

ORIGINAL RESEARCH

Observations of environmental changes and potential dietary impacts in two communities in Nunavut, Canada

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ABSTRACT

Introduction: Inuit from communities across the Arctic are still existing in subsistence living. Hunting, fishing and gathering is an important part of the culture and the harvested 'country food' provides sources of nutrients invaluable to maintaining the health of the populations. However, Inuit are voicing their concerns on how observed climate change is impacting on their traditional life. The objective of this study was to report on observed climate changes and how they affect the country food harvest in two communities in the Canadian Arctic. The nutritional implications of these changes are discussed and also how the communities need to plan for adaptations.

Methods: A total of 17 adult participants from Repulse Bay and Kugaaruk, Nunavut were invited to participate. Participants were selected using purposeful sampling methods selecting the most knowledgeable community members for the study. Inuit Elders, hunters, processors of the animals, and other community members above the age of 18 years were selected for their knowledge of harvesting and the environment. Two-day bilingual focus groups using semi-directed, unstructured questions were held in each community to discuss perceived climate changes related to the access and availability of key species. Key topics of focus included ice, snow, weather, marine mammals, land mammals, fish, species ranges, migration patterns, and quality and quantity of animal populations. Maps were used to pinpoint harvesting locations. A qualitative analysis categorizing strategy was used for analysis of



data. This strategy involves coding data in order to form themes and to allow for cross-comparison analysis between communities. Each major animal represented a category; other categories included land, sea, and weather. Results were verified by the participants and community leaders.

Results: Three themes emerged from the observations: (1) ice/snow/water; (2) weather; and (3) changes in species. Climate change can affect the accessibility and availability of the key species of country foods including caribou, marine mammals, fish, birds and plants. Various observations on relationship between weather and population health and distributions of the animal/plant species were reported. While many of the observations were common between the two communities, many were community specific and inconsistent. Participants from both communities found that climate change was affecting the country food harvest in both positive and negative ways. Key nutrients that could be affected are protein, iron, zinc, n-3 fatty acids, selenium and vitamins D and A.

Conclusion: Community members from Repulse Bay and Kugaaruk have confirmed that climate change is affecting their traditional food system. Local and regional efforts are needed to plan for food security and health promotion in the region, and global actions are needed to slow down the process of climate change.

Key words: Arctic, caribou, climate change, country food, Inuit, local marine mammals, nutrients, nutrition, observations, traditional diet.

Introduction

'Country food' is locally derived plant, animal, and fish foods, which are harvested from the surrounding environment. It is a well documented source of nutritional, cultural, physical, social, and economic strength for Inuit communities across the Arctic¹⁻⁵. Currently country food is a major contributor of key nutrients to Inuit populations across the Arctic, even though it makes up only 8–38% of food energy³. In Repulse Bay, country food is the major source of protein, iron, zinc, phosphorus, thiamine, riboflavin, niacin, vitamin B6 and vitamin B12, even though it makes up a mere 16% of total energy intake⁶. Country food in Kugaaruk, although only 10% of food energy intake, was found to be the major source of protein, niacin, vitamin B6, vitamin B12 and cholesterol and an important source of vitamin A, thiamine, riboflavin, iron and zinc⁷. Furthermore, marine mammal blubber is a major source omega n-3 fatty acids⁸. Besides having superior nutritional value, the harvesting, processing, and consumption of country food is associated with a more active lifestyle, an increase in cultural morale and food diversity, and participation in culturally-specific

activities⁹. Decreased intake of country food and increased intake of high-energy, low nutrient market food may put Inuit communities at risk for micronutrient deficiencies³, obesity, cardiovascular disease, cancer, and diabetes^{9,10}. Furthermore, consumption of country food is associated with greater food security^{6,7}.

As numerous studies suggest, Indigenous populations of the Arctic including Inuit, have already experienced climate change and its impacts¹¹⁻¹⁷. Some of these climate changes observed in the regions studied, include unpredictable weather, earlier break up and later freeze up of ice, thinning ice, melting glaciers, decreasing lake and stream levels, and changes in animal populations and travel conditions^{12,13,15}. These changes can affect the access and availability of country food in either positive or negative ways, depending on the locations of traditional ground, availability of mode of transportation for the hunters, and the changes of distribution of the animals in relation to the location of the villages.

There is now a consensus within the scientific community that increasing temperatures and other climate changes over the last 50 years are caused by human industrial activity¹⁸.



Although the majority of greenhouse gases do not come from the Arctic region, climate change is occurring there at an increased rate compared with other parts of the world¹⁹. Over the next century, the level of atmospheric CO₂ compared with the pre-industry level is expected to double²⁰, and overall temperatures in the Arctic are expected to increase by 2.5°C by mid-century, to 5–7°C by the end of the century²⁰.

Climate change can potentially impact the harvest of plants and animals which are nutritionally, culturally, and economically important to Inuit. The aim of this study was to report on climate change observations from two Inuit communities in the Canadian Arctic and to make direct links to key species and nutrients that may be affected in the Inuit diet. The objectives were to: (i) gather qualitative information regarding the potential influences that climate change is having on species and hunting/harvesting activities in two Arctic communities; and (ii) identify the sensitive areas where adaptation plans for the environmental changes are needed.

Methodology

Participating communities

Kugaaruk and Repulse Bay community members were participants in this study due to their extensive country food use and their concern over climate change impacts in their communities.

Kugaaruk (latitude 68.5327, longitude 89.807495): The English translation of Kugaaruk is ‘River flowing through the community or used as a water supply and for fishing’. The predominantly Inuit community of Kugaaruk (formerly known as Pelly Bay) is located along the east coast of the Kitikmeot region of Nunavut, Canada (Fig1). Although it had long been a meeting place for semi-nomadic families, it was not until 1968 that Kugaaruk became a permanent

settlement²¹. In 2006 the community consisted of 688 people living in 137 dwellings²². The main sources of income are subsistence harvesting, government jobs, selling of handicrafts, and government assistance⁷. In 2001, the yearly income for a family of four in Kugaaruk was \$37,000²², compared with the territorial average of \$48,100 in Nunavut⁷. Most frequently consumed country food in the Kitikmeot region are caribou, Arctic char, muskox, trout, eider duck, ringed seal, and beluga³.

Repulse Bay/Naujaat (latitude 66.56057, longitude 86.24727): The English translation of Naujaat is ‘Seagull nesting place’. Repulse Bay, or Naujaat is in the Kivalliq region of Nunavut, Canada (Fig1). It is a coastal town with 153 dwellings and 748 people, as in the 2006 census²³. In the Kivalliq region, the most frequently consumed country food is caribou, char, beluga, trout, ringed seal, walrus and narwhal²². The main sources of income are government or community jobs, government assistance, fishing, trapping, hunting, and the sale of handicrafts⁶. Yearly income for full time workers in 2001 was recorded as \$34,300²² compared with the territorial average of \$48,100 in Nunavut for that time.

Ethics and research agreements

Ethical approval was obtained from the Human Ethics Review Committee of the Faculty of Agriculture and Environmental Sciences, McGill University. Preliminary meetings with leaders of Kugaaruk and Repulse Bay, Nunavut took place in February 2005 and research agreements detailing the research protocol, responsibility of the researchers, risks and benefits to the communities and forms of results of communications were signed between the researchers and the Hamlet Council. A participant consent form (written in both Inuktitut and English) was used in order to bring greater clarity to the collaborative relationship and to define participant and researcher rights and responsibilities.

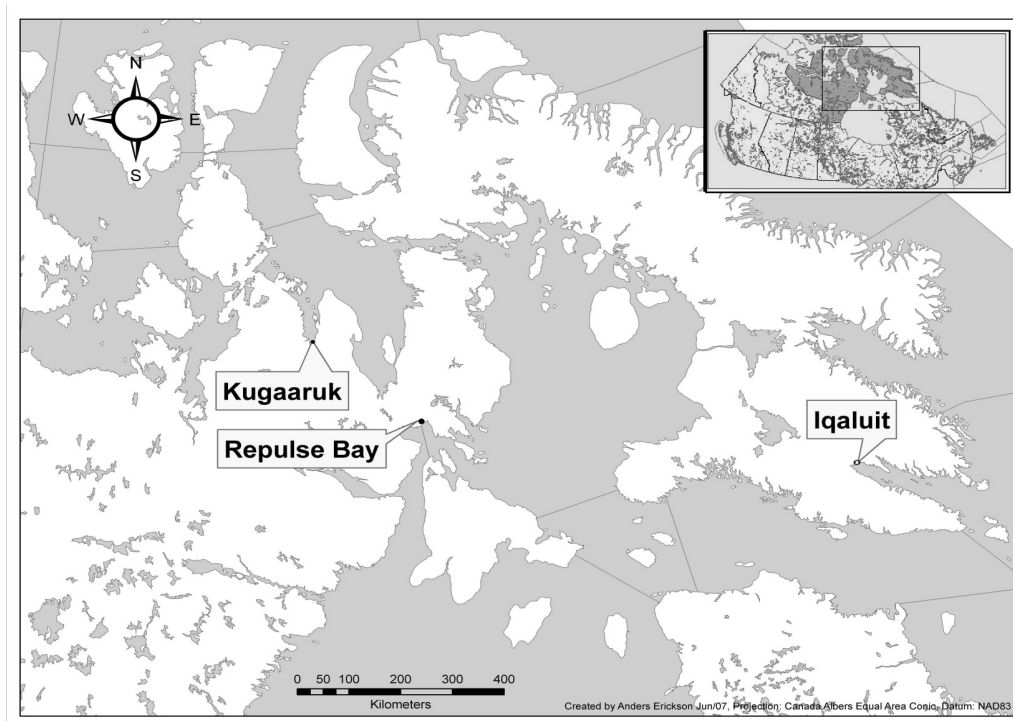


Figure 1: Map of Nunavut, Canada, with locations of Kugaaruk and Repulse Bay.

Focus groups

Two-day bilingual focus groups were held in each community to discuss perceived climate changes related to the access and availability of key species. The Kugaaruk meeting was held in March 2005 and the Repulse Bay meeting was held in April 2005. Participants were selected using purposeful sampling methods²⁴, selecting the most knowledgeable community members for the study. Inuit Elders, hunters, processors of the animals, and other community members above the age of 18 years were selected for their knowledge of harvesting and the environment. The Hamlet councils organized the selection process, which included radio advertising and word of mouth.

Key topics of focus included ice, snow, weather, marine mammals, land mammals, fish, species ranges, migration

patterns, and quality and quantity of animal populations as they have been identified as potential issues related to climate change in previous studies^{12,13}. Maps, on a scale of 1:250 000 and 1:50 000, were used to pinpoint harvesting locations. Focus groups were conducted using semi-directed, unstructured questions, a method employed with success in similar studies with Inuit in Northern Canada^{11,14-17}. Meetings started with general observations of environmental change, and subsequently each harvested species was discussed in detail. Observations were recorded pertaining to changes in animals or the community's ability to harvest the animals. On-site translation was conducted by community translators and meetings were recorded with audio-recorders.

Data analysis

Qualitative data collected from focus groups were analyzed with the objective of understanding the current perceptions



on how environmental change is affecting access and availability of country food. The meeting tapes were transcribed into English with the help of community translators. Data were checked with community members for accuracy. A qualitative analysis categorizing strategy was used for analysis^{11,24}. This strategy involves coding data in order to form themes and to allow for cross-comparison analysis between communities. Coding was randomly cross-checked for accuracy.

Validity

A possible source of error is participant bias: saying what the researcher wants to hear or reactivity²⁴. To minimize such bias, focus groups were conducted in a semi-directed unstructured manner¹⁴⁻¹⁷. Specific, directed questions such as 'How is climate change impacting your country food?' were avoided, so as not to imply the intended goal of the researcher. Rather, questions were asked such as 'Have you noticed any changes in how or when you harvest food?' These types of questions allowed participants to draw their own conclusions and tell their own truths. Preliminary results were validated by selected participants of the focus groups.

Results

A total of 10 community members participated in the focus groups in Repulse Bay, three women and seven men. In Kugaaruk, seven people participated, including one woman.

A multitude of climate observations relating to changes in harvesting were given by members of each community. Three themes emerged from the observations: (i) ice/snow/water; (ii) weather; and (iii) changes in species.

Ice, snow and water

Summary of the observations are presented (Table 1). Respondents in both Repulse Bay and Kugaaruk observed that ice was thinner and that it melted earlier in the spring. Repulse Bay participants noted that this was an asset to hunting ringed seal, caribou and fish. Kugaaruk respondents reported an increase in 'rotten ice', or ice in an advanced stage of disintegration²⁵. While hunting seals in the spring, rotten ice prevented hunters from moving freely between ringed seal breathing holes, which made harvesting more difficult and dangerous.

When the floe edge was closer to the community, harvesting seals and walrus was reported to be easier. Repulse Bay participants reported that presently, the floe edge proximity varied slightly from year to year. Snowfall had increased in both communities and had become more variable in Repulse Bay. Hunters and Elders in both communities stated that caribou like to be where there was less snow in order to access vegetation. In Repulse Bay, where snow and ice once remained throughout the summer on hills and mountains, reported complete melting during the summer. Kugaaruk Elders noted that in the spring, soft snow that before would harden at night now remained soft.

Participants from both communities reported that the water table was lower in lakes and the ocean. Repulse Bay residents now accessed islands at low tide which previously had been inaccessible and new reefs had appeared in Kugaaruk. In Repulse Bay, respondents reported a stronger water current in the spring. A river in Kugaaruk was said to have nearly dried up, making fishing for lake trout and Arctic char in that area impossible.

Weather

Increasing unpredictability of weather and an increased intensity and heat of the summer sun was reported in both communities. There was also increased summer rain that boosted vegetation growth, translating to healthier, fatter caribou. Also, it was described that more rain let hunters



stalk caribou more quietly. Increase in summer rain also led to increased berry harvest. Repulse Bay participants reported that wind changed quickly and was stronger. In 2004, a freeze-thaw event occurred in Repulse Bay that changed the migration pattern of caribou making access more difficult. Repulse Bay participants reported warmer winters and that the position of the stars have changed. Kugaaruk community members reported increased freezing rain and described that there was no more 'ice fog' and that the sun rose more steeply in the sky. These changes of ice/snow conditions and astronomical positions make navigation using traditional knowledge challenging and increase the risk of hunting or fishing.

Changes in wildlife and fish

Respondents from both communities reported a multitude of specific changes they had noticed happening in the species that they usually harvest (summary, Table 2). Generally, participants from both communities reported that the health of the animals has declined, and the taste and texture of caribou and fish had changed. Participants from Kugaaruk cited the reason as being pollution from exploration, or using wooden storage containers for the fish instead of using ice.

Both Kugaaruk and Repulse Bay community members stated that presently the caribou population was close to the community and that caribou were tamer and easier to harvest. However, respondents from both communities suggested that because of an increased population, the meat did not look as healthy and was infested with more parasites and warble flies than before. Repulse Bay participants reported that caribou hide was thinner, easier to tear, while Kugaaruk participants said the fur was not as healthy. Repulse Bay community members described that caribou were skinnier and sometimes there was sandy material between the skin and the meat. Furthermore, they said that caribou no longer migrated over the sea ice; their migration patterns varied.

Ringed seal was found to be more abundant in both communities. The size and proximity of the ringed seal

population and their fat content fluctuated according to floe edge distance, as well as the orca whale and polar bear populations. When their predators were close or numerous, the ringed seal population decreased as did their fat content. However, the seals tended to congregate closer to the shore when predators were near, which made them easier prey for Inuit. Presently, community members said, the orca whale population was resurging. As well, ringed seals had less fat, which presented a problem when hunting. It was reported that less fat equaled less buoyancy when shot in the water, and therefore hunters lost more seals. Furthermore, it was mentioned that fatter ringed seals had tastier livers but Kugaaruk participants reported observation of liver diseases in ringed seals. Beluga populations reportedly did not come close anymore to the community of Repulse Bay but polar bear, narwhal and bowhead whale populations had increased.

Participants in Repulse Bay noticed a decrease in two types of shrimp, as well as jellyfish and seaweed. The Arctic char and lake trout population in Repulse Bay was reported to be abundant; however, the flesh was paler than before which makes them less appetizing. The change in color of the flesh also suggested that the fish might have switched to a different diet.

Members of both communities observed a decrease in native bird species and an increase in non-native bird species. Ptarmigan population and body size had reportedly decreased. More ravens were observed in Repulse Bay while Kugaaruk residents reported decrease in eider duck, Arctic tern, other shorebird, and song bird populations. Geese and swan were reported to have increased in both communities and more of them were hunted as a result.

Availability of berries in Repulse Bay was reported to have declined; blueberry, blackberry, and cranberry were being diminished by migrating geese and caribou populations. Participants in Kugaaruk reported that the 'vegetation was getting bad' and caused the caribou to migrate elsewhere to find healthy forage.



Table 1: Environmental changes observed by Kugaaruk and Repulse Bay residents affecting the ability to harvest wildlife

Theme	Repulse Bay	Kugaaruk
Ice/Snow/ Water	<ul style="list-style-type: none"> ice thinner now lower water table variable snow fall snow and ice on hills and mountains melts now in the summer, whereas in the past it stayed all year water current stronger in spring proximity of floe edge varies each year 	<ul style="list-style-type: none"> ice thinner now, increase in rotten ice lower water table more snow this year
Weather	<ul style="list-style-type: none"> late autumn rain, then quick freeze-up unpredictable now wind quicker to change and stronger summer sun is hotter, more intense warmer winters position of stars have changed 	<ul style="list-style-type: none"> increase in freezing rain unpredictable now more rain in summer sun much hotter no more ice fog sun rises straight up, before shallow

Table 2: Summary of changes observed in population, health and distribution of key species of wildlife

Theme	Repulse Bay	Kugaaruk
Caribou	<ul style="list-style-type: none"> ↑ caribou close to the community meat does not look as healthy ↑ in parasites in meat tamer now hide easier to tear, thinner easier to harvest migratory route varies, no longer on the sea ice caribou are skinnier sandy material found between skin and meat 	<ul style="list-style-type: none"> ↑ caribou close to the community meat does not look as healthy ↑ in parasites in meat tamer now fur not as healthy
Marine mammals	<ul style="list-style-type: none"> ringed seal population size/proximity, fat content fluctuates according to floe edge distance, orca whale and polar bear populations hunt more seals when floe edge is closer 5 years ago, there were more seals fat abundance varies each year seals are skinnier this year ↑ narwhal, orca whale populations beluga population not close 	<ul style="list-style-type: none"> seal population is abundant now seal population is cyclical illness in seals ↑ narwhal ↑ bowhead whale ↑ polar bear
Fish/sea life	<ul style="list-style-type: none"> abundant Arctic char and lake trout populations fish flesh is whiter than before 	<ul style="list-style-type: none"> fish eat pollution left by exploration companies ↓ in shrimp, jellyfish, and seaweed
Birds	<ul style="list-style-type: none"> ↑ in non-native species ↓ in native bird species 	<ul style="list-style-type: none"> ↑ in non-native species ↓ in native bird species
Plants	<ul style="list-style-type: none"> more rain equals more berries berries eaten by geese berry leaves broken by caribou 	<ul style="list-style-type: none"> vegetation getting bad berries eaten by geese



Discussion

The observed climate changes could have both positive and negative consequences on the Arctic ecosystem and have the potential to affect the amount of food harvested and eaten in Inuit communities. Changing ice, snow and water conditions will impact on the animals that are harvested by Inuit. On one hand, using boats to harvest seals earlier may increase ringed seal consumption; however, increased rotten ice may translate to harvesting less seals in the spring which would decrease valuable nutrient intake. Early break up of ice, an Arctic-wide symptom of climate change¹⁸, may reduce ringed seal numbers by decreasing pregnancy rates and pup survival²⁶ and by shortening lactation and moulting times¹⁸. Ringed seal flesh is extremely high in protein, iron, and zinc²⁷. The blubber is an excellent source of n-3 fatty acids⁸, and vitamin E²⁸, while intestines are a good source of vitamin E²⁸. Zinc can be found in very high levels in ringed seal eyes²⁷, which are traditionally eaten by women.

Earlier boating may increase access to caribou (shot from the boat) and fish. Like most country food, caribou boasts a whole host of micro and macronutrients, including protein, iron, zinc and phosphorous from the flesh²⁷, and vitamins A and D from the liver²⁷⁻²⁸. Vitamin E is found in the flesh, liver, and fat²⁸. Caribou stomach and stomach contents are good sources of manganese and magnesium respectively²⁷. Arctic char and lake trout are an excellent source of vitamin D, which is important for Inuit due to low consumption of fortified milk beverages²⁷ and limited sun exposure during the winter. Arctic fish are also excellent sources of protein²⁷ and n-3 fatty acids⁸. Thus more access to caribou and Arctic fish by earlier boating could increase consumption of these valuable foods and their nutrients.

Participants in both communities observed that the water table, including rivers and fishing spots, was lower. This observation is supported by scientific data reported in the literature²⁹. Since 1983, a series of limnological records

show a lower water table, summer drying of substantial bodies of water and ponds, and changes in water chemistry; elements which, in the Arctic, have been stable for millennia. The authors cited an increased evaporation/precipitation ratio due to warmer temperatures and a longer ice-free season as the cause of these changes²⁹. The drying of these bodies of water could change the health and the structure of invertebrate populations and led to loss of essential habitats for wildlife and migratory birds, thus affecting local food supply. However, a lower water table has increased access at low tide to small islands, thus giving greater access to caribou hunting areas. The long-term effect on local diet is uncertain.

Repulse Bay reported annual variability of the proximity of the floe edge. The Arctic Climate Impact Assessment (ACIA) predicted that the summer floe edge would retreat, changing the habitat, feeding, and breeding conditions for ringed seal, walrus, and polar bear¹⁸. Ringed seals would unlikely to survive in regions where there is no summer ice. Polar bear survival would also be threatened because ringed seal is their primary food source¹⁸. Vitamin A intake would be affected if polar bear consumption decreases²⁷ and adequate alternative foods were not consumed. Bottom feeding walrus would lose access to productive coastal areas if the floe edge retreats and Inuit would lose an important mode of transportation if floating sea ice is reduced¹⁸. The main nutrients affected from change in walrus consumption would be vitamin A and n-3 fatty acids²⁷.

Caribou survival is heavily influenced by weather conditions. Both increased snow cover and freeze-thaw ice layers would drive caribou south. Access by Inuit to the nutrients provided by caribou may be diminished if these weather patterns continue. However, increased rain and wind may benefit the status of caribou by increasing summer vegetation and providing relief from insect harassment respectively. Furthermore, if caribou are easier to stalk in rainier conditions, Inuit may gain more access to caribou's beneficial nutrients.



Nutrients in meats (whale, caribou) and fish are concentrated and become up to three times higher when dried²⁷, a traditional practice in both communities. Residents of both Kugaaruk and Repulse Bay reported that the sun's heat was more intense and hotter, at times spoiling the fish or meat before it is dry, making it soft and inedible. If drying practices are affected by climate change, an old tradition may be at stake, as well as valuable nutrients. Decline in the quality of meat and fish and an increase in parasites may have a negative effect on the consumption of nutrients from caribou, ringed seal, and fish, especially for attracting the younger generation to eat country food.

It is assumed that the increase and decrease of animal populations will translate to a relative increase or decrease in consumption for Inuit. Table 3 summarizes the key nutrient intakes that could be affected by observed or predicted changes in species availability. Reported decreases in ringed seal, ptarmigan, and king eider duck and ptarmigan body size, may have negative consequences for Inuit relying on those nutrients (Table 3). Ptarmigan and King Eider are both high sources of iron and protein, and contain a variety of other micronutrients, according to the CINE nutrient database (<http://www.mcgill.ca/cine/resources/nutrient/>).

Assuming that increased population means greater consumption, growth in narwhal, bowhead whale, goose and swan populations will provide greater access to some valuable nutrients. Sea mammal fats are very high in n-3 fatty acids including the very healthy eicosapentanoic acid (20:5n3) and docosahexanoic acid (22:6n3)⁸, as well they are excellent sources of vitamins A, E, and D²⁸. Dried narwhal meat is extremely high in phosphorus and sea mammal skin is a high source of protein²⁸. Geese and swan were harvested by both communities in small numbers, and if the harvest increases, this would contribute to protein, iron, zinc and copper levels³⁰.

Respondents from both Repulse Bay and Kugaaruk have noticed however, that higher numbers of geese consume more berries thereby decreasing their availability to Inuit.

Caribou, it was noted by Repulse Bay community members, trample and destroy the berry leaves during their migration. Arctic berries, such as blueberries, blackberries, and cranberries contain phytochemicals³¹, carbohydrates²⁷ and vitamin C, according to the CINE nutrient database (<http://www.mcgill.ca/cine/resources/nutrient/>). Due to poorer quality vegetation, caribou are reported as being 'skinnier' than in the past and having to migrate further, thus decreasing access to caribou's superior nutrients.

The increase in orca whales in Repulse Bay may alter the amount of ringed seals available to the community. Repulse Bay participants noted that when the orca whale population is close, the seals are skinnier and they stay closer to the shore. This may translate to increased access for Inuit. However, since skinnier seals sink more easily when shot, hunters have less access to valuable nutrients from seals.

Conclusions

It is evident that climate change is having a perceived impact on the way the communities of Repulse Bay and Kugaaruk are able to harvest their regional species. However, no consistent trend in observations was discernable from the interviews which identified both negative and positive consequences of climate change on traditional food availability, hunting and harvesting. Changes in weather and landscape, as well as changes in the animals, have both diminished and given greater access to country food, depending on the species. Inuit have historically adapted to changes in climate and species distribution^{32,33}. However, current climate change is happening at record speed¹⁸. This, together with encroaching global culture, increasing contaminant deposition¹⁸, and imminent natural resource exploitation, creates a multi-faceted scenario, to which Inuit hunting culture must respond.



Table 3: Nutrients potentially affected by changes in country food as a result of observed changes in species availability

Observation	Consequence	Country food	Major nutrients affected
↓ Quality of meat, ↑ parasites	More effort needed to hunt good meat	↓ caribou ↓ seal ↓ fish	<ul style="list-style-type: none"> • iron, zinc, protein • iron, protein, n-3 fatty acids • vitamin D, protein, n-3 fatty acids
↓ Animal population	Harvest less	↓ seal ↓ ptarmigan ↓ king eider	<ul style="list-style-type: none"> • iron, protein, n-3 fatty acids • protein, iron • protein, iron
↑ Animal population	Harvest more	↑ fish ↑ narwhal ↑ bowhead ↑ goose ↑ swan	<ul style="list-style-type: none"> • vitamin D, protein, n-3 fatty acids • vitamin A, E, D, n-3 fatty acids • vitamin A, E, D, n-3 fatty acids • protein, iron, zinc, copper • protein, iron, zinc, copper
Loss of fat	Seals: sink faster Caribou: less healthy	↓ seal ↓ caribou	<ul style="list-style-type: none"> • iron, protein, n-3 fatty acids • iron, zinc, protein
↑ Orca whale	↓ Seal population	↓ seal	iron, protein, n-3 fatty acids
↑ Goose	Destroy vegetation	↓ berries	vitamin C, phytochemicals
↓ Bird body size	Less meat	↓ ptarmigan	protein, iron
Caribou break leaves	Less berries	↓ berries	vitamin C, phytochemicals
Vegetation getting bad	Affect caribou migration	↓ caribou	iron, zinc, protein
↑ Parasites, warbles flies	Caribou harassment	↓ caribou	iron, zinc, protein

Besides the great cultural and economic significance, the nutritional value of the food that Inuit harvest from the land and sea is unparalleled. Further studies, such as monitoring nutrient intake changes in these communities, more observations of animal numbers and characteristics and analysis of meats for nutrient profiles are needed. On a global scale, policy must be implemented to curb fossil fuel emissions and hinder climate warming in the Arctic. Country food is extremely important to Inuit communities across the Arctic, the access of which must be encouraged and supported.

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