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Inuit adaptability to changing environmental conditions over an 11-year period: A case study of Ulukhaktok, NT

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Abstract

Current understanding of climate change impacts, adaptation and vulnerability among Inuit in the Arctic is relatively static, rooted in the community and time that individual case studies were conducted. This paper seeks to capture the dynamism of Inuit-climate relationships by applying a longitudinal approach to assessing vulnerability to climate change among Inuit in Ulukhaktok, Northwest Territories. Data were collected in the community in 2005 and 2016 using semi-structured interviews, participant observation, and analysis of secondary sources following a consistent methodological framework for vulnerability assessment. Findings from the two studies are comparatively analysed together with longitudinal sea ice and harvesting data to examine how Inuit experienced and responded to climatic changes over an eleven-year period. The data reveal that many of the climatic changes recorded in 2005 that adversely affected hunting activities have persisted or progressed, such as decreasing sea ice thickness and extent, and stronger and more consistent summer winds. Inuit are responding to these changes by altering travel routes and equipment, taking greater pre-trip precautions, and concentrating their efforts on more efficient and accessible hunts. Rising costs of living and subsistence activities, time-constraints due to wage employment, changes in the generation and transmission of traditional knowledge and land skills, and the concentration of country food sharing networks on fewer hunters were identified as key constraints to adaptation. The findings indicate that the connections between subsistence activities and the wage economy are central to understanding how Inuit experience and respond to climate change.

Keywords: adaptation; adaptive capacity; Inuvialuit; longitudinal; social learning; subsistence; resilience

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1. Introduction

Inuit in the Arctic have been identified as particularly sensitive to climatic changes due to a high dependence on the environment for their subsistence-based livelihoods (Berkes and Jolly 2002; Larsen et al. 2014). Recognition of Inuit sensitivity to climate change has led to a broad body of scholarship focused on climate change impacts, adaptation and vulnerability (IAV). Much of this research employs a vulnerability approach, drawing upon multiple methods, including interviews with community members, to identify and characterize community-relevant risks and adaptive responses (Ford and Smit 2004; Smit and Wandel 2006). This work has provided substantial information on how Inuit are experiencing and responding to climatic changes, mostly focusing on subsistence activities, and opportunities and barriers to adaptation (Ford et al. 2010; Pearce et al. 2015a). Most studies have been conducted at the settlement scale, having Inuit identify what climate conditions are relevant and important to them, and what adaptations are realistic and desirable (McDowell et al. 2016). This research shows that subsistence activities including hunting, fishing, trapping, and gathering are already being adversely affected by climatic changes, and that adaptability is influenced by a suite of socio-economic, cultural and environmental conditions operating at multiple spatial and temporal scales (Pearce et al. 2011a; Ford et al. 2012). Despite the notable challenge of climate change, adaptations are available, feasible, and Inuit have considerable adaptive capacity. Pearce and others (2015a) describe policy interventions for realizing this adaptive capacity and overcoming adaptation barriers.

Current understandings of climate change IAV in the Arctic, however, are relatively static, rooted in the place and time that the individual studies have been conducted. Our

understanding of the dynamism of Inuit-climate relationships, including the nature of climatic risks and the processes by which people cope with and adapt to changing conditions, is thus limited (Ford and Pearce 2012; Archer et al. 2017). Poor understanding of long-term climate trends and the related human processes that shape risk and adaptation may ultimately limit the efficacy of adaptation interventions and potentially lead to maladaptive outcomes (Barnett and O'Neill 2010; Birkenholtz 2012; Bennett et al. 2016).

In this article, we examine how Inuit in Ulukhaktok, Northwest Territories adapt to changing environmental conditions over time. We conduct interviews in the settlement and compare findings with interview data collected in 2005 and longitudinal sea ice and harvest datasets. We take a specific focus on subsistence activities, consistent with the original 2005 study. The following section provides a brief description of Ulukhaktok and the methods used, including the longitudinal study design. Results are then presented and discussed, and adaptation opportunities are identified that take into account longer-term trends in climate and society.

2. Case study: Ulukhaktok, NT

Ulukhaktok is an Inuit community of approximately 400 (Statistics Canada 2017) located in the Inuvialuit Settlement Region (ISR) in the Western Canadian Arctic. More specifically, Ulukhaktok is located at the mouth of Prince Albert Sound (PAS) on the West coast of Victoria Island (70°45'42'N, 117°48'20'W) (Figure 4.1) in the region that was historically home to the Northern Copper Inuit, who were migratory seasonal hunters (Damas 1972). The settlement was established in 1939 with the Hudson's Bay Company

installing a trading post on King's Bay, followed by a Roman Catholic Mission; however, concentrated settlement did not occur until the late 1950s (Damas 2002). The community was later moved west onto Queen's Bay, its current location. During this time, trapping and subsistence hunting remained central to livelihoods (Condon 1996), but there was also a growing reliance on modernized hunting equipment and external markets for imports and exports, largely due to the shift from migratory seasonal hunting to settlement (Condon et al. 1995). Because of this, Ulukhaktok, like much of the Canadian Arctic, was heavily impacted by international bans on the importation of seal pelts throughout the 1970s and 1980s (Condon et al. 1995). The loss of a key subsistence-compatible source of income crippled the ability of many hunters to engage in subsistence hunting to the same degree as they had previously and has had lasting adverse effects on the community.

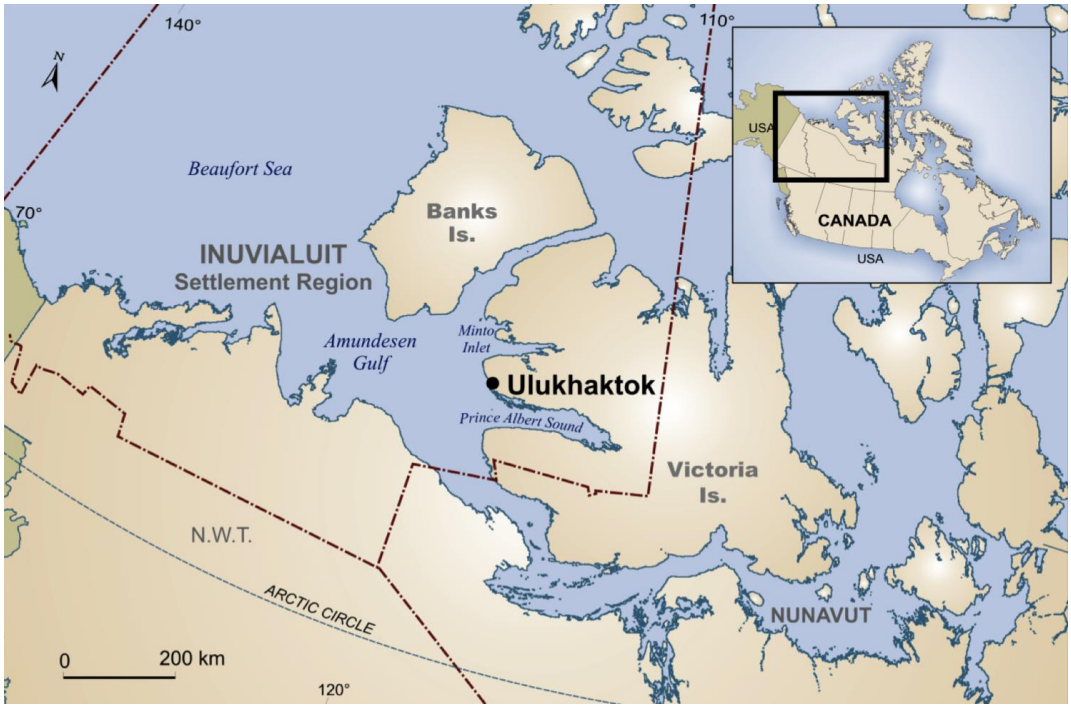

Figure 1: Location of Ulukhaktok, NT in the ISR.

Since moving into a permanent settlement, a mixed economy, including subsistence and wage employment, has developed. Cash has become increasingly important in the mixed economy and necessary to purchase hunting equipment and supplies. Access to income is a barrier for many hunters to access the land, as are the time constraints of wage employment, both which have resulted in some Inuit spending less time involved in subsistence activities and more time engaged in community activities. Less time on the land has also effected the generation and transmission of environmental knowledge and land skills among some Inuit (Pearce et al. 2010; Pearce et al. 2011b), with implications for adaptability to changing environmental conditions (Pearce et al. 2015b). Despite changes in environment and society, subsistence hunting, fishing and trapping continue to have strong economic, dietary, and cultural importance for Inuit in Ulukhaktok (Pearce et al. 2011b; Collings et al. 2016).

3. Methods

3.1 Longitudinal vulnerability assessment

The research employed a modified vulnerability framework, described by Smit and Wandel (2006) and employed by Pearce and others (2010) in the original 2005 study, to examine how Inuit are adapting to changing environmental conditions over time. The framework is used to guide data collection by having respondents identify the conditions and adaptive strategies that are relevant and important to them, beyond those often identified *a priori* by researchers, and to help structure data analysis. In this study, aspects of both cohort and trend longitudinal assessments were applied (see Fawcett et al. 2017). This included re-interviewing as many people from the original sample as

possible, using the findings from 2005 to frame the 2016 interviews, and considering interview data together with longer-term trends in climate and society.

3.2 Data collection

Data for this article were collected over an eight-week period in Ulukhaktok between June and August 2016. Protocols for data collection were approved by the Human Research Ethics Board at the University of Guelph (#16MR034), and the research was licensed by the Aurora Research Institute (#15913), which oversees research in the Northwest Territories. Data were collected in a consistent manner to the 2005 study and included semi-structured interviews and participant observation. Since this study is interested in examining how Inuit adapt to changing environmental conditions over time, other sources of longitudinal data were collected and included local sea ice data, harvest data for key species of wildlife important for subsistence (e.g. polar bear and muskox), and economic data associated with the costs of subsistence activities.

A purposive sampling strategy was used to include as many respondents as possible from the 2005 study and identify new respondents who actively participate in subsistence but were unavailable or under eighteen years of age in 2005. Thirty-two respondents, men and women, of varying ages were recruited including fourteen respondents from the 2005 cohort and eighteen new respondents. The inclusion of more respondents from the original cohort would have been ideal, but was not feasible due to participant attrition. Sixteen respondents from the 2005 cohort had passed away, ten respondents were not living in the settlement at the time of the research, and four respondents declined to participate in the new study. A description of the research sample is provided in Table 1. The male bias (22/10) is consistent with the 2005 sample and may

be due to a higher proportion of males being actively involved in subsistence activities and the research team being entirely male.

Table 1: Demographics of 2005 and 2016 cohorts.

2005 cohort (n=60)		**2016 cohort (n=32)**	
Category	Respondents (%)	Category	Respondents (%)
Gender		*Gender*	
Male	40 (67%)	Male	22 (68.75%)
Female	20 (33%)	Female	10 (31.25%)
Age		*Age*	
18-29	9 (15%)	18-29	3 (9.375%)
30-39	10 (16.67%)	30-39	4 (12.5%)
40-49	10 (16.67%)	40-49	9 (28.125%)
50-59	6 (10%)	50-59	4 (12.5%)
60-69	15 (25%)	60-69	5 (15.625%)
70-79	4 (6.67%)	70-79	5 (15.625%)
80+	6 (10%)	80+	2 (6.25%)
Harvest Participation		*Harvest Participation*	
Active	28 (46.67%)	Active	17 (53.125%)
Passive (specific seasons)	15 (25%)	Passive (specific seasons)	8 (25%)
Recipient	17 (28.33%)	Recipient	7 (21.875)

3.2.1 Semi-structured interviews

Interview questions were open-ended and guided by a semi-structured interview guide (see Appendices I and II). The open-ended structure was used to minimize interview bias and allow respondents to discuss issues that were important to them and in terms that made sense to them and reflected their priorities. Interview questions focused on what conditions were relevant and important to the respondents, whether these conditions had changed and if so, in what ways, how were respondents dealing with these changes, and what was making it easier or more difficult for them to cope with or adapt. Interviews were conducted by the university researchers together with a local Inuit researcher in English or Inuinnaqtun at the respondent's house or the house that the

research team was staying at. Written or oral consent was obtained from each respondent prior to interviews and for the purposes of audio recording (all interviews were recorded). After each interview, draft transcripts were reviewed and verified by the research team.

Interviews were complimented with informal discussions and experiential trips on the land, ice and sea (referred to hereafter together as 'land') with community members, and participation in community life and activities. Informal discussions with community members helped clarify and expand upon what was shared during interviews. In particular, during experiential trips on the land, the researchers were able to observe hunter behaviour including pre-trip preparations and real-time responses to changing conditions. Participating in community life and activities, such as meal preparation, drum dances, organized sport, and vehicle maintenance and repair helped the researchers build rapport with community members and develop a better understanding of the broader societal context for the research. Daily observations were recorded as field notes and in a reflexive journal that considered researcher experiences and positionality.

3.2.2 Longitudinal datasets

Three types of longitudinal data were collected to compliment and expand upon the interview data. Sea ice data were attained from the Canadian Ice Service (CIS) and included data derived from satellite imagery, and marine, aerial, and terrestrial observations (Gagnon and Gough 2005; Laidler et al. 2009). Sea ice data was included to substantiate what respondents shared in interviews, both in 2005 and 2016, about changing sea ice thickness and extent, and implications for travel on the sea ice. The data span from 1968 to 2016, covering fifteen data points around Ulukhaktok. Six data points were selected for further analysis based on their location relative to trails and hunting

areas identified during interviews. In their original format, the data refer to the concentration of ice coverage on a ten-point scale, with 10/10 representing maximum ice coverage. The data were analysed to determine the break-up and freeze-up times for each year, and the overall change between the two from year-to-year. Consistent with Gagnon and Gough (2005), the break-up date was defined as the earliest day in the spring when ice coverage reached 5/10, and the freeze-up date was defined as the first day in the autumn where concentrations climbed to 5/10. Both were listed numerically, providing freeze-up dates, break-up dates, and the number of open-water days for each year.

Wildlife harvest data were obtained from the Government of the Northwest Territories (GNWT) and the Ulukhaktok Hunters and Trappers Committee (HTC). These data include, muskox and polar bear commercial and subsistence hunting data (number of animals taken for each type of hunt) from 2006 to 2016, and the number of allocations and quantity of each allocation for the commercial char fishery in Ulukhaktok from 2008 to 2016.

The economic costs of subsistence activities included detailed prices for individual items important for these activities (e.g. costs of equipment, fuel and supplies) and the cost of specific hunts (e.g. muskox hunt, caribou hunt) in 2005, 2009, 2013 and 2016. Data from the Inuvialuit Harvesters Assistance Program (IHAP) were also collected and included the number of applications, total funding available, and number and dollar amount of allocations from 2005 and 2010-2016.

3.3 Data analysis

The interview data were analysed using the principles of latent content analysis (Bernard 2012). First, the interviews were transcribed and scanned to identify common or recurring themes related to exposure-sensitivities and adaptation to changing environmental conditions. The interview data were then coded and analysed based on these themes using NVivo 10 qualitative data analysis software (QSR International). Each coding scheme was cross-referenced to identify connections between themes. Next, the longitudinal part of analysis involved comparing the findings from the 2005 and 2016 studies. Key themes from the two studies were compared and contrasted, including direct comparisons between interview transcripts of respondents who took part in both studies. Interview data are complemented, when relevant, with data from longitudinal datasets to better understand key changes between the two studies. Sea ice data were analysed with interview data to compare respondent experiences with any changes to sea ice relative to changes in sea ice cover in the area, and how these changes have affected subsistence activities and safety. Hunting and economics data were analysed with interview and participant observation data to generate basic quantification of some of the changes discussed by community members. These included, for example, the costs of hunting supplies and estimates for specific hunting trips in different seasons, and how key changes at specific points in time affected hunting behaviour and the number of species hunted.

4. Results

4.1 Exposure-sensitivities

Respondents described several climatic and non-climatic factors that are affecting subsistence activities, acknowledging both the biophysical and social components of risk. These are characterized here as exposure-sensitivities and include: 1) compromised travel routes and increased travel risk, 2) declining quality and availability of wildlife, and 3) financial and time constraints (Table 2). These findings are similar to 2005, but here increasing travel risks and compromised travel routes have been combined, and hunting-related time and economic concerns have been added.

Table 2: Description of key exposure-sensitivities documented during interviews with respondents in Ulukhaktok in 2005 and 2016.

Exposure-sensitivities	
2005	2016
<u>Increased travel risk</u> • More variable and less predictable weather • Variable winds and increased storminess • Rapid seasonal transitions and hazardous conditions lead to more hunters being stranded or injured • Changing sea ice dynamics <u>Compromised travel routes</u> • Early and rapid spring melt • Longer autumn, and less snow in some years • Sea ice taking longer to freeze (or is not freezing) and melting earlier, becoming more unstable overall • Changing wind-ice regime <u>Quality and availability of wildlife</u> • Decrease in number and condition of ringed seals and Peary caribou • Limited access to Dolphin Union caribou due to wind, distance, and equipment requirements • Access to eider ducks restricted by changes to sea ice, wind, and boat cost/access • Shift from caribou to muskox, but muskox are getting further away	<u>Compromised travel routes and increased risk</u> • Spring melt is early and becoming very rapid (n=21) • Snow fall is occurring later and affects travel (n=14) • Consistent trend towards later sea ice freeze-up and earlier break-up (n=24) • Sea ice is thinner leading to a greater flux in safe conditions and more travel on land in winter (n=18) • Winds are stronger, and more consistent and variable in direction, leading to smaller windows of opportunity and increased precautionary costs (n=22) <u>Quality and availability of wildlife</u> • Fewer seals, partially due to sea ice decline (n=9) • Wind conditions make caribou hunting more dangerous, costly, and cause time constraints (n=11) • Changes to sea ice and shorter migration window are restricting access to eider ducks (n=15) • Muskox are further away/fewer, leading to less hunting success and access constraints (n=17) <u>Financial and time constraints</u> • Time and financial constraints are sometimes forcing travel in risky conditions (n=8)

4.1.1 Compromised travel routes and increasing risk

In 2005, respondents reported an increase in the frequency and magnitude of climate events that had increased travel risks and compromised access to some hunting grounds (Pearce et al. 2010). In 2016, many of these hazards had persisted or progressed. In particular, increasing variability, unpredictability and speed of onset of weather continues to be problematic for hunters: spring is becoming consistently shorter, snow and river and lake ice are melting earlier and over a shorter time period (within a few hours or days); in the autumn, it is snowing later, and river and sea ice are taking longer to freeze-up; and stronger, less predictable winds are more common throughout the year. A rapid and unpredictable melt can leave hunters stranded on the land, with few options but to take risks and travel in melting conditions, exposing their snowmobile to damage from rocks. In 2005, many respondents reported that these conditions were contributing to their snowmobiles getting stuck and/or damaged. In 2016, respondents reported that conditions have worsened, but few reported being stranded due to unpredictable spring melts, noting that they have learned to avoid these conditions, even if it restricts their access to certain hunting areas. In the autumn, if lake ice is not sufficiently thick to travel over with a snowmobile, hunters must travel around the lakes (assuming there is enough snow), which takes more time and fuel, and exposes their equipment to wear and damage from rocks. These conditions are problematic for spring and autumn ice fishing at inland lakes including, for example, the annual trip to Fish Lake (*Tahiq*, ~80km northeast) for autumn ice fishing. Hunters usually travel to Fish Lake by snowmobile in early October, though in 2016 many respondents said that they have started to make the trip later in October or in early November to allow the ice on Fish Lake and other lakes along the way to freeze

and snow to fall. However, there can still be a lack of adequate snow cover by this time, increasing wear on snowmobiles. The regulated fishing season at Fish Lake closes at the end of November and later trips have started to conflict with the timing of the fishing season.

Respondents explained that there were variations in the timing of sea ice freeze-up and break-up among years but the trend was towards later freeze-up and earlier break-up. These observations are consistent with instrumental sea ice data recorded at locations on the sea ice near Ulukhaktok (Figure 2). Thinner sea ice is also more susceptible to strong winds and ocean currents, which hinders ice formation. For example, the increasing frequency and intensity of wind in the winter months together with later freeze-up, prevents 'old' thick ice from forming. Previously, sea ice would set at approximately 5-9 feet thick, but in 2016 respondents reported that sea ice is now mostly 2-3 foot 'young' ice.

> "Now it's really thin, we know that. Out there in the open sea, winter time, ice must be only a little over two feet sometimes. Old ice, like uh, quite a few months, like three, four months ice never move and stays thick. It's really changed." – Elder Pat Ekpakohak, 2016

Young ice is more susceptible to strong winds, resulting in broken ice piling, making travel on the sea ice more difficult, if not impossible. As a result, many respondents reported travelling on the land along the coast in the winter months rather than on the sea ice. Doing so requires more time, gasoline and leads to greater wear on snowmobiles and sleds from rocks. These observations are consistent with 2005 and the new data confirms a continuing downward trend in the timing of sea ice freeze-up and break-up, and ice conditions.

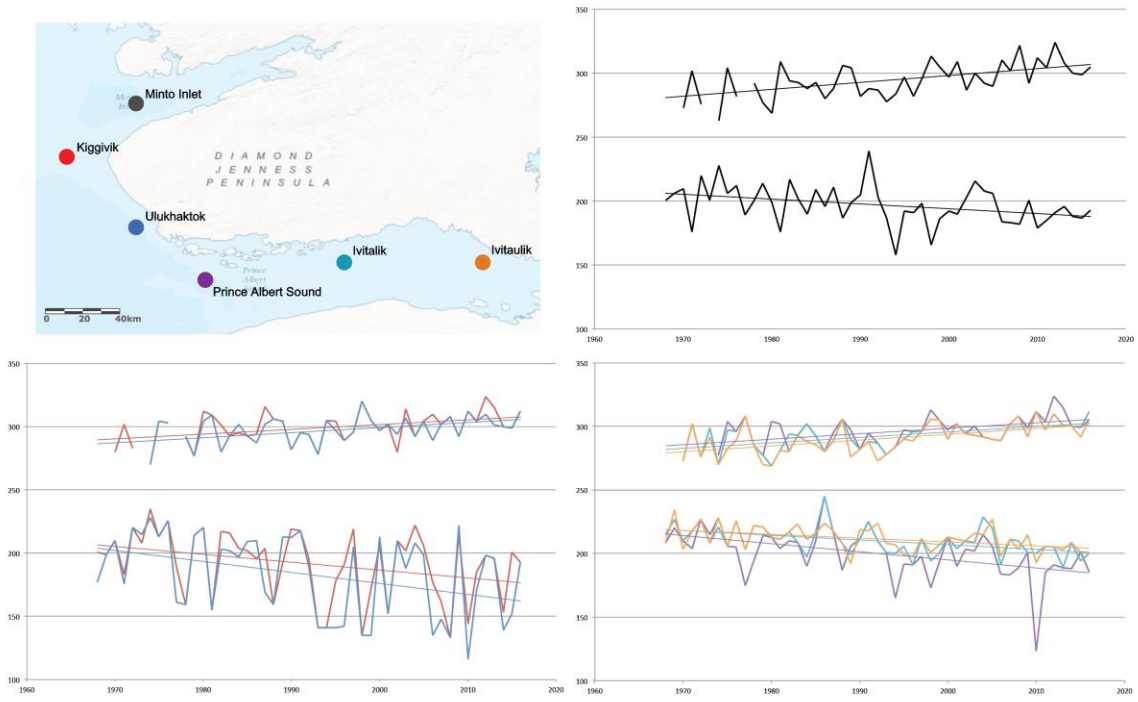

Figure 2: Changes to sea ice freeze-up (top of graphs) and break-up (bottom), with trend lines included, from six important hunting or travel areas from 1968-2016.

In 2005, respondents noted that winds were becoming more of a problem in the summer months when people travel to hunting areas by boat. In 2016, wind conditions have continued to change and exacerbated travel risks. Summer winds have grown so strong and consistent with such great directional inconsistency that they are making windows of opportunity for boating more narrow and unpredictable. Wind can create wave activity that makes boating difficult, if not impossible, and makes some hunting areas inaccessible. Depending on the wind direction, broken sea ice can be pushed back into the community's bays or into PAS, restricting travel by boat. Even if wave conditions are manageable, increased wave activity results in higher fuel consumption and greater risk. Due to the variability of wind conditions there is now an ever-present

risk of being stuck on the land while waiting out wind conditions, which can sometimes take weeks.

4.1.2 Declining quality and availability of wildlife

In 2005, observed changes to the quality and availability of wildlife included a notable decrease in the number of young ringed seals, poor body condition of adult ringed seals, a decline in the number of Peary caribou, and changing summer wind patterns restricting access to caribou hunting grounds in PAS (Pearce et al. 2010). These conditions have persisted, and in some cases new challenges have emerged. In 2016, hunters reported a decline in the presence of ringed seals, young and adult, in the area (congruent with Harwood et al. 2015), and believe that changes in the number of seals is related to two factors: seals following food sources into PAS and seal dens being affected by sea ice piling. Fewer seals mean less meat for the community, less income from selling seal pelts, and negative implications for polar bears who depend on seals as their main source of food. Peary caribou remain far from Ulukhaktok, albeit a few animals have been harvested near the community in recent years generating hope among respondents that they will eventually return, and wind conditions continue to challenge boat travel to caribou hunting areas in PAS (Dolphin-Union herd).

Respondents reported the occurrence of new species of wildlife and increases in the population of some predators. Since 2005 there have been documented observations and successful hunts of grizzly bears and hybrid 'grolar' bears on Victoria Island. Grizzly bears are thought to be competing with polar bears for food, and there have been observed kill sites where it is believed a grizzly has killed several muskox but only ate

specific pieces of select animals. There has also been a noted increase in the presence of wolves, near the community and further inland, adding another hunting pressure on muskox. In 2014 there was an unprecedented hunt of thirty-two beluga whales in waters near the community, producing large amounts of food and excitement. Several respondents expressed that they hoped this trend would continue in the future – although the whales have yet to return in such numbers – and perhaps also include other species migrating north such as elk and moose.

Ulukhaktok is one of two communities in the Arctic that hunt the western population of king eider duck. Access to hunting ducks due to early sea ice break-up was a key issue in 2005 and 2016 with people more often hunting ducks by boat rather than snow machine, with varying degrees of success. Calm winds, light fog, and a stable sea ice platform are ideal duck hunting conditions, but respondents explained that they are not seeing the combination of these conditions as often anymore. In 2016, ducks migrated past the community earlier, in a shorter time frame, and in fewer large groups. Even with adequate sea ice conditions, many respondents reported missing the hunt because of the concentrated migration.

> "Ducks season used to be one season, maybe three times - they would run maybe three times…Now it's like only one bunch just fly for how many days of the year, and you never see them again…people used to quit before the ducks stopped flying. They had enough. Used to get more than what we get now." (Anonymous Elder, 2016)

Another change between 2005 and 2016 was a reported decrease in the number of muskox near the community.

> "Yeah, especially the muskox now. They're starting to get further and further. You've got to get more than five gallons to go out there and back, unless you get lucky and it's like two or three miles out of town." (Isaac Inuktalik, 2016)

In the late 1990s muskox had replaced caribou as the primary source of meat because of the scarcity of caribou and the close proximity and abundance of muskox. In 2005, respondents reported that they were starting to see a slight decline in muskox and they had to travel a little further to hunt them. At the time, respondents suggested that this was due to over-harvesting driven by their emergence as a key species important for subsistence and the cash incentives that were being offered for their hides. Eleven years later, respondents reported that there are even fewer muskox and that they are moving progressively further away from the community. Respondents attributed the decline to natural cycles, the presence of more wolves, grolars and grizzly bears, and increased harvest pressure as muskox have become a focal point of subsistence hunting and income (e.g. sport hunting, meat resale, and the sale of horns and hides). This has made muskox more difficult and expensive to hunt (cost of fuel and supplies), with reduced chance of hunting success. Hunters now have to travel as far as Minto Inlet or Walker Bay to find muskox, and one respondent reported travelling 120km by ATV one day in July 2016 without seeing any muskox (Adam Kudlak, personal communication, 4 July 2016). As a result, hunting muskox now requires more extensive knowledge of areas on the land further from the community, and with increased fuel costs and greater uncertainty for a successful hunt, some hunters are choosing not go.

4.1.3 Financial and time constraints

Increased time constraints due to wage employment and/or schooling have forced some hunters to make shorter trips and sometimes travel back to the community in risky conditions. Other hunters noted being unable to afford the high costs of some supplies and have run out of supplies while on the land, also resulting in them traveling back to

the community in risky conditions. Of particular concern for respondents were gas prices, which have increased from $1.23/litre in 2005 to $1.81/litre in 2016, and oil and naphtha, which were respectively $7.99/litre and $3.41/litre in 2009 and increased to $16.99/litre and $4.38/litre in 2016. These rising costs are compounded by the need to travel further to reach hunting grounds, requiring more fuel and supplies, and more time. A day trip to hunt muskox in the summer now uses an average of 4L more gas according to one respondent who actively hunts muskox (personal correspondence, Adam Kudlak, 29 July 2016). Hunters now take an extra jerry-can of gas (23 litres) for a muskox hunting trip in the winter, bringing gas costs for a trip to approximately $166.52 (92L x $1.81/L). In 2013, the gas costs for these trips were estimated to cost $117.30 (69L x $1.70/L), with the increase being driven by rising gas prices and longer travel distances. Another example of how time and financial constraints have combined to adversely affect subsistence is caribou hunting in PAS. Summer caribou hunting by boat has always been expensive but can now cost as much as $2000/boat because of the need for extra gas and supplies to be prepared for unpredictable wind and ice conditions.

Increasing wear on vehicles is also becoming a problem that can constrain consistent participation in subsistence and enhance exposure to hazards on the land.

> "I have to go further and I spend more on gas. Sometimes your quads go down and you gotta order more parts and wait, and wait, and wait." (Jack Akhiatak, 2016)

Due to changes in snow and ice conditions, especially during the shoulder seasons, hunters have to replace parts and maintain their equipment at greater expenses, limiting how they can prepare for hunts or if they can go out altogether. This year alone, one respondent had to replace five sets of carbides (steel runners on the bottom of the skis) on

his snowmobile at $100 per set due to a lack of snow on the rocky land (personal correspondence, Roland Notaina, 11 July 2016). These challenges are further compounded by the lower success rates of some hunts.

4.2 Adaptive strategies

Four main themes emerged from the interview data about how Inuit are responding to these changing climatic conditions: 1) extra precautions, 2) flexibility, 3) sharing networks, and 4) community hunts (Table 4.3). Consistent with the adaptive strategies documented in 2005, adaptive strategies employed in 2016 were largely autonomous and reactive, with emerging roles for institutions at the community and regional scales.

Table 3: Description of key adaptive strategies documented in Ulukhaktok in 2005 and 2016.

Adaptive strategies	
2005	2016
<u>Extra precautions</u> • Taking extra precautions and supplies/gas • Travel in groups and closer to town • Increasing use of communication or navigation technology <u>Alternative transportation and routes</u> • Increasing use of boats in shoulder seasons as ice melts earlier – costs can restrict access • Shift from caribou to muskox • Change routes and locations <u>Food sharing and diet change</u> • Important adaptive strategy, starting to be restricted • Changes to species harvested • Supplement diet with store food	<u>Extra precautions</u> • More precautionary supplies required, sometimes constraining adequate preparation (n=16) • Increased avoidance of risky conditions (n=9) • Travel in groups or communicate travel plans (n=17) • Technology is widely used, often within the context of individual skills and knowledge (n=20) <u>Flexibility</u> • Under pressure, more difficult to be flexible (n=13) • Flexible equipment and trail use (e.g. caribou hunt by ATV) (n=17) <u>Sharing networks</u> • Increasing concentration on family units to enable a few hunters to be active (n=12) <u>Community hunts</u> • Provide those who may not otherwise have access to a reliable source of country foods with food (n=15)

4.2.1 Extra precautions

In 2005, hunters reported taking extra precautions, beyond what they would normally do, before and during travel in anticipation of encountering problematic conditions. In 2016, most hunters continued to take these precautions, but some expressed concern that the increased costs of hunting sometimes limited their ability to take adequate precautions such as traveling with extra fuel and supplies. In some cases where the wind has not let up for extended periods of time, some respondents reported taking extreme risks to travel back to the community by boat in dangerous wave conditions because they had run out of supplies or needed to make it back for work or school commitments.

The uptake of new communication and navigation technologies continued in 2016; many hunters now commonly carry satellite phones, Global Positioning Systems (GPS) and cell phones. Financial constraints, however, limit who can access these technologies, with some hunters sharing equipment and others relying on the Canadian Ranger's equipment. The unreliability of GPS has led many hunters to mistrust this technology for navigation and several respondents said that they take a GPS with them as a fall-back in case they get caught in a difficult situation such as a whiteout or if they temporarily lose their bearings and need to reorient themselves. In fact, these technologies have seemingly found a niche where they are often used, but not overly relied upon. Instead, hunters try to be prepared to camp temporarily if they are stranded and are otherwise prepared with a VHF radio or satellite phone.

A major change in communication technology since 2005 has been the diffusion of high-speed Internet in the settlement and the installation of a cellular reception tower

in September 2014. Many people who travel close to Ulukhaktok now use cell phones to communicate with people in the community and beyond. Some experienced hunters leverage social media as a form of communication, especially with younger community members. Almost everyone in the community uses Facebook, either directly or indirectly through a family member. Some people use Facebook as a means to communicate environmental conditions and share reports from hunters who are on the land.

4.2.2 Flexibility

Inuit have always used flexibility as an adaptive response to the Arctic environment and flexibility continues to be important in adaptation to recent environmental changes. In 2005 and 2016, several flexible responses to changing conditions were documented including, the use of alternative equipment to continue pursuing specific subsistence activities and using alternative travel routes to access hunting areas. Respondents also reported flexibility in the timing of subsistence activities (e.g. traveling to Fish Lake later in the autumn when river and lake ice is frozen) and in the species of wildlife harvested (e.g. the switch from caribou to muskox, or hunters learning about and hunting new predators such as grizzly bears). The ability of hunters to be flexible depends on their access to income and freedom from work and other social commitments, and their knowledge of the environment and land skills.

4.2.3 Sharing networks

In 2005, food-sharing networks were identified as providing community members with country foods in spite of factors that may affect their involvement in subsistence. It was noted, however, that food-sharing networks were not functioning as they did in the

past and food sharing had become more restricted to immediate family members. This trend continued in 2016 and these networks now included cash exchanges. An emerging trend in Ulukhaktok is families pooling financial resources to support one or two members to hunt and provide country food. This investment in one or two members to do the hunting for the family reflects the high costs of hunting and the need for wage employment to pay for travel equipment, fuel, and supplies. One active hunter noted that his mother purchased a snowmobile for him because he provides country food for her and his family network. Without this help, he would not have been able to afford a new snowmobile, which would have limited his ability to actively engage in subsistence activities during the winter and therefore his family's access to country foods.

4.2.4 Community hunts

Community-sponsored hunts have recently been organized to help provide community members with country foods, who may not otherwise have access to them. These hunts have involved the local Hunters and Trappers Committee and Community Corporation hiring local hunters to harvest wildlife (mainly muskox), which is then shared with Elders, single mothers, and other marginalized groups in the community. Thirty-two muskox were hunted over the course of two community hunts in 2015/2016 and the meat was distributed to households throughout the community. The hunts have been well received by community members, many who would not otherwise have had access to country foods at those times of the year. Some respondents, however, noted that it is important to consider the health of the wildlife species being hunted, and to not deplete a population that is already stressed.

4.3 Adaptation constraints

Key constraints to adaptation documented in 2016 include: 1) capital resources and time, 2) hunting economics, and 3) environmental knowledge and land skills (Table 4). These findings are similar to 2005, but also include hunting economics.

Table 4: Description of key adaptation constraints documented in Ulukhaktok in 2005 and 2016.

Adaptive constraints	
2005	2016
Capital resources and time • Finances constrain adaptive strategies (e.g. flexibility), limit participation in subsistence • Time constrains subsistence activities and causes conflicts with unpredictable weather • Polar bear sport hunt is an important source of income Traditional ecological knowledge • Crucial to adaptive capacity, but transmission is no longer functioning as effectively as previously	Capital resources and time • Finances increasingly constrain adaptive strategies (e.g. flexibility), limit activities (n=24) • Time constrains subsistence activities and causes conflicts with unpredictable weather (n=12) Hunting economics • Loss of polar bear sport hunt has constrained income and increased pressure on muskox (n=9) • Local commercialization of country food (n=6) Environmental knowledge and land skills • Transmission continues to be problematic and is compounded by other factors (e.g. increasing costs) that limit subsistence activities (n=9)

4.3.1 *Capital resources and time*

In both 2005 and 2016, access to capital resources and time constraints due to wage employment and/or school were constraining adaptation. There is limited access to income in the community due to few economic opportunities and constraints on subsistence-compatible sources of income (see section 4.3.2). Two members of the local HTC even noted that programs such as the IHAP and the Community Harvesters Assistance Program (CHAP) are receiving more applications due to increasing financial pressures, but the amount of funding available has not increased for several years. Financial pressures are problematic as access to equipment and alternative modes of transportation are essential to enable flexibility to adapt to changing conditions. For

example, in response to more open water and stronger and more consistent winds and waves, some hunters have purchased larger boats, but winds in the summer months have become so strong and consistent that even hunters with the largest boats have difficulties finding opportunities to travel. As a result, in 2016 some hunters leveraged their access to ATVs and barrels of gasoline stored on the land to go caribou hunting by ATV. The development of this adaptation pathway required access to multiple modes of transportation, and the money and time in the winter to buy and position barrels of gas at strategic locations on the land.

4.3.2 *Hunting economics*

The economics of subsistence can both help facilitate and constrain adaptation. Several hunters access financial capital through subsistence including trapping (mostly foxes), hunting wolves (biological samples and pelts can be worth $600-950 per animal), the commercial char fishery, selling muskox hides, horns, and meat, and muskox sport hunt guiding. Alternatively, the economics of subsistence can constrain adaptation as hunting is more expensive and hunters are traveling longer distances to find wildlife with lower rates of success. Since 2005, there have been three major developments that have impacted the economics of subsistence in Ulukhaktok: (i) the 'end' of the polar beat sport hunt, (ii) rise of the muskox sport hunt, and (iii) commercialization of country foods.

Prior to 2008, the polar bear sport hunt provided important financial resources to the community via income for Inuit guides and helpers. In Ulukhaktok, each polar bear sport hunt typically earned approximately $3,000 to the Inuit helper and $8,000 to the Inuit guide, who provided a dog team, travel equipment, and supplies. In 2008, however, the U.S. Fish and Wildlife Service (USFWS) banned the importation of polar bear

trophies under the Endangered Species Act. Because the majority of sport hunters visiting Ulukhaktok were American, the number of polar bear sport hunts in the community dropped from 10 in 2007/08 to 3 in 2008/09, and down to 0 in 2009/2010 (GNWT 2011). As a result, an important source of subsistence-compatible income is gone, and several hunters who once guided polar bear sport hunts noted that this has affected their ability to purchase and maintain their large equipment (e.g. snowmobiles, ATVs) and to train and keep dog teams.

Some respondents reported that since the polar bear ban in 2008, the muskox sport hunt, which has historically fluctuated, has become a more important source of income, resulting in greater competition for guide and helper commissions. The HTC selects guides and helpers for muskox sport hunts and there are a limited number of hunts and an increased number of applicants, making it more difficult to be awarded a commission as a guide or helper. Guides gross approximately $1500 on muskox sport hunts, substantially less than a polar bear sport hunt, and some guides reported a net loss after paying for fuel and supplies because muskox are now further from the community and more difficult to find. One hunter suggested that they might have to look for new hunting grounds to take sport hunters as current areas have been depleted.

> "The last couple summers we've been lucky to get some muskox for the [sport] hunters, but we had to kind of go more-further from our camping areas, base camp. So I think we're gonna have to start looking at alternate hunting grounds, cause we've been hunting in the same areas for a while now. I think we're going to have to go further up the island" (Jack Akhiatak, 2016)

A third emergent theme related to hunting economics is the commercialization of some country foods. Some local businesses including, the Quickstop (convenience store) and hotel buy meat, mostly muskox, from local hunters for resale, and in 2016 the

community was testing the feasibility of expanding their commercial char fishery to support a local processing plant by increasing commercial char tags from the standard 500 to 700. Several hunters have also started to independently market country food on social media. For example, one hunter shared that he sells medium-sized Ziploc bags of ground muskox meat for $40 each, almost exclusively to people who are unable to hunt themselves for a variety of reasons. The commercialization of country foods has implications for local sharing networks, which play an important role in supporting local food security, and potential implications for the health of the food source itself .

4.3.3 Environmental knowledge and land skills

In 2005, respondents expressed concern that some environmental knowledge and land skills were not being shared with younger generations, resulting in some younger Inuit not being well-equipped to engage in subsistence activities, especially under changing conditions. These observations were later substantiated with evidence of changes in the transmission of environmental knowledge and land skills among Inuit men in Ulukhaktok (Pearce et al. 2011b). To what extent this has changed is beyond the scope of this research to characterize, but in 2016 some respondents, especially from older generations, expressed concerns that some environmental knowledge and land skills were not being transmitted to younger generations. Commonly reported stresses to transmission included time constraints due to wage employment and schooling, increased costs of hunting, changing motivations for some youth, and compromised travel conditions limiting time on the land.

5. Discussion

The research findings show the evolution of climate change impacts, adaptations and vulnerability over time. From 2005 to 2016 there has been a progression, or at the very least consistent directional trend, in the evolution of some climate conditions that are relevant to subsistence activities. The evolution of these changes together with evolving socio-economic changes have created conditions that are beyond the scope of what hunters are used to, and thus necessitate new responses. An example of this is the evolution of the summer caribou hunt in PAS. Stronger, less predictable winds have restricted access to caribou hunting grounds in PAS by making travel unpredictable due to dangerous wave activity and/or shifting ice conditions. Trips are more difficult to time for those who work, and more expensive due to increasing prices of fuel and supplies. Since 2005, some hunters have purchased larger boats and motors, in part to try to accommodate rougher seas and carry more weight. For the purposes of overcoming rougher seas, this strategy proved temporarily successful, and reduced the risk of being stranded due to rough ocean conditions. However, with particularly strong and consistent winds the last few summers, even larger boats have been unable to travel. In 2016, several hunters, frustrated by the consistently windy conditions, abandoned their boats and elected to travel overland by ATV. When some hunters returned successful, others also altered their plans to travel overland by ATV. Travelling overland eliminates exposure to ocean conditions and ATVs use much less fuel than boats. ATVs, however, also have a reduced hauling capacity compared to boats meaning fewer caribou can be transported. Fewer caribou means less meat for the hunter and less meat to share. The use of ATVs to travel overland to hunt caribou is not new, but until now has been a less

desirable option, and may be used as a coping strategy until a longer-term adaptive strategy is developed.

The finding that climate change is being experienced in the context of multiple social and ecological stressors is consistent with other studies in the Arctic (Clark et al. 2016; Loring et al. 2016; Archer et al. 2017) and among other Indigenous populations (McCubbin et al. 2015). In particular, the research findings show a growing tension between the subsistence and wage economies. The capital costs of subsistence hunting have risen between 2005 and 2016 and changing climatic conditions have further exacerbated these costs by increasing exposure to risks on the land and affecting travel routes to some hunting areas. Some hunters are unable to adapt to the longer time requirements needed to travel further and cope with changing trail conditions due to employment commitments and others are unable to afford the costs of extra gas and supplies. Still others are forgoing travel altogether because they do not feel confident traveling in uncertain conditions, particularly during shoulder seasons and on the sea ice. The end of the polar bear sport hunt reduces the flow of external money into the community and further restricts access to subsistence activities as some hunters lost their primary source of income, while others no longer have the opportunity to travel and hunt with experienced teachers as they did during the sport hunts (e.g. helpers and guides). Taken together, these forces have exacerbated existing tensions between the subsistence and wage economies previously discussed in a larger Arctic context by Wenzel (2013).

Inuit in Ulukhaktok are showing ingenuity in their responses to changing conditions, often being opportunistic in both the subsistence and wage economies. For example, some families have directed financial resources to a full-time hunter and some

country foods are being sold for cash income. Changing demographics in Ulukhaktok have likely contributed to these responses, such as the increase in the number of single female- and male-headed households, many who have full-time wage employment and do not have an active hunter in their immediate network or access to a spouse's network (see Collings et al. 2016). These demographics have also created a new demand for country foods and financial incentives, something that is controversial for some community members who believe that country foods should be shared and not sold; similar concerns have been documented in Nunavut (Ford et al., 2016).

The data on how Inuit are responding to changing conditions advances our understanding of adaptation pathways. In 2005, hunters were largely participating in what Pahl-Wostl (2009) refers to as single-loop social learning, making incremental alterations to their routines. This included adaptive strategies such as taking greater pre-trip precautions. Hunters were also undertaking what Pahl-Wostl (2009) defines as double-loop learning, and were beginning to reframe the problem and their responses to achieve their goals, such as with the switch from hunting caribou to muskox. In 2016, single-loop responses continued, as did some double-loop responses (e.g. hunting caribou overland by ATV). However, the commercialization of country food and a greater inclusion and pooling of financial resources in sharing networks can be characterized as what Pahl-Wostl (2009) call triple-loop responses to multiple dynamic conditions. Triple-loop responses involve changes to the structural context of adaptation. The commercialization of country food and greater inclusion and pooling of financial resources in sharing networks represent shifts in how the subsistence and market economies are engaged to adapt to environmental and socio-economic changes. The commercialization of certain

country foods also represents a shift in how some hunters approach food distribution and how they finance their hunting operation. It is worth noting, however, that these types of changes are not entirely novel: Chabot (2003) found a similar use of monetary resources in Inuvik and Collings (2009) found money to typically be viewed and shared as a capital resource similar to tools or equipment within sharing networks in Ulukhaktok.

The findings also point to examples of cascading effects. Some exposure-sensitivities are creating what has been termed a 'ratchet effect' in hazards (Chambers 1989) and climate change vulnerability literature (Ford et al. 2013). A 'ratchet effect' is where the accumulative effects of conditions, responses, or specific successive events reduce the ability of a group or an individual to respond to future stressors. For example, some Inuit in Ulukhaktok are engaging in subsistence activities less than they would like to because of financial and time constraints. This has serious implications for the generation and transmission of TEK and the capacity of these hunters to safely travel and ultimately deal with changing conditions on the land. Other hunters tend to be relying heavily on a few species, or even specializing on one or two species (e.g. wolves, musk-ox) as a flexible response to changing wildlife quality and availability and as an opportunistic source of income. This focused pressure, in turn, could have negative consequences for the population health of the targeted species.

6. Conclusion

This paper applies a longitudinal approach to examining how Inuit in Ulukhaktok adapt to changing environmental conditions over an eleven-year period. Taking a longitudinal approach enhanced our understanding of the interactions between climatic

and non-climatic factors, and revealed that since 2005 climate change is having a progressively larger impact on the ability of Inuit to participate in subsistence activities or carry them out as effectively and safely. The temporal dimension of the research also highlights the importance of the socio-economic environment in shaping how climate change is experienced and responded to. Adaptive responses in Ulukhaktok have varied in nature and success over time, but are being increasingly affected by the growing tension between subsistence activities and the increasing level of financial resources required to participate in subsistence and respond to changes in the environment, and the time restraints these requirements can place on subsistence in the context of the mixed economy. Efforts to support adaptation to climate change in Ulukhaktok, and elsewhere in the Arctic, need to address the dynamic socio-economic context of adaptation, particularly the tension between the wage and subsistence economies, and its effects on participation in subsistence and related potential 'ratchet' effects. Entry points for adaptation could include increasing or renewing harvesters assistance programs and programs focused on the generation and transmission of environmental knowledge and land skills. Alternatively, there may be potential to creatively combine programs and streams of funding for an array of benefits, such as combining nutritional subsidies, community hunts, and environmental knowledge and land skills programs for youth.

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Hunting under changing conditions in Ulukhaktok, NT

Inventory #1: Socio-Demographic Interview

ID# Interview # Name (if consent given) (Inuinnaqtun name if offered)	
Gender	
Age	
Education Level	
Livelihood Activities	
Household characteristics (rent or own, how much per month, household size and makeup – who lives in the house, list names)	
How long have you lived here? Before? Plan on staying?	
# of operating snowmobiles	
# of operating boats with kickers	
# of operating ATVs (Hondas)	

Inventory #2: Semi-Structured Interview & Free-listing

General Questions to ask (whenever fits):

1. Do you get out as much as you want? If you haven't been able to get out, why? What makes it difficult to get out? What did you do? Where did you get country food?
2. If you get lucky when you're out, who have you been distributing meat to? Who distributes meat to you?
3. Do you run into any problems when you're out on the land?
4. Do you think people are prepared when they go out? Are young people prepared? Why?
5. How do you think increasing cruise ships will affect the community?

Questions about subsistence harvesting based on the seasonal cycle:

Spring

1. How has your spring hunting and fishing been?
2. Where did you go?
3. What did you get?

Free-list: what are the best conditions for hunting ducks? Spring fishing?

4. Have you been getting these conditions? If not, what have the conditions been like? Is this different from other years? How do these changed conditions affect you?
    a. Have you been getting conditions that make it more difficult to get out, or that affect you when you are out audlaking?
5. How are you dealing with this? Is it working?
    a. Is there anything making it easier / more difficult for you?

Winter

1. How was your winter?
2. Where did you go?
3. What did you get?

Free-list: what are good ice conditions for audlaking?

4. Have you been getting these conditions? If not, what have the conditions been like? Is this different from other years? How do these changed conditions affect you?
    a. Have you been getting conditions that make it more difficult to get out, or that affect you when you are out audlaking?
5. How are you dealing with this? Is it working?
    a. Is there anything making it easier / more difficult for you?

Fall

1. How was your fall hunting?
2. Where did you go? (Fish Lake? Caribou?)
3. What did you get?

Free-list: what are the best conditions for audlaking in fall time?

4. Have you been getting these conditions? If not, what have the conditions been like? Is this different from other years? How do these changed conditions affect you?
    a. Have you been getting conditions that make it more difficult to get out, or that affect you when you are out audlaking?
5. How are you dealing with this? Is it working?
    a. Is there anything making it easier / more difficult for you?

Summer

1. How was the fishing last summer? Did you go for caribou?
2. Where did you set your nets? Where did you go?
3. What did you get?

Free-list: what are the best conditions for summer fishing? For hunting caribou?

4. Have you been getting these conditions? If not, what have the conditions been like? Is this different from other years? How do these changed conditions affect you?
    a. Have you been getting conditions that make it more difficult to get out, or that affect you when you are out audlaking?
5. How are you dealing with this? Is it working?
    a. Is there anything making it easier / more difficult for you?

Supplement #1: Questions about Pre-Trip Audlak Information, Preparation, and Rescue

1. Where do you get your information before audlaking?
2. Do you talk to anyone before you audlak?
3. Where do you get you weather, sea ice, and wind information?
4. Do you take a radio or sat phone? Do you take a GPS?
    a. When do you use it?
5. Have you ever gotten in trouble on the land?
    a. What happened? What did you do?
    b. Would you do anything differently next time?

Supplement #2: Seals and Whales

1. How were the seals this year? Did you get any? How many? Where? What about the years before that?
    a. What affected your ability to get seals this year? The last few years?
2. Do you think (beluga) whales will come back this year?
    a. Are you ready if they do?

Supplement #3: Guides for Polar Bear Sport Hunts

1. Can you tell me about a polar bear sport hunt you guided?
    a. What year was that? How many hunts did you guide in a year? For how many years?
2. What was the pay for guiding? Did you have to buy gas and supplies with that?
3. What year was the last hunt you guided?
4. Did you guide any hunts this past year? If not, how come?
5. Do you keep dogs? If no, how come? If yes, how come?
6. How did fewer hunters coming to hunt polar bear affect you and your family?
7. Do you do anything differently now to make the income that you would have from guiding polar bear hunts? What made this easier/more difficult?

APPENDIX II: INUINNAQTUN INTERVIEW GUIDE

Semi-Structured Interview & Free-listing

Opingnahak

4. Ukiukmi, anguvaktutit qanogitpa? Ikalukhiuk paktutitlu?
5. Aulaakganat, humut aulaakpuktutit?
6. Hunumik anguvakpakpit?

Free-list: Tingmiakhukkangat, hila qanokituhaut? Ikalukhiaktunilu? Aulaakpaktutit aulaakgmangnakhikput? Aulaaknitgavit ayoknakhivaktok qanok?

6. Hila, hikulu, namakgaluaktuk aulaakganat? Nagungitmat qanokgitpaktuk?
    a. Allagnoktuk ipaat ukiumik? Qanok allakpakpit taimaaganat?
7. Qanok illitoknahovgitaat taimialuganat? Naunualiktok?
    a. Hila tiamiliuganat ayoknakhikpaktok?
8. Angoganat, kinamut payoktakpakpit?

Ukiuk

6. Qanogitpaa ukiuk?
7. Humut allakpakpit?
8. Hunamik angovakpakpit?

Free-list: allakganat, hiku kanogituhaut?

4. Hila, hikulu, namakgaluaktuk aulaakganat? Nagungitmat qanokgitpaktuk?
    a. Allagnoktuk ipaat ukiumik? Qanok allakpakpit taimaaganat?
5. Qanok illitoknahovgitaat taimialuganat? Naunualiktok?
    a. Hila tiamiliuganat ayoknakhikpaktok?

Ukiukhak

6. Qanokgitpa ukiukhak aullaktutit?
7. Humut allakpakpit?
8. Hunamik angovakpakpit?

Free-list: hila, hikulu, nunalu, qanokgituhaut aullaakganat?

4. Hila, hikulu, namakgaluaktuk aulaakganat? Nagungitmat qanokgitpaktuk?
    a. Allagnoktuk ipaat ukiumik? Qanok allakpakpit taimaaganat?
5. Qanok illitoknahovgitaat taimialuganat? Naunualiktok?
    a. Hila tiamiliuganat ayoknakhikpaktok?

Aoyak

6. Ikalukiututit qanogitpaa? Tuktuhiukpapit?
7. Humut illivgapaktat kuvatiit?
8. Hunamik angovakpaktutiit?

9. Hila, hikulu, namakgaluaktuk aulaakganat? Nagungitmat qanokgitpaktuk?
    a. Allagnoktuk ipaat ukiumik? Qanok allakpakpit taimaaganat?
10. Qanok illitoknahovgitaat taimialuganat? Naunualiktok?
    a. Hila tiamiliuganat ayoknakhikpaktok?

Supplement #1: Questions about Pre-Trip Audlak Information, Preparation, and Rescue

6. Kinamut ukakpaktutit aullaakganat? Kinamit hila hiut piuaktutit?
7. Nahakpaktutiit nalautmik, telephonemiklu, GPSmiklu?
    a. Humi tupguat atokpaktatit?
8. Aulaakagnat ayokhapakpit? Ayokhagivit hulivakpaktutit?

Supplement #2: Seals and Whales

3. Natiit qanokgipat? Angovakpakpit nitikmik? Kaffit? Humit?
4. Ihumaluktutiit qilalugat kinahuakfaktut? Kifaakpat tamayatiit naoniaktut?