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To cite this version:

Michel Rapinski, Alain Cuerrier, Cory Harris, Elders Of Ivujivik, Elders Of Kangiqsujuaq, et al.. Inuit Perception of Marine Organisms: From Folk Classification to Food Harvest. Journal of Ethnobiology, 2018, 38 (3), pp.333-355. 10.2993/0278-0771-38.3.333 . mnhn-03954871

HAL Id: mnhn-03954871

https://mnhn.hal.science/mnhn-03954871v1

Submitted on 14 Feb 2023

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Source: Journal of Ethnobiology, 38(3):333-355.
Published By: Society of Ethnobiology
https://doi.org/10.2993/0278-0771-38.3.333
URL: http://www.bioone.org/doi/full/10.2993/0278-0771-38.3.333

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Journal of Ethnobiology

2018 38(3): 333–355

Inuit Perception of Marine Organisms: From Folk Classification to Food Harvest

Michel Rapinski[1*], Alain Cuerrier[1], Cory Harris[2], Elders of Ivujivik[3], Elders of Kangiqsujuaq[4], and Mélanie Lemire[5]

Abstract. To survive in the Arctic, the Inuit have developed a unique relationship with the marine environment and its living organisms. Unlike large marine mammals, the importance of smaller marine organisms for food, health, and wellbeing is largely undocumented. To call attention to these components of the food system in Nunavik, in northern Québec, and to understand their importance for health and wellbeing, Elders in two Inuit communities, Ivujivik and Kangiqsujuaq, were interviewed in May 2014. The objectives of this study were to: 1) document all marine organisms harvested and consumed in these communities; and 2) highlight the importance of these country foods through their position within the Inuit zoological classification, as well as their perceived contribution to health and wellbeing. Fifty-seven species of marine organisms were identified as part of the past or current food system, including birds, mammals, fish, mollusks, crustaceans, echinoderms, and algae. Harvesting location is an important characteristic in the local classification. Nearly a third of all organisms listed can be harvested on the seashore and are collectively called *tininnimiutait*, which derives from seashore (*tininni*q) and includes seaweed, shellfish, and certain fish. *Tininnimiutait* differ from *irqamiutait*, which come from the bottom of the water (*irqa*). Furthermore, *irqamiutait* are a relatively recent addition to the diet that have the potential to positively impact health. Activities related to the harvest and consumption of these organisms are often associated with health and wellbeing. The abundance of *tininnimiutait,* their proximity to the land, and year-round accessibility make them an important food source today, particularly in light of growing concerns related to climate change, lifestyle and dietary transitions, food security, and sovereignty in the North.

Keywords: ethnozoology, Inuit, marine organisms, Inuit classification, food sovereignty

Introduction

Food security and sovereignty is of increasing concern in northern Canada, especially since local populations are growing and climate change is impacting access to the land and resources in the Arctic (Blanchet and Rochette 2008; Council of Canadian Academies 2014). In Indigenous communities, dietary transitions from traditional country foods to imported highly processed market foods (Kuhnlein et al. 2004) are one among many observable changes stemming from interrelated socio-economic, cultural, political, and historical factors (Fergurson 2001). Though customary food sharing still pervades in many Inuit communities, such as Kangiqsujuaq (Ready 2016), community social relations and structures can become important determinants of food security (Harder and Wenzel 2012; Ready 2016; Wenzel 2009).

The First Nations and Inuit Regional Health Survey National Steering Commit-

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tee (1999:44) reported that 80% of respondents thought that "a return to traditional ways is a good idea for promoting community wellness." Supporting this idea, epidemiological data reveal that, in Inuit communities, the prevalence of active hunters is higher in food secure households (Huet et al. 2012). Not surprisingly, the Council of Canadian Academies (2014) has stated that traditional knowledge relating to the environment, as well as practices relating to country foods access, including hunting, fishing, trapping, and harvesting, can be understood as a set of cultural practices necessary for food security and sovereignty. Furthermore, Downing and Cuerrier (2011) have described how traditional knowledge, of which country foods are a central dimension, is a key element for Inuit community wellness.

The consumption of marine country foods in Inuit communities has a direct impact on physical health. Early epidemiological-based studies linked low incidence of death from coronary heart disease in Inuit populations to high consumption of ω-3 long-chain polyunsaturated fatty acids (PUFAs), which are found in the fats of marine mammals and saltwater fish (Innis and Kuhnlein 1987). These PUFAs have also been associated with decreased prevalence of cardiovascular disease risk factors, including lower blood pressure, triglyceride concentration, and total to HDL-cholesterol ratio (Dewailly et al. 2001; Lucas et al. 2004; Proust et al. 2014).

The Canadian Polar Commission highlights the increasing importance of documenting the consequences of the nutritional transition in the North (Cournoyea et al. 2014). Although many studies on the nutritional composition of Inuit country foods report that they are typically nutritionally superior to market foods, most of these studies focus primarily on large marine and land mammals, and a number of fish and birds (Belinsky and Kuhnlein 2000; Blanchet et al. 2000; Brunborg et al. 2006; Hidiroglou et al. 2008; Lemire et al. 2015), which require specialized equipment and expertise to harvest. Fewer studies extensively report on the consumption and nutrient composition of more inconspicuous organisms of marine origin, such as mollusks, crustaceans, echinoderms, and algae (but see Egeland et al. 2009; Gagné et al. 2012; Kuhnlein et al. 1996; Wein et al. 1996). Accordingly, nutritional and health studies related to the local diet of Inuit tend to overlook the kinds of small marine organisms that could potentially contribute significantly to improving food security in the North.

To shed more light on the diversity of marine organisms included in the current and traditional food system of the Inuit of Nunavik, we conducted interviews with Elders from the communities of Ivujivik and Kangiqsujuaq (Figure 1). Our objectives were to: 1) create a comprehensive inventory of marine organisms consumed by Inuit, past and present; and 2) provide insight into the cultural importance and relevance of these organisms as reflected by their position within the Inuit zoological classification, as well as their perceived contribution to health and wellbeing.

Materials and Methods

Study Sites

Nunavik is a large territory situated in the northernmost part of Québec, Canada (Figure 1; Supplemental Text 1), and delimited mainly by seawater in Canada's Arctic and Subarctic ecoclimatic regions (Strong et al. 1989). Both Kangiqsujuaq (population 696) and Ivujivik (population 370) are situated on the Ungava peninsula above the tree line (Statistics Canada 2012a, 2012b). Kangiqsujuaq is well known for its residents' unique approach to harvesting shellfish under the shifting sea ice at low tide. Ivujivik is the region's northernmost community and recognized as an important area for *qilalugaq* (beluga; *Delphinapterus*

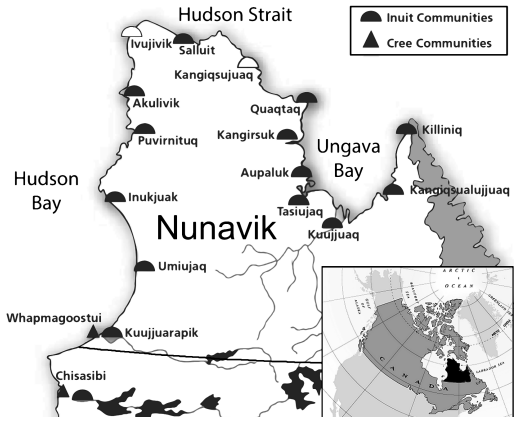

Figure 1. Map of Nunavik, northern Québec, showing the location of Ivujivik, Kangiqsujuaq, and other communities. Figure adapted from a report published under the authority of the Minister of Indian Affairs and Northern Development and Federal Interlocutor for Métis and Non-Status Indians (2009). Top right: Ivujivik in December 2015 (photo credit Michel Rapinski). Bottom right: Kangiqsujuaq in May 2014 (photo credit Alain Cuerrier).

leucas) hunting; residents are well known for climbing the imposing cliffs off Digges Islands to harvest eggs of *appaq* (Common Murre; *Uria aalge*).

Community Consultations and Qualitative Analyses

Support to conduct the study was provided by the Avataq Cultural Institute and the Nunavik Nutrition and Health Committee (NNHC). As the regional ethics committee for research related to health and nutrition (Nunavik Regional Board of Health and Social Services 2018), the NNHC was involved in every step of the study, from approving the proposed study to reviewing preliminary results to approving the final manuscript prior to publication. Permission was also obtained from both Ivujivik and Kangiqsujuaq's mayoral office before starting the study.

Fieldwork took place from May 5 to June 2, 2014. Altogether, 12 interviews were completed with 15 Elders. Six interviews were completed in Ivujivik with seven Elders (mean age 73), and six interviews were completed in Kangiqsujuaq with eight Elders (mean age 67). These were held in English or in Tarramiut, the local subdialect of Nunavik Inuktitut (See Supplement), with the help of an interpreter. Data were collected through semi-structured interviews and participant observation (i.e., observation and participation in harvesting activities). Elders were identified by snowball sampling, whereby participants were identified by community members as being very active and/or possessing a great deal of hunting and harvesting knowledge. Names were initially provided through existing relationships between Elders and one of the authors (Cuerrier and Elders of Kangiqsujuaq 2011), and by consulting each village's administrative buildings. Informed consent was obtained verbally from participants prior to each interview. With an interpreter, the nature of the study and the possible outcomes were explained to the participants. Upon a second meeting, explanations were given once more

to participants before beginning the interviews. Overall, the working approach was conducted with respect to the International Society of Ethnobiology's Code of Ethics (International Society of Ethnobiology 2006).

Interview questions were related to the current and past consumption of local marine organisms, including parts and preparations, associated seasons and methods of hunting, fishing and harvesting, as well as relationships to health and wellbeing. The identification of organisms was confirmed using photos, pictures, and, when possible, actual specimens. Algae samples were dried and preserved for storage at the Marie-Victorin Herbarium (MT) of the Biodiversity Centre at the University of Montréal.

The frequency of citation (FC) was used as a measure of consensus for a given organism (Ladio and Lozada 2004):

$$FC = f/F \quad (1)$$

where f is the number of citing interviews and F is the total number of interviews. FC was calculated for each community and the total FC, obtained by including all interviews from both communities. Participants who preferred to be interviewed together were considered as n = 1, reducing participant sample size.

We used verbatim quotes from participants to further illustrate the relationship and emotional ties with the use of marine organisms, such as their level of appreciation and their perceived health benefits. We recorded the names for cited organisms, including associated terminology and classificatory terms, in Tarramiut. With the help of published dictionaries and lexicon (Dorais 1978; Schneider 2014), Inuktitut names for a given category of organism were translated into their corresponding English terms and concepts. We returned to the communities in December 2015 to validate and confirm terminology, nomenclature, and various concepts related to classification with as many of the Elders who had originally participated as possible.

Statistical Analysis

Statistical analyses were performed using R statistical language (R Core Team 2014). The level of similarity in the FC of marine organisms between communities and the total FC was analyzed using the non-parametric Spearman rank correlation test, where Spearman's rho (ρ) measures their degree of association.

Results

Community Observations and Trends

Overview

A total of 57 species of marine organisms were identified as part of the past and current food system (Supplemental Table 1), with over a third of these being fish, shellfish, and algae (Table 1). Although most species were common to both communities, 12 were unique to Kangiqsujuaq, whereas four species were unique to Ivujivik. Six species could not be fully identified or were tentatively identified.

Although just over half (31 species) of all species mentioned were mammals and birds, only four of these species (*D. leucas*, *aiviq* [walrus; *Odobenus rosmarus*], *natsiq* [ringed seal; *Pusa hispida*] and *Uria. aalge*]) were mentioned by more than 75% of participants (Supplemental Table 1). Indeed, the majority of birds were cited by less than 25% of participants. In contrast, *iqaluppik* (Arctic char; *Salvelinus alpinus*) and *kanajuq* (sculpins; *Myoxocephalus* spp.), such as the fourhorn (*Myoxocephalus quadricornis*) and shorthorn sculpin (*Myoxocephalus scorpius*), along with the majority of shellfish and algae, were cited by more than 75% of participants (Table 1). *Uviluq* (blue mussels; *Mytilus trossulus*), *ammuumajuq* (truncate softshell clam; *Mya truncata*), as well as the brown algae *qirquaq* (Arctic wrack; *Fucus evanescens*) and *kuanniq* (winged kelp; *Alaria escu-*

Table 1. Fish, crustaceans, mollusks, echinoderms, and algae species mentioned by participants from Ivujivik and Kangiqsujuaq as part of the local traditional and current food system. Latin, English, and Inuktitut names are provided along with their frequency of citation (FC). Within each group, organisms are listed in chronological order based on their total FC. Harvesting periods are roughly characterized by ice conditions delimited in part by the ice melt (spring) and freeze-up (fall), as well as the cold icy months (winter) as opposed to warm ice-free months (summer).

Species name			FC (%)			Parts - preparation	Harvest
Latin	English	Inuktitut	Kangiqsujuaq	Ivujivik	Total		
Fish[a]							
Salvelinus alpinus	Arctic char	*Iqaluppik; ivitaruk*	83.3	83.3	**83.3**	All fish, roe – raw (fresh, frozen, dried), cooked, smoked	All year
Myoxocephalus sp.	Sculpin	*Kanajuq*	83.3	83.3	**83.3**	All fish, roe, laid eggs (*qaarjaq*) – cooked (e.g., soup, broth)	All year
Myoxocephalus quadricornis	Fourhorn sculpin	*Kanajuq; qaniqqutuuq; Kanajuvik*[K]	83.3	83.3	**83.3**	All fish, roe, laid eggs (*qaarjaq*) – cooked (e.g., soup, broth)	All year
Myoxocephalus scorpius	Shorthorn sculpin	*Kanajuq; qaniqqutuuq; kanajuvik*[K]	83.3	83.3	**83.3**	All fish, roe, laid eggs (*qaarjaq*) – cooked (e.g., soup, broth)	All year
Gadus sp.	Cod	*Uugaq*	66.7	66.7	**66.7**	All fish, roe – cooked	All year
Gadus morhua	Atlantic cod	*Uugaq*	66.7	66.7	**66.7**	All fish, roe – cooked	All year
Gadus ogac	Greenland cod	*Uugaq*	66.7	66.7	**66.7**	All fish, roe – cooked	All year
Not identified	Unidentified sculpin	*Kanajuq; malairaaq*	50.0	83.3	**66.7**	All fish – raw (fresh)	All year
Salmo salar	Atlantic salmon	*Saama*	33.3	33.3	**33.3**	All fish, roe – cooked	Not specified
7 species							
Shellfish							
Crustaceans							
Hyas coarctatus[b]	Arctic lyre crab	*Putjuuti*	100	83.3	**91.7**	All organism, legs – Raw (fresh), cooked (i.e., broth, soup)	All year
Semibalanus balanoides	Northern rock barnacle	*Kaugaliaq*	100	66.7	**83.3**	Raw (fresh), cooked (i.e., broth, soup)	Summer

Table 1. *(Continued)*

Species name			FC (%)			Parts - preparation	Harvest
Latin	English	Inuktitut	Kangiqsujuaq	Ivujivik	Total		
Shellfish							
Crustaceans							
Pandalus borealis	Pink shrimp	*Kingurlak*	66.7	33.3	**50.0**	Not specified	Not specified
Not identified	Type of decapod	*Naularnaq*	33.3	16.7	**25.0**	Raw (fresh), cooked	Not specified
4 species							
Mollusks							
Mytilus trossulus[c]	Blue mussel	*Uviluq*	100	100	**100**	Raw (fresh), cooked	All year
Mya truncata	Truncate softshell clam	*Ammuumajuq*	100	100	**100**	Raw (fresh), cooked	Spring - Fall
Chlamys islandica	Iceland scallop	*Tallurunnaq; tallujaq*[l]	83.3	100	**91.7**	Raw (fresh), cooked	Summer
Serripes groenlandicus	Greenland cockle	*Kukiujak*	33.3	16.7	**25.0**	Raw (fresh), cooked	Not specified
Not identified	Saltwater snails	*Siupiruq*	16.7	-	**8.33**	Not specified	Not specified
5 species							
Echinoderms							
Leptasterias polaris	Polar six-rayed starfish	*Aggaujaq*	100	83.3	**91.7**	Gonads, digestive glands – raw (fresh), cooked	All year
Strongylocentrotus droebachiensis	Green sea urchin	*Miqqulik; itirk*[l]	83.3	83.3	**83.3**	Gonads – raw (fresh)	All year

Table 1. *(Continued)*

Species name			FC (%)			Parts - preparation	Harvest
Latin	**English**	**Inuktitut**	**Kangiqsujuaq**	**Ivujivik**	**Total**		
Shellfish							
Echinoderms							
Not identified	Sea cucumber[b]	*Quursujuuq*	16.7	16.7	**16.7**	All organism – raw (fresh), cooked	Not specified
3 species							
12 species							
Algae							
Fucus evanescens	Arctic wrack	*Qirquaq*	100	100	**100**	All – raw (fresh, dried), cooked	All year
Alaria esculenta	Winged kelp	*Kuanniq; qijja*[I]	100	100	**100**	All – raw (fresh, dried), cooked	All year
Saccharina longicruris	Hollow stemmed kelp	*Itsuujaq*	66.7	66.7	**66.7**	Connection between stipe and blade, as well as the latitudinal mid-section of the blade; some eat it all – raw (fresh) or cooked	All year
3 species							

[a] Fish gall bladders are removed.
[b] Tentative identification.
[c] Includes the blue mussel hybrids *Myt. trossulus* x *Myt. edulis*.
[K] Kangiqsujuaq.
[I] Ivujivik.

lenta), were mentioned by all. In fact, one Elder described *A. esculenta*, *Myt. trossulus*, and *Mya truncata* as "the best top three to eat" (Peta Kristensen, Ivujivik, May 24, 2014).

When all species were considered ($n = 57$), there was a statistically significant and positive relationship between the FC in Kangiqsujuaq and Ivujivik, as well as with total FC (Figure 2). The correlations within each community (Kangiqsujuaq: $\rho = 0.931$, $p < 0.001$; Ivujivik: $\rho = 0.920$, $p < 0.001$) were stronger than the correlation between the communities ($\rho = 0.745$, $p < 0.001$).

Parts and Preparation

We have reported the summary of parts and preparations for animals mentioned in Supplemental Table 1. We found that, in general, the whole organism is consumed but, for many species, some Elders only ate specific organs. Methods of preparation and consumption include raw (fresh, dried, or frozen), cooked, and aged. Besides *kingurlak* (pink shrimp; *Pandalus borealis*), for which no specifications were given, all seafood (crustaceans, mollusks, echinoderms, and algae) are consumed fresh or cooked (Table 1).

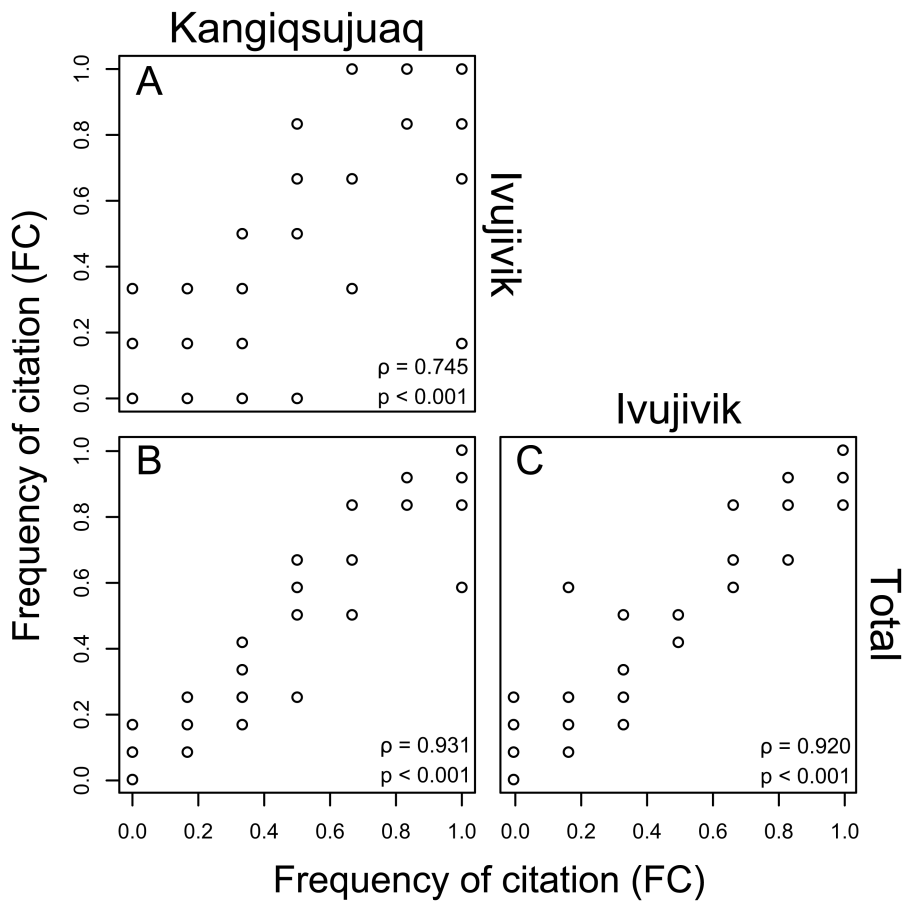

Figure 2. Scatterplot matrices illustrating the correlation between the frequencies of citation for marine organisms mentioned in the community of Ivujivik and Kangiqsujuaq, individually and together. Panel A compares the correlation between Kangiqsujuaq and Ivujivik, Panel B compares Kangiqsujuaq and the total of both communities, and Panel C compares Ivujivik and the total. The corresponding Spearman's rho (ρ) and significance ($\rho = 0.05$) appear in each panel.

Many intertidal organisms, including *Myt. trossulus*, *Mya truncata*, *F. evanescens*, and *A. esculenta*, but also *miqqulik* (green sea urchin; *Strongylocentrotus droebachiensis*) and *malairaaq* (an unidentified sculpin), are often consumed raw or fresh during harvesting (Table 1; Figure 3). According to one elderly couple, "we like it raw [*St. droebachiensis*], straight from the water" (Pitsiulaaq and Eyaku Pinguatuk, Kangiqsujuaq, May 12, 2014). According to another, "you eat it [*F. evanescens*] when you collect *uviluq* [*Myt. Trossulus*], when you are still on the shore. They are very good together" (Lukasi Kanarjuaq, Ivujivik, June 1, 2014). In both communities, *F. evanescens* and *A. esculenta* are particularly well appreciated when prepared in combination with *Myt. trossulus* and *misiraq* (aged and liquefied fat), which is sometimes used as a dip and preferably made from *D. leucas* fat.

Salvelinus alpinus was the only fish reportedly consumed and prepared in various ways other than cooking (Table 1), namely fresh, frozen, or dried as *pitsik*. Though the roe of all fish is consumed, the roe of *Sal. alpinus* is favored for making *suvalik*, a dish made of berries (i.e., *paurngait* [black crowberries; *Empetrum nigrum*] and *kigutanginait* [bog bilberries; *Vaccinium uliginosum*]), fish roe, and marine mammal fat, preferably *D. leucas*.

Harvesting

The majority of organisms are hunted or harvested based on their abundance in

Figure 3. Harvesting *tininnimiutait* at low tide in Ivujivik, QC, in May 2014. Harvesting took place during new moon when tides are some of the strongest. A multitude of organisms are harvested, such as algae, mollusks, and echinoderms. Here, *kuanniq* (*A. esculenta)* is harvested (left panel), along with *uviluq* (*Myt. trossulus*), which is frequently consumed on the spot (right panel). *Qirquaq* (*F. evanescens*) can also been seen on the rocks (Photo credit Michel Rapinski).

the region and their seasonal availability. Some of the most frequently cited organisms (e.g., algae, mollusks, echinoderms) are available all year long and are harvested through open pockets of water along the coast or by lowering oneself under the ice through a hole (Table 1). Access to these organisms relies primarily on lunar cycles, which create the strongest tides at the new and full moon, when harvesting occurs. Marine fish, namely *uugaq* (cod; *Gadus* spp.) and *Myoxocephalus* spp. are also harvested all year long by fishing off the shore in open waters or through a hole in the ice during wintertime. *Pusa hispida* was the only marine mammal reportedly hunted actively throughout the year.

Harvesting efforts for some organisms vary throughout their harvesting period. For reasons of optimal fat content or taste, fall is considered the best time to harvest organisms like shellfish and algae. One Elder explained that "September is the best time to collect *tininnimiutait* (intertidal organisms), because they are fat and the *kuanniq* (*A. esculenta*) are not slippery anymore" (Lukasi Kanarjuak, Ivujivik, June 1, 2014). Another specified, "they [*Myt. trossulus*] are best especially in the fall when they get fat. But you can collect them all year" (Aqujaq Qisiiq, Kangiqsujuaq, May 12, 2014). Furthermore, one Elder added that "[*A. esculenta*] are very good too, around November and that period of time, when the shore is freezing" (Sarah Keatainak, Ivujivik, June 1, 2014).

The consumption of organisms found at the bottom of the ocean, *irqamiutait* (namely *tallurunnaq* [Iceland scallop; *Chlamys islandica*] and *Pa. borealis*), is relatively recent; access has increased with—but remains dependent on—the activities of external parties, such as commercial or community fishing boats. One participant from Kangiqsujuaq recalled on *Pa. borealis*: "In my time, I never really thought we could eat those. I've seen a lot before, in Hudson Strait, where the current is. I just never bothered to collect them" (Attasi Pilurtuut, Kangiqsujuaq, May 8, 2014). He also commented on *C. islandica*:

> We started collecting those recently. We wouldn't see them on the shore when the tide was down. On occasion, when the wind comes around, [the turbulent waters] would dig them up and push them to shore. Now people eat them a lot, now that we have a community boat that collects them and other stuff.

Other participants agreed, "people from Ivujivik never used to collect them. We started eating them when Salluit started collecting them with their boat and started to bring them to the community" (Peter and Annie Ainalik, Ivujivik, June 2, 2014).

Folk Taxonomy

Zoological Nomenclature

Names given to marine organisms were mostly the same in both communities with some differences (Supplemental Table 1). Most notably, participants from Ivujivik specified that the names *tallujaq* (*C. islandica*) and *itirk* (*St. droebachiensis*) were the old terms properly used in Ivujivik (Table 1). In certain cases, multiple species possess the same name. *Gadus* spp. are called *uugaq*, as long as they possessed their distinctive chin barbel. Names, therefore, do not always discriminate between scientifically defined species but, at times, correspond to higher taxonomic levels (e.g., genera). *Myoxocephalus* spp., which are generally called *kanajuq*, are also given multiple names. *Myoxocephalus quadricornis* and *Myo. scorpius* were not distinguished and could also be called *qaniqqutuuq* or *kanajuvik*. Because many types were recognized based on morphology and habitat, they were named differently. *Malairaaq* is given to small sculpins that are picked from under rocks situated on the shoreline and eaten raw, *kanajuvik* and *qaniqqutuuq* are given to large sculpins characterized by a

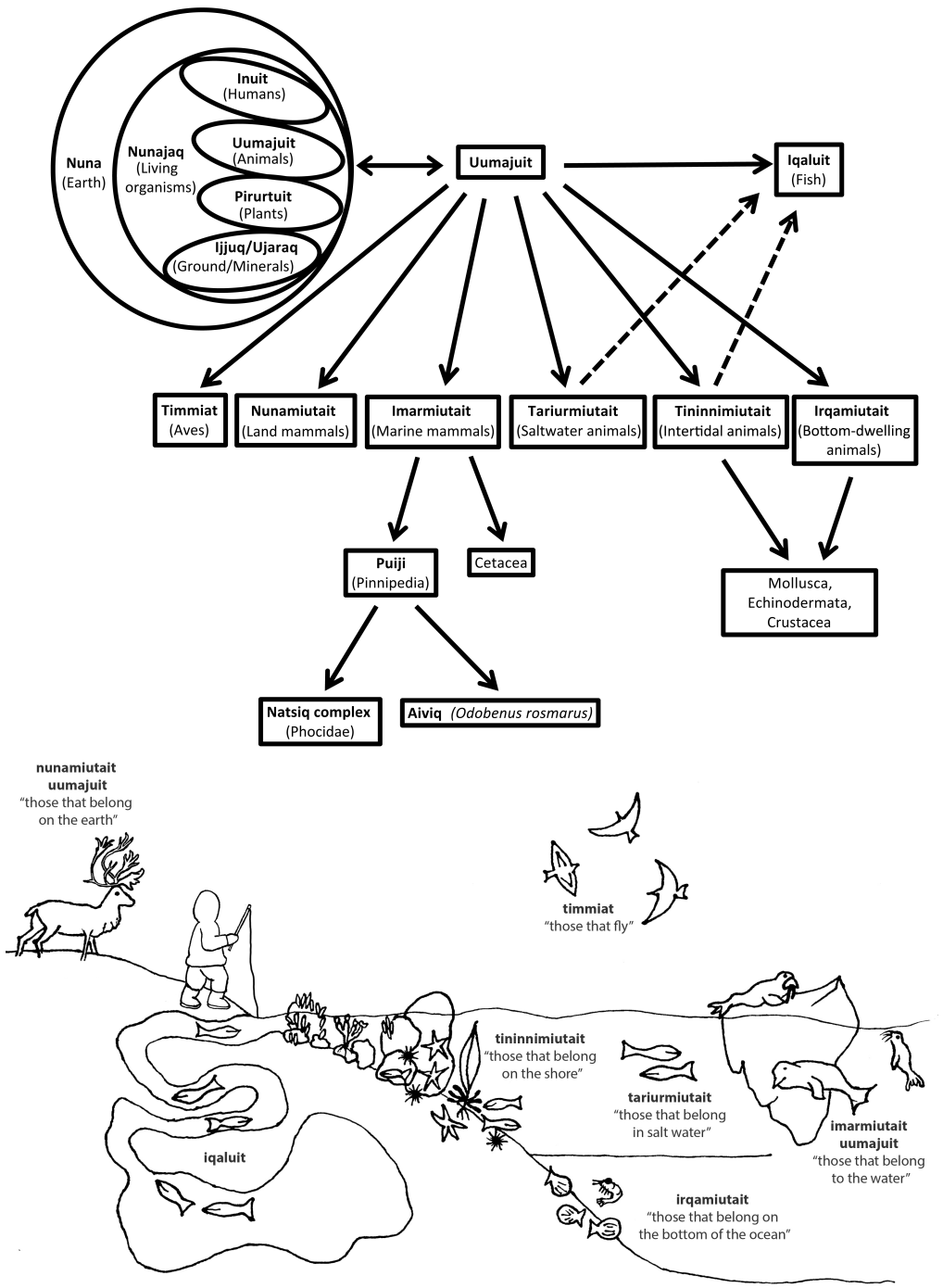

Figure 4. Illustrations of the Nunavimmiut classification of marine organisms (A) and their corresponding seascapes (B; illustration by Michel Rapinski). Complementary terms have been provided by one of the authors through ongoing work with Nunavimmiut and Avataq Cultural Institute (e.g., Cuerrier and the Elders of Kangiqsujuaq 2011). Inuktitut terms for the various seascapes are explained in Table 2.

big mouth, and *papitjuk* is given to riverine sculpins, characterized by a smaller mouth, that can also be found at the river's confluence with the sea.

Zoological Classification

As evidenced by the frequent use of the suffix *–miutait*, (which Randa [1996] breaks down according to the following: *-mi-* "*locative*"; *-u-* "to be"; *-ta(q)-* "belonging"; *-it* "plural") the classification of sea organisms reflects the habitat from which a certain organism originates (Figure 4; Table 2). The term *iqaluit* is used to designate fish species, specifically those that can be caught inland or that can migrate between seawater and freshwater, such as *Sal. alpinus*. Fish like *Gadus* spp. and *Myoxocephalus* spp., that can only be caught in saltwater and near the shore, are not primarily considered *iqaluit* (fish). One participant recalled, "we are not calling those in the sea 'fish.' They are like 'fish,' but we don't call them 'fish'" (Aqujaq Qisiiq, Kangiqsujuaq, May 12, 2014). Instead, *Gadus* spp. and *Myoxocephalus* spp. are considered, first and foremost, to be *tininnimiutait*, intertidal organisms (alongside invertebrates and algae); *irqamiutait*, sea-bottom organisms (alongside other invertebrates); or *tariurmiutait*, saltwater organisms, depending on how far from the shore they were caught.

Fish were not the only organisms classified in multiple groups. With the exception of *imarmiutait uumajuit* (marine mammals) and *timmiat* (birds), shellfish species could be classified in one group or another. Some shellfish could also be classified in multiple groups (e.g., *L. polaris* can be considered *tininnimiutait* or *irqamiutait*), hence revealing their habitat or the proximity of harvesting sites to the shoreline.

Proximity to the shoreline is not the only characteristic fish share with other intertidal organisms. In reference to the specific part of the shoreline affected by the tides, the name of this category, *tininnimiutait* (Table 2), also reflects the influence of lunar cycles on harvesting strategies. Indeed, harvesting activities occur predominantly during and around new and full moon, when low tides expose more of the ocean floor for intrepid harvesters to gain access under the large sheets of ice that accumulate along the shoreline in winter. One participant explained, "it has to be a full moon, or a new moon, because the tide goes down further. When it's a very low tide. We have more chance to pick" (Lukasi Nappaaluk, Kangiqsujuaq, May 16, 2014).

Perception of Health and Wellbeing

Beyond a few specific medicinal uses ascribed to some marine country foods, marine organisms from nearly every group (i.e., marine mammals, birds, shellfish, and seaweed) were generally perceived to help maintain good health and, to some extent, could be used curatively to treat the sick. Notably, algae, like *F. evanescens* or *A. esculenta*, were known mainly for their potential to treat skin problems, like acne and pimples, where they are used externally as a poultice. In Kangiqsujuaq, *A. esculenta* could be eaten if a person is sick with fevers or stomach aches. Similarly, *Myt. trossulus* were eaten if a person had asthma, was "sick," or simply feeling under the weather, very much like a comfort food. Much virtue is attributed to marine organisms, as they provide a feeling of satiety. According to one participant:

> You eat *qallunaat* food (market food), and by supper time you get hungry. But if you eat this [*D. leucas*, *O. rosmarus*, and *Pu. hispida*], it's going to be for a while. You eat it once, and you are good all day. (Lukasi Kanarjuak, Ivujivik, June 1, 2014)

Inherently, the consumption of country foods is an important tenet to the Inuit concepts of health and wellbeing. As one Elder explained: "anything from the land and the sea, the body needs those elements to be healthy" (Mitiarjuk Mangiuk, Ivujivik, May 24, 2014). One Elder clearly expressed

Table 2. List of higher order classificatory terms from the folk classification of the Inuit of Ivujivik and Kangiqsujuaq.

Category	Meaning	Examples
1) *Uumajuit*	Randa (1996) breaks down the word into the following *uuma-* "to live"; *-ju-* "attributive"; *-i-* "multiplicity, diversity"; *-t* "plural." Literally meaning "the living," it encompasses all animals.	
2) *Imarmiutait*	From the root word *imiq* "water," hence meaning "those that belong to the water." *Imarmiutait uumajuit*, however, can be best understood as representing marine mammals.	Cetacea (i.e., *D. leucas*), Pinnipedia (i.e., *O. rosmarus, Pu. hispida*) and *nanuq* (polar bear; *Ursus maritimus*). See Supplementary Table 1 for the full list of mammals.
3) *Timmiat*	From *timi* "who is situated higher than," hence "those that fly," can be understood as birds, without discriminating between marine or terrestrial species.	Aves (i.e., *Uria aalge*). See Supplementary Table 1 for the full list of birds.
4) *Tininnimiutait*	From *tininniq* "intertidal zone," hence "those that belong on the shore." This category includes all the species that may be harvested right off the shore.	Fish species from the Cottidea (i.e., *Myoxocephalus* spp.) and Gadidae (i.e., *Gadus* spp.), Echinodermata (i.e., *St. droebachiensis, L. polaris*), Crustacea (i.e., *Sem. balanoides*, *H. coarctatus*), Mollusca (i.e., *Myt. trossulus*; *Mya truncata*) and Phaeophyceae, brown algae (i.e., *F. evanescens, A. esculenta*).
5) *Irqamiutait*	From *irqa(q)* "the bottom of the water," hence "those that belong on the bottom of the ocean." This category includes all species that are harvested from the bottom of the ocean.	Echinodermata (i.e., *L. polaris*), Mollusca (i.e., *C. islandica*, *Ser. groenlandicus*) and Crustacea (i.e., *Pa. borealis*).
6) *Tariurmiutait*	From *tariuq* "salt," hence "those that belong in salt water." This category includes fish species that live and are harvested in salt water.	Cottidea (i.e., *Myoxocephalus* spp.) and Gadidae (i.e., *Gadus* spp.).
7) *Iqaluit*	Fish.	*Sal. alpinus.*
8) *Puiji*	Name given to any animal that takes its head out of the water to breathe. It refers specifically to pinnipeds.	Odobenidae (i.e., *O. rosmarus*) and Phocidae (i.e., *Pu. Hispida*).

the link between emotional sentiments, country foods, and the practice of traditional activities:

> My body is happy when I go hunting … Only in the 60s, 70s, or something, that we started to eat white people's meat. I can't eat it or my stomach burns. To be healthy, I have to eat country foods. I like it very much. (Lukasi Kanarjuaq, Ivujivik, June 1, 2014)

Other community members also highlighted the importance of being out of the community and on the sea or land:

> To be healthy, I always have to be outside… so when I go out on the land, I feel at peace…You are healthier in your mind when you spend time on the land and hunt, because you're not hearing much about negativities in town. It's best for your health physically and mentally. (Quitsa Tarriasuk, Ivujivik, May 28, 2014)

This feeling was echoed in Kangiqsujuaq:

> When I am out on the sea and land, I feel eased from being in the house like this all day. Do your activities, like hunting and fishing, get some fresh air, get some sunshine, because the sun is good for your health. It's so peaceful, being in an environment like that outside. It's like going down memory lane. (Attasi Pilurtuut, Kangiqsujuaq, May 8, 2014)

Role of Tininnimiutait

Access to resources is one of the most important parameters to consider in securing country foods. If it is not for lack of equipment or expertise, it may be for lack of time, money, or health. The species categorized as *tininnimiutait* were clearly characterized by their proximity to the community, abundance, and year-round accessibility. One Elder explained, "they are right in front of us, on the other side, everywhere on the shores. In the winter, we go under the ice to get the mussels (*Myt. trossulus*). They are probably very good nutritional food" (Attasi Pilurtuut, Kangiqsujuaq, May 8, 2014). According to one Elder, *tininnimiutait*, including algae, are a highly accessible food source that even the young seem to enjoy:

> Even with changing generations, every year, everybody eats *kuanniq (A. esculenta)*, it's the same for *qirquaq (F. evanescens)*. We eat it a lot because there are a lot on our shores and close to Ivujivik. (Quitsa Tarriasuk, Ivujivik, May 28, 2014)

Indeed, Paasa Audlaluk (Ivujivik, June 1, 2014), in her mid-twenties, described, while interpreting one of the interviews, how she takes *Myt. trossulus*: "Wrap it up with *kuanniq* [*A. esculenta*], dip it in a little of *misiraq*. Mmm, it's like a scallop in your mouth! After that amazing taste, you have a bite of *qaarjaq* [*Myoxocephalus* sp., eggs]. Ah!" Similar sentiments were frequently expressed when discussing the consumption of *tininnimiutait* with various Elders who recalled the experience and taste of these organisms. Although these organisms may not necessarily provide the same quantity of food as larger marine organisms, one Elder still recalled how "when we had no food, it [*Myt. trossulus*] saved many lives from hunger" and how *kaugaliaq* (northern rock barnacle; *Semibalanus balanoides*) were "used back then, because we didn't really have food" (Lukasi Kanarjuaq, Ivujivik, June 1, 2014).

Discussion

Folk Classification—Perceiving and Understanding Our Environment

The number of species cited in this paper as harvested by Inuit is most likely underrepresented, and more work is required to identify certain taxa (Table 1). This is particularly true in instances where a single name is applied to more than one

similar species that fit the same morphological descriptions, as evidenced by *uugaq* (*Gadus* spp.) and *kanajuq* (*Myoxocephalus* spp.). Though the Arctic cod (*Boreogadus saida*) was not specified in this study, it possesses the cod's characteristic chin barbel and also goes by the name of *uugaq* in other Inuit groups, where it is considered a food source (Randa 2002; Wein et al. 1996). The association of *uugaq* to *Gadus* spp. and *kanajuq* to *Myoxocephalus* spp. are, therefore, merely tentative and could represent higher order groupings, such as the Gadidae and Cottidae, respectively, as suggested by Graves and Hall (1985) and Randa (2002). Furthermore, *Myt. trossulus* belongs to the blue mussels *(Mytilus edulis*) species complex and hybridizes with *Myt. edulis*, where they coexist in the Arctic and Subarctic (Mathiesen et al. 2017), thus making the distinction between these taxa more difficult.

Much of the terminology employed by the Inuit of Ivujivik and Kangiqsujuaq in their classification of marine organisms is reflective of the terminology used by Inuit across the Arctic (Atran 1987; Cuerrier and Elders of Kangiqsualujjuaq 2012; Dorais 1984; Johnson 1987; Le Mouël 1978; Paillet 1973; Randa 2002; Robbe 1994). The term *timmiat*, or any of its local variants, to designate birds appears to be the most constant throughout. Johnson (1987) has called it a life-form taxon and, at first glance, it meets the definitional criteria, based on gross morphology, of Brown's (1979) description of a universal life-form. Atran (1987) extended this label to *iqaluit* (fish), which, with birds, includes two of the first three universal zoological life-forms that, according to Brown (1979), are added to languages during their development and evolution. Although the classification of *iqaluit* as a life-form taxon seems appropriate, it appears secondary to a different, yet entirely intuitive, classificatory system.

Instead of gross morphology as a founding principal to the local classification, our study finds habitat to be the most important classificatory variable. Indeed, fish that can be harvested on the intertidal zone, alongside algae, echinoderms, mollusks, and crustaceans, can be classified together (*tininnimiutait*). In the community of Kangiqsualujjuaq, on the Ungava Bay's west coast, fish, shellfish, and algae were frequently depicted on drawings of the land-water interface (Heyes 2007). However, fish can also be categorized according to whether they can be found in rivers (*kuummiutait*), lakes (*tasirmiutait*), heavy currents (*qamanirmiutait*), or salt water (*tariurmiutait*) (Cuerrier and Elders of Kangiqsualujjuaq 2012). Atran (1987) translated *tasirmiutait* into lake animals, including fish, such as trout, and some seals. Atran (1987:151) also translated *irqamiut*, representatives of *irqamiutait*, into "bottom-lying sea creatures." Although labeled a life-form taxon, as it includes shellfish, the etymology of the word suggests, as with other classificatory terms reported here (Table 2), a taxon reflective of the environment in which these organisms can be found.

Our results suggest that the criteria for inclusion into one classificatory term or another rely more on an extensive understanding of their relevant ecological, or behavioral, characteristics and their dietary benefits than on morphological appearances. Indeed, the wealth of words employed to describe tidal events, as evidenced in Kangiqsualujjuaq, suggest that such events are particularly important at differentiating space within the land-water interface (Heyes 2007). In classifying an organism into a higher category, one reveals much of the hunting and harvesting strategy, as well as the location where one organism can be found. In the case of *tininnimiutait*, the organism can be harvested near the shore, and with even more success at lower tides, without necessarily having to employ highly specialized equipment or skills. These differ from *irqamiutait***,** which are harder to access, as they lie further down into deeper water and require more specialized equipment to harvest. *Timmiat* imply animals that have the

capacity to fly, whereas *imarmiutait uumajuit* imply highly prized large game species that are considerably adept and mobile in the water (Table 2).

Seashore organisms (*tininnimiutait*) provide the largest number of organisms with a high consensus in both Ivujivik and Kangiqsujuaq. They are frequently associated with high abundance, wide distribution, ease of access, as well as bi-monthly availability for the whole year, qualities that make these organisms particularly useful famine foods. This may explain why knowledge of infrequently or rarely consumed *tininnimiutait* pervades through time, such as *Sem. balanoides*, for which most Elders could recall preparations without having tasted it. Even throughout winter, when country foods are relatively scarce, *tininnimiutait* represents the only group of organisms that can reliably be accessed throughout the year. Because such access relies on the accurate prediction of lunar cycles, harvesting activities are easily planned out by individuals, small groups like families and large groups like the community. Harvesting time can be accommodated in the context of busy schedules due to proximity and the small window of time allowed by the tides. Not surprisingly, in communities where tides are strong, subsistence harvesting of *tininnimiutait* has the potential to act as an increasingly important contributor of nutrients to the local food system and may play an important role in food security and sovereignty (M. J. Gauthier, personal communication, October 2014).

Food Sovereignty—Adapting to Change

Most marine species cited in this study, including fish, shellfish, and algae, also contribute to the food systems of many other Inuit communities across the Arctic (Egeland et al. 2009; Wein et al. 1996). In Sanikiluaq (Belcher Island, Nunavut), fish and shellfish, including *Myt. edulis*, sea urchins (*Strongylocentrotus* sp.), and sea cucumbers (*Cucumaria frondosa*), were most frequently consumed (Wein et al. 1996). In Pangnirtung (Baffin Island, Nunavut), Egeland et al. (2009) cite the most extensive list to date of seafood contributing to Inuit diet, which includes three shrimp species (*Aeginella longicornis, Bentheogennema borealis*, and *Caprella laeviuscula*), snow crab (*Chionoecetes opilio*), two clam species (*Ensis directus* and *Mya arenaria*), *Myt. edulis*, scallop (*Placopecten magellanicus*), sea urchin, and no less than seven sculpin species.

Although seaweeds are cited in these studies, authors only identify them to genus level (Egeland et al. 2009; Kuhnlein and Soueida 1992; Kuhnlein et al. 1991; Wein et al. 1996). Such is also the case of shellfish in some studies (Kuhnlein and Soueida 1992; Kuhnlein et al. 1991). In contrast to large mammals and fish, these organisms seem to be frequently overlooked in dietary and nutritional studies of Inuit country foods, where they are often absent from analyses or simply generically identified. That may perhaps be due to differences in hydrogeological characteristics and access to the sea of the communities included in these studies. Future studies should, therefore, recognize how the unique ecological characteristics of each community or region affect local food systems and include overlooked food sources that may be uncommon or absent from one community's food system but important for another one.

Local food systems are not static, and Inuit communities benefit from integrating the dietary habits of other communities in their regions. From incorporating shellfish and other seafood that were consumed in neighboring communities to harvesting new and previously inaccessible organisms, Elders from Kangiqsujuaq and Ivujivik can recall the evolution of their food system during their lifetime. Although studies have clearly linked dietary transition to recent rapid lifestyle changes (Fergurson 2001), little attention has been given to changes in dietary choices of country foods consumed, which reflect adaptability and resilience

to both socio-cultural and environmental change. As concerns related to access to the sea and land increase with the effects of climate change (Blanchet and Rochette 2008; Council of Canadian Academies 2014), reliance on more readily accessible country foods, such as shellfish, algae, and other seafood, will likely increase. Knowledge of infrequently consumed species may prove increasingly important in an effort to increase food sovereignty and compensate for changes in the abundance of currently preferred country foods.

Some dietary shifts may also be the result of an adaptive response to new economic activities and initiatives. Already, community-oriented and/or entrepreneurial Nunavimmiut are involved in the local and commercial harvest of shellfish and interest for agro-food business is growing (Makivik Corporation et al. 2014). A private scallop fishery operates out of Salluit (Kativik Regional Government 2012) and Nunavimmiut beneficiaries of the James Bay and Northern Quebec Agreement receive *Pa. borealis* and pink striped shrimp (*Pandalus montagui*) from Makivik's UNAAQ Fisheries. Other organisms may be of interest as *Myt. edulis* are cultivated commercially in the cold waters of Newfoundland (Khan et al. 2006), whereas *kukiujak* (Greenland cockle; *Serripus groenlandicus*) and *Mya truncata* have been the target of exploration for subsistence fisheries in Resolute Bay and Arctic Bay, respectively (Stewart et al. 1993). Among five species of brown algae in Ungava Bay, Sharp et al. (2008) found that *F. evanescens* and *itsuujaq* (hollow stemmed kelp; *Saccharina longicruris*) could be harvested under medium level industrial harvest standards. In the absence of large-scale development and exploitation, intertidal hand gathering by local harvesters could be similar to shore-based rockweed harvesting in Nova Scotia (Sharp et al. 2008).

"Our Sea, Our Health"

Our study suggests that marine organisms remain important dietary staples of the current food systems in Kangiqsujuaq and Ivujivik, in part because participants perceive their consumption and acquisition to be important for satiety, health and wellbeing. In Qikiqtaaluk (Baffin Island, Nunavut), the consumption of seaweed, *Laminaria solidungula*, was perceived to benefit general health (Black et al. 2008). In Kangiqlugaapik (syn: Clyde River, Baffin Island, Nunavut), seal was thought to nourish the soul, as well as treat and prevent a multitude of illnesses and diseases (Borré 1994). Preferences for traditional foods over market foods and the beliefs that these possess superior health benefits are not only common among the Inuit, but also common among First Nation and Metis populations across Canada (Wein et al. 1996).

Indeed, fish, shellfish, and seaweed provide an important source of essential macro- and micronutrients, including protein, calcium, folate, magnesium, iron, zinc, selenium, copper, and chromium (Table 3). Nunavut's nutrition fact sheet also provides details on an unspecified *Laminaria* sp., but reports low, yet noteworthy, amounts of iron, magnesium, folate, and fiber (Caughey et al. 2013). Furthermore, *Laminaria* and *Fucus* spp. have become well known sources of iodine since its discovery in brown algae (Courtois 1813). Andersen et al. (2002) report relatively high iodine content in fish and marine mammals from Greenland, while Bourre and Paquotte (2008) indicate higher amounts in mussels in comparison to cod, salmon, shrimp, and scallop (species not specified).

Considerable attention has been given to the health benefits and contribution of ω-3 PUFAs from seals and other marine organisms, as they are the main sources of ω-3 PUFAs in Nunavik, containing exceptional quantities of eicosapentaenoic (EPA), docosahexaenoic acids (DHA), and docosapentaenoic acid (DPA) (Blanchet et al. 2000; Kuhnlein et al. 1991; Lemire et al. 2015). Moreover, a large body of evidence from clinical, experimental, and

epidemiological studies suggest that ω-3 PUFAs, particularly EPA and DHA, can be attributed to a wide array of health benefits from protection against cardiovascular health problems to improved cognitive function in Inuit school-aged children (Supplemental Table 2).

Clinical attention has also been given to the seaweeds *F. evanescens* and *Sac. longicruris,* which contain the beta-glucan laminaran (Ayoub et al. 2015; Rioux et al. 2010; Vishchuk et al. 2013) and fucoidans (Bilan et al. 2002; Rioux et al. 2010). These compounds show a wide array of pharmacological activities, most notably in improving skin health, as reported by participants (Supplemental Table 2). Research suggests that fucoidans may also be found in echinoderms consumed by Nunavimmiut, as they have been found in various species of sea urchin and sea cucumbers (Supplemental Table 2).

Nonetheless, few seafood organisms from the Inuit food system, including shellfish and seaweed, have been thoroughly investigated for their nutritional composition and health benefits. Though *Myt. edulis* cultivated in Ireland and Newfoundland possessed a high content of ω-3 PUFAs (Fernández et al. 2015; Khan et al. 2006), Kuhnlein et al. (1991) found them in small quantities, often trace amounts, in both *Myt. edulis* and clams (*Mya* spp.). This discrepancy may simply be that the contri-

Table 3. Notable macro- and micronutrients found in fish, shellfish, and algae determined in nutritional studies on Inuit country foods (Caughey et al. 2013; Egeland et al. 2009; Kuhnlein and Soueida 1992; Lemire et al. 2015).

Nutrient	Organism
Protein	• Seaweed (unspecified) • Clams • Blue mussels • Shrimp
Calcium	• Kelp and seaweed (unspecified) • Clams • Sculpin with bones • Arctic char skin
Folate	• Seaweed (unspecified)
Magnesium	• Clams • Blue mussels
Iron	• Clams • Blue mussels
Zinc	• Clams • Blue mussels
Selenium	• Clams • Arctic and Atlantic cod • Blue mussels • Shrimp
Copper	• Kelp (unspecified)
Chromium	• Kelp (unspecified)

bution of ω-3 PUFAs to their nutritional composition appears minimal in comparison to considerably larger quantities of these fatty acids found in the adipose tissue of marine mammals. This could also be due to hybridization (Mathiesen et al. 2017) or seasonal variation in lipid contents (Fernández et al. 2015), a phenomenon observed by this study's participants of Ivujivik and Kangiqsujuaq, who agreed that mollusks were fatter in fall, which, therefore, improved their taste. That being said, shellfish, specifically crustaceans, echinoderms, and other mollusks, may also be important sources of these fatty acids, as evidenced by their presence in notable amounts in the roe of the Greek sea urchin (*Paracentrotus lividus*) (Kalogeropoulos et al. 2012).

The shellfish mentioned in this study are known to be low in mercury, although little information is available about their local content in marine toxins and other possible chemical contaminants (Caughey et al. 2013; Lemire et al. 2015). Nonetheless, people from Ivujivik and Kangiqsujuaq are aware and concerned about shellfish contamination, particularly on the shores in front of their community or near the mouths of rivers, which are linked to water systems that surround dumpsites. A review on climate change and seafood safety reassures that most biological contaminants are introduced during handling or result from human sources and are not directly related to climate change (Marques et al. 2010). However, some bacteria and algae, naturally occurring in the marine environment, can be pathogenic. Marques et al. (2010:1776) therefore cautions that microbial contamination, as well as chemical contamination, is "likely to occur more often in the future" with climate change and that "public health authorities will face new challenges to guarantee seafood safety." This is particularly true with increasing population size projected in the North.

Conclusion

Some species, namely those from the intertidal zone (i.e., mollusks, crustaceans, echinoderms, algae, and some fish), deserve more attention in future studies so as to properly include and identify them, as well as to better reflect the diversity and their nutritional contribution in local food systems. Our study shows that these organisms hold a clear and definitive place in the local classification of marine species in Kangiqsujuaq and Ivujivik. This classification, based on species' environment and habitat, acts as an atlas and a collection of ecological knowledge that provides information on acquisition strategies to the hunter or harvester. In light of the need to develop efficient initiatives and strategies to strengthen food security and sovereignty, the contributions of *tininnimiutait* to Inuit diet, nutrition, and health warrant considerably more attention than received to date. Finally, studying the impact of long-term and short-term harvesting on these food sources would be beneficial to establishing sustainable harvesting practices

Acknowledgments

This manuscript is dedicated to Dr. Éric Dewailly, authority on environmental and human health in the circumpolar world, and a brilliant mind. Several times, informal discussions took place with Éric, a man of the sea, on the importance of better studying smaller marine organisms with respect to Inuit knowledge, wellbeing and health in our on-going projects in the Arctic. Through this manuscript, we testify to his long-lasting legacy.

Special thanks to the communities of Ivujivik and Kangiqsujuaq for their great support and generosity. This work was supported by Éric Dewailly, Mélanie Lemire, and Alain Cuerrier's ArcticNet research grant, as well as Cory Harris' IRSC research grant. We also thank the NNHC and Avataq Cultural Institute for their support. Thanks to Claire Dupont for helping with fieldwork. Thanks to Monica

Pinguatuq, Paasa Audlaluk, and Mary Paningajak for interpretation, translation, and helping with the Inuktitut. Finally, many thanks to all participants, Annie Ainalik, Peter Ainalik, Lizzie Irniq, Amaamak Jaaka, Jaaka Jaaka, Lukasi Kanarjuak, Sarah Keatainak, Peta Kristensen, Mitiarjuk Mangiuk, Lukasi Nappaaluk, Attasi Pilurtuut, Eyuka Pinguatuk, Pitsiulaq Pinguatuk, Aqujaq Qisiiq, and Quitsa Tarriasuk, for their willingness to take the time so as to share their knowledge.

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