AN INVESTIGATION INTO THE LOCAL AND TRADITIONAL ECOLOGICAL KNOWLEDGE OF THE SAUGEEN OJIBWAY NATION REGARDING THE STATUS OF CISCOES (*Coregonus* spp.) IN LAKE HURON

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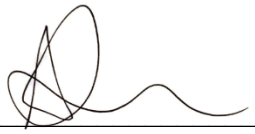
Signature: 

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ABSTRACT

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The ciscoes (*Coregonus* spp.) of Lake Huron are a poorly understood group of fish that have experienced declines in population numbers and a collapse of their ecological communities. Ciscoes are culturally and socio-economically important to the people of the Saugeen Ojibway Nation (SON), who have harvested them for food and commerce for generations. The decline in cisco populations has had significant impacts on the SON's economy and traditional food availability, a key pillar of Indigenous food security. A community-based investigation SON fish harvesters' Indigenous ecological knowledge (IEK) was conducted to address concerns about the cisco fishery and to determine if this knowledge can inform fisheries governance and social-ecological relationships with ciscoes in Lake Huron. Sixteen semi-structured mapping interviews were held with past and current SON fish harvesters. Their IEK represented unique contributions that account for social and ecological perspectives. Two groups of ciscoes were identified, lake herring (*Coregonus artedi*) and chub (*Coregonus* spp.). The former is an important traditional food fish while the latter was a significant component of the SON fishery from the 1990s until the 2000s. A practical application of this IEK was successful cisco-specific sampling that was conducted in 2019. The results reveal that IEK has the potential to inform governance by identifying meta-level governance elements and the application of a two-eyed seeing approach. The IEK of the SON and their connection to these fish has been altered by numerous anthropogenic and ecological factors, but their legacy lives on.

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LIST OF ACRONYMS

CIRNAC: Crown Indigenous Relations and Northern Affairs Canada

DCM: Data Collection Manual

FEK: Fisher(s) Ecological Knowledge

FLEdGE: Food: Locally Embedded, Globally Engaged

GIS: Geographic Information System

GLFC: Great Lakes Fisheries Commission

IEK: Indigenous Ecological Knowledge

LEK: Local Ecological Knowledge

MEB: Multiple Evidence Base

OCHP: Ontario Community Hatchery Program

OMNRF: Ontario Ministry of Natural Resources

PIN: Personal Identification Number

SARA: Species at Risk Act

SON: Saugeen Ojibway Nation

TAC: Total Allowable Catch

TEK: Traditional Ecological Knowledge

TRCC: Truth and Reconciliation Commission of Canada

UNDRIP: United Nations Declaration on the Rights of Indigenous Peoples

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Chi-miigwetch,

Alexander Duncan

CHAPTER 1: INTRODUCTION

Fish and other aquatic food resources are essential to many populations, cultures, and economies around the world (Levkoe et al. 2017). Unfortunately, a dominant economic and Western-centric management regime, a disregard for subjective and experiential ecological knowledge, the commodification of fish, environmental degradation, and mismanagement have led to an international crisis (Pauly and Zeller 2003; Gray 2006; Levkoe et al. 2017). This crisis is evident in declining fish health, decreasing population numbers, extirpation, and in some cases extinction (FAO 2018). These issues have severe implications for the communities and cultures that rely on fish for their livelihoods and wellbeing. This is especially true for Indigenous peoples, who have interacted and depended on their local environments for millennia. The Indigenous ecological knowledge (IEK) of these communities and cultures can provide critical insight into the status and management of fisheries (Johannes et al. 2000). Indigenous ecological knowledge can be defined broadly as any cultural, experiential, temporal, spatial, or personal knowledge from Indigenous peoples regarding local ecological systems and components (Davis and Ruddle 2010). Distinct from other forms of ecological knowledge, IEK represents a connection to culture and shared history with the environment in an Indigenous context.

The IEK of the Ojibway people of the Saugeen Ojibway Nation (SON) in southwestern Ontario, Canada, has the potential to inform fisheries governance and management while offering a unique contribution that accounts for social and ecological perspectives. Fish harvesters are of particular interest due to their experience on the waters and the cultural relevance of fish harvesting for the SON. Through a community-based and qualitative approach, this thesis synthesizes SON fish harvesters' IEK and its implications for fisheries governance. This approach is particularly useful for SON fish harvesters and their connection to the ciscoes

(*Coregonus* spp.) of Lake Huron, which has been severely impacted by ecological and anthropogenic changes in the lake (Eshenroder and Lantry 2013; Eshenroder et al. 2016). In addition to these changes, legacies of colonialism, restrictive policies, and cultural disruption have altered how the SON interacts with their local environments and how IEK is produced, transmitted, and understood. The overarching research goal was to determine how the IEK from SON fish harvesters could inform fisheries governance and social-ecological relationships with ciscoes in Lake Huron. The research goals included documenting IEK, engaging with SON fish harvesters and elders, data-sharing through collaboration, promoting Indigenous and community-based research, and developing an ethical framework for community-based research with the SON.

1.1 CASE STUDY DESCRIPTION: THE SAUGEEN OJIBWAY NATION

The SON is an amalgamation of two First Nations situated in southwestern Ontario on the Saugeen (Bruce) Peninsula. The representative bands include the Chippewas of Nawash Unceded First Nation No. 27 (referred to as Nawash) and the Chippewas of Saugeen First Nation No. 29 (referred to as Saugeen). Together, these bands govern their expansive traditional territory (Figure 1) through a SON Joint Council composed of their respective Chiefs and Councils. The traditional territory of the SON, known as Saukiing Anishnaabekiing in Anishnaabemowin (Ojibway), is comprised of 6,500 km^2 of land including the many islands around the peninsula and 10,000 km^2 of the Lake Huron and Georgian Bay lakebed. There is undisputed evidence, archaeological and otherwise, that the ancestors of the SON have continuously occupied this territory for thousands of years (Koenig 2005; Fitzgerald 2016). This time of occupancy has created an intimate connection to the land, the waters, and all living relations.

Central to SON's history and culture is the connection to fish, evident in Ojibway ceremony and totemic systems, Nation-to-Nation negotiations, and stories passed on by elders (Johnston 1990; Johnston 2003). The SON's more recent history of treaties and subsequent exclusions from management and policy, reveal severe injustices and wrongdoing (Blair 1996; Keeshig-Tobias 1996; Morito 1999; Akiwenzie and Roote 2004; Koenig 2005). However, the SON remains committed in the assertion and practice of their rights while governing natural resources throughout the territory.

Figure 1. Saugeen Ojibway Nation traditional territory (Saukiing Anishnaabekiing).

Formally Cape Croker, Nawash was officially renamed Neyaashiinigmiing in 1992, which roughly translates to a point of land surrounded on three sides by water (Keeshig-Tobias

1996). This toponym reclaims a cultural sense of place and enforces Indigenous self-determination. The community is situated on the shores of Georgian Bay, north of Owen Sound. The reserve is approximately 64 km^2 in size and is home to 726 residents (INAC 2020a). The total number of registered band members in 2020 was 2,747, revealing that the majority of individuals live off reserve (INAC 2020a). In 2016, the unemployment rate was 15%, more than double the national rate of 7% (Statistics Canada 2020a; 2020c). In terms of food availability, economic constraints, a lack of formal food retail stores within the community, and a 25-minute drive to the closest grocery store make access to food an issue. Other constraints and mechanisms act as barriers to accessing traditional foods such as fish, a once dominant staple of SON diets (Lowitt et al. 2018).

Saugeen translated to English is the mouth of the river, and it is synonymous with love (Keeshig-Tobias 1996). Like Neyaashiinigmiing, the toponym Saugeen represents the SON's connection to place and how their place names relate to significant local geography and allegory. The Saugeen River runs through the reserve into Lake Huron and it is an essential feature for fish and wildlife as well as an important historical site. The reserve is situated south of Sauble Beach and north of Kincardine on the shores of Lake Huron. Highway 21, which connects both sides of the peninsula, passes through the community and brings a large number of visitors each year. The current population of the 50 km^2 reserve is 980, while the total number of registered band members is 1,910 (Statistics Canada 2020b; INAC 2020b). Saugeen's 2016 unemployment rate of 37% was also much higher than the national rate (Statistics Canada 2020b). For Saugeen, access to food is less limited than Nawash due to a closer proximity to grocers and more retailers with foodstuffs within the community, but access is still constrained by economic factors (Lowitt et al. 2018). Similar to Nawash, access to traditional foods is also constrained, especially due to

the fact that there was only one active commercial fish harvester within the community during the time of this study. Many band members from Saugeen do, however, fish for subsistence purposes, and there is a retailer selling SON harvested fish within the community.

1.2 CISCOES AND THE SAUGEEN OJIBWAY NATION

There have been rapid and countless changes to the Laurentian Great Lakes ecosystems since European contact. Most of these changes are the result of explosive increases in commercial fishing effort, proliferation of invasive species, pollution, habitat degradation, serious algal (*Cladophora* spp.) blooms, and fisheries mismanagement (Bogue 2000; Mandrak and Cudmore 2010; Gaden et al. 2012). Commercial fishing has played a critical role in the settlement and ongoing development of the Great Lakes region, gaining even more prominence as harvesting and processing technology improved (Brenden et al. 2013). Along with increased fishing effort, these changes have significantly affected fish populations and consequently, the Indigenous communities who have relied on them for millennia. Fortunately, since the mid-1900s there has been noteworthy progress in the multi-jurisdictional conservation and rehabilitation of several indigenous fish species and a progression in fisheries governance towards collaboration and inclusivity (Nesper and Sclender 2007; Gray and Hatchard 2007; Berkes 2010; Gaden et al. 2012). Nonetheless, the Great Lakes and its native fish species continue to be influenced by anthropogenic and ecological factors.

Among these affected species, salmonids are of primary concern for the SON and resource authorities because of their ecological, socio-economic, and cultural significance. More specifically, members of the genus *Coregonus* require attention due to their poorly understood behaviour, biology, and severe population declines. These species (here considered forms) include lake whitefish (*Coregonus clupeaformis*), lake herring (*Coregonus artedi*), shortjaw

cisco (*Coregonus zenithicus*), bloater (*Coregonus hoyi*), deep-water cisco (*Coregonus johannae*), blackfin cisco (*Coregonus nigripinnis*), kiyi (*Coregonus kiyi*), longjaw cisco (*Coregonus alpennae*), which was synonymised with *C. zenithicus*, and shortnose cisco (*Coregonus reighardi*) (Koelz 1929; Todd et al. 1981). Excluding lake whitefish and lake herring, these fish belong to a flock of six deep-water forms that are endemic to the Great Lakes and are collectively referred to as chubs (Eshenroder et al. 2016). Together with the lake herring, these fish are commonly referred to as ciscoes. As planktivores and critical prey fish, ciscoes play a vital role in the fish communities and food webs of Lake Huron, supporting important commercial and sport species such as the lake trout (*Salvelinus namaycush*) (Scott and Crossman 1973; Roseman et al. 2014).

Along with other native fish species, the ciscoes of Lake Huron hold a cultural and socio-economic significance to the people of the SON, who have harvested, consumed, and traded them for a number of generations (Lowitt et al. 2018; La Riviere and Crawford 2013). During their residency on the shores of Lake Huron, the people of SON have developed an intimate understanding and connection with native fish species, never surrendering their rights to fish for food, ceremony, commerce, or to manage their own fisheries (Akiwenzie and Roote 2004; Koenig 2005; Harris and Millerd 2010). The declines in native fish populations like lake whitefish and ciscoes have had significant impacts on SON livelihoods, culture, and traditional food availability, a key pillar of Indigenous food security (Power 2008; Lowitt et al. 2018; Gobin and Lauzon 2020). These declines represent a loss of connection to once prominent species. The connection to all living beings as equal parts is a key tenet of Ojibway or Anishinaabe culture and spirituality (Johnston 2003). Impacts from anthropogenic and ecological factors continue to

affect this connection, which is not only confined to culture and spirituality, but also to subsistence, governance, and socio-economic realities.

1.3 PURPOSE AND OBJECTIVES

Scientists, SON community members, and organizations including the Great Lakes Fisheries Commission (GLFC) and Parks Canada Agency, Fathom Five National Marine Park, have expressed concerns and interest regarding the ciscoes of Lake Huron. Evidently, there is a need to address these concerns and to address the lack of explicit knowledge, ecological and otherwise, surrounding these fish. This information can be used to evaluate the SON's opportunities of re-engagement with a once prominent fishery, to re-establish the SON's connection to ciscoes which has been severely altered, and to better inform the SON communities on the current status and past importance of ciscoes. More information on the distribution and abundance of ciscoes can also aid in future monitoring, critical habitat protection, and understanding the Lake Huron ecosystem.

As the primary rights holder and active party in the governance and co-management of their own fisheries, the SON would like to broaden their understanding of ciscoes through collaboration so that they may renew their relationship to these fish in the future. Fishing for commercial and subsistence purposes is a constitutionally protected right afforded to the SON from their past negotiations with colonial and contemporary governments (R. v. Jones 1993; Blair 1996; Morito 1999). The perspective of the SON is that fish do not need governing because they govern themselves and have always done so without anthropogenic intervention (Lauzon and Ryan 2019). Further, the SON believes that human behaviour and interaction with the fish and the waters is what is needed to be governed. This perspective reflects a common Indigenous view that humans are embedded within nature and should work with it rather than control it. As

the primary rights holder, the SON is more than just a stakeholder in the fishery, they are stewards engaging in governance that need to be recognised as equals.

Much broader than management, governance is an important process that is defined by Kooiman and Bavinck (2005) as, “the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them.” (p. 17). At its core, governance is concerned with understanding values, images, principles, and perspectives within a given system and using that understanding to make decisions (Song et al. 2013). These meta-level governance elements have historically been overlooked and disregarded, especially when they are from the SON. By bringing forward these elements and taking a culturally and ecologically integrated approach, this research can strengthen the governance process, and give the SON and their fish harvesters a larger voice in academic and policy arenas.

To address the concerns surrounding ciscoes, I conducted a participatory community-based investigation into the IEK held SON fish harvesters. The documentation and dissemination of SON fish harvesters’ IEK can appropriately and respectfully voice their concerns to broader audiences, decision-makers, and research partners. Through the application of community-based and participatory principles, I engaged with the SON and its fish harvesters directly allowing for more inclusion in the research process. The inclusion of their input and perspectives is something that past research and management has failed to do adequately. Currently, there are no SON specific manuals or frameworks for conducting this type of socio-ecological research. As part of this research, a SON specific data collection manual (DCM) was created, which may also be helpful in future projects.

In addition to the overarching research goal, four research questions guided this research:

a) What do ciscoes represent to past and present SON fish harvesters?

b) How can SON fish harvesters' IEK aid in the understanding of cisco biology, critical habitat, abundance, distribution, behaviour, and natural history?

c) How can SON fish harvesters' IEK be used to inform future biological sampling, monitoring, management, and policy decisions among provincial resource authorities and the SON?

d) How will SON fish harvesters' IEK shed light on the future commercial and cultural role in the communities of the SON?

1.4 CRITICAL REFLEXIVITY AND POSITIONALITY

It is imperative to place one's self in research to address any bias or influence (Brown and Strega 2015). Critical reflexivity enables the researcher to locate themselves within the context of their research and to their relations with the participants. I am a band member of the Chippewas of Nawash. I do not claim to be exclusively Indigenous, as I also have European ancestry and I identify mostly as a Canadian. My mixed heritage is important and lends into the ideas of two-eyed seeing. My previous work experience includes working on the Fisheries Assessment Program for SON, serving as an intern at the SON Environment Office on the nuclear energy file, and working as a SON archeological monitor. These positions granted me exposure to fisheries mechanisms, SON history, Indigenous consultation, and management of natural resources. From May 2019-July 2020, I was employed by the Fisheries Assessment Program as the Cisco Field Researcher and worked closely with local fish harvesters, the SON, and our project partners. The partners included Parks Canada (Fathom Five National Marine

Park); Lakehead University; the University of Toronto; the GLFC; and the Department of Fisheries and Oceans Canada. The position was part of an initiative to gain a deeper understanding of the SON's connection to ciscoes, to create novel collaborations, and to share knowledge with the SON and other interested parties. I was involved in the research design, execution, analysis, and dissemination. Located within this initiative is this thesis, specifically concerned with a subset of the interviews. This position allowed me to become embedded within the community and engage in participant observation at fisheries related events, strengthening my understanding of community context and informing my interview questions (McGoodwin 2001; Musante and Dewalt 2002).

I was taught how to fish and hunt at a very young age by my late grandfather Ted Johnston, a respected veteran and community member. While he was a devout Christian and spoke little of his times at residential school or Indigenous spirituality, he garnered in me a deep respect for nature. I have mostly lived off the reserve throughout my life, but I was always very close and spent a lot of time there. Many summers and weekends were spent on the reserve exploring and spending time with family. I always knew that fishing was a large component of our culture and I became fully immersed when I was first offered a job with the Fisheries Assessment Program. During my time with the Fisheries Assessment Program, I built relationships with SON fish harvesters and employees. I came to realize that our fish harvesters have faced many hardships and continue to do so. These people are my family and fellow community members and it is difficult to see them struggle with a lifestyle that has been so ingrained into who we are. I have become invested in my people, the people of the SON, and I want to give them a larger voice and share their knowledge with my research.

My undergraduate degree at Lakehead University in the science of forestry taught me to be a critical thinker and to rely, perhaps too heavily, on strictly quantitative science. As I progressed academically and became a Master's student, I was exposed to a different world of science, the world of qualitative science. It changed the way I looked at research and led me to the conclusion that qualitative and quantitative science are useful in their own ways and can be even more powerful when used in unison. This is a driving theme for the broader cisco initiative; the merging of these two sciences and ways of knowing like IEK and Western science. This Master's was made possible by Social Sciences and Humanities Research Council funding from FLEdGE (Food, Locally Embedded, Globally Engaged) and it was part of sustainable fisheries research with my supervisors Drs. Charles Levkoe and Kristen Lowitt.

The reason I wanted to conduct this research was three-fold. Principally, I wanted to do this work to support my community and make relatively implicit knowledge explicit for the benefit of fisheries management and general understanding. I wanted to explore this issue because it holds significance to myself and my ancestors, who relied on fish to a much higher degree than I currently do. I believe, in some form, exploratory research such as this can aid in cultural revitalization, facilitate education and a better understanding of our environment, and promote intrigue into a practice that has so strongly influenced my people and their history. The secondary reason why I wanted to do this research was to contribute to the broader literature and discussions on fisheries management and governance. My third reason was to build my analytical and personal skills for my future, so that I can continue to give back to the community and the country that has raised me to be the person I am today.

1.5 OVERVIEW

The proceeding chapters will be concerned with background information and context (2), methods and methodology (3), knowledge gathered by the interview process (4), how that knowledge pertains to the research questions (5), and conclusive reflections and steps forward. The main themes of this research center on fisheries governance and management, ciscoes, IEK, and the SON fishery. By examining these factors, this research provides insight into the current governance processes and how the IEK of SON fish harvesters might better inform them. It also challenges the dominant governance and management decisions led by resource authorities and governments as part of the SON's self-determination.

CHAPTER 2: LITERATURE REVIEW

There are three main themes that will be examined in this chapter. First, I explore the history and contemporary status of ciscoes in Lake Huron. By understanding their history of decline, we can begin to understand the significance of ciscoes to the fisheries of Lake Huron, the development of the Great Lakes region, and the SON. Second, I explain how IEK is understood within the existing literature and in this study. Third, I discuss governance and management with a focus on fisheries. Historically, the Western science fisheries management regime had many flaws, as exhibited by the current fisheries crisis, which are still largely present today. The inclusion of SON fish harvesters' perspectives grounded in IEK may serve to improve this process and account more appropriately for social and cultural factors. Acknowledging past events is critical for providing context, especially because fisheries management and governance occur over broad spatial and temporal scales. These themes will set the context and give an account of the past so that we may understand what is happening currently.

2.1 CISCOES OF THE GREAT LAKES

As the glaciers receded following the Pleistocene, the progenitor of the cisco complex, assumed to resemble lake herring, re-entered the proglacial lakes that would soon come to form the Great Lakes (Turgeon and Bernatchez 2003). Over time, this ancestral fish and its successors became dominant planktivores in shallow and deep waters (Eshenroder and Lantry 2013). At the time of European contact, Lake Nipigon and each of the Great Lakes supported a complex of seven ciscoes that varied between each lake. Six of these seven forms inhabited deep, offshore waters while lake herring remained inshore. All of the deep-water ciscoes and lake herring were historically present in Lake Huron. Alongside lake trout, ciscoes represented a key component in

Lake Huron's simple, yet specialized fish community. Koelz (1929) provided the first comprehensive account of the ciscoes in the Great Lakes. At the time of Koelz's initial descriptions, the ciscoes were already experiencing declines in populations and changes in community structure due to overfishing.

The early fisheries for Lake Huron ciscoes were exclusively inshore and focused on lake herring, taking advantage of their pronounced abundance (Eshenroder et al. 2016). Technological advancements in locomotion and the introduction and widespread use of gillnets in commercial fishing operations allowed fish harvesters to move further offshore and target deep-water forms (Figure 2). These ciscoes were collectively marketed as chub and as demand grew, they became subject to intensive harvesting starting in the 1860s (Koelz 1929). As a chub collective, landings of deep-water ciscoes were not separated by form making historical interpretations of specific form abundance difficult. Koelz (1926) reported that Lake Huron chub were being harvested in Canadian waters out of Goderich, Kincardine, Southampton, Tobermory, Lion's Head, Cabot's Head, and Wiarton. While the chub fishery was prominent in both the U.S.A and Canada, it was considerably more significant in the U.S.A. in terms of total harvest and economic importance (Koelz 1926). Principally size dependent, the chub fishery systematically removed the larger forms out of Lake Huron and facilitated their replacement by smaller forms (Smith 1968). Coupled with this successional chub fishery, the exploitation of lake trout relieved predation pressure on the smaller forms of chub, further allowing them to proliferate (Eshenroder et al. 2016).

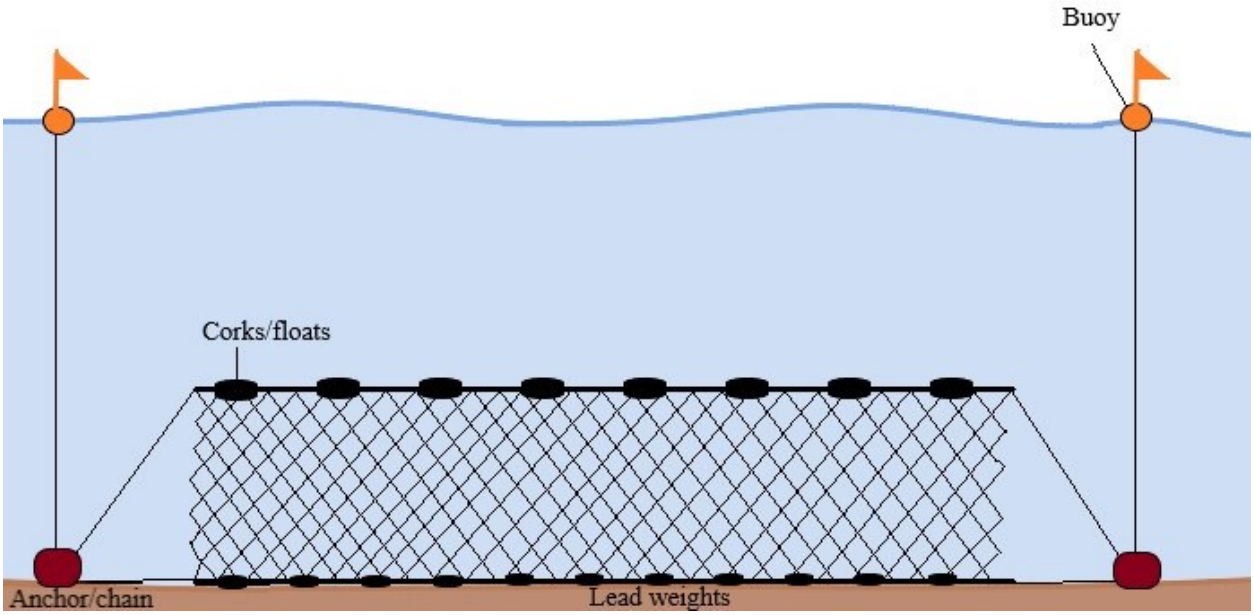


Figure 2. Representation of a single gillnet section.

At the turn of the 18th century and until present, ciscoes and the Lake Huron deep-water fish community have been significantly impacted by anthropogenic and ecological factors. These factors have included successional overharvesting, a collapse of the deep-water fish community, and introductions of sea lamprey (*Petromyzon marinus*), alewife (*Alosa psuedoharengus*), rainbow smelt (*Osmerus mordax*), dreissenid mussels (*Dreissena* spp.), and stocked predatory salmonids (*Oncorhynchus* spp., *Salvelinus* spp.) (Smith 1968; Riley et al. 2008; Eshenroder and Lantry 2013). Eshenroder and Burham-Curtis (1999) define the effects of these factors as "successional setbacks" that have made the study and management of ciscoes increasingly difficult. In addition to these successional setbacks, extinctions and extirpations of certain cisco forms to varying degrees in each of the Great Lakes have led to disputes over their status and glaring data deficiencies. This represents a unique research and management opportunity as each of the Great Lakes has been affected differently.

Conservation conventions like the Species at Risk Act (SARA) and the International Union for Conservation of Nature's Red List of Species have many of the forms listed as either threatened, extirpated, or extinct (Mandrak and Cudmore 2013; Government of Canada 2019; IUCN 2019). Mandrak et al. (2014) report that there are only three extant forms of cisco in Lake Huron, lake herring, bloater, and shortjaw cisco, but Eshenroder at al. (2016) suggest otherwise. Table 1 from Eshenroder et al. (2016) reveals the perceived status of ciscoes in each of the Great Lakes in the most recent cisco monograph.

Table 1. Contemporary cisco status throughout the Great Lakes Basin (Eshenroder et al. 2016).

Major Form	Lake					
	Superior	**Michigan**	**Huron**	**Erie**	**Ontario**	**Nipigon**
alpenae	–	Extinct	Introgressed	Extinct	–	–
artedi	**Extant**	**Extant**	**Extant**	Extirpated	**Extant**	**Extant**
hoyi	**Extant**	**Extant**	Introgressed	–	Reintroduced	**Extant**
johannae	–	Extinct	Extinct	–	–	–
kiyi	**Extant**	Extirpated	Introgressed	–	Extirpated	–
nigripinnis	Uncertain	Extinct	Extinct	–	–	**Extant**
reighardi	Uncertain	Extinct	Introgressed	–	Extinct	–
zenithicus	**Extant**	Extirpated	Introgressed	–	–	**Extant**

In addition to their poorly understood nature and disputes over their status, ciscoes have a taxonomy that is unclear and they are difficult to identify, exhibiting high phenotypic plasticity and geographic variation (Scott and Crossman 1973; Eshenroder et al. 2016). This is a poorly understood phenomenon, but it is likely a result of introgressive hybridization of the deep-water forms, a possible outcome of increasingly stressed populations, or convergent evolution (Todd and Stedman 1989; Seehausen 2004; Stern 2013). This layer of uncertainty has made it difficult to understand and adequately document cisco abundance and distribution. A theory posited by Eshenroder et al. (2016) suggests that only lake herring and an introgressed deep-water hybrid swarm or form, *Coregonus hybrida,* are extant in Lake Huron. The forms that are suspected to

have introgressed are considered extirpated or extinct (Table 1), although elements of their morphology may still be observed. These taxonomic complexities call into the question the validity of the initial descriptions, possibly suggesting the reclassification of ciscoes (Eshenroder et al. 2016).

To identify specific cisco forms, morphometric and meristic measurements are used. Variations in these measurements can provide insight and can help identify what form a given sample most closely resembles. Morphometrics are body length measurements presented as ratios and meristics are counts of body parts like gill rakers. The taxonomic complications with ciscoes also make it challenging to identify and delineate critical habitat for protection, an essential component of the SARA (Mooers et al. 2010). Naumann and Crawford (2009) discuss the need for a better understanding of cisco habitat use and the problems associated with habitat identification for such a poorly understood and rare flock of forms.

2.2 INDIGENOUS ECOLOGICAL KNOWLEDGE

The long history of Indigenous peoples residing in North America represents a high-quality source of ecological knowledge that has been developing for millennia (Ostertag et al. 2018). Traditional ecological knowledge (TEK) is defined by Adams et al. (2014, p. 1) as a multidimensional way of knowing that, "provides an understanding of local and interconnected patterns and processes over large spatial and temporal scales." Traditional ecological knowledge is inherent in many Indigenous groups throughout the world and represents a specific worldview in addition to a source of knowledge (Inglis 1993). The worldview expressed by TEK explains the interconnectedness of nature by placing human beings within nature rather than separate and by emphasizing principles that regulate human interaction with the natural world (Johnston 2003; Davis and Ruddle 2010). It is a way of knowing and understanding the world that is founded on

the cultural accumulation of observational, contextual, and experiential information that is rooted in survival and gained through trial, error, and residency in a given area (Berkes et al. 2000; Huntington 2000; Drew 2005). It is an important source of intergenerational knowledge transfer that represents a shared history with the environment, providing critical and contextual insights that conventional Western science cannot (Houde 2007).

Rather than a single body of knowledge, TEK is diverse and represents a dynamic source of knowledge held by many individuals on a local scale (Adams et al. 2014). This notion reinforces the need to engage with multiple individuals, as a single individual cannot hold a complete understanding of the environment. Cultural and oral tradition are the vehicles in which TEK is transferred from generation to generation (Drew 2005). Lasting impacts from residential schools and changes in community and cultural structure have led to a disruption in the social mechanisms responsible for the transfer of this knowledge in Canada (TRCC 2015a). Fortunately, there has been an increasing amount of attention towards TEK, the reconciliation of TEK and Western science, and incorporating TEK into contemporary management and cultural revitalization (Berkes et al. 2000; Ruddle and Davis 2013).

Traditional ecological knowledge is distinct from other forms of ecological knowledge like local ecological knowledge (LEK) and fisher ecological knowledge (FEK) due to its connection to Indigenous culture and spirituality, long history of residence relative to other forms of ecological knowledge, and oral tradition, yet they are essentially the same in every other aspect. However, the use of the term “traditional” is problematic and exclusive, especially in legislative and management domains, implying a sense of time and connection to Indigenous spirituality (Davis and Ruddle 2010). Many individuals may be of Indigenous descent, but do not practice ceremony or ascribe to Indigenous spirituality. Impacts from residential schools and

attempts of cultural assimilation from governmental powers have further complicated Indigenous peoples' connection to the traditional (TRCC 2015a).

The use of the term TEK fundamentally excludes knowledge that is not grounded in tradition or spirituality. Also, tradition is always evolving and adapting, and cultures are becoming more intertwined as we continue down a path of shared existence as treaty people (Hunn 1993; Epp 2008). This is inherently confusing for researchers and decision-makers when considering the incorporation of TEK into their work. What constitutes TEK? What separates individuals grounded in Indigenous spirituality and ceremony from those who are not? How does TEK compare to FEK, LEK, or IEK? For these reasons I use the term IEK from this point forward to ensure that no knowledge is dismissed because it is not perceived as sufficiently traditional while maintaining its connection to Indigenous peoples. Therefore, IEK can be defined as any Indigenous knowledge, theory, or observation generated by experience or inter-generational transmission that relates to socio-ecological systems.

2.3 GOVERNANCE AND MANAGEMENT

In general, Western science is based on a reductionist system of knowledge that relies on the scientific method to understand the world and to devise universal laws. Historically, natural resource management and policy decision making have been dominated by a rigorous Western science regime, which has been largely driven by networks of experts known as epistemic communities (Berkes 2010). This dominance has often disregarded and marginalized ecological knowledge from both Indigenous and non-Indigenous land-based experts due to their anecdotal natures and alternative perspectives (Shackeroff and Campbell 2007). This regime has also neglected to consider that Indigenous peoples have been interacting with their local environments for millennia, developing an intimate understanding of their surroundings and

ecological processes (Mazzocchi 2006). Ecological knowledge research can bring forward meta-level governance elements through discussions with those who use and rely on natural resources the most (Song et al. 2013). This contextual information is often what is missing from research and management. The overwhelming neglect of this knowledge has had severe implications in the management of resources, Nation-to-Nation relations, and resource access. For example, the quantitative fisheries science regime and the omission of ecological knowledge played a significant role in the decline and collapse of the Newfoundland cod fishery (Neis 1992; Bavington 2010). Perhaps if the insights from the local fish harvesters were taken into consideration, this tragic event could have been avoided or lessened.

This research will emphasize the importance of including IEK in governance and management. Collaborative and participative governance processes are essential for sustainable and just management of natural resources because they consider input from all rightsholders, stakeholders, and interested parties (Bundy et al. 2008; Jentoft et al. 2010). This is critical because the historical Western science approach has solely relied on the input from the epistemic community, who are often much more disconnected than those on the ground like fish harvesters (Gray and Hatchard 2007). Therefore, IEK represents high-quality input and insight for governance and management of natural resources. The basis for the epistemic community is sound as it considers input from experts in their respective fields, but it neglects contributions and input from those at the bottom of the hierarchical governance pyramid. Collaborative governance challenges the traditional hierarchical model of governance and highlights the diversity and utility of ecological knowledge held by those whose livelihoods are dependent on fishing (Symes 2006). Collaborative governance also works towards making ecological knowledge and meta-level governance elements like values and principles explicit, aiding in

engaging the complexity of governance (Berkes et al. 2000; Song et al. 2013). Participative and collaborative governance frameworks are important components of ecosystem-based management, an increasingly popular and promising mode of resource management (Link 2010). Through the embodiment of good governance, collaborative processes can achieve democracy, legitimacy, accountability, and transparency.

Ecosystem-based management and other similar approaches are facilitating structural changes to historically dominant resource management regimes, but change is slow (Link 2010). Fisheries management objectives have historically been focused on a limited number of ecological or social goals; however, there are multitude of socio-economic and cultural values tied to the Great Lakes (Heck et al. 2014). Heck et al. (2015) report that views of social science among fisheries managers are mostly negative and stem from concerns over credibility and their general lack of understanding regarding social science methods and principles. This attitude towards social science is concerning given that fisheries managers are tasked with governing socio-ecological systems (Hunt et al. 2013). And as managers of socio-ecological systems, fisheries managers need to account for biological, ecological, economic, social, and cultural factors, key components of ecosystem-based management (Link 2010). In addition, the ecological knowledge that land-based experts have could also prove to be useful by giving managers insights on an ongoing basis. The lack of knowledge and negative perceptions around social science and IEK need to improve for more successful management and governance of fisheries.

An important step towards the consideration of the social dimensions of fisheries management is research that conveys its practicality and utility. This is exemplified by the GLFC, a multi-jurisdictional fisheries governance organization. One of their mandated research

themes is concerned with the human dimensions of Great Lakes fisheries management, which "play a central role in Great Lakes fisheries in terms of fishery values, desired management outcomes, and management challenges" (Dobson et al. 2005; Heck et al. 2014, p. 1). Johannes et al. (2000) exhibit the utility of fish harvester IEK in marine resource management, alluding to six examples of where it has improved management. Tobias (2009) demonstrates the benefits of mapping IEK, as land-use and occupancy maps can be central in negotiations with governments or industrial developers. Andrews et al. (2019) compile recent research, certified angling catches, historic accounts, grey literature, and anecdotal reports to aid in the future research and the management of striped bass (*Morone saxatilis*) in Atlantic Canada, which led to the suggestion for a new Designatable Unit. Like culture and tradition, ecological knowledge of any form is constantly evolving overtime from person to person, revealing the need for ongoing research and work to make this knowledge explicit for the benefit of management and decision making.

2.3.1 The Intersection of Western Science and Indigenous Ecological Knowledge

An important concept that lends from both ways of knowing, two-eyed seeing, was brought forward by the Mi'kmaw elder Albert Marshall in 2004 (Bartlett et al. 2012). Two-eyed seeing emphasizes the importance of both Western science and IEK, while recognizing their distinct differences (Tsuji and Ho 2002; Martin 2012; Tengö et al. 2014). The most profound difference between these two ways of knowing is that IEK is generally guided by a holistic approach, while Western science is guided by reductionist and positivist approach (Pringle et al. 2017). While they may seem contradictory, these two ways of knowing can benefit each other greatly (Pedersen et al. 2020). Through two-eyed seeing, both ways of knowing are granted equal footing, allowing for deeper insight and a broader understanding. However, there will always be potential for contradictory results. By using a two-eyed seeing approach, each

contradictory result can provide a unique contribution in a governance context. This concept can be extended and used to facilitate meaningful and equitable partnerships between Indigenous communities, resource authorities, academic institutions, and governmental organizations.

While the merging of IEK and Western science may seem like a logical and ethical step forward to address management issues, it has been met with significant criticism by some in Western science (Casimirri 2003). A common perception is that IEK and the ecological insights it contains lack the objective and methodological rigidity of conventional science. There are concerns whether these insights should be incorporated into contemporary management due to their subjectivity, reliability, utility, and variability from person to person (La Riviere and Crawford 2013; Berkes et al. 2000). Murray et al. (2008) explore the intersection between fisheries IEK and conventional fisheries science, explaining that while there are benefits to gathering IEK such as revealing useful data, there are a number of challenges including concerns of validity and commensurability. A striking difference between Western science and IEK research is the lack of independent and blind repetitions of study, which can corroborate data (Gilchrist et al. 2005).

Davis and Ruddle (2010) suggest that IEK researchers need to employ rational skepticism more frequently to query statements, theories, and claims that are not backed up by empirical evidence. With rational skepticism, researchers can evaluate accuracy and address concerns over validity. As rational skeptics, researchers will scrutinize IEK just as any other knowledge is scrutinized, as Huntington (2000) recommends. Similarly, the two-eyed seeing framework can be used to validate assumptions and theories from both Western science and IEK. Some studies suggest validating IEK through ground-truthing, quantitative evaluation, inquiring with other informed individuals, or comparing IEK with previously surveyed areas and sampled species

(Huntington 1998; Gilchrist et al. 2005; Anadón et al. 2009). Initial perceptions of the validation of IEK may be negative and be seen as disrespectful to the knowledge holder. However, as Gratani et al. (2011) found, the validation process can actually empower IEK holders and be seen as necessary for their IEK to be considered by scientists and decision-makers.

The challenges associated with incorporating experience based IEK and conventional Western science are numerous (Agrawal 1995; Nadasdy 1999; Pringle et al. 2017). This is often a result of contradictions between IEK and Western science and variability among participant responses. A contradiction might warrant further deliberation and validation of data, but this may have negative effects. Some argue that the validation of IEK may serve to negatively affect and devalue this form of knowledge (Nadasdy 1999; Brook and McLachlan 2005). Others see IEK as a distinct knowledge system that does not require Western science for validation and that it cannot be adequately translated from one form of knowing to another (Loring 2020). Simpson (2004, p. 380) states, "coercing our knowledge to conform to the rules of the colonial power structure serves only to further denigrate and attack the nature of Indigenous Knowledge." It is important to consider that each way of knowing has its own framework for evaluation and in many cases evaluation of knowledge from either side may be inappropriate. This re-enforces the idea of the co-production of knowledge and two-eyed seeing. It also echoes the sentiment Berkes (2017, p. 292) shares, that "each is legitimate in its own right, within its own context; each has its own strengths. The two kinds of knowledge may be pursued separately but in parallel, enriching one another as needed."

The foundation of two-eyed seeing is the application of two knowledge systems to gain a deeper understanding than what is possible with only one. Similarly, the idea of connecting multiple and diverse knowledge systems through a multiple evidence base approach (MEB) can

enhance the collective knowledge of a particular issue, topic, or concern (Tengö et al. 2014). Rather than only relying on two ways of knowing, MEB champions using several local, scientific, and Indigenous knowledge systems (Figure 3). Tengö et al. (2012, p. 2) note that a key strength of this approach is the "triangulation of information across knowledge systems and thus evaluation of the relevance of knowledge and information at different scales and in different contexts." The application of using a MEB approach may address some of the challenges with incorporating IEK and Western science like validation or commensurability.

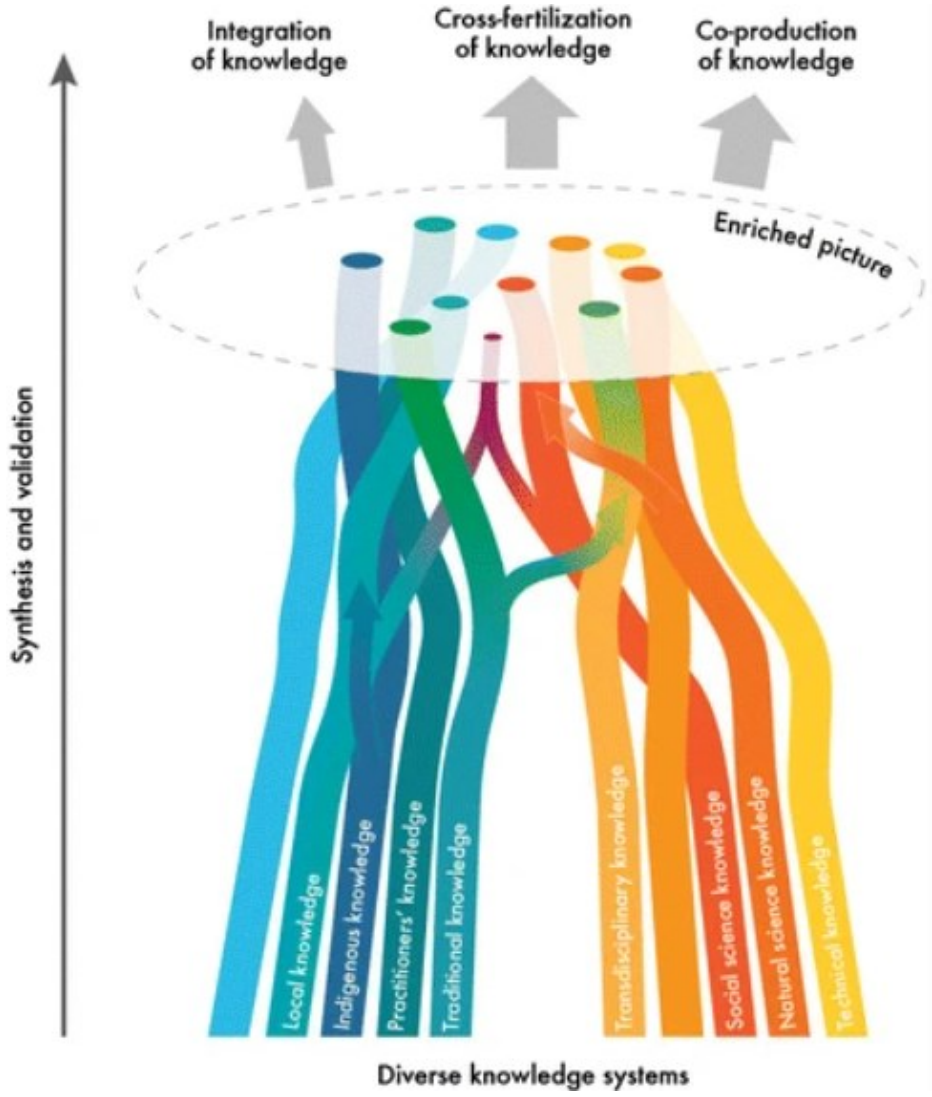


Figure 3. The multiple evidence base approach (Tengö et al. 2014).

2.3.2 Reconciliation

An essential component in natural resource management and Nation-to-Nation relations in an Indigenous context is the concept of reconciliation (Blackburn 2007; Moola and Roth 2019; Lowitt et al. 2019). As defined by the Truth and Reconciliation Commission of Canada (TRCC), reconciliation is "an ongoing process of establishing and maintaining respectful relationships" (TRCC 2015a, p. 16). Historical actions by colonial and federal governments have affected North American Indigenous culture, knowledge, and the way Indigenous communities interact with local environments and generate IEK. The Report of the Royal Commission on Aboriginals in Canada of 1996 advocated that Canadians begin a process of reconciliation, but its recommendations were not taken seriously (Government of Canada 1996; TRCC 2015a). From 2008 to 2015, the TRCC conducted research on the impacts and legacies of residential schools in Canada. In 2015, they concluded their work and produced a final report and 94 calls to actions (TRCC 2015b). While the calls to action were primarily focused on residential schools, some can be extended to resource management. For instance, Call 52 deals with the recognition of Indigenous title.

The calls for action also support the United Nations Declaration on the Rights of Peoples (UNDRIP), a resolution (non-legal document) that also advocates reconciliation through Nation-to-Nation relations (United Nations General Assembly 2007). The UNDRIP articles are of critical importance for any resource management that involves Indigenous peoples and should be considered by all decision-makers. Some prominent articles include Articles 3, 26, and 29, which state that Indigenous peoples have rights to self-determination, to their traditional territories, and to the conservation and protections of the environment, respectively (United Nations General Assembly 2007). These frameworks provide an avenue of reconciliation for current decision-

makers through promoting collaboration and understanding. The utilization of the principles in these documents may help bring forward a new era of resource management and Nation-to-Nation relations and negotiations around the Great Lakes and around the world.

CHAPTER 3: METHODS AND METHODOLOGY

This chapter will examine the approaches and principles that informed the research process. It also describes the SON fishery as the case study for this thesis. Central to this research are SON fish harvesters and their experiences with management and governance. An account of the past negotiations and key events are essential to fully understand the current state of the fishery. To adequately account for ethical considerations, this research was guided by a set of principles that ensured respectful and fair treatment of participants and their knowledge. These principles were an important component of the research methods, which involved semi-structured interviews with SON fish harvesters using a modified map biographic process as well as biological sampling. Analysis of the qualitative and spatial data from the interviews was facilitated using Nvivo 12 and ArcGIS 10.6 software. The knowledge that was produced from this research will be disseminated through various media. However, the COVID-19 pandemic occurring during the time of this writing has delayed all dissemination events until it is safe to proceed.

3.1 THE SAUGEEN OJIBWAY NATION FISHERY

The picturesque SON territory (Figure 4) was rich in natural resources and arable lands prior to European contact, making it very attractive to incoming settlers. Over time, numerous factors including increased settlement with European arrival and growing concerns over encroachment, particularly fisheries related, led to the signing of several treaties with the British Crown during the mid-1800s (Keeshig-Tobias 1996; Morito 1999). In 1836, Treaty No. 45 ½ surrendered 1.5 million acres of land in the southern portion of the territory in return for the protection of the Saugeen Peninsula from encroachment and for economic assistance “to enable you to become civilized and to cultivate land” (CIRNAC 2020).

Figure 4. Saugeen Peninsula escarpment (Lion's Head, ON).

Exclusivity of their fisheries was of great importance to the people of the SON, but encroachment of this resource continued to occur, reflecting the British Crown's failure and violation of its own fiduciary responsibility and legal and moral obligations (Morito 1999). This continued encroachment prompted an Imperial Declaration in 1847 from Queen Victoria, which recognized the SON's rights to the Saugeen Peninsula and any islands within seven miles from the mainland (Koenig 2005). In the second half of the 19th century, more treaties and re-negotiations resulted in the cession of the entire Saugeen Peninsula save two small reserves, their territorial waters, a 9.3 km^2 hunting ground situated in the northern portion of the peninsula, and a culturally important site known as Chief's Point. In total, there were 10 "surrenders" in which the SON was dispossessed of its land with some form of compensation (Schmalz 1977).

Following the signing of the treaties, the British colonial and later Canadian governments significantly restricted the SON's participation in management and fishery access through legislation like the Fisheries Act of 1858, the fishing-license system, and the fishing-lease system (Blair 1996; Koenig 2005). Tensions and conflict over resource use and access were prevalent during this time and reached a new height in the 1990s when criminal charges were laid by the Province of Ontario against two Nawash fish harvesters for exceeding the imposed communal quota. Largely regarded as a defining and precedent-setting moment in SON history, R. v. Jones (1993) represented a turning point for the SON fisheries and communities as a whole. Like the majority of resource use and access legislation relating to Indigenous and treaty rights in Canada, SON's constitutional right to fish for substance and trade was reaffirmed through the court of law (Harris and Millerd 2010). The court ruled that what is now the Ontario Ministry of Natural Resources and Forestry (OMNRF) unjustifiably infringed upon the SON's Indigenous and treaty rights. Through the application of the principles laid out in R. v. Sparrow (1990), Judge Fairgrieve recognized that the SON's rights take priority over all other groups after conservation (R. v. Jones 1993). Judge Fairgrieve also recognized that many of the issues arising from this court case were a direct result of the SON's exclusion from fisheries management and research (Akiwenzie and Roote 2004). All criminal charges were dismissed.

The court case resulted in increased tensions around the peninsula, but emerging from this episode was the beginning of negotiations between the OMNRF, the Canadian government, and the SON. It is important to note that while this court decision is generally seen as a victory, there was no form of compensation for loss of use. In an attempt to give the SON more autonomy and authority over their traditional fishery, the OMNRF began to "buy-back" quotas from the non-Indigenous commercial fish harvesters. This process was successful and eventually

all quotas were bought. Many SON members bought their gear (e.g. nets, anchors, and flags) and fishing vessels from the fish harvesters whose quotas were bought out. In 2000, the OMNRF, the Canadian government, and the SON signed the first four-year Fishery Agreement to be renewed every five years.

The purpose of this agreement was to promote long-term cooperation and to address fisheries management issues. Key aspects included the implementation of Indigenous and treaty rights, territorial limits for commercial fishing, monitoring and compliance, data sharing, and total allowable catches (TAC) for commercial lake whitefish harvests (Akiwenzie and Roote 2004). Presently, the commercial fishery is managed through a 2011 Framework Agreement and a 2013 Substantive Commercial Fishing Agreement, which was amended in 2018 and extended to 2023 (Gobin and Lauzon 2020). The most recent agreement represented a significant shift to begin reconciliation with the Canadian and Ontario governments and to address historical injustices, sustainability, and fish stocking (Lowitt et al. 2019). This agreement does not cover fishing for food, ceremony, or social purposes.

Currently, the SON operates one of the largest Indigenous commercial fisheries in the Canadian Great Lakes (Lowitt et al. 2019). It has been continuously monitored by the Fisheries Assessment Program since 1995, a critical program for the support and co-management of the fishery (Gobin and Lauzon 2020). The SON Joint Fisheries Committee oversees the fishery and makes recommendations to the SON Joint Council, which co-manages the waters with the OMNRF. Also involved with the SON fishery, a grassroots non-profit organization called the Bagida-waad Alliance has been voicing concerns of the SON fish harvesters and conducting community-based research (Johnson 2019; Bagida-waad Alliance 2020). Commonly used fishing vessels include tugs (Figure 5) and open punts. Utilizing both Lake Huron and Georgian Bay,

SON fish harvesters target a number of species, with lake whitefish and lake trout comprising the majority of their harvest. Lake whitefish, a culturally and economically important species, is the only species to receive a TAC under the terms of the Substantive Fishing Agreement. This TAC has rarely been met due to a number of factors (Lowitt et al. 2018).

Figure 5. W. H. Wheeler, a Nawash commercial fishing tug (Nawash, ON).

Other species that are caught in lesser numbers include yellow perch (*Perca flavescens*), suckers (*Castostomus* spp.), carp (*Cyprinus carpio*), salmon (*Oncorhynchus* spp.), trout (*Salvelinus* spp.), pickerel (*Sander vitreus*), lake herring, and ling (*Lota lota)*. Chub were once harvested in large numbers, but significant reductions in catch led to a cessation of that fishery in the mid-2000s (SON 2020). Like the chub, substantial lake whitefish declines in unison with market uncertainties are directly affecting livelihoods and the SON way of life (Lowitt et al.

2018; Gobin and Lauzon 2020). In response to the lake whitefish decline, the Bagida-waad Alliance has been placing tobacco ties on the shores of Georgian Bay since October 5, 2019 in an attempt to draw attention to this issue and to promote an Indigenous-led recovery program for this species (Bagida-waad Alliance 2020).

While these co-operative Fishing Agreements are important steps towards reconciliation, there are still several concerns regarding the management of Lake Huron and continued infringement upon inherent rights. Lowitt et al. (2018) and Gobin and Lauzon (2020) report concerns from the SON regarding the stocking of fish, invasive species, and access to resources. Akiwenzie and Roote (2004) express their concerns regarding SON's omission from signing the 1997 GLFC Joint Strategic Plan for Management of Great Lakes Fisheries (GLFC 2007). This plan is multi-jurisdictional, bi-national, and includes U.S.A. tribes but not Canadian First Nations due to different interpretations of management rights (Norman 2015). The SON's participation in networks like the GLFC and their strategic management plan will be a critical component of self-determination and authority over their fishery (Lowitt et al. 2019). This notion is compounded by the fact that fish do not respect international, provincial/state, or municipal boundaries, and that management actions in the U.S.A. have direct impacts on how the SON and their fish harvesters interact with their fishery. Through research like this study and the larger cisco project, we hope to bridge the divide and work towards shared goals and meaningful collaboration.

3.2 RESEARCH APPROACHES

It was critical that this research was guided by a set of principles to ensure community-based, socially just, and equitable research that maintains a fair balance of power between all parties. From its inception, the First Nation ethical principles laid out by Ownership, Control, Access, and Possession (OCAP) and the Tri-Council Policy Statement: Ethical Conduct for

Research Involving Humans were used to guide this research and the partnership between Lakehead and the SON (Tri-Council 2018; FNIGC 2019). These principles supported the SON's authority over research taking place within their territorial boundaries through involvement at every step and the establishment of data handling protocols (Schnarch 2004). In addition to these principles, this research also closely aligned with the ethical guidelines outlined in the Royal Commission on Aboriginal Peoples which address collaboration, Indigenous knowledge, and applications of data (Government of Canada 1996).

Historically, Indigenous peoples and communities have predominantly been subjects of research, receiving little to nothing in return, instead of being equitable partners or the ones conducting the research (Government of Canada 1996; Peltier 2018). This unbalanced approach has cemented a disdain for outside researchers making many Indigenous groups hesitant to share their information (Blair 2015). By implementing ethical principles and approaches to research, researchers can address historical injustices and improve their reputation by giving associated communities direct authority over the research process and by being transparent in the proposed outcomes (Peltier 2018; FNIGC 2019). This participatory community-based and community-engaged research framework is critical in a First Nation's right to self-determination.

An important facet of community-based research is a strong rapport and respectful relationship with the subject community or communities (Tobias et al. 2013). As band member, employee, and someone with prior experience with the fishery and the SON communities, I had already established a relationship with the SON and some of their fish harvesters. This relationship was significant for two reasons. First, already having a connection and rapport allowed for less participant hesitation in the sharing of information and more confidence that the information would not be used to disparage the participants or the SON. This trust was essential

for researcher transparency and the participants' willingness to participate. Second, it can be difficult for outside researchers to become embedded within the community and understand contextual information and nuance.

On the inside, rather than the outside, a researcher is privy to more personal, contextual, and controversial insights. Access to these insights is central to social research as they can reveal important information that would otherwise not be shared. I was granted a higher level of involvement because I had already built personal and professional relationships with SON fish harvesters and council members; however new relationships were also created during this study. This allowed me to operate on emic and etic levels. These anthropological terms relate to research and perspectives from within a social group (SON) and from outside a social group (Lakehead Master student) respectively (Morris et al. 1999). Two different perspectives, much like what two-eyed seeing promotes.

Initial discussions between researchers and the SON began in March of 2019. The formation of a research committee allowed ideas to develop and provided a support system for this study. The research committee was composed of Drs. Charles Levkoe (Lakehead University), Kristen Lowitt (Queen's University), Brian McLaren (Lakehead University), and Mr. Ryan Lauzon (Chippewas of Nawash). Charles Levkoe is the Canada Research Chair in Sustainable Food Systems who studies food movements and sustainability. He has worked with Kristen Lowitt, Ryan Lauzon, and Kathleen Ryan (SON Environment Office) on research about food sovereignty and fisheries governance. Kristen Lowitt is an assistant professor at the School of Environmental Studies who had previously conducted fisheries research with the SON concerning food security and sovereignty. Brian McLaren is an associate professor of wildlife management and the Graduate Studies Coordinator for the Faculty of Natural Resources

Management. Ryan Lauzon is the Chippewas of Nawash Fisheries Biologist who oversees the Fisheries Assessment Program and any associated research. It was of critical importance to include Ryan Lauzon in this committee as he served as a SON representative. These committee members brought unique experience and insight into this research project from different backgrounds. Interdisciplinary research teams are particularly useful in IEK, fisheries, and related research because they can draw connections from different literature and approaches from their respective fields (Nelson et al. 2013; Shackeroff and Campbell 2007).

While this thesis is only concerned with a subset of the interviews, it cannot be extracted from the larger cisco project and the novel collaborations that were made as a result. Most significant was the partnership between the SON and Parks Canada. Alongside Lakehead University, the Fathom Five National Marine Park served as a primary collaborator committing valuable resources and support. Their role was crucial in the development and execution of the larger cisco project. They were invested in developing a meaningful relationship with the SON and in increasing their understanding of ciscoes in Lake Huron. Other important collaborators included a group of researchers from the University of Toronto investigating ocular adaptations of deep-water fishes in Lake Huron, and the Department of Fisheries and Oceans Canada. Finally, a novel collaboration was made with the GFLC to share data and fill knowledge gaps surrounding the ciscoes of Lake Huron. This partnership was of particular importance as the SON was previously omitted from the 1997 GLFC Joint Strategic Plan (Akiwenzie and Roote 2004; GLFC 2007). As well, I was instrumental in the SON becoming a member band of the Native American Fish and Wildlife Society. These partnerships proved invaluable, allowing the SON to become more involved in fisheries governance and management discussions around

Lake Huron and across national borders. The partnerships also reinforced the concept of two-eyed seeing through meaningful collaboration and the sharing of perspectives.

A research proposal followed by a proposal letter to the SON Joint Fisheries Committee and the SON Joint Council that outlined the project and the perceived outcomes were created (see APPENDIX I). The SON Joint Council reviewed and approved the proposal letter with a Band Council Resolution on June 25, 2019. Following approval, the project was subject to review from the Lakehead University Research Ethics Board. After minor revisions, the proposal was approved on July 18, 2019 (see APPENDIX II).

3.3 METHODS

Semi-structured mapping interviews were held in both communities (n = 16). The interviews took place over the span of four months, August-November of 2019. Participants were invited to central interview locations, which included the Saugeen Fisheries Office, the Nawash Board of Education boardroom, and an outdoor gazebo located in Nawash. All interviews were held at these locations except two, which took place in a participant's home and on a commercial fishing vessel. Following the interview process, sampling of lake herring and chub took place over a span of three months, October-December of 2019.

Two personnel were hired by the Fisheries Assessment Program to aid in the research process. Initially, a SON high school summer student, Edwin Keeshig, was hired to assist in the interview process. Edwin's father was an active fish harvester at the time, so he was already familiar with the SON fishery and fish harvesters. This position offered Edwin an opportunity to learn about qualitative research while also learning from prominent SON fish harvesters. Natasha Akiwenzie, one of the founders of the Bagida-waad Alliance, was also hired to aid in the

transcription process. Another individual who provided support in the interview process was Owen Melanson, a SON high school summer student whose duties were to assist the SON fisheries technician in assessment work. An important component of community-based research is to involve the community as much as possible; by bringing on community members, the community-based approach was strengthened.

3.3.1 Participant Selection and Engagement

Prior to the interviews, a list of potential participants was created to inform participant selection. These individuals were selected based on two criteria: their perceived knowledge of ciscoes, and whether they harvested ciscoes in the past. In total, 88 individuals were identified and subjectively ranked into three tiers based on the two criteria. The perceived most knowledgeable, Tier 1, was composed of 13 individuals, while Tiers 2 and 3 were composed of 23 and 52 individuals, respectively. Past and present fish harvesters, most notably captains, were chosen as appropriate participants because they have the most direct connection to the water. They have depended on fish for a livelihood and have developed a deeper understanding of the Lake Huron ecosystem than regular community members. Crew members of fishing operations were also considered because they commonly interact with fish more than captains (e.g. net picking and dressing). Elders were chosen because they are the respected knowledge holders of the SON and have arguably the strongest connection to oral history. They have witnessed the countless changes in Lake Huron and were able to provide deep insight into the state of the ciscoes overtime. It is increasingly important to document their knowledge for future generations before they and their knowledge disappear.

On July 31, 2019, a flyer was distributed in both communities to gauge interest and to inform SON members about the cisco research (see APPENDIX III). This one-page flyer

outlined the project's partners, purpose, goals, and contact information. There were no responses to this flyer. Informational letters were then given to prospective participants that were identified earlier (see APPENDIX IV). Selection of these individuals included both purposeful and snowball sampling. In contrast to random sampling and other sampling methods, purposeful sampling ensured that only the most knowledgeable individuals were approached to participate. This is critical because not all SON fish harvesters or elders have had experiences with harvesting ciscoes, especially chub.

The Saugeen community was selected first and prospective participants in Tier 1 and Tier 2 were approached and asked to participate. After six interviews were completed in Saugeen, prospective participants in Tier 1 and Tier 2 from Nawash were approached. During the interviews, participants were asked to identify any individuals they thought were the most knowledgeable and who they believed to be appropriate for consultation. The individuals that were identified were then added to the prospective participants list if they were not already on it. Described as snowball sampling, this method utilized existing social networks to seek out participants who exhibited the two criteria (Cohen and Arieli 2011). This approach enforced notions of community-based research as it considered the individual's perspectives by engaging participants and allowing them to become a key component of participant sampling. Snowball sampling also validated some of the entries in the initial list, sometimes changing their tier designation.

Snowball sampling proved useful in the context of this study due in part from the prominence of chub and the relatively small community sizes. In total, 34 recommendations were given with a mix of individuals from Saugeen, Nawash, and off reserve communities like Southampton. Out of the 34 recommendations, there were 21 individuals. Eight of these 21 were

recommended more than once with the most recommended individual being referenced on four separate occasions. The most common recommendations were SON elders. Nine of the 21 recommended individuals were interviewed. Unfortunately, many of the participants referenced individuals who have died, representing a loss of valuable knowledge and insight.

An important component of this research and engaging with the participants was opportunity to conduct participant observation to further my understanding of the SON fishery from an emic perspective. I was able to accomplish this during fisheries related meetings, gatherings, and sampling excursions. Observing the participants during sampling provided the highest level of immersion into the SON fish harvesters lifestyle. I was afforded access to something that many researchers from outside the SON would not have been privy to. While the interviews granted me insight into the SON fish harvesters' perspectives, participating in sampling allowed me to learn through action and dialogue. There were many things I learned on those excursions and I am grateful to have had that opportunity.

3.3.2 Participant Data

Table 2 collates descriptions of each of the 16 participants. Five of the participants were Saugeen band members and the remaining 11 were band members from Nawash. The participants were also all male, which is representative of the current fishery as a whole; however, there have been female fish harvesters and processors in the past. In terms of tier designation, 11 individuals were from Tier 1 and five were from Tier 2. The fishing positions were a mixture of crew member and captain, with the majority (10) as previous or current captains. There was significant overlap in the positions that they held, as many of the individuals would work their way up to owning and running their own fishing vessel. The average birth year was 1962, with 1986 and 1948 as the youngest and the oldest birth years respectively. Seven of

the participants were born before 1960, therefore denoting them as elders. While this is an arbitrary and subjective distinction, it serves as a useful way to analyze the information that was shared. The rational behind this distinction is twofold, primarily because the 1950s and 1960s represented a period of unprecedented change in Lake Huron and secondarily because these individuals have lived through at least two generations.

Table 2. Participant information.

PIN	Fish Harvester (past/present)	Elder (Y/N)	Tier Designation
001	Past	N	1
002	Present	N	2
004	Past	Y	1
005	Past	Y	1
006	Past	N	1
009	Present	N	1
010	Past	N	1
011	Past	Y	1
012	Present	N	1
013	Present	Y	1
014	Present	N	1
015	Past	Y	2
016	Present	N	2
017	Past	Y	1
018	Present	N	2
019	Present	Y	2

3.3.3 Interviews and Mapping

Tobias (2009) explains in detail the importance of mapping land or water use and occupancy for Indigenous communities through a process called map biographies. Map biographies consist of semi-structured interviews in which individual participants identify

temporal and spatial features on a map where they have engaged in a particular activity or where they believe a specific resource is located. These features are recorded on a map and then coded for reference. With map biographies, the scope is generally broad and concerned with more than one species or harvest activity. Once the map biographies are complete, the maps produced will undergo a digitization process using ArcGIS 10.6 to aggregate the results for dissemination. The resulting maps are thematic and provide a clear way to convey the knowledge that was gathered (see Figure 9 and 12; Tobias 2009).

There are a multitude of applications for map biographies, many of which build community capacity and facilitate self-governance in Indigenous communities. Some key applications include providing evidence for court cases, supporting treaty and title claims, generating baseline data, and developing curricula (Tobias 2000). The approach used in this study differed from conventional map biographies because the interviews were cisco-specific in scope and paid more attentions to social, cultural, and economic factors which are often less emphasized in a typical map biographic process more focused on spatial and ecological dynamics. The goals of the mapping were to identify past and present cisco harvest locations, movement, and spawning locations in addition to understanding how the SON fish harvesters interacted with Lake Huron and Georgian Bay.

The interviews were over an hour on average and designed to be one-on-one or two-on-one (when Edwin was present). They were semi-structured to allow for flexibility and for the discussion to evolve organically. The flexible nature of this method accounted, in part, for the Indigenous view that everything in nature is interconnected and cyclical (Johnston 2003). With this mindset, it is difficult to only talk about one specific group of fish without also addressing other ecological and anthropogenic systems or components. Semi-structured interviews also

allowed the interview to focus on the participant and their history with the fishery and with ciscoes, which is important because personal experience is a major tenet of IEK. This approach was more appropriate than group interviews or focus groups because of perceived personal politics, conflicts amongst SON fish harvesters, and variable fish harvester schedules. Many of the participants were actively fishing at the time of this study and while the summer season is rather slow compared to the fall, many SON fish harvesters were going out daily to harvest fish. Focus groups would have been difficult to schedule. In one particular instance, I was able to interview a participant on a tug while going out to sample for chub. Another benefit of this approach was avoiding groupthink, a phenomenon where participants adjust their responses to concur or to conform with the rest of the group (Turner and Pratkanis 1998).

Prior to the interview, the interviewer(s) set up the interview room with one large table, chairs, interview supplies, and a taped down 105 cm x 90 cm customized paper base map of the Saugeen Peninsula. Before the participant arrived, a 3-digit personal identification number (PIN) was assigned based on their order in the interview process. This PIN ensured anonymity regardless if the participant consented to use their own name. Once the participant arrived, the interviewer(s) would review the project and encourage the participant to ask any questions or to voice any concerns. Informed consent was obtained by using a clearly phrased and easily understandable consent form (see APPENDIX V) and informational letter. An option for verbal consent was available for those who did not wish to or could not provide written consent.

After informed consent was obtained and questions were answered, the lead interviewer would introduce the session. Two audio recorders were used in each interview in case technical difficulties arose. At all stages of the interview, written notes were recorded. One of three interview question lists based on the participants designation (elder, fish harvester, or combined)

was utilized by the interviewer(s) to keep the discussion on track and to ensure that an appropriate number of topics were covered in detail (see APPENDIX VI). There were three broad categories of questions that were asked, personal and general information about the participant, questions related to ciscoes, and mapping questions. Generally, more personal questions were asked first to get the discussion going and learn about the participant. These question lists served as a guide and as the discussion developed, unique questions were asked based on the participant's responses. Due to variation and uncertain taxonomies among cisco forms, a form guide was used during the interview. This guide contained representations of the eight historical forms from Eshenroder et al. (2016) including the synonymized longjaw cisco and four contemporary forms courtesy of Randy Eshenroder. Contemporary forms were only shown to five individuals who were actively fishing at the time of this study. There were only two instances in which participants did not view either form guide.

As the mapping questions were asked, line, point, movement, and polygon features would be recorded by the lead interviewer on the map (see Figure 9 and 12). These features represented harvest locations, movements, and spawning locations of ciscoes. Each feature was assigned a two-part code. The first part of the code was represented by an uppercase letter that denoted the feature's season if there was one and two uppercase letters that denoted the form of cisco (see APPENDIX VII for form specific codes). Fall, winter, spring, and summer were represented by F, W, V, S, respectively. The second part of the code was numerical and ascended with each new feature. For example, if the participant's first feature was a fall chub harvest event, the code would be FCH001. If the season was not specified, the code would be CH001. After the interview had ended, the participant was asked to sign the map confirming this information was

theirs and to sign an honorarium form (see APPENDIX VIII) confirming they received their honorarium.

The DCM that was created for this project documented procedural conventions and guides for the interviews. Tobias (2009) explains that such manuals are critical to ensure that the research follows a strict methodology. The significance of this document far extends the scope of this project as it can now serve the SON as a guide for future research and similar investigations. Already, it is being used to develop a research project examining the interactions between lake trout and lake whitefish with a focus on the SON's IEK and a Parks Canada project on lake whitefish (Ryan Lauzon pers. comm. May 2020; Zachery Meilhausen pers. comm. May 2020).

3.3.4 Sampling

Sampling provided an avenue for participant observation and to apply the SON fish harvesters' IEK in a practical way. All sampling efforts relied on the experience and IEK of the SON fish harvesters. Lake herring and chub were both sampled using distinct approaches. Sampling was identified as an important part of the broader cisco project because it provided a source of detailed contemporary data and a way to validate the spatial harvest knowledge that was shared in the interviews. The sampling also provided an avenue for collaboration with the GLFC. Discussions with Randy Eshenroder at the International Association for Great Lakes Research's State of Lake Huron Conference identified knowledge gaps in the lake herring data around the Saugeen Peninsula. This led to a partnership between the GLFC and the SON to fill those data gaps by providing them with data from lake herring samples attained through SON fish harvesters. He invited myself and my colleagues to Ann Arbor, MI to process the lake herring samples and to assemble morphometrics and meristics in January of 2020 (see APPENDIX IX for data form). I extended the invitation to the SON Joint Fisheries Council and

Nick Saunders, a Nawash council member, accepted (Figure 6). The research team from the University of Toronto, GLFC employees, and Michigan Department of Natural Resources employees were also present at the workshop. Prior to sampling, Randy Eshenroder provided instruction on how to properly pin each sample for photographs to serve as reference for future inquiry and measurement (Figure 7).

Figure 6. Nick Saunders counting gill rakers.

Figure 7. Pinned lake herring from participant 012.

Lake herring samples were collected through purchase from SON fish harvesters, all three of which were participants in this study (009, 012, and 014). These samples were caught as incidentals in whitefish harvests during the whitefish spawn. A price of $2.00/lb was determined to be much fair price and higher than what fish buyers normally pay. As instructed by Randy Eshenroder, sample sizes needed to include at least 20-30 fish from the same location. Fish that were ripe and spawning were the most preferable for identification and measurement.

Chub were not as readily available as lake herring and required a different approach, which utilized a fishing tug and a mechanized puller to sample at the appropriate depths. The chub sampling relied on the spatial information that was shared in the interviews to identify appropriate harvest locations. Following the interviews, a flyer was distributed within the SON informing the community and asking for any interested SON fish harvesters to participate in the sampling (APPENDIX X). There were no responses to this flyer. Interview participants who operated tugs and wanted to aid in the sampling were then approached. Three captains, all of whom were from Nawash and participated in the interviews (009, 012, and 014), were hired at a

rate of $6400.00 per excursion. This fee was determined to be competitive and covered operation costs for each excursion.

Monofilament gillnets were purchased from Johnston Net and Twine (Wheatley, ON), a common net retailer for SON fish harvesters. Several net dimensions were selected to account for any variations in chub size (Table 3). Net sizes were determined by Ryan Lauzon and were based on previous sampling efforts. The chub that were sampled were pinned (Figure 8) and measured using the same methods as described by Randy Eshenroder.

Table 3. Sample net sizes.

Individual Sections	Section Length (m)	Net Height (m)	Mesh Size (cm)
8	45.72	1.83	1.90
8	45.72	1.83	2.54
8	45.72	1.52	3.18
40	45.72	1.83	3.81
8	45.72	1.83	5.08

Figure 8. Pinned chub from participant 009.

3.4 ETHICAL CONSIDERATIONS

Social science research requires the application of ethical standards and principles to protect participant dignity and anonymity while accounting for welfare and justice (Tri-Council 2018). This is especially true for participants from Indigenous communities who are perceived as marginalized. As the lead interviewer and researcher, it was critical that I had a strong understanding of ethical procedures and principles. Literature provides an avenue for such understanding, but it is often broad in scope and missing important contextual information. To address this gap, I participated in the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics. An equally, if not more important way to ensure the research was ethically sound included conversations with the SON Joint Council, my research committee, and the Fisheries Assessment Program. As a community-based research project, it was crucial to have engagement from those involved in the community and to involve them as much as possible during the research process. These principles shaped the way research and the plan for dissemination were approached.

Only the SON Joint Council, the SON Joint Fisheries Committee, the Fisheries Assessment Program, and the research team has access to the interview transcripts, mapping data, and any identifiable materials. All quotations from participants in this thesis are verbatim, expect instances in which individuals are named (e.g., son or wife). All data (interview notes, audio recordings, maps, and interview transcripts) are securely stored and locked in the Fisheries Assessment Program office and in password-protected computer files. The data is currently stored at this office and will remain there for a minimum of 5 years. The SON has primary control over any use of the data, ranging from publications to conference presentations. Any materials to be disseminated are subject to approval from the SON Joint Council. Any additional and future uses of the data will also be subject to approval from the SON Joint Council.

The writing of this thesis followed the procedure required by the Faculty of Natural Resource Management and included input from the SON Joint Fisheries Committee and the SON Joint Council. In July 2020, a completed draft was reviewed by the Internal Committee comprised of my research committee. After revisions, the thesis was then sent to an external reviewer, Dr. Nicolas Brunet of Guelph University, and the SON Joint Fisheries Committee for review. Following the review of Dr. Nicolas Brunet and the Joint Fisheries Committee, the thesis was defended September 14, 2020. The defence was successful, and the thesis was accepted with minor revisions.

There are many benefits of this research and few perceived risks. Informed consent ensured that the participants were aware of all possible risks and benefits of this study. The benefits to the participants included the opportunity to share their insights into the status of ciscoes, to meaningfully contribute to SON research, and to receive compensation for their contributions. Many of the participants were concerned about the status of the ciscoes,

particularly chub, and became invested in the research project once they participated and learned more. All participants that were interviewed expressed interest in the results of the project. The compensation for each interview was $200.00 from contributions from Parks Canada and Social Sciences and Humanities Research Council funding through Dr. Charles Levkoe (via the FLEdGE research collaborative). Another benefit of participation was the possible opportunity to participate in the sampling efforts.

A potential risk was that some questions about the fishery and personal recollections could have been perceived as sensitive, and participants may have withheld certain information about themselves or their community/organization/business. To address this concern, we emphasized our primary interest in understanding the connection to, and status of ciscoes and that we would not share any specific data that can be traceable back to the participant. Unless the participant explicitly consented to be identified by name on the consent form, their identity will remain confidential. Every effort, like the use of PINs, was made to remove individual and organizational/business characteristics that could identify the participant. The participatory nature of this research was emphasized in the informational letter and by the interviewer(s). The participant was reminded prior to the interview that they had the opportunity to withdraw from the study at any time up until publication or dissemination, as indicated in the informational letter and consent form. What the participants shared was entirely up to them. If a participant wished to go off the record, the interviewer(s) would respect their wishes and turn off the audio recorders until the participant was comfortable to be recorded once more. To protect personal communications or interactions during the interview, these instances were omitted from the transcripts. There were no objections or concerns over the risks that were presented.

3.5 DATA ANALYSIS

Data analysis consisted of two components, map analysis and interview analysis. Interview analysis began with the transcription of the interviews and discussions with the research team about the major themes that were prevalent throughout. The transcription process involved an initial verbatim transcription, which was followed by a secondary transcription to confirm accuracy and to ensure that the transcripts aligned with the conventions outlined in the DCM. During the secondary transcription, themes were identified using a data-driven and inductive approach and coded using Nvivo 12 (Creswell and Poth 2017).

The coding offered a way of organizing and synthesizing the data. Table 4 reveals the themes that were coded and quantifies the number of times a participant made reference to the themes. A reference was any phrase, sentence, or paragraph that referred to one or more of the themes. All subtheme references were located within their parent theme as well as any other references which did not fit into a subtheme. Changes referred to any social, cultural, or ecological changes. Social issues referred to any issues within the SON or outside of the SON pertaining to the fishery and governance decisions. Indigenous knowledge referred to ceremony and spirituality.

Table 4. Summarized coding results (n =16).

Themes	Subthemes	Interviews Referenced	Total References
Changes		16	323
Chub		16	1047
	Chub Harvest	16	473
	Chub Significance	16	179
	Chub Status	16	159
Cisco		14	93
Community		16	189
Conflict		11	74
Dreissenid Mussels		10	47
Economics		16	309
Fisheries Management		16	239
Lake Herring		16	147
	Lake Herring Harvest	11	59
	Lake Herring Significance	12	44
	Lake Herring Status	10	20
Learning to Fish		16	111
Salmonid Stocking		16	262
Social Issues		16	274
Suggestions for Research		7	13
Indigenous Knowledge		14	148
			Total = 3276[a]

[a] Subthemes (e.g., Chub Harvest) were not included in total value.

Map analysis consisted of digitizing and georeferencing the maps through ArcGIS 10.6 producing several thematic maps. These maps provided insight into harvest locations, harvest depths. spawning sites, and movements throughout the year. Aggregating the maps thematically was an important prerequisite for dissemination as these maps will serve as the primary tool for sharing the knowledge that was generated. Generally, SON community gatherings utilize posters or maps to easily convey information.

3.6 DISSEMINATION

The knowledge that was generated by this research will be disseminated in various ways to reach different audiences. Most importantly, this information will be shared with the SON through community gatherings. These events will take place in partnership with Parks Canada to promote the successful collaboration. Events like these commonly include ceremony, a feast, and a presentation or open house. Summaries of the research will be available for any community member at these events. Dissemination events also offer an opportunity for community members to ask any questions regarding the research process, results, cisco sampling, steps forward, and possible benefits. Presentations will also be given at Parks Canada events. The individuals who participated will receive a copy of the thesis, a summary of the findings, and a complementary map with their identified features. The COVID-19 pandemic has delayed all dissemination events and proceedings. The delays are for the safety of the SON people and events will take place once it is safe to do so.

Complementary to community events, this research will be disseminated to academic audiences through various venues including conferences and publications. Publications will allow this research to be disseminated to a wide audience. Two publications are expected, one pertaining to the larger cisco project and this thesis as a whole, and one pertaining to the cisco data that was shared with the GLFC. Conferences offer an opportunity to reach a broad academic audience and to network with other interested parties. For instance, the partnership with the GLFC came as a result of a conference presentation. Already, with approval from the SON Joint Council, this research has been shared at conferences. These conferences include The Wildlife Society and American Fisheries Society First Joint Conference 2019 (Reno, NV), the International Association for Great Lakes Research State of Lake Huron Conference 2019

(Saginaw, MI), and the Canadian Indigenous and Native Studies Association Conference 2020 (Peterborough, ON). Other conferences planned for 2020 were cancelled and include the Native American Fish and Wildlife Society's annual conference (Miami, FL), and the International Association for Great Lakes Research's annual conference (Winnipeg, MB).

3.7 LIMITATIONS

Limitations from this thesis and the larger cisco project mostly arose from scope, budget, and time. The primary limitation was that not all individuals with cisco experience were consulted. To have done so would have been expensive and time consuming. In addition, not all individuals who were approached or who received the flyers wished to participate. The interviews were on average 67 minutes long, but transcription, coding, and digitization required significantly more time. The initial transcription process roughly equated to 3 hours of transcription per 1 hour of interview audio. The secondary transcription process was less time consuming. Scheduling interviews also proved difficult at times, as the SON fish harvesters were often busy with their own fishing operations. The budget was also constrained with each interview honorarium of $200.00 in addition to the costs for sampling.

While this project is community-based and directed for the SON, expanding the scope and interviewing non-Indigenous commercial fish harvesters could have complemented this research. In some cases, these individuals provided guidance, transmitting their knowledge of commercial fishing to the SON fish harvesters. These individuals operated at a much larger scale than the SON prior to R. v. Jones (1993). Their insights could provide an account of the changes in chub populations leading up to the 1990s. It is clear from the literature that ciscoes, both lake herring and chub held a prominent place in the fisheries of Lake Huron (Koelz 1926; Dobiesz et al. 2005; Eshenroder et al. 2016). Bringing together the results in this study and the knowledge

from the non-Indigenous fish harvesters who once held a quota would provide a much more detailed account of the ciscoes in Lake Huron and their relationships to those who call the peninsula home.

CHAPTER 4: RESULTS

This chapter presents the findings through four sections. The first section, on the IEK of the SON fish harvesters, focuses on examining the origins of this knowledge, how it is practiced, and how it is shared. The second section presents findings about the knowledge of ciscoes and SON fish harveters' connection to them. This knowledge pertained mostly to socio-economic relationships and ecological insights that can be used in future management, governance, and research. The third section focuses on the SON fish harvesters' perceptions of fisheries management and governance. As socio-ecological systems, fisheries need to account for socio-economic and cultural factors that have not been addressed in the past. State-led fisheries governance and management in the context of the SON have failed to address their concerns and insights. The fourth section focuses on the 2019 sampling efforts. Sampling was an important avenue for participant observation and a significant outcome of this study that relied heavily on the interview process. These results will provide insight into the SON fish harvesters' connection to ciscoes, their past, and their future, addressing the research goal.

4.1 THE SAUGEEN OJIBWAY NATION AND INDIGENOUS ECOLOGICAL KNOWLEDGE

Indigenous ecological knowledge represents facts, insights, and observations about local environments, but these are contextual and cannot be removed from social, cultural, historical, and experiential realities. The IEK that the SON fish harvesters hold has been influenced by colonialism, infringement upon inherent rights, changes in the Lake Huron ecosystem, and societal factors. These factors and influences are critical to understanding and appreciating the IEK of the SON and how it has evolved over time. This section will explore these factors and influences through the IEK tenets of knowledge transmission, relation to culture, personal experience, learned values or principles, and changes to IEK over time.

4.1.1 Knowledge Sharing

Participants were asked to identify individuals who showed them how to fish. Each participant listed up to four individuals who engaged in knowledge transfer. These individuals were predominately from within the SON and were often brothers, fathers, or uncles. The family element was most common amongst older participants. When discussing who taught him, participant 004 said: "Pretty well everybody. My parents and everybody. They all used to fish." Similarly, participant 009 shared: "You know I fished with my dad. I fished with my brothers out of punts. They taught me how to fish." It was in this way, by experience and for sustenance or money, that many of the SON fish harvesters learned to fish. Observation, practice, and inquiry were ways in which this knowledge was shared. This knowledge took the form of important values and information on how, when, and where to fish. Spending time on the waters made these knowledge transmitters attentive to changes and occurrences. Participant 014 explains being out on the water with his father: "… my dad used to make me look at stuff… my dad used to make me pay attention to a lot of things."

Of the family and community members, elders were identified as important knowledge holders and transmitters. This was as true for SON elders as it was for non-Indigenous elders. As an elder, these individuals were perceived to have a significant amount of knowledge gained through their greater levels of experience and time on the waters. As noted in a number of interviews, many elders have passed on, representing a loss of knowledge. A common response to the question about participant recommendations would be names of elders who had passed. The participants believed that these individuals would have been the appropriate persons to interview. With regards to knowledge transfer, general inquiry and observation were most important. General inquiry was most significant for those engaging with older individuals as

elders were not commonly practicing harvesting due to age and health restrictions. Participant 019 explains: “So you see the older ones doing certain things and you ask them why.” Likewise, participant 002 relates his spatial knowledge of chub harvest locations to non-Indigenous elders. Participant 015 encapsulates this relationship: “Try and learn something. Try to listen to them and see what, why they are telling you this stuff. There’s got to be a reason, they’re not just saying it to hear themselves talk.”

Eight participants noted that they learned aspects of fishing from non-Indigenous individuals from outside of the SON. Before R. v. Jones (1993), a number of SON members fished on non-Indigenous commercial fishing tugs. They learned to commercially harvest fish this way. This knowledge was technical and related to harvesting (e.g., when, where, and how), running a commercial fishing operation, and operating a tug. This knowledge would have complemented any IEK the SON fish harvesters held prior, revealing the importance of utilizing different perspectives and observations.

Following R. v. Jones (1993) and the quota buy-back, it was common for non-Indigenous fish harvesters who once held quota to help the emerging SON commercial fishery. As participant 018 explains: “Most of the stuff I learned fishing, I learned from the non-native guys that commercial fished before we go our rights back.” Although participant 009 was taught by his father and brothers as previously mentioned, he was taught the intricacies of commercial fishing in Lake Huron from a non-Indigenous individual from Stokes Bay. In some cases, deals were struck between SON and past non-Indigenous fish harvesters as discussed by participant 002: “… those are the two non-native guys who taught us how to fish when we bought it [fishing vessel], it was part of the deal.” Other cases involved the SON fish harvesters hiring or seeking guidance from past non-Indigenous fish harvesters for their insights. Some of these non-

Indigenous individuals were repeatedly mentioned in the interviews, portraying their importance to several of the SON commercial fishing operations.

This knowledge transfer continues today for the youth, and as the next generation of fish harvesters enter the SON fishery. Participant 019 shares: “Well I take my grandchildren out, you know, because I want them to continue it… I have them pull the net. I have them tell me what kind of fish we are bringing in… And show them how to fillet. It’s all good. As they grow older, they’ll appreciate it more. Much like me.” In the same way, participant 016 harvests fish with his eldest son, a decision the son made himself. He teaches his son how to run a business and most importantly, he teaches him to have respect for what he does and the fish he harvests. He explains: “And part of that respect is to not take more than you need… if you take it from the lake to the plate, right, you don’t have to take out so much to generate the same amount of dollars.” Respect was often cited as an important principle that was shared.

The SON fish harvesters identified several concerns as youth and the next generation of fish harvesters enter the fishery. These concerns mainly focused on the risks of participating in the fishery and the decline in native fish species like lake whitefish and the chub before them. Native fish populations were of concern because they are foundation and mainstay of the SON fishery and without them the commercial fishery would not be able to operate. Also, the connection to the native fish species is a cultural and generational one, as the SON have depended on them for survival over millennia. There are several individuals from the SON who have passed from fishery related deaths. Participant 018 shares his concerns about his son entering the fishery: “… it’s a dangerous profession, it’s a very dangerous profession and when things happen it just happens so quick that you got to make sure that your crew’s got your back.” He explains further: “But see for my son, growing up, because I fished so many years out there, I

didn't want him to start fishing like this because of the dangers out here." By dangers, participant 018 was referencing the uncertainties in weather, mechanical failures, and possible injuries from pulling in and setting nets. There is also a risk of altercations with locals and sport fishers around governance decisions that favour the SON, like R. v. Jones (1993) and the upcoming lakebed and title claim.

Participant 012 describes his concerns about his children entering the fishery:

> "That's what I worry about fishing. I got my boys. They come out on the boat with me, but I don't want to push them into it because I feel like this decline of fishing. You know I hate to get them all into fishing and it's just not there for them. I don't want them to struggle, you know if fishing ain't there. I want them to have a good life not worrying about bills. It's stressful, you know, when you're out fishing every day and you're not even making enough to cover what you're doing. Meanwhile your bills piling up… That's when I worry about passing it on because my boys like to go fishing, they like it too…They're young, they could be getting an education learning a different trade…"

While each participant learned how to fish from those around them (e.g., family and community) and those with interest in the fishery (e.g., non-Indigenous individuals), much of their own experiences had a significant influence in how they understand the waters and fish. Many of the lessons that are learned fish harvesting, especially commercially, are lessons that come from experience and being out on the waters. Participant 018 explains: "But it's kind of hard to teach it… because you see all the different things. And there's so many styles of how people fish." He expands further: "There's a lot of things that happen that you have to know and those things you really only know by hands on training or seeing it." This is as true for the crew members as it is for the captains, although they carry different responsibilities. While you can be

informed as to where and when to fish for a given species, it is only through experience will you come to understand how they move throughout the water, when and where they spawn, and the status of their populations.

4.1.2 Culture and Ceremony

Ceremony was discussed as important component of life and harvesting fish by multiple participants. Ceremony in this regard generally consisted of laying down an offering of tobacco in a reciprocal manner to give thanks to the waters and the fish or to pray for a safe journey while out on the water. While offerings are a more recognized ceremony, other actions that are taken with respect and care can be deemed ceremonial. Participant 016 explains: “Take pride in what you do. You know? Even if it’s gutting a fish. That’s a little ceremony in itself…” Pipe ceremonies and sacred fires were also mentioned. From the participants recollections, ceremony was practiced much more commonly by their parents and ancestors before them, as participant 019 shares: “… with the elders and my uncles it was just like a thing you do.” Participant 011 recalls: “And they always did that ceremony for the water, for the fish, for the trees, for the land, well everything. They always did that pipe ceremonies, the old people, because they had that respect.”

From the perspective of the participants, ceremony represented a way to give back to the resource and the environment through respect and reciprocity. In a way, ceremony reinforces the place of humans in nature and their connection to it. Being situated in nature and believing that nature looks after itself were commonly discussed by participants. In response to a question about humans’ place in nature, participant 011 explained: “To be giving thanks for everything he’s got… To put tobacco down for them and thank the Creator for everything that he’s given us.

That's our place. Through sacred fires and stuff like that. Giving those thanks to the water, the fish, everything we got."

Participant 011 spoke at length about ceremony and how through those experiences, he was taught and shown many things. In response to a question about how one taps into tradition and knowledge he replied: "You have to go through ceremonies." He elaborates further:

> "Yeah, you have to go in through your, like I said, your vision quest first to find exactly what you're suppose to be doing in life. It will show you, it will show you everything. And then after that, you have to keep going to ceremonies like sweat lodges and that. When you're kept really… mind, body, and spirit is cleaned inside and out through these lodges. They show you stuff. The spirits will show you stuff… So the deeper and deeper you get into spirituality, the more and more you get shown. You got to respect that fire and the ceremonies that go with it. Ceremonies that go with all our fires and sweat lodge and everything. It's just an understanding. It's just a respect of traditional people by other traditional people. It's all it is. Like our grandfathers, they used to know this knowledge before, you know, they could understand it..."

Not all participants practiced ceremony. Some noted that they did not observe ceremony at all amongst the elders. Participant 015, an elder, recalls: "The traditional, I've never seen that in my day and I hung around with old people. I treated them good because I thought this is the way I wanted to be treated and they never told me about the pow-wows or dancing or anything like that." Similarly, some of the participants explained that they were not traditional or spiritual. Participant 014 explained that the only tradition he practices is fishing, a tradition that has remained in practice throughout time. It is a practice that has been passed down to him from his father and their ancestors before them. He believed that fish harvesters represent some of the last

traditionalists in the strictest sense. To him, there are no true traditionalists left, not even fish harvesters. He explains further:

> "I don't go around and beat a drum or say that I'm a traditionalist. I live in a house, you know. There is no true traditional that's left anymore. Do you see anybody riding a pony? Living in a teepee? Hunting with a bow and arrow? Or spear? Do you see anybody walking around with furs on their backs? Do you see anybody with leather hiding their extremities? No, there is no traditionalist left."

Although not all participants practiced ceremony or were spiritual, they all had a deep respect and reverence for the waters and the fish. As participant 017 explains: "Yeah, well we were always taught to respect the resources back then. Never take what, never take more than you need and you always shared with your community… if you do catch more than you need, you always share it with other people in the community, especially the old people." This respect was important to the people of the SON, ensuring that they never abused or mistreated their resources and more appropriately, their living relations. It was practiced through teachings and actions. Through action, respect took the form of treating the fish and waters fairly, taking only what you need, giving fish to the community, and ensuring nothing would be wasted. Participant 005 would put respect into action by burying sick and diseased fish on land rather than throwing them back into the water or leaving them on shore for birds to consume and reintroduce into the water.

Through teaching, individuals could explain why respecting fish and the waters is important for sustainability and matters of principle. Participant 016 shared a way in which he teaches his son about respect: "With [his son], I always try to teach this to him. 'You know [his son] think of, think of it this way. Our ancestors would be rolling over in their graves if they seen

us take six fish and go and sell them for $20, which is six meals, for that $20 and then go and piss that away at McDonalds for one meal." Although this respect can come from teachings and actions, participant 019 explained that it also comes from a much stronger dependence, and therefore connection, to the natural world. He explains: "But we were on the land more then. We had, I guess a stronger dependence on the resources… And with that comes a stronger connection." This dependence for older SON members was more pronounced and enforced a sense of respect so that they and their descendants could interact with these resources for generations to come. This connection also directly translated to knowledge and experience.

As indicated above, the spiritual connection participants held for lake herring and chub was mostly focused around value systems, ceremony, principles, and the connection to nature. There were no legends or folklore regarding chub or lake herring. Lake herring was suspected to have held some prominence before European contact; however, as participant 011 explained: "… I've never heard of any legends about them… just that people used to fish them and eat them." When discussing both chub and lake herring, he also shared: "Nobody really looked at that as being a species that… there wouldn't be traditional knowledge behind it, I know of anyway. I never heard talked about that way." Perhaps if the elders who have passed were still alive, they would have been able to provide more insight in this respect.

The significance of chub and lake herring was commonly related to their time alongside the people of the SON, whether traditionally harvested or not. The common Indigenous sentiment "since time immemorial" is extended to native species, who have lived and shared the waters with the SON. This sentiment holds native species in high regard and consequently affords them inherent value over invasive species. Participant 015 elaborates further: "They

belong here. You know, before contact they were alive and thriving." Participant 014 shares his perspective on native species:

> "Well everything is important to me, you know. I feel related to everything. That's the way I feel you know? Whether it's a deer running around in the bush. Bear, which I feel sorry for when man feeds them. You know because that's their death sentence right there, when you start trying to domesticate something wild. But I feel for the chub fishery, you know. The whole ecosystem needs each and every little thing to be, to survive."

4.1.3 Changes in Indigenous Ecological Knowledge

The production and transmission of IEK has been influenced and altered for decades. There are lasting impacts from residential schools, assimilative policies, and governance decisions that have excluded the SON and their fish harvesters. In addition, the way in which commercial SON fish harvesters interact with the waters and fish has also changed due in part to technological advancements, the return of their fishery, and ecological changes. While these are significant changes, fishing and the strong connection to the SON fishery have persisted.

Contemporary fish harvesting is much different than how it was approached previously. The sustenance factor was much more pronounced than it is currently, and it was observed that there were more people engaged in fishing. Without advanced navigational technology, the fish harvesters relied on their knowledge of the waters, often only utilizing a compass and a watch. The vessels that they used were rowboats, canoes, and boats fashioned out of cedar strips and wood that were made by SON members. Gill nets were used; however, they were much shorter than what is used today. Cotton nets were often used and a common practice for net upkeep was net seaming, a practice that repairs nets manually. Today, seaming is not as prevalent as it once

was, as participant 015 recalls: “But after they fished, they would hang their nets up and they would seam them… Those guys would actually redo it, seam them. They knew how to ties those. When they were done it, it just looked like a whole new net again.” Participants also explained that there used to be fishing camps throughout the SON on the shores and islands for the fishermen to sleep in while they waited overnight for their nets or lines. One participant noted that some fish harvesters would go without these camps and sleep on the shore.

Other harvesting methods included weirs constructed out of cedar logs, spearing, seining, and long lining. Participant 011 shares: “…my dad’s time, they all fished those, they fished the long line with wire and they made their own hooks up, their own I guess you could call it lures. They’d cut cans and have their spinners. They would make it all themselves. And they caught lots, but they couldn’t catch them fast enough.” The lake trout harvest and longlining were significant in the SON communities.

Participants noted that the introduction of sea lamprey led to a significant crash of both lake trout and the whitefish populations. These were trying times for the SON, representing a period when fish went from overly abundant to exceedingly scarce. The older participants remembered this time, often referencing that fishing had all but ceased. Participant 019 shares: “So when I was young in 19… a teenager, ’64-whatever the teenage years are, we burnt the last of the boats. The old timer’s boats that were just rotting on the shore because there was no fish. And you know, we never thought about how vibrant those boats were in prior years. We just knew no fishermen were going out anymore.” Later introductions of other invasive species and the predatory salmonid stocking programs also had deleterious effects on the waters and the native fish species. These effects will be discussed in later sections in relation to ciscoes, but their impacts were widespread. As a result, their altered the utility of the IEK from the elders, as

participant 016 explains: “And I remember the old guys always had tidbits of advice. You know, go set there, go try there. But, of course, over the years that information has become kind of null and void because things change, right?”

Residential schools and attempts at assimilation proved disastrous for Indigenous spirituality and ceremony. However, the people persisted and there is now a resurgence in spirituality and ceremony. The problem is that there was a significant amount of knowledge and teaching lost in the interim. In addition, youth were commonly abused for speaking Ojibway and partaking in cultural practices, causing a forced regression away from tradition and culture. Participant 011 provides insight: “So they said all the medicine people got together and they put away their bundles because it was too hard on the younger generation at that time. They were always getting whipped for nothing.”

4.2 CISCOES

The SON fish harvesters held a wealth of ecological and technical knowledge about the ciscoes of Lake Huron and their harvest. Unfortunately, the connection to ciscoes as a whole has been greatly influenced by a variety of ecological and anthropogenic factors. The connection may not be as apparent as it once was, but it has persisted through their knowledge. This section will explore IEK specifically pertaining to the harvest of chub and lake herring, including their socio-economic importance and impact in the SON, changes in abundance, interactions with other species, and the spatial data that was gathered through the mapping process. These data will prove useful for future management and governance, especially because these fish are so poorly understood. The IEK of the SON fish harvesters can make a number of contributions to understanding the ciscoes and Lake Huron, especially as part of a two-eyed seeing approach.

Two categories of cisco with variable nomenclature were identified through the form guide. This included chub (deep-water cisco) and lake herring (shallow-water cisco). Other names for chub included rainbow chub, cisco, and tullibee, and for lake herring other names included blue herring and cisco. A third category of fish, cisco, was identified through discussion and mostly represented round whitefish (*Prosopium cylindraceum*). There were some minor contradictions between round whitefish and lake herring as they are both known as cisco. Some participants viewed them as different fish and some did not. Tables 5 and 6 summarize the historical and contemporary identifications of each form. Although there were contradictions over nomenclature, all the participants who viewed the form guide referenced lake herring and correctly identified them from the form guide. The chub proved more difficult due to the various forms, but together, participants identified all seven of the historic forms. A portion of the participants admitted to not noticing the subtle differences between the different forms of chub, as mentioned by participant 014: “Jeez, I don’t know. I’m not a biologist.” This confusion of forms is likely a result of similar morphology and because they are marketed as a collective. In the literature, there is some confusion over exact terminology and reference to the large number of known common names. As per the context of this study, only lake herring and chub will be discussed further.

Table 5. Frequency of identified historic cisco forms (n = 14).

	Cisco Form	Participants
Chub		
	Bloater (*C. hoyi*)	11
	Shortjaw cisco (*C. zenithicus*)	6
	Kiyi (*C. kiyi*)	4
	Shortnose cisco (*C. reighardi*)	4
	Blackfin cisco (*C. nigripinnis*)	3
	Deepwater cisco (*C. johannae*)	2
	Longjaw cisco (*C. alpenae*)	1
Lake herring		
	C. artedi	12

Table 6. Frequency of identified contemporary cisco forms (n = 5).

Cisco Form	Participants
Parry Sound cisco	4
Shorthead cisco	2
Manitoulinus	2

4.2.1 Chub Harvest

Chub were once a significant component of the SON commercial fishery from its contemporary conception in 1993 until their populations could no longer support a commercial fishery in the late 2000s. Chub is seen as an important fish through an economic, ecological, and social lens. It was smoked, eaten, shared, and sold providing employment and income. Many of the participants characterized chub as a delicacy, sometimes referring to them as the best smoked fish to consume. Chub were also thought to play an essential role in the Lake Huron ecosystem. They were described as being relatively small, sometimes reaching 1 lb. Prior to the court case,

they were harvested by SON members both on non-Indigenous tugs and smaller SON vessels like rowboats or punts. The tugs used mechanized pullers (Figure 9) to bring up the chub nets while the smaller vessels would bring them up by hand.

Figure 9. Mechanized puller.

As a native fish species, chub were perceived as an essential component to the ecological processes of Lake Huron. They are known as a bottom feeder, like lake whitefish, and as prey for burbot, lake trout, and other stocked predatory fish. Chub populations were perceived as cyclical on a rotation of population increase and decrease every 8-10 years. As participant 009 explains: "… seems like a 7- to 8-year cycle there where they go really strong and they die off and then they go really strong and then they die off… we might be just in that transition year, right?" Participant 016 likened their cyclical nature to that of the rabbit. Recognizing cycles and

understanding them are an important component of living off the land and waters, as participant 011 states: “There’s nothing on this Earth that doesn’t follow the cycle and that was our, we didn’t call it religion, that was our way of life. You know, to understand those things, the cycles.”

There were uncertainties as to whether chub were traditionally harvested by the SON. When asked, participant 019 replied: “Well, they’ve always been fished.” Participant 017 similarly answered: “I’m not certain about that, but as long as I remember people have been fishing chub and I am 65, right?” This contrasts with other responses like participant 002: “Indians never fished for chub.” The participants, especially elders, explained that the chub progressively moved into deeper waters from 100 ft out, making harvesting by hand on rowboats and punts nearly impossible. This took place during the late 1980s and early 1990s, preceding a drastic decline in chub. Participants were unsure of why this migration to deeper waters occurred. Some believed it was to escape predation pressure from stocked salmonids. Once R. v. Jones (1993) was won and some of the SON fish harvesters purchased their own tugs, they were able to venture deeper and catch chub. These tugs also allowed SON fish harvesters to target other species at greater volumes and to incorporate more individuals as crew members. Most of the participants commercially harvested chub from the 1990s until the late 2000s when they became increasingly scarce due to a variety of suspected factors. These included the stocking of predatory salmonids and effects from invasive species like dreissenid mussels.

Gear and harvest specifications varied among participants but fell within the ranges listed in Table 7. Monofilament gill nets weighed down with a series of lead weights and anchors along the bottom of the lake were the primary method for harvesting chub. Many participants compared these chub nets to perch nets due to similarities in mesh size and net height. In some

instances, individuals recalled using cotton gillnets. The gillnets are strung together to create straps, which stay in the water for 24-72 hours and are commonly laid east to west. Unlike lake whitefish and shallow water species, chub nets can remain in the water for longer durations without risk of spoiling due to the colder temperatures in deep waters. This allowed fish harvesters to have up to five individual straps or "sets" at different locations on an ongoing basis. The water temperature is, however, dependent on the time of the year, reducing the duration in which a fish harvester can leave their nets submerged in the summer months.

Table 7. Gear and harvest specifications for chub.

	Depth (feet)	Strap Length (yards)	Net Height (feet)	Mesh Size (inches)	Number of Sets
Lowest	100	300	2	1.50	1
Highest	700	36960	6	2.87	5
Average	978	5706	3	2.55	3
Average Range[a]	189-400	2217-6717			

[a] Depth and Strap Length were given as ranges in the interviews.

Chub were harvested at all times of the year with a preference for summer, spring, and late fall after the whitefish spawn was over. Five participants noted that harvests in the late fall/winter and spring coincided with the chub spawn. During their spawn, the chub were observed to migrate to waters as shallow as 90-190 ft over fine gravel; however, they could still be caught in deeper waters. Some chub were said to spawn in the same depths that they were commonly harvested at, regardless of spawning migrations. One participant also noted that chub were gravid during the summer harvest.

Chub harvests occurred in both Lake Huron and Georgian Bay over mud substrates and in proximity to banks, shelves, and pockets on the lakebed. These locations were characterized as having cold-water temperatures and strong currents believed to carry forage for the chub. Strong currents and water temperatures were viewed as critical factors in determining whether chub were present. One participant explained that to find a current, he would tie a log to a weight with a long rope and place it into the water so that it floated. If the log moved in a particular way, he could identify the direction and relative speed of the current. Other participants explained that they only needed to find the associated geographical formations or a certain range of depths to locate chub. Participant 010 described where to find chub: "It didn't matter. As long as you passed that 250 ft, you start setting east and west you're going to catch them."

There was some dispute over whether the straps were set across or along these geographical formations. Some believed that chub move parallel to the current and some believed that they migrated vertically. These formations served another purpose in relation to the moon, which was addressed by two participants. As participant 004 explained: "So if the moon's coming up on the west, east, then set in the shadows on this side. Set all along there and they'll come back to you and your nets will be full. You can have someone sitting right beside you and they'll set on the other side. They won't catch a damn thing."

The mapping portion of the interviews produced a large amount of spatial and temporal data. In total, 73 features representing past chub harvest and spawning locations were recorded (Figure 10). Seven movement features were also recorded, which illustrated chub migrations in the lake throughout the year. The map reveals that harvesting occurred in three general zones. One zone encompasses the waters around Nawash in Georgian Bay, the other in the Lake Huron

main basin west of Southampton, and one east of Tobermory. These zones provided the basis for the sampling that took place following the interview process.

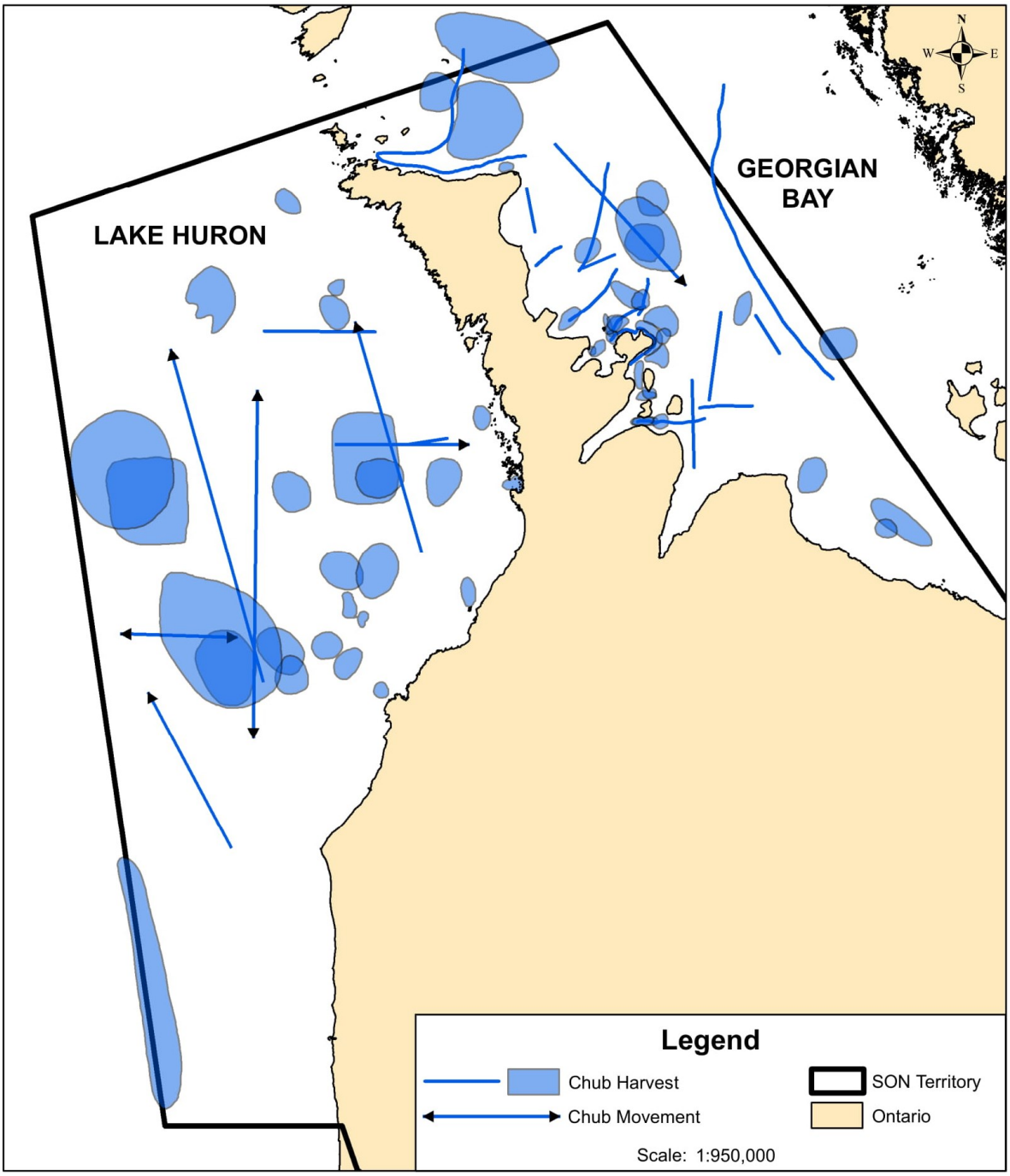


Figure 10. Chub feature map.

4.2.2 Socio-Economic Importance of Chub

The primary focus of the SON fishery has been lake whitefish, but chub were once lucrative and offered diversification. Some chose to target only chub, like participant 009, who recalled: “I never really targeted whitefish because I was making it so good on chub.” Others fished chub seasonally, when other fish prices were low, or when other fish species became difficult to find. Participant 001 demonstrates: “They were pretty important. We made a living at it. When the whitefish were scarce, we’d go after the chub.” The chub provided flexibility within the fishery, which was important ecologically, as it lessened its impact on other species, and economically, because it offered fish harvesters options when markets were volatile, or when target species were scarce. Many of the participants noted that, while lake whitefish and lake trout prices were subject to fluctuations and uncertainties, chub prices remained steady and comparatively high. Participant 017 relates chub’s importance and his connection to them through livelihood and sustenance, as he explains: “All we know is when we catch chub, we sell it. We smoke it. We eat it. We share it; well, we used to. Other than that, it’s just a commodity. It just sustains people. It used to sustain us.”

Drawbacks to fishing for chub included the amount of travel on the water and the amount of effort compared to other larger fish species. Participants recalled travelling on tugs for several hours at a time to reach the appropriate harvest locations. As participant 018 shared: “When you’re working, you’re leaving the house at 5:00am. You’re getting back at midnight; you don’t have time to go anywhere.” Some operations would travel so far that they could see buoys along the Canada-U.S.A. border. Due to their small size, there are significantly more chub to a fish box (100 lb) than whitefish, requiring more effort to dress them. As chub caught in the net are retrieved from the water, their swim bladders inflate from pressure differentials, sometimes even

leading to them exploding. These bloated chub needed to be dislodged and picked out of the nets as they came into the boat. Other fish species can be removed from the nets much easier.

Chub were collectively marketed, and the chub market was size selective. This differentiated catches into four size categories: small, medium, select, and jumbo. They were mostly sold dressed, but some SON fish harvesters sold them in the round at a reduced rate. Small chub were sold for $1.90/lb to $2.50/lb while selects and jumbos could reach up to $5.00/lb. In general, SON fish harvesters targeted selects and jumbos. On average, participants recalled selling chub between $2.00/lb to $3.00/lb. Chub roe was only sold by one participant for $6.00/lb. Participant 004 would use the roe for bait to catch trout in the Saugeen River. He exclaimed: “They go crazy over that stuff… It won’t take you long to catch fish, I’ll tell you that.” On a typical day before the chub declined, a SON fish harvester operating a tug could expect anywhere from 10 to 50 fish boxes of chub. Those on smaller vessels could expect up to six.

The chub fishery provided SON fish harvesters employment opportunities and significant amounts of income during their harvests due to high demand. Participants attributed this high demand to fish markets in the U.S.A. and specifically the Fulton Market in Manhattan, NY which has one of the largest fish markets in the world. Chub caught in Lake Huron by SON fish harvesters would be sold to companies that shipped them to U.S.A. markets to be smoked and sold once again. As a value-added product, smoked chub is revered as a delicacy. A number of individuals within the SON smoked their own chub, making $18.00/lb or higher. There was also demand from local fish buyers like Howell’s Fish in Wiarton, which has been conducting intergenerational business with SON fish harvesters for decades. Together, the participants identified eight chub buyers, which included Lougheed Fisheries Limited (Owen Sound, ON),

Presteve Foods (Wheatley, ON), All Temp Foods (Leamington, ON), Howell's Fish (Wiarton, ON), Cheer's Bar (Chatsworth, ON), the Saugeen fish store owned by the Ritchie family (Saugeen, ON), La Nassa (Kingsville, ON), and Rick Knowles (location not given).

4.2.3 Chub Decline

The loss of the chub harvest represented a loss of livelihood and income, especially for those who targeted them specifically. Chub harvesters had to switch to other species or quit fishing all together, something none of the participants in this study did. Most participants switched to harvesting lake whitefish and lake trout. This shift in the SON fishery placed more pressure on species like the native lake whitefish and reduced the flexibility of the fishery. If markets are volatile and fish prices are unstable, SON fish harvesters' options are now reduced. Fish buyers may begin underpaying for SON fish, especially if there has not been adequate infrastructure to preserve fish (e.g., cold storage) to sell when prices are high. Some participants suspected this to already be occurring.

All participants agreed that chub populations remain in a poor state, but many believed that they were still present, just not in the same abundance. Participant 015 explains: "There was always chub there when we went. It was never, we never came out with nothing. So they were there all along, it was just a matter of how many there were." Even though they were thought to still be present, they all but disappeared from the SON communities. The only exception were infrequent incidentals in harvests targeting other species. The older individuals may still remember chub, but the connection is lost and most youth are not aware it. Participant 017 explores this suggestion further: "You ask any kid in the community here… They don't know what a chub is… The chub have been gone for so long that people don't talk about them anymore. They don't remember them anymore."

The chub decline was attributed to a variety of ecological and anthropogenic factors. Most notably, the stocking of predatory salmonids like lake trout, chinook salmon (*Oncorhynchus tshawytscha*), and splake (*Salvelinus namaycush x Salvelinus fontinalis*). All participants in this study attributed the stocking of salmonids and their subsequent predation to the decline of chub. The SON fish harvesters began to notice these salmonids as incidentals in their chub nets, something that was fairly uncommon before the decline. As incidentals, their abundance grew, as participant 011 explains: "until there was so many salmon in the chub grounds that they were eating them like crazy. We were getting more boxes of salmon than chub after a while." Or participant 015: "It seemed odd to catch salmon that deep because usually they're around 100 ft, 180 ft, not 300 ft." Participants mostly referenced salmon or lake trout, while only a few referenced splake. Participant 009 discussed the effects of splake in great detail: "It was the splake back in that day that wiped out the chub… When they introduced the splake heavy." Participant 016 compared splake and salmon: "Yeah, you know there's different ways to look at it. One way with the splake, it messes with the natural ecology of the lake and the same with the salmon. It's in the same boat. They eat the indigenous species, right? And like the salmon, they're voracious." Many participants recalled gutting incidental salmonids and finding several chub in their stomachs. Introductions were worrisome, as these introduced fish are not native, consume a large amount of forage, and continue to be injected into the lake.

Other factors that are thought to have contributed to the decline of the chub include dreissenid mussels, changes in water clarity and temperature, loss of forage, and swarming disease from stocked salmonids. The most significant of these was the invasion of the dreissenid mussels. Their impact in the Lake Huron ecosystem has been widespread, occurred quickly, and influenced a variety of ecological processes and native species. As participant 001 explained: "…

the zebra mussels just destroyed the lakebed, just killed everything." Many of the participants recalled a time when there was no dreissenid mussels in Lake Huron. As a child, participant 014 remembers his father first noticing them and proclaiming: "It's going to be an infestation." He was right, as the zebra mussel (*Dreissena polymorpha*) and later quagga mussel (*Dreissena bugensis*) proliferated across the lake. Dreissenid mussels filter feed, constantly filtering and consuming the micro-organisms that larval chub and fingerlings of other fish species depend on. They aggregate so heavily that they become caught throughout the nets, often leading to damage if not properly dealt with (Figure 11).

Figure 11. Dreissenid mussels from a 1-hour chub sample set in Georgian Bay.

When discussing the decline of chub, participant 002 shared: "Well I would put it to like a handful of factors, like the lack of plankton in the water for them to eat you know, the water,

the side effects that happen from zebra mussels. You know the water gets cleaner, gets warmer, chub don't like warm water." Participant 004 noted that the stocked salmonids and the dreissenid mussels did just as much damage to the lake and the chub. Many participants expressed that the increased clarity of the water led to the propagation of algae in the lake. Participant 014 explains: "They clean the water so good that the sun penetrates further and then it makes a lot of algae and it makes all the growth like, things grow like that shouldn't be growing as massive as it does. But it creates a lot of things, you know. And then when this algae goes and dies, it turns white and then it's like a poison. Any fish that goes in will die."

Many participants were hopeful for the future of chub and possible opportunities for re-engagement in the fishery. One of the final questions that was asked during the interview was about the importance of chub and its future. The sentiment of hope was strong for those currently fishing and for the next generation of SON fish harvesters. Even if there was no possibility of harvesting them once again, the SON fish harvesters were still concerned about the status of chub, as they are an essential component of the ecosystem and held an important place in the SON fishery. Their absence has impacted the fishing community quite significantly. Without chub, SON fish harvesters are not afforded the same flexibility when certain fish species become scarce and markets are volatile. This is especially true as lake whitefish continue to decline. Concerns over the lost connection and status of chub brought about this research project.

Most of the participants were intent on learning more about the status of chub and whether there is still a healthy population in the lake. Some of the individuals with children expressed that they were concerned about their children entering a fishery that was in the decline and not as flexible as they were accustomed to, believing that chub could provide a good source of income for those entering the fishery. Currently, there is still enough demand for chub from

markets outside the SON and from within the SON. For instance, participant 016 who runs a fish shop in Saugeen mentioned that people come to the store and ask for chub. The question regarding the future of SON fish harvesters and chub is whether they are abundant enough and of significant size to support a commercial fishery. Further sampling, monitoring, and research will answer this question.

4.2.4 Lake Herring

Although lake herring share their genus with chub and lake whitefish, they did not hold the same prominence and reputation among the participants from a socio-economic standpoint. They were described as being much larger than chub, commonly weighing around 2 lb, and were characterized as having blueish backs. Other defining features include prominent mandibles and a superior positioned mouth, easily differentiated from the similar looking lake whitefish with an inferior positioned mouth. Four participants targeted lake herring specifically, but only in the past, while all 16 participants caught them as incidentals in their whitefish harvests. Participant 010 was directed towards harvesting lake herring by a non-Indigenous individual in Tobermory who explained how and when to harvest them. Participants noted that lake herring aggregate around the same spawning shoals where lake whitefish spawn, likely to consume the spawn. This arrival was said to overlap with the end of the lake whitefish spawn in late fall and continue for about two weeks. During this time, lake trout were also said to aggregate around the spawning shoals, most likely to prey on lake herring and lake whitefish.

The most common gear for lake whitefish harvests is the bottom-set monofilament gillnet that stays in the water for 24 hours. The mesh of these nets varies around 5 inches. One participant specifically targeted lake herring during their spawn, with his chub and perch nets catching up to 50 fish boxes in a single set. The harvest depths were commonly referred to as

shallow and ranged from 6-90 ft. Incidental harvests could yield several hundred pounds depending on strap length and time of year. Lake herring can be caught in either Lake Huron or Georgian Bay, but they are mostly caught around the Fishing Islands of Lake Huron and in shallow bays around the Saugeen Peninsula. Participants noted that the lake herring moved up and down the shoreline, as participant 005 explains: "You set your nets along the shore. Follow the shoreline because they follow the shoreline. They even catch them on rod and string." Or participant 010: "And all up and down Lake Huron shoreline is all the perfect refuge for whitefish and herring and everything. It just depends what time of year you're at…"

The contemporary importance of lake herring to SON fish harvesters was limited, as discussed by participant 010: "Then herring, no one's even gone after herring here for, oh shit I don't know how long." Many of the older participants recalled lake herring being an important traditional food fish for the SON. When conveying their importance during the winter months, participant 011 shared: "… they used to pickle, pickle fish. We'd pickle whitefish and we'd pickle herring. We'd put them in salt brine in a barrel, a wooden barrel, as you needed and you just took them out of there and rinsed them really good. Boil them." He also recalled that: "There used to be all kinds of it when I was a kid." Using wooden barrels and salt brine to preserve the fish was common practice at one time, as participant 015 explains: "… because nobody had a fridge or anything too keep them in." Participant 005 expressed: "Well yeah, they're good eating. A lot of the guys used to prefer them to any other fish. The old timers… They would rather have herring than whitefish anytime."

Some participants noted that unless they were smoked, lake herring were not preferable to eat due to their pin bones. The bones made consumption, dressing, and filleting difficult. No participants shared that they were currently eating or had recently eaten lake herring. Lake

herring were also used as bait for other species like lake trout. Lake herring were seen more as a historically and traditionally important fish, not only for the SON community, but also for the fishing communities around the Saugeen Peninsula. When talking about non-Indigenous fishing operations out of ports like Howdenvale and Oliphant, participant 010 explained: “That’s where they’d fish them by the tonnes. Mega tonnes. And they were just and barreling them. That’s why there is a barrel factory at Howdenvale.”

Lake herring were not perceived as marketable aside from their roe which were sold for $3.00/lb up to $6.00/lb. During the lake herring spawn participant 010 described them as: “just full of eggs. Nice beautiful orange eggs,” as seen in Figure 12. He also expressed that during the lake herring spawn, aggregations are significant and that they can be easily harvested: “Just like grapes.” As for the fish, they were much harder to sell for a profit. Many of the fish buyers would rarely purchase lake herring from SON fish harvesters and if they did, they would not purchase many. If a fish buyer wanted to purchase lake herring, they would only be willing to purchase it from $0.10/lb to $0.65 /lb.

Figure 12. Lake herring roe.

These prices are very low compared to other fish species in Lake Huron, making the impetus to harvest them poor. Therefore, the only reason to target them specifically would be to sell the roe and the smoked fish, to use as baitfish, or for subsistence purposes. Participant 012 noted that individuals will approach him and ask for smoked lake herring, but he does not provide them smoked As incidentals, lake herring can generate some income especially when smoked, but it is limited at best. As participant 009 shared: "… I caught a lot of herring, but nobody wants them. Nobody wants to do anything with them. There's no market for them." If incidentally harvested lake herring are still alive when the lake whitefish nets are being brought into the fishing vessel, some participants put them back into the water because doing so would not result in a large sacrifice of profit and so that the lake herring could continue to spawn.

There were conflicting statements regarding Lake Huron lake herring populations and their status in the past. Some participants perceived the lake herring populations as abundant and healthy for quite some time. Participant 010 shared: "… even the white guys would say they'd come in so thick you could walk across the water on them." Participants noted an increase in lake herring presence over the past few years. The lake herring were observed by many participants as particularly abundant during the end of the lake whitefish harvest in the last few years. Some individuals mentioned that they have not seen lake herring aggregate so heavily before. Four participants recalled a time when lake herring were less abundant, suffering from a decline related to some known and unknown factors like stocked salmonid predation. As participant 018 explains his operation's incidental lake herring harvest: "… we get like 6 to 7 boxes right now lifting in the fall and when I started, we were lucky to get a box." Responding to a question asking if there were more lake herring now, he replied: "Oh yeah. Oh my god, enormously. Crazy." This contradicts the observation that they have been healthy for as long as some participants can remember. It is difficult to gauge the health of their population as so few individuals targeted them specifically and for a long enough time to get an adequate understanding of changes in their abundance. After the whitefish spawn, all fish harvesters move off the spawning shoals to look for lake whitefish elsewhere rather than staying for the lake herring spawn.

The mapping portion did not produce as much spatial information for lake herring, likely due to the SON fish harvesters' lesser interaction with this species. In total, there were 15 identified harvest and spawning locations (Figure 13). These features were concentrated in two separate zones. One of the zones was situated in Lake Huron along western side of the Saugeen Peninsula to around Douglas Point. The other was north of the first zone in proximity to the

Fishing Islands. No movement features were marked, but as discussed earlier, they were observed to move along the shoreline.

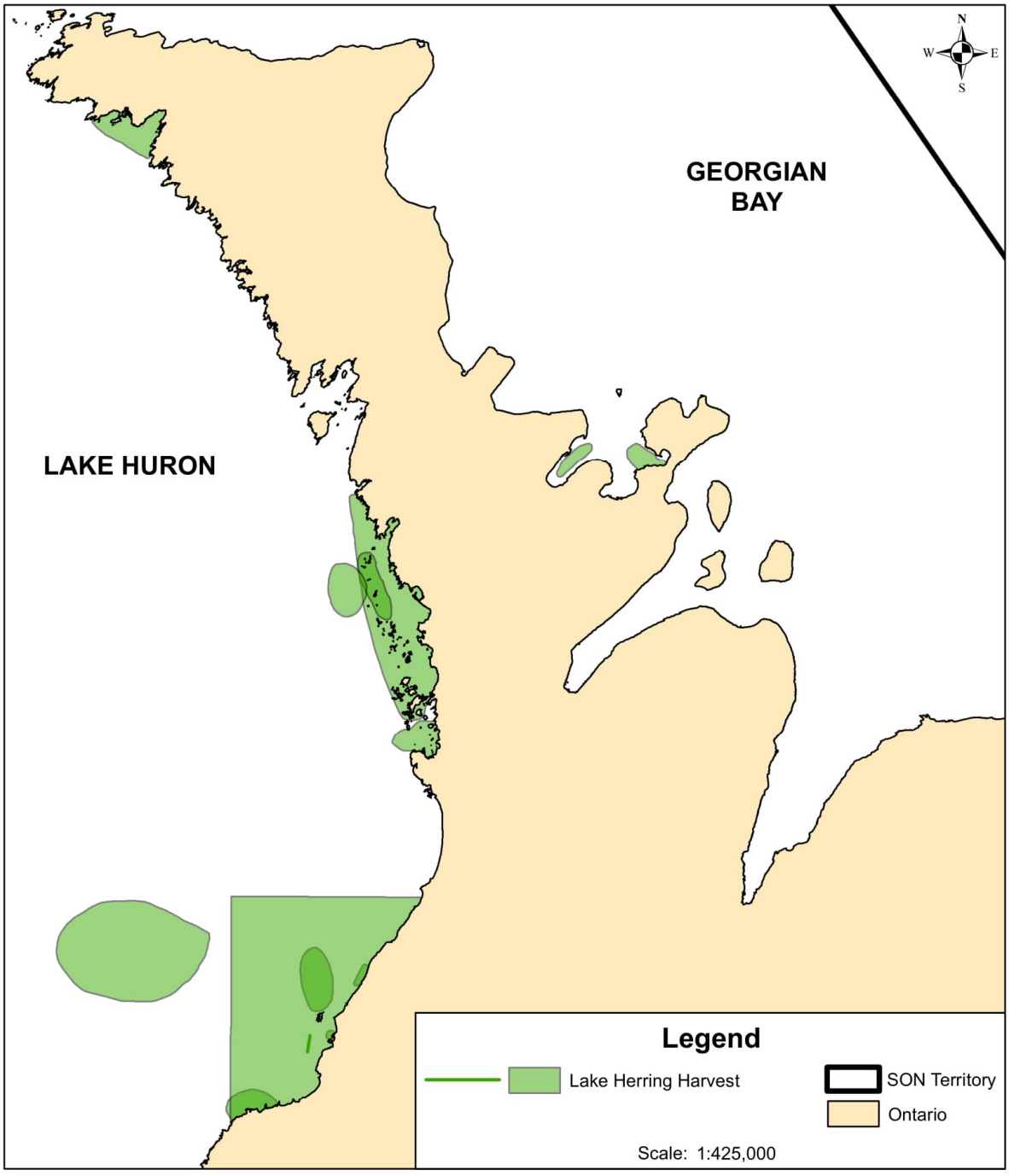


Figure 13. Lake herring feature map.

4.3 PERCEPTIONS OF GOVERNANCE AND MANAGEMENT

Fisheries governance is flawed from a SON fish harvesters' perspective. Those interviewed believed that their concerns are not adequately considered in decision-making by the OMNRF and the SON Joint Council. This is realized in the lack of support to the SON fish harvesters, financial and otherwise, the absence of their formal consultation regarding the stocking of fish, and the omission of their IEK and perspective in decision-making. As participant 014 shares: "… we speak to deaf ears and we are seen with blind eyes, that's the truth."

At the forefront of the SON fish harvesters' concerns with governance are the decisions that have been made around the stocking of predatory salmonids. Stocking in the Canadian waters of Lake Huron is undertaken by the OMNRF and various sports fishing clubs. The fishing agreements that the SON and OMNRF have signed have been about co-management, even addressing fish stocking in the latest iteration; however, to this day, there has been no formal consultation with the SON on the stocking of fish in their territorial waters. This oversight led to serious concerns from the SON fish harvesters, who advocate for a formal consultation process and the cessation of stocking or at least a moratorium.

Participants were critical of the OMNRF's Western science-based approach to ecological issues, as addressed by participant 016: "You know I had someone say to me, 'But science has got us where we are.' True, but is where we are a good place?" He also shared: "You know, the way they operate is there's a problem and then they'll try to fix it by introducing something else. You know? Possibly a baitfish or whatever to feed the predator fish because there's only one fix. Leave it alone… Nature's just fine on its own." The belief that nature has agency and that it can operate without human authority was common amongst the participants. They saw stocking as a

way to control nature, rather than working with it, something in direct violation of their belief in nature's agency.

Concerns about stocking are realized in the effects on their native ecosystem, the chub collapse, the ongoing collapse of lake whitefish, and an unfair governance process that does not include the SON fish harvesters. Participants believe stocking is done to support the sports fishing industry, which generates millions of dollars every year. This preference all but excludes the SON. The SON fish harvesters' view stocking as a serious threat to the SON fishery and to a traditional SON livelihood, and as an infringement upon the SON's inherent rights to fish. Participant 014 explained: "I don't believe that fishing is a privilege. I see it as an inherent right given to me by my forefathers and their forefathers before them. And it should be the same for my children and their children and their children after that." By stocking without formal consultation, the OMNRF is affecting these rights, which are generational and culturally significant to the SON. Participant 017 explains: "So I'm thinking that to destroy our fishery would be to destroy our native rights. If there's no fish for us, we'd have no income, we'd have no substance, we'd have no argument."

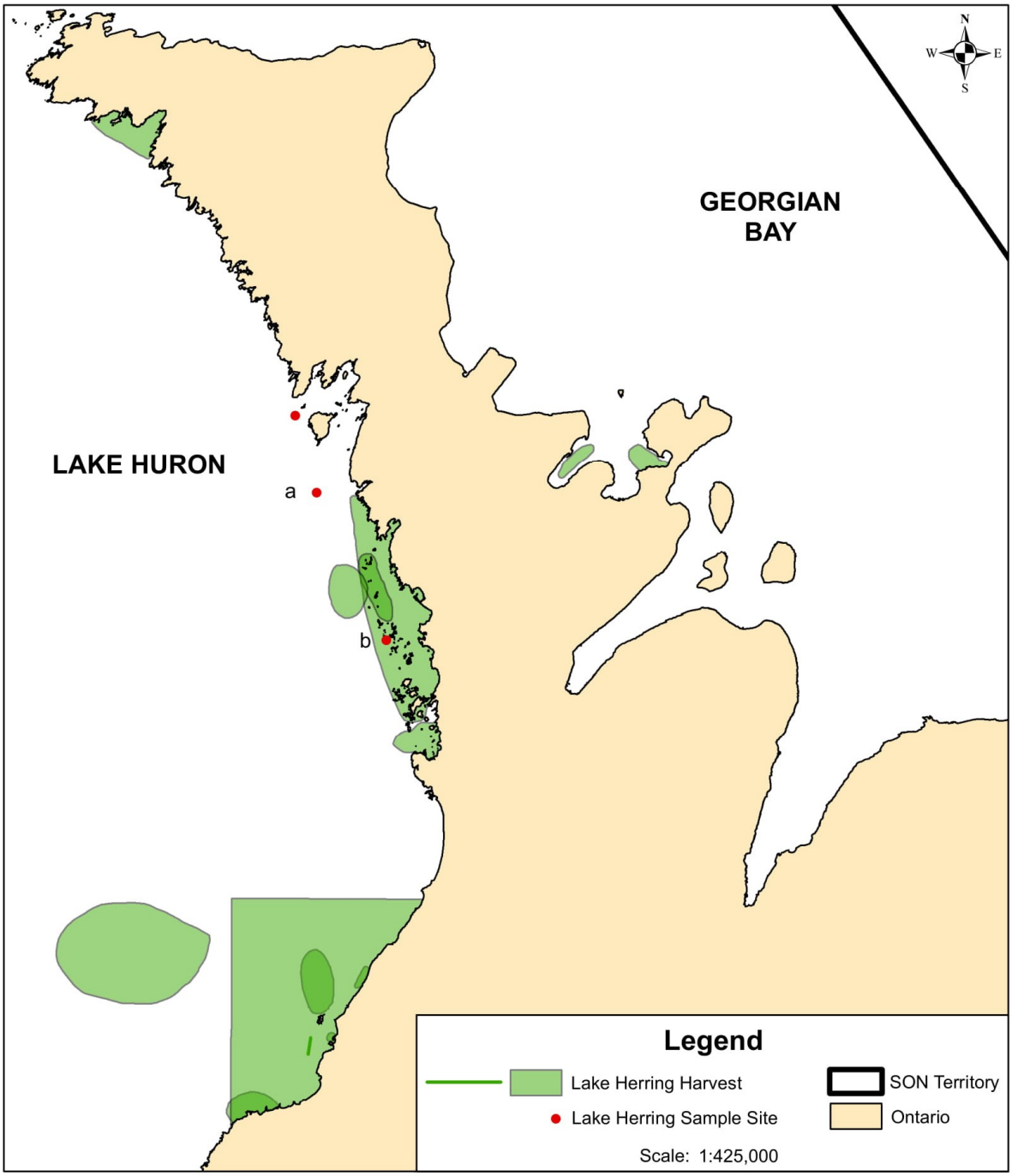
The suspected effects from stocking efforts are also changing the way that SON fish harvesters are interacting with the waters and generating IEK. Participant 013 addresses this issue in reference to native fish species:

> "And in the end, you know Aboriginal people always said our ancestors fished this fish since time immemorial. If the fish changes, are we going to be able to say that about the salmon? They're changing who we are without even talking to us. They're impacting on our Aboriginal and Treaty right. They're changing our culture and our heritage indifferent if it was somebody else, the non-native people."

4.4 FINDING CISCOES

In total, four collections were purchased (Figure 14). The collections came from the western side of the Saugeen Peninsula (Figure 15). These harvest locations coincided with the IEK and observations that were shared in the interviews. The lake herring were aggregating in proximity to the same shoals that the lake whitefish were spawning on. Many of the lake herring were mature and preparing to spawn, as revealed by the gravid females. The last collection that was purchased was ripe and spawning. Several SON fish harvesters observed that the lake herring aggregations this year (2019) were exceptionally greater than previously witnessed.

Figure 14. Incidental lake herring harvest purchased from participant 012.



[a] Two harvests occurred at the same location.
[b] This harvest was not measured.

Figure 15. Lake herring sample sites.

The first collection of lake herring purchased from participant 012 contained many more fish than what was needed. This presented an issue because I did not want any fish to go to

waste. As a solution, fish were given out to community members to eat. I drove around Nawash and handed them out in person. Although lake herring are not perceived as an economically important fish to the SON fishery, many of the recipients were grateful. This reveals that economic significance or selling price of a given fish species does not determine its worth and importance to the SON as a food fish. It was a fulfilling feeling giving back to the community in this way.

After each exchange, the lake herring were photographed following the pinning method and frozen to be transported for processing in Ann Arbor, MI. While in Ann Arbor, MI only three of the collections were processed as one did not have enough samples. A second set of images were taken and isotopic, DNA, otolith, and scale samples were extracted from each sample. Overall, 79 fish were measured. In gratitude for his help and direction, Randy Eshenroder was given two lake herring for his personal preserved collection.

For chub, sampling took place within the three zones that were identified by all 19 of the interviews (Figure 16). Within each zone, two separate sample sets took place. On the first excursion around Nawash, participant 014 explained that the relatively small mesh size would catch a significant amount of fish during a 24-hour or 72-hour set. He concluded that due to the depth, many of the fish that would be brought up in the net would die as a result. He harkened back to a lesson that he learned from his father, “take only what you need.” A decision was made to set the nets for one hour at the first site to see if there were any chub. That set was successful and 303 chub were caught among other fish species. From that point on, the sampling method followed the same process.

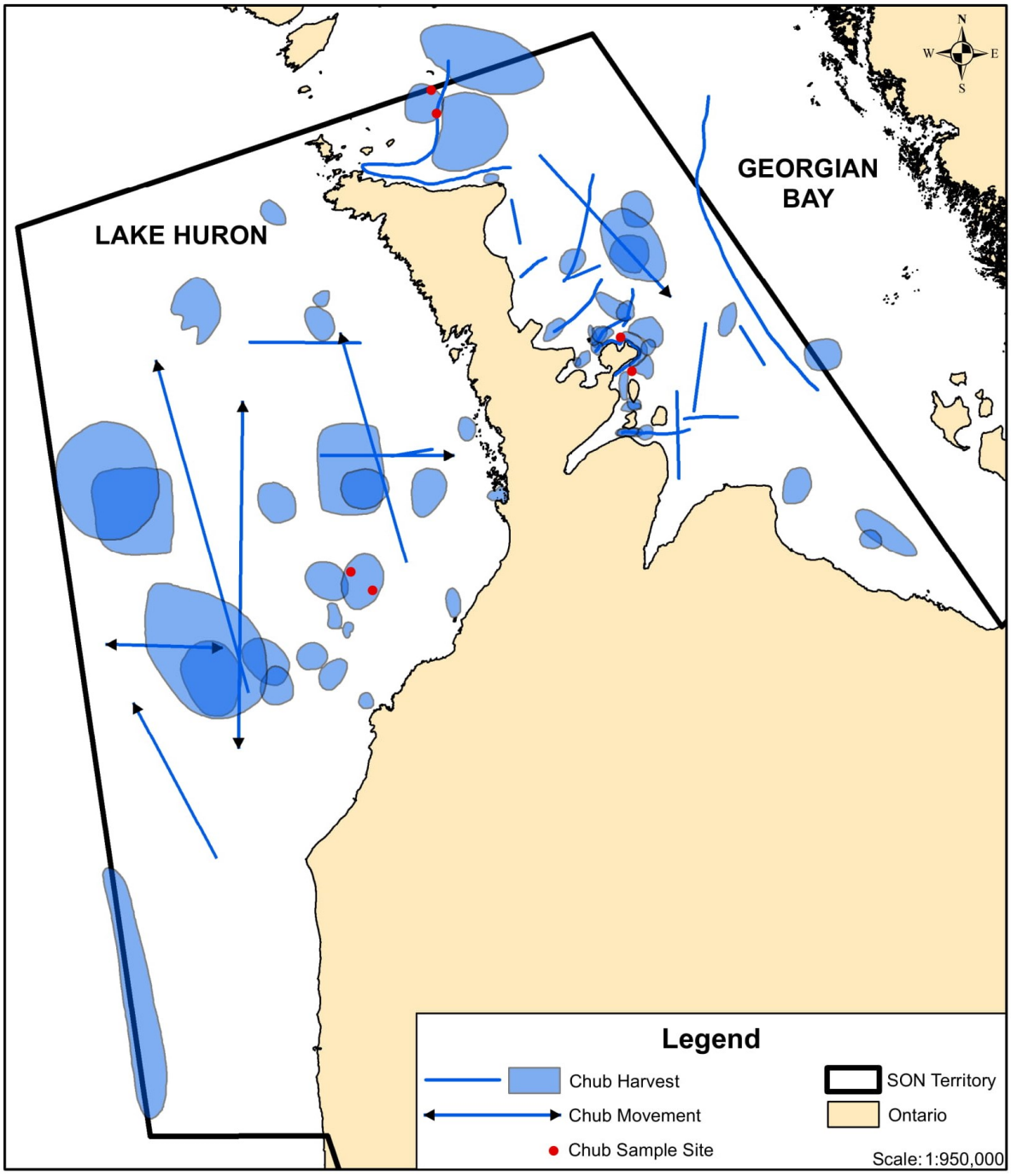


Figure 16. Chub sample sites.

All three excursions validated that the SON fish harvesters' IEK was ecologically accurate. The chub were occupying the same depths and locations that were identified in the interviews. In total, 922 chub were caught. A large portion of these chub were mature and the

females were gravid, indicating that they were going to spawn soon. Lake trout, rainbow smelt, alewife, suckers, gobies (*Neogobius melanostomus*), and ling were also caught. Of these 922, 91 were measured. A significant amount of dreissenid mussels were also caught in the nets. One of the samples northeast of Tobermory produced six deep-water scuplin (*Myoxocephalus thompsonii*). This species is protected as a species of special concern under the SARA, and these samples represented their first recorded presence in the area (Government of Canada 2019). Three of the samples were given to Parks Canada.

In total, 91 chub were measured. The sizes of the chub were small in comparison to prior SON harvests, as explained by the participants. While the crew members and captains where excited to see chub once again, they were concerned about the size reductions. Some individuals expressed that if mesh size and effort duration was increased, larger fish may be caught. With regards to larger mesh size, the sample data does not support this claim. The largest chub that was sampled measured 201 mm in standard total length (STL) and 45.48 mm in body depth (BDD), while the average STL and BDD were 128.94 mm and 31.02 mm, respectively (Figure 16). Most of the sampled chub would be able to swim through the larger mesh sizes as shown by the frequency of caught chub per size of mesh. The smallest mesh sizes (0.75 inch and 1 inch) caught the majority of the sampled chub. The largest mesh (2 inch) only caught one chub out of six individual sets. From the results of the sampling, it is difficult to assume that increased effort duration will produce larger chub; however, this is an area for further investigation.

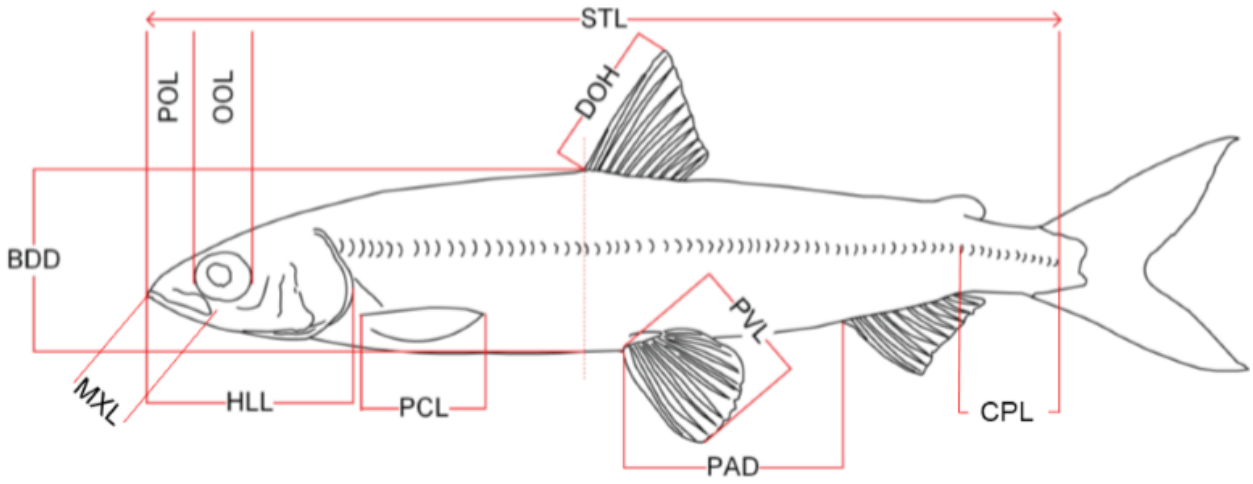


Figure 17. Cisco morphometric measurements (Eshenroder et al. 2016).

4.5 CONCLUSION

In conclusion, the IEK from the SON fish harvesters was in depth and provided insight into the complex socio-ecological relationship and connection to the ciscoes of Lake Huron. It gave an account of the history of ciscoes and the SON, while bringing forward multiple ecological and governance issues. These issues are significant as they affect livelihood and the rights of the SON. Embedded within this knowledge are values and principles which are critical factors in the decision-making process of fisheries governance. The application and consideration of this knowledge in governance and management decisions are paramount to more appropriately account for the complexity of fisheries as socio-ecological systems. The following chapter discusses these key themes in more detail.

CHAPTER 5: DISCUSSION

The SON fish harvesters' connection to ciscoes is one that has endured and developed over time in spite of serious declines and conflict. Lake herring and chub were both important in their own ways, but what binds them to the SON is their connection to the waters, to culture and identity, and to the past. Together as a cisco collective, their socio-economic and cultural influence on the SON is significant. By engaging with those who have depended on them and have interacted with them, this research aims to revitalize that connection. By sharing their story and importance to the people of the SON, this research intends to keep ciscoes relevant. This chapter will explore the significance of these results by relating them to the research goal of determining how the IEK from SON fish harvesters could inform fisheries governance and social-ecological relationships with ciscoes in Lake Huron. It will also respond to the four research questions:

a) What do ciscoes represent to past and present SON fish harvesters?

b) How can SON fish harvesters' IEK aid in the understanding of cisco biology, critical habitat, abundance, distribution, behaviour, and natural history?

c) How can SON fish harvesters' IEK be used to inform future biological sampling, monitoring, management, and policy decisions among provincial resource authorities and the SON?

d) How will SON fish harvesters' IEK shed light on the future commercial and cultural role in the communities of the SON?

5.1 THE CONNECTION TO LAKE HERRING

The connection between the SON fish harvesters and lake herring stems from a shared existence as living relations within the SON territory. As a native fish, lake herring represent an essential component of Lake Huron's ecological processes, to which other native species contribute and on which they rely. While lake herring are not contemporarily popular amongst the SON fish harvesters, they still have made an impact in the communities' history as a traditional food. Fish in a SON context are, however, much more than food, as they are part of culture, tradition, and identity. Lake herring are mentioned several times in Koenig's (2005) interviews with SON members revealing their past importance, but this importance has diminished over time due to poor market demand. As a result, the presence of lake herring in the SON communities has been greatly reduced, cementing a perception from SON fish harvesters and some community members that lake herring are not as useful or important as other marketable species. This view is contrary to the perceptions expressed by elders in this study and to participant recollections of elders, who in their youth relied on lake herring to a much higher degree. A possible reason for the decline in the popularity of lake herring within the SON is the regression of people away from traditional foods and a greater reliance on affordable and accessible foods from local grocers. While lake herring are not as contemporality and economically prominent as other native species, they are still important to the SON fish harvesters and represent a native fish that has lived alongside the SON since time immemorial. Additionally, lake herring can provide numerous future opportunities for the SON in food access, economic endeavours, and research.

As a food fish, lake herring were important to the SON, but they also influenced the other fishing communities on the Saugeen Peninsula. The lake herring fishery was intense, much like

the chub fishery, and severely impacted populations across Lake Huron leading to the cessation of spawning runs in Saginaw Bay, MN by the middle of the 20th century (Eshenroder et al. 2016). As noted by participant 010, the lake herring fishery around the peninsula was significant, leading to the creation of some barrelling factories. The Lake Huron lake herring populations could not support a fishery after the mid-1960s and they are suspected to have remained in low abundance due in part to the proliferation of invasive species like rainbow smelt (Dobiesz et al. 2005).

From the interview and the sampling data, it is clear that lake herring populations have recovered or remained in a suspected healthy state in the waters around the Saugeen Peninsula. This outcome of the study is surprising given that other populations around the lake have been greatly reduced or extirpated. Eshenroder et al. (2016) and Dobiesz et al. (2005) suspect that lake herring are only present in Georgian Bay, the northern waters of the main basin, and the North Channel. The results from this study are contradictory and shed light on a population overlooked by scientists. The ability to identify local populations and contradictions to current Western science knowledge represent the strengths of using IEK as part of a two-eyed seeing approach.

Likened to a rabbit in relation to aquatic predators, the lake herring is primary prey for lake trout and other predatory fish in Lake Huron (Scott and Crossman 1973). This predator-prey relationship is similar to that of the chub, but the connection between lake herring decline and stocked salmonids was seldom mentioned in the interviews. Instead, SON fish harvesters believe stocked salmonid predation has primarily affected lake whitefish and chub. The relationship between stocked salmonids and lake herring warrants further investigation.

The future of lake herring and the SON is promising; however, it may not currently be clear. Access to food and traditional food for both SON communities is constrained by a variety

of factors, especially economic constraints. As a traditional food fish, lake herring can provide the SON with affordable and healthy food. It was clear when I handed them out that they were appreciated, but a few individuals refused the offer due to limited dressing space, the perceptions around eating them (e.g., full of bones and not good to eat), and because some did not know how to properly dress or fillet them. Lowitt et al. (2018) identifies that inadequate skills prevents certain SON members from consuming fish. Training and educational outreach in the SON communities could help to improve their confidence when handling fish and encourage them to actively seek it out. Another factor effecting the consumption of fish is the prices that they are sold for. More marketable and in demand fish like lake whitefish and lake trout are expensive. To keep their businesses running and to support themselves as well as their crew, SON fish harvesters need to sell these fish. The sale of these fish is oftentimes not even enough to keep the business running. This need to sell, coupled with the lack of infrastructure, makes it difficult for SON fish harvesters to give away their fish or sell it at a reduced price to community members.

Lake herring, relatively cheap and not in demand, has the potential to help feed the SON and generate income for the SON fish harvesters. This would require a re-emphasis on the connection to lake herring and their potential to make an impact in the community. Lake whitefish harvest will always produce lake herring at some capacity and the increasing incidental harvests could be directed back to the community. Lowitt et al. (2018) list several access mechanisms to support the connection between local fisheries and food security in the SON that can help lake herring become a more prominent food fish. The SON fish harvesters could attempt to sell these fish within the community as an affordable substitute to other more expensive species or approach other markets and businesses outside of the SON for sale.

Another promising opportunity is the possibility of future academic inquiry, monitoring, and sampling. Lake herring received an abundance of academic attention during the first half of the 20th century and is in need of more contemporary studies that focus on diet composition, population trends, genetics, movement, and spawning (Scott and Crossman 1973; Eshenroder et al. 2016). The populations that are present around the Saugeen Peninsula represent an opportunity to conduct such research, which can be greatly complemented by the spatial and technical information gathered by this study. Ongoing sampling and monitoring from the Fisheries Assessment Program could also prove to be useful by documenting changes in populations. These efforts could generate comprehensive data on an ongoing basis. Already, there is an abundance of biological data from DNA, isotopic, scale, and otolith samples from the collections that were gathered in 2019.

The lake herring populations also represent an opportunity for collaboration with resource authorities like the OMNRF and bi-national organizations like the GLFC. For instance, the Michigan Department of Natural Resources has been engaging in the rehabilitation of this species through a stocking program in the American waters of Lake Huron (Michigan Department of Resources 2020). The lake herring in the territorial waters of the SON could provide a source population for further research or stocking. This resource sharing could be an opportunity for bi-national collaboration to replenish the stocks throughout the Great Lakes.

5.2 THE CONNECTION TO CHUB

The connection to nature and living relations is prominent in Ojibway culture, ideology, and spirituality (Johnston 2003). Having that connection altered is serious and can have lasting social and economic effects. Fortunately, chub are not extirpated and although they are no longer present within the SON communities aside from rare incidentals, their legacy and importance

endures. Fish harvesters entering the SON fishery will most likely not be familiar with chub, but it is through the stories of the experienced SON fish harvesters that this connection to chub lives on. Embedded within these stories is their IEK.

The collapse of the Lake Huron deep-water fish community from the 1990s to the 2000s and onward is well documented (Dobiesz et al. 2005; Riley et al. 2008; Eshenroder and Lantry 2013). The discussions that Koenig (2005) had occurred during this collapse, which his participants noted and related to the stocking of predatory salmonids. This collapse of chub is documented to a lesser extent than the deep-water fish community as a whole and is mainly focused on U.S.A. waters. The literature suggests that this more recent decline is a result of successional setbacks such as reductions in forage for chub and impacts from invasive species, but there is little reference to increased predation from stocked salmonids (Dobiesz et al. 2005; Eshenroder and Lantry 2013). Crawford (2001) raises a similar point that much of the literature has not focused on the predation of native species from stocked salmonids. This is surprising given that all participants in this study and some in Koenig (2005) believed that predation by stocked salmonids was a significant factor in the collapse of chub.

As revealed from the sampling and the literature, chub are present and seemingly abundant in the offshore waters of both Lake Huron and Georgian Bay. However, the process of introgressive hybridization has reduced their size relative to the former forms that were once harvested (Eshenroder et al. 2016). In addition to this reduction in size, their vulnerability to invasive species and successional state do not make them candidates for future commercial harvests or for consumption. Therefore, re-engagement will have to look different, whether that takes the form of future scientific inquiry or education. Like the lake herring, continued monitoring and sampling will provide insight into their population changes and biology.

There is increasing attention towards re-establishing the native deep-water fish species of the Great Lakes as exemplified by a defining theme of GLFC research (Zimmerman and Krueger 2009; OMNRF 2020). The chub specific knowledge generated in this study may be able to provide further insight that can aid in support of this theme. The chub populations around the Saugeen Peninsula were abundant during the sample period. Perhaps these population can provide further scientific inquiry or even a source population for stocking the hybrid swarm of chub elsewhere in Lake Huron and across the Great Lakes.

The chub fishery, although short lived, greatly benefited SON fish harvesters, providing food and income until their drastic decline during the 1990s and 2000s. The chub represented a significant component of the SON commercial fishery for almost two decades, and before that they were important to the non-Indigenous fishing operations around the Saugeen Peninsula. While not technically a traditional food fish, chub were consumed and revered by the participants. Future opportunities other than research and education are limited, but the story of the SON and chub can be used to advocate for better governance processes that consider the SON fish harvesters' concerns.

5.3 INDIGENOUS ECOLOGICAL KNOWLEDGE

The IEK explored in this study is characterized by ecological insights into a group of fish poorly understood by Western science, knowledge pertaining to ceremony and culture, and values and principles of the SON fish harvesters. The ecological insights that the participants shared informed their own assumptions about the effects of management and governance decisions like stocking, and their suspected effects on the local environment. The results also reveal that socio-ecological relationships with ciscoes stem from culture and economic dependence. These relationships are complex and have been influenced over time by numerous

factors. This knowledge represents high-quality information, perspectives, and meta-level governance elements for use in management, governance, and legislative contexts.

For management purposes, the information can be used to inform future sampling and monitoring. A better understanding of cisco-specific gear, depths, harvest locations, and spawning times will provide a basis for successfully sampling and monitoring the ciscoes of Lake Huron. The practical utility and application of this information was emphasized in the sampling efforts, which were successful and relied entirely on the IEK from the SON fish harvesters. In addition to ecological insights, the application of meta-level governance elements into sampling and monitoring will be critical moving forward as treaty people engage in co-management. For instance, incorporating IEK from the participants allowed the sampling to account for some of the principles and values regarding wasting and respecting the fish. This was an important consideration of the SON fish harvesters and can be applied in the future. This relationship between method, values, and principles is important and emphasizes the contributions of IEK to Western science approaches to understand ecology and species interactions like sampling and monitoring.

Fish harvesters are often the first to observe declines and depletion in a given species due to their time spent on the waters and their dependence on the resource. For SON fish harvesters today as it was historically, IEK directly translates to survival. Therefore, the success of their harvests is reliant on a sound understanding of ecological processes and species interactions. Their knowledge of principles and values ensures that this success can be passed down generationally to their descendants and other community members in a sustainable manner. If fisheries managers were proactive and actively sought out and heeded IEK, perhaps they could act sooner and make more appropriate decisions. Taking observations and insights of fish

harvesters seriously could play a major role in the future of the resource and how it is monitored, as it did for the Eastern Beaufort Sea beluga (*Delphinapterus leucas*) population (Ostertag 2018). Conversely, ignoring this knowledge or disregarding it for its anecdotal nature could prove fatal for the resource as exemplified by the collapse of the Atlantic cod fishery (Neis 1992; Bavington 2010). The latter example more closely aligns with what happened with the chub, a decline that occurred while SON fish harvesters were vocal and in objection to the stocking of predatory salmonids. Again, this ignorance of SON fish harvester observations and IEK is occurring with lake whitefish, which continue to decline.

Documenting fish harvester IEK can make meta-level governance elements explicit for the benefit of fisheries governance. Governance is an inherently political, social, and challenging process that attempts to make decisions about complex systems like fisheries. Located within this complexity are the meta-level governance elements that actors, rights holders, and stakeholders hold. The IEK form the SON fish harvesters are an important component of this because meta-level governance elements are embedded within this way of knowing. This knowledge can inform decision making; however, it is often underrepresented, ignored, and not explicit as it is currently for the SON fish harvesters who feel left out of the governance process. Song et al. (2013) suggest that making these meta-level governance elements explicit needs to occur to broaden the discussion away from the epistemic community, raise new research questions, and include more diverse insights. By doing so, decision makers can increase transparency and account for socio-economic, cultural, and power relationships in a fair and equitable way.

The SON fish harvesters' IEK can be used to support the SON in legislative domains like court cases related to harvesting rights. As Harris and Millerd (2010) explain, court cases are common vehicles for Indigenous rights recognition and reaffirmation. These authors conclude

that reconciling Indigenous and Canadian histories in a fisheries context requires a balancing of interests that can be accomplished and negotiated through agreements, much like the Substantive Fishing Agreement. When negotiations are not successful or the agreement does not appropriately account for rights, values, and principles, then the courts become involved through litigation. When the courts become involved, information about changes in the lake and fish, water use, impacts from management and governance decisions, and concerns from those who interact with the waters will be important for the courts to make a decision. The IEK of the SON fish harvesters represents such information, which has important ties to tradition and culture, and interactions with other stakeholders and rightsholders.

For instance, the SON is currently in the process of undertaking a lakebed and Indigenous title claim in response to breaches of constitutional and fiduciary responsibilities by the Canadian and Ontario governments that came from the treaties (Ontario Superior Court of Justice 2019). In regard to the title claim, the SON wishes to "seek recognition of their historic and continuing connection to their territory, which in this case, is their water territory. This connection to the water relates to their economy, their way of life, their culture, and their spirituality." (Ontario Superior Court of Justice 2019, p. 3). The SON's witnesses for this ongoing court case include a number of community members who engage and interact with the waters like fish harvesters. Along with other community members, these individuals have shared their IEK pertaining to the waters to inform the court and the judge about the SON's connection to the waters and the fish. The results from this study could be used to help support the SON in this court case and any possible future ones that relate to the waters and the fishery.

Koenig (2005) represents the connection to Indigenous spirituality and tradition as complex and variable from person to person. This study acknowledges that complexity and

reinforces the idea that the use of terms like tradition or traditional can be problematic. To proport that all the knowledge accrued by this research was TEK because the informants were Indigenous would be dishonest. Not all the information was grounded in tradition or spirituality, but rather personal experience and understanding. To introduce a traditional factor in most instances would not align with what was being shared.

Additionally, many of the participants learned fishing through various non-Indigenous and Indigenous individuals. The knowledge that the SON fish harvesters in this study held can be recognized as IEK even though a portion of it was informed by non-Indigenous individuals. For this reason, some could argue that the use of IEK is problematic; however, it is critical to include the Indigenous element for a number of reasons. These include but are not limited to, culture, the effects of assimilation policies, fisheries legislation that restricted Indigenous access and use of the fishery, conflict arising from R. v. Jones (1993), and other historical injustices.

This relationship between the non-Indigenous and SON fish harvesters reinforces the idea of two-eyed seeing and the need to use science and IEK in a respectful and meaningful way. It also reflects the shared history of Indigenous and non-Indigenous peoples as treaty peoples. While one perspective and way of knowing may be sufficient enough for base understanding of socio-ecological processes, it is only through the combination of different perspectives like Western science, non-Indigenous fish harvester ecological knowledge, and IEK that we can truly comprehend these complex systems. Martin (2010, p. 38) explains that “no one perspective is ever be complete and whole” on its own, as systems are complex and the way humans perceive and interact with the world vary. This approach to understanding and co-producing knowledge should be extended to the governance process. It is here that it could make the most direct impact

to the SON community and Nation-to-Nation negotiations. Through two eyes, the concerns and insights from the SON fish harvesters will not be omitted or overlooked.

5.4 IMPLICATIONS FOR FISHERIES GOVERNANCE AND MANAGEMENT

The participants of this study echo the desire and need in the SON to have its members, especially fish harvesters, more appropriately included and considered in fisheries management and governance decisions. The well recognized co-management and collaborative governance processes require collaboration at all stages of the governance process (Symes 2006; Bundy et al. 2008; Jentoft et al. 2010; Song et al. 2013). They also rely on the input and meta-level governance elements from those involved. While there are many successes in the collaboration between the OMNRF and the SON (e.g., research, fisheries assessment, and data sharing), there are still some areas that need to be improved. Chief among them is more adequately incorporating the SON fish harvesters' perspectives and IEK in governance processes. In this regard, the results raise questions about the OMNRF's duties in the Fishing Agreement and the federal governments fiduciary responsibility to protect the SON from encroachment and infringement upon their inherent rights.

R. v. Jones (1993) and previous treaties between the SON and the Crown can be used to make judgements on the OMNRF and federal government's promises to the SON. Other documents like UNDRIP (United Nations General Assembly 2007), the TRCC (2015a), and the Royal Commission on Aboriginal Peoples (Government of Canada 1996) should also be applied. With respect to the OMNRF, they have failed to adequately address fisheries management issues with the SON in the spirit of collaboration and co-management, and as promised in past Fishing Agreements. The omission of the SON's input in decision around stocking represents a serious breach of the current Substantive Fishing Agreement. Like other Indigenous Nations like the

Heiltsuk and the Mi'kmaq, the SON negotiates these multi-year agreements with the province, but these documents do not have constitutional status (Harris and Millerd 2010). While the fishing agreements are not afforded constitutional status, they have to operate within the framework of constitutional rights. The OMNRF is not upholding their responsibility to co-manage the lake with the SON and recognize their constitutional rights to the waters and the fish resources.

With support from the GLFC and various sports fishing associations/clubs (e.g. Ontario Federation of Anglers and Hunters, Sydenham Sportsmen's Association, and the Bruce Peninsula Sportsmen's Association), the OMNRF undertakes the stocking of fish for rehabilitative purposes (e.g. lake trout) and to support Ontario's recreational fishery (OMNRF 2020). Sports associations and clubs also undertake stocking efforts that are commonly funded and supported by the OMNRF, like the Ontario Community Hatchery Program (OCHP) (OCHP 2020). Other objectives for stocking include filling the niches left by extirpated native species and biological control of invasive species (Crawford 2001). These objectives have been decided and acted upon without input from SON and their fish harvesters. For instance, since the beginning of 2020, the Bruce Peninsula Sportsmen's Association (member of the OCHP) has stocked 54,000 fingerlings into Colpoy's Bay, with their most recent effort toward introducing 15,000 chinook salmon on July 15, 2020 (The Bruce Peninsula Press 2020). There was no notification, invitation, or a formal request for permission sent to the SON.

As the primary rights holder to their territorial waters, the SON and their fish harvesters should be represented more appropriately in decisions regarding its stocking. The perspective of the SON and their objection to the stocking of predatory salmonids are long standing and have been identified in numerous publications (Morito 1996; Akiwenzie and Roote 2004; Koenig

2005; Lowitt et al. 2018). These concerns reflect some of the same problems that have plagued the Western science dominated fisheries management regime and Nation-to-Nation relations. Hence the question: Why have the issues involving stocking not been adequately addressed from the perspective of the SON? Negligence to do so is in violation of the multiple iterations of the Fisheries Agreements between the SON, the province, and Canada. It is also a significant breach of the fiduciary responsibilities of the Crown to the SON to protect them from encroachment promised in its treaties (CIIRNAC 2020). Additionally, it infringes upon the rights of the SON and several of the articles in UNDRIP, such as Article 18:

> "Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions" (United Nations General Assembly 2007).

The consideration of the SON's perspective should also extend to other jurisdictions in Lake Huron, especially since the governance and management of the lake is a bi-national and multi-jurisdictional task. Wider recognition of the stance that SON has taken against the stocking of predatory salmonids is important, but the focus should be applied closer to home first. Stocking is as serious an issue today as it has been for the last two decades (Roote and Akiwenzie 2004; Koenig 2005; Lauzon and Ryan 2019; Gobin and Lauzon 2020). The gravity of the situation is significant as livelihoods have changed (e.g. chub harvesting) and continue to change (e.g. lake whitefish harvesting). Still, stocking continues to occur and often in the name of conservation, an issue that has significant political implications that arise from the R. v. Sparrow (1990) ruling. The legislative interpretation of the term conservation is critical and will play a major role in future decisions regarding stocking. This interpretation will vary dependent

on the type of stocked fish (e.g. lake trout and chinook salmon). If stocking can be deemed a conservation effort, then it will supersede the rights of the SON as laid out by R. v. Jones (1993). Still, the OMNRF should be required to formally consult with the SON about the stocking of fish.

If the SON fish harvesters believed their voices are being heard and considered in the governance process, then it is working. But this is not the case. For the governance process to work, significant effort needs to be put into reengaging with the SON and rebuilding that trust. Some participants have stopped going to fisheries related meetings in the community because they do not see it as productive. Actions like formal consultation on stocking and community gatherings that more appropriately elicit and apply the SON fish harvesters' perspectives and insights need to occur. Although there is a co-management agreement between the SON and the OMNRF, it still seems as if they are caught in the same historical governance hierarchy that has caused so many issues in fisheries governance (Figure 17).

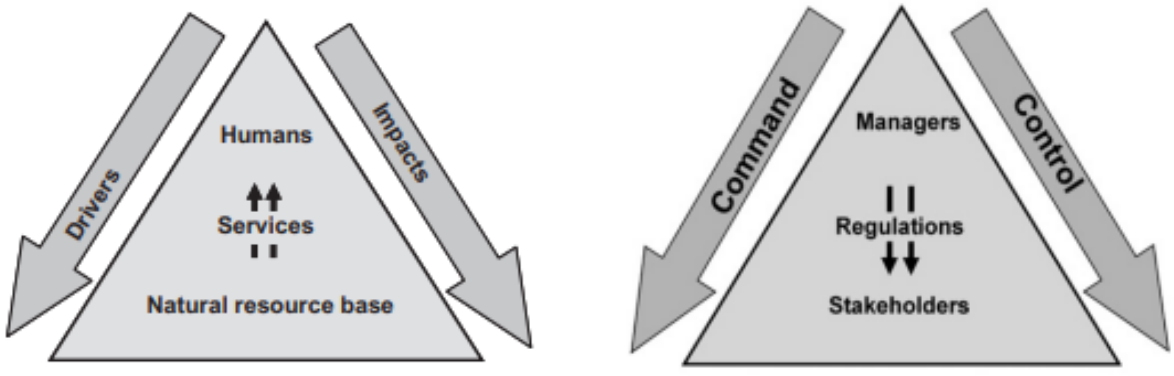


Figure 18. Traditional system to-be-governed (left) and governing system (right) (Jenotft et al. 2010).

Instead, the governance system should more closely resemble the one advocated by Jentoft et al. (2010) (Figure 18) with the addition of First Nations as an additional pedal. This

system is more holistic and accounts for more diverse socio-ecological perspectives and relationships. Similarly, Bundy et al. (2008) advocate for an alternative way to view the system to be governed (Figure 18). Their view places humans at the fulcrum and emphasizes the importance of social justice and good governance. As the fulcrum, humans are recognized as part of the system (environment) and accountable for their actions. Balance is essential to ensure that benefits are derived from the environment in a sustainable manner for generations to come. This view could reflect the sentiments revealed the SON fish harvesters about being connected to nature and working with it rather than controlling it. By embedding humans within nature and identifying the need for more accountability and responsibility, these models will better account for the complexity of socio-ecological systems like fisheries.

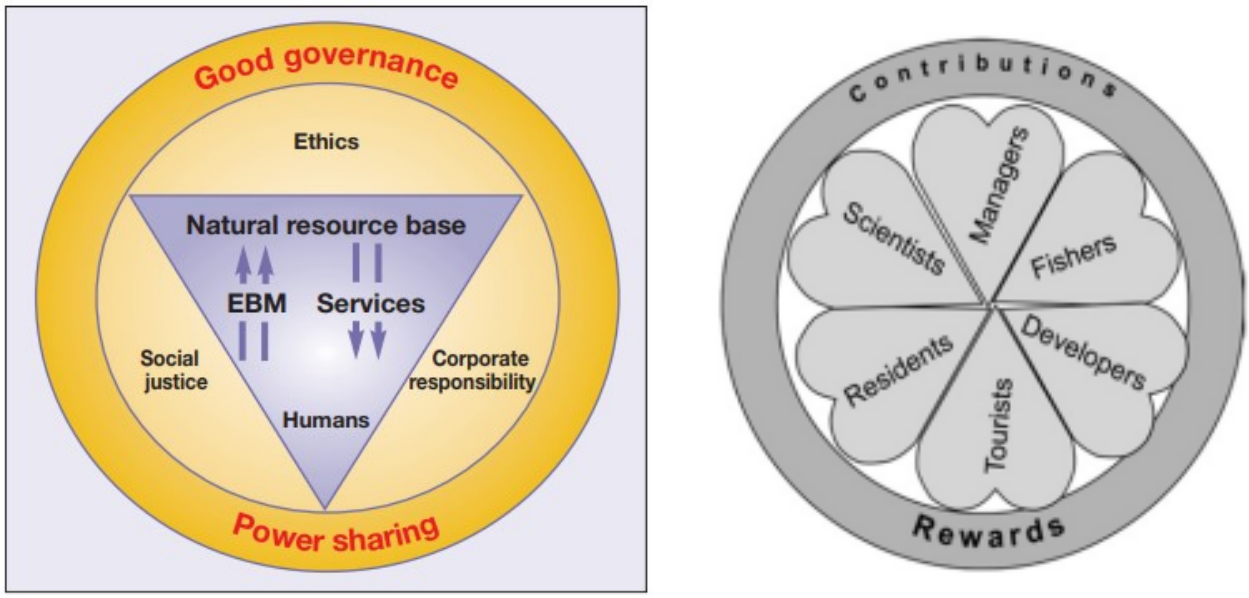


Figure 19. Alternative system-to-be-governed (left) and governing system (right) (Bundy et al. 2008; Jentoft et al. 2010)

Models like these should be applied to the next iteration of the Fishery Agreement. They prove to be more closely aligned with some of the principles and values that the SON and other Indigenous groups hold (Lauzon and Ryan 2019). These include but are not limited to respect,

reciprocity, sharing, and the place of humans in nature rather than separate. They also reinforce the idea that the approach to management needs to be more holistic. Models that challenge the current status quo and IEK have the potential to improve the governance process and more appropriately account for factors and perspectives that are commonly looked over.

CHAPTER 6: OUR FUTURE AS TREATY PEOPLE

The results of this study give an important account of the IEK that some SON fish harvesters hold regarding the ciscoes of Lake Huron. This knowledge provides historical, cultural, and socio-economic context to the relationship that the SON fish harvesters have with the water and this group of fish. It also challenges the current governance process relating to issues of responsibility on behalf of the Ontario and Canadian governments, the inclusion of SON IEK, and the governance hierarchy that places insights from the epistemic community over that of the SON fish harvesters. Embedded within this knowledge were meta-level governance elements that can be applied with a two-eyed seeing approach to inform future decision making.

This study reveals that SON and non-Indigenous histories have been, and remain, intertwined. As treaty people, Indigenous communities aim together and teach each other respect. Through the application of two-eyed seeing, we as treaty people (e.g., the OMNRF, SON membership, and other Canadian citizens) can work together to identify and address issues of governance and socio-ecological systems. This connection was best exemplified by the non-Indigenous commercial fish harvesters who became involved in the SON fishery after R. v. Jones (1993). This example reinforces the notions around collaboration and two-eyed seeing. It sheds light into how our futures together as treaty people should look. To properly govern humankind's relationship with the waters, we need to do it in a unified manner that can identify and address issues in a way that considers perspectives and experiences from fish harvesters and scientists alike. Alternative methods to governing are appealing and will prove to be useful in the future. It is responsibility of the OMNRF and the Canadian government to recognize that the rights of the SON continue to be infringed upon, and that formal consultation on the stocking of fish in

territorial waters needs to occur. Furthermore, the SON and their fish harvesters would like a more active role in the decision making and governance processes around the lake.

The results presented in this study are intriguing and offer many pathways forward for the SON. These include but are not limited to education, future research and monitoring, continued collaboration with project partners, and arguably most importantly, advocacy for their fishery and fish harvesters in academic, legislative, and governance domains. Ciscoes offer numerous opportunities for future inquiry, food security, and collaboration. Similarly, the methodological approach of this research could be applied to other native species of Lake Huron and the connection that the SON or other Indigenous groups have to them. For instance, a research project that focuses on the SON and lake whitefish or lake trout could greatly improve our collective understanding. The DCM will serve an important guiding document for these inquiries and any other possible projects related to the SON fishery and IEK.

Over the past year with help from the larger cisco project, the Fisheries Assessment Program now attends GLFC Lake Huron Technical Committee meetings where we make our voices heard. In the same respect, we are attending academic conferences and sharing our research to wider audiences. These events are critical for the future of the SON fishery and by participating, we can advocate and put pressure on those involved in the governance process to advance it.

Additionally, this research provides insight into the issues with fisheries governance and management in Lake Huron. Fisheries managers, scientists, and decision makers should take heed of the concerns of the SON fish harvesters and actively seek out other alternative perspectives that have not been considered yet. Like for the Atlantic cod fishery, there are significant risks to the native environment that individuals are witnessing on the waters firsthand.

These experiences and insights need to be more appropriately considered. Fortunately, the OMNRF has recently expressed interest in addressing the issue of stocking with the SON; however, there is still much to be done.

Personally, I found the discussions with the SON fish harvesters very insightful and I am grateful I had the opportunity to learn what I did. I also found those discussions alarming. It was difficult to hear them speak of the issues plaguing the governance process because these issues directly effect their quality of life, their connection to their ancestors, and their connection to the waters. Their plight is one that has persisted since European encroachment and continues to this day. Our people have fought hard to retain our fishery and fishing rights so that future generations may prosper. We have come a long way but there is still more to be done. I hope that by conducting work like this, sharing my people's voice, and engaging with wider audiences and arenas, I can start to make a difference. I too am continuing the fight like my family and ancestors before me. I recognize that we are all treaty people and I wish to extend that recognition to all those who the interact with the lake.

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APPENDICES

APPENDIX I
LETTER AND BAND COUNCIL RESOLUTION TO JOINT COUNCIL

BRIEFING NOTE FOR JOINT COUNCIL

DATE: May 24, 2019

SUBJECT: Alexander Duncan master's research request

BACKGROUND:

Alexander Duncan, a Nawash band member, and a master's student at Lakehead University has attached a letter for SON, requesting approval for a thesis research project. The project will focus on the traditional ecological knowledge that SON members possess regarding ciscoes (lake herring and chub) and how that information can be used to inform biological sampling, fisheries management, and governance. This research will be directly related to the initiative already in place by SON to collect traditional ecological knowledge (TEK) and biological data regarding the ciscoes of Lake Huron. As a community-based project, the thesis will follow the First Nation ethical principles of OCAP (ownership, control, access and possession).

Within the last few decades, deep-water ciscoes have experienced a decline in abundance throughout the Great Lakes and a collapse of their deep-water communities. These fish have been culturally and economically important to the people of SON who have harvested, consumed, and traded them since time immemorial. Currently, the scientific knowledge of ciscoes is severely lacking. An investigation into the traditional ecological knowledge that SON members possess could provide intimate and critical insight that can inform future sampling and recovery strategies.

RECOMMENDATIONS:

We, the Joint Chiefs and Councils of the Saugeen Ojibway Nation Territories, do hereby approve the research and data collection request from Alexander Duncan for his proposal to investigate the traditional ecological knowledge that SON members possess regarding ciscoes as described in the attached letter.

May 24, 2019

Dear Chiefs and Councils,

I am writing to seek approval for my master's thesis research project and to create an equitable partnership between the Saugeen Ojibway Nation (SON) and Lakehead University. My name is Alexander Duncan, I am a band member of Nawash, and I am currently undertaking a Master of Science degree at Lakehead University. My research will be directly related to the initiative already in place by SON to collect traditional ecological knowledge (TEK) and biological data regarding the ciscoes (lake herring and chubs) of Lake Huron. Presently, I am employed by SON as a "Cisco Field Researcher" and I am responsible for guiding the initiative to learn more about ciscoes. As part of this position I will be holding interviews with knowledge holders in the community like elders and fish harvesters and using maps to better understand cisco abundance, distribution, and the knowledge that SON has.

To accomplish my thesis, I propose using information collected in my role as a Cisco Field Researcher to inform my master's project. This master's project will be guided by the First Nation principles of OCAP (ownership, control, access and possession) to ensure ethical collaboration. While I will use this information to write my thesis (and possibly academic publications and conferences), all information collected will be held and controlled by SON.

The overarching goal of my thesis project is to understand how local and traditional ecological knowledge can contribute to scientific understanding and inform fisheries governance and management in Lake Huron. An investigation into First Nation knowledge systems like TEK may reveal a deeper understanding and history of these fish compared to conventional Western science which is currently lacking. The rationale behind this research is to increase the understanding of these fish so that SON may monitor their status and develop recovery strategies.

This master's project will be designed to protect anonymity, so that individuals who participate will not be named in any results without their consent. All stages of this research process will be undertaken in equal partnership with SON. When the thesis is complete, a review process will begin with Ryan Lauzon (fisheries biologist), then the Fisheries Joint Council, and the SON Joint Council. The research committee is composed of Dr. Charles Levkoe (Lakehead University) and Dr. Kristen Lowitt (Brandon University) who have previous experience working with SON. Also, on the committee is a mentor of mine, Dr. Brian McLaren (Lakehead University), and Ryan Lauzon. The information generated from this project will be shared in a community event after the thesis is complete. There is also a possibility of academic publications and conference presentations with consent and after review from SON. For more information about the research, please contact Alex at anytime.

Sincerely,

Alexander T. Duncan
t. (226)-668-5221
e. atduncan@lakeheadu.ca

Charles Levkoe (Co-Supervisor)
t. (807)-346-7954
e. clevkoe@lakeheadu.ca

Kristen Lowitt (Co-Supervisor)
e. lowittk@brandonu.ca

Brian McLaren (Committee Member)
e. bmclaren@lakeheadu.ca

Ryan Lauzon
e. nawash.fisheries@gmail.com

APPENDIX II
LAKEHEAD RESEARCH ETHICS BOARD APPROVAL

Research Ethics Board
t: (807) 343-8283
research@lakeheadu.ca

July 18, 2019

Principal Investigator: Dr. Charles Levkoe
Co-Investigator: Kristen Lowitt
Student: Alexander Duncan
Faculty of Health and Behavioural Sciences\Health Sciences
Lakehead University
955 Oliver Road
Thunder Bay, ON P7B 5E1

Dear Dr. Levkoe and research team members:

Re: Romeo File No: 1467253
Granting Agency: SSHRC
Agency Reference #: 1465345

On behalf of the Research Ethics Board, I am pleased to grant ethical approval to your research project titled, "An investigation into the local and traditional knowledge of the Saugeen Ojibway Nation regarding the status of ciscoes in Lake Huron.".

Ethics approval is valid until July 18, 2020. Please submit a Request for Renewal to the Office of Research Services via the Romeo Research Portal by June 18, 2020 if your research involving human participants will continue for longer than one year. A Final Report must be submitted promptly upon completion of the project. Access the Romeo Research Portal by logging into myInfo at:

https://erpwp.lakeheadu.ca/

During the course of the study, any modifications to the protocol or forms must not be initiated without prior written approval from the REB. You must promptly notify the REB of any adverse events that may occur.

Best wishes for a successful research project.

Sincerely,

Dr. Kristin Burnett
Chair, Research Ethics Board

/sm

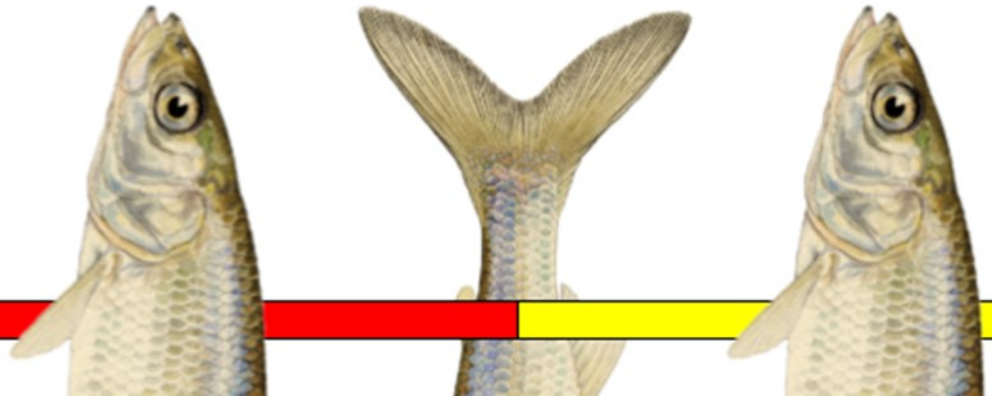
APPENDIX III
COMMUNITY FYLER

July 29, 2019

Lake Herring and Chub Research Project

The Saugeen Ojibway Nation's Fisheries Assessment Programs are conducting a research project in partnership with the Department of Fisheries and Oceans Canada, Parks Canada, University of Toronto, and Lakehead University. This project will involve interviews with knowledge holders within the community about chub and herring. The goal of this research is to address community concerns, to broaden our understanding of the traditional waters, and to better inform monitoring within the traditional waters. Interviews will begin in August and run until September 2019. A portion of this research will also be used to support a Nawash community member's Masters' degree. For more information, please contact:

Alexander Duncan, Cisco Field Researcher
Chippewas of Nawash Unceded First Nation Fisheries Assessment Program
226-668-5221 or atduncan@lakeheadu.ca



APPENDIX IV
LAKEHEAD INFORMATIONAL LETTER

Information Letter

Dear Potential Participant:

Thank you for your interest in this research project titled "An investigation into the local and traditional knowledge of the Saugeen Ojibway Nation regarding the status of ciscoes in Lake Huron." This letter gives some basic information on the research, what you can expect, how the data will be handled and used in the future. If anything is unclear or you want more information, please feel free to ask any question you wish, our contact details are at the end of this document.

What is the project about?

My name is Alexander Duncan and I am a band member of Nawash. Currently, I am working towards my graduate degree at Lakehead University by undertaking a thesis research project sponsored by the Social Sciences and Humanities Research Council of Canada. My goal for this project is to explore the knowledge that the Saugeen Ojibway Nation (SON) has regarding a threatened group of fish, chubs and lake herring, also known as ciscoes. Scientific understanding of these fish is severely lacking, and an investigation into them could contribute some important information that can aid in community understanding, future engagement with the traditional fishery, biological sampling, and protection. This project is directly related to a larger initiative headed by SON to collect knowledge and biological data of ciscoes, which have been traditionally important to SON.

What is being requested of me?

In order to gather information needed for this study, I will be conducting interviews with fish harvesters, elders, and other knowledge holders within the community. The interview is expected to take anywhere from one to two hours. It will consist of mapping and a range of questions dealing with cisco harvesting, abundance, habitat, behaviour, and status. The information that will be shared in the interview session will be audio recorded upon your consent. This knowledge will be used to inform the community, to restore the traditional fishery, and to gain a deeper understanding of these fish. As a participant, you will be asked to attend one or two interview sessions. There is no obligation to participate in this study and you will be free to withdraw at any time without prejudice except for after the point of data submission due to the

anonymous nature of the data. You may decline to answer any question that you do not feel comfortable answering. By participating in this study, you will be compensated a total of $200.00.

The information you provide will be protected, and you as a participant will not be identified in any written publication. Only the members of the research team (see last page) will have access to the interview transcripts, other data, and identifiable materials including audio recordings, hand-written notes, and your consent form. All raw data, audio recordings and typing up of interviews will be encrypted and stored on password protected computers and in locked filing cabinets at Nawash and Lakehead University for up to 10 years and then destroyed for a minimum of 5 years following completion of the research. The final research results will be shared through a variety of methods including community knowledge-sharing workshop as well as in conference presentations. I intend to use the results to complete my Masters' thesis and to publish the results in a reputable academic journal. Summary pages can be requested at any time by contacting the research team directly.

Are there any benefits or risks I should be aware of?

While there are very few perceived risks from participating in this study, we recognize that some questions about fishing locations and past recollections may be sensitive in nature and that you may not want certain information made available to others. We assure you that nothing you say will be attributed to you individually and that your identity will remain anonymous in any research results unless otherwise consented. Your participation is voluntary, and you are only being asked to offer information you feel comfortable sharing. As a participant in this project, you will be able receive a copy of the research results.

This study has been approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team, please contact Sue Wright at the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

I look forward to working with you, building community capacity, and furthering our knowledge of these poorly understood and threatened fish.

Thank you.

APPENDIX V
LAKEHEAD CONSENT FORM

Consent Form

This research an undertaking of the Saugeen Ojibway Nation in partnership with Lakehead University titled "An investigation into the local and traditional knowledge of the Saugeen Ojibway Nation regarding the status of ciscoes in Lake Huron." The purpose is to gain a better understanding of lake herring and chubs (ciscoes) through mapping and holding interviews. The information will be used to promote high quality biological sampling and management of our fisheries within the traditional territory as well as to re-engage with the lake herring and chub fishery. The information will also be used to support a Nawash band member's graduate degree at Lakehead University.

I agree to the following:

1. I have discussed the details of this research project and agree to participate in the research.
2. I understand that the purpose of the research is to address the communities' concerns, to map lake herring and chub distribution, and to gain a better understanding of their behaviour/status in Lake Huron.
3. I understand that my participation in this study will bring minimal risks or harm.
4. I understand that my participation in this study is voluntary and that I may withdraw up until the point of data submission for any reason without penalty.
5. I understand that there is no obligation to answer any questions that I do not feel comfortable answering.
6. Unless explicitly agreed to otherwise, I understand that information I provide will never be attributed to myself individually.
7. I understand that the results of this study may be distributed in academic journals, conference presentations and in other publications and that a summary of the results will be available to participants by contacting Alexander Duncan at 226-668-5221 or atduncan@lakeheadu.ca.
8. I understand that only the interviewers will hear or read the transcript of the recording and it will be stored securely for 5 years.
9. All of my questions have been answered.

YES / NO I wish to give oral consent.

YES / NO I agree to my interview being audio recorded.

YES / NO I wish to remain anonymous.

I am fully aware of the nature and extent of my participation in this project as stated above.

_____ _____

Participant's Signature Date

_____ _____

Interviewer's Signature Date

_____

Home or email address if you would like a summary of the findings

If you have any questions or concerns about this study, please contact Dr. Charles Z Levkoe (clevkoe@lakeheadu.ca; 807-346-7954). If you have questions about your rights as a research participant in general, please contact Sue Wright at the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

APPENDIX VI
INTERVIEW QUESTIONS

SECTION A - ELDERS

PART I (General information)

1) What is your birth year?
2) During what time did you harvest fish?
-Who taught you?
3) Are you familiar with the different types of chubs(bloater) and herring?
- Present identification materials.
- Explain the difference between the historical forms and the present forms. Ask which ones they are most familiar with. Ask if they have noticed a change.
- Ask about any other names that are associated with chubs and herring.
- Record the specific species that they are familiar with for later questions.
4) What memories or stories do you have of fishing chubs and herring growing up?
- When did you start fishing for chubs and herring?
- Was it to feed yourself and your family or was it for trade?
- How often did or do you eat chub and herring?
- How do you prepare chub or herring
- Who taught you how to fish for these fish?
- What are some of the things you learned?
- How important were chubs and herring to you and your family?
5) Do you know of any legends or stories about chubs and herring?

PART II (Mapping)

6) How often would you fish for chub or herring? Together or separately?
- How would you fish for them? (What is the best gear and depth?)
- Did fishing techniques change with the seasons? What seasons
- Record the specific times that they would harvest ciscoes for later questions.
7) Can you point to some places where you would go to harvest chub and herring and what season you would fish there?
- Did fishing techniques or locations change over time and if so indicate approximately when these changes took place?
- Ask them to clarify what depth they would fish at.
- Ask how each location compared to the others (ex. poor, good, excellent).
8) Are you aware of any seasonal movements of the chub and herring?
- Can you indicate the seasonal paths you think chub and herring make?
- Have their movements changed overtime?
9) Are you aware of any spawning locations?
- Can you identify where you think they spawn?
- When would they spawn?
10) Could you indicate where you think other people were fishing for chub and herring?
11) Have you noticed a change in the behaviour or amount of chub and herring over time?

- If they noted a change ask them to provide an explanation

12) Where do you think chub and herring are located now?

PART III (Additional information)

13) Who else do you think would have knowledge of chub and herring that we could interview?
- Make sure they give both first and last names. Repeat the name for clarification.

SECTION B – FISH HARVESTERS

PART I (General information)

1) What is your birth year?

2) How long have you been harvesting fish?
- Commercially and personally.
- Who taught you?
- How did you come to know of chub (bloater) and herring?

3) Are you familiar with the different types of chub and herring?
- Present identification materials.
- Explain the difference between the historical forms and the present forms. Ask which ones they are most familiar with. Ask if they have noticed a change.
- Ask about any other names that they are associated with.
- Record the specific species that they are familiar with for later questions.

4) What memories or stories do you have of fishing chub or herring growing up?
- When did you start fishing for chub and herring?
- Was it to feed yourself and your family or was it for trade?
- Who taught you how to fish for chub and herring?
- What are some of the things you learned?
- How important were the chub and herring to you and your family?

PART II (Mapping)

5) How often do you fish for chub and herring?
- Has this changed over time?
- How do/did you fish for chub and herring? (What is the best gear and depth?)
- Does the way you fish for chub and herring change with the seasons?

6) Can you point to some places where you would go to harvest chub and herring and what season you would fish there?
- Did fishing techniques or locations change over time and if so indicate approximately when these changes took place?
- Ask them to clarify what depth they would fish at.
- Ask how each location compared to the others (ex. poor, good, excellent).

7) Are you aware of any seasonal movements of the chub and herring?
- Can you indicate the seasonal paths you think chub and herring make?
- Have their movements changed overtime?

8) Are you aware of any spawning locations?

- Can you identify where you think they spawn?
- When do they spawn?
- Have their spawning locations changed overtime?

9) Could you indicate where you think other people were/are fishing for chub and herring?

10) Where do you think chub and herring are located now?

PART III (Additional information)

11) Who else do you think would have knowledge of chub and herring that we could interview?
- Make sure they give both first and last names. Repeat the name for clarification.

12) Do you remember a time when chub and or herring were harvested in large numbers?
- Why do you think that has changed?
- Have you noticed a decline?
- If yes, how would you explain such a decline?
- Have you noticed any other changes in behaviour, size, movements etc.

13) Is the future of chub and herring important to you and why?
- How do you think this can be achieved?

14) Do you have any further knowledge you would like to share about chubs and herring?
- Life history (larval, juvenile, development, maturity, spawning, vulnerable life stages), abundance, distribution, signals related to behaviour change, relationships with other species (competition, predator-prey, invasives)
- How did you come by such information?
- Why do you think they are so poorly understood by Western scientists?

15) How do you think we can learn more about these fish?

SECTION C – COMBINED

PART I (General Information)

1) What is your birth year?
2) How long have you been harvesting fish?
- Commercially and personally.
- Who taught you?
- How did you come to know of chub (bloater) and herring?

3) During what time did you harvest fish?
-Who taught you?

4) Are you familiar with the different types of chub and herring?
- Present identification materials.
- Explain the difference between the historical forms and the present forms. Ask which ones they are most familiar with. Ask if they have noticed a change.
- Ask about any other names that they are associated with.
- Record the specific species that they are familiar with for later questions.

5) What memories or stories do you have of fishing chub or herring growing up?
- When did you start fishing for chub and herring?
- Was it to feed yourself and your family or was it for trade?
- Who taught you how to fish for chub and herring?
- What are some of the things you learned?
- How important were the chub and herring to you and your family?
6) Do you know of any legends or stories about chubs and herring?

PART II (Mapping)

7) How often would you fish for chub or herring? Together or separately?
- How would you fish for them? (What is the best gear and depth?)
- Did fishing techniques change with the seasons? What seasons
- Record the specific times that they would harvest ciscoes for later questions.
8) Can you point to some places where you would go to harvest chub and herring and what season you would fish there?
- Did fishing techniques or locations change over time and if so indicate approximately when these changes took place?
- Ask them to clarify what depth they would fish at.
- Ask how each location compared to the others (ex. poor, good, excellent).
9) Are you aware of any seasonal movements of the chub and herring?
- Can you indicate the seasonal paths you think chub and herring make?
- Have their movements changed overtime?
10) Are you aware of any spawning locations?
- Can you identify where you think they spawn?
- When would they spawn?
11) Could you indicate where you think other people were fishing for chub and herring?
12) Where do you think chub and herring are located now?

PART III (Additional Information)

13) Who else do you think would have knowledge of chub and herring that we could interview?
- Make sure they give both first and last names. Repeat the name for clarification. Have you noticed a change in the behaviour or amount of chub and herring over time?
- If they noted a change ask them to provide an explanation
14) Do you remember a time when chub and or herring were harvested in large numbers?
- Why do you think that has changed?
- Have you noticed a decline?
- If yes, how would you explain such a decline?
- Have you noticed any other changes in behaviour, size, movements etc.
15) Is the future of chub and herring important to you and why?
- How do you think this can be achieved?
16) Do you have any further knowledge you would like to share about chubs and herring?
- Life history (larval, juvenile, development, maturity, spawning, vulnerable life stages),

abundance, distribution, signals related to behaviour change, relationships with other species (competition, predator-prey, invasives)

- How did you come by such information?
- Why do you think they are so poorly understood by Western scientists?

17) How do you think we can learn more about these fish?

APPENDIX VII
FORM SPECIFIC CODES FOR MAPPING

BL – Bloater (*C. hoyi*)

CH – Chub (refers to all cisco species excluding the lake herring)

CI – Cisco (refers to all cisco species including the lake herring)

DW – Deepwater cisco (*C. alpenae*)

KI – Kiyi (*C. kiyi*)

LH – Lake herring (*C. artedi*)

LJ – Longjaw cisco (*C. johannae*)

SJ – Shortjaw cisco (*C. zenithicus*)

SN – Shortnose cisco (*C. reighardi*)

APPENDIX VIII
HONORARIUM FORM

PIN: _____

I, _____

agree to the terms set out in the Saugeen Ojibway Nation's policy for honoraria at a rate of $200.00 per interview in the form of a cheque for sharing my knowledge. My signature below indicates that I have received the honorarium for participating.

_____ _____

Participant's Signature Date

_____ _____

Interviewer's Signature Date

APPENDIX IX
MORPHOMETRIC AND MERISTIC DATA FORM

Processing Date:_____ **Species Code:**_____

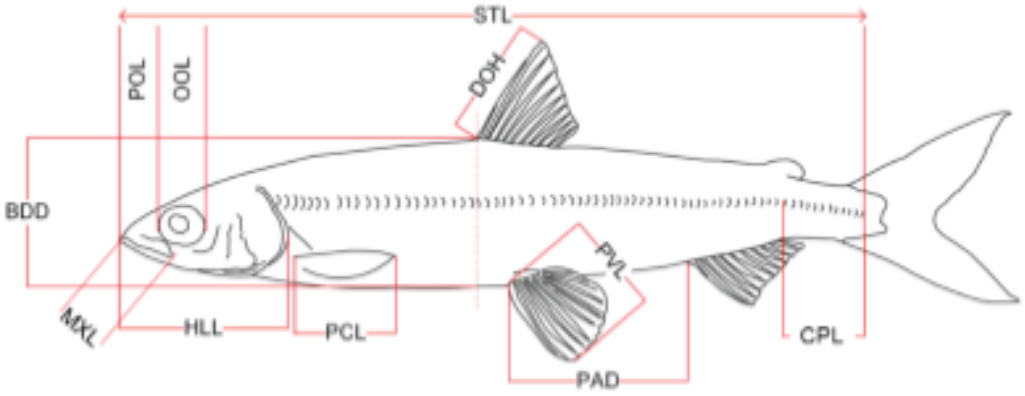
Collector: _____ **Collection Date:**_____

FishID:_____ **Collection Site:** _____

Other identifiable information:_____

Image captured? ☐

Measured by:	*Count by:*
Total length (TTL):	Total gill raker count (TGR):
Standard Length (STL):	
Preorbital length (POL):	
Orbital length (OOL):	Sex: M or F
Dorsal height (DOH):	Wet weight: _____g
Head length (HLL):	Maturity: Immature or Mature
Body depth (BDD): Bloated? ☐	Otolith taken: Yes or No
Maxillary length (MXL):	Genetic tissue: Yes or No
Pectoral fin length (PCL):	Isotopic tissue: Yes or No
Pelvic fin length (PVL):	Stomach removed: Yes or No
Pelvic anal distance (PAD):	
Caudal peduncle length (CPL):	



Comments:

APPENDIX X
SAMPLING FLYER

November 1, 2019

Lake Herring and Chub Research Project

The Saugeen Ojibway Nation's Fisheries Assessment Programs are looking for fish harvesters interested in helping to sample for chub this fall/winter. Sample sites have been chosen from interviews held in the last few months. We will provide nets for sampling and fair reimbursement for participants. If you are interested please contact Alex Duncan (226-668-5221) or Ryan Lauzon (519-375-1012) **before November 18th** for more details and to set up some possible dates. There will also be opportunities to sample for chub in the spring of 2020.

The goal of this project is to understand the status of lake herring and chub in Lake Huron. We appreciate your help and interest.

Miigwetch,

Alexander Duncan