longer used to ferment baby walrus, "qasiqaq" (the term for this delicacy in Yupik) is usually eaten on the 4th of July and at birthday celebrations. Some of the older stakeholders were concerned that low catches of females and calves has meant that their grandchildren have not yet tasted these delicacies, and there is a fear that they will not develop "a taste for them" if they are not eating this food from a young age. Some stakeholders reported being worried that this unique part of their culture will be lost.

Additionally, community members reported making less dried meat from bearded, ringed, and spotted seals as seal harvests have been lower in recent years. Stakeholders did not all agree on the exact timeframe of declining harvests. One person noted decreasing seal harvests over the past ten years; another person said just in the last two years. Hunters also addressed the health of seal species in reference to the 2011-2016 Alaska Pinniped UME. Several stakeholders noted that seals are healthier now than they were several years ago when animals were reported as having "balding skin" and "being skinny." When asked when she noticed the change in the health of harvested seals, an elder and food preparer responded: "*Maybe for the past seven years, but this year is the first year I seen healthy ones, 'cause I always cut up seals when my son brings them up." (Gambell, age 63)*. Stakeholders did not report a change in seals' stomach contents, providing evidence that dietary changes are not occurring, making it less likely that diet was a major factor in the UME.

Hunters voiced concern about the reproductive success of female walruses and ice seals. Regarding the 2019 spring harvest season, one hunter said:

> *"Hardly any female with calves… they've caught none. And whether [they've] already gone past us, or [what] we don't know. That's one of the things that we get concerned [about], if they gave birth in the water, and there's no means to feed their calves, there must be a high mortality rate for the females with their calves, and that's one of the big concerns we have for the female [walrus]." (Gambell, age 68).*

Furthermore, lack of sea ice will take away the only platform hunters have to harvest walrus and ice seals on, *"… 'cause if there's no ice, there's no means for them to get on ice to give birth to their young, or to harvest them. [We] harvest the walrus on ice and bearded seal." (Gambell, age 68).* Animals are shot on the ice, so the animal does not sink. Butchering is also conducted on the ice when stable.

Lastly, several stakeholders remarked that dead young bearded seals have been washing up for several years. One stakeholder attributed the deaths to the pups being crushed by fragmented sea ice. He estimated female bearded seals are currently losing a quarter of their young to this mortality. Bearded seals are valued for their meat, and hunters said (as with walrus) that lack of sea ice has made them harder to find in recent years. Other stakeholder comments were that shore ice is important pupping habitat for ringed and spotted seals, that spotted seals are showing up later in the year, and that there were few to no ribbon seals in 2018.

Fish

Fish were often talked about during discussions. The species consumed included: Pacific halibut (*Hippoglossus stenolepis*), Pacific cod (*Gadus macrocephalus*), walleye pollock, all five salmon species (*Oncorhynchus sp.*), dolly varden (*Salvelinus malma*), sculpin species (*Cottidae sp.*), Bering wolffish (*Anarhichas orientalis*), polar eelpout (*Lycodes turneri*), Pacific herring (*Clupea pallasii*) and herring eggs, Pacific sand lance (*Ammodytes hexapterus*) and salmon sharks (*Lamna ditropis*). Though fish ranked high in the number of times discussed, this is, in part, attributed to discussions around commercial fishing, as Savoonga has a commercial halibut longline fishery. Halibut are fished for subsistence use, but fish were generally less valued as a subsistence food resource than marine mammal meat, including bowhead whales (*Balaena mysticetus*). While fish are consumed frequently, they likely outranked whale species in topic frequency (Figure 2) because the nature of discussions focused on subsistence resources changes.

Stakeholders reported seeing large increases in both walleye pollock and Pacific cod. There is a commercial halibut longline fishery Savoonga. When asked if Pacific cod are ever caught, one fisherman replied: *"[We catch] too much cod…They were biting all our halibut hooks. Maybe 80% of our catch was codfish. Catch too much cod we have to pull our lines and move 'em somewhere else." (Savoonga, age 54).* The perceptions of why fish stocks have moved varied. Many attributed the shift to sea ice loss; others who do not participate in the commercial fishery in Savoonga have also witnessed changes in fish stocks, as evidenced by more outside commercial fishing presence in the area. One Gambell resident stated:

> *"… they're experiencing less pink salmon in Norton Sound, whereas out here, we see more fish coming around St. Lawrence Island, around Gambell – cause we have no commercial fishing here. And it seems that commercial fisheries, fishermen are pushing the fish further this way because we have no commercial fishing except for Savoonga that does commercial halibut fishing." (Gambell, age 68).*

This person's view was that fishing effort is moving due to less resource availability in neighboring areas, not that commercial fish stocks were moving due to environmental changes.

The increase in Pacific cod was not viewed with optimism by stakeholders. Though some stakeholders consume the fish, it is not considered a preferred food item, and not all stakeholders eat it. One individual felt the fish is "too mushy," and he simply releases codfish he catches when jigging. Further, the fish do not currently provide economic benefits to fishermen. As one fisherman explained: *"…we have to get a separate license to get cod to sell, but they're not as expensive as the halibut is. They're only like 50 cents a pound. And we have to gut 'em, and it's just not worth it." (Savoonga, age 54).* Similarly, Walleye pollock was documented as being consumed by some, but most stakeholders did not mention eating them, making their increase in abundance not of immediate interest to stakeholders. What was of great concern to stakeholders was that increases in commercial fish stocks would also bring increases in visiting commercial fishing fleets.

Crabs

Stakeholders noted two significant changes regarding crabs: 1) Hanasaki crab (spiny king crab; *Paralithodes brevipes*) is becoming much more abundant, and 2) crabs are far less accessible in recent years due to sea ice loss. As one individual stated: *"The Hanasaki crab from Japan is taking over this 5 miles east of us, we're getting the Hanasaki crab by the hundreds." (Savoonga, age 60).* Many other stakeholders echoed this comment. Both blue king crabs (*Paralithodes platypus*) and the Hanasaki crabs are harvested primarily in winter under the sea ice using weighted lines. Unfortunately, for several years people have been unable to access these valuable resources due to a lack of sea ice. One stakeholder reported: *"But we have no more shore ice, we don't go handline crabbing anymore because there's no ice, for the past seven years or so I guess it's been like that." (Gambell, age 63).* The stakeholders we spoke with enjoy harvesting and consuming this new species; however, their growing abundance and strange spiny carapace brought them much attention during discussions.

Community responses to change

> *"[Our] people are here today because we use our own resources and common sense." (Gambell, elder age 81).*

Community responses to change were classified in two ways: previously documented responses and undocumented responses. Previously documented responses to ecosystem changes include consuming less preferred food items and utilizing all edible resources (Bockstoce 1995). In our study, stakeholders identified sea ducks (*Histrionicus histrionicus, Clangula hyemalis*, and *Somateria sp*.), ribbon seals, and belugas (*Delphinapterus leucas*) as less preferred food items. Sea duck meat is less desirable than marine mammal meat; however, as one stakeholder said, *"it is better than nothing"* when he is at Whaling Camp (a place name for the whaling location Savoonga hunters launch from outside of the village). Stakeholders reported that ribbon seals are present and abundant when the last of the sea ice passes by the island at the very end of the walrus harvest. Hunters acknowledged that these seals have dark, bloody meat, but if they are unsuccessful in harvesting walruses, they may take a young ribbon seal back to feed their family.

Additionally, hunters reported spending more time harvesting bearded seals during other times of the year if they do not fill their freezers with walruses and bowhead. Belugas are considered a delicacy by mainland Alaska Native communities; however, stakeholders on SLI showed an aversion to the idea of consuming that "oily, fishy" meat. In addition to poor tasting meat, when asked why belugas are not targeted, hunters often said because their ancestors did not hunt them and that they are more focused on the opportunity to harvest a bowhead during this time. As one stakeholder said: *"…we don't generally go after them like the mainland hunters. We're hunting bowhead whales instead of belugas." (Savoonga, age 54).* Food is strongly coupled with cultural identity, and such views are common across cultures, especially among Alaska Native cultures (Borré 1991). However, stakeholders did note that belugas are an

abundant resource and can be found year-round. On the other hand, bowheads are not successfully hunted each year in either SLI community.

Beachcast seafoods are edible plants and animals that are washed up on shore and consumed. These include shrimp, sea stars, tunicates, sculpin, and seaweeds. Collecting beachcast seafoods is a community activity and has likely increased in years with decreasing sea ice extent as stakeholders reported more stormy weather due to the lack of protection from sea ice. Diminished shorefast ice no longer protects these coastal communities from the surf in winter. Stakeholders reported more storms, erosion, and greater wave action along the shorelines due to climate change. While storm surges bring more opportunities for harvesting beachcast seafoods, some residents reported that they are in poorer condition and are not always fresh enough to eat compared to a decade ago.

This study identified two previously undocumented responses to ecosystem changes: night hunting and harvest of beachcast cetaceans. Night hunting was not historically practiced, and changes in regulations have limited whale harvests. In Savoonga, one resident that had just returned from a nighttime hunting trip explained:

> "*…this is the first time we went out at night, there was a[n] abundance of walrus with calves out there, so we couldn't miss that opportunity…We have to do a lot of things that are uncomfortable …unfavorable weather. Especially when there's females with calves out there, we went out just before dark, which we would never do in the past. But looking at the weather forecast, there's going to be north winds coming, and this could be our only chance to possibly harvest. So, that was something different." (Savoonga, age 54).*

Having always hunted walrus during the day, this stakeholder found the night hunting experience uncomfortable because the animals behaved much more aggressively in the dark. Walruses got off of the ice floes, and the whole herd approached the boats in the water. The boats had to retreat. However, night hunting was not new to all stakeholders. The youngest stakeholder in the study reported:

> *"We did it [hunted at night] because the ice was passing by. My uncle wanted to go, and other crews were going out, and they were saying there were moms and babies, so we went to go harvest them… there's no reason why we gotta time when to go in or when to go out." (Savoonga, age 20).*

A discussion with an elder brought some clarity to these conflicting reports. He stated that they always hunted walrus in the daytime when he was growing up. This suggests that night hunting is likely a new response to access female and calf pairs.

The second undocumented response reported was that stakeholders utilize the meat, blubber, and skin from beachcast cetaceans. Regulations imposed by the International Whaling Commission (IWC) prevent them from hunting minke (*Balaenoptera acutorostrata*), gray (*Eschrichtius robustus*), and humpback whales (*Megaptera novaengliae*).

Community attitudes towards oil and gas development in the region

Stakeholders were asked about the impacts human activities might have on subsistence practices in the region. The greatest concerns were oil and gas development, increased shipping and vessel traffic, commercial fishing, and contaminants (Figure 3).

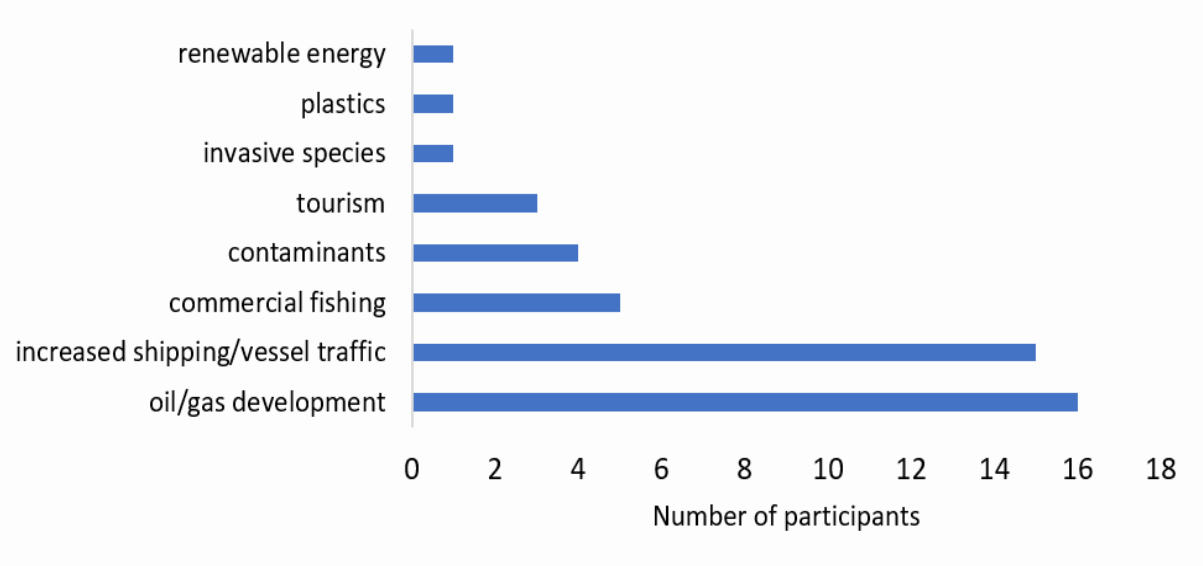

Figure 4. The number of participants listing various human activities as a concern.

Sixteen stakeholders were concerned about the impacts that oil/gas development would have on important subsistence resources and consequently said they would be unsupportive of its development in the region. Six stakeholders were unsure if they would support oil/gas development, and two stakeholders said they would be "supportive if…" giving a condition that would need to be met to gain their support. The reasons for the lack of support of oil/gas development were fear of displacing game or an oil spill contaminating game. In the words of one individual: *"…if those things happen to develop here, our game would just go further out somewhere. Or even we would be exhausted of mammals we hunt around our island. Big impact on our diet." (Gambell 72).* To another stakeholder, "the region" for consideration was not the immediate vicinity of the island or even the Bering Sea but extended into the Chukchi Sea:

> *"[I'm] kinda worried about the Chukchi Sea being opened up to oil and gas development because we are…so close to where all the marine animals live and if there should be a disaster, oil spill, it's gonna kill a lot of what we harvest for food and I'm against it." (Gambell, age 63).*

Residents expressed concerns that the community has no facility or training to deal with the response required to clean up an oil spill

The two individuals who gave conditional support made it clear that the oil/gas company would have to benefit SLI residents and communities. One simply stated: *"[I would] support [it], if [it] benefits our community, but unsupport if it just benefits those companies." (Gambell,*

age 68). The other stakeholder provided an example of a balance that he viewed worked well for the Alaska Native communities in the North Slope Borough:

> *"…before that happens, I'm sure we'll start seeing[like what the] Alaska Eskimo Whaling Commission (AEWC) has, their own agreement with [the] oil company, the ships that pass by Arctic Slope, Chukchi, and Beaufort Sea. They have an agreement. They're out whaling or harvesting walrus or anything that they have to harvest, they (the oil company) got to put a stop to that and after they're (the hunters) done with that seasonal harvesting, they could start moving again…That agreement, if I remember correctly is a Conflict Avoidance Agreement, CAA...Which is pretty effective, especially to their hunters, providers… I'm sure we'll start seeing those… we'll need some sort of agreement in place to protect our lifestyle out here, indigenous lifestyle. Especially to feed our family, friends, and relatives." (Savoonga, age 52).*

CAAs include industry time and area closures that allow hunters to harvest during a break in operations (Lefevre 2013).

Perceptions about the future of subsistence

Not all stakeholders commented on whether future generations would witness changes in the number of animals harvested or the amount of indigenous foods consumed. Nine of the 14 stakeholders who addressed these questions predicted that the next generations would see decreasing subsistence harvests (particularly for marine mammals), consume less subsistence foods, and potentially witness changes in how animals behave. As one retired whaling captain explained:

> *"I'm very positive and sure that they will. Whether we will continue to have ice, if we don't there will be no walrus and bearded seals on ice. They'll be in the water…especially the polar bear; we hunt polar bear too. But it's the ice that we're most concerned [about], that will make the biggest change in our hunting practices of marine mammals. The walrus, the bowhead, the bearded seal – cause if there's no ice, there's no means for them to get on ice to give birth to their young, or to harvest them." (Gambell, age 68).*

Stakeholders most often attributed the anticipated decline in indigenous food consumption to loss of sea ice but also mentioned other factors, including increasing grocery deliveries from mainland Alaska and economic hardships. When asked if younger generations will experience changes in the amount of subsistence foods that they eat in their lives, one stakeholder said:

> *"Yup, that's already impacting us with three or four flights a day that are bringing groceries, but a lot of times when you're unemployed, you know, you have no choice but to go out. I'd rather get subsistence food right now, compared to the price of groceries from the store." (Savoonga, age 54).*

Another stakeholder said:

> *"We're harvesting less than half of what we used to harvest 10 years ago, 20 years ago and as the ice loss continues, that is going to decline and our people…we are really in desperate need of – coming up with our own self-generating, self-sustaining economies." (Savoonga, age 60).*

Of the remaining five stakeholders that addressed the future of subsistence, two expected to see no change and three were unsure or hopeful that there would be no changes. Here is the perspective of one individual who expects younger generations will not see changes in the number of animals that they're able to see or harvest:

> *"I doubt it…with the help of science nowadays, from my understanding – both the walrus and the bowhead whale, they're pretty much healthy now in population. And that's about the only way I'm hoping it will just grow… [that] they don't drastically get commercially hunted again. That's what kind of depleted them back in the later part of 1880s. From there up until now, population, from my understanding, is getting healthy – healthier." (Savoonga, age 52).*

Discussion

This study builds on research documenting how climate change is impacting the ability of coastal Alaska Native communities to utilize subsistence harvested foods from the Bering Sea (Ahmasuk et al. 2008, Huntington et al. 2013, 2016, Krupnik & Benter 2016).

Key marine resources

Walruses, seals, fish, and crabs were the top four marine resources discussed by Gambell and Savoonga community members. It was not surprising that walruses were the most discussed species; approximately 84% of the Pacific walrus harvest in the United States occurs in waters around SLI (McCracken et al. 2017). Historically, walrus were valued not just as a human food source but for feeding dog teams, making skin boats, ropes, drums, and summer homes. What was surprising was that bowhead whales did not rank higher. We anticipated bowhead whales to rank second among all species. This lower ranking may be because not all residents have access to harvest bowheads due to social rank, family relations, time constraints from employment, or the expenses of owning a boat, motor, and equipment. Residents can go fishing, crabbing, and seal hunting without the expensive equipment, family connections, and time commitment required by whaling captains and crew. While incorporating information from captains, crews, and expert harvesters, this study's stakeholder data was more reflective of subsistence harvest and consumption patterns of the broader SLI communities.

Ahmasuk et al. (2008) conducted household subsistence surveys in Alaska Native villages in the Bering Strait and documented harvest and consumption of marine mammals during 2005-2006. Based on pounds of meat harvested, Gambell and Savoonga reported walrus as their greatest harvest followed by bearded, spotted, ringed and ribbon seals and polar bears.

No harvested cetaceans were reported, including bowhead whales. Though not quantified, the present study supports the notion that these targeted subsistence species have not changed in the past 15 years.

Changes in key resources

Walruses and seals

The greatest changes reported regarding walruses and seals were 1) limited access to walrus herds during hunting, 2) increased hunting effort for both walruses and seals, and 3) impacted reproduction rates for walruses and seals. Stakeholders attributed these changes to the loss of sea ice. Stakeholders also reported declining walrus harvests over the past two decades, which is reflected in federal harvest reports that show a steady decline in U.S. and Russian harvests since 2000 (MacCracken et al. 2017). In 2013, Gambell harvested approximately one-fifth of its annual mean catch (Krupnik & Benter 2016). Hunting success is highly dependent on effort, which is determined by the weather (Huntington et al. 2013, Krupnik & Benter 2016). Huntington et al. (2013) found that wind and ice conditions explained one-quarter to one-third of the variability in the number of hunting trips attempted. The vessels used for whaling and walrus/seal hunting are typically 16-foot aluminum skiffs, and increasing distances in open ocean put hunters in greater danger. Hunters reported that without the protection of sea ice, boats are exposed to larger swells.

Hunters also reported concerns about the health and survival of walruses and seals, particularly regarding birthing. Walruses are considered an ice-obligate species as they use sea ice as a platform during mating, birthing, molting, and resting (Moore & Huntington 2008). Scientists and managers have reported concerns about reproduction and calf survival of walrus. Since 2007 increasingly large herds have been observed using terrestrial haulouts (Fischbach et al. 2009, Fischbach et al. 2016), and stampedes on land have resulted in disproportionately large deaths of calves and juveniles (Fischbach et al. 2016). Ray et al. (2016) predicted that changing sea ice structure may have detrimental impacts on winter reproductive habitat and impact breeding success. However, there is little information regarding birthing behavior, which underscores the value of documenting traditional and indigenous knowledge about the importance of walrus and seals giving birth on sea ice platforms.

Tracking ice seal strandings in Alaska is also essential. In 2011-2016 the State of Alaska declared an ice seal UME, which involved both live and dead stranded ringed, ribbon, and spotted seals in northern and western Alaska (www.fisheries.noaa.gov). The minimum estimated number of infected animals was 233 dead seals, 179 subsistence hunted seals, and 245 live stranded seals (totaling 657 impacted seals). It was determined that an abnormal molt caused the lesions and symptoms presented by stranded seals; however, no underlying cause was determined, and the UME closed in 2016. Another ice seal UME involving the same species is ongoing at the time of this report (2018-2020) for the Bering and Chukchi Seas. However, animals from this UME are not presenting lesions as in the 2011-2016 event. No stakeholders

reported seeing "balding" or lesions on washed-up seals as they had during the previous UME. Stranded animals in the current UME represent all age classes, with 277 seals effected as of February 2020 (www.fisheries.noaa.gov). All of this is information is timely as federal managers prepare to create a proposal for critical habitat for Arctic ringed seals and the Beringia bearded seal distinct population segment (Federal Register 2014).

Fish

Stakeholders reported increasing abundances of walleye pollock and Pacific cod, which is supported by recent NOAA trawl surveys. NOAA conducted northern Bering Sea trawl surveys in 2010, 2017, and 2019. The 2017 survey found that walleye pollock biomass and Pacific cod biomass increased by 1.3 million tons and 254 thousand tons, respectively (Lauth et al. 2019). The 2019 northern Bering Sea trawl survey found an approximate 5000% increase in walleye pollock biomass and a 1000% increase in Pacific cod biomass since their 2010 survey (personal communication Lyle Britt (AFSC)). Data from this recent trawl survey are still being analyzed during the time of this publication. While stakeholders agreed that the increases in walleye pollock and Pacific cod happened within the last ten years, participants noted that the change has been more abrupt. One SLI expert in fishing recognized the increase in walleye pollock to have occurred 3-4 years ago. Pinpointing this shift in fish distribution is important as NOAA trawl surveys suffered a 7-year gap in their data collection. With only three years of effort (2010, 2017, and 2019), it is possible that the survey in 2010 missed the walleye pollock population that was already present. However, this knowledge from local users affirms that this species is a recent arrival in the northern Bering Sea and that its abundance is increasing.

Stakeholders voiced concern about potential interactions with commercial vessels utilizing these shifting fish stocks. Previous interactions with commercial fishing and crabbing vessels have negatively impacted marine mammal hunting around the island (Magdanz & Olanna 1985). Further, stakeholders were fearful that fishermen would overfish other marine subsistence resources that they harvest and rely upon. One of the advantages of using RQI research is to document "silent voices" (Creswell 2013) during times of rapid change. Bringing this concern to resource managers' attention before a conflict will allow for better relationships between subsistence and commercial users and managers.

Crabs

Historically, the blue king crab has been the dominant shellfish harvested in the nearshore waters of SLI. Early Alaska Department of Fish and Game (ADF&G) reports document that blue king crabs were a commodity that SLI residents traded and sold to visitors (Lean 2005). Today SLI fishermen continue to barter and trade this resource with other villages on the mainland (Menard et al. 2018). On SLI, people simply call them "blue crabs." Little information is known about the abundance of red king crab (*Paralithodes camtschaticus*) around the island. Regional biologists consider red king crabs to be absent or in very low abundance in the nearshore waters of SLI due to the rocky substrate, which is preferred by blue king crab (personal communication,

Dawn Wehde, Crab Biologist Norton Sound Economic Development Corporation (NSDEC)). However, SLI community members have separate Yupik names for the two subspecies, and a comprehensive subsistence report conducted by Kawarek in 2009 found that residents caught both red and blue king crabs, although catches of blue king crab were three times that of red during that year (Tahbone & Trigg 2010).

Since 1984, waters within 10 miles of SLI have been closed to commercial fishermen to protect stocks harvested by SLI subsistence fishermen and to limit the impacts of commercial vessels on marine mammal presence in the area. Unlike neighboring Norton Sound, the Bering Strait waters surrounding SLI have not been consistently surveyed by ADF&G (Menard et al. 2018), making data on crab abundance and catch scarce and underscoring the importance of this information coming from SLI residents today. Reasons for discontinuing surveys include the closing of the Division of Subsistence office in Nome due to sudden declines in oil prices in the spring of 1986 (personal communication Jim Magdanz), and establishment of the Northern Bering Sea Research Area and SLI Habitat Conservation Area by the North Pacific Fishery Management Council in 2008 (https://www.npfmc.org). Trawl fishing is banned in the Northern Bering Sea Research Area; however, permits allow some research trawling to occur.

The Hanasaki crab was first documented in 2003 when a single crab was harvested at Little Diomede Island (personal communication, Jim Menard, ADF&G). In 2012-2013, several specimens were caught during the winter commercial fishery in Nome. According to reports from Gambell, entire subsistence catches were comprised of Hanasaki crabs by the summer of 2013, including gravid females. NSDEC crab biologists speculate that the Hanasaki crab is establishing a population near Norton Sound with an "epicenter of abundance" occurring near SLI (personal communication, Jim Menard, ADF&G). To date, the most recent ADF&G trawl survey report published was from 2014 and encompassed only Norton Sound (Soong & Hamazaki 2015), lacking any abundance estimates of crabs near SLI. Neither *P. brevipes* catch nor was biomass recorded in the more recent NOAA northern Bering Sea trawl survey reports, as only results for U.S. commercial crab species have been published (Lang et al. 2018, 2019, Zacher et al. 2020). The Hanasaki crab are commercially harvested in Japan, but no commercial fishery has been established for them in Alaska. Data on the distribution and abundance of Hanasaki crab is lacking and requires further attention by the scientific community.

Food security

The overarching theme we discovered is that lack of sea ice has led to food insecurity. Decreased walrus harvest was identified as a significant factor leading to food scarcity. A woman in Gambell stated: "…Four or five walruses…our meat racks would be full. Our freezers would be full. Right now, our meat racks are empty and our freezer barely has any." (Gambell, age unknown). It does not take many of these large marine mammals to feed one family; this point illustrates that even harvesting a handful of walruses has become a challenge. While the walrus harvest has historically been variable (Krupnik & Benter 2016), current harvest numbers

are much lower than 5-10 years ago. Between 2010-2014 the average walrus harvests from Gambell and Savoonga were 821 per year (MacCracken et al. 2017). From 2015-2019 walrus harvests averaged 277 and 391 per year for Gambell and Savoognga, respectively (personal communication Brad Benter, USFWS).

None of the stakeholders directly stated that they experienced food scarcity due to a lack of crabs. However, historical subsistence surveys conducted on SLI document blue king crab as an important and regular dietary resource for some households (Magdanz & Olanna 1985). Historical subsistence reports regarding crabbing on SLI were conducted in 1983 and 1984 and addressed the harvest years of 1979-1984 (Magdanz & Olanna 1984, 1985). In 1984, 15 households were surveyed and nine reported crabbing, catching 733 blue king crabs, an annual household average of 81.4 crabs. In Savoonga, crabbing is done further from the village. Of the 23 households that participated in the 1984 study, three reported crabbing at Whaling Camp and six at an area five miles east of town. The catch was low at Whaling Camp, but the other site's catch was 165 crabs, with an annual household average of 23.5 crabs (Magdanz & Olanna 1985).

Subsistence harvest surveys have not been carried out continually in these communities, so it is impossible to say if household consumption of blue king crab has varied much since the 1980s; however, stakeholders made clear that access has been cut off from this resource due to sea ice loss, greatly reducing harvest opportunity. Participants reported that crab pots could not be used due to the strong currents that have caused them to be washed offshore in the past. Based on comments regarding decreased access and the percentage of times crabs were mentioned across all discussions, we suspect that blue king crabs, and now Hanasaki crabs, are key marine resources consumed by a sizeable part of the population in both Gambell and Savoonga when ice conditions allow. This resource may be overlooked by managers due to a lack of data.

Community responses to change

The communities of Gambell and Savoonga remain among the most isolated Alaska Native villages in the state. This is evidenced by the fluency with which the adult population still speaks in their native language. Closer to mainland Russia than mainland Alaska, cut off from roads, and at times service from planes and vessels, the survival of SLI inhabitants has been tightly coupled with the sea since time immemorial. Yet, in these recent times of rapid change, it seems that these communities' ability to be resilient is being constrained in new ways. Resilience in social-ecological systems has been defined as a system's capacity to maintain its fundamental properties despite large perturbations (Brinkmen et al. 2007). In contrast, adaptability is the capacity that a system's *stakeholders* have to influence their resilience (Walker et al. 2004). Together, resilience and adaptability allow subsistence-based communities to persist in today's economic driven society.

Results from this study indicated that SLI residents are responding to environmental changes in a variety of ways. Like any other culture, SLI residents have cultural food preferences, but these preferences are replaced with whatever foods are available in times of

need. This adaptive strategy has been practiced historically and has allowed for survival when marine mammals were scarce. One such example is the harvesting of sea ducks, which are consumed in times of need though they are less preferred than marine mammal meat. The people of SLI have survived in this isolated and remote region because, as a Gambell elder stated, "We use our own resources." This has meant consuming all that is edible, including sea stars, tunicates, sculpin, seaweeds, and even the hides of walruses during times of great famine (Bockstoce 1995).

Other responses to environmental changes included hunting walruses at night and harvesting beachcast cetaceans such as humpback, gray, and minke whales that residents are otherwise prohibited from harvesting. Stakeholders stated that, historically, SLI people hunted gray and minke whales, and gray whale meat is considered a delicacy that rivals even bowhead. Regulations imposed by the International Whaling Commission currently prevent any take on these species, and communities abide by these rules by consuming beachcast whales whenever they are fresh enough to be consumed.

Community attitudes towards oil and gas development in the region

Most of the stakeholder participants were against the development of oil and gas near SLI due to fear of contamination of game and fear of disturbance that would cause game to leave the area. A quarter of stakeholders were unsure if they would be supportive/unsupportive of oil and gas development. This uncertainty was likely due, in part, to communication challenges. Researchers in this study noted that several times, when asked about oil and gas development, stakeholders misinterpreted the question to be about engine or heating fuel, responding that "prices were too high." The use of the words "exploration" and "development" was not always clear to stakeholders, so researchers used the term "drilling" to provide clarity if needed. In addition, stakeholders frequently stated that their corporation deals with these issues as SLI residents opted for land ownership of SLI under the Alaska Native Claims Settlement Act (ANSCA 1971), and SLI is considered a "sovereign nation." This fact may have increased the number of individuals that were indecisive regarding oil and gas development.

Perceptions about the future of subsistence

Many stakeholders felt that younger generations will eat less subsistence harvested foods and turn toward "less healthy" store foods, yet most families find store foods unaffordable. Stakeholders were interested in adaptive solutions for solving issues of both food security and economic hardships. One new avenue discussed for generating a self-sustaining economy on SLI was the potential to start producing reindeer (*Rangifer tarandus*) meat as a commercial product. While this would provide jobs and new sources of income, it could reduce the number of people participating in the harvest and consumption of subsistence foods from the Bering Sea and increasing reliance on reindeer consumption.

Conclusions

SLI community members lack control over environmental (sea ice loss and a shifting Bering Sea ecosystem) and extrinsic (food prices and the job market) drivers that impact food security and cultural values. In the past, residents have filed for economic disaster relief in years of poor walrus harvests (Krupnik & Benter 2016). Today it is unlikely that any policy actions will return harvest rates to their historical levels.

Cultural preferences may inhibit the flexibility of inhabitants to utilize other resources, as is the case with harvesting belugas on SLI, which are more abundant and more easily harvested than bowhead whales. However, there are examples in which communities have altered targeted game species based on access and availability. One such example is on Prince of Wales Island in Southeast Alaska, in which extensive logging created easier access to deer. In one generation, inhabitants switched hunting practices from primarily marine resources to Sitka black-tail deer (*Odocoileus hemionus sitkensis*) (Brinkmen et al. 2007). Yet, it is unlikely that such a drastic change will arise in the future on SLI if this adaptation to easier prey did not occur in times of declared disasters. More likely, SLI residents will desire to hunt other abundant cetacean species that have historically provided for their ancestors, including grey and minke whales. In the future, regulators may expect these species to be petitioned for hunting quotas to replace ice-obligate and ice-associated species such as walrus, bowhead, ice seals, and polar bears. Further, community members discussed their interest in commercially producing the island's local reindeer meat. This would require an increase in reindeer herd size and establishing a meat processing plant, which is also being discussed. It is possible that local protein consumption may shift towards more domestic, terrestrial resources within the next decade.

Educational programs are already underway to address community concerns about the loss of culture on SLI. In 2019, Savoonga school began teaching the Yupik language (Bering Strait School District Bilingual Curriculum) for the first time in 25 years; a change brought about by residents' demands during formal community meetings. The curriculum is an avenue for teaching the values and indigenous knowledge embedded within the Yupik language. Most adults age 40 and older are fluent in the language, but there is a large generational gap in which younger adults and youth cannot speak or understand it. Another challenge is to bring subsistence knowledge into the schools. High school is the highest level of education offered on the island, and currently, there are no units that discuss the Marine Mammal Protection Act or co-management. Youth lack access to understand how they can manage their communities' resources and lack of knowledge that there are laws in place for indigenous management of resources may be the greatest inhibitor to community resilience. Communities can be empowered by incorporating these lessons in the schools, and empowered communities are not trapped communities; they are resilient ones.

In summary, significant findings from this study reveal that:

- SLI hunters are concerned about walrus and seal calf/pup drowning mortalities due to sea ice loss and seal pup mortality from crushing by fragmented sea ice.
- Some SLI hunters are traveling farther (80-100 miles) to access walrus, resulting in increased risks to human safety.
- Hunters are adapting to change by employing a more opportunistic hunting style, including hunting walrus at night.
- Community members are increasing their food security by consuming deceased, beachcast cetacean species that they are not allowed to hunt. This study provided the first documentation of this harvesting strategy on SLI.
- Blue king crab and Hanasaki crab are undervalued key resources that require further scientific study to document species abundance and distribution around SLI.
- Changes in commercial fish stocks may lead to increased commercial fishing pressure around SLI. Residents expressed concerns about the impacts this may have on local subsistence fish, crabs, and marine mammal abundances.
- Most stakeholders were not supportive of oil and gas development near SLI in the Bering Strait due to concerns about oils spill contaminating food resources and operations causing disturbance and dispersal of hunted marine mammals.

This information highlights concerns about the perceived impacts of climate change on the communities of Gambell and Savoonga. A proactive approach with clear and open communication between resource managers, SLI residents, and commercial fishing vessels, and oil/gas companies is recommended to ensure SLI inhabitants can maintain their indigenous, subsistence-based lifestyle.

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Appendices

Appendix 1: Letters of support from the Native Village of Gambell and Savoonga.

NATIVE VILLAGE OF GAMBELL

P.O. BOX 90 • Gambell, Alaska 99742
Telephone: (907) 985-5346 • FAX: (907) 985-5014

December 18, 2018

Jenell Larsen and Shannon Atkinson, Ph.D.
University of Alaska Fairbanks, Juneau Campus
College of Fisheries and Ocean Sciences
17101 Point Lena Loop Rd
Juneau, AK 99801

Dear Ms. Jenell Larsen and Dr. Shannon Atkinson,

The Gambell IRA Council strongly supports your proposed research by the University of Alaska Ph.D. Candidate Jenell Larsen and her advisor Dr. Shannon Atkinson, studying "change and resiliency in the Bering Sea ecosystem: assessing changes in marine resources and subsistence use." Ms. Larsen has worked in our community in the past for her previous Ph.D. research on walrus. We understand that this research will include interviews with community members and key informants that are considered experts in subsistence harvesting.

In support of this research, the Gambell IRA Council will assist the project leaders in identifying these knowledgeable experts for interviews on the abundance, seasonality and overall health of our marine animals and plants. We also understand and are in support of the project including a local resident and UAF undergraduate student as a research assistant.

Ms. Larsen and Dr. Atkinson have already shared their project goals and a draft interview questionnaire with our tribal council and we are interested in this work and their results. We understand that this research will take place during the year 2019 and that results will be presented in person to our community by 2020. The Gambell IRA Council strongly supports this research and looks forward to working with Ms. Larsen and Dr. Atkinson to determine how our ecosystem is changing and the effects this is having on our community.

Sincerely,

Brandon Boolowon

Brandon Boolowon

President, Native Village of Gambell

"Established in 1934, dedicated to serving the members and preserving the culture."

NATIVE VILLAGE OF SAVOONGA • P.O. BOX 120, SAVOONGA, AK 99769 • PHONE 984-6414 • FAX 984-6027

Jenell Larsen and Shannon Atkinson, PhD

University of Alaska Fairbanks, Juneau Campus

College of Fisheries and Ocean Sciences

17101 Point Lena Loop Rd

Juneau, AK 99801

Dear Ms. Jenell Larsen and Dr. Shannon Atkinson,

The Savoonga IRA Council strongly supports your proposed research by the University of Alaska Ph.D. Candidate Jenell Larsen and her advisor Dr. Shannon Atkinson, studying "change and resiliency in the Bering Sea ecosystem: assessing changes in marine resources and subsistence use." We understand that this research will include interviews with community members and key informants that are considered experts in subsistence harvesting.

In support of this research, the Savoonga IRA Council will assist the project leaders in identifying these knowledgeable experts for interviews on the abundance, seasonality and overall health of our marine animals and plants. We also understand and are in support of the project including a local resident and UAF undergraduate student as a research assistant.

Ms. Larsen and Dr. Atkinson have already shared their project goals and a draft interview questionnaire with our tribal council and we are interested in this work and their results. We understand that this research will take place during the year 2019 and that results will be presented in person to our community by 2020. The Savoonga IRA Council strongly supports this research and looks forward to working with Ms. Larsen and Dr. Atkinson to determine how our ecosystem is changing and the effects this is having on our community.

Sincerely,

Fritz Waghiyi, Vice President

Native Village of Savoonga

Appendix 2: IRB approval.

(907) 474-7800
(907) 474-5444 fax
uaf-irb@alaska.edu
www.uaf.edu/irb

Institutional Review Board
909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

June 12, 2019

To: Shannon Atkinson, Ph.D.
Principal Investigator

From: University of Alaska Fairbanks IRB

Re: [1321844-3] Change and resiliency in the Bering Sea ecosystem: assessing changes in abundance and seasonality of marine resources and effects on subsistence communities

Thank you for submitting the Amendment/Modification referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title:	Change and resiliency in the Bering Sea ecosystem: assessing changes in abundance and seasonality of marine resources and effects on subsistence communities
Received:	June 5, 2019
Expedited Category:	7
Action:	APPROVED
Effective Date:	June 12, 2019
Expiration Date:	February 25, 2020

This action is included on the July 3, 2019 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

(907) 474-7800
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Institutional Review Board

909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

February 12, 2020

To:	Shannon Atkinson, Ph.D. Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[1321844-4] Change and resiliency in the Bering Sea ecosystem: assessing changes in abundance and seasonality of marine resources and effects on subsistence communities

Thank you for submitting the Continuing Review/Progress Report referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title:	Change and resiliency in the Bering Sea ecosystem: assessing changes in abundance and seasonality of marine resources and effects on subsistence communities
Received:	February 5, 2020
Expedited Category:	7
Action:	APPROVED
Effective Date:	February 12, 2020
Expiration Date:	February 25, 2021

This action is included on the February 5, 2020 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.