Muskrat Ecology in the Mackenzie Delta: Insights from Local Knowledge and Ecological Field Surveys

by Chanda Brietzke

INTRODUCTION

Arctic deltas have been called keystone ecosystems because of the numerous processes they influence at the land-ocean interface, such as nutrient cycling and sea ice formation (Lesack et al., 2014). Climate change is proceeding more rapidly in the Arctic than in any other region (ACIA, 2004), and low-lying Arctic deltas are expected to be significantly affected by the combined effects of changes in both terrestrial and marine environments (Walker, 1998). Terrestrial changes that are particularly concerning include increases in summer precipitation and the altered timing of spring breakup (Goulding et al., 2009; Lesack et al., 2014). Marine processes, including sea level rise, increased storm surge activity, and reduced sea ice cover will also affect Arctic deltas (ACIA, 2004; Lantz et al., 2015).

The Mackenzie Delta in Canada’s western Arctic, the second largest Arctic delta in the world, is a low-lying alluvial plain that contains thousands of small lakes (Emmetton et al., 2007) (Fig. 1). The numerous water bodies in the delta offer abundant habitat for fish, birds, and mammals, including muskrats (*Ondatra zibethicus*). Muskrats are semiaquatic furbearers whose populations respond to water levels and may serve as an indicator species for changes in wetland ecosystems (Fuller, 1951; Weller, 1988). They are prey species for marten, mink, red fox, black bear, otter, wolves, and grizzly bears (Fuller, 1951; Jelinski, 1989) and can have significant effects on the vegetation in their habitat (Errington, 1963; Nyman et al., 1993; Smirnov and Tretyakov, 1998).

Muskrats also supported a prolific fur and subsistence economy in the North throughout the 19th and 20th centuries (Stevens, 1953; Krech, 1976; Alunik et al., 2003). While participation in the fur trade has declined since the 1950s as a result of low fur prices and the high cost of trapping, muskrats remain important culturally and economically and are still used for subsistence and income (Gwich’in Elders, 1997; A. Gordon, pers. comm. 2013).

Like other northern mammals, muskrats exhibit periodic cycles in population size (Errington, 1963; Krebs, 1996). It has been suggested that these cycles are caused by disease outbreaks, predator population cycles, and intrinsic and external factors (Erb et al., 2000; Krebs, 2013). Research on fur returns from the Mackenzie Delta in the late 1800s to early 1900s indicates that population cycles in the delta average around 10 years between highs (Clarke, 1944). In recent years, many residents of the Mackenzie Delta region have reported declines in muskrat abundance that are outside the normal range of variation (ABEKS, 2003, 2008).

This decline is likely to have significant impacts on local communities that rely on muskrats for subsistence, trapping income, and overall wellbeing (Parlee et al., 2005; Gill et al., 2014) and may be related to changes in the climate and hydrological processes in the Mackenzie Delta.

The primary objective of my research is to investigate reported declines in muskrat populations and examine linkages between habitat use and biophysical conditions in the Mackenzie Delta. The traditional knowledge held by land users, informed by the experiences of past and present generations, is a valuable resource for understanding why, when, and where changes in muskrat ecology and harvesting have taken place. In the first part of my research, I explore the insights that local knowledge holders provide regarding changes in muskrat ecology and harvesting practices in the Mackenzie Delta over the last 100 years. In the second part of my research, I use field surveys to identify and characterize biophysical conditions linked to muskrat habitat use.

MUSKRAT ECOLOGY

Muskrats live in still and slow-moving water bodies throughout North America and are found in lakes in the Mackenzie Delta. In the summer, they consume emergent shoreline vegetation (*Equisetum fluviatile*) and some submerged macrophytes (*Potamogeton* spp.), but in the winter their diet is restricted to the roots and rhizomes of...
submerged macrophytes that persist on lake bottoms under the ice (Jelinski, 1989). To extend their feeding range and survive the northern winter, muskrats move their burrow locations adjacent to deeper water (Jelinski, 1989) and construct push-ups—mounds of vegetation insulating an ice hole and a feeding platform (Stevens, 1955). Muskrats move burrow locations because they require an abundance of submerged macrophytes for food and the presence of water that does not freeze to the bottom during the winter (Stevens, 1955). The availability of sufficient winter habitat is likely a fundamentally limiting factor for northern muskrat populations (Stevens, 1955), and adequate lake depth and macrophyte productivity may be important determinants of muskrat winter lake occupancy.

Submerged macrophyte productivity and community composition vary significantly among lakes in the Mackenzie Delta (Squires and Lesack, 2003) and likely affect winter habitat quality. Factors influencing macrophyte productivity and community composition in delta lakes are strongly related to the frequency and duration of spring flooding by the Mackenzie River (Squires and Lesack, 2003). Lakes in the delta can be divided into three categories based on their flooding regimes: no closure (lakes are connected to the river all summer); low closure (lakes flood in the spring, annually); and high closure (lakes flood in the spring, but not every year) (Marsh and Hey, 1989). Documented biophysical differences between these closure classes include lake transparency and sedimentation rates (Marsh et al., 1999; Squires et al., 2002); amount of lake water renewal from the river (Lesack and Marsh, 2010); stability of water solute chemistry, including pH and nutrient levels (Lesack et al., 1998); nutrient and organic matter content of sediment (Squires and Lesack, 2003); and macrophyte community composition and productivity (Squires et al., 2002; Squires and Lesack, 2003).

Closure class may also affect habitat suitability directly: local knowledge suggests that no-closure lakes are not good winter muskrat habitat because push-ups can be destroyed when water levels decrease in the fall and the ice drops down (J. Rogers, pers. comm. 2014). In the Peace-Athabasca Delta, declines in muskrat populations have corresponded with reductions in spring flooding over the last 40–50 years (PADEMP, 2014), leading park managers to conclude that spring flooding may be critical to sustaining muskrat populations. Trappers in the Mackenzie Delta also suggest that some degree of flooding, whether yearly or less often, is necessary for productive trapping lakes (D. Esagok, pers. comm. 2014). Flooding frequencies in the delta are likely to change with altered climatic conditions, including earlier and warmer spring breakups and changes in the timing of spring melt (Goulding et al., 2009; Lesack et al., 2014), which will in turn affect the biophysical parameters noted above.

METHODS

To ensure the relevance of my research to community members, I have and will continue to pursue a collaborative research methodology. Research objectives and methods for this project were developed jointly with numerous community organizations in the Mackenzie Delta, including the Gwich’in Renewable Resource Councils (RRCs) in Inuvik, Aklavik, Fort McPherson, and Tsiigehtchic, the Gwich’in Renewable Resources Board (GRRB), and the Gwich’in Social and Cultural Institute (GSCI). I will continue to work with these organizations and delta residents during the data collection, analysis, and writing stages. Support and collaboration from these organizations is required to conduct research that is meaningful to the communities in the Mackenzie Delta.

In the summers of 2014 and 2015, I conducted 10 semi-structured map-based interviews with 13 participants. Potential participants were contacted by an interview coordinator from Fort McPherson, Northwest Territories, who arranged and took part in the interviews. Gwich’in and Inuvialuit traditional knowledge holders were asked a series of
Interview participants discussed many aspects of muskrat ecology and harvesting in the Mackenzie Delta. Emergent themes include 1) economic and social changes in the last 50 years and their effects on muskrat harvesting; 2) changing beaver, otter, and muskrat interactions; and 3) muskrat population dynamics. Many interview participants asserted that water levels and spring flooding strongly influence muskrat populations, but responses also indicated that changes in muskrat populations have not occurred consistently in all areas of the delta. However, numerous interviewees stressed that recent declines in muskrat numbers have been more extensive and ongoing than declines witnessed in the past. Further analysis of interview responses will explore spatial patterns and population dynamics discussed by participants. Ongoing analysis of ecological data will also contribute to our understanding of the biophysical drivers of muskrat lake use in the winter months and their potential impact on population dynamics.

**ANTICIPATED SIGNIFICANCE**

This project emerged out of community concerns that muskrats are declining in the Mackenzie Delta, and many delta residents are very interested in the findings. To ensure that my analysis is accessible to residents, I will produce a booklet detailing the results of my research for use in schools or other educational programs and will present my findings at community meetings in the spring of 2016. I hope that by involving youth and community members in field surveys and interviews, this project will also increase the regional capacity for community-based ecological monitoring and traditional knowledge studies.

This research will also contribute to our understanding of muskrat habitat use and selection, which will inform decisions made by local co-management bodies responsible for wildlife in the delta, including the Gwich’in Renewable Resources Board and the Inuvialuit Game Council. As climate change continues to affect the hydrology and ecosystem functioning of the delta, insights into how muskrat populations may respond will be valuable to these organizations.

There are a number of long-term muskrat monitoring initiatives in the North that will contribute to a broader picture of regional patterns and trends. Ongoing surveys of muskrat push-up abundance are being conducted in the Old Crow Flats, Yukon Territory, and the Peace-Athabasca Delta in Wood Buffalo National Park, Alberta, as part of studies examining the health and functioning of these ecosystems (PADEMP, 2014; Straka et al., 2014; J. Brammer, pers. comm. 2015). Aerial surveys of muskrat push-ups in the Mackenzie Delta will be repeated for at least two more years, providing a longitudinal data set that will contribute to a better understanding of population dynamics. Collectively, muskrat research in the Yukon, Northwest Territories, and Alberta will contribute to our understanding of how ongoing climate change in northern regions will affect this species and the people who rely on it.

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REFERENCES


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