Climate Change Effects on Traditional Inupiaq Food Cellars

Center for Climate and Health

Michael Brubaker, Jacob Bell, Alicia Rolin

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This paper reports on a special concern identified in Point Hope during a recent Climate Change Assessment: the thawing of traditional food storage cellars due to warming soil temperature. This phenomenon is reducing the quality and quantity of food available to residents of Point Hope. Climate change is a likely cause and adaptive strategies are necessary to restore food security for Point Hope and other communities that depend on traditional storage cellars.

Introduction

In May of 2009, the Alaska Native Tribal Health Consortium (ANTHC) performed a Climate Change Assessment in Point Hope, Alaska. It was performed by ANTHC's Center for Climate and Health in partnership with the Maniilaq Association, the regional tribal health consortium for Northwest Alaska. The purpose of the assessment was to record local observations related to climate change and to explore adaptive strategies for improving community health. The purpose of this paper is raise awareness about an emerging health issue and to identify potential adaptation strategies.

Background

Point Hope is an Inupiaq community of about 700 residents. It is located on a gravel spit that creates a natural peninsula extending out into the Chukchi Sea. It is an ideal location for hunting and gathering wild foods, most importantly bowhead whales. Whaling defines the identity of Point Hope and drives social and cultural activities. From a nutrition, food security and mental health standpoint, whaling is critical for overall community wellness.

During our assessment, twenty-two interviews were performed including the Mayor, the Tribal Council President, other representatives of the city and tribal council, as well as the school, health clinic, fire department, police department, and public works. Elders were interviewed, including retired whaling captains, and there were discussion with students and presentations at Tikigaq School. Throughout the interviews, concern about the thawing food cellars was expressed repeatedly as was the desire to find a solution.

In Point Hope, underground cellars dug into the permafrost have provided food storage for thousands of years. Nature provided the Inupiaq with all the necessary materials: whale bone and drift wood for the frame, sod for the roof, and frozen ground for refrigeration. The traditional cellars, "siġl·uaq" in the Inupiaq language, are still in use today. They offer convenience (located near the old town site), ample space, and an economical method for refrigeration (see a site in Figure 1 below).

However, over the last decade the average air temperature in Point Hope crossed a threshold, and the "permafrost" was no longer permanent. Above average temperatures result in siġl·uaqs that are thawed and sometimes flooded with melt water. As a result, whale meat is sometimes in storage for months before the ground temperature is cold enough to freeze. This can result in spoiled meat, increase the risk of food related illness and become an attraction for polar bears and other animals. If warming trends continue in the Northwest Arctic, we expect to see decreasing periods when soil temperatures are adequate for food storage. The subsequent loss of the siġl·uaq is a crisis for Point Hope and other Arctic villages.

The Northwest Arctic has been gradually warming for at least the last 60 years with about a 3.2°F total increase in annual temperature between 1949 and 2006 (UAF Alaska Climate Research Center). Alaska's climate is projected to increase 1.5°F to 5°F by 2030 and 5°F to 18°F by 2100. This trend is supported by measurements of sea ice, glaciers, permafrost, vegetation, and snow cover. Although climate models project increases in precipitation across Alaska, higher summer temperatures would also increase evaporation resulting in drier conditions and reduced soil moisture (Meehl, et. al 2007). Permafrost temperatures have increased throughout Alaska since the late 1970s (Lettenmaier et. al 2008). As much as the top 30 ft of discontinuous permafrost is projected to thaw in Alaska over this century (Parson 2001). The largest increases have been measured in the northern part of the state (Osterkamp, T., 2007).

Vulnerability & Adaptation

Arctic indigenous peoples are known to be particularly vulnerable to health impacts of climate change, in part because of the threat to traditional food safety and food security (Confalonieri et al., 2007). The traditional subsistence diet of Alaska Natives is nutritious and protective against the development of

cancer, heart disease, diabetes and other metabolic disorders (Boyer et al., 2007). Loss of adequate storage effects food security and also raises concerns about the potential for foodborne illnesses.

Fig. 1 Siġl·uaq – Old Town Site, Point Hope (note: bail buckets) Photo by M. Brubaker

The most common types of foodborne illnesses in humans are caused by bacteria such as Campylobacter, Salmonella and E. coli, and Norovirus. Higher temperatures have been found to increase incidences of *salmonella* cases (Kovats et al., 2004). These pathogens typically cause symptoms such as fever, diarrhea and abdominal cramps. Pregnant women, infants, the elderly and those with weakened immune systems are at higher risk for severe infections. The community health aides in Point Hope have not reported any unusual change in the number of food related illnesses in Point Hope (A. Davenport, personal communication, 2009). However the health aides and other residents, including whaling captains, expressed concern about the decreasing quality of siġl·uaq stored whale meat (J. Towksjhea, personal communication, 2009).

The environment inside the siġl·uaq, including both temperature and moisture, is critical to food safety. Bacteria must multiply before enough are present in food to cause disease. Given warm moist conditions and an ample supply of nutrients, one bacterium that reproduces by dividing itself every half hour, can produce millions of progeny in a single day. Refrigeration prevents virtually all bacteria from growing (Sobel et al., 2004). At temperatures of 32°F to 40°F bacteria, mold and yeast can still grow. Below freezing temperatures (32°F to 0°F) stop most bacteria growth but allow some to survive. The optimal storage temperature for most frozen foods is from 0°F to -10°F (USDA, 1994). Whale meat and whale blubber preserve differently at different temperatures and temperatures below -10°F are even better, allowing for preservation for up to year (D. Drum, personal communication, 2009).

Preservation of food is accomplished in several ways. In addition to refrigeration, high levels of salt, sugar or acid keep bacteria from growing, which is why salted meats, jam, and pickled vegetables are time honored methods for preserving foods. Similarly, microbes are also killed by heat. If food is heated to an internal temperature above 160°F for even a few seconds it is sufficient to kill most parasites, viruses and bacteria. The toxin that causes botulism is completely inactivated by boiling. This is why canned foods must be cooked to a high temperature under pressure as part of the canning process. To address these food security and safety problems in Point Hope, alternative methods for food storage can be developed. There are several possible adaptive approaches: 1) improve the environment at the current location, 2) establish new siġl·uaqs at a location with a better subsurface environment, and 3) develop an alternative method for food storage.

1. Improve the environment at the current location

The conditions at the siġl·uaq location in Point Hope make continued use of the traditional sites very challenging. Erosion has caused many of the siġl·uaqs to be reclaimed by the sea. Storm surges can flood the old town area. This was the reason Point Hope was relocated in the mid 1970s. Permafrost melt creates two problems; the lack of adequate soil temperature and high moisture and humidity. Factors including ventilation, drainage, and temperature should be considered in developing appropriate strategies.

2. Establishing new siġl·uaqs at a location with a better subsurface environment

There may be other locations near Point Hope where the conditions are better suited for underground food storage. With an understanding of permafrost conditions, other sites could be considered. Year

round soil temperature is a key measure. Currently there is at least one soil boring located in Point Hope actively logging soil temperatures throughout the year. This was established through a collaborative project between the Tikigaq School and Kenji Yoshikawa of the University of Alaska Fairbanks, Geotechnical Institute. There are also plans underway to install temperature loggers in siġl·uaqs, to acquire more information about year round temperature. Development of test borings in other sites could help identify potential alternative sites.

3. Develop an alternative method for food storage

There are alternative methods of food storage that could be considered, community freezers using conventional systems and alternative approaches that blend new technology with traditional knowledge. Alternative methods for using underground cellars have been developed in many places around the Arctic and provide models that are efficient and cost effective. Training courses are available in Alaska that provide instruction on how to build food storage structures that achieve optimal temperatures (0^{o}F to -10^{o}F) with maximum efficiency (D. Drum, personal communication, 2009). Another possibility is the development of siġl·uaqs that are assisted during warm months by refrigeration powered by alternative energy systems (J. H'ebert, personal communication, 2009). Funding for these kinds of projects is becoming increasingly available in Alaska.

Discussion

Thawing of traditional food storage cellars is occurring in Point Hope and other Arctic communities in Alaska, due to melting permafrost and warming soil temperature. This phenomenon is reducing the quality and quantity of food available to residents. Climate change is a likely cause and adaptive strategies are necessary to restore food security. Any response should be locally driven, culturally appropriate, economical, sustainable and meet public health guidelines. Adaptive practices for food management can help to reduce the negative effects of climate on health (Lake et al. 2009). Without adaptive measures, current temperatures will destabilize food security and increase the risk of foodborne illnesses in Point Hope.

For more information contact: Mike Brubaker at the ANTHC Center for Climate and Health. mbrubaker@anmc.org 907-729-2464, or visit our website at www.anthc.org/chs/ces/climate

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University of Alaska Fairbanks, Alaska Climate Research Center

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