



Springtime in the Delta: the Socio-Cultural Importance of Muskrats to Gwich'in and Inuvialuit Trappers through Periods of Ecological and Socioeconomic Change

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Abstract

Global socioeconomic and ecological changes strongly impact Indigenous communities by affecting food security, physical health, and overall wellbeing. Throughout the 1900s, residents of the Mackenzie Delta in Canada's western Arctic relied heavily on the muskrat (*Ondatra zibethicus*) for food, fur, and culture, but recent changes to ecological and economic conditions have altered the nature of this relationship. We investigated the role of muskrats in the cultural traditions and land-based livelihoods of the Gwich'in and Inuvialuit residents of the Mackenzie Delta through interviews and meetings with over 70 community members. Although the role of muskrats has changed over the last 100 years, muskrat harvesting continues to offer Delta residents a meaningful way to remain engaged in, perpetuate, and strengthen their cultural identity and land-based traditions among generations, and ultimately, to foster individual and community wellbeing.

Keywords Canadian Arctic · *Ondatra zibethicus* · Muskrat harvesting · Indigenous peoples · Gwich'in · Inuvialuit · Cultural keystone · Subarctic · Traditional ecological knowledge · Health · Wellbeing

Doesn't quite feel like springtime in the Delta if you don't go out and get some rats... Therapeutic for Delta people.

Trapper from Inuvik, NT

Introduction

Socioeconomic changes over the last two centuries have transformed Indigenous communities by introducing new economies, worldviews, political systems, and material goods (Berry 2008; Freeman 2000; Nuttall 2000). Across the globe,

Indigenous Peoples' traditional lifestyles have been altered as they have transitioned to permanent settlements, whether by choice or forcibly, and lost access to all or part of their traditional territories (Colchester and Chatty 2002; Maldonado *et al.* 2013). Human relationships to ecological systems are also in flux, as communities that previously relied entirely on hunting, fishing, or traditional agriculture have become involved in mixed and wage economies (Lu 2007; Usher 1971). The land itself is undergoing changes as industrial agriculture expands and global forest cover declines (DeFries *et al.* 2004; Foley *et al.* 2005), freshwater resources become more vulnerable (Kundzewicz *et al.* 2008), and climate change creates more extreme and unpredictable weather (Coumou and Rahmstorf 2012; Krupnik and Jolly 2002).

The Arctic is currently experiencing the most rapid changes in climate of any region on earth (ACIA 2004). These changes are affecting ecosystem structure and function, permafrost stability, and the abundance and distribution of wildlife (Post and Forchhammer 2008; Segal *et al.* 2016). Northern regions are also subject to intensifying human development, including the construction of roads, oil and gas infrastructure, and hydroelectric projects, which can alter physical conditions and ecosystem structure and function (Beltaos 2014; Gill *et al.* 2014b). In many northern

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communities there is growing concern about the cumulative effects of climate change and development on local ecosystems and land-based livelihoods (Schindler and Smol 2006; Tyson *et al.* 2016). Ongoing landscape change and shifts in peoples' ability to access their traditional territories strongly impact the health of northern communities by affecting food security, physical health, and overall well-being (Paci *et al.* 2004; Parlee and Furgal 2012; Receveur *et al.* 1997).

The impacts of environmental change on subsistence economies can be particularly intense when changing conditions limit access to species of exceptional cultural significance. For example, barren-ground caribou have been a primary food source for many peoples in Canada's north for thousands of years, but dramatic population declines and changes in accessibility in recent decades have resulted in lower harvests and increased reliance on store-bought foods (Canadian Wildlife Service *et al.* 1975; Festa-Bianchet *et al.* 2011; Receveur *et al.* 1997). Similarly, camas, an important food species for Coast Salish Peoples in the Pacific Northwest, has been all but eliminated from people's diets through processes of environmental and social change and resulted in negative health and social implications for many Nations (Cornstassel and Bryce 2012). The significance of culturally important species in maintaining the continuity of knowledge and traditions and community health and wellbeing is also increasingly being recognized (Joe 1994), with other examples including western red cedar (Garibaldi and Turner 2004) and riceroot (Joseph 2012) in the Pacific Northwest, and teparly beans in southern North America (Nabhan and Felger 1978). In recent years, the term cultural keystone species has become prominent in ethnological literature to describe species that play a fundamental role in the identity of a people (Garibaldi and Turner 2004; Moss 2016).

Throughout the 1900s, residents of the Mackenzie Delta Region in the Northwest Territories of Canada relied heavily on a cultural keystone, the muskrat, for food, fur, and culture, but recent changes to ecological and economic conditions have altered the nature of this relationship. Like other northern mammals, muskrat population cycling is well documented and varies among regions (Erb *et al.* 2000; Errington 1963). It has been suggested that disease outbreaks and predator population cycles are the underlying causes of these oscillations in numbers, but the process is not fully understood (Erb *et al.* 2000). In recent years, many residents of the Mackenzie Delta region have reported declines in muskrat abundance that are outside the normal range of variation for this region (Arctic Borderlands Ecological Knowledge Society 2002, 2008; Brietzke 2015). In this study, our main objective was to better understand the role of muskrats (*Ondatra zibethicus*) in the cultural traditions and land-based livelihoods of the Gwich'in and Inuvialuit residents of the Mackenzie Delta throughout periods of rapid social, ecological, and economic change.

Study Region

The Mackenzie Delta of Canada's western Arctic lies within the Inuvialuit Settlement Region (ISR) (Indian and Northern Affairs Canada 1984) and the Gwich'in Settlement Area (GSA) (Gwich'in Tribal Council and Indian and Northern Affairs Canada 1992) (Fig. 1). The Mackenzie Delta ecoregion includes the alluvial terrain from Point Separation to north of the treeline in the outer delta (Ecosystem Classification Group 2007) (Fig. 1). The Delta is a productive environment that provides habitat for many species important to the subsistence and fur economy in the region, including mink, marten, bear, wolf, wolverine, muskrat, and numerous fish and waterfowl species (Martell and Pearson 1978).

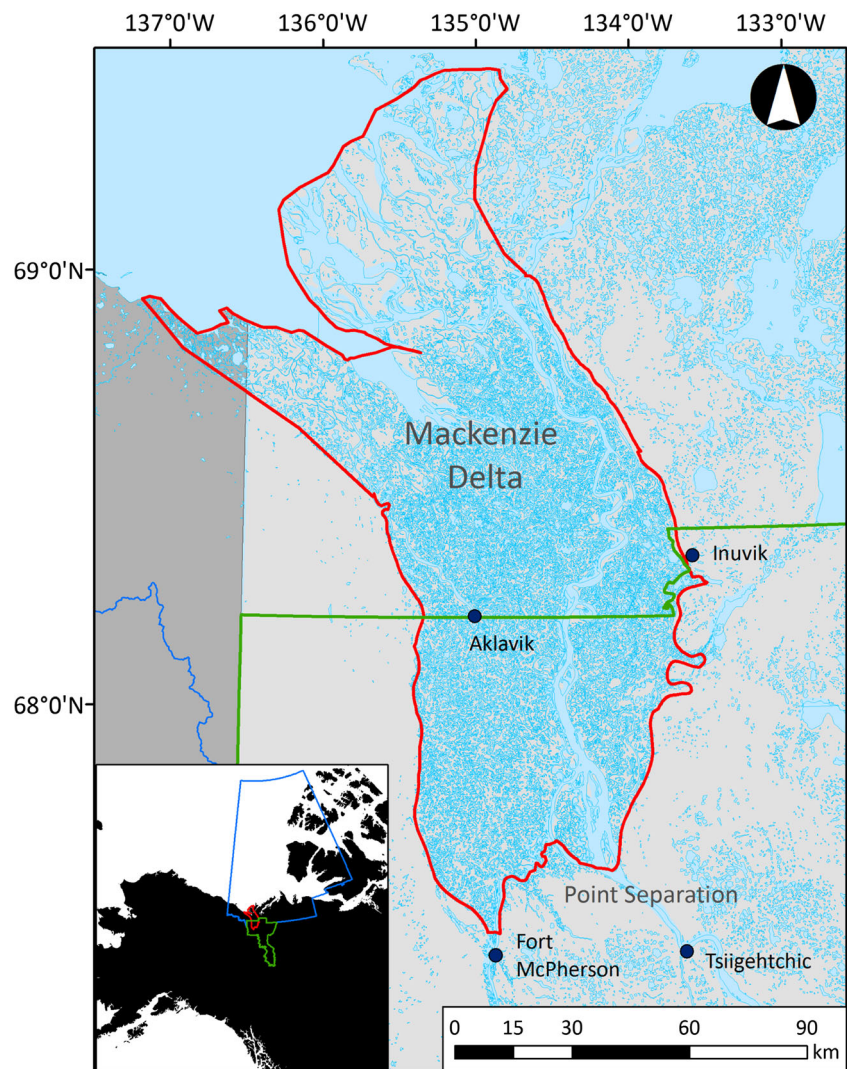
The communities located in and around the Mackenzie Delta region include Inuvik (pop. ~ 3463), Aklavik (pop. ~ 633), Tsiigehtchic (pop. ~ 143), and Fort McPherson (pop. ~ 792) (Fig. 1). Inuvik, Fort McPherson, and Tsiigehtchic have year-round road access with the exception of freeze up and break up times, and Aklavik is accessible only by ice road in the winter months. Residents of all four communities frequently travel in the Delta throughout the year by boat, automobile, and snow machine for subsistence and income harvesting and to maintain extended social and family networks.

Gwich'in and Inuvialuit Peoples occupying the Mackenzie Delta Region have depended on subsistence fishing, whaling, hunting, and gathering foods for hundreds of years, resulting in a high degree of reliance upon and connection to the land and ocean (Alunik *et al.* 2003; Heine *et al.* 2007). Socioeconomic change has been ongoing in the Mackenzie Delta Region for over 200 years: explorers, whalers, traders, missionaries, trappers, settlers, and oil and gas development have all impacted life in the Delta and altered traditional subsistence economies practiced by its residents (Alunik *et al.* 2003; Krech 1976; Lyons 2007; Usher 2002). During a period of rapid transition in the early 1900s, fur prices rose and trade networks increased in scope and volume. Delta peoples seized the economic opportunity offered by this changing situation and many families prospered by harvesting muskrats in the early to mid-1900s (Alunik *et al.* 2003; Krech 1984). The current economy in the region is mixed, with many people still engaged in subsistence harvesting and trapping, and some working steady wage labour jobs, primarily in Inuvik (Pearce *et al.* 2011; P. J. Usher 2002).

Methods

We employed a collaborative, community-based research methodology (Castleden *et al.* 2012) that involved developing research objectives and methods jointly with organizations in four communities through face-to-face meetings, phone calls, and emails. These organizations included the Gwich'in Renewable Resource Councils (RRCs) in each community, the Gwich'in

Fig. 1 Map of study region. The boundary of the Mackenzie Delta Ecoregion (Ecosystem Classification Group 2007) is shown in red. The northern boundary of the Gwich'in Settlement Area (Gwich'in Tribal Council and Indian and Northern Affairs Canada 1992) and southern boundary of the Inuvialuit Settlement Region (Indian and Northern Affairs Canada 1984) is shown in green. Communities involved in the study are marked with dark blue circles. Water bodies are outlined in cyan. Inset map shows location of study area in northwestern North America and full extent of the Inuvialuit Settlement Region (blue) and the Gwich'in Settlement Area (green)



Renewable Resources Board (GRRB), and the Gwich'in Tribal Council (GTC) Department of Cultural Heritage. A formal Research Agreement was signed with the GTC Department of Cultural Heritage, who administer the GTC's Traditional Knowledge Policy. Existing relationships with the Inuvialuit Joint Secretariat and the Inuvik and Aklavik Hunters' and Trappers' Committees were also fundamental to this project. Working closely with community organizations allowed us to hire community coordinators to arrange and conduct interviews in Fort McPherson, hire youth technicians in Fort McPherson and Aklavik, and ensured that we conducted interviews and site visits in a manner consistent with local expectations and cultural norms. The involvement of the first two authors in previous projects in the region (Bennett and Lantz 2014; Gill *et al.* 2014a; Tyson 2015) also allowed for continuity in the structure and content of interviews and built on respectful and productive relationships with key community members and organizations.

To explore the changing role of muskrats in the lives of Gwich'in and Inuvialuit residents of the Mackenzie Delta

Region, we conducted 20 interviews with participants from Aklavik ($n = 5$), Inuvik ($n = 3$), Fort McPherson ($n = 10$), and Tsiigehtchic ($n = 2$) between June 2015 and April 2016. Interview participants were chosen based on recommendations made by staff members at the Gwich'in RRCs and GTC Department of Cultural Heritage, and the results of past studies of environmental change in the region (Bennett and Lantz 2014; Gill *et al.* 2014a; Tyson 2015). Several participants also contacted the lead author in order to take part. Participants had varying degrees of experience harvesting and utilizing muskrats in the past and present, and offered a broad array of perspectives on the social, economic and ecological significance of muskrats. We also reviewed transcripts from 11 interviews conducted with 14 Inuvialuit participants from Aklavik ($n = 6$) and Inuvik ($n = 8$) between 2012 and 2014 as part of regional community-based environmental monitoring projects that contributed to the identification of muskrats as a salient research topic (Bennett and Lantz 2014; Gill *et al.* 2014a; Tyson 2015). Most interview participants, including all young people, were active harvesters

($n = 25$), while others, largely elders, were not currently active on the land ($n = 9$). Overall, seven women and 27 men were interviewed.

Interviews were semi-structured, and questions were designed to allow participants to share their experiences with and memories of muskrats, as well as their knowledge of muskrat ecology and habitat in the Delta (Supplementary Appendix 1). Some participants also used maps to identify specific locations where observations were made. All interviews were transcribed and transcripts were provided to participants, the majority of whom reviewed them for accuracy prior to analysis. Some participants consented to having their specific responses associated with their names, while others did not wish to be identified by name.

We also held public meetings in the spring of 2016 in Aklavik, Inuvik, and Fort McPherson. These meetings began with a brief update on research activities, followed by an extensive community-led discussion. Each meeting was attended by between 12 and 17 people, with five to seven attendees actively participating in the discussion. Public meetings were attended by an approximately the same number of men and women, but male participants were the most active in discussions. All meetings were documented with comprehensive notes or recorded and transcribed. Meeting participants did not consent to being identified by name and are referenced by their community only.

Overall, transcripts and notes from 34 interviews and three meetings were reviewed as part of this study. Interview transcripts and meeting notes were analysed by iterative coding, which sought to identify key ideas present in participants' narratives. Subsequently, these codes were reviewed and used to develop broader topic categories that included closely related ideas. Associations among coding nodes were identified and used to create a smaller number of overarching themes for analysis (Richards and Morse 2013), each of which included many of the topic codes previously developed (Supplementary Appendix 2). Observations were organized using these themes to explore similarities and divergence among participants and identify important intersections for discussion.

Results

Socioeconomic Importance of Muskrats

That little animal has raised a lot of families.

Fort McPherson Community Member

The majority of participants highlighted the economic and socio-cultural importance of muskrats. Fred Koe, a trapper from Fort McPherson, explained that prior to the 1960s, trapping was “the only way people make a living [and] they were making a

real good living.” The late Inuvialuit elder, James Rogers, recounted how important muskrats were as a source of income for his family in the 1940s:

Every time [my dad] want something... he gives us 20 traps apiece, “go trap.” Like that spring he wants a new outboard motor, “go trap.” Trap enough muskrat for an outboard motor, finish.

From the 1920s to 1950s muskrats provided the primary income for families throughout the Delta, who were living in camps throughout the delta (Fig. 2). Many interview participants reported families bringing in an average of 2000–3000 muskrat pelts each year in this time period (Gwich'in Elders 1997), and sometimes a large family could have an annual harvest of up to 10,000 pelts.

In addition to muskrats being financially important, they were also an abundant source of food. One community member from Fort McPherson described how “we just lived on that muskrat because it's so good!” Dog teams were fed with the excess carcasses and the muskrats that were unfit for human consumption, which provided a source of energy for transportation.

Learning how to make a living on the land from parents and grandparents was a fundamental part of the subsistence harvesting lifestyle. As the late James Rogers put it, “what they taught us... you never forget.” A young trapper from Aklavik described learning the “majority of life lessons... in the bush. Stuff that could apply to everyday life... It was just as much of a[n] education as going to school.” This sentiment was echoed by numerous other interview participants ($n = 11$).

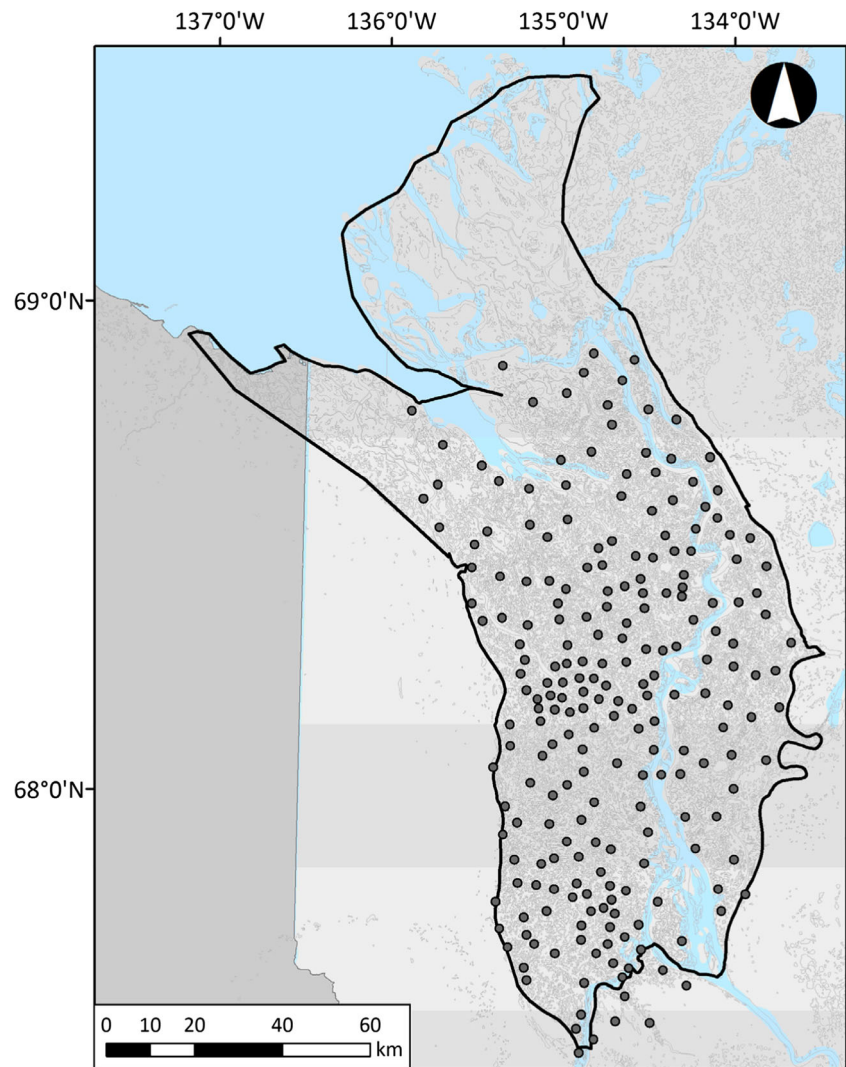
People chose to harvest muskrats because they enjoyed it. Doug Esagok explained how his dad “made plenty of money, he didn't have to trap. But he just loved it, so he always pulled us out [of school to go trapping.]”

Muskrat Ecology and Populations

Interview and meeting participants noted that there has been a large decline in muskrat abundance in the Mackenzie Delta in recent decades. Nearly every interview participant (29 of 34) reported that there are fewer muskrats than in the 1960s and 1980s, and there was consensus among attendees at each community meeting that populations had declined. Abraham Wilson was one participant who described the magnitude of this change: “certain lakes, you might see one or two rat houses; 20 years ago there was hundreds of them [...] all on one lake.”

There was a clear consensus that muskrats are less abundant than they used to be throughout the Delta, but interviews also suggested that the rate of decline in population density has not been spatially uniform. Participants from Fort McPherson and Aklavik who trapped in the upper Delta between these two communities ($n = 11$) described how muskrats have largely disappeared from this area in the last 5–10 years. However, Eddy

Fig. 2 Map of trapping camps in the Mackenzie Delta in the 1950–51 season (data digitized from Wolforth 1971)



McLeod from Aklavik asserted that “down below [north of Aklavik] it’s not too bad.” Danny C. Gordon, an active trapper in the lower Delta, reported getting around 800 muskrats in 2014. This was significantly more than any other trappers reported, but he still emphasized that “for sure there’s a decline of muskrats, we know that... and we don’t know why they’re declining.”

Participants discussed potential causes of the decline in muskrat abundance, frequently citing changes to habitat and climate, interactions with other wildlife, and shifts in harvesting pressure. Declines were also often attributed to hydrological changes that made lakes unsuitable for muskrats, such as drained and drying lakes, changing water levels in the river and lakes, and changing flooding patterns.

Changing wildlife interactions may also be affecting muskrat populations, as participants discussed increases in the population densities of otter (*Lontra canadensis*) and beaver (*Castor canadensis*) in the last 20–30 years. Increasing beaver and otter populations are both seen as negative changes. Delta residents do not trap beavers or otters with the same enthusiasm or intensity as muskrats; there is little to no desire for their meat, both

animals are larger, fatter, and harder to skin than muskrats, and the low value of these furs do not make up for the increased effort required to trap them. Some participants ($n = 7$) described how otters are extremely efficient predators of the muskrat with the ability to “clean the lake right out [of muskrats],” and asserted that they are likely influencing muskrat populations through predation. Numerous participants ($n = 13$) also agreed that “the population of beaver is expanding, [and that there are] too many in the Delta.” This change was concerning to trappers who noted that beavers may be affecting habitat conditions and food availability, or transmitting diseases or parasites to muskrats.

Participants also discussed the impact that reduced harvesting may have had on muskrat abundance. While most participants spoke about muskrat populations cycling between high and low in the past, many ($n = 15$) specifically mentioned that they do not recall populations remaining so low for so long. Doug Esagok explained how “the year after [harvesting many muskrats], there’d be lots again... People always caught lots of muskrats.” Eddy McLeod explained what happened in the 1980s:

For a while everybody just quit trapping and there was muskrats everywhere... nobody was trapping and then, after that was no muskrat. So [...] maybe they got sick or cleaned the food out.

The Shifting Role of Muskrats

Many participants indicated that muskrat harvesting has decreased considerably in recent years, and pointed to economic causes of this change in addition to the reduced populations. Fred Koe of Fort McPherson explained how the economic incentives have changed: “today I would say... it’s better to just try to get a job and work in McPherson, because the Delta is not very good now.” Some (n = 7) described how trapping had become “just like kind of a hobby” rather than a lifestyle or means of making a living.

Residents of Fort McPherson who attended a public meeting discussed how fur prices declined in the 1980s, and subsequently “[they] all moved back to town and looked for jobs.” Eddy McLeod, a trapper from Aklavik, described his personal situation:

Well the fur price went down so I thought I’ll work for a few years and if it comes back up I’ll go back to trapping and hunting but it never did come back up enough so I just quit.

Ten interviewees and several participants at public meetings described how low muskrat populations are a key factor that prevents them from trapping. Many Delta residents also expressed anger, resentment, and sadness at the low muskrat populations, and some didn’t want to talk about it at all, saying merely “I don’t get out there anymore” or “there’s nothing there,” in lieu of an interview. These sentiments were echoed by interview participants. Abraham Wilson, among others, was regretful that he could not trap because of the low populations: “You know, I wish I could trap this spring, but no muskrat houses ah?” Others, like Fred Koe, were frustrated with the way things are: “I told [my brother] the hell with it. You know, it’s a bother. It’s not worth it!”

Interview participants often discussed the prohibitively high cost of trapping in terms of gas prices. Doug Esagok of Inuvik explained “the price of gas is getting crazy [...] and if you’re not catching a lot of fur you’re burning gas still anyway.” Rising gas prices were also cited by a young trapper from Inuvik, who continued:

[a]nd now, it’s... a bit harder I guess to make a living doing stuff like that. So a lot of people have taken jobs in town and it’s just not as common to see families going out anymore [...] People still make time to go out, but

[...] not for the whole muskrat season right from March till June.

Many participants recounted with nostalgia and some sadness how it was “long ago.” Neil Snowshoe explained that “everybody ...[trapped] but nowadays nobody hardly goes.” A trapper in Fort McPherson described the significance of the reduction in the number of people who spend time out on the land, “It’s just so horrible you know, because our people used to *live* in the Delta,” further explaining, “trapping muskrats was a *really big deal*, way back in the day. It was a big deal.”

Numerous participants (n = 11) expressed concerns about the processes of knowledge development and transfer being affected by people spending less time on the land. At a public meeting in Inuvik, a community member described how people in the past knew about animals and the environment because they spent long periods of time on the land, watching and learning. He lamented how this is changing as people spend more time in communities working wage jobs. An interview participant from Fort McPherson described the loss of knowledge transfer from “our parents... [and] grandparents where we learn all these things from[.] They’re gone.” The late James Rogers echoed this sentiment, saying “long ago, what our parents taught us... we’re slowly losing it. And that’s the sad part... It should be kept on you know.” These observations were often accompanied by the perception that “the younger generation now, don’t really care to do these things.”

Continuity

Despite population declines, the increased cost of trapping, reduced trapping effort, and lower fur prices, participants were not concerned about the continuity of muskrat harvesting as an important cultural tradition. The majority of participants expressed optimism and certainty that when the muskrat populations increase, people will return to the land. When community members at a public meeting in Fort McPherson were asked if they thought this would be the case, the response was a resounding yes, with one person describing how the community would be a “ghost town, everybody go out to bush camp.”

Participants gave a number of reasons why they continue to trap despite the changes in economic and ecological conditions. Many trap for food for themselves or family members. Muskrat meat has been described a “seasonal delicacy for Delta folks,” and carcasses are sold off to hungry friends and relations within days or even hours of returning from the bush. As Doug Esagok put it, “a lot of times people are beating down your door ... asking to buy your muskrats.” This “craving” for muskrat meat is part of what ensures the continuity of muskrat harvesting.

People also described a desire to continue to go out on the land to maintain traplines even when there are few or no muskrats. A trapper from Aklavik explained how he still

wants to “go out and check it out! You always think it might come back.” Similarly, Eddy McLeod from Aklavik described how “I don’t want to have no place to go so I keep a little area open yet, with trails and that.”

There are many people who continue to trap because of their emotional attachment to the experience and tradition. A trapper from Fort McPherson stressed the value of the tradition of muskrat harvesting: “I like seeing people go, whether they make a living out of it or not because it’s a tradition that we need to keep [...] alive.” People frequently spoke about going on the land to trap in the spring as “liv[ing] that traditional time of year.” A trapper from Aklavik described trapping and shooting as something you “just look forward to [...] every spring and you just want to go out there”. A trapper from Inuvik eloquently described his own personal connection: “it doesn’t quite feel like springtime in the Delta if you don’t get out and get some rats, [a]fter a long cold winter you get out there in the spring and ... plants are growing back and all the birds are making noise, it’s just good for you...therapeutic, for Delta people.”

Discussion

Intensive muskrat trapping in the Mackenzie Delta from 1900 to 1950 created a regional economy based on this animal and fostered the development of Gwich’in and Inuvialuit cultural traditions rooted in this economy. While ecological and economic changes have led to a decline in muskrat trapping in the Mackenzie Delta, our analysis suggests that ongoing muskrat use provides communities with a way to cultivate health and wellbeing and maintain cultural knowledge, traditions, and values in the face of ongoing socio-ecological change.

Cultural Significance

Interview data, historical accounts, and contemporary observations all demonstrate that muskrats have been and continue to be a vital part of Gwich’in and Inuvialuit cultures, occupying the role of a cultural keystone species. A cultural keystone is defined as a species that shapes the identity of a people and is important in traditional practices, food, and lifestyles (Garibaldi and Turner 2004). Wolforth (1971) reported that in 1948 there were approximately 228 trappers with registered traplines in the Delta, only one year after the registration of traplines was introduced. Assuming each trapline was used by a family of 2–5 people suggests that 30–75% of Aklavik’s 1953 population of 1556 (Alunik *et al.* 2003:211) was engaged in trapping at this time. The integrated economic and cultural significance of muskrat use is also evidenced by the inclusion of the springtime harvesting season in the Gwich’in Seasons Calendar and John A. Snowshoe’s clock of life (Loovers 2010: 155–156). Other indicators of the muskrat’s cultural importance include oral

traditions and stories about muskrats (Alunik *et al.* 2003; Gwich’in Elders 1997; Heine *et al.* 2007).

Every spring during traditional muskrat trapping time, each Delta community has a multi-day event, called a Jamboree, which includes skidoo races, old-time dances, feasts, games, and contests. These jamborees highlight the ongoing importance of muskrats by celebrating time spent out on the land in the springtime, people coming together, and the importance of this seasonal harvest. One of the highly anticipated events at all of the jamborees is the muskrat skinning contest, which brings this tradition off the land and into the community for a short time (Fig. 3). Muskrat is one of the many important traditional foods offered at the opening feasts of these and other community events. The muskrat is also featured on the community of Aklavik’s flag (Fig. 3). The multifaceted importance of muskrats suggests that they can be considered a cultural keystone species in the Mackenzie Delta Region.

Decline in Muskrat Harvest

Despite the ongoing importance of muskrats, trapping effort has declined considerably since the 1980s. The conditions leading to the reduction in harvesting effort are interrelated and include both economic and ecological factors: the increased cost of trapping, substantial reductions in fur prices, the proliferation of wage labour, and reduced muskrat populations.

Socioeconomic changes have reduced trapping effort by altering the cost:benefit ratio of muskrat harvesting for trappers in the Delta. Wolforth (1971) asserted that the decline in muskrat trapping began in the late 1950s following the ‘Muskrat Period’ from 1900 to 1950, when a drop in fur prices caused many trappers to transition to part-time trapping. By the 1960s very few people were supporting themselves solely on their trapping income. Wolforth (1971) speculated that this decreased harvesting effort may have also been partly caused by an increase in wage work associated with the construction of the town of Inuvik in the early 1950s. In the 1980s, the price of muskrat pelts declined further, when the anti-fur movement gained worldwide momentum and brought demand to a standstill (Alunik *et al.* 2003; Emberley 1997). Prices per muskrat pelt in the Yukon dropped from ~\$20 in 1979 to less than \$3 in 1989 (prices adjusted for inflation; Brammer 2016). For many people, including several interview participants, this reduction in income was the main stressor that brought them off the land and into the expanding wage labour market. Costs for fuel and equipment have also increased over time, especially as snowmobiles replaced dog teams and fuel became a necessary input for trapping. Participation in the wage economy has added an additional dimension of cost to trapping: people with full-time jobs do not always have the time and energy required to harvest traditional foods (Kuhnlein and Receveur 1996). Conversely,

Fig. 3 Images showing the ongoing cultural importance of muskrats in the Mackenzie Delta. **a–c)** Muskrat jamboree and participants in the muskrat skinning contest 2016. Photos by Chanda Turner. **d)** Aklavik town flag. Photo by Sharon Famel



those without jobs may have the time and energy, but not the financial opportunity, to go out harvesting.

Many of participants in this study also explained how reduced muskrat abundance has contributed to declines in their trapping efforts. Participants discussed many potential causes of this population decline, including changes to climate, habitat and hydrology, interactions with other wildlife, and shifts in harvesting pressure. The complexity of interactions among these factors makes it difficult for harvesters, researchers, and managers to assess which changes may be contributing most to the observed decline in muskrat abundance. Understanding muskrat population dynamics is further complicated by high spatial and temporal variability associated with muskrat movement and cyclic populations (Clarke 1944; Jelinski 1984; Stevens 1953). More long-term ecological research is needed to determine the magnitude of the decline throughout the Delta and characterize the effect of the drivers noted above. The cumulative effects of socioeconomic and ecological changes on the cost:benefit ratio of harvesting have led many people to characterize muskrat trapping as “not worth it!” Fewer trappers has resulted in a marked decrease in overall access to muskrats and participation in harvesting activities, which has a suite of potential implications for individuals and communities in the Mackenzie Delta.

Socio-Cultural Impacts of a Declining Harvest

Interview participants identified several ways that reduced harvesting effort and decreased access to muskrats for food, fur, and culture may impact the health, wellbeing, and cultural traditions and identity of individuals and communities in the Mackenzie Delta. Participants expressed their fear of the loss of cultural identity when they spoke about the sadness they felt because muskrats could not provide a

livelihood anymore. Reduced access to muskrats also means that they are not always available for personal consumption, feasts, and other important community gatherings. This can result in younger community members never developing a “taste” for this traditional food, and older community members losing the ability to practice this aspect of their cultural identity. Previous research indicates that wellbeing can be negatively impacted when self-reliance in attaining traditional foods is compromised, resulting in lowered self-esteem and reductions in cultural practices, identity, and pride (Kuhnlein and Receveur 1996; Paci *et al.* 2004; Parlee and Furgal 2012; Turner and Turner 2008). These impacts can be intensified when access to a cultural keystone species like muskrats is reduced because of their more prominent role in people’s lives (Moss 2016).

Decreased harvesting and consumption of traditional foods has also been shown to negatively affect the maintenance and development of traditional knowledge (Deur and Turner 2011; Kuhnlein and Receveur 1996). As wage jobs and school keep most families from being out in the bush for extended periods, there are fewer people engaged in the process of knowing, creating, and recreating knowledge through observation and interaction with the environment (Berkes 2012). Muskrat trapping was formerly an activity that most individuals were involved in, which meant that multiple generations were on the land together, teaching and learning from one another. It is likely that reduced trapping will result in decreased transmission of cultural traditions through these processes, especially as, in the words of a trapper from Aklavik, “it’s not as common to see families going out anymore.” The loss of this time spent on the land together may also affect the transfer of cultural values, including work ethic, respect for the land and other beings, feelings of pride and responsibility for trapping areas, and a willingness and desire to contribute to one’s community.

Many elders expressed concerns about the decrease in the transfer of cultural values that are best learned and reinforced on the land in important places and through harvesting practices.

Continuity in Muskrat Use and Significance

Despite concerns surrounding the reductions in muskrat harvesting and use in the Delta, our interviews with young and old, active and inactive harvesters all made it clear that muskrats still provide a vital connection to the land that engages people with their culture and the environment. Ongoing muskrat harvesting in the Delta provides a powerful focal point for sustaining cultural traditions and fostering healthy communities. The role of muskrat harvesting in mental, spiritual, and emotional wellbeing is shown by the words of many participants, including one who described spring trapping as “therapeutic.” In the Delta, the muskrat trapping and hunting seasons provide an opportunity for individuals to remain engaged in both harvesting and wage-employment. Trappers can take two to three weeks off of their regular job and participate in the traditional economy in the short-term, providing an important input of traditional food, emotionally-fulfilling time out on the land, and income from muskrat fur to balance out the majority of their year spent working in town. The inherent value of time spent on the land, away from town and its daily stressors, was also described as a key component of what makes berry picking important by residents of Fort McPherson (Parlee *et al.* 2005). One berry picking participant explained how “even if I knew there were no berries there, I would still go visit those places” (Parlee *et al.* 2005:133). Many interview participants echoed this sentiment when they described how they continue to go out on the land and “check the lakes” even in the absence of muskrats. This indicates that being out on the land in the spring-time is as important as the actual economic result of muskrat harvesting.

Land-based activities including harvesting and environmental monitoring can reinvigorate cultural identities in youth (Brunet *et al.* 2016; Cuerrier *et al.* 2015) and many Delta residents are actively engaged in increasing cultural knowledge transmission. In all of the Delta communities, there are school programs and the GNWT’s Take a Kid Trapping program, which run each spring and ensure that youth attending school have the opportunity to take part in on the land experiences. Some young people in the Delta also still have the opportunity to get out and harvest muskrats with their grandparents and parents, and appreciate the intrinsic value of these experiences. A young trapper from Inuvik emphasized the importance of this continued knowledge transfer among generations: “all our knowledge we have of hunting and stuff is all useless

if we don’t hand it on to the next people.” Muskrats have an integral role in cultural events and the mixed economy of the Delta, which continues to connect individuals and communities to the land, and offers an experiential way for community members of all ages to remain active and engaged with their cultural practices and identity. The commitment of Delta residents to maintaining and reviving muskrat harvesting traditions contributes to individual and community health and wellbeing in tangible and intangible ways and highlights the potential role that muskrat harvesting traditions can play in efforts to maintain and strengthen cultural identity and knowledge transfer.

Conclusion

Our research investigated the impacts of ecological and socio-economic changes on muskrat harvesting in the Mackenzie Delta. Muskrats have become less abundant in this region and make a smaller contribution to income and food than in the recent past. This has changed the nature of their role in these communities, but this species remains a vibrant and vital part of Gwich’in and Inuvialuit cultures in the Delta. We suggest that muskrats can be viewed as a link to the land and to the practices and traditions of the past, present, and future as ecological and socioeconomic conditions continue to change. Muskrats offer Delta residents a meaningful way to remain engaged in, to perpetuate, and to strengthen their cultural identity and land-based traditions among generations, as well as to foster individual and community wellbeing.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest in relation to the funding for the research.

Ethics Approval Ethics approval for the research was obtained from the University of Victoria Human Research Ethics Board and the project was approved by the Gwich'in Social and Cultural Institute (now the Gwich'in Tribal Council Department of Cultural Heritage) through a formal Research Agreement.

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