COMMUNITY-BASED RESESARCH ON UNDERGROUND FOOD STORAGE IN ALASKA

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ABSTRACT

In northern Alaska communities, Indigenous peoples have used underground food storage facilities like ice cellars and pits to preserve and share locally harvested food and maintain their lifeways. Their food storage practices have changed due to rapid environmental fluctuations (e.g., permafrost thawing, including consequences of thawing and moisture) and the arrival of colonialist education, technologies, and global economy. Preliminary results of this current study suggest that sharing food and knowledge with family and community members strengthens their physical and spiritual health and cultural identity. However, storage maintenance and observation of underground food storage tradition have not been widely discussed in past research. In this research we developed partnerships with the communities of *Anaqtuuvak* (Anaktuvuk Pass), *Tikiġaq* (Point Hope), *Sivungaq* (Savoonga), and *Sivuqaq* (Gambell). We also work alongside natural scientists to monitor physical conditions of the land and climate, and as cross-cultural social scientists we discuss how community-based research provides locally relevant meaningful information for communities. This is achieved in part through assisting community planning for cultural revitalization in terms of food security, food sovereignty, and food "life-history." This paper reports on the ongoing research on underground cold storage in partnering communities, the primary methods associated with this inquiry, and our preliminary findings.

INTRODUCTION

Alaska Native peoples have long used various types of subterranean, semisubterranean, and terrestrial caches and pits to preserve and share locally harvested meat, fish, and plants and to maintain their lifeways (Binford [1978] 2012; Burch 2006; Burgess 1974; Campbell 1998; Foote 1992; Hall et al. 1985; Houlette 2009; Hughes 1960; Jolles 2003; Paneak and Campbell 2004; Rainey 1947; Sakakibara 2020; Spearman 1979; Spearman and Nageak 2005; Spencer 1976). Storing locally harvested meat in underground pits is practiced among the Arctic and sub-Arctic communities for at least three reasons: storing a mass of meat supports the food needs of community residents; quickly storing meat in a cellar helps prevent meat from spoiling; and some meat processing and storage techniques require building, maintenance, and preservation skills to achieve precise and safe conditions of meat fermentation. These skills are local, traditional cultural knowledge that is passed between generations, and these serve as a symbol of community and ethnic identity.[1] For example, traditions of harvesting, preparation, and distribution of local food strengthen people's cultural identity physically and spiritually because their ancestors and

family have practiced these lifeways to live successfully with the land, water, air, and their inhabitants, with planning and actions being taken in consideration of future generations.

People in the Arctic and sub-Arctic have observed changes in underground food storage usage due to rapid environmental fluctuations such as permafrost thawing and moisture conditions and the arrival of assimilationist education, modern technologies, and global economy (Houlette 2009; Jolles 2002; Nyland et al. 2017; Rainey 1947; Sakakibara 2020; Wolforth 2015). Our interdisciplinary research team (social, natural, and Indigenous scholars) proposed the project to potential partnering communities to establish conditions for cooperative research. We then applied for and received funding (National Science Foundation and National Park Service) and began community-based research relevant to each community's sociocultural preferences. Research team members organized a community meeting for each visit to each community for the exchange of ideas regarding the research. As a part of this community-engaged process, researchers update their findings derived from previous fieldwork, and residents share their concerns and interests about the project so that project goals can be fine-tuned to meet community needs and preferences.

In 2021 and 2022 we conducted preliminary, pre-research field trips to *Anaqtuuvak* (Anaktuvuk Pass), *Tikiġaq* (Point Hope), *Sivungaq* (Savoonga), and *Sivuqaq* (Gambell) and met with local government board members and Elders to hear their concerns about the conditions and changes of underground storage traditions. We learned that storing locally harvested meat in underground cellars and caches was practiced for many generations. During fieldwork and communication with local communities, researchers discovered community interests in the project differed slightly based on their sociocultural traditions and preferences and on local sociological and ecological conditions in the present.

This paper is an overview of our underground food storage project in Alaska, its process and goals, methods, and initial findings. We provide this as a contextual example of research that is being conducted on food security and food sovereignty in Alaska Native communities. This is a part of the special section of this issue of the *Alaska Journal of Anthropology*, a portion of which is firsthand accounts of dealing with local effects of climate change and economic globalization. Our project investigates changes in underground food storage traditions and practices surrounding the "life-history" of food and how local capacity to adapt to sociocultural and ecological changes in northern communities is effectively applied in terms of resilience and well-being. Our three main research questions are:

1. What are the traditions surrounding underground storage practices in the community?
2. What have community members observed over their lifetimes regarding thawing frozen ground conditions in their regions—especially since the 1960s?
3. What are the communities' concerns regarding underground food storage and climate change in the present and future?

Our project goals are to provide each community a comprehensive record of food life-history for those foods stored in the underground caches in the past to the present, and to develop food security plans and strategies with communities due to recent sociocultural and ecological environmental changes. Through the project, residents of study communities share with researchers their experiences and observations of the changes in landscape and climate. Alongside the communities' interests and preferences, we plan to establish recommendations for maintaining existing underground food storage caches as part of an overall strategy for community energy independence. This paper focuses on the overall process of establishing research partnerships with communities (which helped to inform the research focus); methods used for data collection and how this is being carried out (including the role and process of community involvement); and how with initial findings the community becomes a part of the decision-making process for next steps in the research project.

PLACE: PARTNER-COMMUNITY BACKGROUNDS

With research funded primarily by the National Science Foundation (NSF), our partnering study communities include *Sivuqaq* (Gambell) and *Sivungaq* (Savoonga) on *Sivuqaq* (Saint Lawrence Island) in the Bering Sea, *Tikiġaq* (Point Hope) on Alaska's northwest coast, and *Anaqtuuvak* (Anaktuvuk Pass) in Alaska's western Brooks Range (Fig. 1). Coastal communities *Sivuqaq*, *Sivungaq*, and *Tikiġaq* traditionally store seafood in their family's underground cache, distributing their catches to community members, while inland Iñupiat in *Anaqtuuvak* built their community underground caches to store mostly caribou and mountain sheep meat. Indigenous people in the Alaska Arctic have stored whale, walrus, seals, and other animals

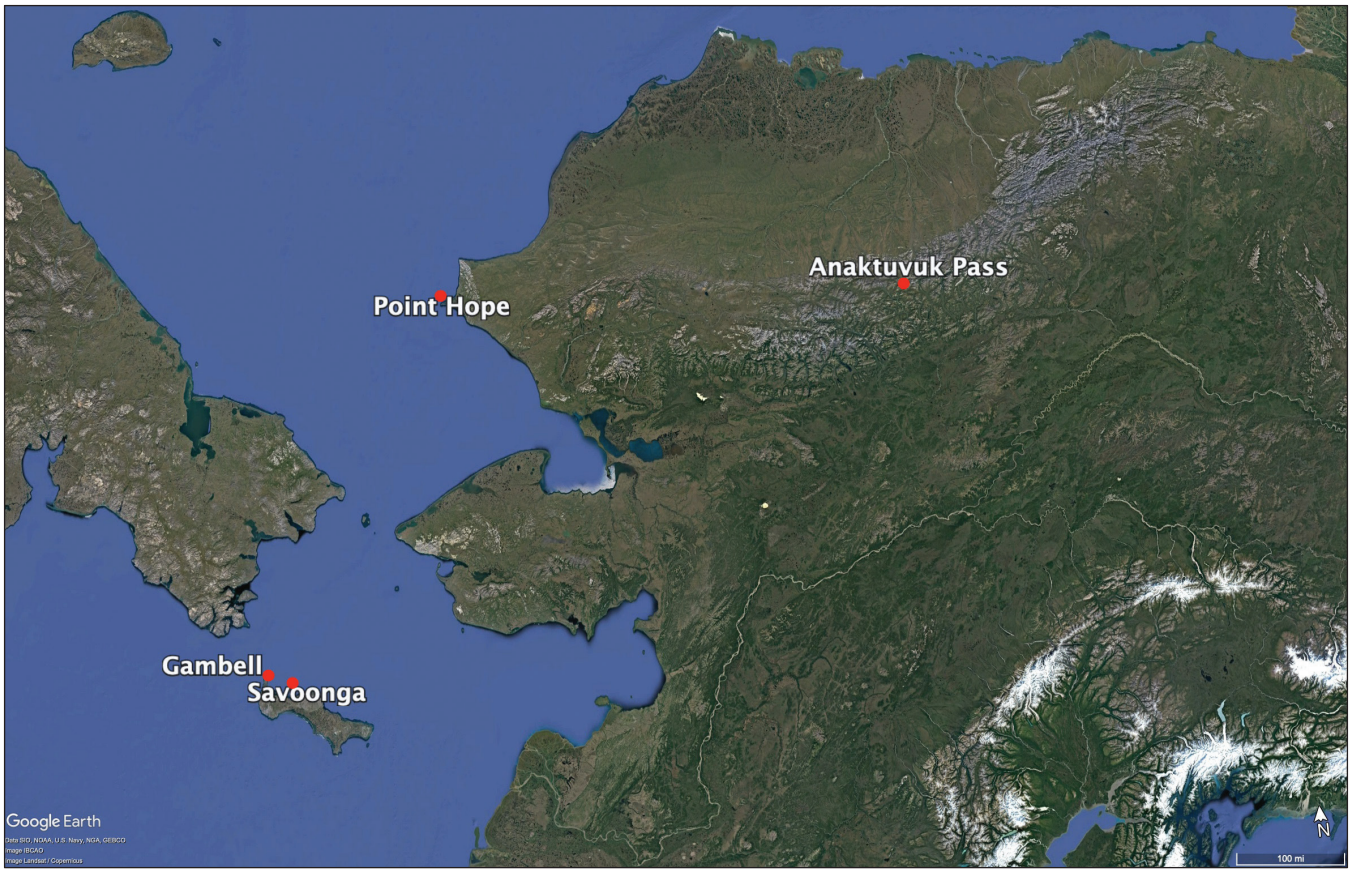

Figure 1. A map of partner communities. Source: Google Earth.

for food preservation and distribution, but they did not document the details of the use and maintenance of the ice cellars in written form. These skills and knowledge, and their relevance to food security in the Arctic through the practice of natural cold storage, are central to this project and of continuing interest and relevance to partnering community members. However, this knowledge was shared locally through storytelling and by participating in community activities, since these were fully oral languages until the twentieth century. Though this local sharing of knowledge of cold storage traditions continues, it is becoming much less frequently shared (and used) in the present, and community members have expressed the need for its documentation.

SIVUQAQ (GAMBELL) AND *SIVUNGAQ* (SAVOONGA)

The English translation of *Sivuqaq* is "squeezed out dry" (Jolles 2002:55) or "wrung-out" (Gambell resident, pers. comm. 2004). According to several sources, after the Creator made the Earth and the two continents (Alaska/North America and Siberia/Eurasia), "it[2]…took a piece of the earth from under the sea, squeezed it [wrung it out] and placed it between these [continents]" (Jolles 2002:54–55). Another account suggests that it was a giant from Siberia who took a piece of ground from under the sea to create a step to reach Alaska (Gambell resident, pers. comm. 2004). This correlates generally with a Gwich'in story in eastern Alaska that tells of a people—the *Naantsai'*—who were able to raise the land from under the sea to cross from Siberia to Alaska and who subsequently passed through Gwich'in (and others') territory to travel to other parts of the Americas (Beaver resident, pers. comm. 2008).

Jolles (2002) explains geologists' account of the land formation. During the last Ice Age, approximately 12,000 to 15,000 years ago, the land that is Saint Lawrence Island was part of the Bering Land Bridge. By 6000 years ago, as the ice melted and water rose, the gravel, rock, and tundra terrain of the island took shape. Saint Lawrence Island has no trees but many mountains, volcanic rock, and extensive tundra (Fig. 2).

Famine and associated disease caused a sudden and steep decline in the islanders' population in the winter of

Figure 2. Sivuqaq Gambell, Alaska. September 2021. Photo by Yoko Kugo.

1879–1880 that also led to the use of whiskey (Nelson [1899] 1983:269). Islanders had access to whiskey, rifle cartridges, and other supplies from vessels that traveled across Bering Strait—many of these American whalers. The United States government introduced Saint Lawrence Islanders to reindeer herding in 1900, and some islanders established a reindeer camp at the present site of Savoonga (*Sivungaq*) in 1916. Savoonga is on the north-central coast of the island. The government of the City of Gambell (*Sivuqaq*) was established in 1963 and that of the City of Savoonga was established in 1969. The current community of Gambell is located at the western edge of Northwest Cape on the island (Jolles 2002:17). When the Alaska Native Claims Settlement Act (ANCSA) was enacted in 1971, the communities of Gambell and Savoonga decided not to participate, instead opting to receive the land in fee simple title,[3] and therefore they jointly own the island (Kawerak, Inc. 2018). This decision meant that settlement funds from ANCSA were not received, but the fee simple title provides greater local control over their land.

Saint Lawrence Islanders' Indigenous language is Saint Lawrence Island Yupik, a variation of what linguists call Siberian Yupik, and is nearly identical to some of the Siberian Yupik dialects spoken on the eastern coast of Siberia's Chukchi Peninsula. The main use of their underground food cellar—a *siqlugaq* in Saint Lawrence Island Yupik—is to store and ferment walrus meat. They seasonally hunt for whales, walrus, and other marine mammals; migratory birds; plants; and reindeer (Houlette 2009; Hughes 1960). Residents stated, "We have hunting season year-round" (pers. comm. 3 October 2021).

Walrus (*Odobenus rosmarus*) meat is one of the staple foods among the people of Saint Lawrence Island. Spring is the major walrus hunting season (Hughes 1960; Jolles 2002; Nelson 1983). According to one of Jolles's Gambell respondents, in the late 1980s and early 1990s hunters usually harvested four walruses, never killed more than what

was needed, and never wasted anything from the catch (Jolles 2002:280). They tried to make about a hundred *tuugtaq*/*iiqwaq*—"meatballs"—each about five to six basketballs in size, to store in a *siqlugaq* (underground meat cellar) during the spring season for people and dog food (Jolles 2002:280). When the (female) walrus belly is being processed, it is referred to as *tuugtaq*, as the meat is sewn within the walrus hide with babiche made from the hide itself. Once it is deposited into the *siqlugaq*, it is called *iiqwaq*. After the people bring the meatballs into their house, they prepare it for eating by cutting it into pieces. Saint Lawrence Islanders maintain a *siqlugaq* according to groups of relatives and/or clans that strengthen the local economy among relatives through cooperative hunting by men and the processing of the men's catch by women, children, and the elderly (Krupnik and Chlenov 2013:154).

TIKIĠAQ (POINT HOPE)

The previous and present settlements of *Tikiġaq* are located at the tip of a low-lying peninsula surrounded by the Chukchi Sea. The literal meaning of *Tikiġaq* is "index finger" in the Iñupiaq language (Asatchaq and Lowenstein 1992:xxviii). Early evidence of human occupation in the region dates from about 600 BC (Burch 1981:11), though local accounts place their presence here millennia earlier. Archaeologists discovered here the now well-known Ipiutak site and other prehistoric settlements dated from approximately AD 400 (Foote 1992; Rainey 1947).

After American whaling ships discovered the abundance of bowhead whales in the Bering Strait in the mid-nineteenth century, they established a whaling station near *Tikiġaq* called "Jabbertown" due to the many languages spoken in the settlement. They not only hired *Tikiġaġmiut* (people of *Tikiġaq*) for commercial whaling by paying with ammunition, molasses, flour, tobacco, and other items, but Euro-Americans also brought to *Tikiġaq* diseases and alcohol that resulted in *Tikiġaġmiut* population declines (Foote 1992:21). The City of Point Hope, *Tikiġaq*'s municipal government, was incorporated in 1966. The *Tikiġaġmiut* subsequently moved from "Old Tigara" or *Nuvak* to the current location of *Tikiġaq*/Point Hope due to erosion and when governments started building the school and houses at the nearby new location in the 1970s (Asatchaq and Lowenstein 1992; Foote 1992; North Slope Borough 2023) (Fig. 3).

The people of *Tikiġaq* are coastal Iñupiat (*Taġiuġmiut*) who traditionally speak Iñupiaq. The *Tikiġaġmiut* have

Figure 3. Present-day Point Hope, Alaska, June 2023. Photo by Yoko Kugo.

hunted and lived with *aġviq* (bowhead whales, *Balaena mysticetus*), *ugruk* (bearded seal, *Erignathus barbatus*), *natchiq* (ringed seal, *Pusa hispida*), other marine mammals, *tuttu* (caribou, *Rangifer tarandus*), fish, migratory birds, and other sources of wild food in their region for many generations (Burch 2006; Foote 1992; Lowenstein 1980; Spencer 1976). Whaling has long been a central focus and concern among coastal Iñupiaq societies, including among the *Tikiġaġmiut* (Burch 2006; Lowenstein 1980; Rainey 1947; Spencer 1976). Whaling captains and their families traditionally store seafoods, mostly *aġviq* meat and blubber, and *ugruk*, in *siġḷuat* (plural: underground ice cellars) at *Nuvuk* (Old Tigara, the previous location of *Tikiġaq*). Spencer (1976:60) reported that every household had its own cellar to store meats. The cellars were relatively small and were dug into the permafrost with bone picks. "The cellar was supported with whale ribs and a whale skull placed at the entrance, the roof covered with sod" (Spencer 1976:60). The size of the *siġḷuaq* indicated a man's wealth, which is a reflection of skill to acquire and store meat and a willingness to share it widely with the community.

In her book *The Tigara Eskimos and Their Environment*, Foote (1992:31–32) describes whale hunting and distribution rules on how whaling captains harvest and distribute their catches among the members of whaling boats and communities at certain seasons and ceremonies. Whaling captains and their families maintain and use their *siġḷuat* for storing and for aging specific parts of the whale, including whale meat and *aŋirruk* (whale tails), with blubber wrapping the meat making it look like a small whale (Point Hope resident, pers. comm. June 2023). When seal hunting, *Tikiġaq* hunters prefer *ugruk*, and they prepare *tuktuk* (*ugruk* meat and blubber wrapping with the skin) and quickly store it in *siġḷuat* (Foote 1992:8). They also store portions of *ugruk* for dog food in the shallow part of *siġḷuat*, though this practice is much reduced due to the replacement of dog teams with snowmachines (snowmobiles).

ANAQTUUVAK (ANAKTUVUK PASS)

The literal meaning of the Iñupiaq word *anaqtuuvak* or *anaqtuġvik* is "place of caribou droppings" (Bright 2004:38). The ancestors of the *Nunamiut* ("People of the Land") of *Anaqtuuvak* formerly lived near the community's current location and relied heavily on caribou year-round by traveling across the country. Fully nomadic before settling in *Anaqtuuvak*, the *Nunamiut* continue to use these surrounding areas for their sustenance and well-being.

Inland Iñupiat—the *Nunamiut*—of the pre-settlement period were nomadic and adopted their way of life and settlement patterns in reaction to (and in concert with) the changes in the surrounding natural environment. Archaeological research suggests that extensive and increasing human occupation in the Brooks Range appeared in the area of Anaktuvuk Pass and surrounding valleys beginning in the 1860s for about two decades (Hall et al. 1985:51). Groups of Iñupiat had contacted fur traders such as those from the Hudson Bay Company on the middle Yukon River for trading their furs for nonlocal foods and manufactured goods (Gubser 1965:4). The inland Iñupiat inhabited the eastern Brooks Range until around 1890, and later some groups moved farther east to follow caribou herds, with some traveling to the Arctic coast to work for commercial whalers. These Iñupiat gained access to Euro-American products such as flour and ammunition, but Iñupiat populations declined due to the introduction to diseases, especially influenza and measles (Gubser 1965:7).

The capitalist economy of colonialism, colonial assimilationist policies, and Christianity delivered by missionaries became embedded in Iñupiaq ways of life during this period (Amsden 1977; Campbell 1998; Gubser 1965; Hall et al. 1985). While some Iñupiat settled in Point Barrow (*Nuvuk*, near *Utqiaġvik*), Wainwright (*Ulġunik*), Point Hope (*Tikiġaq*), and other coastal communities, other Iñupiaq groups remained inland between 1890 and 1920 (Amsden 1977; Hall et al. 1985) in the Brooks Range or along the Kobuk River. When the caribou population declined, in large part due to hunting by whalers who used caribou for food, Dall sheep, ptarmigan, ground squirrels, and migratory birds became important to the diet of the inland Iñupiat. After 1920, the caribou population recovered in the interior, and trapping continued to be profitable during the period, but the Iñupiat who resided in coastal areas were reluctant to return inland because of the opportunities provided by the whaling economy.

In the late 1920s and 1930s, several families returned to the Colville, Chandler, Anaktuvuk, and Kanayut Rivers in the Brooks Range, with news of caribou herds and opportunities for trapping for fox, wolves, and wolverines (Spearman 1982:42–43). In 1939, the four principal *Nunamiut* families seasonally settled around the Anaktuvuk, Chandler, and Killik Rivers in winters and at Chandler and Tulugak Lakes in summers (Hall et al.

1985:65). In 1947, pilot Sig Wein arrived at Chandler Lake and contacted the *Nunamiut* in the area. He encouraged them to move to the Anaktuvuk River valley. The *Nunamiut* leaders moved and established the village of Anaktuvuk Pass at the present location near Eleanor (or Summit) Lake between the John and Anaktuvuk Rivers in 1951 (Hall et al. 1985:67).

Inland Iñupiat (*Nunamiut*) in the area of Anaktuvuk Pass stored food in small semisubterranean caches and/or covered pits along the trails (Binford 2012; Campbell 1998; Paneak and Campbell 2004; Spearman 1982). Binford (2012) examined *Nunamiut* settlement patterns and explained that the *Nunamiut* used drying and freezing techniques for food preservation. To dry meat, a tripod-pole rack was built at spring and summer camps and a square platform was used in the permanent village. Hunters used natural freezing for meat preservation, especially when hunting conditions were poor, enabling its access at various places across the landscape where meat had been cached. Binford (2012:123) recorded that "the average depth of the three cellars in current use (in *Anaqtuuvak*) is 15.4 feet from the entrance to the ice floor. The cellars are bottle- or bell-shaped, wide at the bottom and narrow at the surface." The *Nunamiut* built *hiġḷuat* (ice cellars in the *Nunamiut* Iñupiaq dialect) in 1956 primarily to preserve the meat of caribou and sheep, with caribou, especially, having been overhunted by nonlocal people (Binford 2012:123; Campbell 1998; Hall et al. 1985:67; Ingstad 1954). (Fig. 4) According to *Anaqtuuvak* residents in the twenty-first century, residents stopped using these cellars in the late 1970s in part due to the arrival of electricity and the electric freezer (Anaktuvuk Pass resident, pers. comm. July 2022). These cellars are now inundated and cannot be used or recovered.

POSITIONALITY AND METHOD

At its core, this project is a community-based research project with elements of participatory research by the community, according to what is most appropriate to their interests. In this sense it lies somewhere on the spectrum between community-based research and community-based participatory research. Both of these related methods are appropriate for this sociocultural research due to the research questions being community-focused and partnering communities having direct interest in the research process. As such, this community-based project is somewhat altered in its focuses depending on the interests of each individual community.

Fundamental to any assessment of food security and community well-being is a local perspective that includes local concerns and notions of need, informed by local ethics and values that derive from the culture of the community (Fienup-Riordan 2010; Kawagley et al. 1998; Koskey 2020; Martens et al. 2016; Smith 2006; Wilson 2008). This varies within cultures, and even within communities, and so arriving at an assessment of needs regarding food security and community well-being must include community-based approaches that are ideally participatory. Part of a community-based participatory research method is an understanding of the notion of Indigenous knowledge and its importance in informing the nonlocal researcher (Cochran et al. 2008; Sahota 2010; Saint Denis 1992; Webster and John 2010). Community-based approaches to sociocultural research have become increasingly common since the 1990s (Koskey 2020; Sahota 2010; Saint Denis 1992). Community interests include being able to use collected social and climatic data, as well as assessments of permafrost thawing and consequential subsidence, for community planning and development, whereas others are interested in rebuilding and revitalizing underground food storage caches, with some others concerned about detecting underground flows of contaminated water. We seek through this project to address each community's particular practical needs while also addressing our project's academic research questions.

Procedurally, we began by contacting potential partner communities, first through email and by sending summaries of our proposed research. Due to our partnership with the Research Institute for Humanity and Nature (RIHN)-funded Japanese project focused on very similar research questions, we were able to use funds from this first non-Alaska phase of the project to travel to the potential partner communities to more effectively communicate our ideas and capacities through this research. This proved to be key in eliciting interest, and though we initially wanted to focus on eight Alaska communities, we eventually settled on the four mentioned throughout this paper, based on level of interest and available funding. Our experience has shown us that reducing the focus from eight communities to four greatly enhanced our capacity to serve the four that partnered with our project. We are following up with other interested communities in subsequent future research.

FIELDWORK IN 2022 AND 2023

Project social and natural scientists conducted fieldwork in *Anaqtuuvak* (Anaktuvuk Pass), *Sivungaq* (Savoonga), and *Sivuqaq* (Gambell) in 2021, 2022, and 2023 and at *Tikiġaq* (Point Hope) in June 2022 and 2023. In the summer of 2021, we met with community leaders, hired local assistants through the local governments for meeting potential knowledge-bearers for the interviews, and organized community meetings. We proposed to the community's leadership a community-based approach to conducting the research, which in part included the hire of local assistants to facilitate oral history interviews with Elders, in which they recounted food storage practices in their lifetimes from their perspectives. Community assistants and local government board members helped us to review our interview questions to assess their local relevance, and they assisted Elders in their responses by helping to trigger memories and providing language translation when preferred or necessary. Asking some questions in their Indigenous language helped Elders to recall memories about the details of food-processing traditions and techniques used in building and repairing underground food storage cellars.

During the community meetings in *Anaqtuuvak* (Anaktuvuk Pass), *Sivungaq* (Savoonga), and *Sivuqaq* (Gambell), community leaders and Elders explained the difficulties in maintaining their ice cellars under current climatic conditions and told us that they no longer rely on storing meat underground due to permafrost thawing and shoreline erosion. One *Anaqtuuvak* Elder reported that their regional government (North Slope Borough) introduced the electric freezer to the community in the 1960s, and that this weakened their traditional food storage prac-

Figure 4. One of the community ice cellars (hiġḷuat) used by the community until the late 1970s. Anaktuvuk Pass, Alaska, July 2023. Photo by Yoko Kugo.

tices. However, some people have difficulty maintaining a freezer due to the cost, and even large chest freezers have minimal storage capacity compared to family-based or community-based underground storage facilities. Many Elders in *Sivuqaq* and *Sivungaq* noted that their traditional fermented whale and walrus meat and blubber are difficult to process using the electric freezer (Fig. 5, *Sivungaq* traditional food). Elders explained that they miss the taste of those foods. Researchers devised plans with community leaders each field season to determine the best time to observe their food preparation customs and techniques (hunting, storing, and sharing the locally harvested food).

In the summer of 2022, we stayed approximately four to six days in each of the four communities to conduct oral history interviews with Elders; install temperature sensors to monitor temperature, moisture, and light inside the ice cellars; and organize community meetings for sharing our preliminary findings with residents and learning their insights on these. As a result, we conducted a total of nine interviews (three in *Anaqtuuvak* and six in *Sivuqaq*). The respondents included two females and seven males between their late 60s and early 90s in age. Each interview consisted of broad, open-ended questions such as "What are the underground food storage practices and traditions in your community?" and "How did you learn to use and care for the underground food storage cache when you were a child?" Project researchers (Koskey and Kugo) also asked respondents about their concerns using and maintaining underground food storage caches in relation to climate change and culture change during their lifetimes. We recorded their narratives in audio files after we received consent, or took notes if respondents preferred us not to record their voices. We transcribed their interviews word-for-word (if recording was permitted), and we contracted with local language translator(s) for accurate

Figure 5. **Sivunqaq** *traditional food at a resident's kitchen, May 2022. Photo by Yoko Kugo.*

translations of Native words and phrases. Some of the responses from the Elders indicate changes in food lifeways (Table 1).

Sivuqaq and *Anaqtuuvak* respondents in their 60s to 90s clearly remember that underground food caches were an integral part of their lifeway, storing and sharing the meat with family and community members. In *Sivuqaq*, some respondents recalled that they stored walrus meat for human and dog food because dogs in teams were their main "engines" for transport before the arrival of snowmachines (snowmobiles) and four-wheelers (all-terrain vehicles). Because our interview questions were broad and open-ended, respondents shared information that was relevant from their local perspectives, such as that *Sivuqaq* people only use *siqlugat* to ferment and store food because of its pleasant aromas. Individuals have their own preference for aging meat. Many knowledge-bearers in *Anaqtuuvak* and *Sivuqaq* reported that people cleaned inside the underground food storage every spring and used or shared the meat with others during the spring hunting season. Some respondents commented that "the older [the meat] gets the better."

One *Anaqtuuvak* respondent recalled that the men and women worked together to excavate the community *hiġḷuat*. It took less than two weeks to excavate the pit even though their tools were limited to pickaxes, buckets, and shovels (*Anaqtuuvak* resident, pers. comm. 27 July 2022). *Anaqtuuvak* respondents also reported knowledge of a subterranean seepage or small stream that flows near or through their now-unused *hiġḷuat* due to climate and consequent landscape change. In *Sivuqaq*, respondents observed that *siqlugat* caved in due to permafrost thaw. One Elder reported that she saved bowhead whale jawbones when her family *siqlugaq* was destroyed, with the intention that it would be rebuilt, and the research team hopes to assist in this effort. Respondents have consistently observed changes in weather and ice and permafrost "melting" (thawing) throughout their lives.

Respondents always included their family stories related to their underground food storage practices, including who taught them how to use the facility and where they traveled to hunt, gather, and trade when they were growing up. Some narrators in *Sivuqaq* and *Anaqtuuvak* recalled that their family formerly stored meat and food underground at seasonal camps, or they reported that other family members had underground food caches at their camps. Their stories illustrate that family members consistently shared observations of the landscape, and Elders today continue to tell stories based on their own experiences and oral traditions rooted in the local environment.

When respondents discussed the details of their traditional food (especially fermented food, such as *tuugtaq/iiqwaq*—fermented walrus meatball in *Sivuqaq*), they expressed their feelings surrounding this process in their language (Saint Lawrence Island Yupik). Their facial expressions and comments demonstrated that sharing the knowledge and skills required to harvest traditional food often requires the use of their Indigenous language to clar-

Table 1. Examples of responses to some topics

Underground Food Storage	Food Preservation	Weather Changes
I grew up with it [*siqlugaq*].	Just put [the meat] in. We leave them just forget about it until fall time.	We don't get cold anymore. It's getting warmer and warmer, and short winter.
Our native food, even though the smell bad, but they're delicious.	We used to ferment everything even the auklet.	Too fast. The ice goes out too early. Too much wind in the fall.
We gave away, we don't keep [food].	Our fermentation is not done inside the house. It's either in the shed or in the separate building.	The ground used to be frozen at the end of September, and the snow comes around the first week of October.
We share with our family.	Seal skin make it into a poke, and it is a good storage for food.	We could hear the waves in January, February.
Any meats that we get, we put them in.	We used it year-round. The older [the meat] gets the better.	It is hard for us to get meat. We had to conserve all the meat that we have and try to make them last longer.
Some year, we don't get many walruses. We tried to get as many for dogs, too because dogs were our main engine before snow machine and Hondas.	We don't keep the meat [inside the *siqlugaq*] for two years.	Notice the changes in the mid-50s.

ify details of the condition of the foods, odors and aromas, and techniques for preservation and processing.

In partnership with community leadership in *Sivuqaq*, *Sivungaq*, and *Anaqtuuvak*, researchers and local assistants conducted additional interviews with narrators (Elders and local knowledge-holders) in May, June, and July 2023. The Native Village of Point Hope (municipal government of *Tikiġaq*) asked the project team to work with their whaling captains because it is they who maintain and use *siġḷuat* to store the whale blubber, whale meat, and other locally harvested seafood. One of the board members of Native Village of Point Hope, local historian Steve Oomittuk, invited University of Alaska Fairbanks researchers to *Tikiġaq*'s whaling feast—*Qagruq*—in 2022. Koskey and Kugo participated in the feast activities and began establishing rapport with local residents (Koskey and Kugo 2023). In June 2023, Kugo traveled to Point Hope before *Qagruq* to participate in the feast preparation and to observe and participate in seasonal hunting practices and daily chores after the event. She conducted six interviews with current and retired whaling captains and crew members. According to the narrators, community Elders prefer the aged flavor of blubber and meat stored in *siġḷuat* to the meat stored in electric freezers. *Tikiġaq* whaling captains use large electric freezers for storing large amounts of whale meat and blubber, which does not allow for the obtaining of the preferred flavor since it often overfreezes and dries the meat (freezer burn), losing the natural flavor acquired by aging and fermentation. Some whaling captains stated that it is their responsibility to maintain *siġḷuat* and share their traditional aged food with their community Elders, and this strengthens their cultural identity.

Whaling captains who own *siġḷuat* reported that they must remove water from inside of the *siġḷuat* after heavy rains and storms, and that they frequently watch for rodents and other small animals that may try to burrow their way inside. When necessary, whaling crews repair their *siġḷuaq* by reconstructing it and placing new sod on top in the summer. As with hunting, the construction and maintenance of the *siġḷuat* requires considerable skill that is learned by observing and participating with Elder hunters.

FURTHER CONSIDERATIONS

This project seeks to understand the natural and social processes that have led to a decline in the capacities and changes in the conditions for attaining and maintaining food security, ideally within considerations of food sovereignty, and alongside concerns for energy independence, all within a global economic context. In general, while food security is concerned with having access to sufficient food, food sovereignty includes notions of *culturally appropriate* food, with this being defined and acted upon locally, and being readily accessible. Such are the capacities that this project's researchers seek to understand in local and global contexts, while working with the partnering communities to address these and related issues, including the investigation of the uses (and disuse) of underground meat storage caches.

As a part of these goals, we seek to provide each community with a comprehensive record of "food life-history" for those foods stored in underground caches in the community, in the past and in the present, enabling more effective locally based planning for food security needs. We work to accomplish this by using, with local assistance, local traditional knowledge (including ecological, cultural, and cosmological knowledge traditions) to accurately inform our understanding of the local food cycle and food life-history. By this effort we will develop food security plans and strategies alongside communities.

To attain a better understanding of the variations and uses of underground food storage caches, we intended to identify an underground cache site (before 1960s electric refrigeration) for future excavation in a follow-up project. A number of such sites are available, and if local community interests support excavation, we intend to bring this archaeological element to this already interdisciplinary project. As a part of our efforts to better understand the construction and uses of caches, we compare the physical qualities of underground storage caches between communities, their ideal and fundamentally crucial conditions for effectiveness, limitations, and capacities for responsive innovation, and we intend to share this between communities (facilitated by a National Park Service grant). By the project's completion we intend, in cooperation with communities, to make substantial recommendations including jointly developing approaches to mitigate or prevent effects of warming in new construction, including the modification and maintenance of existing ice cellars. Without the partnership of cryosphere and climate change partner researchers on this project, this effort would be of much less interest to local communities and demonstrates the value of interdisciplinary research in addressing local, practical concerns.

This paper provides a glimpse into how cooperative research and co-production of knowledge is important in

the efforts to include community knowledge in research—including local, traditional, and Indigenous knowledge—and for the effective application of research to address the social needs of partnering communities. As an overview of this ongoing research within methodological contexts, we aimed to demonstrate the central role played by research communities as partners in research rather than as research "subjects," enabling the research to serve the interests and needs of both. And as an example of ongoing research within the closely related topics of food security and food sovereignty, through this article we sought to provide insight into addressing these in a community-based way, with community input being more significant than adding to or assisting in data collection. We therefore expect findings and outcomes to be more valuable for local needs and interests, and that partner co-analysis of shared knowledge will result in more accurate findings that will better inform local management and planning efforts.

NOTES

1. In this paper we use the words "traditional" and "traditionally" not as an opposite to "modern" but in their original meaning: a custom, behavior, or other cultural activity passed across generations. By this definition traditions can be old or new, and all cultures are in some ways traditional—practicing customs from previous generations.
2. The Creator is usually depicted as genderless/nongendered.
3. Fee simple is the highest form of land ownership in the United States, meaning the land is owned outright, without any limitations or restrictions other than local zoning ordinances.

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