Master of Forestry, Final Thesis Report

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REVIEW OF POTENTIAL CO-MANAGEMENT STRATEGY FOR MOOSE IN NOVA SCOTIA: THE APPLICATION OF TWO-EYED SEEING

by

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Abstract

The modern movement towards Indigneous sovereignty began in different times in various First Nations communities but is becoming an increasingly prominent issue in Canadian politics. A significant component of Indigneous sovereignty is partial or predominant management of natural resources, wildlife in particular. Cooperative management, sharing of responsibilities and decision-making between governmental and Indigneous agencies, has been successfully implemented in the Canadian Territories by various co-management boards. A co-management system is effective in the Territories, as the region is culturally, ecologically, geographically, and socially different from much of Canada. This paper seeks to identify components of successful co-management regimes and how they may be applied in the province of Nova Scotia with regard to the eastern moose (*Alces alces americanus*), which is critically endangered in mainland Nova Scotia at the time of writing. The hope of a successful co-management regime is to combine the knowledge and resources of current wildlife managers with the province's Mi'kmaq communities to positively contribute to enhancing the current population and maintaining it as a sustainable resource for Indigenous and non-Indigenous users. This report will provide preliminary information to potential managers that may be used during early research stages and knowledge gathering.

Acknowledgements

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List of Abbreviations

DFO: Department of Fisheries and Oceans

GCLCA: Gwich'in Comprehensive Land Claim Agreement

GRRB: Gwich'in Renewable Resources Board

GSA: Gwich'in Settlement Area

HTC: Hunters and Trappers Committee

HTO: Hunters and Trappers Organizations

IFA: Inuvialuit Final Agreement

ISR: Inuvialuit Settlement Region

MEK: Mi'kmaq Ecological Knowledge

MMU: Moose Management Unit

mtDNA: Mitochondrial DNA [deoxyribonucleic acid]

NLCA: Nunavut Land Claims Agreement

NSA: Nunavut Settlement Area

NSDNR/NSDLF: Nova Scotia Department of Natural Resources (pre-2018)/Nova Scotia Department of Lands and Forestry (2018-present)

NWMB: Nunavut Wildlife Management Board

NWT DENR: Northwest Territories Department of Environment and Natural Resources

RRC: Regional Resource Council

RWO: Regional Resource Organization

TEK: Traditional Ecological Knowledge

TES: Two-Eyed Seeing

TK: Traditional Knowledge

UFA: Umbrella Final Agreement

UINR: Unama'ki Institute of Natural Resources

WMAC (NS & NWT): Wildlife Management Advisory Committee [North Slope & Northwest Territories]

YDE: Yukon Department of the Environment

YFWMB: Yukon Fish and Wildlife Management Board

Preface

As a third-party review, this report was based on publicly accessible information and is therefore partially incomplete. Rather, this report will hopefully serve as a basic literature review of some relevant information regarding wildlife co-management generally, and moose management in Nova Scotia specifically. I am not an expert in the fields of wildlife or moose co-management, wildlife or Indigenous law, or Mi'kmaq culture, nor am I the first to consider how these fields of study can positively contribute to wildlife management in Nova Scotia. In recent decades, significant headway has been made towards Indigenous sovereignty and management of resources; hopefully this report will contribute to this progress in a meaningful way. Managers and experts in these fields, as well as Mi'kmaq harvesters and elders must be properly consulted in the development of a Nova Scotia moose co-management plan; this report will hopefully provide stimulating ideas or questions, case studies of successful co-management, potential pitfalls to co-management in Nova Scotia, and recommendations in moving forward with implementing a co-management system. Recommendations made here are based on the best available information but are by no means the final word on co-management in Nova Scotia. Moving forward, it is important to be flexible to accommodate stakeholder feedback and new knowledge about the mainland moose, with a focus on the relevant, applicable data.

When referring to a species for the first time, the common name is English is used first in the body of the text, followed in brackets by the Latin binomial name in italics, then the Mi'kmaq name in bold italics. Mi'kmaq names are only used when applicable; for example, the Mi'kmaq do not have names for grizzly bears and coyotes as they were not historically present in Mi'kmaq territory. Mi'kmaq names are used approximately if a

specific name is not known; the Mi'kmaq name used for walrus, ***Gisguàgw***, refers broadly to "ancient sea mammal that lives to an old age", and may also apply to seals. While some whale species have specific names, the Mi'kmaq name ***Put'p*** can be applied to all whales and is used in this report to refer to narwhals. Animal names were sourced from the Mi'kmaw Bestiary (Hebda, 2014).

1. Introduction

The eastern moose (*Alces alces americana;* ***Tia'm***), also referred to as the mainland moose, was a pillar of the existence of Aboriginal tribes across eastern Canada long before European arrival and continues to provide immeasurable value to the first nations today. The largest extant member of the deer family, moose have long been a source of food and materials to harvesters and their communities, as well as a deep cultural connection to their history and the land; bones, tendons, meat, teeth, hide, antlers, and some organs are all used to varying degrees, and that which isn't used is considered an offering to nature and used by coyotes, eagles, and insects.

Generally, moose exist at low densities which creates few opportunities for counting, and are very inaccessible and expensive to survey, particularly when confounded by poor weather and low precision (Kellie et al., 2019). This is true for particularly northern habitats such as the Territories and possibly Cape Breton but may not be accurate in mainland Nova Scotia. Dietary preferences vary significantly depending on region and season, but in general consist of softwood shoots in the spring, aquatic vegetation where present in the summer, and the shoots and bark of numerous species in the fall and winter (Franzmann, 1980), such as willow (*Salix sp.;* ***Lmu'ji'jmnaqsi***) and spruce (*Picea sp.;* ***Kwatkw, Kawatkw***)(AMEC Environment and Infrastructure, 2013). Outside of cow-calf groups, moose are solitary animals that generally do not associate with other individuals outside of the rut, when males are highly aggressive towards each other as they fight for mating rights. However, moose are not territorial and are observed feeding in close proximity to each other (Peterson, 1955).

Moose have a complicated history of management in North America, as European arrival signaled the beginning of the significant contraction of moose populations across

the continent as they were hunted extensively for the resources they provide The population experienced a variable decline across the Maritimes through the 1800's and early 1900's, from significant decline in New Brunswick, near extirpation on mainland Nova Scotia, to complete extirpation on Cape Breton. This population decline continued in most jurisdictions until the 1900's when the culmination of new management techniques, hunting closures, and conservation efforts began to help the species partially rebound. Eastern moose were officially listed as "endangered" in mainland Nova Scotia in 2003, with population estimates at the time between 1,000 and 1,200 individuals. As a whole, moose in Nova Scotia continue to face different challenges, but habitat fragmentation, poaching, land use change, lack of genetic diversity, and the introduction of parasites like brainworm and winter tick are foremost in mainland NS (Parker, 2003). The long-term sustainability of moose populations is a significant concern for native and non-native managers, and collaborative projects have been undertaken in an effort to share resources and knowledge.

Co-management is the practical implementation of the "Two-Eyed Seeing" approach developed by elder Albert Marshall, which strives to balance the preciseness of western science/management with the guiding wisdom of traditional knowledge – the two systems "walking and talking with each other". Two-Eyed Seeing (TES) is the blending of two knowledge systems, scientific western knowledge and traditional knowledge, when trying to solve or view a problem from a different perspective (Bartlett et al., 2012). From the perspective of resource management it often refers to the use of western knowledge gained through the application of the "scientific method", such as estimates of herd health based on population surveys and modeling, with traditional ecological knowledge (TEK), the information passed down and learned through continued existence with, and use of,

local natural resources. More specifically, co-management is the joint management of a natural resource between local Indigenous groups and state managers of natural resources such as Provincial, Territorial, or Federal resource agencies. State management is the norm in the North American Model of Wildlife Management; a system that is founded on the principles that, among other tenets, 1) fish and wildlife are for the non-commercial use of the people and 2) that these resources are to be managed such that this use is perpetual and sustainable (Organ et al., 2012). This management ethos could be seen as highly similar to traditional Indigenous practices, which both intimately use, and therefore, manage, the land and resources (The Wildlife Society, 2016). This system is credited with the salvation of many charismatic species that are central to the belief systems and traditions of various North American Indigenous groups, including the grizzly bear (*Ursus arctos horribilis*), and therefore has significant value as a structure for wildlife management. Combining the proven success of State wildlife management with local Indigenous ecological knowledge may be an even more effective strategy.

In 2014, the Unama'ki Institute of Natural Resources (UINR) produced a report of Mi'kmaq Ecological Knowledge (MEK) surrounding moose management in Cape Breton by practicing the Two-Eyed Seeing method. The report included scientific information such as geologic history of the island and population estimations, alongside summarized traditional knowledge collected from elders about moose in Cape Breton, including the history of the Mi'kmaq, how "Tiam" is and was a part of the Mi'kmaq lifestyle, methods of harvest, prevalence of the moose on the island, anatomy and use of body parts, etc. There is no comparable report for mainland moose, and the development of such is beyond the scope of this thesis.

Development of a summarized MEK report and/or a proposal for co-management of mainland moose should be undertaken by representatives of Nova Scotia Mi'kmaq bands. This report will strive to summarize the current understanding of moose ecology, condition of the moose herd in Nova Scotia and neighboring jurisdictions, and existing plans for moose management in the province, thereby providing a foundation for more thorough planning. The Two-Eyed Seeing approach will be central to this report; therefore, a review of such practices will also be required. If similar plans exist in other jurisdictions, their findings and recommendations will be included, however the report developed by the UINR will be the guiding document. The thesis will make management recommendations to maintain traditional values and harvest methods by integrating MEK and established sources of traditional knowledge, and practices employed by western-science wildlife managers. If native managers have not established plans, this report will make specific recommendations to do so.

2. Moose in Nova Scotia

The province of Nova Scotia has several documents outlining the state of the mainland moose population, as well as its recovery goals and actions. The three documents provide a thorough explanation of 1) a summary of the mainland moose population circa 2003 (Parker, 2003), 2) a plan outlining recovery goals and objectives circa 2007 (NSDNR, 2007), and 3) the required knowledge and pertinent actions necessary to meet recovery goals circa 2013 (McNeil, 2013). A complete review of these documents is unnecessary however a brief review is valuable.

Moose have been a vital resource throughout the period of human habitation in eastern North America, however extensive hunting pressure and habitat loss led to the

implementation of restrictive game laws in the 1880's. Hunting was first closed on the mainland in 1938, followed by periods of open and closed seasons until 1981 when it was ultimately closed until populations rebounded. As of 2003, the province believed mainland moose to number 1-1,200 individuals distributed in three distinct subpopulations and approximately 55,000 km². Since the 1960's, the main population centers are believed to be Cobequid Hills and Pictou-Antigonish Highlands (Northeast population), Tobeatic Wildlife Management Area (Southwest population), and Guysborough-Halifax-Shelburne-Queens-Yarmouth counties (Eastern population, consists of four loci). The genetic exchange between subpopulations, including from New Brunswick and Cape Breton populations, is poorly understood, but believed to be insufficient. The genetic composition of the mainland moose is of great concern to the province, therefore individuals migrating from New Brunswick may be desirable, while those from Cape Breton may not be. Across the mainland, the moose population is primarily limited by unlicensed harvesting, loss of mature coniferous canopy, and the presence of a meningeal parasite introduced by invading white-tailed deer. Additional factors include predation on calves (mostly by black bears), non-brain worm parasitism (mostly winter ticks, includes an unknown disease complex), and cadmium poisoning or other heavy metal accumulation. While the relative impact between primary and secondary limiting factors is fairly well understood, the absolute impact of each limiting factor is unknown.

Moose are a critical cultural symbol and physical resource to many rural people in Nova Scotia. They have long been intensively managed by game and resource managers, and their sustainability is a high priority. In the 2007 Recovery plan, the authors identified eleven areas in which current knowledge gaps are limiting the province's ability to effectively manage the mainland population. Most knowledge gaps relate to negative

population drivers which are known to affect the mainland herd, but the extent and relative proportion of which are unknown. It is useful to describe these gaps and the likelihood that Two-Eyed Seeing and traditional knowledge (TK) to provide some clarity;

2.1 Basic demographic on herd/group size and structure

It is likely that TK can provide information on historic population size and demographics. It is known that early European settlers often provided highly inaccurate descriptions of the moose (Jackson, 2008), therefore their estimates of moose density and abundance must be taken cautiously. In Deer of Nova Scotia, Benson and Dodds (1977) suggest the province had a pre-contact population near 15,000 individuals; this means the current mainland herd might account for 2% of carrying capacity at the time. The pre-contact moose population has limited application for modern management practices, however, since the environmental conditions are so drastically different. Other factors such as historic sex ratios and calving rates may be known and is important to understand the historic dynamics of the mainland population. Population structure and dynamics are well understood in other jurisdictions that continue to hunt the eastern moose such as New Brunswick and Maine; finding a balance between *theoretical* traditional knowledge from Nova Scotia and *certain* western knowledge from elsewhere is a challenge for managers.

2.2 Reproduction and recruitment

The Mi'kmaq almost certainly had an intimate understanding of the annual cycles of moose behaviour. The UINR suggests that "traditionally, Mi'kmaq harvested moose year-round whenever they needed food, although it's believed that they would have taken a break during the calving season in the spring" (Lefert et al., 2014). Modern moose management in all jurisdictions is determined by breeding habits, including the best

practices outlined by the UINR on Cape Breton. Therefore, it is unlikely that TK can provide additional information of practical concern to managers; some reference to traditional practices may inform local hunting regulations or best practices, although it is clear that such traditions are already practiced.

2.3 Disease and mortality

Traditional Knowledge will not provide useful information regarding the impact of disease on the mainland population. Brainworm was not present in the province until the introduction of white-tailed deer in the early 1900's, during which time the Mi'kmaq were not involved in regular hunting of moose; one can therefore assume western knowledge should be the primary source of disease information. Loss of mature forest canopy and illegal harvesting are also primary drivers of mortality, which are unlikely to be understood through TK. There is evidence the Mi'kmaq manipulated the forest canopy to improve hunting grounds, therefore TK may provide useful baseline information.

2.4 Extent and level of illegal harvest on herds/groups

There are conflicting management principles on mainland Nova Scotia; while hunting seasons across the mainland have been closed since 1981, Mi'kmaq are within their traditional rights to harvest wildlife to provide a "reasonable livelihood". Therefore, the mainland Mi'kmaq's right to harvest moose is both legally protected under their traditional rights, and illegal since 1981, and would be registered as poaching by the Department of Lands and Forests (also referred to as "unlicensed harvest". Both the total amount and relative proportion of Mi'kmaq unlicensed harvest is unknown, and while traditional knowledge (i.e. long-term) may not provide practical information regarding the intensity of harvest, there may be knowledge within communities regarding the number

of moose taken annually. Although Mi'kmaq harvesters are within their rights to harvest moose, it will be extremely unlikely to capture the real harvest number. TK may provide some information on what the approximate number of moose harvested per capita to sustain a community, albeit with significant variation within seasons and between years. Elders may be reluctant to share this information, as it could be seen as attempting to rigidly define "reasonable livelihood" and therefore restrict traditional practices.

2.5 Habitat preference and availability

Traditional knowledge should provide a wealth of knowledge in this area, in reference to where moose densities were high, where they were hunted, how they travelled within the year, what they associated as habitat/travel corridors/etc. Although habitat loss and fragmentation is a relatively recent (1700's) factor on the moose population, there may be strong indicators useful to determining habitat currently thought of as non-preferential. Using the methods outlined by Abu and colleagues, non-Indigneous historical information as presented by Benson and Dodds could positively contribute in this area (Abu et al., 2019; Benson and Dodds, 1977).

2.6 Critical loading of heavy metals and other toxins

Traditional knowledge will not provide valuable information in this arena, as it is both a highly modern phenomenon, and requires intensive and specific scientific analysis of soil and plant material. Related factors such as physiological markers traditionally known to indicate unhealthy moose is an area worth exploring.

2.7 Dietary deficiencies

There may be valuable traditional knowledge about the lack of palatable browse for moose following disturbances such as flooding, draining, fire, storm, etc., however,

large scale, modern disturbances such as urbanization may not be captured. Benson and Dodds (1977) describe the severe increase in wildfire following European settlement in the southwest in the 1700 and 1800's, which although from a non-Indigenous perspective, may also provide value. This may correlate with knowledge centered around habitat.

2.8 Disturbance factors

There is likely quality TK surrounding the impact of European settlement and its influence on the disturbance regime of mainland Nova Scotia, as described above. The change in practices from pre-colonization to modern day may function as a form of meta-knowledge on the disturbance factors, in that the different (lack of) practices today can be interpreted as being influenced by the disturbance factors that we know to be present (human encroachment, agriculture, habitat manipulation, biotic invaders, etc.). From this perspective, traditional knowledge may be considered "traditional interpretation", wherein Elders may provide their interpretation and/or understanding of why things are the way they are, rather than direct or inherited knowledge and experience.

2.9 Genetic diversity

The value of traditional knowledge regarding genetic diversity can be seen through two lenses; from one perspective, TK has no value in parsing the minute differences between locally distinct groups, such as been done using mtDNA analysis between the three modern mainland subpopulations, and may have little value in even understanding the difference between the two subspecies which are now present within Nova Scotia (*Alces alces americanus* [eastern] and *A. a. andersoni* [western]). Conversely, traditional guidance will provide critical knowledge regarding the significance of this genetic diversity and whether the existence of "genetically pure" eastern moose is more important

than its existence at all. One could assume based on the engagement of Mi'kmaq managers with the western subspecies in Cape Breton that TK is not concerned with genetic diversity beyond the specific epithet; the mainland tribes must be consulted on this. The question surrounding genetic diversity from a TK perspective is important to answer; genetic distinction may not be considered important knowledge at all.

2.10 Significance of all the above to herds/groups

Understanding the significance of these impacts from both perspectives is an unequal comparison, in that there are different units of measurement for significance. It is obvious that TK cannot assess the significance of factors it cannot measure (i.e. heavy metals, genetic diversity), however it is less obvious how TK would rank the relative significance of the various other limiting factors acting on the mainland moose population. While western science has numerous tools for statistically determining the most significant factor, TK may not consider certain aspects to be significant limiting factors. When unlicensed harvesting contributes to additive mortality in a vulnerable population, western knowledge would consider it a limiting factor to long-term population viability, however TK may not view unlicensed harvesting (traditionally, all harvesting would have been unlicensed) as of utmost concern due to 1) a distrust of the results of western population surveys, 2) the importance of maintaining a traditional relationship with moose i.e. hunting as vital to the moose's existence within the culture, 3) a disagreement with the current structure of game management and hunting rights, or 4) some herein undescribed factor(s).

2.11 Interrelatedness of all factors

As not all factors should be understood from a TK lens, it is safe to assume that the complete interrelatedness will also not be understood. However, the interrelatedness of the ecosystem is a hallmark of TK and Two-Eyed Seeing, therefore there will be significant value regardless. In an ecosystem marked by modern disturbance factors not captured in the sphere of traditional knowledge, western knowledge may become more relevant in understanding the relationships between such disturbances and the moose population.

3. Examples of co-management

Various levels of First Nations wildlife management exist; the lowest level (excluding 'no involvement') is consultation or prior-consent management, where current management systems are practiced with First Nations' opinion considered in management decisions. Conversely, the highest level is total and independent management of wildlife, such as on Indian Reserve land in the United States, where federal (i.e. Bureau of Indian Affairs) and state managers may act as partners, consultants, or not at all. Co-management could be seen as the "middle-ground", and may involve any number and level of government agencies and new or existing tribal or band agencies responsible for wildlife or resource management (i.e. Department of Lands and Forestry, UINR). This system is preferable to previously mentioned systems, as it allows more autonomy over local resources, while taking advantage of pre-existing knowledge, resources, and capital.

3.1 Co-management background

A review of co-management literature found significant disparities by region. This report primarily judged quality of information on the accessibility of data (plans, survey

results, governance structure, other documents), and secondarily by other factors within the data (scientifically accurate survey methods, consistency across documents, up-to-date reports and plans, completeness of management plans, quality of writing, etc.). It is important to note, however, that this method is not a perfect system of analysis as some jurisdictions likely have complete wildlife co-management plans developed that are not accessible to members outside the community. For example, the Tŝilhqot'in Nation and Gitxsan Nation have co-management agreements with the Province of British Columbia based on court preceedings on Aboriginal land title (*Delgamuukw v. British Columbia, 1997; Tsilhqot'in Nation v. British Columbia, 2014*); they are excluded solely on the basis of inaccessibility to the public. Tribal management systems in the United States are also excluded, as the political and legal context is unlikely to provide practical examples that could be implemented in Canada.

By far, the highest quality co-management systems are found in the Territories. There are one or more successful co-management boards operating in each of the Territories, with jurisdictions defined by self-governance agreements signed with the federal government in the 1980's and 90's. Co-management began with the signing of the Inuvialuit Final Agreement (IFA) in 1984 and the associated creation of the Inuvialuit Settlement Region (ISR) (S.C. 1984, c. 24). The ISR covers land in the present Yukon and Northwest Territories that was historically occupied by the Inuvialuit, a band of Inuit people. The most complicated agreement, it was both the first self-governance agreement, had to consider Inuvialuit activities in two territories and Alaska, and created Ivvavik National Park. This was soon followed by the signing of the Gwich'in Comprehensive Land Claims Agreement (GCLCA) (S.C. 1992, c. 53), the Umbrella Final Agreement (UFA) (S.C. 1994, c. 34), and the Nunavut Land Claims Agreement Act (NLCA) (S.C.

1993, c. 29), the latter of which formed the modern boundaries of the territory of Nunavut (Armitage et al., 2011). These agreements granted broad land titles to a few Inuit and First Nations groups across their traditional territories in modern Territories of Yukon, Northwest Territories, and Nunavut. Among other rights, the land claim agreements granted pertinent First Nation and Inuit bands the right to direct involvement in the management of wildlife and fisheries within their territories. The Umbrella Final Agreement laid the groundwork for further land claims to be made by individual First Nations not included in the initial major agreements and resulted in the creation of Vuntut National Park.

The co-management boards formed by these agreements are as follows (Table 1): (i) the Yukon Fish and Wildlife Management Board (YFWMB) covers the area defined by the Umbrella Final Agreement, generally in the south and south-eastern Yukon, up to and including Vuntut National Park (Figure 1); (ii) The Gwich'in Renewable Resources Board (GRRB) covers the area of the GCLCA, in central Northwest Territories along the Yukon-NWT border including significant portions of the Peel and Arctic Red river drainages and the Mackenzie River Delta (Figure 2); (iii) The Wildlife Management Advisory Council (WMAC) forms two boards; the area of the ISR on the Arctic coast of Yukon and Ivvavik National Park is known as the North Slope and managed by the WMAC-North Slope [NS], while the Arctic coast of the Northwest Territories is managed by the WMAC-NWT (Figure 3); and (iv) The entire modern territory of Nunavut was established by the NLCA, and as such, the entire territory is co-managed by the Nunavut Wildlife Management Board (NWMB) (Figure 4).

Table 1. Summary of various management and community boards relevant to wildlife co-management created under respective Arctic land claim agreements

Agreement, Year	Year	Region	Territory	Management Board(s)	Community Board(s)
Inuvialuit Final Agreement (IFA)	1984	Inuvialuit Settlement Region (ISR)	YT, NT	Inuvialuit Game Council (IGC)	Hunters and Trappers Committees (HTC); 6
			YT, NT	Fisheries Joint Management Committee (FJMC)	
			NT	Wildlife Management Advisory Committee (WMAC); NWT	
			YT	Wildlife Management Advisory Committee (WMAC); North Slope, Yukon	
Gwich'in Comprehensive Land Claims Agreement (GCLCA)	1992	Gwich'in Settlement Area (GSA)	NT	Gwich'in Renewable Resources Board (GRRB)	Renewable Resource Councils (RRCs); 4
Nunavut Land Claims Agreement (NLCA)	1993	Nunavut Settlement Area (NSA)	NU	Nunavut Wildlife Management Board (NWMB)	Hunters and Trappers Organizations (HTOs); 27
					Regional Wildlife Organizations (RWOs); 3*
Umbrella Final Agreement (UFA)	1993	Settlement Land (Category A, Category B, Fee Simple)	YT	Yukon Fish and Wildlife Management Board (YFWMB)	Renewable Resources Councils (RRCs); 11

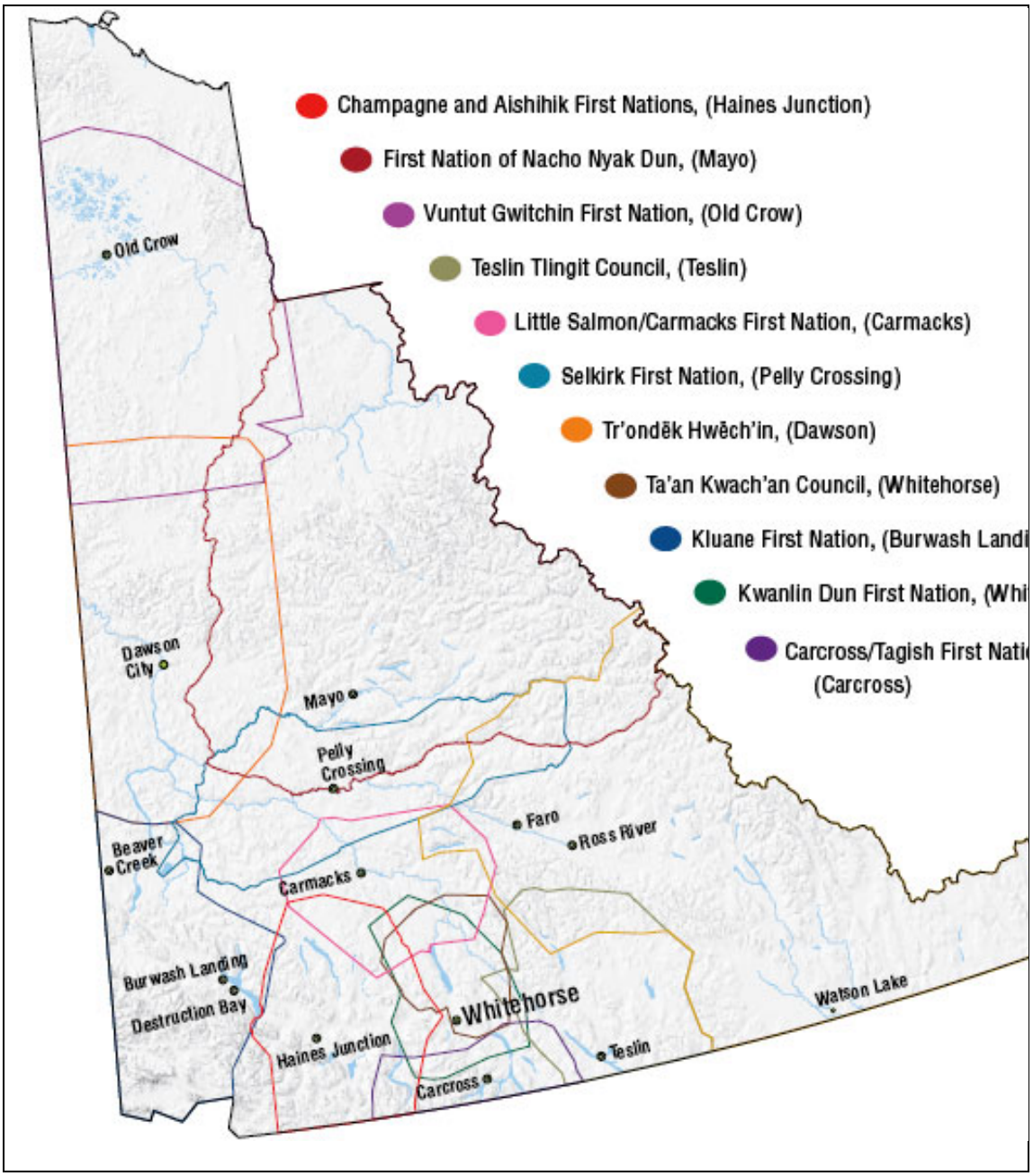

Figure 1: Area of individual Yukon First Nations agreements under the Umbrella Final Agreement. Boundaries are defined by the area of traditional use as claimed by each First Nation. Named towns are the seats of respective Tribal councils including Renewable Resource Council (RRC) (Indigenous and Northern Affairs Canada, 2016)

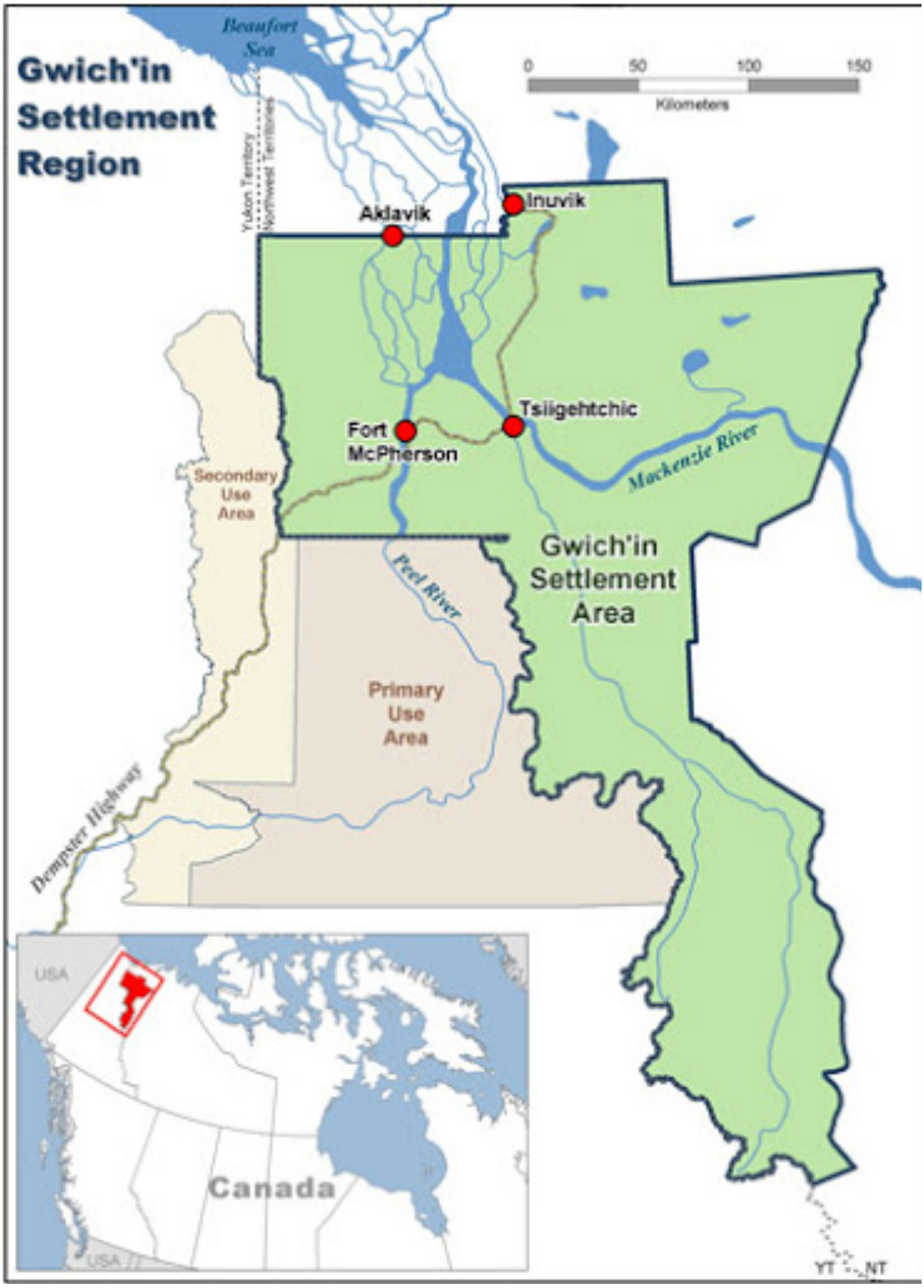

Figure 2: Gwich'in Settlement Area including Primary and Secondary Use Areas. Communities of Aklavik, Inuvik, Tsiigehtchic (Arctic Red River), and Fort McPherson are the seats of the
Regional Resource Councils (Gwich'in Renewable Resources Board, 1992).

Figure 3: Map of the Inuvialuit Settlement Region distinguished by Private Land ownership by community including National and Territorial Park land. Aklavik, Inuvik, Tuktoyaktuk, Sachs Harbour, Paulatuk, and Ulukhaktok (Holman) are the seats of local Hunters and Trappers Committees (HTCs) (Joint Secretariat, 2001).

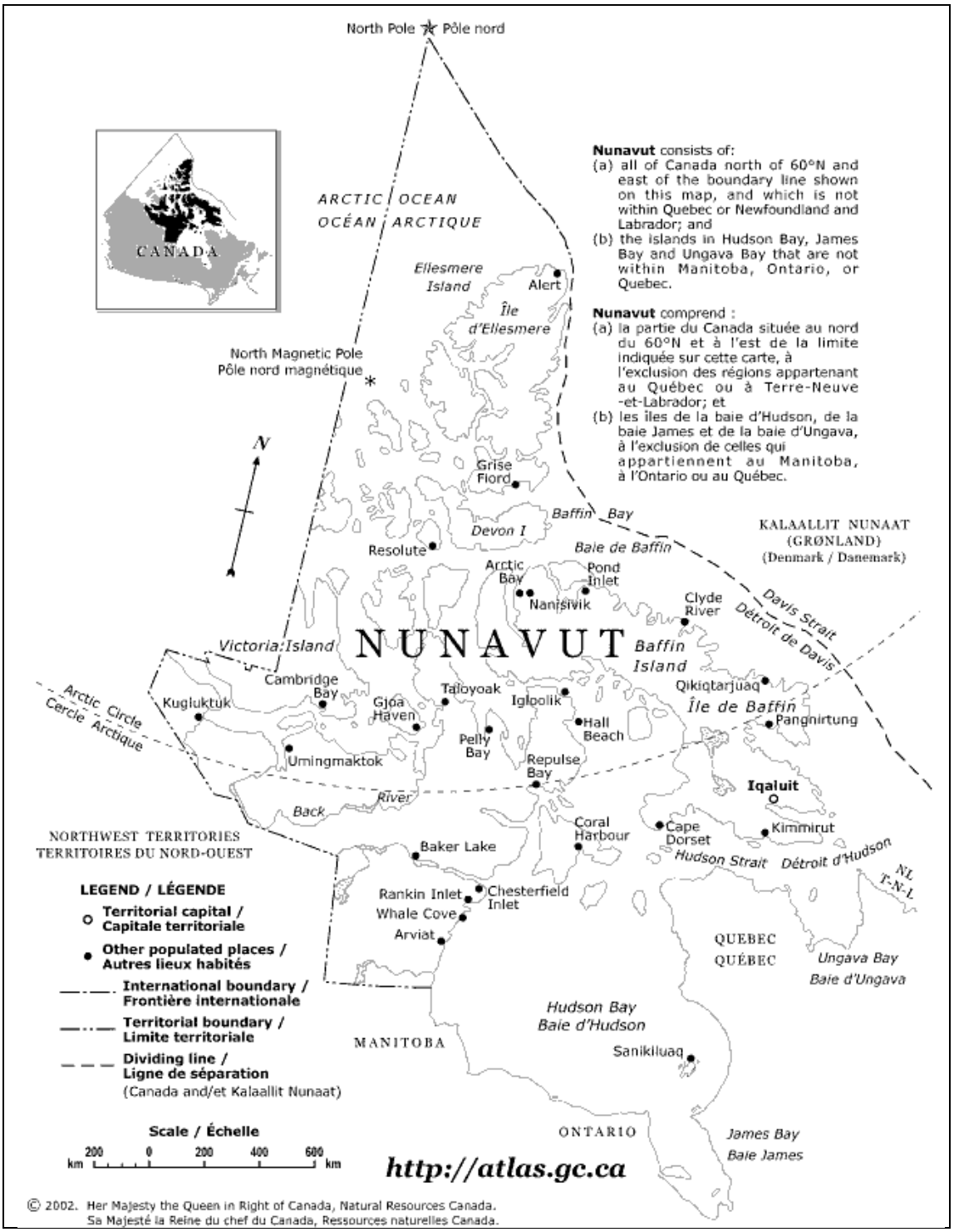

Figure 4: Map of the Nunavut Settlement Area (NSA) including political boundaries and significant populated places. The boundaries of the Territory of Nunavut is exactly the NSA. All mapped places have local Hunters and Trappers Organizations (HTOs) (Nunavut Wildlife Management Board, 2002).

3.2 Yukon Fish and Wildlife Management Board

The Yukon Fish and Wildlife Management Board (YFWMB) has not published a comprehensive management plan for moose on Indigenous land in the territory; this is because the Umbrella Final Agreement (UFA) which formed the YFWMB was designed to allow each First Nation in the Territory (Appendix I) to sign independent final agreements pertaining to wildlife management on their land. Despite this, an understanding of the state of moose co-management can be gathered through three documents; the Moose Harvest Management Framework published by the YFWMB (YFWMB, 2019), the Territorial management plan published by the Yukon Department of Environment (YDE, 2016), and the YFWMB's annual reports (YFWMB, 2018). The YDE's guidelines begin by stating they are the "science-based" aspect of a management scheme designed to complement processes laid out by the YFWMB, the Wildlife Management Advisory Council's North Slope division, and local Renewable Resource Councils (RRCs), and emphasizes the inclusion of local and traditional knowledge alongside public input and scientific research when making management decisions.

The scientific guidelines produced by the YDE include best estimates of population across the territory including sex ratio, calf recruitment, and adult mortality, broken down by most recent survey in each Moose Management Unit (MMU). Notably, the section on annual allowable harvest (maximum number of legal adults removed by hunting) distinguishes between MMUs inside the Inuvialuit Settlement Area and those outside; non-IFA lands are further divided between areas that are or may be subject to terms by a Yukon First Nation final land claim (i.e. Umbrella Final Agreement lands), and those that are not. The Department states that First Nations harvest pressure is not

uniformly reported, as some Nations do not give harvest reports, others give voluntary numbers generated by hunters, while others give highly detailed harvest reports.

The Moose Harvest Management Framework includes a number of recommended management tools, including the circumstances when the tool should be implemented and issues that can arise during or after implementation. Additionally, community consultations found four recommendations that members believe would positively contribute to management in the territory. As the UFA intended for each Nation to sign independent final land claims, the YFWMB publications appears to serve as a foundation for more specific management plans, as well as broad recommendations for Territory-wide moose management. The YFWMB Annual Reports also identify the broad goals and objectives for broad-scale management in Yukon, which are mostly focused on becoming integrated with fish and wildlife management as per the Final Agreements.

3.3 Gwich'in Renewable Resources Board

A prime example for the implementation of a co-management strategy for large ungulates is by the Gwich'in Renewable Resources Board (GRRB), operating in the Yukon and Northwest Territories and based in Inuvik, NT. The GRRB was formed from the Gwich'in Comprehensive Land Claims Agreement in 1992 as the body responsible for wildlife, fish, and forest management in the Gwich'in Settlement Area (GSA)(Appendix II). alongside a number of Aboriginal and non-Aboriginal management partners. The structure is common among the co-management schema developed at the time, with Regional Resource Councils (RRCs) representing the four communities within the GSA, being Aklavik, Inuvik, Tsiigehtchic, and Fort McPherson (S.C. 1992, c.53).

The GRRB sets strong goals and objectives for the moose management plan, as well as qualitative, but precise management principles centered around "effective co-management [...] using traditional, local, and scientific information on moose [and] involving communities in the research and management of moose" (Gwich'in Renewable Resources Board, 2000). Management plans developed by the GRRB are particularly good examples of co-management because they heavily blend western science-based population surveys completed by NWT ENR with traditional knowledge; failure to do so is a limiting factor in long-term successful wildlife management (Nasdady, 2003).

The moose plan is thorough in planning with complete Work and Action Plans addressing six areas of concern to wildlife planning; Population Characteristics, Habitat and Range Use, Harvest Management, Co-management, Culture and Education, and Industry and Tourism. The Action Plans further describe each section by the Current Status of relevant research and programs in the GSA, Concerns regarding moose management including missing information or community concerns, and Solutions designed to address the concerns. The Work Plan provides a recommended time frame for addressing each concern (annual or estimated completion), as well as which organization will lead and which will support addressing the concern. Conversely, the plan is lacking in technical information regarding the moose, saying:

> "*Management agencies know very little about moose population dynamics, habitat use and seasonal movements in the GSA. Moose exist at a low density compared to other similar areas in the north. [...] The reasons for this are not well understood, however browse is not limiting, and snow depths do not appear to seriously affect movements.*"
>
> -GRRB, "Moose Management Plan", 2000

The low density of moose in Arctic and sub-Arctic regions is common (Kellie et al., 2019), and is not necessarily related to the health of the moose population, nor the GRRB's ability

to conduct wildlife surveys. The GRRB acknowledges the lack of recent, accurate survey data in the Action Plan, and agreed to continue the Moose Harvest Survey as part of the Work Plan to address the issue. Neither harvest results after 2001 nor population estimates based on surveys after 1999 have been made public.

3.4 Wildlife Management Advisory Council

The grizzly bear (Ursus arctos) management plan is administered by the Wildlife Management Advisory Council (WMAC), both Northwest Territories and North Slope agencies. The WMACs were formed as a part of the Inuvialuit Game Council, itself formed by the Inuvialuit Final Agreement in 1984 as the first large-scale self-governance (i.e. co-management) agreement between Indigenous people and the Canadian government (S.C. 1984, c. 24). It covers grizzly bears within the Inuvialuit Settlement Area, roughly covering the western edge of the Canadian Arctic Archipelago the coastal areas of the Northwest Territories, and the Barn, British, and northern Richardson mountains, collectively known as the Yukon North Slope (Appendix III).

The most recent grizzly bear population studies in the Yukon North Slope region was completed in Ivvavik National Park in 1995, and while a study was slated to be completed in 1999, the results have not been made public (Nagy and Branigan, 1998). The Aklavik Community Management Plan indicates research and quota assessment is being conducted, and that "recent work on Yukon North indicates [a] healthy population that has increased since work done in [the] 1970's" (Wildlife Management Advisory Council (NWT), 2016). The WMAC also produced an extensive report on Inuvialuit Traditional Knowledge, interviewing several knowledge holders currently involved in the

management of grizzly bears in Ivvavik National Park and elsewhere on the Yukon North Slope (Wildlife Management Advisory Council (North Slope), 2008).

The framework of the grizzly bear management plan is very similar to the GRRB's moose plan, including Action and Work Plans, but is more descriptive. While the moose plan was produced before the grizzly plan, the WMAC pre-dates the GRRB by nearly a decade, as the IFA was signed before the GCLCA; therefore, it is likely that the structure of the WMAC and its' subsequent wildlife management plans was the inspiration for the land claims and co-management agencies that would come after (Nagy and Branigan, 1998).

3.5 Nunavut Wildlife Management Board

Use of narwhal (Monodon monoceros) by Inuit people in Canada has probably persisted for about 2,000 years, as a critical food resource and important source of materials. Modern management began with the Narwhal Protection Regulations (1971) assigning harvest quotas to individually approved hunters but was updated to assign community-level quotas in 1977, which better reflected population estimates which were based on historic community catches. Community quotas were further changed in 1993 under the Marine Mammal Regulations; the same year the Nunavut Land Claims Agreement was settled. In 1999, the NWMB facilitated community-based management that mostly maintained prior harvest levels but was further changed in 2009 in favor of quotas set by management zones, better aligned with management of the Fisheries Act under DFO (Department of Fisheries and Oceans, 2012).

As a migratory marine mammal, narwhals are subject to more complex interaction between management bodies; while the Minister of DFO retains the final say regarding

the protection of animals pursuant to the Fisheries Act, the NWMB is the primary management body in the Nunavut Settlement Area, and the NLCA takes precedent over the Fisheries Act where they are inconsistent regarding management decisions.

Satellite telemetry, genetic, and contaminant data suggest two distinct populations of narwhal; the Northern Hudson Bay unit, and the Baffin Bay unit, the latter of which is also found in Greenland. Numerous characteristics of narwhals make them very difficult to manage; marine mammals are poorly studied, they are highly transient, have indefinite home ranges (although narwhals show high site fidelity), and population estimates are confounded by "diving" individuals. "Local" practices are complicated, because although the Inuit people may be culturally indistinguishable in eastern Nunavut and northwestern Greenland, today they are constituents of two different modern countries, one of which is actually an autonomous region of a far distinct mainland European country. The NWMB may also be unaccountable, as the Fisheries Minister has the ability to mandate management actions without the input of local users. The stated objective of narwhal stock assessment, a critical component of management, is to better understand population dynamics to support a sustainable hunt; the management plan suggests information gaps and the actions necessary to close them.

3.6 General Discussion

The management plans discussed show distinct levels of specificity and detail proposed in the plan; the moose and bear plans show great structural similarity, but the bear and narwhal plan show greater similarity in level of detail, both in terms of describing goals and management principles, as well as background on the species in question. The YFWMB moose management plan is, perhaps unfairly, also highly detailed, as the

complete management plan is composed of three distinct documents. Having highly specific goals and principles provides more guidance to managers and makes progress more measurable. However, it can also be limiting; less specific measures allow managers more room and flexibility to achieve progress in different ways. Management plans should be flexible to allow for updates as local conditions change, and highly specific plans would require frequent meetings with relevant stakeholders to discuss and approve changes with managers. Higher engagement with stakeholders is desirable, however it can become inefficient and costly when stakeholders must frequently travel great distances by airplane to meet. This could be alleviated through the use of technology. Detailed background on the target species may be either unnecessary or difficult to produce; considering all plans discussed here have the goal of increasing and disseminating information about the species in the area of interest (managers should follow suit and implement this wherever), as much detail as is practical should be included. Conversely, data on the life history of large mammals in the Territories are lacking due to vast areas of wilderness, low species densities, and very costly surveillance (helicopters, airplanes, large areas, short season requiring frequent visits). This will remain true in Nova Scotia, in particular areas which likely have the highest moose population density, but not to the extent of the north. Additionally, TEK is an oral history, and thus may be incomplete, lost, or held by people not captured in surveys or community consultation.

Additionally, both the benefits and costs can change depending on the season, resource harvested, necessary labour, etc. While all ungulate species may provide high cultural value and significant material resources (meat, hide, bone, sinew, etc.), moose are solitary, relatively vagrant, difficult to transport and butcher due to their size, and exist at very low densities in some areas. When compared to other available ungulate species such

as caribou or whitetail deer, moose may prove too inaccessible to support desired hunting levels. Moose have a large, potentially disproportionate cost to obtain compared to caribou or deer, however they are still harvested and managed for sustainability, as the cultural value likely supersedes a pure cost-benefit analysis. This highlights an important, necessary intersection of culture and science; in a complex management scenario involving multiple, overlapping resources, cultural value is preserved by the scientific knowledge that determines population status and the harvest potential of vulnerable resources. This is assumed to be a highly effective strategy, or else these co-management agreements, now decades old, would have been abandoned.

The significant difference between current moose co-management practices in mainland Nova Scotia and elsewhere is the continuous Indigenous hunting practices (Popp et al., 2019). Not only does this indicate continued traditional practices and therefore traditional knowledge, but also produces useful western information in the way of harvest reports as an index of population. The solution to addressing lack of Traditional Knowledge in mainland Nova Scotia may be to borrow knowledge from these regions where it may be more intact. It is convenient that moose are and were present in nearly all of Canada, therefore tribes across the country will have traditional knowledge relating to many of the factors described above. In Nova Scotia where the western subspecies is present in Cape Breton, it may in fact be preferential to apply the traditional knowledge of the tribes present in the natural range of *A. a. andersoni*, rather than that of the Mi'kmaq. The practicality of this idea is heavily dependent on many factors including the level of concern regarding the genetic lineage of moose in Nova Scotia, and the practical differences between western and eastern moose ecology.

4. Limits to application in Nova Scotia

Effective management of wildlife from a purely science-based perspective is challenging, and the addition of cultural and historical perspectives, as well as additional layers of administration associated with TES can only increase the complexity. Padilla and Kofinas, through analysis of a specific co-management conflict in the Northwest Territories, identified four general issues that arise when implementing TEK in wildlife management (Padilla and Kofinas, 2014). How these issues may limit application in Nova Scotia are discussed below.

4.1 Context-specific nature of TEK limits its application in resource management regulations

As one of the first tribes contacted by European settlers, the Mi'kmaq have experienced the longest period of colonial influence of any Canadian Aboriginal groups. It follows that the Mi'kmaq experienced intensive pressure to conform to European lifestyles, and while traditional knowledge is retained, the precise extent of knowledge lost is unclear but presumed to be significant. In contrast, tribes from western and northern regions of Canada may have experienced cultural pressure to a lesser degree, as, until recently, the expansion and maintenance of European colonies in large swaths of these areas depended on Aboriginal ways of life including trapping and hunting. It is likely that these tribes have retained a greater proportion of their TK than the Mi'kmaq; this presents unique opportunities and challenges with regards to moose co-management in Nova Scotia.

It is unlikely that the moose itself is of any concern to the application of TEK between Nova Scotia and elsewhere. While there are a number of genetically distinct subspecies in Canada, they are practically indistinct beyond small size variation and

preferred species browse, and adaptable when translocated to suitable habitat (Franzmann, 2007, pg.532). More relevant is the relation and interactions between First Nations and moose; the TEK that developed in the Arctic regions is no substitute for that which developed in Nova Scotia. The context in which the cultures exist was and is vastly different; time present in the region, influence of weather, climate, and seasons, other game species present, population density of humans and moose, and the ecosystem in which they lived. These factors shape the local dependence on moose for resources, therefore influencing the significance and cultural relevance to communities. Due to the stratified moose habitat across the Territories, tribes near high moose densities in the southern Yukon and Northwest Territories would likely have greater reliance, and therefore more intimate connection to moose compared those in northern areas and Nunavut, where caribou, fish, and marine mammals are the primary sources of protein. Even within the same geopolitical boundaries and broad cultural association (i.e the Gwich'in First Nations group), the TEK surrounding moose may be different, suggesting the transferability of Arctic TEK, while possibly more intact than that of the Mi'kmaq, is extremely limited.

4.2 Changes in traditional [systems] affect the effectiveness of TEK approaches in a contemporary social setting

Reconciling traditional rights to harvest in the modern era is difficult and was the basis for some legal decisions made in the 1980s and 1990s that contributed to the recognition of subsistence harvesting, also known as "right to a moderate livelihood". Despite this conclusion being relatively widespread and accepted, there is still significant conflict surrounding the definition of "moderate livelihood". Traditional techniques for hunting and fishing can be made far more efficient by substituting modern tools for those

used in the past; dogsleds have been largely replaced by trucks where feasible, hand-made bark canoes replaced by aluminum and carbon fibre crafts, yew- and ash bows replaced by mechanically advantageous compound bows, gill nets made from hand-sewn bark fibre replaced by high-test fluorocarbon line, etc. These modern materials allow for extreme efficiency in harvesting over traditional ones, leading some to argue that First Nations using tools not available to them prior to European contact is beyond their traditional harvest rights. Proponents argue that harvesting rights cannot be static, and, like traditional knowledge, must live and grow with the holders of that knowledge. The issue is further complicated by the differences in economic systems of colonial and modern Canada; livelihood in the past meant acquiring food and the resources to perpetuate your existence and ability to provide for yourself. Today, livelihood provided by the exploitation of resources is measured by financial returns, which may be seen as contradictory to First Nation's traditional use of the land. Discussing moderate livelihood is worthy of a separate thesis.

Regardless, traditional systems, in many cases, conflict with both cultural and ecological contemporary settings. The condition of wildlife populations across Canada are vastly different today than in pre-contact times, meaning it may be inappropriate or impossible to practice traditional harvest methods today due to the presence, absence, or vulnerability of target and non-target species. There are a number of potential game species no longer present in Nova Scotia that would have presumptively been highly valuable to the Mi'kmaq in pre-contact times including the woodland caribou (*Rangifer tarandus;* ***Qalipu***), Atlantic walrus (*Odobenus rosmarus rosmarus;* ***Gisguàgw***), and great auk (*Pinguinus impennis;* ***Abaqtuqwech***). There are a number of species whose populations are generally accepted to be too vulnerable to support regular sustainable

harvesting including the eastern moose (*Alces alces americana;* ***Tia'm***), atlantic salmon (*Salmo salar;* ***Plamu***), and a number of cetaceans (Mysticeti, Odontoceti; ***Put'p***) (Province of Nova Scotia, 2017). Additionally, contentious, non-native species including white-tailed deer (*Odocoileus virginiana;* ***Lentuk***) and eastern coyote (*Canis latrans*) are now present in Nova Scotia, which each have an impact. The decline of moose and caribou are strongly associated with the presence of white-tailed deer, yet it may provide a suitable replacement to them as a source for food and materials. Coyotes may produce different predatory pressures on species than the extirpated eastern wolf (*Canis lupus lycaon;* ***Paqtism***) (Whitaker and Beazley, 2017), which could change the natural mortality rates, and therefore harvest potential, of ungulates. The role of introduced species and vulnerable populations must be a considerable part of research and community discussions.

4.3 Indigenous efforts toward self-government and political autonomy limit regional co-management consensus in a heterogenous cultural landscape

First Nations cultural heterogeneity is a non-factor in Nova Scotia. Those places with the most intact TEK such as Arctic regions and in British Columbia are also places with regions of significant cultures and linguistic heterogeneity. This simultaneously is an advantage and challenge when it comes to implementing wildlife co-management plans; TEK is more complete for a number of reasons, and geographically isolated communities within the same cultural group may compensate when knowledge is lost within them. However, distinct yet geographically close cultures may have competing views on the use of a resource in their immediate area, leading to conflict around the management of said resource. This is exemplified in the management conflicts surrounding the construction of the Dempster Highway and management of the local Porcupine Caribou Herd (Padilla and Kofinas, 2014).

Cultural heterogeneity is not a factor in co-management of moose in Nova Scotia. Individuals, communities, and management groups may have different opinions regarding hunting and management of moose and their habitats, but all communities within Nova Scotia are part of the Mi'kmaq First Nation. There is no expected difference in TEK between communities, except where it may be more complete than elsewhere. As the UINR states, Mi'kmaq TEK is being "rediscovered"; this could lead to different interpretations of quite fractured systems of knowledge, thereby creating differences in "modern" Mi'kmaq TEK (Lefert et al., 2014) . This will be more understood as knowledge is gathered from elders across the province.

4.4 The mismatch of agency enforcement of hunting regulations and TEK-based education is problematic

Co-management defined by locally informed and enforced regulation; otherwise there is no difference between centralized co-management and historic state management of wildlife with First Nations consultation. Success of these co-management strategies hinge on the interactions between enforcing agencies and the communities to which wildlife regulations apply (Nadasdy, 2003).

The authority of a First Nations person to harvest moose on Nova Scotia may be unclear; while there is an established and multi-year partnership between Parks Canada and the Unama'ki Institute of Natural Resources to allow Mi'kmaq moose harvest in Cape Breton, this is in response to a stated "hyperabundance" on the island and is not comparable to populations in mainland Nova Scotia. First Nations do have a legally proven right to provide a "moderate livelihood" within their traditional means, which would theoretically include harvesting moose both for resources to provide income and as avoided costs from groceries. Lands and Forestry, Nova Scotia's government body

responsible for management of wildlife and other resources, acknowledges this right to harvest natural resources, like most other provincial wildlife and resource management bodies (NSDLF, 2019, pg.44). In contrast, co-management boards recognize the First Nations right to harvest as being secondary only to the conservation of long-term, sustainable wildlife populations. This belief is embodied in numerous voluntary harvest closures initiated by the management boards in response to vulnerable populations. This should be intuitive, as First Nations harvesting rights can only exist as long as the resources exist to harvest sustainably.

Key to the long-term, successful co-management schema found in the Territories is the reciprocal acknowledgement of this fact; that the Aboriginal right to harvest natural resources is predicated on the fact that those resources exist in a healthy, self-sustaining population. Co-management must, therefore, be treated not as a method of circumventing pre-existing wildlife management laws, but rather a variation of management that includes regulations common to traditional North American Wildlife Management-model systems, such as voluntary closures to protect vulnerable resources.

5. Recommendations

Co-management of moose in Nova Scotia is effectively very limited, and the official capacity of Mi'kmaq managers is to participate in a cull within Cape Breton Highlands National Park. Their involvement in setting management objectives, participating in data collection, and indirect management activities (i.e. forest management, predator control, etc.) appears unclear or limited. This is probably because the moose harvest is part of a broad plan to recover boreal forest habitat in the national park, and the hyperabundant moose population is attributed to over-browsing boreal

species. The occurrence of the moose cull on (near?) the national park is significant; the national park system in Canada began with the notion that non-revenue generating activities (i.e. traditional hunting and trapping) would be excluded, however many modern national parks such as Ivvavik (YT), Vuntut (YT), Kluane (YT), and Torngat Mountains (NL) were formed with the intention that traditional activities would continue in the newly protected area. It is not a stretch to believe First Nations subsistence activities should be a significant component of park management. Therefore, the sole example of cooperative management in Nova Scotia could be interpreted as a fortunate intersection of Parks Canada's management goal, and the UINR's cultural goals. This provides an excellent foundation for future co-management projects.

The primary problem of implementing a co-management regime for moose in Nova Scotia are unanswered questions regarding the feasibility. It may be that numerous factors make a co-management system so difficult to implement in Nova Scotia that it is impractical to do so.

5.1 Questions that should be addressed

1. How important is the genetic heritage of moose, relative to its presence?

The moose currently managed by Parks Canada and hunted by the Mi'kmaq in Cape Breton were imported from Elk Island National Park in Alberta, and as such are the western subspecies (*A. a. andersoni*), genetically distinct from the native eastern subspecies in mainland Nova Scotia (*A. a. americanus*). Western moose fill an identical ecological niche to the eastern moose, and there is no indication they should be managed differently. Sustainable harvest is a prerequisite to a successful co-management system; therefore, potential co-managers must identify whether their priority is to maintain the

genetic purity of eastern moose in Nova Scotia or have a sustainable population of indistinct heritage.

RECOMMENDATION: *The mainland moose population is extremely vulnerable. Co-managers should consider translocating moose from healthy populations (those that support hunting) outside the mainland; populations of eastern moose exist in New Brunswick and Newfoundland, while western moose can be introduced from Cape Breton.*

2. What are the limiting factors to moose in mainland Nova Scotia?

Vulnerable populations cannot recover if unfavourable conditions persist. The issues outlined by the Nova Scotia Moose Recovery Plan must be identified, ideally using both scientific and traditional knowledge where possible. Potential co-managers must work to identify TK that can help answer questions but should contribute resources and capital to help government managers answer questions using western knowledge. Co-management is fundamentally about distinct groups cooperating to manage a shared resource.

RECOMMENDATION: *Members of communities participating in co-management must be trained in western wildlife management practices; those who see with both eyes are more effective managers than two managers who each see with one eye. Demographics; Harvest; Disturbance factors are well-suited issues for managers with TK to address*

3. What new management structures must be in place?

Comprehensive co-management is complex, and success requires specialized groups and individuals. Several First Nations management groups exist, including Unama'ki Institute of Natural Resources and Mi'kmawey Forestry. These groups are experienced in drafting and implementing management proposals, and members within them have practical experience in a number of fields including wildlife, forestry, and fisheries. These institutions, among others, may be perfect candidates to form the base of co-management structures, and could be expanded or modified. Co-managers must be careful balancing

necessary resources with expanding bureaucracy; pre-existing government and tribal agencies have multiple levels, and merging institutions can prove very complicated, impeding effective and responsive management.

RECOMMENDATION: *Base future co-management government structures on systems that have shown success; create or modify existing groups to achieve a balance of community involvement, thorough and informed consultation, and efficient decision making.*

4. What legal issues may be encountered?

Likely the most significant challenge to implementing territorial co-management in Nova Scotia is the drastic legal distinctions between Nova Scotia and the Territories. Land ownership was a relatively simple issue in the territories at the time of land claim settlements, as the vast majority of land was either publicly owned or privately owned by First Nations corporations. Conversely, long and complicated court battles in British Columbia and the Maritimes have been settled over the use of land and resources, yet the legal status of First Nations resource use and management is not settled nor clearly understood. Nova Scotia is composed of a complex patchwork of public- and privately-owned land, with diverse resources and user groups, and implementing broad-scale co-management will prove controversial

RECOMMENDATION: *Cooperation with government agencies is critical. Partnerships with user groups and the Department(s) of Environment, Lands and Forestry, Fisheries and Aquaculture, and Parks Canada may help facilitate relationships and minimize conflict with user groups*

5. How should nonusers be consulted?

Conflict over natural resources between users and nonusers is common, particularly concerning hunters and nonhunters. Generally, groups that tend to oppose hunting concede that the practice is vital to the culture of Indigenous people; paradoxically, non-native hunters often express frustration and anger towards Indigenous harvesters, claiming Indigenous harvest rights are unfairly preferential, illegal, unnecessary, and/or exploitative. Hunting is a central tenet of co-management, and opponents will object to harvesting wildlife from a variety of positions. While opposition views cannot be fully incorporated into wildlife management systems (doing so would fundamentally restrict most management actions), it must be the goal of managers to minimize conflict and improve community cohesion, including nonusers.

RECOMMENDATION: *Opponents to hunting in general and preferred Aboriginal hunting specifically must be considered and properly consulted before harvesting is implemented in a potential co-management system.*

6. How should users and community members be consulted?

Gathering TK is imperative to a functional co-management strategy. In the past, community members from First Nations on Cape Breton have been involved in knowledge gathering regarding the moose harvest; this should be continued, while consulting more knowledge holders. Elders and harvesters from Mi'kmaq communities around mainland Nova Scotia may be a priority, but other jurisdictions must be considered. New Brunswick and Quebec have Mi'kmaq and non-Mi'kmaq communities that exist in regions with larger, more continuous moose populations; there may be knowledge that was lost or that may enhance traditional knowledge from Nova Scotia. Traditional knowledge is locally

and culturally specific, and the most important knowledge comes from the land and community. Perhaps more fundamentally, it is knowledge that comes from, and perpetuated by practicing on the land. Just as moose were imported and became naturalized, it may be possible to do so with traditional knowledge.

RECOMMENDATION: *Considering its fragmented nature, Mi'kmaq traditional knowledge must be consolidated where possible and augmented where necessary. Managers should consider gathering knowledge along three axes (in descending order of proximity and priority); 1) Mi'kmaq Traditional Knowledge within Nova Scotia, 2) Mi'kmaq Traditional Knowledge from Mi'kmaq communities extraneous to Nova Scotia, 3) Traditional Knowledge about moose extraneous to Mi'kmaq communities*

5.2 How *Limits to Application* may be addressed

Traditional Ecological Knowledge is necessarily dependent on the culture of the people holding it, and the local environment they live in. The nature of TEK makes it vulnerable, however, as a breakdown in the continuity of culture or resource use can reduce or eliminate the knowledge base; while this breakdown certainly happened to Indigenous groups across the country, the Mi'kmaq have likely experienced the most significant reduction of TEK. To alleviate the problem of reduced TEK, two general paths should be followed:

1. Continue to gather as much in-context (within Nova Scotia) TEK as possible
2. Gather and share out-of-context (outside of Nova Scotia, outside of Mi'kmaq culture) TEK where necessary and feasible. Managers must accept that some TEK has been lost from the province and adapt to solve problems. Out-of-context TEK should not be considered as valuable. Consider molding and changing out-of-context TEK to be more applicable and complimentary to the knowledge and management conditions in Nova Scotia.

There are several existing organizations focused on Mi'kmaq-led resource conservation and management; these organizations may be modified and incorporated into a new management structure. The nested structure of successful territorial co-management boards should serve as a model for a Nova Scotia-wide co-management board. Important characteristics include local community-focused resource councils for consultation and implementing management decisions, regional boards to coordinate action between community boards (Cape Breton, Mainland regions), and a provincial management board that makes final decisions. Cooperation with government-management agencies at all levels is important. A preliminary review of successful co-management strategies was published by Elinor Ostrom (Ostrom, 1990), and later updated by Cox and colleagues (Cox et al., 2010). These documents provide very useful analyses and characteristics of co-management systems that will help develop long-term institutions.

The primary cultural concern of territorial management boards is the heterogeneity of Indigenous cultures; for example, there are eleven First Nations tribe in the Yukon representing six principle groups (Kutchin, Hän, Kaska, Tagish, Tutchone, Teslin) (Coates, 1993), as well as Inuvialuit Inuit. There are cultural differences between these Indigenous groups, however both Indigenous and non-Indigenous people in the Yukon likely have a more homogenous and positive support of subsistence hunting and land use. Conversely, in Nova Scotia, there is only Mi'kmaq culture, but a greater variety of opinion on land use, hunting, and Indigenous harvest. The challenge is to maintain cooperation with opponents to hunting and Indigenous management and harvest; non-users must be critically considered and included as a part of community and provincial consultations.

Understanding how Indigenous management can be applied in Nova Scotia's legal context is critical. It must also be well understood that self-restricting aboriginal harvest,

despite the legal right to, is a critical aspect to maintaining sustainable wildlife resources that support long-term harvesting. It is likely that some proportion of 'unlicensed harvesting', as called by the government of Nova Scotia, is done by Indigenous people practicing their right to a moderate livelihood. Indigenous-led community management groups will be conducive to honest consultation with these users. Indigenous harvest rights in the short-term *cannot* precede sustainable, informed wildlife management; this will involve voluntary harvest restrictions. Such restrictions have been effectively implemented by the territorial management boards and are already recommended by the UINR.

6. Conclusions

It is clear that the incorporation of Western and Traditional Knowledge in the frame of Two-Eyed Seeing has advantages over using just one in any given management scenario. That being said, it is not a perfect system, and there are contradictions and clear gaps in knowledge that still exist after consulting both knowledge sets. Traditional Knowledge struggles relative to Western Knowledge is in its erodibility and fragility; while scientific information is constantly updated and based on repeatable studies, Traditional Knowledge exists within people and practice and can be lost if not passed down to younger generations. Clifford Paul, moose manager with the UINR states as much saying "for many years, the traditions of the moose harvest were lost because there were no moose [... but today] the traditional ways are being rediscovered" (UINR, 2014). It is unclear the volume and depth of information that has been lost from the Mi'kmaq, however it appears that the knowledge base, in general, is far more fragmented that those of tribes from Western, Plains, or Arctic regions, likely due to a longer period of

colonization over a smaller geographic area. Conversely, Western Knowledge lacks guidance, and requires input and context from managers to develop hypotheses and objectives that drive the direction of research and management. The benefit of Two-Eyed Seeing and co-management is that both systems of knowledge work to mitigate the weaknesses of each other.

Two quotes are relevant to the future of co-management in Nova Scotia. Esteemed moose researcher W.C. Gasaway noted during a review of moose population parameters that the two most common restrictions to proper wildlife management are the lack of funds and lack of creativity on the part of biologists and hoped that "[...] technology and funding rather than biologists limit management success" (Gasaway et al., 1985). Development of thorough, efficient, and informative techniques for surveying and estimating the critically vulnerable moose population in mainland Nova Scotia has been and will be challenging, but it is the foundation of sound management; thoughtful and creative solutions are necessary. Second, Brian Czech concluded that American Indians might leverage their ecological knowledge, vast territory, and political sovereignty, in combination with comprehensive training in western scientific management, to achieve effective natural resource management. He wrote "all else equal, no one makes a better wildlife conservationist (whether it be in the form of a technician, biologist, or concerned citizen) than one who was born and raised on the land they will manage" (Czech, 1995). This illustrates the importance of Mi'kmaq community members being trained in science-based management techniques; while cooperation between managers of separate systems is vital (two people seeing with one eye each), it is more efficient and perhaps more insightful when both systems can cooperate within one person (one person seeing with two eyes)

(Bartlett et al., 2012). Such was the inspiration Elder Albert Marshall in first developing the concept.

A growing body of research suggests co-management is an effective strategy for enhancing resource management. In particular, as the Canadian government seeks to improve relationships with First Nations people in the era of reconciliation, co-management, when implemented correctly, is a win-win scenario. First Nations people are given a mandate for hands-on management of the resources so critical to their culture and history. State managers have access to a large volume of knowledge and a potential workforce that has an intimate knowledge of the resources and land at question. An initial assessment of practical co-management in Canada provides useful context; where is it being practiced, how long has it been practiced, what are the best examples, what role do existing institutions take, and what new institutions were developed provides useful context for developing further co-management systems. Implementing a co-management system is worth investigating, for the cultural and ecological value it may provide.

7. References

Abu, Razak., M. G. Reed, & T. D. Jardine. 2019. Using two-eyed seeing to bridge Western science and Indigenous knowledge systems and understand long-term change in the Saskatchewan River Delta, Canada. International Journal of Water Resources Development. doi: 10.1080/07900627.2018.1558050

AMEC Environment and Infrastructure. 2013. A Mi'kmaq Traditional and Ecological Knowledge Review of three Wind Project Development Properties: Historical and Field Survey Information. Report # TV134003, AMEC, Dartmouth, NS, December 2013, p. 73

Armitage, D., F. Berkes, A. Dale, E. Kocho-Schellenberg, & E. Patton. 2011. Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. Global Environmental Change, 21(3), pp. 995–1004. doi: 10.1016/j.gloenvcha.2011.04.006

Bartlett, C., M. Marshall, & A. Marshall. 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(4), pp. 331–340. doi: 10.1007/s13412-012-0086-8

Benson, Denis A. & D. G. Dodds. 1977. The Deer of Nova Scotia. Department of Lands and Forests, Province of Nova Scotia, 92 p.
Coates, K. S. 1993. Best left as Indians: Native-White relations in the Yukon Territory, 1840-1973. McGill-Queen Press. ISBN 9780773511002, p. 384

Cox, M., G. Arnold, & S. V. Tomás. 2010. A review of design principles for community-based natural resource management. Ecology and Society, 15(4), 38. doi: 10.5751/es-03704-150438

Czech, B. 1995. American Indians and wildlife conservation. Wildlife Society Bulletin 23(4), pp. 568-573

Delgamuukw v. British Columbia (1997) 3 SCR 1010 (SCC)

Department of Fisheries and Oceans. 2012. Integrated fisheries management plan (IFMP) for narwhal (*Monodon monoceros*) in the Nunavut Settlement Area, https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/narwhal-narval/index-eng.html

Franzmann, A. W. 1980. Chapter 5: Moose. Big Game of North America: Ecology and Management, Compiled and Edited by J. L. Schmidt and D. L. Gilbert, 2nd Ed., Stackpole Books, pp. 67-81

Franzmann, A. W. 2007. Restraint, Translocation, and Husbandry. In Ecology and Management of the North American Moose (2nd Ed.), pp. 519-557. Boulder, CO: University Press of Colorado.

Gasaway, W. C., & S. D. DuBois. 1985. Estimating moose population parameters: a review. Alaska Department of Fish and Game, Fairbanks, AK, p. 49. http://www.adfg.alaska.gov/static/home/library/pdfs/wildlife/research_pdfs/estimating_moose_population_parameters_review.pdf

Gwich'in Land Claim Settlement Act (S.C. 1992, c. 53)

Gwich'in Renewable Resources Board. 1992. Inuvik, NT. Retrieved from http://www.grrb.nt.ca/settlementarea.htm

Gwich'in Renewable Resources Board. 2000. Moose Management Plan for the Gwich'in Settlement Area, Northwest Territories. Inuvik, p. 20, http://www.grrb.nt.ca/pdf/wildlife/moose/00-05%20Moosemagmtplan.pdf

Hebda, A. J. 2014. The Mi'kmaw Bestiary: a compendium of documented Mi'kmaw terms and phrases relating to animals, Curatorial Report Number #103, Nova Scotia Museum, Halifax, p. 80. https://ojs.library.dal.ca/NSM/article/view/5391/4840
Jackson, K. 2008. Moose. Reaktion Books, p. 200

Joint Secretariat. 2001. Inuvik, NT. Retrieved from https://www.jointsecretariat.ca/where-we-are

Kellie, K. A., K. E. Colson, & J. H. Reynolds. 2019. Challenges to monitoring moose in Alaska. Alaska Department of Fish and Game, Wildlife Management Report ADF&G/DWC/WMR-2019-1, Juneau, p. 86http://www.adfg.alaska.gov/static/home/library/pdfs/wildlife/mgt_rpts/challenges_monitoring_moose_alaska_wmr_2019_1.pdf

Lefert, N.., C. Paul, E. Johnson, & C. Dennis. 2014. Tiam; Mi'kmaq Ecological Knowledge: Moose in Unama'ki. Unama'ki Institute of Natural Resources (UINR), p. 28 http://dev.uinr.ca/wp-content/uploads/2014/05/Moose-MEK-web-1.pdf

McNeil, J. 2013. Action plan for the recovery of Eastern Moose (Alces alces Americana) in Mainland Nova Scotia. Nova Scotia Endangered Species Act Action Plan Series, Mainland Moose Recovery Team and Mersey Tobeatic Research Institute, Kempt, Nova Scotia, p. 26 https://novascotia.ca/natr/wildlife/biodiversity/pdf/actionplan/Mainland%20Moose%20Action%20Plan_FINAL.pdf

Nadasdy, P. 2003. Reevaluating the co-management success story. Arctic, 56(4), pp. 367–380. doi: 10.14430/arctic634

Nagy, J. A., & M. Branigan. 1998. Co-management plan for grizzly bears in the Inuvialuit Settlement Region, Yukon Territory and Northwest Territories. Inuvik, NT Department of Resources, Wildlife, and Economic Development, Wildlife Management Advisory Council, North Slope and Northwest Territories, p. 63.

Nova Scotia Department of Natural Resources (NSDNR). 2007. Recovery plan for moose (*Alces alces americana*) in Mainland Nova Scotia. Nova Scotia Endangered Species Act, Recovery Plan Series, p. 40

https://novascotia.ca/natr/wildlife/biodiversity/pdf/recoveryplans/MainlandMooseRecoveryPlan.pdf

Nova Scotia Department of Lands and Forestry (NSDLF). 2019. Nova Scotia Hunting and Fur Harvesting Summary of Regulations, 2019 Nova Scotia Hunting and Fur Harvesting Summary of Regulations, pp. 44–45 (2018).

Nunavut Land Claims Agreement Act (S.C. 1993, c. 29)

Nunavut Wildlife Management Board. 2002. Iqaluit, NU. Retrieved from https://www.nwmb.com/en/139-english/sidebars/environment/110-nunavut-maps

Organ, J.F., V. Geist, S.P. Mahoney, S. Williams, P.R. Krausman, G.R. Batcheller, T.A. Decker, R. Carmichael, P. Nanjappa, R. Regan, R.A. Medellin, R. Cantu, R.E. McCabe, S. Craven, G.M. Vecellio, & D.J. Decker. 2012. The North American model of wildlife conservation. Technical Review 12-04, p. 60. The Wildlife Society, Bethesda, Maryland, USA https://wildlife.org/wp-content/uploads/2014/05/North-American-model-of-Wildlife-Conservation.pdf

Ostrom, E. 1990. Governing the Commons: The evolution of institutions for collective action. doi: 10.1017/cbo9780511807763, Cambridge University Press, p. 280

Padilla, E., & G. P. Kofinas. 2014. "Letting the leaders pass": barriers to using traditional ecological knowledge in co-management as the basis of formal hunting regulations. Ecology and Society, 19(2) 7. doi: 10.5751/es-05999-190207

Parker, G. 2003. Status report on the Eastern Moose (*Alces alces americana* Clinton) in Mainland Nova Scotia., p. 77 https://pdfs.semanticscholar.org/d4e0/d16f85f72bdaf7aa477d34fd51251579d980.pdf?_ga=2.76746965.1199988151.1588113155-342681838.1588113155

Peterson, R. L. 1955. North American Moose. University of Toronto Press

Popp, Jesse N., P. Priadka, & C. Kozmik. 2019. The rise of moose co-management and integration of Indigenous knowledge. Human Dimensions of Wildlife 24(2), pp. 159-167.

Province of Nova Scotia. 2017. Categorized List of Species at Risk. Retrieved from https://novascotia.ca/just/regulations/regs/eslist.htm

The Wildlife Society. 2016. Standing Position: The North American Model of Wildlife Conservation. Retrieved from https://wildlife.org/wp-content/uploads/2016/04/SP_NorthAmericanModel.pdf

Tsilhoq'in Nation v. British Columbia, 2014 SCC 44

Western Arctic (Inuvialuit) Claims Settlement Act (S.C. 1984, c. 24)

Wildlife Management Advisory Council (North Slope), Aklavik Hunters and Trappers Committee. 2008. Aklavik local and traditional knowledge about grizzly bears of the Yukon North Slope: Final Report. Whitehorse, Yukon: Wildlife Management Advisory Council (North Slope). P. 46 https://wmacns.ca/resources/aklavik-grizzly-bear-traditional-knowledge-study/

Wildlife Management Advisory Council (NWT). 2016. Aklavik Inuvialuit Community Conservation Plan, Akaqvikmiut Nunamikini Nunutailivikautinich. Inuvik, NT., p. 153. http://www.screeningcommittee.ca/pdf/ccp/Aklavik_CCP.pdf

Whitaker, A. N., & K. F. Beazley. 2017. Evidence for the historical occurrence of wolves (Canis spp.) in Nova Scotia, Canada. The Canadian Field-Naturalist, 131(1), pp. 32-36. doi: 10.22621/cfn.v131i1.1775

Yukon First Nations Land Claims Settlement Act (S.C. 1994, c. 34)

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