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Wild Resources, Harvest Data and Food Security in Nunavut's Qikiqtaaluk Region: A Diachronic Analysis

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ABSTRACT. The security of the Inuit food system is the focus of extreme concern in Nunavut today. Despite this concern, little detailed analysis of the system's traditional resource component has been done, primarily for lack of comprehensive recent information on harvesting. An exception is the harvest surveys carried out by the Nunavut Wildlife Management Board (NWMB) from 1996 to 2001. This comprehensive survey provides potentially important, albeit temporally limited (five year), information on recent Inuit wildlife use. To overcome this temporal limitation, we compared the NWMB data to information from the Baffin Regional Inuit Association (BRIA) 1980 to 1984 harvest survey for the 13 communities of the Qikiqtaaluk-Baffin Region. Together, these datasets provide two five-year "windows" on wild resource use in Nunavut's most populous region. This comparison indicates declines in the total volume and per capita availability of wild foods in most communities relative to the early 1980s. We conclude that a partial cause for this change was hunters' reduced access to monetary resources after the collapse of the European sealskin market (ca. 1983–84). When coupled with rising harvesting costs, this change significantly reduced the number of intensively engaged harvesters relative to the region's growing population.

Key words: Inuit food security; wild resources; harvest data; Qikiqtaaluk-Baffin Region; Malthus

RÉSUMÉ. En ce moment, la sécurité du système alimentaire inuit est une source de préoccupation extrême au Nunavut. Malgré cette préoccupation, peu d'analyses détaillées ont été effectuées au sujet de la composante des ressources traditionnelles de ce système, principalement en raison d'un manque d'information récente et exhaustive sur les récoltes. Le Conseil de gestion des ressources fauniques du Nunavut (CGRFN) a toutefois effectué une enquête sur les récoltes entre 1996 et 2001. Même si elle est limitée dans le temps (cinq ans), cette enquête approfondie fournit des renseignements susceptibles de revêtir de l'importance à propos de l'utilisation récente de la faune par les Inuits. Afin de surmonter cette limitation dans le temps, nous avons comparé les données du CGRFN à l'information de la Baffin Regional Inuit Association (BRIA) puisée dans son enquête sur les récoltes entre 1980 et 1984 relativement à 13 collectivités de la région Qikiqtaaluk-Baffin. Ces ensembles de données présentent deux « fenêtres » de données de cinq ans au sujet de l'utilisation des ressources sauvages dans la région la plus peuplée du Nunavut. Cette comparaison laisse entrevoir la diminution du volume total et de la disponibilité par habitant de la nourriture issue de la nature dans la plupart des collectivités comparativement au début des années 1980. Nous concluons qu'une cause partielle de ce changement est attribuable à l'accès réduit des chasseurs aux ressources monétaires après l'effondrement du marché des peaux de phoque en Europe (vers 1983-1984). Jumelé aux coûts des récoltes à la hausse, ce changement a eu pour effet de diminuer considérablement le nombre de récolteurs consacrant beaucoup de temps aux récoltes par rapport à la population grandissante de la région.

Mots clés : sécurité alimentaire des Inuits; ressources sauvages; données sur les récoltes; région Qikiqtaaluk-Baffin; Malthus

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INTRODUCTION

The security of the Inuit food system is a dominant theme in northern social science research in Canada (see Duhaime, 2002; Duhaime and Bernard, 2008; Ford and Berrang-Ford, 2009; Egeland et al., 2011a, b; Huet et al., 2012). Traditional resources (often termed "country foods") are considered critical to the system's overall quality and to Inuit cultural well-being from Nunatsiavut to the Inuvialuit Settlement Region and across a range of research foci, including climate change (Ford, 2009; Ford et al., 2006, 2008), Inuit nutritional and physical health (Kuhnlein and Receveur, 1996; Kuhnlein and Chan, 2000; Furgal et al., 2002; Kuhnlein et al., 2004; Lambden et al., 2007; Ferguson, 2011) and the impact of globalization on wildlife use (Wenzel 1991, 2009).

This theme is most apparent in two contemporary literatures that address food security: that on diet and nutrition and the other on the effects of climate change. Both place importance on traditional resources, but in ways that are

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TABLE 1. Qikiqtaaluk Region community characteristics.

Name (population)[1]	Location	Primary harvest areas	Major food species
Arctic Bay (823)	73°02′ N, 85°09′ W	Admiralty Inlet, Somerset Island, Prince Regent Inlet	narwhal, ringed seal, polar bear, caribou
Cape Dorset (1363)	64°13′ N, 76°32′ W	Hudson Strait, Great Plain of Koukdjuak, Nettilling Lake	ringed seal, beluga, Arctic char, caribou
Clyde River (934)	70°28′ N, 68°35′ W	Baffin Bay, Buchan Gulf to Home Bay	ringed seal, caribou, Arctic char, narwhal
Grise Fiord (130)	76°25′ N, 82°53′ W	Southern Ellesmere Island, Jones Sound, Devon Island	peary caribou, muskox, polar bear, ringed seal
Hall Beach (546)	68°46′ N, 81°13′ W	Melville Peninsula, Foxe Basin, NW Baffin Island	caribou, ringed seal, walrus
Igloolik (1454)	69°22′ N, 81°47′ W	Melville Peninsula, NW Baffin Island, Foxe Basin	walrus, caribou, ringed seal
Iqaluit[2] (6699)	63°44′ N, 68°31′ W	Frobisher Bay, Amadjuak Lake, Meta Incognita Peninsula	caribou, Arctic char, ringed seal, beluga
Kimmirut[2] (411)	62°50′ N, 69°52′ W	Hudson Strait, Meta Incognita Peninsula, Soper River	caribou, ringed seal, beluga, Arctic char
Pangnirtung (1425)	66°08′ N, 65°41′ W	Cumberland Sound, Nettilling Lake, Hall Peninsula	beluga, ringed and harp seal, caribou, Arctic char
Pond Inlet (1549)	72°41′ N, 77°57′ W	Lancaster Sound, Milne, Navy Board and Pond Inlets	narwhal, ringed seal, Arctic char, caribou
Qikiqtarjuak[2] (520)	67°33′ N, 64°01′ W	Home Bay, Davis Strait, Nettilling Lake	ringed seal, walrus, Arctic char, caribou
Resolute (214)	74°41′ N, 94°49′ W	Somerset, Prince of Wales and Bathurst Islands, Barrow Strait	narwhal, polar bear, caribou, Arctic char
Sanikiluaq[2] (812)	56°32′ N, 79°13′ W	Eastern Hudson Bay, Belcher Island	eider ducks, ringed seal, mollusks, beluga

[1] Population data from Statistics Canada, 2011 census.

[2] Communities so indicated were formerly known as Frobisher Bay, Lake Harbour, Broughton Island, and Belcher Islands.

more than a little paradoxical. The health literature notes the high quality of traditional foods frequently, but also emphasizes their decline in the Inuit diet. This perceived emerging dietary shift or transition, especially among younger Inuit (notably the under 25 age cohort) (Kuhnlein and Receveur, 1996; Kuhnlein et al., 2004; Lambden et al., 2007; Egeland et al., 2011b; Ferguson, 2011), is thought to compromise nutrition and food security. The climate change literature has a more cautionary message regarding Inuit traditional food resources, positing that changes in the physical environment (loss of sea ice, autumn rain-freeze events) will reverberate through the biological subsystem. These changes, in combination with diminished intergenerational transfer of traditional ecological knowledge, will result in destabilization of the traditional food sector (Furgal et al., 2002; Ford et al., 2006, 2008; Ford, 2009; Henshaw, 2009; McNeeley and Shulski, 2011).

While both these approaches mention the importance of traditional resources to the contemporary mixed food system and to Inuit food security, they each lack a critical element: neither provides any quantitative information on the present (or recent past) contribution of traditional resources to the system. This absence stands in sharp contrast to discussions of the market food component of the system. As a result, much of this discussion—substantive and anecdotal, positive and negative—of food security in Nunavut centres on the system's market or imported food sector. As the Council on Canadian Academies (2014:83) notes, wildlife harvest studies offer potentially important data on traditional resource use by Nunavut Inuit and other northern populations.

Our objective here is to provide baseline data on the wild resource component of the Inuit food system in the Qikiqtaaluk Region of Nunavut and to propose an explanation for the trend these data indicate with respect to availability of traditional foods. To do so, we analyze two sets of data: the Baffin Regional Inuit Association (BRIA) harvest surveys, (BRIA, 1981, 1982, 1983, 1984, 1985; Pattimore, 1985; Donaldson, 1988) and the 1996–2001 Nunavut Wildlife Management Board Harvest Study (Priest and Usher, 2004). This analysis provides a temporal perspective on harvested food species and food security in the Qikiqtaaluk Region.

THE COMMUNITIES, HARVEST SURVEYS AND HARVESTING DATA

Regional Overview

Formerly known as the Baffin Region (and in earlier times, the District of Franklin), the Qikiqtaaluk is the largest of Nunavut's three administrative regions in both area (~ 1 040 000 km^2) and population (with 16 000 Nunavummiut, or about half of the territorial population) (Nunavut Bureau of Statistics, 2011). The region comprises 13 communities, including Iqaluit, Nunavut's capital and largest town (population ca. 7000, or approximately 40% of the regional population), and Nunavut's most northern and southern communities (Grise Fiord and Sanikiluaq, respectively). The 60% of the region's Inuit population living beyond Iqaluit reside in communities ranging in size from approximately 130 Inuit residents in Grise Fiord to 1500 in Pond Inlet (see Table 1; Statistics Canada, 2011).

Inuit are the majority in all Qikiqtaaluk communities and it is only in Iqaluit that they are less than 95% of the population. Historically, almost all the communities became loci of permanent (that is, year-round) Inuit residence after the Second World War (see Damas, 2002), with movement into many communities taking on momentum only in the 1960s (for a description of one community's evolution, see Wenzel, 2008). With the possible exception of Iqaluit, communities across the region derive considerable benefits from the harvesting and consuming of wild resources, benefits that range from supplying much of the protein in local diets to contributing to Inuit cultural identity.

Harvest Surveys

Harvest surveys are counts of the volume (usually the number of individuals captured) of a wildlife species extracted from a defined region by a specific group (occupational, cultural) during an identified period of time. The resulting statistics represent a best estimate of the total number of animals captured in a geographic area, by a category of harvesters, or both (Usher et al., 1985; Usher and Wenzel, 1987). What distinguishes harvest surveys from explicitly biological resource studies is that harvest surveys employ various social science techniques, including interviews, questionnaires, and reporting diaries and calendars that are maintained by hunters. Ideally, harvest surveys combine at least two methods of data collection and continue over a series of seasons or years.

The term "Native Harvest Survey" came into widespread use at the time of the James Bay and Northern Québec Agreement (JBNQA) of 1975 (Usher et al., 1985). A critical provision of the JBNQA required that information on Aboriginal hunting, fishing, and trapping be used to set minimum preferential harvest levels for all the species used by Cree and Inuit (James Bay and Northern Quebec Native Harvesting Research Committee [JBNQNHRC], 1975, 1976a, b, 1982, 1988). In addition, harvest information might be used to estimate monetary compensation should harvesting activities be disrupted by industrial projects.

The survey methods developed for the JBNQA exercise were applied in subsequent studies of harvesting in what today is Nunavut. In the early 1980s, BRIA, the Keewatin Wildlife Federation (KWF), and the Government of the Northwest Territories (GNWT) each conducted unconnected regional surveys, while in the late 1990s, the NWMB carried out a single, unified pan-Nunavut study.

Perhaps because of the explicit focus of these parties on the biological or political aspects of harvesting, or both, the results of the various surveys were rarely used outside the sphere of wildlife management or across time (but see Wenzel, 1997). Broader application of these data was further hindered by the fact that the 1980s surveys were not coordinated as to their respective durations, with BRIA covering five years (1981–85), KWF three years (Gamble, 1984) and the GNWT just two years (Jingfors, 1986). Indeed, when used at all, these harvest survey results have generally been employed to establish community and regional Total Allowable Harvest (TAH) and quota levels for species of concern (D. Lee, pers. comm. 2014; G. Williams, pers. comm. 2014).

The Baffin-Qikiqtaaluk Harvest Records

The harvest information gathered for the Qikiqtaaluk-Baffin Region through the BRIA and the NWMB surveys possesses the temporal breadth for reasonable diachronic analysis of trends and patterns in traditional resource harvesting. To apply the two studies for relevance to food security, the basic survey results were integrated with information on: 1) regional and community populations, 2) harvester status, and 3) estimated net amount of food produced, as derived by applying a "standard" adult animal weight (see Keene, 1985:163; Ashley, 2002) to each food species. Taken together, these data allowed assessment of the volume of traditional resources potentially available for human consumption in the communities across the region.

The BRIA and NWMB surveys employed similar methods. A harvest calendar was supplied to each participant with instructions to record his catch of each species in that month. Local fieldworkers collected these calendars at or near the end of the month. Follow-up interviews were generally not a part of the BRIA survey, but the NWMB survey used interviews, albeit inconsistently (J. Noble, pers. comm. 2014), in order to obtain geographic information related to local hunting activities.

In broad terms, the species counts from the collected calendars were used to estimate the harvest for that month of all survey-eligible adult males in the community, with the formula: $Y = y(N/n)$, where Y = the estimated harvest, y = the reported harvest, N = the survey population, and n = the number of hunters responding. For a complete explanation of the NWMB survey strategy, see Priest and Usher (2004:23–42).

Methodological Challenges and Caveats

Harvest surveys are not without problems, the most general of which are inadequate rate of response, insufficient sample size, survey difficulties, and respondent bias (see Usher et al., 1985; Usher and Wenzel, 1987; Usher and Brooke, 2001).

The annual rate of response in these surveys ranged from 89% (Clyde River) to a low of 64% (Frobisher Bay) during the BRIA period (five-year average across the region's 13 communities: 76.9%) and from 98% (Arctic Bay) to 70% (Qikiqtarjuak) during the NWMB years (regional five-year average: 80.1%) For present analytical purposes, the BRIA annual community reported harvests (Y) were averaged for comparison to the NWMB reported harvest (Y).

With respect to sample size, both the BRIA and NWMB surveys attempted to census the hunter cohort (males from 18 years of age and older) in each Qikiqtaaluk community. The rate of response across the 13 communities annually averaged from 75% to 85%. Procedural difficulties mostly relate to respondents' unfamiliarity with the survey process, poor fieldworker training, and "survey fatigue." For example, in 1996–97, the first NWMB survey year, collection inadequacies in Iqaluit and Cape Dorset (J. Justus, pers. comm. 2010) required the exclusion of the data from those two communities. As for respondent bias specific to the BRIA and NWMB surveys, employment of local fieldworkers familiar with the survey population provided the main control. Additionally, multi-year surveys like those carried out by BRIA and the NWMB possess sufficient temporal perspective to correct for such errors within the framework of the surveys' objectives.

TABLE 2. Traditional food inventory (in kg unless otherwise indicated).

Species	Live weight	Edible weight
Ringed seal	45.0/33[1]	18.0/13[2]
Bearded seal	273.0	68.0
Harp seal	135.0	36.0
Walrus	682.0	460.0
Polar bear	453.0	158.0
Narwhal[3]	454.0	90 .0
Beluga[3]	454.0	90.0
Muskox	300.0	100.0
Barren-ground caribou[4]	68.0	45.0
Peary caribou[4]	56.0	37.0
Arctic hare	2.0	600 g
Ducks (all species)	1.3	750 g
Geese and brants	4.0	2.0
Ptarmigan	1.0	600 g
Loon	2.5	1.0
Murre and guillemot	1.0	600 g
Arctic char	3.5	2.5
Mollusks[5]	30 g	10 g

[1] The lesser value relates to seals harvested at Sanikiluaq as per McLaren (1958).

[2] Meat only.

[3] *Maktaaq* only.

[4] Meat and *tunuk* (fat).

[5] Mollusks were not included in the community analyses.

However, different challenges face researchers who want to use harvest data to answer questions about topics that require additional data beyond hunters' species counts. Food security is a case in point. The BRIA and the NWMB (and harvest surveys in general) are not designed to include information on the proportion of harvested resources that was consumable or was actually consumed. At best, they provide an indication of resource volume potentially available to consumers.

To more meaningfully apply the BRIA and NWMB harvest information to the issue of food security, we processed the data from the two surveys using the following procedures. As the data from both surveys were presented as the number of individual animals of a species taken in a given year, the total annual harvest of each species in a community's resource suite was converted to the total live weight for that species. This conversion was done by applying the standardized individual adult animal's average weight (see Foote, 1967; G.W. Wenzel, unpubl. field notes) to the total annual harvest of each species. An averaged edible weight standard (see Ashley, 2002) for an adult of a species, adjusted for locale (see Table 2, ringed seal and Peary caribou), was then applied, and the total edible weight of each species in a community's harvest was calculated.

We applied several further procedures to the edible weight determinations in order to compensate for the lack of age class information in the surveys. First, we used only the reported harvest of animals, rather than an estimate. Second, we calculated a meat-only weight for each species (except that for simplicity, birds were grouped in classes: various ducks; geese and brants) by converting the constituent percentage of live weight accounted for by various organs, edible or not, and hides, fat, and bones (Foote, 1967) into kg (or g) and subtracting these amounts from the adult live weight. (Small cetaceans were an exception to this standard meat calculation; for narwhal and beluga whales, only *maqtaaq* (Foote, 1967) was considered.) Last, we excluded a number of species because of rarity or absence in the Inuit diet (various canids: Arctic wolf *Canis lupus* and foxes *Vulpes lagopus*, bowhead whale *Balaena mysticetus*, hooded seal *Cystophora cristata*, gulls, owls, and raptors) or because weight data were unavailable (mollusks, Arctic cod *Boreogadus saida*, sculpins).

The one other exception was polar bear (*Ursus maritimus*). Bear, although very much part of the diet of many Qikiqtaalummiut, was dropped from the analysis because the harvests recorded for several communities deviated significantly from their regulated annual quotas, including in one case a take of polar bears nearly double that allowed. For example, in 1983 there was a regional discrepancy of 50 animals from the official Canadian Wildlife Service record (see Wenzel, 2008). Because of this uncertainty about the accuracy of those data, the species was excluded. As a result, because of these exclusions and edible weight discounting, the data provide a conservative calculation of the estimated availability of country food.

Using 1980 data for Clyde River (BRIA, 1981) to provide an example, Table 3 shows the species in the community's resource inventory (Rows 2–12). The number of animals harvested of each species in Column 2 was converted to total live weight (kg) in Column 3 and then total edible weight (kg) in Column 4, using the standardized live and edible species weights in Table 2. We determined annual per-person food availability (kg) by dividing the edible weight yield by the community population (Row 15). Converting that figure to grams and dividing by 365 gave us daily per capita availability (g), shown in Row 16. We applied the same procedure to the food inventories of all 13 Qikiqtaaluk communities, adding or deleting species on the basis of the annual harvest record of each community in a given BRIA or NWMB survey year.

FOOD SECURITY VARIABLES: CONSUMERS, HUNTERS AND HARVESTING CAPACITY

Two other analytical issues are relevant to discussing security (or insecurity) in the traditional food sector. The first is the need to consider traditional resource availability in relation to the population of human consumers. The second is the capacity of the hunter cohort to support this overall population by their numbers, frequency of activity, or technological means, or a combination of these.

While some non-Inuit consume (but less often produce) traditional foods, the explicit concern here is the Inuit of the region. Nunavut Bureau of Statistics (2011) and NWMB datasets were used to determine the Inuit populations of Qikiqtaaluk communities from 1996–97 to 2000–01, while

TABLE 3. Food species harvest[1] and food availability, Clyde River, 1980.

Species	Individuals harvested	Total live weight (kg)	Total edible weight (kg)
Ringed seal	3905	175725	70290
Bearded seal	38	10374	2584
Walrus	1	682	460
Narwhal	37	16798	3330
Beluga	0		
Caribou	976	66368	43920
Arctic hare	198	990	514
Ptarmigan	652	652	391
Geese	52	182	83
Ducks	618	988	679
Arctic char	4368	15288	11793
Clyde Inuit Population	444		
EW/P/Y[2]	302		
EW/P/D[3]	827		

[1] Excludes minor species, principally sea birds, mollusks, Arctic cod, and sculpin.
[2] Edible weight per person per year expressed in kilograms.
[3] Edible weight per person per day expressed in grams.

community population information for 1980–84 was taken from Devine (1984). Where no official figure was available for a community, the rate of annual population growth was calculated using the standard equation:

$$PR = (V_{present} – V_{past})\ 100/V_{past} \text{ with } PR/N$$

where PR = percent rate of growth, $V_{present}$ = present population, V_{past} = past population, and N = number of years between $V_{present}$ and V_{past}).

The other critical data regarding traditional resources and food security are population information on the food species in the regional harvest records and the size of the harvester subpopulations of the communities. Regarding food species, cautionary recommendations in the mid to late 1990s aimed to limit beluga whale hunting in the eastern Hudson Bay-southeastern Baffin Island areas and, of course, placed quotas on walrus, polar bear, and small cetaceans. Otherwise, the harvesting of other food species in the region (ringed and bearded seals, caribou, birds, and Arctic char) was unregulated.

Information on production capacity, the other critical variable with respect to traditional resources and food security, seems easily established: it is essentially the number of hunters. The BRIA and NWMB surveys both enumerated the hunters in each community. In the BRIA surveys, this number included every male 18 years of age and older who held a General Hunting License. The same age range was included in the NWMB survey, provided a person was registered with the community Hunters and Trappers Organization (HTO). A majority of HTO members in both periods were male, but it is not unknown for women to be registered as well. Nonetheless, it is likely that the hunter designation in both surveys refers overwhelmingly to males 16 years of age and older (see Table 4).

TABLE 4. Baffin/Qikiqtaaluk community hunter cohorts, 1984[1] and 1999[2].

Community[3]	1984	1999
Arctic Bay	81	310
Cape Dorset	164	510
Clyde River	93	245
Grise Fiord	22	73
Hall Beach	83	181
Igloolik	163	307
Iqaluit[4]	308	540
Kimmirut	62	114
Pangnirtung	175	224
Pond Inlet	146	408
Qikiqtarjuak[3]	79	192
Resolute	32	75
Sanikiluaq	77	181
Totals	1485	3360
Most engaged cohort as % of all hunters	311 (20.9%)[5]	424 (12.6%)[6]

[1] Source: Pattimore, 1985.
[2] Source: Priest and Usher, 2004:26.
[3] Communities are here identified by present name; in the BRIA surveys, Qikiqtarjuak was recorded as Broughton Island, Iqaluit as Frobisher Bay, and Kimmirut as Lake Harbour.
[4] The BRIA surveys recorded harvests at Iqaluit (Frobisher Bay) and nearby Apex separately; the NWMB surveys aggregated the data from these two communities.
[5] Combined intensive and active hunter cohort based on Clyde River ringed sealskin sales (NWT Annual Fur Report, Clyde River 1980–81), with active cohort percentage projected to all communities.
[6] Combined intensive and active hunter cohort based on self-reported ringed seal harvesting in all communities (Priest and Usher, 2004).

Another element of capacity regarding traditional resource production and food security is the intensity with which individuals participate in harvesting. However, for reasons ranging from cultural appropriateness to limited hunting time because of wage employment, hunter classification is often elusive (see Usher and Wenzel, 1987).

The BRIA surveys made little attempt at hunter classification (but see Donaldson, 1988). The NWMB study (Priest and Usher, 2004:26–27), however, qualitatively stratified hunters as 1) Intensive ("repeatedly and regularly engages in all or nearly all…types of hunting activities during an annual cycle…always country food in the household"); 2) Active (regularly engages in some, but a limited number, of major harvesting activities during the annual cycle… participation may be short but intense"); and 3) Occasional ("Participation is usually short-term, such as day-trips or weekend outings").

The problematic of assignment aside, of the 2792 hunters that participated in the NWMB surveys in 1996 (Priest and Usher, 2004:27–28), 267 were classified as Intensive, 675 as Active, and 1850 as Occasional hunters. Across all 13 Qikiqtaaluk communities, 9.5% of hunters harvested intensively, and the Intensive and Active categories together represent approximately 34% of the region's hunters.

QIKIQTAALUK HARVESTING: BRIA AND NWMB SURVEY RESULTS

Overview

The harvest data for virtually all Qikiqtaaluk communities in the BRIA years show prodigious five-year cumulative volume (1980–84 = 10 866 404 kg) and average per person annual country food availability of 292.5 kg (online Appendix 1). Within that period, 1980 was the richest harvest year with respect to both total annual edible biomass (2 963 658 kg) and average per person country food availability (417 kg annually; 1142 g daily). But even if 1980 is discounted as being anomalously high, the daily average amount of food available per person over the last four BRIA years remains a robust 715 g.

The NWMB study presents a rather different picture from that of the BRIA period in that it shows a steady year-to-year downward trend. Over its five years, the total volume of traditional resource production was 7 485 414 kg (31% less than in the BRIA period), and the average amount available per person annually was 125.5 kg (a decline of about 70% with respect to the BRIA period). Even when the BRIA results for 1980 are discounted and only the average annual volume of the last four BRIA surveys is compared to the NWMB annual average, the comparison indicates a nearly 25% decline in per capita food availability.

This difference between the two surveys, whether the measure is overall five-year production, average annual harvest, or yearly per capita food availability, makes clear that by the end of the last century, the Qikiqtaalummiut traditional food sector was less secure than was the case in the early 1980s. Why this occurred is important in light of contemporary food security discussions, especially as food security is now understood to have implications that reach beyond quantity to encompass qualitative and cultural factors that developers of food security policy must consider.

Examining interannual changes within each survey provides some answers, since both surveys were designed to gather the most basic data on the number of individuals of a given species harvested by Qikiqtaalummiut each year. For a more focused food security analysis, however, additional information is needed: the amount of production that is edible, the number of consumers being supplied, and size of the harvester cohort.

BRIA Results

Both surveys make it clear that interannual variability in traditional resource production is not something confined to the ethnographic past. Interannual differences in harvesting during each survey period were modest (online Appendix 1), generally a 10% to 20% variation in production, even though the harvest could vary greatly from year to year. It is also evident that boom years, such as 1980, were far from the rule.

On the other hand, even communities that maintained relatively steady levels of production through the middle years of the BRIA survey (Cape Dorset, Arctic Bay, Clyde River, and Kimmirut) saw some attrition in the amount of food available per person per day, most likely because of population growth. However, because the rate of population change in the 1980s was relatively modest in most communities, this effect, except in a truly bad year, likely did not seriously affect food availability.

Much clearer in the BRIA data is the impact that the collapse of the sealskin market had on the region's communities. The sociocultural and economic effects on the Inuit of the seal boycott initiated by the European Economic Community (EEC) in 1983 are generally known (see Malouf, 1986; Wenzel, 1991; Freeman, 1996), but harvest data from 1984 (BRIA, 1985) help to quantify the influence of this political event on the traditional resource economy.

The foremost effect was a significant decrease in the ringed seal harvest across the region. From 1980 to 1983, the aggregate average annual harvest was 36 779 animals (edible weight of 649 347 kg), but in 1984, the combined harvest fell nearly 20% to 29 545 animals (517 070 edible kg). More importantly, in eight of 13 Qikiqtaaluk communities the 1984 harvest of ringed seals was 25% to 63% lower than the previous four-year average.

The effect on the traditional food sector of these communities was considerable. In the four years up to 1984, ringed seals contributed 40% to 58% of the traditional foods available each year in smaller Qikiqtaaluk communities like Qikiqtarjuaq, Clyde River, Kimmirut, Sanikiluaq, and Grise Fiord, and from 11% to 33% in other communities. However, in 1984, the year after the EEC boycott came into effect, the food contribution from ringed seals was 37% less than the 1980–83 annual average for Clyde River and almost 54% less for Qikiqtarjuaq.

While the relationship between the closure of the sealskin market and the decline in the ringed seal harvest is a strong one, the BRIA data also suggest that the sealskin ban had effects beyond seal harvesting. One apparent correlative effect concerns caribou; from 1980 through 1983, the annual average harvest was more than 13 500 animals, while in 1984 the harvest dropped to 12 407 animals. The difference between 1984 and the annual average for the four earlier survey years seems slight (just 9% less), but community-level examination of these data shows that seven of 10 communities (no caribou hunting was done at Sanikiluaq, and harvest data are incomplete for Kimmirut and Resolute Bay) saw their combined annual average harvests decline by half (from a mean of 8178 in 1980–83 to 3885 in 1984). The gap between the overall regional decline and the seven communities that experienced severe declines relates to the fact that Iqaluit's 1984 harvest more than doubled, from a four-year average of 2293 to 4784, while Pond Inlet and Hall Beach experienced modest increases (15% and 33%, respectively). Together, Iqaluit, Pond Inlet, and Hall Beach harvested 68% of the regional total (8522 of 12 407), whereas during the previous four years, their combined average yearly contribution was only 39%.

The BRIA data make it clear that 1984 was a difficult food year for many Qikiqtaaluk communities, especially for those heavily dependent on ringed seals. The data also point to the EEC boycott as a cause for the decline in the ringed seal harvest, a conclusion qualitatively supported by other sources (Malouf, 1986; Wenzel, 1991). There is no explicit relationship between the sealskin boycott and the caribou catch. However, two factors possibly linked to the loss of the sealskin market, but which are not explicated by the BRIA data, may be important to 1984 food availability.

The first is that the collapse of the sealskin market, perhaps caused in part by loss of commercial value, brought a consequent decline in the ringed seal harvest and thus reduced the availability of ringed seals for food. From the BRIA data, it is impossible to know if this was the case or, if so, what percentage of pre-1984 ringed seal harvest was intended for the market. Nonetheless, even if some seals were harvested principally for sale, their meat offered insurance in case of shortfalls in other resources.

The second is whether the sealskin market crash had an impact on the caribou harvest. In the early 1980s, the sale of wildlife byproducts, from sealskins and polar bear hides to narwhal and walrus ivory, was still an important way to access the monetized sector of the mixed economy (Wenzel, 2013). It is therefore possible that loss of the revenue from the most abundant marketable resource affected other areas of the harvesting system. While a correlation seems possible, the BRIA data are inconclusive.

NWMB Results

The NWMB surveys do not show the dramatic year-to-year changes in harvesting that appear in the BRIA surveys. However, comparison of the two surveys (online Appendix 1) indicates that in the NWMB survey years, the traditional resource component of the regional food system not only was less robust than in any BRIA year, but also traced a steady downward trend throughout the survey period.

Not surprisingly, ringed seal remained the primary focus of harvesting in Clyde River, Pangnirtung, Grise Fiord, and Qikiqtarjuaq, the four communities most dependent on the species for food in the 1980s. In each, the mean annual take from 1996–97 to 2000–01 closely approximates the harvest level in 1984, the year after the European market collapse. However, Pond Inlet, the third most productive sealing community before the boycott (Jelliss, 1978), as well as Sanikiluaq, Cape Dorset, and Arctic Bay, all recorded deeply depressed ringed seal harvests; only Resolute Bay recorded a five-year average harvest higher than in the BRIA surveys. Overall, from 1996 to 2001, the average annual harvest was 12 727 fewer seals than in the 1980s period, which translates to an annual reduction in available food of approximately 229 000 kg.

The caribou harvest showed a similar though less pronounced trend. The average annual harvest from 1980 to 1984 was 14 579 animals, which provided 65 600 kg of food. The average annual harvest for the NWMB period was 10 417 animals, which provided slightly less than 46 980 kg of edible biomass (again, meat only). When combined, the reductions in the caribou and ringed seal harvests meant 112 500 fewer kilograms of food annually.

Looking beyond these aggregate numbers, comparison between the two surveys of community caribou harvests indicates that in this region, only Pangnirtung had a larger average annual catch of caribou than in the 1980s; otherwise, modestly to severely reduced harvests prevailed across the region. For instance, the East Baffin communities of Qikiqtarjuaq and Clyde River averaged harvests 69% and 54% smaller than in the 1980s, Cape Dorset on Southeast Baffin Island averaged 70% fewer caribou annually, and the caribou harvest for Resolute Bay became almost non-existent, falling from a BRIA annual average of 200 animals to an NMWB yearly average of 17.

This simultaneous decline in ringed seal and caribou harvests particularly affected communities dependent on these species as their primary food resources, while communities with access to significant alternative prey species experienced a much smaller change. Two communities with near-year round access to Foxe Basin walrus, Igloolik and Hall Beach, together doubled their average 1980s annual harvest of that species. From 1996 to the end of the NWMB study in 2001, walrus contributed more than 113 000 kg of edible biomass to the two communities each year.

In terms of other food resources, the NWMB data show no consistent patterns. Catches of Arctic char, an important food everywhere except in the High Arctic communities, was generally steady or slightly decreased. Only Pangnirtung, which almost tripled its average annual catch, and Clyde River, with a more modest 28% gain, appreciably increased their char harvests above those of the 1980s.

The greatest variation in the NWMB harvest record concerns the variability communities experience regarding small cetaceans, for which the data show a "boom-bust" pattern in most communities. This phenomenon is also present in the BRIA year-to-year narwhal and beluga records. In 1982, an abnormally heavy ice summer limited the narwhal catch to 11 animals, whereas the annual average of the other survey years was 41. While natural events were the usual cause of such variation, this was not always the case. In Pangnirtung, the harp seal, which had been a significant species (approx. 3600 annually) in the 1980s, all but totally disappeared as a significant harvest species, falling to fewer than 350 a year, during the NWMB period. That change was almost certainly the result of the collapse of the sealskin market.

DISCUSSION AND CONCLUSIONS

The diverse literatures concerned with Inuit food security posit various reasons for the actual or perceived decline in the presence of traditional resources in the overall food system. These explanations include a dietary shift by Inuit to market foods (whether this change is one of choice or necessity is not addressed), negative effects of climate change on traditional food species, loss of traditional ecological knowledge among young Nunavummiut, and the prohibitive costs of modern harvesting. The BRIA and NWMB results made it clear that a steady decrease in traditional resource production began around 1984, but these datasets neither directly support nor refute the postulated explanations.

This ambiguity relates in part to the original design of both harvest surveys. In addition, because little substantive information is available regarding dietary changes, climate change impacts, and generational erosion of TEK, it is difficult to interpret these data vis à vis food security. Information on the economics of Inuit hunting documents the escalating costs of equipment during the period of the surveys (see Moyer, 1972/73; Müller-Wille, 1978; Wenzel 1989, 1991; Ford et al., 2013), but this literature is not necessarily informative about the constraining effects on harvesting. It is far from news that the capital, maintenance, and operational costs of harvesting have increased substantially since Qikiqtaalummiut, like Inuit across the North, adopted mechanized equipment for harvesting (Hall, 1971; Smith, 1972). As Inuit shifted residence from the land to centralized communities, the snowmobile and other "non-traditional" equipment became essential not only to the material culture, but also the social dynamics of Inuit subsistence culture (Kemp, 1971; see also Jorgensen, 1990; Wenzel, 1991, 2000; Harder and Wenzel, 2012; Brinkman et al., 2014). Put simply, the cost of snowmobiles, boats, and outboard engines now prevents men who would like to engage in harvesting more regularly from doing so. Indeed, for a significant minority whose only access to money is through the social transfer system, even the cost of fuel, oil, and replacement parts for their equipment is a constraint (Chabot, 2003; Brinkman et al., 2014).

An indicator of the increase in the cost of harvesting is that in the early 1970s, Müller-Wille (1978) found it reasonable to calculate the cost of a snowmobile (then approximately $1000), by the number of ringed sealskins needed (approximately 115) to purchase a machine. In 1983, when sealskins attained their maximum value and the year before the European Community boycott took full effect, Inuit received about $25.00 per sealskin (Wenzel, 1991), and a snowmobile cost roughly $2300.00, or about 95 pelts. In 1984, with the European boycott (and the worst BRIA harvest year), the price fell to $2.00 per skin. Until the European Community modified its stance on the importation of Inuit harvested seal products in August 2015 (Nunatsiaq News, 2015), the average price for Inuit-harvested ringed sealskins was $12.47 (News/North, 2012); with the $13.00 subsidy provided by the Nunavut Government added, the value is approximately what a hunter received circa 1983. This increase in no way matches the present $15 000 cost of a snowmobile. Today, this cost converted to sealskin units would be at least 550 ringed seals, or 17% of all the ringed seals harvested by 55 Clyde River hunters in 1983. This difference in the cost of a snowmobile (and by extension harvesting in general) from the early 1980s to the present highlights a fundamental economic barrier that confronts Inuit harvesters across Nunavut, since in 2006 the average per capita income for Inuit in Nunavut was $19 686 (ITK, 2007:10).

While the economics of producing traditional resources is relevant to food security, even correlating the downward trend in annual harvest volumes with changes in the cost of hunting does not necessarily explicate how harvesting was affected. To measure this effect, we used the number of hunters participating in provisioning the regional population and their degree of involvement in harvesting.

The harvester population surveyed in the NWMB study was composed of the holders of General Hunting Licenses in the region's 13 communities. The study also stratified hunters into three harvester categories: Intensive, Active or Occasional, using several means but especially hunter self-identification. In the final NWMB survey year, for instance, of the 2864 hunters enumerated, 971 (34%) were classified as either Intensive (a hunter who "repeatedly and regularly engages in…nearly all types of hunting" and who "always had country food in the household,") or Active (a hunter regularly engaged in "some…of the major harvesting activities" for brief but intense periods harvesters (Priest and Usher, 2004:26). The remaining 1893 survey respondents identified themselves as Occasional Harvesters, participating only "irregularly" (Priest and Usher, 2004:26–27).

Similar stratification was not done either before or during the BRIA study. However, prior to the EEC sealskin boycott, ringed seals were both the principal traditional food and the main trade commodity in most Qikiqtaaluk communities (Wenzel, 1989, 1991; Kuhnlein et al., 2000:86). For this reason, we used sealskin sales to the Hudson's Bay Company (HBC) as a proxy for measuring individual harvester activity during the BRIA survey era.

The community sales reports from Clyde River were the only complete series for all five years (1980–84) available for examination. For analytical purposes, the HBC report for 1980 (GNWT, 1981) was chosen as representative of a "normal," that is, pre-European boycott, seal harvest year. Using the number of sealskins sold, or the money received from sealskins by individuals, or both, Clyde River hunters were stratified as either Intensive or Active harvesters according to one of two criteria: whether they had traded a minimum of 50 ringed sealskins (approximating a harvest of one seal per week in that year) or whether they had earned more than $999.00 from sealskins. Hunters who sold a minimum of 50 sealskins or earned $1000–$1499 from their sales were placed in the "Active" category and those with sales of more than $1500 were classified as "Intensive" harvesters. Those who recorded sales below these marks were considered to be Occasional hunters.

Using this method, of the 90 hunters (20% of Clyde River's total population) who recorded a sealskin sale (average price = $17.00), 30 (32%) were classified as either "Active" (n = 19) or "Intensive" (n = 11) harvesters. Further, these

Intensive and Active hunters accounted for 70% of the 3372 pelts sold and presumably harvested a similar proportion of the estimated 533 seals that did not enter into trade that year (harvest = 3905, BRIA, 1981). While detailed trade records are not available for the other Qikiqtaaluk communities, projecting the Clyde River harvester estimate to the region suggests that in the early 1980s there were 1400 to 1500 hunters, of whom some 30% (about 450) were Intensive or Active harvesters.

As noted above, the NWMB study in 2001 enumerated 2864 harvesters in an overall population of 12 540. Within this group, 275 reported themselves as harvesting intensively and 686 as actively (Intensive + Active = 961). Overall, comparison of the projected hunter population for the BRIA period and the NWMB hunter cadre shows that although the number of hunters almost doubled, the Intensive and Active categories grew by only slightly more than 3%.

When, however, ringed seal harvesting is used as a proxy for hunting frequency, harvesting intensity during the NWMB years appears different. The final NWMB survey year of 2001 (Priest and Usher, 2004:27) identified 275 Intensive, 686 Active, and 1891 Occasional harvesters. The mean number of Qikiqtaaluk hunters harvesting ringed seals (as derived from individual community summaries) in that year was 1246. Applying the NWMB percentages of Intensive (10%) and Active (24%) hunters derived for the entire self-identified group only to those who engaged in seal hunting yields a combined Intensive-Active sealing cohort of 424 hunters with virtually the same percentages in the Intensive and Active categories as when harvesters self-identified themselves as belonging to one or the other of the two strata.

Although the accuracy of this proxy approach is not absolute, it seems that the number of harvesters who "aggressively" engaged in sealing (the most widespread and arguably the most essential harvesting activity in the region) was roughly the same during the NWMB period as in the early 1980s. As was shown using the ringed seal proxy from Clyde River and projected for all communities, a small cohort of harvesters relative to the total number of hunters likely contributed significantly (and disproportionately) to the traditional food sector of their communities. Similarly, a study of Dene and other Native communities in the Alaskan interior concluded that 10%–20% of the hunters surveyed accounted for 70% of harvest production (Brinkman et al., 2014).

The number of hunters involved in the harvesting is obviously important to the traditional resources sector of the food system, and the overall number shows impressive growth since the early 1980s. However, in terms of intensity of participation, and if Intensive and Active category harvesters are the primary contributors of country food, the change between the two periods was far lower than the 63% increase experienced in the regional population from the end of the BRIA period to the last year of the NWMB surveys (online Appendix 1).

This gap between highly active hunters and consumers appears to be reflected in the difference in food production between 1984, the worst BRIA year, and the final NWMB year. Whereas the total number of harvesters had grown by 59% by 2000, the country food harvest in 2000 was 29% less than that in 1984. In terms of food availability, this combination of population increase and decline in harvest volume reduced the daily amount of country food available to each person by 55%, from 660 g to 295 g.

Importantly, while from 1984 to 2000 the regional consumer population increased by 63% and the overall number of harvesters by a robust 11%, the proportion of highly engaged harvesters (that is, Intensive and Active hunters) remained essentially unchanged. It seems that the increase in the consumer population alone does not explain the steep decline in harvest volumes recorded between 1996 and 2001, and it is for other reasons that NWMB era hunters were only 40% as productive (477 kg per harvester in 2000–01) as their BRIA counterparts (1205 kg in 1981).

Per person daily food availability, despite the startling decrease between the BRIA and NWMB periods, still remained a substantial 295 g across the region in 2000. A more meaningful result with respect to food security is that by the NWMB period, except for a "windfall" harvest year, most Qikiqtaaluk communities had little, if any, surplus food as a buffer against times of poor harvesting (online Appendix 1). In 1981, the overall harvest at Pond Inlet plummeted to 99 000 kg, but the annual average in the other BRIA years was more than 228 000 kg. There are no data on what portion of Pond Inlet's 1980 harvest may have been stored for consumption in 1981, but it is possible that not all of that year's harvest (246 698 kg total edible weight; 976 g per person) was consumed. The NWMB data make it evident that in the 1990s, few communities in the region enjoyed such a potential buffer.

The fact that in two decades the traditional food sector lost the robustness needed to do any more than meet the immediate needs of Qikiqtaalummiut (and in some communities, not even that) should resonate with present food security discussions. One possible reason for this loss of productivity, namely, that the monetary costs of hunting inhibit the regular participation of at least a portion of "Occasional" harvesters, has been developed here by bringing harvest data together with Inuit trade information. The result is informative about the situation of country food as a component of the overall food system at the end of the NWMB research, and it may also be relevant to understanding the apparent dietary shift from traditional to market foods.

The substantial increase in the cost of hunting by the NWMB years suggests that economics affected the harvesting intensity of a portion of the hunter population. Thus, although the total number of Qikiqtaalummiut identified as harvesters by the NWMB was nearly twice that projected for the early 1980s, the proportion in the Intensive and Active harvester categories showed only a marginal increase (ca. 4%) from the 1980s.

The fact that nearly two-thirds of the NWMB harvesters enumerated were in the Occasional stratum is significant with respect to food security, as the increase in the regional population from the end of the BRIA period was 37%. If, as was posited for the 1980s, the most active hunters are the significant variable in traditional food production, then the difference in the NWMB period between growth in the Intensive and Active harvester strata and growth of the regional population assumes an importance that was masked by the doubling of harvesters in the NWMB period. Growth in the most engaged harvester categories lagged significantly behind that of the total population, so that the volume of country food produced in the NWMB years, while sufficient in most communities for basic sustenance, offered little extra as a buffer against environmental or other exigencies or to satisfy cultural expectations.

On the basis of regional population growth, we hypothesized that the relationship between population and volume of traditional resources would in the 1990s have the appearance of a Malthusian population-resource problem (Malthus [1798] 2004). In the classic Malthusian formulation, the human consumer population increases geometrically, while the resources that population requires grow arithmetically. Instead, the data on country food volume, and consequently daily food availability, showed a marked decline rather than a slow increase.

Other than the sharp drop in the ringed seal harvest, possibly accompanied by reduced catches of caribou, that affected the majority of Qikiqtaaluk communities in 1984, there is little indication in the surveys or in the biological literature of declines in major food species proportional to the reduction in harvest volume in the 1990s. This evidentiary absence for an extended decrease in one or more country food species seems to cast doubt that resource depletion (the usual focus in a Malthusian calculus) is what caused significant weakening of the Qikiqtaalummiut food security situation between the BRIA and NWMB survey periods.

However, if the number of harvesters, especially those in the most intensive harvesting cohorts, replaces prey as the resource of pertinence to food security, the Malthusian population-resource relationship is reasserted. As pointed out earlier, we determined the size of the most critical harvester categories for the BRIA period by applying criteria related to sealskin sales at Clyde River and applied these proportions to the known number of ringed seals harvesters in the NWMB surveys. The result was that although the size of the total harvester population had grown significantly since the BRIA period, the combined size of the high-intensity hunter strata had increased by less than 5%, while the regional population had increased by more than 60%.

Of the various reasons posited for the decrease in the production and consumption of traditional resources, or both, only the economics of harvesting provides sufficient data, the escalation in the cost of hunting equipment from the 1970s to the 1990s having been documented by Moyer (1972/73), Müller-Wille (1978), Wenzel (1989, 1991) and more recently by Ford et al. (2013) and Brinkman et al. (2014). These data show that the purchase price of a snowmobile, the principal item used by Inuit in a variety of harvesting activities, increased some 600% since the 1970s, and the cost of ammunition rose nearly 120% (G.W. Wenzel, unpubl. field notes). The trend in costs, as shown by comparing early (1980) and late (1984) BRIA harvest totals, was only exacerbated in 1983–84, when hunters' access to money from traditional activities plunged after the loss of the sealskin market.

The information in the BRIA and NWMB surveys on country food production is important for several reasons. First, the datasets illuminate the extent of change in the traditional resource sector in two very different economic periods. The BRIA surveys span the critical period when harvesting passed from being a full livelihood to being only one part of a complex, mixed-economy adaptation.

Second, the data from the NWMB study show that although the country food sector was reduced in that period compared to the early 1980s, Qikiqtaaluk harvester activities were generally sufficient to provision the majority of the regional population, albeit well below the level of the earlier BRIA years. Even using the conservative approach adopted here, we conclude that the country food sector in the 1990s produced an impressive 1.3 million to 1.5 million kg of food annually.

Third, the data suggest that with respect to the traditional resource component of the food system, food security has at least two dimensions. One is very basic: how much food is available for immediate consumption. A second, more inferential, conclusion is that traditional food security requires harvesters to optimize resource opportunities as a buffer against the seasonal and interannual variability inherent in the biophysical system.

Finally, integrating harvest data with other information can contribute to a wider understanding of the economic (Brinkman et al., 2014) and social dimensions (Wenzel, 1991) of food security. Here, consideration of the effect of economics and the frequency of hunters' participation in harvesting suggests a strong interdependence between traditional resource production, monetary resources, and the capacity of the harvest sector's human capital to meet the need for country food (see Wenzel, in press). When formulated as a Malthusian problem, the resource that is critical to the traditional food sector (and also to food system quality) is the number of harvesters available to participate in country food production.

On a more minor level, aspects of the analysis presented here suggest that harvest data, in combination with various historical records, can explain what appear to be anomalous and unexplainable variations in the harvest record of a community or even the region. In this regard, knowledge of the 1982 summer sea ice situation on the eastern coast of Baffin Island sheds light on Clyde River's depressed narwhal harvest in that year. Similarly the precipitous decline in the harp seal catch at Pangnirtung from the BRIA years to the NWMB years accords with qualitative analyses of the European sealskin boycott's impact on Inuit in many of the communities in the then Northwest Territories. The steepness of this decline and the lack of recovery also suggest the relatively minor role of that species in the traditional food sector of Pangnirtung.

While the analysis presented here does not directly address how traditional resources fit with the contemporary food security situation in the Qikiqtaaluk Region, it does have several relevant implications. One is that food security has a dual temporal dimension: the daily need for nutritious food and the need to produce surpluses when possible as insurance against unpredictable environmental events that occasionally disrupt harvesting. A second is that the escalation of opportunity costs associated with harvesting from the time of the BRIA surveys to that of the NWMB study was at least a partial contributor to the decline in harvest production by the latter period. Finally, if the Malthusian dilemma evidenced in this survey comparison is to be mitigated, the provisioning of the country food sector under conditions of a rapidly growing consumer population requires a dedicated cohort of harvesters that is materially, as well as culturally, supported.

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APPENDIX 1

The following table is available as a supplementary file to the online version of this article at:
http://arctic.journalhosting.ucalgary.ca/arctic/index.php/arctic/rt/suppFiles/4562/0
TABLE S1. Annual harvest volume and food availability summary for communities in the Qikiqtaaluk region.

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