

*Improving the American Eel Fishery
Through the Incorporation of Indigenous
Knowledge into Policy Level Decision
Making in Canada*

**Amber Giles, Lucia Fanning, Shelley
Denny & Tyson Paul**

Human Ecology
An Interdisciplinary Journal

ISSN 0300-7839

Hum Ecol
DOI 10.1007/s10745-016-9814-0



Your article is protected by copyright and all rights are held exclusively by Springer Science +Business Media New York. This e-offprint is for personal use only and shall not be self-archived in electronic repositories. If you wish to self-archive your article, please use the accepted manuscript version for posting on your own website. You may further deposit the accepted manuscript version in any repository, provided it is only made publicly available 12 months after official publication or later and provided acknowledgement is given to the original source of publication and a link is inserted to the published article on Springer's website. The link must be accompanied by the following text: "The final publication is available at link.springer.com".

Improving the American Eel Fishery Through the Incorporation of Indigenous Knowledge into Policy Level Decision Making in Canada

Amber Giles¹ · Lucia Fanning¹  · Shelley Denny² · Tyson Paul²

© Springer Science+Business Media New York 2016

Abstract Effective management of ecosystems, natural resources, and harvesting practices is essential for ecosystem health and the sustainable use of marine resources. Although the value, importance, and benefits of the incorporation of indigenous knowledge, particularly of traditional ecological knowledge into western science-policy decision-making have been well recognized over the past few decades, suitable mechanisms for collecting and incorporating indigenous knowledge into policy level decision making are not yet well understood. This study examines the Canadian government's assessment process for the American eel, *Anguilla rostrata*, as well as the community level management process for the eel fishery in Eskasoni First Nation, Cape Breton, Nova Scotia, Canada. This case study allows for an exploration of the challenges arising from differing worldviews and possible mechanisms for meaningful integration of indigenous values into governmental policy level decision-making.

Keywords Indigenous knowledge · Knowledge systems · American eel fishery · Eskasoni First Nation · Canada

Introduction

Effective management of ecosystems, natural resources, and harvesting practices is essential for ecosystem health, and

sustained harvesting (Chapin *et al.* 2009). Although the value, importance, and benefits of the incorporation of indigenous knowledge systems (IKS), particularly of traditional ecological knowledge, into western science-based knowledge systems have been well recognized over the past few decades (Berkes *et al.* 2000; Berkes *et al.* 2007; Houde 2007; Reo and Whyte 2012; Simpson 2004; Whyte 2013), suitable mechanisms for collecting and incorporating IKS into policy level decision making are not yet well understood. As a result, current natural resource management decision-making processes in Canada, especially at the governmental and academic levels, are guided primarily by western science-based knowledge systems.

The Mi'kmaq people of Eastern Canada, particularly those of the Unama'ki district (Cape Breton Island, Nova Scotia), have recognized the socio-ecological value to be gained by adopting a "two-eyed seeing" approach to decisions affecting natural resource management (Marshall 2004). This concept, also referred to as *Etuaptmunk*, is described by Mi'kmaq Elder Dr. Albert Marshall (2004) as "... learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing ... and learning to use both these eyes together, for the benefit of all."

Indigenous knowledge systems contain unique ways of understanding ecological relationships intertwining biological, spiritual, cultural, social, and management information that could contribute to more informed decision making over natural resources when coupled with western, science-based knowledge systems. Developed over millennia of intricate relationships between indigenous peoples and their territories, IKS have been adapted and transmitted across generations (Reo and Whyte 2012). Many Indigenous knowledge systems, including those of the Mi'kmaq, are interconnected by nature but for the ease of conceptualization we will separately

✉ Lucia Fanning
lucia.fanning@dal.ca

¹ Marine Affairs Program, Dalhousie University, Halifax, NS, Canada

² Unama'ki Institute of Natural Resources, Eskasoni, Cape Breton, NS, Canada

discuss five components: practice, beliefs, values, adaptation, and transmission (Berkes 2006).

Using Mi'kmaq knowledge of the American eel, *Anguilla rostrata*, each component of the knowledge system will be introduced. Similar to the findings identified by Reo and Whyte (2012) for the hunting practices of the Lac du Flambeau Band of Lake Superior Chippewa Indians, the beliefs and values of the Mi'kmaq knowledge system form a moral code and give a framework for determining acceptable and non-acceptable eeling practices. Eeling knowledge has been transmitted through generations by oral tradition and observation, and adapted over time to the changing environment and socio-economic landscapes. This has resulted in a continual accumulation of communal knowledge about the American eel within the Mi'kmaq knowledge system.

The American eel has been important to the Mi'kmaq for thousands of years for medicinal, subsistence, health, social and ceremonial as well as economic purposes (Davis *et al.* 2004). Over the past several decades, directed commercial fisheries, habitat destruction and fragmentation from hydro dams and other anthropogenic factors have led to the decline in abundance and distribution of the American eel (G. Chaput *et al.* 2014; Miller and Casselman 2014). This decline has led the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to recommend listing the American eel as threatened, and has triggered consideration of a listing under Canada's 2003 *Species at Risk Act* (SARA). Aboriginal people have the right to fish, hunt and gather for food, social or ceremonial purposes, the right to self-governance, a legal stake in resource conservation and management decisions, and a responsibility to their territory and all of its inhabitants (Wildsmith 1995). The implications of a threatened designation under SARA could significantly affect Mi'kmaq ability to access the resource, maintain their relationship with the American eel, and exercise their Aboriginal and Treaty rights and responsibilities. This research uses a case study approach to examine the COSEWIC and SARA assessment process for the American eel, as well as the community level management process of the eel fishery in Eskasoni First Nation, Cape Breton, Nova Scotia. We explore the challenges arising from differing worldviews and possible mechanisms for meaningful integration of indigenous values into governmental policy level decision-making.

Knowledge Systems

A knowledge system held by a community, whether indigenous, scientific, or local fishing community, is the system by which knowledge is developed, accumulated, and adapted over time (Carm 2014). Knowledge is expressed through the five components of the system: transmission, practice, beliefs, values and adaptation (Fig. 1). Knowledge is transmitted

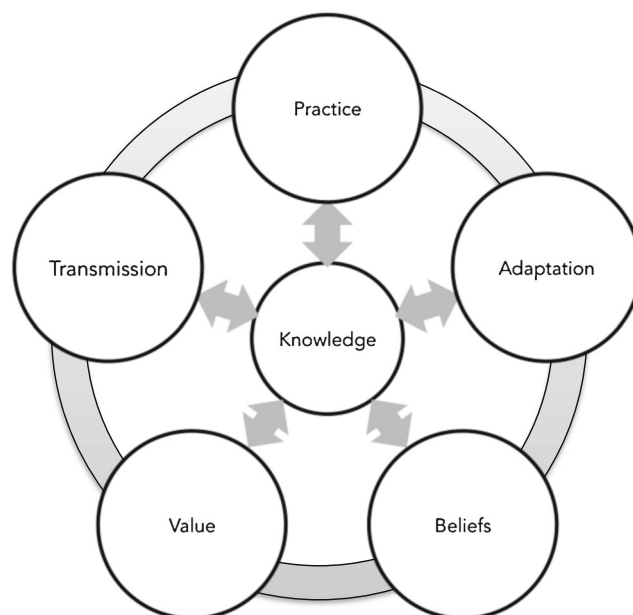


Fig. 1 Conceptual model illustrating each of the six parts of a knowledge system and how they are interconnected

through conversations, stories, observation, participation, body language, writing, and facial expressions, influenced by language and location. The practice component occurs in the practical application of knowledge, finding best practices over time to achieve objectives. Beliefs provide reasoning for choosing one practice over another. Along with the values, beliefs act to provide a moral code that distinguishes right and wrong (Reo and Whyte 2012). Knowledge systems are dynamic, constantly adapting as events ranging from local to global impact the environment of knowledge holders (Battiste 2005).

Mi'kmaq Knowledge Systems

The ultimate source of knowledge for many indigenous people is the land itself (Simpson 2014; Turnbull 2009; Wildcat *et al.* 2014). Some scholars have noted that while colonization has systematically displaced many indigenous nations from their homelands, their knowledge systems remain deeply rooted in their ancestral territories, intertwining spirituality, culture, beliefs, environmental knowledge, and social code into practices in all aspects of life (Cornthassel 2012; Wildcat *et al.* 2014). For the Mi'kmaq, this non-compartmentalized approach to knowing provides important ecosystem knowledge and frameworks for thinking about natural resources (Barnhardt 2005).

Indigenous knowledge has been defined and classified in many ways, often referred to as aboriginal traditional knowledge (Berkes and Henley 1997), traditional ecological knowledge (Houde 2007; Reo 2011), or, in Mi'kmaq territory,

Mi'kmaq ecological knowledge. Each term has different connotations and definitions, notably within different organizations or disciplines. This inconsistency further adds to the difficulty of integrating indigenous knowledge into policy (Whyte 2013).

Indigenous knowledge is commonly defined in relation to western knowledge and presented as a dichotomy, for example that indigenous knowledge is generally trusting of inherent wisdom and is holistic while western knowledge is inherently skeptical and compartmentalized. Others note indigenous kinship with the environment while a western knowledge system sees dominance. For some as well, the dichotomy includes the spirit being recognized in everything in a Mi'kmaq knowledge system as opposed to a western knowledge system that recognizes only humans as having a spirit (Barnhardt 2005; Usher 2000). Although this dichotomy can be useful for conceptualizing some of the differences between the knowledge systems, it should be recognized that indigenous knowledge is more than just the binary opposite of western knowledge (Battiste 2005).

Within the Mi'kmaq knowledge system, two concepts predominate: *Netukulimk*, which recognizes that sustenance is physical and spiritual, and that harvesting practices should not foreclose on options for the next seven generations to sustain themselves (UINR 2009); while *M'sit No'kamaq* translates as 'all my relations' and acknowledges that Mi'kmaq people are related to all those with whom they share their territory. The concept acknowledges the spirit in all species and implies reciprocal responsibilities.

Western Knowledge Systems

The scientific way of knowing, also referred to as science-based knowledge (Kuhn 2012), is a systematic verification process to test questions from observations and designed to reduce bias (Hurlbert 1984). There are five key-components to an experimental approach, (1) hypothesis, (2) design, (3) execution, (4) analysis, and (5) interpretation. This approach, also known as the hypothetico-deductive method or the scientific method, defines the practice for the investigation of the natural world and accumulation and transmission of knowledge (Hassan and Hanapi 2013; Kuhn 2012; Weiss *et al.* 2013). The scientific method aims to produce empirical information that can be repeatedly regenerated. These results are generally transmitted in the form of a report, peer reviewed journal article, or presentation at a discipline-specific conference.

Western society often accepts scientific ideas above other sources, considering science-based knowledge to be fully objective and indisputable (Longino 1990). Like all systems of knowledge, scientific practices are governed by values and beliefs (Longino 1990).

Research Site

Eskasoni First Nation, located along the Bras d'Or Lakes of Unama'ki or what is now known as Cape Breton, Nova Scotia (Fig. 2), is the largest Mi'kmaq community on the continent, with a population of approximately 4000 and covers 36.4²km (Eskasoni 2014a, b). The current location was established in the 1940s following a centralization policy relocating Canada's Aboriginal people to specific locations. Like other First Nations communities in Canada, a community-elected Chief and Council govern Eskasoni.

The community of Eskasoni is involved in fisheries for both commercial and subsistence, social and ceremonial purposes. The community owns and operates a commercial fishing company, which is the largest employer in Eskasoni, employing 12 full time staff and 150 fishers, contributing 9.46 % of the community's annual revenues (Eskasoni 2014a; FishWIKS 2013). Eskasoni is also home to the Unama'ki Institute of Natural Resources (UINR), which represents the five Mi'kmaq communities of Unama'ki and was formed to address concerns regarding natural resources and their sustainability (UINR 2013).

Methods

This research addresses concerns raised by many indigenous communities regarding their level of participation in research activities by adopting a fully participatory approach (Battiste 2011; Castleden *et al.* 2008; Simpson 2004; Smith 1999). We consider a participatory approach to have as its core philosophy inclusivity and recognition of the value of engaging communities into the research process, with the intent of providing something that will be useful to the community (Cargo and Mercer 2008; Cochran *et al.* 2008). The community of Eskasoni First Nation, including members of the Band Council, commercial fishers and representatives from UINR have been instrumental in the development of both the research focus and methodology of this research.

Interviews were conducted during the summer of 2014 with two groups of participants - Eskasoni First Nations eel fishers and federal government management representatives involved in the assessment process under SARA and COSEWIC.

Eskasoni Eel Fishers

All fishers from Eskasoni with past or present involvement in the eel fishery were invited to participate in this research. Thirteen open-ended interviews focused on information regarding timing, fishing practices, numbers harvested, perception on stock status over time, purpose for fishing and how knowledge is acquired and shared. All

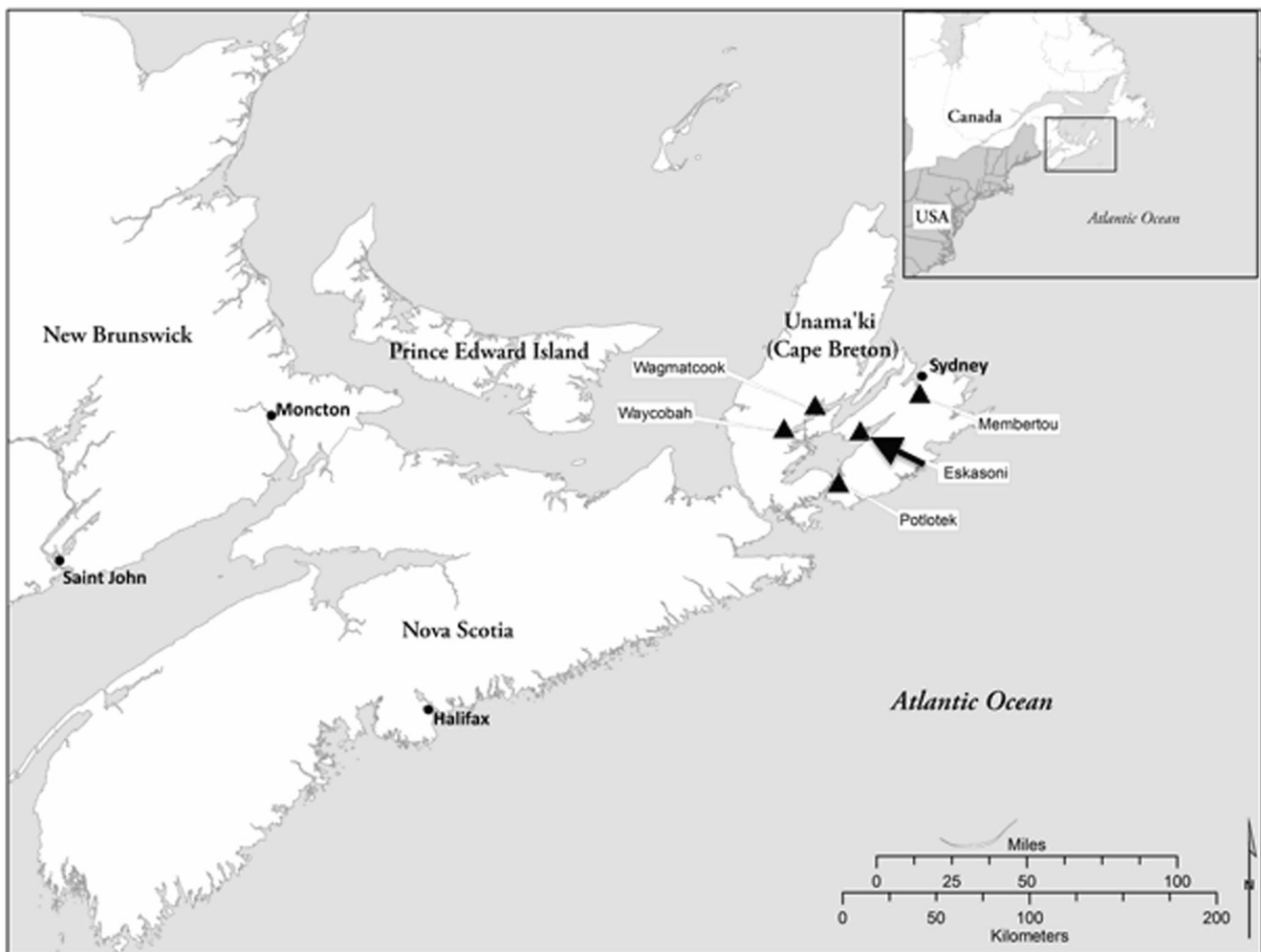


Fig. 2 Map showing the location of Eskasoni First Nation on the Bras d'Or Lakes, Cape Breton, Nova Scotia (Source: www.cdc.gov/pcd/issues/2012/12_0039.htm)

interviews were recorded, transcribed and the responses coded manually. Fishers ranged in age between early 20s to mid-70s and only one was female. Eelers responses were commonly in the form of a story.

During the interviews, participants were also invited to indicate areas where eeling took place on maps. Nine participants shared their knowledge regarding fishing locations. Maps were then digitized using Arc GIS and areas were outlined with polygons. A generalized approach was purposely taken when digitizing the mapping data at the suggestion of the community to protect individual fishers as well as the community.

Governmental Respondents

Five governmental participants involved in the SARA and COSEWIC process for the American eel agreed to be interviewed using open ended questions. The responses centered around the process used to manage eels, the organizational and legal requirements to collect and use

aboriginal traditional knowledge, constraints and opportunities affecting the use of aboriginal knowledge, awareness of implication of restricted harvesting of American eel on Mi'kmaq communities and the current relationship with the Mi'kmaq regarding eel management.

The Case Study

To examine how indigenous knowledge is incorporated into policy level decision-making, we have chosen a case study approach that allows the scope of the research to be narrowed while still taking an in-depth look at the problem (Tellis 1997; Yin 2013). This research explores the Canadian governmental COSEWIC and SARA processes to assess the status of the American eel. The following sections outline various aspects of the case study, providing a unique perspective on differing worldviews and how they affect policy level decision-making.

The Mi'kmaq People and Eels

Mi'kmaq have developed deep and reciprocal relationships with species that inhabit Unama'ki. Of particular interest for this study is the relationship between the Mi'kmaq and the American eel or *Kataq*. Eels have not only been an important source of food and nutrition for many Mi'kmaq people but are also socially, medicinally, economically, spiritually, and culturally important. Eels have the ability to bring a community together through fishing and feasting activities and they have been shown to be important in the strengthening of community bonds (Weiler 2011). The depth of the Mi'kmaq people's relationship with the eel is illustrated through legends, art, petroglyphs, numerous technologies for harvesting, ceremonies, and social events (Davis *et al.* 2004).

Legal Landscape

Eels have also played an important role in Mi'kmaq people's efforts to have their inherent and treaty rights recognized by the Canadian government, specifically in the iconic and significant 1999 *Marshall Decision* (R. v. Marshall 1999). Donald Marshall Junior was arrested in August of 1993 for fishing and selling eels without a government-issued license. This event sparked a lengthy court battle and ultimately the tumultuous readmission of the Mi'kmaq people into the fishing industry by recognizing the treaty right of Mi'kmaq and Maliseet peoples to participate in the commercial fisheries and to obtain a moderate livelihood (Davis *et al.* 2004; R. v. Marshall 1999; Wicken 2002). In addition to the *Marshall Decision*, in the 1990 *Sparrow Decision* Supreme Court of Canada acknowledged that Aboriginal people's inherent right to harvest resources for food, social and ceremonial purposes takes precedence over all other uses of the resources (commercial or recreational), with the exception of conservation (DFO 2013; Sparrow v. the Queen 1990; Wildsmith 1995). The *Sparrow Decision* was also integral in ascertaining Aboriginal peoples' legal right to be consulted by the Crown when there is the possibility of infringement on Aboriginal rights.

American Eel

The American eel (*Anguilla rostrata*) is a catadromous species of eel distributed widely along the western Atlantic Ocean, primarily along coastal areas, as well as the inland rivers and lakes of Eastern North America (Jessop 2006). American eels are semelparous, having only one reproductive event (Chaput *et al.* 2012). Much of their life is spent in the lakes, rivers, and estuarine environments. They migrate only after sexual maturation the thousands of miles to the Sargasso Sea to spawn (Miller and Casselman 2014), although the exact location of

spawning remains a mystery (Jessop 2006; Miller and Casselman 2014).

Populations of American eel have been in decline since the 1950s (COSEWIC 2011b). Potential threats to eels include climate change, further hydroelectric development, and effects of stocking programs. Among current threats, fishing and dams have been identified as having the largest impact (Schuegraf, Dowd 2007). As eels are semelparous, all pre-spawning eel deaths reduce reproductive capacity. Further contributing to the complexity of eel management, targeted fisheries for the American eel takes place over different stages of the life cycle, from juveniles to mature adults (Chaput *et al.* 2012).

Eels and COSEWIC and SARA Processes

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established in 1977 as an independent body of scientific experts tasked with identifying species that are at risk in Canada (COSEWIC 2014; SARA 2008). COSEWIC is not mandated to take into consideration economic, political, or social factors during evaluations. In 2003, the establishment of Canada's Species at Risk Act (SARA) legally designated COSEWIC as an advisory body to the government and established the Aboriginal Traditional Knowledge Subcommittee (ATK SC) within COSEWIC (SARA 2008). COSEWIC can assign species to various "risk categories" including extirpated, endangered, threatened or special concern (COSEWIC 2011a). Once the recommendation from COSEWIC has been accepted by the government, the species can qualify for legal protection and recovery planning under SARA, pending further assessment and evaluation of economic, political, and social factors (COSEWIC 2014).

In April 2006, the American eel was designated as a species of "special concern" by COSEWIC (COSEWIC 2011b). The population continued to decline and in May of 2012, the status of the American eel was reevaluated, and was found to be at a higher risk. As of May 2012, the American eel is listed as threatened (COSEWIC 2011b; SARA 2014a).

Given that conservation takes precedence over all categories of fishing, the designation of eels with threatened status by COSEWIC and the consideration for listing eels under SARA may have implications for both the food, social and ceremonial and commercial eel fisheries. However, the potential implications for such a listing have yet to be laid out to Aboriginal communities (Denny and Paul 2012). Despite the presence of an Aboriginal Traditional Knowledge subcommittee on COSEWIC, some Aboriginal organizations have voiced concerns that meaningful and significant Aboriginal input had not been incorporated into the process (Schuegraf, Dowd 2007).

Mi'kmaq Approach to the Eel Fishery

Reflecting the components of the knowledge system (Fig. 1), the results from interviews with Mi'kmaq fishers are first presented below, followed by a discussion of the findings.

Fishing Practices, Values and Beliefs

Fishers eeling experience ranged from two to 60 years. The majority began eeling in the summer between the ages of eight and 12, and were taught by family members. The first two or so years of eeling were spent observing others after which time interviewees spoke of eventually wanting to try for themselves and simply picking up a spear one day. A few of the participants who were not taught to eel by a family member spoke of hearing stories of eeling from family or friends and eventually being offered or seeking a friend to teach them or teaching themselves.

Eeling takes place throughout the year. In the summer and fall, eeling is generally done from a boat with a lantern at night, using a summer spear to catch the eels. Some eelers fish from a dock or wade into shallow water. While some mentioned nets, all use spears, although there is variation in spear design (Fig. 3a, b). Some of the younger eelers have experimented with new methods of catching eels, such as diving with a spear and flashlight wrapped in a plastic bag, or Hawaiian sling (a tiny slingshot spear gun).

In the winter, eeling occurs near the shore, and is limited by the presence of good ice. Eelers cut a hole in the ice using an axe or chainsaw, and using a winter spear (Fig. 3c), they methodically circle the hole searching the unseen muddy bottom with their spear.

Eeling trips occur for a variety of reasons, but generally are initiated by the need for food and the right weather conditions. One eeler recalled how his father used to go eeling when a community member died and would make *Kataqaboul* (eel soup) to bring to the wake. He expressed concern over the loss of this tradition and the implied lack of respect for deceased community members.

The connection between practice, values and beliefs among Aboriginal eelers highlights how knowledge is transmitted and adapted over time (Table 1). For example, by undertaking a period of observation, eelers show respect for the eel as well as the oral tradition. Through this period of observation, the concept of *M'sit No'kamaq* is expressed and eelers learn patience, respect for the eel, proper eeling techniques, and how to identify and respect place. The proper eeling technique during summer helps ensure the survival of an escaped eel by targeting the tail, thereby avoiding critical internal organs and fatal injury. The observation period also illustrates how eelers value the transmission of knowledge through oral tradition (i.e., stories), observation, and experiential learning.

The values of kinship and generosity are demonstrated in the way eelers transmit knowledge, distribute harvest, and interact during eeling trips. All eelers had either been taught to eel or had been told stories about eeling by a family member. Similar to findings in other Nations (Reo and Whyte 2012), eeling trips were largely initiated by family members, community, or elders' requests for eels. Nonetheless, demand must be consistent with *Netukulimk* and influences the number of eels harvested. While all eelers spoke of valuing the ability to share eels with elders, family, or other community members, some of the older eelers spoke of fishing as a time for relaxation and reflection to connect with nature.

At the same time, although there is a great deal of respect for eels and place, there is also a great deal of fun and humour. The Mi'kmaq people are known for their humour and exhibited this during interviews and eeling trips by telling funny stories of their misadventures, teasing eelers who missed, or mistook a stick for an eel. This sense of the humour displayed by eelers demonstrates the depth of camaraderie that takes place during eeling trips, and the joy that eelers get from their relationship with the eel, place, their family, and their community. As in many indigenous communities, eel fishing in Eskasoni facilitates the transmission of knowledge through oral tradition, maintains community bonds, and instils young eelers with social values such as kinship obligations and generosity.

Fig. 3 Handmade eeling spears for summer eeling (a & b) and winter eeling (c)

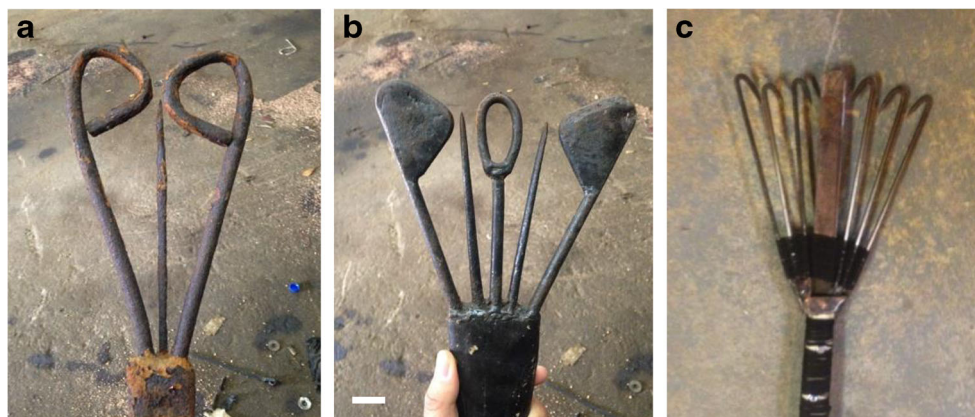


Table 1 Various Eskasoni Mi'kmaq eeling practices and the associated community beliefs and values

Eeling practice	Community beliefs	Values expressed
Sharing eels with elders, family, and community members	<ul style="list-style-type: none"> • Share with those who cannot eel for themselves • Showing respect for Elders 	<ul style="list-style-type: none"> • Kinship • Reciprocity • Generosity
Undertaking a period of observation before eelers begin to eel	<ul style="list-style-type: none"> • Proper skills are needed so eels will not get harmed • Learning how to identify habitat • Patience 	<ul style="list-style-type: none"> • Respect for the eel • Oral tradition • <i>M'sit No'kamaq</i>
Deciding to leave the commercial eel fishery	<ul style="list-style-type: none"> • Commercial fishery is hurting eel populations 	<ul style="list-style-type: none"> • 7 Generations • <i>Netukulimk</i>
Using spears over nets	<ul style="list-style-type: none"> • Nets catch too many eels • Only take what you need 	<ul style="list-style-type: none"> • Respect for the eel • <i>Netukulimk</i>
Keeping all eels caught during winter spearing	<ul style="list-style-type: none"> • Eels will die if you put them back, it is wasteful 	<ul style="list-style-type: none"> • Respect for the eel • <i>M'sit No'kamaq</i> • 7 Generations
Not fishing or only taking enough for the elders during years of low populations	<ul style="list-style-type: none"> • Not right to eel when population are low • Still want to respect elders 	<ul style="list-style-type: none"> • 7 Generations
Visiting eeling sites only once in a cycle	<ul style="list-style-type: none"> • Avoid overexploitation • Avoid too much pressure on the eels 	<ul style="list-style-type: none"> • <i>Netukulimk</i> • Relationship with territory • Respect for place
Being extremely selective during summer fishing, only taking the "good sized ones"	<ul style="list-style-type: none"> • Leave the smaller eels to have a chance to grow and reproduce 	<ul style="list-style-type: none"> • <i>Netukulimk</i> • Respect for the eel

Language and Interaction with Place

Unlike many Mi'kmaq communities in Nova Scotia that have a limited understanding of the Mi'kmaq language, the community of Eskasoni has been implementing a language immersion program in its educational system for the past 15 years and has become the largest Mi'kmaq-speaking community in Atlantic Canada (Beswick 2013).

Eelers felt that including a list of critical eeling words would help to capture the connection between language and eeling knowledge (Table 2). For the eelers, it was not enough to document words but their significance should be understood and they should be used as a means of sharing of knowledge via language.

Interactions with Place

Mi'kmaq knowledge is place-based, generated with and from their territory (Barnhardt 2005). The maps drawn by eelers illustrate how they interact, move within, and use place. Three categories of use were examined - summer eeling, winter eeling, and place of their first eeling trip.

Summer eeling was identified in six areas in the Bras d'Or Lake (Fig. 4). Some eelers identified places that had traditional eeling grounds for their family for hundreds of years. Other eelers identified places they had discovered or been shown based on habitats, such as muddy bottoms or eelgrass. Due primarily to more favourable weather, summer eeling has the

Table 2 Mi'kmaq words relating to eels or eel fishing and their English definitions, gathered during interviews with eelers in Eskasoni First Nation

Mi'kmaq word	Definition
Nkioql	Eel spear for summer
Sum'kwati	A pole for eeling made from black spruce
Kataq	Eels
Katew	A single eel
Saqsikwemk	Eeling at night using a light, the action of spearing
Katewapu	Eel soup or eel stew
+pqasaw	A bigger eel with more meat, big enough to bake it, preparation of dried eel
Pqwi'kn	Hole
Kate'j	Baby eels or little eels
Kata'skw	Eelgrass
Skmoqn	Mucus or slime on a eel
Welpaqawipk	Calm
Wi'just'napaqsi't	Wind makes calm water un-clear
Kate'kemk	Catching eels
N'atuwaqn	Eel spear for winter
L'natkw	Black spruce
Mejikapua'q	Dirty murky water
Paqs+m+n	Cutting along the back bone to open eel up to bake
Siskuwik	Muddy soft bottom
Kato'mo	Eel oil
Wasoqnmaq	Lantern or touch
Wasapa'q	Crystal clear water

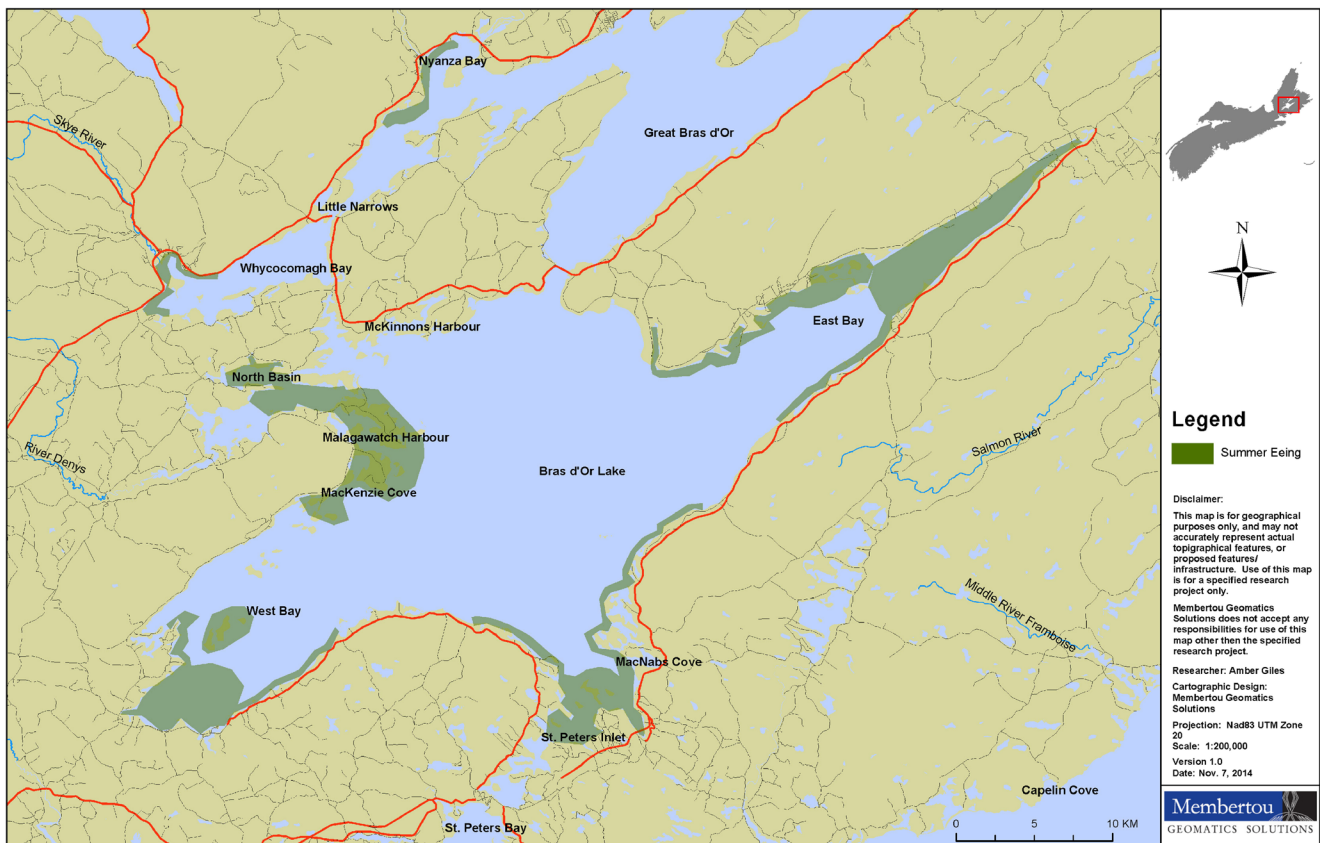


Fig. 4 Map of Bras d'Or Lakes summer eeling areas identified by Eskasoni eel fishers

largest distribution across the Bras d'Or Lake with a large amount of activity focused along the shores.

Winter eeling was identified in four areas in the Bras d'Or Lakes (Fig. 5). Like summer eeling spots, many areas had been traditional family eeling grounds for hundreds of years. Some potential winter eeling spots were found during summer eeling trips, and marked in relation to a unique tree or other landmark.

Only one area in the Bras d'Or Lakes, along the shores of the community, was identified as where eelers experienced eeling for the first time (Fig. 6). Three sub-areas were identified, known to locals as the beaches, John Paul's Lane, and Goat Island and surrounding islands.

The identification of all eeling locations handed down for generations signalled the intergenerational relationship with territory. This awareness facilitates the eelers' ability to detect changes in their environment through observation and to respond to these changes. Eelers felt reciprocity to both eels and to place and this was reflected in their practice of visiting sites only once within a cycle (Table 1). Unlike a fixed closed period common to governmental management responses, this self-imposed cycle for each eeler was different, generally ranging between a year and 5 years. This response to the decline in eel abundance was rooted in *Netukulimk*. Eelers, regardless of age or having children, spoke of wanting to

make sure that the eels would be around for the next seven generations due to the important lessons it can teach about respect and the environment.

Adaptation to Population Decline

Based on an observed decline in their catch from "buckets full" to at most a dozen eels, the majority of respondents stated that there are far fewer eels today than when they started eeling and described eeling as "very much in trouble." Many respondents felt that commercial fishing for eels had caused the decline of populations, and some voiced specific concerns with the elver fishery.¹ Several participants shared their anger and frustration with the non-native elver fishery and that it is allowed to continue when the eel population is so low. Development was also identified as a potential cause of decline, specifically new roads, bridges, a causeway and cottages built too near the lakeshore. It was felt that these new developments destroy habitat, act as barriers restricting eel movement, and create stress for the eels that prevents them from settling.

¹ The Department of Fisheries and Oceans manages the eel fishery in two groups, the adult eel fishery and the elver fishery, which is directed at eels under 10cm in length (Chaput *et al.* 2014).



Fig. 5 Map of Bras d'Or Lakes winter eeling areas identified by Eskasoni eel fisher

Values are also expressed in the various adaptations eelers have made in technique, technology, and fishing habits. In addition to refining the technological aspects of fishing during different seasons through spear design aimed at minimizing escape once speared (Fig. 3), seasonal adaptation to eel management is reflected in the acceptable size of harvest. In the summer, there is generally a set number that is acceptable (a dozen or so per trip), while in the winter it is acceptable to take as many as one can get. Furthermore, in the summer, it is not acceptable to harvest small eels, while in the winter it is an unofficial rule that eelers keep all the eels harvested, regardless of size. These adaptations, based on *M'sit No'kamaq*, reflect eelers' respect for the eel and a deep understanding of the cycles of their territory.²

Commercial Eel Fishing

Only two respondents indicated that they had been involved in the commercial eel fishery, and both had since chosen to leave because of concerns about the eel population decline. The majority had never been involved in the commercial eel fishery or ever sold eels. Some shared strong moral objections to

² There are different dishes for different sizes of eels, so whatever eelers catch they are able to use. Large eels are baked, and smaller eels are used in soup or stew.

the commercial fishery, feeling it was disrespectful to sell eels. While they acknowledged commercial eeling takes place within and outside the Bras d'Or lakes, they noted that commercial fishers are primarily non-indigenous and target the lucrative elver fishery, which, along with habitat destruction, they consider to be a significant factor influencing the decline of the species and impacting their ability to harvest eels for food, social and ceremonial purposes.

Canadian Governmental Approach to the Eel Fishery

Management officials interviewed described the decision-making process to list the American eel under the Species at Risk legislation that begins with the release of the general report on the status of wildlife species in Canada, which is prepared every 5 years (Fig. 7). This report identifies species requiring further assessment by COSEWIC. COSEWIC consists of 10 Species Specialist Subcommittees and the ATK SC (COSEWIC 2014). Each subcommittee is co-chaired and has members from each of the 10 provincial and three territorial wildlife agencies, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Canadian Museum of Nature) and three non-

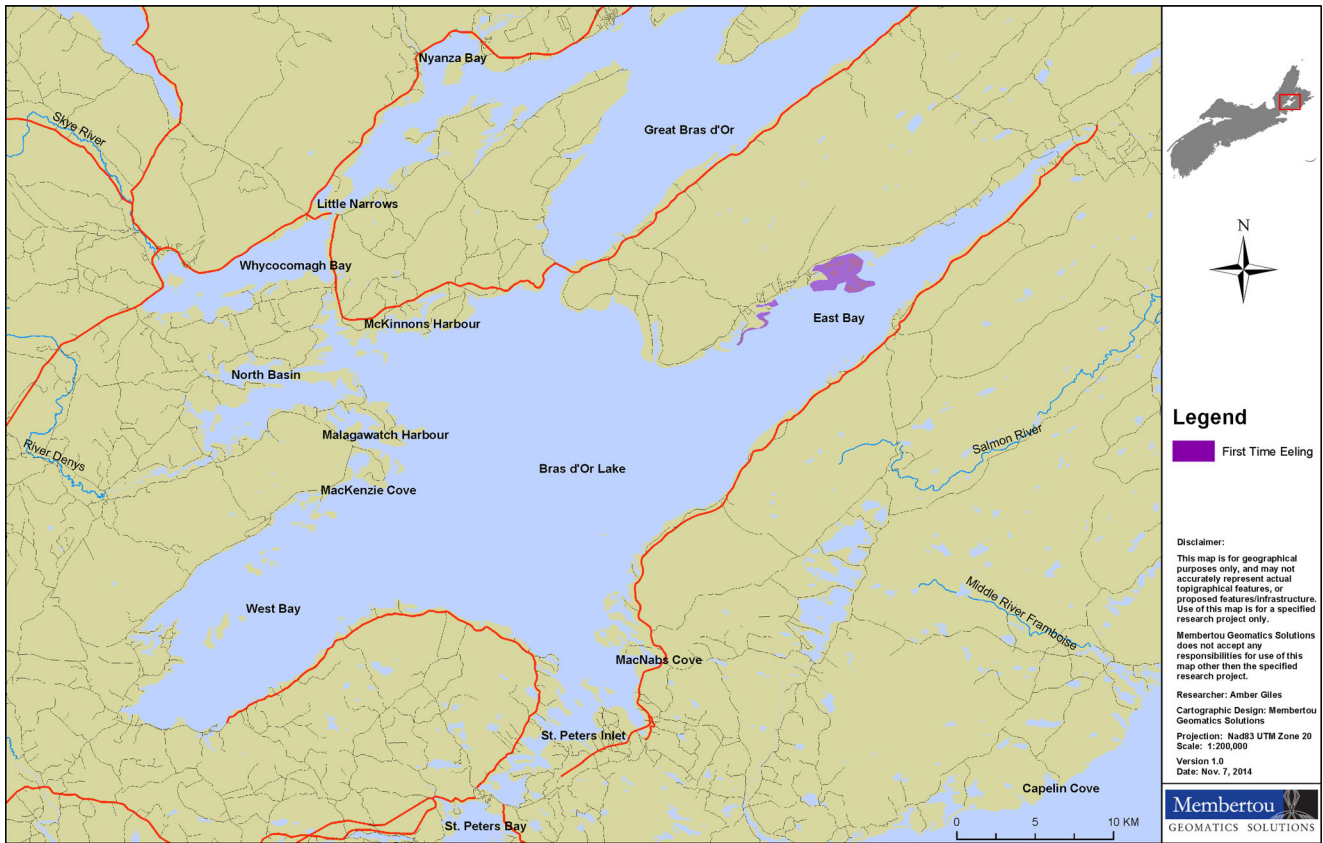


Fig. 6 Map of Bras d'Or Lakes first time eeling areas identified by Eskasoni eel fishers

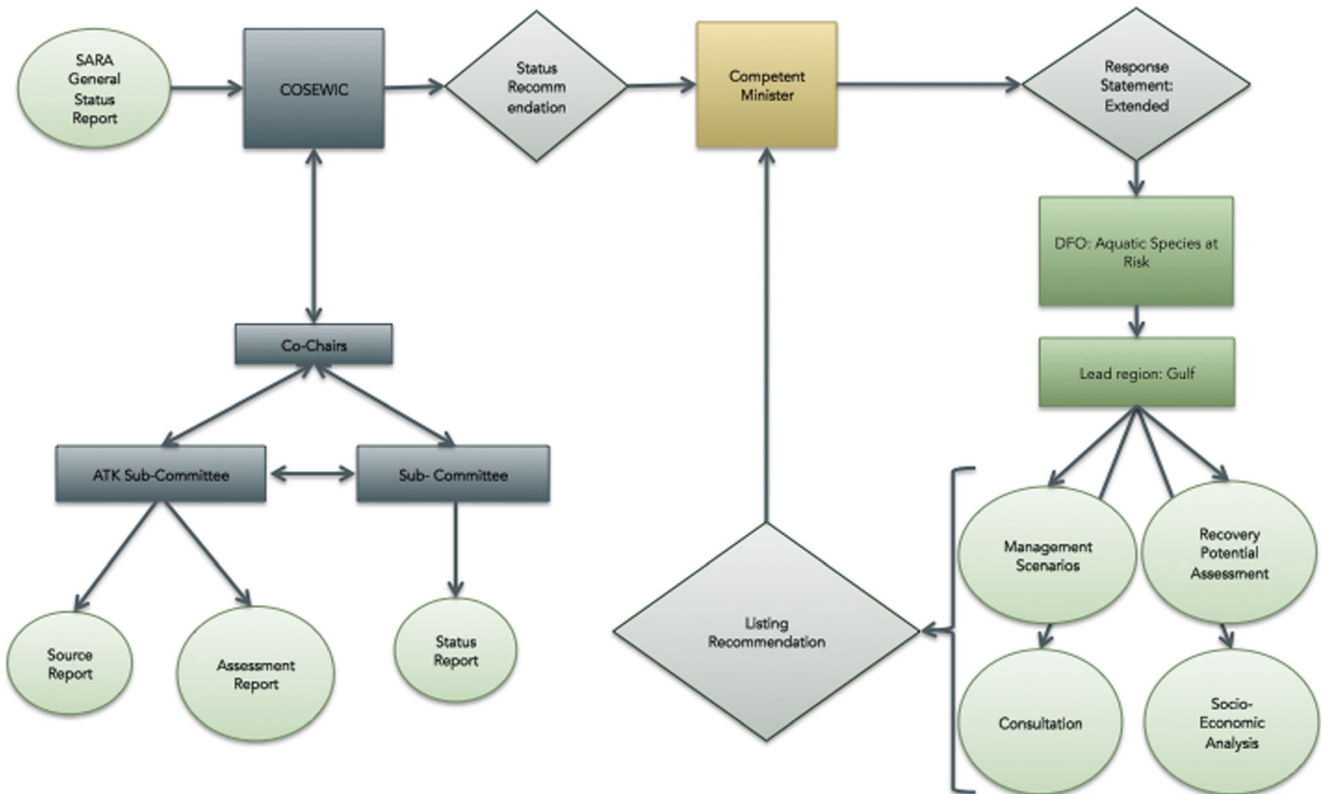


Fig. 7 Flow chart outlining the COSEWIC and SARA status assessment process

government science members (COSEWIC 2014). The Fresh Water Fish subcommittee conducted the assessment for the American eel.

The ATK SC may provide both solicited and unsolicited input to support the specialist sub-committees in their assessments either in the form of a source report or an assessment report, depending on the amount of indigenous knowledge available and the significance of the species to indigenous communities. Additionally, the ATK SC can create its own prioritized list of species for consideration and provide recommendations based on their significance to native communities.

Following the submission of the ATK report to the sub-committees, the respective status reports are provided to the voting members of COSEWIC, comprised of all co-chairs of the 10 sub-committees. All voting members review each status report and vote on the appropriate listing for the species. The American eel was last assessed in 2012 and COSEWIC recommended that it be listed as threatened under the SARA (SARA 2014b).

Upon receiving the listing recommendation, the Minister of Environment can list the species immediately, undergo a normal listing process, or as in the case of the American eel, undergo an extended listing process. The extended listing process can include a recovery potential assessment, management scenarios, consultation, and a socioeconomic assessment (DFO 2014). In the case of the American eel SARA assessment, the lead region is the Department of Fisheries and Oceans (Gulf Region), which is responsible for making the listing recommendation to the Minister of Environment.

Eel Fishery Management

In eastern Canada, there are three general categories of eel fishing: commercial, Aboriginal (food, social and ceremonial), and recreational. The federal Department of Fisheries and Oceans regulate all management decisions, licenses, quotas, gear restrictions, and fishing areas. Both the commercial and recreational eel fisheries operate under licenses and quotas. Management respondents confirmed that eels are fished using various methods including spears, pots, weirs, nets, long lines, traps and rod and reel (COSEWIC 2011b). The eel fishery is managed as two different fisheries, an elver fisher and an adult eel fishery. The recreational eel fishery is also divided into two fisheries, pots (which is being phased out) and other gear such as spears. Recreational eelers are allowed to harvest a maximum of 10 eels per day with spears, and all eels harvested must be a minimum of 35 cm long (Ford, personal communication, 2014). There are approximately 10 commercial communal (Aboriginal) eel licenses in the Maritime Region. However, while this study identified that commercial eeling is not occurring in Eskasoni, it could not be determined which of those licenses are currently active.

The food, social and ceremonial fishery is managed separately from the commercial and recreational eel fishery under

Aboriginal Fisheries Strategy agreements between the Department of Fisheries and Oceans and the First Nations communities. While all communities have licenses, there are no individual licenses or quotas. Eel fishing takes place over many different habitats and throughout the entire year (Weiler 2011).

As indicated by management respondents, the Canadian governmental approach to eel fishery management and conservation is based on science-based knowledge, governmental processes, and mandates that stem from legislation. As such, it employs a bureaucratic top-down approach that values compartmentalization and order. For example, the commercial elver fishery and adult eel fishery are managed by separate sectors from the food, social and ceremonial fishery, and the assessment status of the species is done by two different organizations. The ultimate objective of this approach is to maintain the population so that harvesting can continue.

Discussion

Information from interviews with indigenous fishers, advisors and managers for the governmental process affecting the status of the American eel provided valuable insights into how the different knowledge systems influence decision making and the extent to which indigenous world views are incorporated into the process.

Comparing indigenous and governmental approaches to the eel fishery

We identified differences in values between indigenous (Mi'kmaq) and governmental approaches to the eel fishery. The Mi'kmaq knowledge system is underpinned by values related to kinship, sustainability (*Netukulimk*, *Msit Nokoma*, seven generations), respect for the eel and place, and generosity. This contrasts with the governmental approach, which is underpinned by a western scientific worldview that values process, science-based knowledge, compartmentalization, economic benefits and conservation. The Mi'kmaq approach also suggests an intertwining of management with the practices, stories, and social norms of the community while the governmental approach seeks legitimacy in mandates and processes stemming from legislation.

While both knowledge systems value the conservation component of sustainability, the definition, objectives and rules for a sustainable eel fishery differ. Non-indigenous commercial and recreational fishers look to the government for management rules and harvesting guidance. However, indigenous eelers indicate they would voluntarily stop eeling and participate in monitoring and recovery initiatives if that secures the ability of present and future generations to maintain their cultural connection to the species.

Challenges to Incorporating IKS into Eel Fishery Management Decision-Making

Respondents involved in the governmental process identified a number of challenges for incorporating IKS into the decision making process that fall into three categories: logistical, conceptual, and communication.

Logistical challenges

All governmental respondents identified the lack of an existing process guiding the actual collection and incorporation of IKS as a significant barrier for its inclusion into advisory and governmental reports, processes, and decision-making. Despite the presence of the ATK SC within COSEWIC, there appears to be considerable confusion both inside and outside this sub-committee on the collection process to be followed and the expectations for incorporating Mi'kmaq knowledge within COSEWIC. Respondents acknowledged that there are many challenges affecting the development of such a process as the complex nature of traditional knowledge and diversity of the many Aboriginal Nations and groups in Canada make it difficult to develop a "one size fits all" approach. Additionally, the lack of capacity within their own governmental organizations to undertake the development of such a process was highlighted.

Ownership of data presents a second major challenge. Participants identified legal, ethical and logistical concerns that arise with the inclusion of Mi'kmaq knowledge into reports and processes. Once such knowledge is included into a report and released to the public, there is no mechanism to protect its ownership and monitor what is done with it.

The challenges of working with limited time and money were identified by all advisory respondents, who are mostly in academia. Limited time and funds necessitate the collection of ITK from previous publically available information, mostly found on websites or in reports. Primary collection of traditional knowledge data from communities for every relevant species assessed by COSEWIC and SARA is viewed as unrealistic with current budgets. Thus trade-offs need to be made between the numbers of species that can be assessed, compared to primary data collection. These compromises can create moral and ethical dilemmas for regulators and COSEWIC advisors. In contrast, the majority of Aboriginal eelers felt more time should be spent talking to them about management approaches, while others spoke of feeling like the 'scapegoat' being blamed for the decline of fish populations for many species. While this sense of being blamed could lead to unwillingness by some to collaborate with managers and advisors even if funds and resources were made available, our research findings suggest that the significance of the species to the Mi'kmaq could be a key factor in overcoming this distrust.

Conceptual challenges

Many of the participants involved in the governmental process had difficulty explaining how and where aboriginal knowledge fits into the COSEWIC and SARA assessment reports. Many easily saw links between traditional ecological knowledge and the assessments but the cultural and spiritual aspects were much more difficult to place. The phrase "there is no place for it" in reference to the cultural and spiritual components of a Mi'kmaq knowledge system and COSEWIC, as well as within other parts of the process was used repeatedly during interviews. The ongoing negative consequences of this approach are exemplified in the differing interpretation of the behaviour of Aboriginal eelers and non-Aboriginal eelers with respect to catches during winter. In the former case, the cultural practice required the taking of all eels caught due to the inability of the fisher to see the fish and respect for the eel in giving its life, while in the latter, only eels above a given length were kept according to management requirements. This perpetuates the perception of wastage held by Aboriginal fishers of non-native fishers and a general feeling by the former that management is not accounting for the cultural aspects of Mi'kmaq knowledge. On the other hand, non-native fishers perceive Aboriginal fishers as ignoring conservation objectives by keeping under-sized eels during winter.

Concepts such as time and resources and their socioeconomic consequences are also interpreted differently. Many of the governmental participants recognized these differences in interpretation as a challenge when working with Aboriginal communities and organizations and some appreciated the difficulties this poses in taking into account the socioeconomic and cultural implications for the Mi'kmaq of a specific listing. For example, managers and politicians operate within a relatively short and finite timeframe, while indigenous communities generally operate on a much longer timescale, referring to the next seven generations when discussing management of the eel.

Communication Challenges

The use of different languages or the interpretation of words in the same language was a commonly identified challenge among participants. Additionally, all participants spoke of mistrust between indigenous communities and government, or organizations affiliated with the government, and attributed historical trauma as the seed of this mistrust. Interestingly, the majority of governmental respondents identified a gap in their own education that had omitted the historical traumas faced by indigenous people in Canada, and subsequently having

to educate themselves. This increased awareness was considered instrumental in building respect, a key component for improving the relationships between their organizations and Aboriginal communities.

Members of COSEWIC noted the hesitancy of aboriginal groups to share information during the consultation phase resulting in concerns being raised in response to the Committee's report after its publication. This may be due to previously mentioned intellectual property concerns and the perception of COSEWIC as a governmental organization despite its arms-length advisory nature. However, it is also likely due to the nature of information COSEWIC considers appropriate for the assessment, leading to an apparent dismissal of knowledge based on the Mi'kmaq knowledge system. Ultimately COSEWIC would like to increase awareness and trust with indigenous communities to build opportunities for communication at the beginning of the assessment process. However, respondents recognized that funding, time limitations and the required format of the information would delay this occurrence.

Finally, the perception as well as the interpretation of terms such as aboriginal traditional knowledge, indigenous knowledge or indigenous knowledge system by resource managers and policymakers impact how they are incorporated into processes (Weiss *et al.* 2013). In Canada, the term as used by government and their advisors is aboriginal traditional knowledge. Our research identified many different definitions, understandings, and comfort levels with this term by members of these organizations. We also found that traditional ecological knowledge is generally the first thing that comes to mind for many involved in the governmental process. The challenge arises since traditional ecological knowledge is limited to describing knowledge about the environment and does not include the cultural, spiritual, or management facets of the Mi'kmaq knowledge system, which is essential in order to meaningfully incorporate Mi'kmaq knowledge into decision-making.

Although the National Aboriginal Council on Species at Risk (NACOSAR) and Aboriginal Fund for Species at Risk (AFSAR) were not mentioned in any of the interviews, they were identified in the literature as playing potentially important roles for the incorporation of aboriginal traditional knowledge into the process of eel management. This lack of awareness of such potentially influential indigenous bodies among both governmental and Mi'kmaq respondents in Nova Scotia is troubling and may be due to the national rather than regional nature of these entities or may simply be a reflection of the lack of promotion on the part of the organizations. The Aboriginal Fund for Species at Risk provides funding for species recovery plans after their status has been approved by the Minister of Environment. Its objective is to foster

“meaningful collaboration with Aboriginal people and organizations in the implementation of programs under the Species at Risk Act” (Canada 2014). The National Aboriginal Council on Species at Risk was established under the SARA, and its members are appointed by the Minister of Environment to represent Aboriginal peoples of Canada (NACOSAR 2014). The Council's role is to provide advice to the Minister and to provide recommendations to the Canadian Endangered Species Conservation Council (NACOSAR 2014). Both of these organizations provide opportunity to incorporate indigenous world views and knowledge into the process.

Benefits to Cross-Cultural Collaboration

Prior to contact, indigenous communities managed their territories and natural resources using their own management framework embedded in their knowledge systems (Gratani *et al.* 2011; Simpson 2004; Turnbull 2009). Within the Mi'kmaq knowledge system, the inherent connectedness, long-term planning, and values could contribute to current fisheries management and promote long-term sustainability of eels. While attempts have been made to put in place structures to incorporate indigenous knowledge into the assessment of the status of species in Canada, the management system for natural resources has very little meaningful incorporation of indigenous knowledge systems into policy-level decision-making processes.

The adoption of the “two-eyed seeing” concept promulgated by the Mi'kmaq (Marshall 2004) may provide opportunities for collaboration between the Mi'kmaq and western scientific governmental management approaches to the eel fishery. While there are numerous factors challenging the adoption of this shared approach, its benefits may be substantial at both the operational and strategic levels.

Strategically, it allows for a greater appreciation of two different worldviews and facilitates reconciliation and cross-cultural understanding of how these differences and commonalities may influence and enhance decision-making (Ens *et al.* 2012). Additionally, the inclusion of indigenous knowledge systems into western processes builds needed mutual respect and is responsive to the spirit and content of the Canadian Constitution, existing Treaties and rights and court decisions.

Operationally, benefits of including IKS into policy level decision-making and science-based knowledge include but are not limited to the generation of baseline assessments, improved monitoring and evaluation capacity (Berkes 2006), innovations and improved practices and enhancement of long-term planning (Ryan 2012).

Recommendations to Improve Mi'kmaq Input into American Eel Assessment

These recommendations on possible mechanisms for enhancing the use of Mi'kmaq knowledge in the governmental assessment process on the status of the American eel are built around a willingness by both the Mi'kmaq communities and the federal government to increase the level of meaningful communication to build and strengthen relationships between each other and with non-native eel fishers. Furthermore, it requires a willingness on the part of the federal government to expand the understanding of aboriginal traditional knowledge to more than just its ecological component and to do this by clarifying the legal context around which indigenous knowledge is used to inform assessment level decision making. This is essential as the absence of legal frameworks creates legal, and ethical concerns for Aboriginal communities as well as the governmental organizations and advisors producing assessment reports.

Fisheries Management Recommendations

- Currently, the full understanding of a Mi'kmaq knowledge system is not reflected in management decisions. The practices of aboriginal eel fishers contain management decisions, based on the indigenous values and beliefs (Table 2). Currently the Department of Fisheries and Oceans is in talks with various aboriginal organizations to update the American eel Integrated Fisheries Management Plan (IFMP) for the Maritimes region. The plan is used by the Department to “guide the conservation and sustainable use of marine resources” (DFO 2010). The update (Table 3) provides the opportunity to explore the complementarity among the First Nations and western scientific approaches to

management while allowing for value systems and beliefs among the different knowledge systems to be respected.

COSEWIC and SARA Process Recommendations

An in-depth examination of the COSEWIC and SARA process identified seven distinct areas in the assessment of the American eel that could lead to an increase understanding and the incorporation traditional knowledge in the decision making process (Fig. 8).

Within the three Aboriginal knowledge gathering components of the process, ATK SC, National Aboriginal Council on Species at Risk (NACOSAR) and Aboriginal Funding for Species at Risk (AFSAR), opportunities exist to use decolonized methods for the collection of all components of traditional knowledge (ecological, socioeconomic, cultural and spiritual) that are reflective of the values and beliefs held within the Mi'kmaq knowledge system. This sharing of knowledge through ceremonial methods (e.g., talking circles) allows for the interconnectivity inherent in indigenous ways of knowing to be conveyed without having to adhere to imposed colonial methodologies (Simpson 2004). Scholars have argued that using decolonized methods will build trust between aboriginal organizations and communities, help to build and strengthen relationships, and to empower aboriginal people and their cultures (Smith 1999; Wilson 2008), which would be further enhanced by including more aboriginal members on these committees, as advisory boards were one of the few identified examples where successful relationships with Aboriginal communities or organizations had been established.

Table 3 Management recommendations incorporating an IKS approach to the eel fishery

Eeling practice	Management recommendations
Sharing eels with elders, family, and community members	• Minimum FSC level ensured
Undertaking a period of observation before eelers begin to eel	• Courses for fishers which include Mi'kmaq cultural awareness
Deciding to leave the commercial eel fishery	• Conservation objectives
Using spears over nets	• Gear restrictions
Keeping all eels caught during winter spearing	• Change to seasonal management for fishery
	• Varying size limitation of seasonal periods
Not fishing or only taking enough for the elders during years of low populations	• Adaptive management
	• Monitoring programs based on FSC needs
Visiting eeling sites only once in a cycle	• Conservation objectives
Being extremely selective during summer fishing, only taking the “good sized ones”	• Size limits for summer eeling

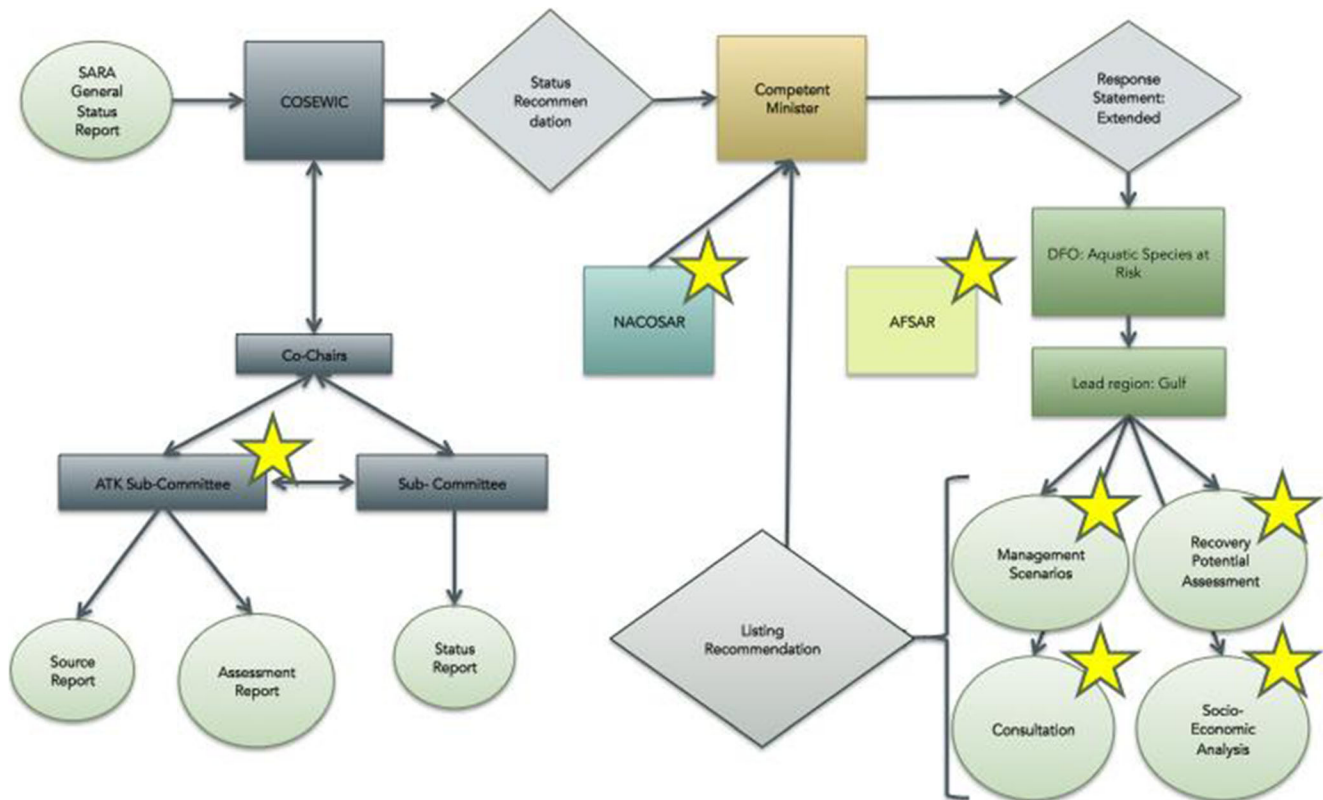


Fig. 8 Opportunities in the COSEWIC and SARA assessment process to improve the incorporation of IKS

Of the three components, the ATK SC provides the opportunity to ensure all aspects of traditional knowledge are considered early in the advisory process undertaken by COSEWIC. The latter two components serve to ensure the continuous involvement and input of traditional knowledge to inform the decision-making process of the Minister and continued engagement in the development of recovery plans once a decision has been made.

An additional three components centered around the recovery potential assessment, consultation and socioeconomic analysis all provide additional opportunities to expand the discussion with aboriginal communities in terms of sharing indigenous knowledge. These also represent areas where more aboriginal input can be incorporated into the process through membership on these information-gathering advisory committees.

The seventh component aimed at developing management scenarios for potential listing provides an excellent opportunity to embrace IKS and the corresponding management responses into management scenarios and in the updating integrated plan for the American eel. Aboriginal communities already have adapted management practices in response to observed decline in the American eel and have indicated a willingness to limit its exploitation. These management adaptations could work to enhance sustainability of species and provide

added opportunity for cross-cultural understanding between the government and aboriginal communities.

Conclusion

Results from interviews with eel fishers from Eskasoni First Nation show how the Mi'kmaq knowledge system is interwoven into all aspects of the eel fishery and management at the community level. This is in contrast to the federal government's approach to fisheries, which is process intensive and compartmentalized. A number of opportunities for incorporating Mi'kmaq knowledge beyond its ecological component into the American eels assessment process were identified. However, this requires effort from both the First Nation communities and the governmental organizations in overcoming logistical, conceptual and communication challenges. While the differing world views underpinning the Mi'kmaq and western scientific decision-making processes currently result in frustration and distrust on both sides, there is considerable opportunity in the management of the eel fishery to use a "two-eyed seeing" approach. This acknowledgement of the values inherent in both management approaches could, with a willingness on the part of both parties, easily be reflected in

specific management actions that are consistent with the goals of both governmental managers and the First Nations communities.

Acknowledgments The authors would like to acknowledge with thanks the willingness of all participants who agreed to share their knowledge for this study and the anonymous reviewers for their valuable suggestions.

Compliance with Ethical Standards Research involving human participants: This study is based on research involving human participants and has obtained Ethics Approval from Dalhousie University Research Ethics Board as well as Ethics Approval from the Mi'kmaq Ethics Watch.

Informed Consent All participants in this research have provided the authors with signed letters of Informed Consent.

Funding This study was funded by the Social Sciences and Humanities Research Council (SSHRC) Partnership Grant #895-2011-1007.

Conflict of Interest The authors declare that they have no conflict of interest.

References

- Barnhardt, R. (2005). Indigenous Knowledge Systems and Alaska Native Ways of Knowing. *Anthropology & Education Quarterly* 36(1): 8–23.
- Battiste, M. (2005). Indigenous Knowledge: Foundations for First Nations. *World Indigenous Nations Higher Education Consortium-WINHEC Journal*.
- Battiste, M. (2011). *Reclaiming Indigenous Voice and Vision*. UBC Press.
- Berkes, F. (2006). From Community-Based Resource Management to Complex Systems: The Scale Issue and Marine Commons. *Ecology and Society* 11(1): 45–64.
- Berkes, F., and Henley, T. (1997). Co-Management and Traditional Knowledge: Threat or Opportunity? *Policy Opinions Montreal* 18(1): 29–30.
- Berkes, F., Armitage, D. R., and Doubleday, N. (2007). *Adaptive co-management: Collaboration, learning, and multi-level governance*. UBC Press.
- Berkes, F., Colding, J., and Folke, C. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications* 10(5): 1251–1262.
- Beswick, A. (2013). Eskasoni Educators Fight to Save Mi'kmaq Language. Retrieved 5/12, 2015 from <http://thechronicleherald.ca/novascotia/1160998-eskasoni-educators-fight-to-save-mi'kmaq-language>.
- Canada. (2014). Aboriginal fund for species at risk. Online: <https://www.retablissement-recovery.gc.ca/afsar-faep/index.cfm?fuseaction=home.main&lang=E>.
- Cargo, M., and Mercer, S. L. (2008). The Value and Challenges of Participatory Research: Strengthening its Practice. *Annual Review of Public Health*. (29) 325–350.
- Carm, E. (2014). Inclusion of Indigenous Knowledge System (IKS)—A Precondition for Sustainable Development and an Integral Part of Environmental Studies. *The Journal of Educational Research* 4(1): 58–76.
- Castleden, H., Garvin, T., and First Nation, H. (2008). Modifying Photo Voice for Community-Based Participatory Indigenous Research. *Social Science & Medicine* 66(6): 1393–1405 doi:10.1016/j.socscimed.2007.11.030.
- Chapin, F. I., Folke, C., and Kofinas, G. P. (2009). Principles of Ecosystem Stewardship. Resilience-Based Natural Resource Management in a Changing World. In *A Framework for Understanding Change*. Springer, New York, pp. 2–38.
- Chaput, G., Cass, A., Grant, S., Huang, A.M., and Veinott, G. (2012). Considerations for Defining Reference Points for Semelparous Species, with Emphasis on Anadromous Salmonid Species Including Iteroparous Salmonids. (No. 2012/146. v+48 p.). DFO Canadian Science Advisory Section.
- Chaput, G., Cairns, D. K., Bastien-Daigle, S., LeBlanc, C., Robichaud, L., Turple, J., and Girard, C. (2014). Recovery Potential Assessment for the American eel (*Anguilla rostrata*) for Eastern Canada: Mitigation Options. No. 2013/133. v+30 p.). DFO Canadian Science Advisory Section Research Documentation.
- Cochran, P. A., Marshall, C. A., Garcia-Downing, C., Kendall, E., Cook, D., McCubbin, L., and Gover, R. M. (2008). Indigenous Ways of Knowing: Implications for Participatory Research and Community. *American Journal of Public Health* 98(1): 22–27 doi:10.2105/AJPH.2006.093641.
- Cortassel, J. (2012). Re-Envisioning Resurgence: Indigenous Pathways to Decolonization and Sustainable Self-Determination. *Decolonization: Indigeneity, Education & Society* 1(1): 86–101.
- COSEWIC. (2011a). Canadian Wildlife Species at Risk. Accessed December 2014, http://www.cosewic.gc.ca/eng/sct0/rpt/rpt_csar_e.pdf.
- COSEWIC (2011b). American eel. Accessed November 2014, http://www.cosewic.gc.ca/eng/sct1/searchdetail_e.cfm?id=891&StartRow=1&boxStatus=All&boxTaxonomic=3&location=All&change=All&board=All&commonName=American%20Eel&scienceName=&returnFlag=0&Page=1.
- COSEWIC. (2014). COSEWIC Composition. Accessed November 2014, http://www.cosewic.gc.ca/eng/sct6/sct6_4_e.cfm#3
- Davis, A., Wagner, J., Prosper, K., and Paulette, M. J. (2004). The Paq'tnkek Mi'kmaq and ka't (American eel): A Case Study of Cultural Relations, Meanings, and Prospects. *The Canadian Journal of Native Studies* 24(2): 359–390.
- Denny, S., and Paul, T. (2012). Mi'kmaq Fisheries of Unama'ki. UNIR, Eskasoni Nova Scotia.
- DFO. (2010). Integrated Fisheries Management Plans. Retrieved 11/30/2014, from <http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmg-gmp/index-eng.htm>.
- DFO. (2013). Mission, Vision, and Values. Accessed January 2014, <http://www.dfo-mpo.gc.ca/about-notre-sujet/org/vision-eng.htm>.
- DFO. (2014). Listing Process for Aquatic Species not on Schedule I of the Species at Risk Act (SARA). Accessed November 2014, from <http://www.dfo-mpo.gc.ca/species-especes/policy-politique-eng.htm#8>.
- Ens, E. J., Finlayson, M., Preuss, K., Jackson, S., and Holcombe, S. (2012). Australian Approaches for Managing 'Country' Using Indigenous and Non-Indigenous Knowledge. *Ecological Management & Restoration* 13(1): 100–107.
- Eskasoni. (2014a). Community Report 2012–2014. Eskasoni. Online: [http://www.eskasoni.ca/uploads/newsletter/COMMUNITY-REPORT-2012-2014-\(web\).pdf](http://www.eskasoni.ca/uploads/newsletter/COMMUNITY-REPORT-2012-2014-(web).pdf).
- Eskasoni. (2014b). Our Eskasoni. Accessed November 2014, <http://www.eskasoni.ca/History/>.
- FishWIKS. (2013). Eskasoni. Accessed November 2014, <http://fishwiks.ca/communities/eskasoni-ns/>.
- Gratani, M., Butler, J. R., Royce, F., Valentine, P., Burrows, D., Canendo, W. I., and Anderson, A. S. (2011). Is validation of Indigenous Ecological Knowledge a Disrespectful Process? A Case Study of Traditional Fishing Poisons and Invasive Fish Management from the Wet Tropics. Australia. *Ecology and Society* 16(1): 1–14.

- Hassan, S. A., and Hanapi, M. S. (2013). "Scientificity" of Social Research: Its Challenges and Implications. *Academic Journal of Interdisciplinary Studies* 2(9): 62–73.
- Houde, N. (2007). The Six Faces of Traditional Ecological Knowledge: Challenges and Opportunities for Canadian Co-Management Arrangements. *Ecology and Society* 12(2): 34–45.
- Hurlbert, S. H. (1984). Pseudoreplication and the Design of Ecological Field Experiments. *Ecological Monographs* 54(2): 187–211.
- Jessop, B. M. (2006). Underwater World: American Eel. Department of Fisheries and Oceans Canada. Online: <http://www.dfo-mpo.gc.ca/Science/publications/uww-msm/pdf/eel-anguille-eng.pdf>.
- Kuhn, T. S. (2012). *The Structure of Scientific Revolutions*. University of Chicago Press, Chicago.
- Longino, H. E. (1990). Introduction: Good Science, Bad Science. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry. Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton University Press, Princeton, pp. 3–15.
- Marshall, A. (2004). Two-Eyed Seeing. Institute for Integrative Science and Health. Online: <http://www.integrativescience.ca/Principles/TwoEyedSeeing/>.
- Miller, M., and Casselman, J. (2014). The American eel: a fish of mystery and sustenance for humans. In Tsukamoto, K., and Kuroki, M. (eds.), *Eels and Humans*. Springer Press, pp. 155–169.
- NACOSAR. (2014). FAQs. Accessed December 2014, <http://www.nacosar-canep.ca/en/faqs/>.
- R. v. Marshall. (1999). SCR 3, 1999 (1999), 456.
- Reo, N. J. (2011). The Importance of Belief Systems in Traditional Ecological Knowledge Initiatives. *The International Indigenous Policy Journal* 2(4): 8.
- Reo, N. J., and Whyte, K. P. (2012). Hunting and Morality as Elements of Traditional Ecological Knowledge. *Human Ecology* 40(1): 15–27 doi:10.1007/s10745-011-9448-1.
- Ryan, T. (2012). Indigenous Knowledge Systems: An Overview. Online: <http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=829E14E5034AD19B411D4EF6D38790B4?doi=10.1.1.296.5045&rep=rep1&type=pdf>.
- SARA. (2008). Species at Risk: Annual Report 2008. Online: https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/reports/sar_2008_0310_e.pdf.
- SARA. (2014a). Response Statement—American Eel. Accessed December 2014, http://www.sararegistry.gc.ca/document/dspHTML_e.cfm?ocid=9474.
- SARA. (2014b). SARA General Status Reports. Accessed November 2014, http://www.sararegistry.gc.ca/document/dspHTML_e.cfm?ocid=7382#General_Status.
- Schuegraf, and Dowd. (2007). Ta'n Telnenas'gl Ga'te'gati'l Gespe'gewa'gig Perceptions of American Eel Habitat In Gespe'gewa'gi. Online: http://www.migmaqresource.org/sites/default/files/temp/GMRC_Eel-Ga%2527t_report_e.pdf.
- Simpson, L. R. (2004). Anticolonial Strategies for the Recovery and Maintenance of Indigenous Knowledge. *American Indian Quarterly* 28(3): 373–384.
- Simpson, L. B. (2014). Land as Pedagogy: Nishnaabeg Intelligence and Rebellious Transformation. *Decolonization: Indigeneity, Education & Society* 3(3): 1–25.
- Smith, L. T. (1999). *Decolonizing Methodologies: Research and Indigenous Peoples*. Zed Books.
- Sparrow v. the Queen. (1990). SCR 1, 1990(1990), 1075.
- Tellis, W. (1997). Application of a Case Study Methodology. *The Qualitative Report* 3(3): 1–17.
- Tumbull, D. (2009). Futures for Indigenous Knowledges. *Futures* 41(1): 1–5 doi:10.1016/j.futures.2008.07.002.
- UINR. (2013). Unama'ki Institute of Natural Resources. Accessed November 2014, from <http://www.uinr.ca>.
- UINR (Producer), and UINR (Director). (2009). Netukulimk. Online: <https://www.youtube.com/watch?v=wsNVewjgKxI>.
- Usher, P. J. (2000). Traditional Ecological Environmental Assessment and Management. *Arctic* 53(2): 183.
- Weiler, M. H. (2011). Mi'kmaq and the American eel. Traditional knowledge relating to the American eel by mainland Nova Scotia Mi'kmaq #1734. Accessed September 2014, http://mikmaki.ca/PDFs/Weiler_Mikmaq_and_the_American_Eel.pdf
- Weiss, K., Hamann, M., and Marsh, H. (2013). Bridging Knowledges: Understanding and Applying Indigenous and Western Scientific Knowledge for Marine Wildlife Management. *Society & Natural Resources* 26(3): 285–302 doi:10.1080/08941920.2012.690065.
- Whyte, K. P. (2013). On the Role of Traditional Ecological Knowledge as a Collaborative Concept: A Philosophical Study. *Ecological Processes* 2013: 7(2) doi:10.1186/2192-1709-2-7.
- Wicken, W. (2002). *Mi'kmaq Treaties on Trial: History, Land, and Donald Marshall Junior*. University of Toronto Press, Toronto.
- Wildcat, M., McDonald, M., Irlbacher-Fox, S. and Coulthard, G. (2014). Learning from the Land: Indigenous Land Based Pedagogy and Decolonization. *Decolonization: Indigeneity, Education & Society*. 3(3): I–XV
- Wildsmith, B. H. (1995). Mi'kmaq and the fishery: Beyond food requirements, the. *Dalhousie LJ*, 18, 116.
- Wilson, S. (2008). *Research is Ceremony: Indigenous Research Methods*. Fernwood Publishing, Winnipeg.
- Yin, R. K. (2013). *Case Study Research: Design and Methods*. Sage publications.