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RESEARCH NOTE

The rise of moose co-management and integration of Indigenous Knowledge

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ABSTRACT

Co-management of resources among Indigenous and non-Indigenous governments offers a holistic approach that invites the inclusion of indigenous knowledge (IK) into conservation and management planning. Although numbers of co-management agreements in Canada are increasing, broad integration of IK-derived information in wildlife management has been limited, leaving an enormous gap in scientific understanding that could otherwise aid in conservation and management initiatives. In this article, we emphasize how wildlife management has benefited from IK integration, often fostered through co-management initiatives, by highlighting several examples of successful past and emerging moose (*Alces alces*) co-management and IK integration initiatives across Canada. Our examples demonstrate that co-management and IK integration is beneficial in all cases and has resulted in initiatives aimed toward ensuring the sustainability of moose for generations to come.

KEYWORDS

Aboriginal; *Alces alces*; collaborative management; First Nation; wildlife management

Introduction

Co-management of resources among Indigenous and non-Indigenous governments is on the rise as the value of such collaboration is increasingly recognized (Berkes, 2009; Houde, 2007; Spaeder, 2005). Key to the success of co-management engagements is the opportunity to incorporate indigenous knowledge (IK) into monitoring, research, and management initiatives for the benefit of land users, stakeholders, and ecosystems (Agrawal, 1995; Houde, 2007; Spak, 2005). IK is the cumulative body of knowledge associated with ecological relationships that is handed down through generations by Indigenous people (Berkes, 2012). IK, fused with Indigenous worldview, reflects a deep understanding of relationships to land and creation (Kimmerer, 2000; McGregor, 2004) and has the potential to play a vital role in achieving environmental solutions (McGregor, 2004). Although IK has improved scientific research and management by informing and strengthening initiatives (Berkes, 2012; Hunn, Johnson, Russel, & Thornton, 2003; Menzies, 2006; Schmidt & Stricker, 2010), broad integration of IK-derived information in wildlife management has been limited, leaving an enormous gap in scientific understanding that can otherwise aid in conservation and management initiatives (Briggs & Sharp, 2004; Houde, 2007; Huntington, 2000; Parlee, 2012).

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Today, successful resource co-management strategies and IK integration can be observed across Canada. Indigenous traditional use of wildlife is constitutionally protected in Canada, which is articulated through nation-to-nation agreements with federal, and in some cases provincial, governments (LeBlanc, McLaren, Pereira, Bell, & Atlookan, 2011). Indigenous people apply knowledge of habitat, animal behavior, and changes across time to inform and develop environmental policies and enforce self-governing laws reflecting traditional values and the needs of their communities (Gadamus et al., 2015). Co-management agreements in Canada often result from land claim agreements or crises regarding the use of a particular natural resource (Spak, 2005). Co-management boards, committees, or organizations often consist of both Indigenous and non-Indigenous government representatives who make resource management decisions through the sharing of power and application of both Western and Indigenous science approaches (Spak, 2005). Although several examples exist that provide support for the value of co-management and IK inclusive initiatives (Aswanni & Lauer, 2014; Butler, Tawake, Skewes, Tawake, & McGrath, 2012; Gadamus et al., 2015; Spak, 2005), it is recognized that there is a need for further initiatives across species and ecosystems.

The objective of our article is to emphasize how wildlife management has benefited from IK integration, often fostered through co-management initiatives. We highlight examples of past and emerging moose (*Alces alces*) co-management and IK integration initiatives across Canada, the country with more than 70% of North America's moose population (Timmerman & Rodgers, 2017).

Moose Co-Management and Incorporation of Indigenous Knowledge

Moose is the largest ungulate species occupying the boreal and temperate regions of North America and Eurasia. In Canada, the species is widely distributed and found in all provinces and territories except for Prince Edward Island (Timmermann & Rodgers, 2017). Moose play a strong ecological role as a food source for large predators such as wolves (*Canis lupus, C. lycaon*) and bears (*Ursus americanus*). Moose co-occur with other ungulate species, including white-tailed deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), and boreal woodland caribou (*Rangifer tarandus caribou*; Franzmann & Schwartz, 1997; Timmermann & Rodgers, 2005). In addition to being an iconic symbol of the Canadian north, moose generate important socioeconomic value as a harvested species that contributes millions of dollars in income through hunting by residents and tourists (Boyce, Baxter, & Possingham, 2012; Timmermann & Rodgers, 2005, 2017).

Currently in Canada, the stability of moose populations varies with drastic declines occurring in certain regions (e.g., Demarchi & Schultze, 2011; Laliberte & Ripple, 2004; Murray et al., 2012), posing a potential threat to the livelihoods of those who rely on this species. Moose remain the primary source of protein for many Indigenous groups, so preserving this species is not only important in terms of food acquisition, but essential for securing traditional ways of life as well as cultural and spiritual values associated with this species. Several factors have been identified as influential to moose population fluctuations, including variables related to climate change, increasing anthropogenic activity, and over-harvest (Brown, 2011; DelGiudice, Sampson, Lenarz, Schrage, & Edwards, 2011; Lenarz, Fieberg, Schrage, & Edwards, 2010; Murray et al., 2006, 2012). However, further research is needed and IK may offer valuable insight. Several examples of successful co-management and/or the integration of IK in moose management planning initiatives across Canada are summarized here.

Biigtigong Nishnaabeg

Biigtigong Nishnaabeg is an Indigenous community situated in northwestern Ontario that consists of approximately 1,200 members with 500 residing on-reserve. Although the reserve land is approximately 3.3 km^2, the Traditional Territory encompasses more than 20,000 km^2. Moose are culturally significant to the community and account for a large portion of citizen diet. Concern over the declining moose population in the community's Traditional Territory has led to a partnership with the Anishinabek/Ontario Fisheries Resource Centre, an organization that is expanding its mandate to include wildlife and develop an autonomous moose monitoring system using a mobile application (i.e., app). This mobile app, typically operating on smart phones, allows hunters and land users to record moose sightings and harvest per unit effort of time. The use of mobile apps is a recent technological advancement for environmental monitoring (Aanensen, Huntley, Feil, Al-Own, & Spratt, 2009; Boyce & Corrigan, 2017; Lane et al., 2010; Olson et al., 2014; Teacher, Griffiths, Hodgson, & Inger, 2013) that has been successfully implemented in another jurisdiction resulting in the provision of an index of moose population change over time (Boyce & Corrigan, 2017). The app allows land users and hunters to record additional information while observing moose, such as IK, which over time can assist with monitoring visible disease prevalence (e.g., warts), twinning rates, and changes in moose behavior (e.g., onset of rut). The app essentially provides a means for merging tradition with technology. Recorded information and IK observations of changes over time have the potential to direct management focus or aid in understanding population level effects.

In addition to engaging in moose monitoring initiatives, 35 members of Biigtigong Nishnaabeg have participated in IK interviews describing the importance of moose to the community, concerns over moose decline, potential effects of moose population declines on the environment, traditional way of life, and health of individuals, as well as factors thought to be related to moose population declines. Once synthesized, the IK survey results will be combined with Western scientific approaches to model key factors associated with declining moose populations, which will complement existing research and provide guidance to potential future co-management direction.

Gitanyow

Moose are an important part of Gitanyow Wilp (house group territory) members' diet (second only to salmon) in northwest British Columbia. Moose hunting provides a spiritual connection to the land and is an integral component to the health and well-being of the community (Koch, 2016). In response to a ~70% moose population decline between 2001 and 2011 in the Nass River watershed (Demarchi & Schultze, 2011), where the Gitanyow Lax'yip (traditional territory) is located, the Gitanyow Hereditary Chiefs have worked toward restoring the moose population through engagement in harvest monitoring and management. Additionally, a Recognition and Reconciliation Agreement and Land Use Plan, signed by the Gitanyow Huwilp Society and government of British Columbia, establishes a framework for shared decision-making involving land and resources, as well as objectives for re-establishing healthy moose populations by managing moose winter habitat (Gitanyow Hereditary Chiefs and the Province of British Columbia, 2012). Broad areas for protection of moose winter range were selected using IK of where moose are typically found in winter and then these areas were mapped using scientific methods.

To restore moose population numbers to levels that support subsistence harvesting, the community has been active in collaborating with local wildlife departments to develop a Moose Recovery Plan. At the Lax'yip scale, a Moose Monitoring and Permitting program is enforced within the community that regulates harvest numbers through a harvest strategy and resolution that is developed annually and prohibits the harvest of cow moose. The permitting program follows on the Gitanyow Ayookxw (laws) whereby all hunters must ask permission of the Chief of the specific Wilp on which they wish to hunt. The Chiefs set a harvest quota and close seasons when the harvest reaches a certain level. As part of the program, moose harvests are closely monitored by Lax'yip Guardians who work full-time in the field monitoring moose activity, moose harvests, and roadkill levels. Guardians communicate regularly with the Gitanyow Chiefs and community members who play an integral role in the program and are given the opportunity to provide feedback on moose harvest success, ease of access to moose habitat, non-local harvest activity, and how the harvest program effects food security in the community (Koch, 2016). Collaboration with industries that impact moose habitat (e.g., forestry, power, transportation) also exists and is recognized as an important factor for moose population recovery (Koch, 2016).

Gwich'in

In the Northwest Territories, a Comprehensive Land Claim Agreement was signed by the Gwich'in and the governments of Canada and the Northwest Territories in 1992 that included objectives to protect Gwich'in rights to gather, hunt, trap, and fish in the Gwich'in Settlement Area (GSA). The Gwich'in Renewable Resources Board (GRRB) was established to mediate co-operative wildlife management in the GSA with affiliated partners and to directly and meaningfully involve the Gwich'in in wildlife management and planning (GRRB, 2000). The GRRB consists of members nominated by the Gwich'in Tribal Council and Government who work together to meet resource management objectives and honor traditional Gwich'in rights and culture (Marshal, 1999).

With respect to moose, IK has been incorporated in the research and planning process, and is outlined in the Moose Management Plan for the GSA (GRRB, 2000). Aerial survey planning has included consultation of land users and board members to delineate high-use areas for moose since 1996. The resulting modified stratified-sampling design for aerial surveys has been extremely successful for improving monitoring efficiency and has increased the amount of data collected (Marshal, 1999). Although harvest reporting is not mandatory for Gwich'in hunters, a harvest study was conducted from 1995 to 2004 under the land claim to supplement aerial monitoring and assist with understanding annual harvest pressure on the local moose population. Hunters were interviewed on a monthly basis by locals hired in each Gwich'in community and asked to report harvest information (GRRB, 2009; Marshal, 1999). Information about the study and results were made public in a report (GRRB, 2009). Results were used for determining the Gwich'in Minimum Needs Level and total allowable harvest for Gwich'in and non-Gwich'in residents, and also supplementing data available on harvested species (GRRB, 2009).

To further preserve and encourage IK to be incorporated in future wildlife research and land-use planning, thorough documentation of Gwich'in Traditional Ecological Knowledge has also been collected and published in two books (Gwich'in Elders, 1997, 2001) through the Gwich'in Environmental Knowledge Project (Marshal, 1999). Furthermore, the Gwich'in

Traditional Knowledge Policy was created in 2004 to guide the incorporation of Gwich'in Traditional Knowledge in development and research initiatives that affect the community.

Unama'ki Institute of Natural Resources

The Unama'ki Institute of Natural Resources (UINR) has been the voice for Cape Breton, Nova Scotia's Mi'kmaq concerns related to natural resources and environmental sustainability since 1999. This institute represents five Mi'kmaq communities of Unama'ki (Cape Breton) including Eskasoni, Membertou, Potlotek, Wagmatcook, and We'koqma'q (UINR, 2017). A Moose Management Initiative was developed through a partnership with the UINR, the Nova Scotia Department of Natural Resources, and Parks Canada. In the Cape Breton Highlands, moose are hyper-abundant with populations of approximately two moose per km^2 in some regions, which has resulted in major environmental impacts including the depletion of the boreal forest (Cape Breton Highlands National Park [CBHNP], 2015). With initiatives such as Park Canada's "Bring Back the Boreal Forest" to restore forest health, the Mi'kmaq have indicated they "want to be part of the solution" (C. Paul, personal communication, December 18, 2017).

Two-eyed seeing, or Etuaptmumk, is a concept described by Mi'kmaq Elder Albert Marshall as the process of learning to see from two eyes: (a) an Indigenous eye, encompassing IK and ways of knowing; and (b) a Western eye, encompassing the strengths of Western knowledge and ways of knowing (Bartlet, Marshall, & Marshall, 2012). By utilizing a two-eyed seeing approach that weaves IK and Western science, the UINR's Moose Management Coordinator is working to engage Mi'kmaq communities in drafting a moose management plan in the Cape Breton Highlands (UINR, 2017). Mi'kmaq communities then assist in developing hunting guidelines and a moose harvest reporting system (C. Paul, personal communication, December 18, 2017). The intent of the reporting system will be to monitor moose population trends, and using IK, record holistic accounts of environmental change that will be related to changes in moose population dynamics. The Mi'kmaq have a strong sense of value of moose and the ecosystem of this species, and believe one should not just manage moose but manage the entire ecosystem because both are connected (C. Paul, personal communication, December 18, 2017). Addressing the hyper-abundant moose problem, the UINR works with Parks Canada to set targets for traditional harvest in the Cape Breton Highland areas that harbor the greatest moose densities. With the intent of reducing the moose population in hyper-abundant regions, the harvest provides substantial quantities of moose meat that are packaged and distributed to other First Nation communities, especially those in need (Weeks, 2017).

Collaboration and Inclusion: Fostering a Brighter Future for Wildlife Management

As the stability of moose populations in many areas of Canada continues to fluctuate, managing this species without a holistic approach, as with many other species in decline, becomes more challenging and uncertain. As evident in our examples described above, co-management and inclusion of IK and holistic perspectives of species and ecosystems can help to fill gaps in scientific understanding and ensure that effective management decisions are

made that lead to sustainable wildlife populations and harvest, fulfilling the needs of Indigenous community members and supporting provincial population objectives. Within our examples, we found evidence that establishing co-management frameworks can create opportunities for collaborative monitoring and strengthen relationships and communication between Indigenous and non-Indigenous groups, resulting in a balanced understanding that acknowledges and fosters validity in the application of both IK and Western science. Strengthened communication and respect among collaborators can also encourage a knowledge sharing system that improves localized monitoring and the detectability of population change, thereby supporting appropriate management decisions that can, and have, directly benefited moose conservation.

Although broad scale co-management and IK integration are not yet fully established within policy and management planning for wildlife in Canada (Spak, 2005), future initiatives surrounding wildlife conservation and recovery can greatly benefit from collaborative efforts between Indigenous and non-Indigenous groups to reach mutual goals. To be effective, co-management will require equal partnerships and sharing of power between both parties to ensure full inclusion and integration of ideas and perspectives, and to respect Indigenous autonomy over resources and land use (Houde, 2007; Parlee, 2012; Spak, 2005). Equal partnership in co-management will help to remove barriers caused by mistrust and disagreement in approaches, and instead allow for progressive and cohesive solutions to be made that can evolve to meet the needs and objectives of all stakeholders (Armitage et al., 2009; Berkes, 2009; Houde, 2007; Huntington, 2000). Further integrating IK with a science-based management approach facilitates not only a balance between consumption and conservation (LeBlanc et al., 2011), but also provides a bi-directional learning opportunity that benefits both stakeholders and wildlife (Spak, 2005). By acknowledging the significance of combining Indigenous and Western science, the future of conservation is not only a bright one, but it is also full of potential for improved resource management.

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References

Aanensen, D. M., Huntley, D. M., Feil, E. J., Al-Own, F., & Spratt, B. G. (2009). EpiCollect: Linking smartphones to web applications for epidemiology, ecology and community data collection. *PLoS ONE*, *4*, e6968. doi:10.1371/journal.pone.0006968

Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and Change*, *26*, 413–439. doi:10.1111/dech.1995.26.issue-3

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., … McConney, P. (2009). Adaptive co-management for social–ecological complexity. *Frontiers in Ecology and the Environment*, *7*, 95–102. doi:10.1890/070089

Aswani, S., & Lauer, M. (2014). Indigenous people's detection of rapid ecological change. *Conservation Biology*, *28*, 820–828. doi:10.1111/cobi.2014.28.issue-3

Bartlet, C., Marshall, M., & Marshall, A. (2012). Two-eyed seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences*, *2*, 331–340. doi:10.1007/s13412-012-0086-8

Berkes, F. (2009). Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management*, *90*, 1692–1702. doi:10.1016/j.jenvman.2008.12.001

Berkes, F. (2012). *Sacred ecology*. New York, NY: Routledge.

Boyce, M. S., Baxter, P. W., & Possingham, H. P. (2012). Managing moose harvests by the seat of your pants. *Theoretical Population Biology*, *82*, 340–347. doi:10.1016/j.tpb.2012.03.002

Boyce, M. S., & Corrigan, R. (2017). Moose survey app for population monitoring. *Wildlife Society Bulletin*, *41*, 125–128. doi:10.1002/wsb.732

Briggs, J., & Sharp, J. (2004). Indigenous knowledges and development: A postcolonial caution. *Third World Quarterly*, *25*, 661–676. doi:10.1080/01436590410001678915

Brown, G. S. (2011). Patterns and causes of demographic variation in a harvested moose population: Evidence for the effects of climate and density-dependent drivers. *Journal of Animal Ecology*, *80*, 1288–1298. doi:10.1111/jane.2011.80.issue-6

Butler, J. R. A., Tawake, A., Skewes, T., Tawake, L., & McGrath, V. (2012). Integrating traditional ecological knowledge and fisheries management in the Torres Strait, Australia: The catalytic role of turtles and dugong as cultural keystone species. *Ecology and Society*, *17*, 34. doi:10.5751/ES-05165-170434

Cape Breton Highlands National Park (CBHNP). (2015). *Bring back the Boreal*! Retrieved from: https://www.pc.gc.ca/en/agence-agency/bib-lib/rapports-reports/core-2018/atl/atl3.

DelGiudice, G. D., Sampson, B. A., Lenarz, M. S., Schrage, M. W., & Edwards, A. J. (2011). Winter body condition of moose (*Alces alces*) in a declining population in northeastern Minnesota. *Journal of Wildlife Diseases*, *47*, 30–40. doi:10.7589/0090-3558-47.4.917

Demarchi, M. W., & Schultze, G. (2011). *A stratified random block survey of moose in the Nass River Watershed*. New Aiyansh, BC, Canada: Nisga'a Lisims Government.

Franzmann, A. W., & Schwartz, C. C. (1997). *Ecology and management of the North American moose*. Washington, DC: Smithsonian Institution Press.

Gadamus, L., Raymond-Yukoubian, J., Ashenfelter, R., Ahmasuk, A., Metcalf, V., & Noongwook, G. (2015). Building an indigenous evidence-base for tribally-led habitat conservation policies. *Marine Policy*, *62*, 116–124. doi:10.1016/j.marpol.2015.09.008

Gitanyow Hereditary Chiefs and the Province of British Columbia. (2012). *Gitanyow Huwilp recognition and reconciliation agreement*.

Gwich'in Elders. (1997). *Gwich'in words about the land. Gwich'in renewable resources board*. Inuvik, North West Territories, Canada.

Gwich'in Elders. (2001). *More Gwich'in words about the land. Gwich'in renewable resources board*. Inuvik, North West Territories, Canada.

Gwich'in Renewable Resources Board (GRRB). (2000). *Moose management plan for the Gwich'in settlement area*. Inuvik, North West Territories, Canada.

Gwich'in Renewable Resources Board (GRRB). (2009). *Gwich'in harvest study final report*. Inuvik, North West Territories, Canada.

Houde, N. (2007). The six faces of traditional ecological knowledge: Challenges and opportunities for Canadian co-management arrangements. *Ecology and Society*, *12*(2), 34. doi:10.5751/ES-02270-120234

Hunn, E. S., Johnson, R. R., Russel, P. N., & Thornton, T. F. (2003). Huna Tlingit traditional environmental knowledge, conservation, and the management of a "Wilderness" park. *Current Anthropology*, *44*, 79–103. doi:10.1086/377666

Huntington, H. P. (2000). Using traditional ecological knowledge in science: Methods and applications. *Ecological Applications*, *10*, 1270–1274. doi:10.1890/1051-0761(2000)010[1270:UTEKIS]2.0.CO;2

Kimmerer, R. W. (2000). Native knowledge for native ecosystems. *Journal of Forestry*, *98*, 4–9.

Koch, K. (2016). *Protecting moose and Gitanyow food security: Gitanyow wildlife harvest monitoring 2015/2016*. Report prepared for Gitanyow Hereditary Chiefs. Kitwanga, BC, Canada.

Laliberte, A. S., & Ripple, W. J. (2004). Range contractions of North American carnivores and ungulates. *Bioscience*, *54*, 123–138. doi:10.1641/0006-3568(2004)054[0123:RCONAC]2.0.CO;2

Lane, N., Miluzzo, E., Lu, H., Peebles, D., Choudhury, T., & Campbell, A. (2010). A survey of mobile phone sensing. *IEEE Communications Magazine*, *48*, 140–150. doi:10.1109/MCOM.2010.5560598

LeBlanc, J. W., McLaren, B. E., Pereira, C., Bell, M., & Atlookan, S. (2011). First Nations moose hunt in Ontario: A community's perspectives and reflections. *Alces*, *47*, 163–174.

Lenarz, M. S., Fieberg, J., Schrage, M. W., & Edwards, A. J. (2010). Living on the edge: Viability of moose in northeastern Minnesota. *Journal of Wildlife Management*, *74*, 1013–1023. doi:10.2193/2009-493

Marshal, J. P. (1999). Co-management of moose in the Gwich'in settlement area, Northwest Territories. *Alces*, *1*, 151–159.

McGregor, D. (2004). Coming full circle: Indigenous Knowledge, environment, and our future. *American Indian Quarterly*, *28*, 385–410. doi:10.1353/aiq.2004.0101

Menzies, C. R. (2006). *Traditional ecological knowledge and natural resource management*. Lincoln, NE: University of Nebraska Press.

Murray, D. L., Cox, E. W., Ballard, W. B., Whitlaw, H. A., Lenarz, M. S., Custer, T. W., … Fuller, T. K. (2006). Pathogens, nutritional deficiency, and climate change influences on a declining moose population. *Wildlife Monographs*, *166*, 1–30. doi:10.2193/0084-0173(2006)166[1:PNDACI]2.0.CO;2

Murray, D. L., Hussey, K. F., Finnegan, L. A., Lowe, S. J., Price, G. N., Benson, J., … Silver, A. (2012). Assessment of the status and viability of a population of moose (*Alces alces*) at its southern range limit in Ontario. *Canadian Journal of Zoology*, *90*, 422–434. doi:10.1139/z2012-002

Olson, D. D., Bissonette, J. A., Cramer, P. C., Green, A. D., Davis, S. T., Jackson, P. J., & Coster, D. C. (2014). Monitoring wildlife-vehicle collisions in the information age: How smartphones can improve data collection. *Journal of Wildlife Rehabilitation*, *34*, 7–16.

Parlee, B. (2012). Finding voice in a changing ecological and political landscape: Traditional knowledge and resource management in settled and unsettled claim areas of the Northwest Territories, Canada. *Aboriginal Policy Studies*, *2*, 56–87.

Schmidt, P. M., & Stricker, H. R. (2010). What tradition teaches: Indigenous Knowledge complements western wildlife science (Report No. 1283). USDA National Wildlife Research Center – Staff Publications.

Spaeder, J. J. (2005). Co-management in a landscape of resistance: The political ecology of wildlife management in western Alaska. *Anthropologica*, *47*, 165–178.

Spak, S. (2005). The position of Indigenous knowledge in Canadian co-management organizations. *Anthropologica*, *48*, 233–246.

Teacher, A. G. F., Griffiths, D. J., Hodgson, D. J., & Inger, R. (2013). Smartphones in ecology and evolution: A guide for the apprehensive. *Ecology and Evolution*, *3*, 5268–5278. doi:10.1002/ece3.888

Timmermann, H. R., & Rodgers, A. R. (2005). Moose: Competing and complementary values. *Alces*, *41*, 85–120.

Timmermann, H. R., & Rodgers, A. R. (2017). The status and management of moose in North America circa 2015. *Alces*, *53*, 1–22.

Unama'ki Institute of Natural Resources (UINR). (2017, December 8). Retrieved from http://www.uinr.ca.

Weeks, J. (2017, December 8). *Meat from Cape Breton moose cull used to fight poverty in First Nations*. Retrieved from http://www.cbc.ca/news/canada/nova-scotia/moose-meat-child-poverty-parks-canada-cape-breton-highlands-cull-1.4440269.