

**Indigenous Partnership and Two-Eyed Seeing in Sea Lamprey Management:
Lessons Learned from the Denny's Dam Rehabilitation with the Saugeen Ojibway Nation**

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Abstract

Bridging knowledge systems is a potential means of equitably and collaboratively working towards shared goals in aquatic ecosystems, such as the management of invasive species. Invasive species pose a significant threat to aquatic ecosystems, and one example of an invasive species with an established control program are sea lamprey (*Petromyzon marinus*) within the Laurentian Great Lakes. Sea lamprey management faces many challenges including climate change and the apparent declining social acceptance of control programs, especially amongst Indigenous communities in the region. Such challenges illustrate the need for sea lamprey management to better engage Indigenous Nations and knowledge systems. Etuaptmumk (Two-Eyed Seeing) is a Mi'kmaw concept that can facilitate knowledge bridging as it enables Indigenous and Western knowledge systems to work together in parallel on a shared issue. This thesis research uses social science and Indigenous methodologies to understand the Denny's Dam rehabilitation (sea lamprey barrier) as a case study for relationship-building and knowledge coexistence between Indigenous and non-Indigenous parties in sea lamprey control. Virtual semi-structured interviews (n = 14) were conducted with key decision-makers and others involved in the Denny's Dam rehabilitation. Results illustrated why and how a knowledge coexistence approach (e.g. Two-Eyed Seeing) could bridge knowledge systems to inform a shared decision-making process. Moreover, findings outline four main factors needed for relationship-building. This study provides practical guidance for practitioners and addresses a gap in the literature concerning Indigenous engagement in sea lamprey management and knowledge coexistence/Two-Eyed Seeing in aquatic invasive species management.

Key words: sea lamprey, Two-Eyed Seeing, Indigenous partnership, sea lamprey control, sea lamprey management, knowledge coexistence

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Positionality Statement

As a white Canadian graduate student with a settler-European background, I (Charity Nonkes) come to this work with a set of biases and relationships shaped by settler colonialism. This research was conducted virtually within the Territory of the Haudenosaunee, Anishnawbe, and Neutral/Attawandaron Peoples and on the Haldimand Tract – land promised to the Six Nations running six miles on either side of the Grand River. As well, this research was conducted within and about Saugeen Ojibway Nation (SON) Territory. I grew up within SON Territory and have spent countless hours in Lake Huron and its tributaries. Through the processes of settler colonialism, dispossession, and oppression, Indigenous Peoples were driven from their lands and waters, leading to myself and my ancestors occupying this area throughout Southwestern Ontario and beyond. It is with this reality I come to this research and as I seek to play a part in reconciliation efforts with the SON and other Indigenous Peoples of Turtle Island.

I am indebted to the Indigenous thinkers and researchers who have introduced me to Two-Eyed Seeing and Indigenous research methodologies, which continually challenge me to reflect on how my privilege and Euro-centric background impacts my approach to this research. I conducted this research of the Denny's Dam rehabilitation in connection with a larger research project entitled Sea Lamprey Research & Management - Indigenous Input & Inclusion (3I Project), which looks at Indigenous perspectives and experience with sea lamprey and sea lamprey control across the Great Lakes Basin.

It is with this set of experiences that I welcome the reader to this thesis with the acknowledgement that this research is shaped by my perspective and interpreted from my point of view.

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1. Introduction

Sea lamprey (*Petromyzon marinus*, bimiizii or ginebigomeg in Anishinaabemowin) are an aquatic invasive species in the Laurentian Great Lakes (hereafter the Great Lakes) that have caused significant ecological and economic damage over the past century (reviewed in Brant, 2019). Due to the scale of impacts, sea lamprey control has been a major priority for the governments of Canada and the United States (U.S.) and a major reason why the bilateral Great Lakes Fishery Commission (GLFC) was founded as per the Convention on Great Lakes Fisheries (1954) treaty (Gaden et al., 2021b). The sea lamprey control management system has been operating and undertaking research for more than 70 years and has demonstrated success in reducing sea lamprey population size by 90% from peak population (Brant, 2019). However, various methods of control are under scrutiny due to issues posed by climate change, shifts in social acceptance, and the growing recognition of Indigenous rights exemplified by the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (United Nations General Assembly, 2007). Sea lamprey control programs occur within (and across) Indigenous territories amongst the Great Lakes basin, but not all Indigenous Nations, fishery leaders, and organizations are meaningfully involved in these programs - especially in the current Canadian context (Gaden et al., 2021a; Steeves & Barber, 2020). Exclusion from sea lamprey control (and fisheries management at large) decision-making spaces may contribute to diminishing support and social acceptance of sea lamprey control methods amongst some Indigenous communities (Gaden et al., 2021a). A re-assessment and re-envisioning of sea lamprey management may be needed to ensure the program's viability and acceptability in the future while embracing opportunities for program enhancement.

The challenges facing sea lamprey management are a microcosm of broader social and ecological issues in the Great Lakes, and perhaps beyond. The sustainability of the Great Lakes for present and future generations depends on a reimagining of fisheries management that bridges knowledge systems and upholds Indigenous communities' relationships, rights, and responsibilities to

their lands and waters (Tribes and First Nations of the Great Lakes Basin, 2004). This thesis will argue that a framework for bridging knowledge systems in fisheries management – including sea lamprey control – is offered by Two-Eyed Seeing. Two-Eyed Seeing (Etuaptmumk in Mi'kmaq) is a concept carried by Mi'kmaw Elder Dr. Albert Marshall, and is defined as, "learning to see from one eye with the strengths of Indigenous Knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing, and to use both these eyes together, for the benefit of all" (Bartlett et al., 2012, p. 335). In this framework, knowledges are not combined, integrated, or tested against one another. Instead, different perspectives are brought together in parallel, while remaining distinct, for consideration in decision-making and advancing understanding. Two-Eyed Seeing imparts a responsibility on participants to not only listen but take action (Reid et al., 2021). This teaching can ultimately be a tool for the GLFC, government partners, and others to re-envision their relationships with Indigenous Peoples and communities and address some of the most pressing social and ecological issues in the Great Lakes.

There is a need for Two-Eyed Seeing in invasive species management and recognition of Indigenous leadership in this domain. As one of the most extensive and longstanding invasive species management programs on the planet, the sea lamprey control program should set an example by adopting principles of Two-Eyed Seeing and knowledge coexistence to create more adaptive and inclusive solutions. This is especially crucial in light of the historical and continued exclusion of some Indigenous groups and knowledge systems in decision-making, and Indigenous opposition to control methods. As well, academic literature focusing on Indigenous partnership in sea lamprey management in the Great Lakes is severely lacking. More generally there is a lack of academic literature recognizing Indigenous agency in invasive species management in North America. There is an assortment of academic literature on Two-Eyed Seeing in resource management but virtually no literature on the application of Two-Eyed Seeing to aquatic invasive species management. There is a need for more in-

depth and directed research into Two-Eyed Seeing and Indigenous partnerships in sea lamprey management in the Great Lakes; this effort is but one first step in this direction. The GLFC and US and Canadian federal, provincial, and state governments have varying degrees of experience in partnering with Indigenous Nations in sea lamprey management and need to work together to equitably engage Indigenous Nations impacted by sea lamprey management. In this research, a case study of a sea lamprey control barrier in the Saugeen River, Ontario, is analyzed to provide guidance for future movement towards a more holistic sea lamprey management system centered on relationship-building, knowledge coexistence, and Two-Eyed Seeing.

This thesis research, *Indigenous Partnership and Two-Eyed Seeing in Sea Lamprey Management: Lessons learned from the Denny's Dam rehabilitation with the Saugeen Ojibway Nation*, will begin to fill a gap in the academic literature on Indigenous partnership in sea lamprey management and more widely address the emerging topic of knowledge coexistence (i.e., Western and Indigenous ways of knowing) in invasive species management and Great Lakes fisheries management. This research was co-produced with the Saugeen Ojibway Nation (SON) and is a case study of the Denny's Dam rehabilitation. The SON are Anishnaabe (Indigenous cultural group, traditionally in the Great Lakes region) and comprised of two First Nations: the Chippewas of Saugeen First Nation and the Chippewas of Nawash Unceded First Nation. Denny's Dam lays across the Saugeen River between the Chippewas of Saugeen First Nation and the community of Southampton, Ontario – all of which is within the traditional territory of the SON.

Denny's Dam served as a sea lamprey barrier but fell into disrepair leading to safety concerns. In the mid to late 2000's the process of rehabilitating Denny's Dam began with conflict as SON was excluded from meaningful involvement in the process, and SON's knowledge and perspective was not given equal consideration. However, the eventual rehabilitation of Denny's Dam in 2018 became possible after the development of a process of knowledge coexistence, respect, and partnership

between SON and the GLFC. This case study provides key lessons on the process of building and maintaining good relationships among Indigenous and non-Indigenous organizations and governments to inform future sea lamprey management and other fisheries and invasive species projects. While the Denny's Dam rehabilitation did not explicitly follow a Two-Eyed Seeing framework, the process and results implicitly reflect the key aspects of that framework. Thus, a Two-Eyed Seeing framework will be used to understand the Denny's Dam rehabilitation process as it happened, and the findings will be used to further understand the potential of Two-Eyed Seeing in sea lamprey management.

The sustainability of the Great Lakes for present and future generations depends on the re-envisioning of fisheries management and the upholding of Indigenous communities' relationships, rights, and responsibilities to the lands and waters (Great Lakes Commons, 2014; TVO, 2016). This study analyzes the Denny's Dam rehabilitation (DDR) through interviews with key decision-makers to understand the opportunities and challenges for transforming Great Lakes fisheries management relationships from exclusion, mistrust, and knowledge extraction into relationships of respect, reciprocity, and equality. The significance of this research lies in its ability to support an action-based framework for Two-Eyed Seeing and knowledge coexistence in sea lamprey management for academic literature and practical use. By conducting research on the relational aspects and process of rehabilitating Denny's Dam, SON can create a framework based on their own experiences and perspectives towards building partnerships in invasive species and fisheries management. This can further inform work in Two-Eyed Seeing in other projects and be used by other Indigenous Nations in similar contexts. As well, this research will provide academic analysis of government-Indigenous partnership and knowledge coexistence in sea lamprey and fisheries management in the Great Lakes.

More widely, this research can serve both Indigenous Nations and federal/provincial governments and agencies to inform engagement in Great Lakes fisheries management while adhering to the rights of Indigenous Peoples as enshrined by the United Nations Declaration on the Rights of

Indigenous Peoples (UNDRIP). Studying the DDR is one step to better understanding how to build meaningful relationships and apply a knowledge coexistence approach to sea lamprey management. These lessons can extend beyond sea lamprey management and help create an environment in which Indigenous Knowledge systems and Western Science can coexist in fisheries management as this is paramount for future work in the Great Lakes.

In the spirit of Two-Eyed Seeing, the use and meaning of the term ‘management’ is approached with a critical lens in this thesis, as it reflects a Western paradigm without an equivalent in many Indigenous contexts. For instance, within the Anishinaabe language (Anishinaabemowin) there is no direct translation of the word ‘management’ (Lauzon & Ryan, 2019). Therefore, the terms ‘fisheries management’, ‘sea lamprey management’, and ‘sea lamprey control’ are incongruous with an Anishinaabe worldview – specifically with respect to spiritual connections and human-environment reciprocity, relationship, and responsibility (Vernon Roote, personal communication, May 26, 2021). Words such as ‘understanding’, ‘stewardship’, ‘responsibility’, ‘relationship’, ‘care-taking’, and ‘decision-making’ better reflect aspects of such worldviews, but none alone fully encompass them. For the purposes of this thesis, the term ‘stewardship’ will henceforth replace the term ‘management’ when referring to fisheries or sea lamprey management (e.g. fisheries stewardship, sea lamprey stewardship). The term ‘stewardship’ also carries its own connotations related to ‘ownership’ over the planet, enforcement of a hierarchy with humans above all other species, and religious understandings of humans borrowing the earth and being held accountable by God (Worrell & Appleby, 2000; Foster, 2005). However, there is no ‘right’ term in English that fully reflects the relationship and responsibilities between humans, other beings, and the environment. Similarly, the term ‘control’ also carries its own connotations of human superiority and dominion; therefore, its use is limited and mainly used when referring to ‘control methods’ or for clarity reasons.

1.1 Research Questions

The research presented in this thesis was guided by three main research questions:

1.1.1 What are the lessons learned regarding the relational aspects of the Denny's Dam rehabilitation project process between the SON and GLFC, Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF), and the Department of Fisheries and Oceans Canada (DFO)?

1.1.2 How can the process that resulted in successfully rehabilitating Denny's Dam inform equitable partnerships and knowledge coexistence (between Western Science and Indigenous Knowledge) in future sea lamprey, other invasive species, and fisheries stewardship projects in the Great Lakes Basin?

1.1.3 What aspects of the Denny's Dam rehabilitation process represent a Two-Eyed Seeing approach and how can these be applied to Two-Eyed Seeing in sea lamprey stewardship in the Great Lakes more broadly?

1.2 Research Objectives

This research seeks to complete the following objectives:

1.2.1 Understand factors, practices, and actions by individuals and institutions from SON, GLFC, DFO and NDMNRF that contributed to collaboration and/or acted as barriers to partnership between the Indigenous and non-Indigenous parties during the Denny's Dam rehabilitation.

1.2.2 Assess the use of Two-Eyed Seeing's core principles in the Denny's Dam rehabilitation and the challenges and successes for knowledge coexistence in the project.

1.2.3 Inform future partnerships and Two-Eyed Seeing between Indigenous and non-Indigenous groups in sea lamprey, other invasive species, and fisheries stewardship projects in the Great Lakes Basin.

2. Literature Review

Collaborative governance is often suggested as a mechanism to address complex issues where multiple actors can work together to make decisions and create solutions; this is often used for environmental issues. However, within collaborative environmental governance there are nuances and inherent rights that come into play when working with Indigenous Nations; thus, it is unacceptable for Indigenous Nations to be treated as mere stakeholders (von der Porten & de Loë, 2013). Subsequently, the SON, for example, prefers to be referred to as a rightsholder. As well, there are considerations that need to be made when bridging diverse knowledge systems together to understand and address environmental problems (Tengö et al., 2014). Two-Eyed Seeing is a tool that respectfully bridges knowledge systems and pairs Indigenous Knowledges and Western scientific knowledges for mutual understanding and equitable partnerships that generate actions to resolve prolonged fisheries stewardship issues (Reid et al., 2021). For example, the Great Lakes fishery, and by extension the sea lamprey stewardship system, operates on a collaborative environmental governance basis that often works with Indigenous Nations and on Indigenous Territory. The sea lamprey control program faces many challenges such as climate change and wavering social acceptance and could benefit from implementing a Two-Eyed Seeing framework.

The following literature review first explains collaborative environmental governance which is followed by a discussion of Indigenous participation in collaborative environmental governance. Then a brief overview of sea lamprey control and Indigenous involvement in sea lamprey stewardship is provided which bridges into the challenges that the sea lamprey stewardship program is facing. Lastly, knowledge coexistence and Two-Eyed Seeing are discussed. This literature review largely focuses on a Western science perspective within the academic literature with limited inclusion of Indigenous knowledge and perspective.

2.1 Collaborative Environmental Governance

Ansell and Gash (2007, p. 544) define collaborative governance as, “a governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets.” This definition centers governmental actions and actors but ignores collaboratives that do not include governmental agencies. Emerson et al. (2012, p. 2) highlight this gap and provide a broader definition: “the processes and structures of public policy decision making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished.” At the heart of both these definitions is the bringing together of diverse groups to collectively make decisions.

Ansell & Gash (2007) created a framework to understand collaborative governance and identify variables to determine effectiveness (Figure 1). These variables include: prior history of conflict/cooperation, incentives to participate, power/resource imbalances, facilitative leadership, and institutional design. These variables set the conditions for a collaborative process which is non-linear and cyclical where feedback from early collaboration impacts later collaboration. The stages of collaborative governance were simplified and identified as face-to-face dialogue, trust building, commitment to process, shared understanding, and intermediate outcomes. The promise of collaborative governance is great, but the right conditions need to be in place in order to expect to achieve the desired outcomes (Ansell & Gash, 2007). The framework seeks to help practitioners determine the key challenges and limitations of collaborative governance in their situations. In this way the framework serves as a contingency theory that organizes “a series of contingent propositions and cause-and-effect relationships” that can be used to determine the potential effectiveness of collaborative governance (Ansell & Gash, 2007, p. 562).

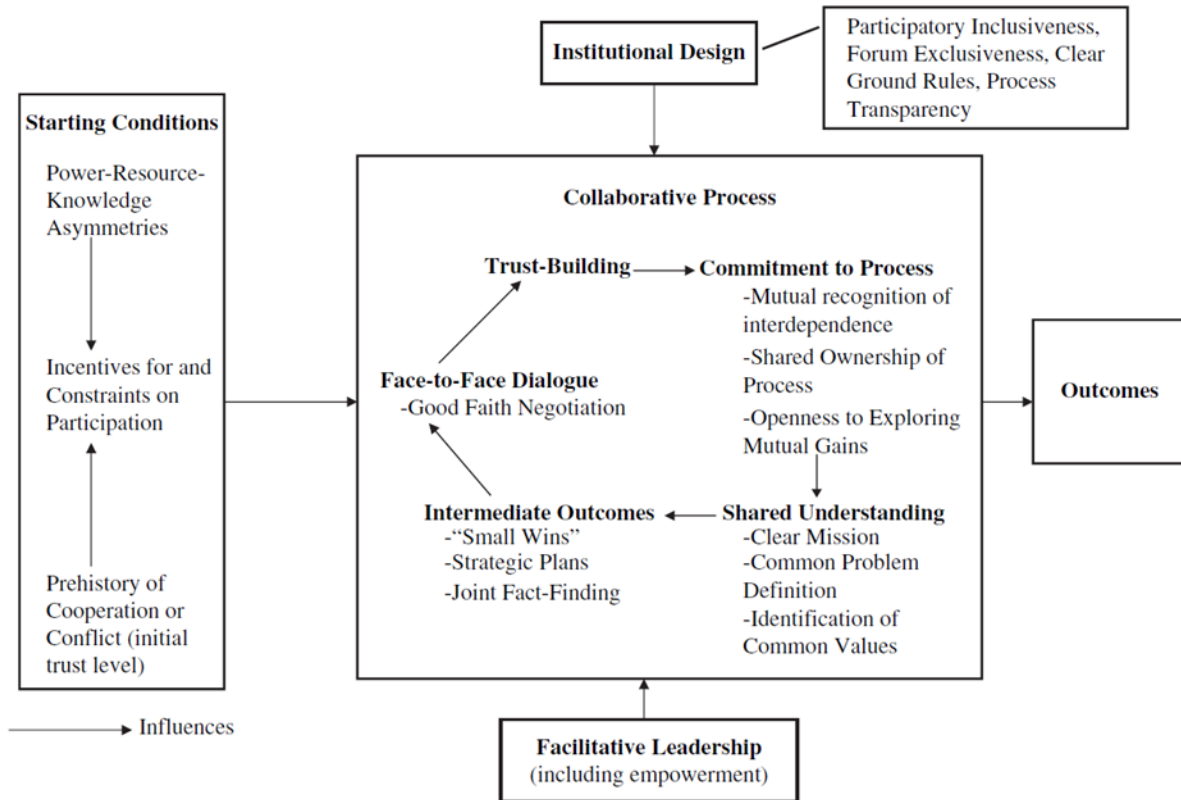


Figure 1. A model of collaborative governance (Ansell & Gash, 2007)

Emerson et al. (2012) also made a framework for collaborative governance (see Appendix C). They highlight the role of 'knowledge' in collaborative governance unlike Ansell & Gash. In collaborative governance, knowledge is generated together to address information needs and once private knowledge is shared during the process. Emerson et al., (2012, p. 16) state, "In essence, collaboration requires the aggregation, separation, and reassembly of data and information, as well as the generation of new, shared knowledge." They call knowledge the 'currency of collaboration'. Collaboratives facilitate social learning which allows diverse knowledge exchange and diffusion that can help to understand and create innovative solutions to complex environmental problems (Bodin, 2017).

As well, Emerson et al., (2012) illustrate the importance of the redistribution of resources for all parties to work together to achieve the common goals. These resources could include funding, technical/logistical support, expertise, or administrative and organizational assistance. Likewise, Bodin

(2017) states collaboratives seeking to address long-term problems need to have the proper resources and funding over time to address it. Emerson et al., (2017) also builds in dispute resolution processes within the framework through principled engagement; thus the framework creates a safe space where conflict can be addressed throughout the process. Whereas Ansell & Gash (2007) suggest facilitative leadership as a tool for mediating conflict or disputes during a collaborative governance process.

Collaborative environmental governance faces the same opportunities and challenges as other collaborative governance frameworks, but there are several unique challenges it confronts. Bodin (2017) explains collaborative environmental governance is often not the right course of action to address environmental problems when the biophysical system does not align with the proposed collaborative governance systems and the actors involved. As well, the temporal nature of the environmental problem may pose issues to the potential of a collaboration process. Issues that need a rapid response would benefit from a collaborative ad hoc network with a more-centralized operation where specific actors distribute tasks (such as in the stewardship of the *Spartina* invasive species in the San Francisco Bay) (Bodin, 2017; Lubell et al., 2017). This helps with coordination and addressing the problem in a timely manner whereas other collaborative environmental governance methods may be too time-consuming to come to consensus.

An example of collaborative environmental governance can be found in the Great Lakes fishery. In this example, collaborative environmental governance is maintained between and amongst government and non-government groups and uses both top-down and bottom-up approaches (Gaden et al., 2021b). This involves many organizations with management authority in the Great Lakes including Canadian and American federal departments, eight states, the province of Ontario, and a few Indigenous Nations/organizations. There are four kinds of management processes that occur in the Great Lakes fishery, each one moving toward stronger stakeholder empowerment: (1) interjurisdictional cooperation; (2) collaborative management; (3) decentralization; and (4) co-management (Gaden et al.,

2012b). However, unlike with Tribes in the U.S., First Nations in Canada do not have the same court affirmed management authority. In the U.S., intertribal organizations began exercising management authority in the 1980s, as affirmed by the 1979 *U.S. v. Michigan* court decision which asserted tribal management authority in Lakes Superior, Michigan, and Huron (see Gaden et al., 2012). However, courts in Canada ruled (*R. v. Sparrow* 1990) that federal and provincial management do not deny First Nation access to fish; therefore, federal and provincial governments can manage fisheries on behalf of First Nations (many First Nations disagree with this) given there is proper consultation and no infringement on First Nation fishing rights (see Gaden et al., 2012). Because of this, co-management does not occur to the same degree between First Nation and provincial/federal governments as it does with Tribes in the U.S. within the Great Lakes fisheries (Gaden et al., 2021b).

These rulings influence the level of involvement Tribes in the U.S. and First Nations in Canada have in decisions concerning fisheries stewardship in the Great Lakes and within the GLFC. It should be noted that the SON has had a series of commercial fisheries agreements with the Ontario government since 2000 that demonstrate SON jurisdiction and co-management of the fishery within their Traditional Territory (which covers a large portion of Lake Huron and Georgian Bay) (Morencie, 2013; Substantive Commercial Fishing Agreement, 2011); yet they are not recognized the same way nor share the same level of decision-making power at the GLFC as some Tribal organizations. This example highlights some of the complexities and issues surrounding proper engagement with Indigenous Nations in the Great Lakes fishery and more widely in collaborative environmental governance.

2.2 Indigenous Participation in Collaborative Environmental Governance

Much of the literature about collaborative environmental governance focuses on the conditions and factors needed in order for it to be effective, yet little attention is given to how specific groups are approached and how that may impact collaboration. Particularly, the role of Indigenous Peoples in

collaborative environmental governance literature and practice is often diminished to “just another stakeholder group”, rather than self-determining nations with inherent rights to make decisions within their traditional territories, which pre-date European settlement and institutions in the area (von der Porten et al., 2015). As well, considerations for free, prior, and informed consent and UNDRIP are not often discussed in the literature, nor is the need for Indigenous Knowledge and perspectives to make more informed decisions. Given the range of Indigenous Territories in North America (and beyond) and the environmental challenges these areas are experiencing, Indigenous Peoples need to be a part of the collaborative environmental governance systems that are being implemented. In doing so, they should be approached in ways that recognize their inherent rights to make decisions concerning these issues. For example, the environmental governance frameworks discussed above (Ansell & Gash, 2007; Emerson et al., 2012) do not mention the dynamics of working with Indigenous Nations (e.g. Indigenous rights, ceremony, or cultural protocols).

Von der Porten & de Loë (2014) conducted a systematic review of collaborative environmental governance literature published between 2003 and 2012 that mentions Indigenous Peoples and found that the majority (52 out of 82 articles) did not acknowledge any concepts of Indigenous governance/self-determination, since Indigenous Peoples were mostly identified as stakeholders, groups, or participants in the collaborative process. Inclusion of Indigenous Peoples in collaboratives was seen as optional and based on utilitarian reasons (for example their knowledge would be useful in decision-making) and seeing them as stakeholders to be empowered. This was echoed in case studies of collaborative water governance that included Indigenous Peoples in British Columbia; in most cases Indigenous Nations were treated as just another stakeholder or minority group (von der Porten & de Loë, 2013). It should be noted that many Indigenous Peoples find the term ‘stakeholder’ offensive as it refers to the process by which settlers divided up and took Indigenous lands.

As well, Von der Porten & de Loë's (2014) case studies showed that many non-Indigenous actors make false assumptions about Indigenous Peoples and water governance, lacked understanding of Indigenous concerns and history, and had inappropriate approaches and motivations for engaging First Nations which made collaboration difficult. Examples of this includes engaging with First Nations only because of legal requirements to do so, using a town hall to meet with multiple First Nations rather than meeting with them individually, and approaching First Nations with already established plans seeking approval without an opportunity for the First Nation to make their own goals or be a part of the planning. There is a need to meaningfully collaborate with Indigenous Nations in a way that moves beyond a check-box process of consultation to foster relationships and recognition for Indigenous governance systems (von der Porten & de loë, 2013). It is essential for an environmental governance process to be culturally appropriated and practice Indigenous ways of participation and decision-making (Bullock et al., 2020). Bullock et al., (2020) explains this may mean creating new spaces that embody Indigenous cultural protocols and traditional values. This is what Ermine (2007) describes as creating an "ethical space" (to be discussed later) (Bullock et al., 2020).

Bullock et al., (2020) similarly assess case studies of Indigenous participation in collaborative environmental governance in Canadian Model Forests and bring up questions about self-determination and whether these models support self-determination or entrench colonialism. It is essential for environmental governance processes to think about these things and how their organization may further colonization and diminish Indigenous self-determination. Merely involving Indigenous Nations in advisory roles works to build relationships, but without decision-making power, ultimately leads to a 'dead-end.' As well, engagement with Indigenous Nations needs to be well-thought out and made worth the time and effort of the Indigenous Nations. This includes consideration for a community's capacity and not overburdening people by the process (Bullock et al., 2020; Hunt, 2013). This consideration for a community's capacity can also serve greater purposes, "when resources are directed toward developing

greater structures that can serve more than one purpose, it can be argued that capacity then begets capacity. Capacity building is both a process and a product of collaboration” (Bullock et al., 2020, p. 12).

Von der Porten et al., (2015) offers six recommendations for collaborative environmental governance with Indigenous Peoples: (1) approaching Indigenous People as self-determining Nations rather than a stakeholder; (2) engage with Indigenous Nations’ existing environmental governance processes; (3) create opportunities for relationship building; (4) use Indigenous venues and processes for decision-making; (5) provide funding and capacity to Indigenous Nations to level the playing field; and, (6) support Indigenous Nations’ environmental decision making and self-determination. These actions can help to address the legacies of colonization in many collaborative environmental governance regimes and recognize Indigenous nationhood.

While these recommendations and the discussion above offers insights into how to engage, approach, and work with Indigenous Nations in collaborative environmental governance, there remains questions on how to engage with Indigenous Knowledge systems and ways of knowing in collaborative environmental governance. There is increasing recognition for the importance of Indigenous Knowledge in resource stewardship (Berkes, 2018; Ogar et al., 2020) as well as in fisheries stewardship (Reid et al., 2021). This comes at the precipice of global climate change and astounding shifts in socio-ecological systems (Ogar et al., 2020).

Indigenous Knowledge, often also referred to as Traditional Ecological Knowledge (TEK), from a non-Indigenous viewpoint has been defined as “a cumulative body of knowledge, practices, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment” (Berkes, 2018, p. 8). Deborah McGregor, an Anishinaabe scholar, explains, “Aboriginal understandings of TEK tend to focus on relationships between knowledge, people, and all of Creation (the "natural" world

as well as the spiritual)” (McGregor, 2002, p. 8). TEK is understood as a verb – a process of participating in relationships with Creation – “TEK is something one does” (McGregor, 2002, p. 8). McGregor goes on to say TEK cannot be acquired or learned without experience; therefore, for TEK to be used in environmental stewardship it must come from and involve Indigenous Knowledge holders (McGregor, 2002). There are many examples across the world that demonstrate the possibilities of bridging Indigenous Knowledge with scientific advances to address difficult environmental challenges (Ogar et al., 2020). However, there is still much skepticism from the scientific community concerning the validity of Indigenous stewardship systems, and likewise skepticism from Indigenous communities concerning scientific experts and practices (Berkes, 2018).

There are many challenges and opportunities with engaging different knowledge systems in collaborative environmental governance. These considerations for different knowledge systems and relationship-building with Indigenous Nations also applies to the sub-section of invasive species stewardship, and in particular sea lamprey control, in the Laurentian Great Lakes.

2.2.1 Sea Lamprey Control and Indigenous Involvement in Sea Lamprey Stewardship

Sea lamprey are a parasitic invasive fish in the Laurentian Great Lakes. There was a steady increase of sea lamprey in the Great Lakes throughout the first half of the 20th century that led to a full invasion by the 1940s and 1950s. This, along with overfishing and other factors, led to the decimation of the Great Lakes’ fisheries during this time – particularly lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupeaformis*) (Brant, 2019; Fetterolf Jr, 1980; Gaden et al., 2012; Hudson & Ziegler, 2014; Siefkes et al., 2012). In response to calls for uniform fishery regulations and a coordinated response to the growing sea lamprey issue the *Convention on Great Lakes Fisheries* was created and signed by Canada and the United States in 1954, which established the GLFC in 1955 (Brant, 2019; Christie & Goddard, 2003; Gaden et al., 2012; Miehl et al., 2020). The GLFC has since coordinated a bi-

national, inter-state-provincial-tribal approach to sea lamprey stewardship which stands as one of the most successful and longstanding aquatic invasive species control efforts in the world (Brant, 2019).

Between the 1940s and 1960s, several sea lamprey control methods were put in place, including mechanical weirs, traps, barriers, and lampricides. These lampricides included TFM (3-trifluoromethyl-4-nitrophenol) starting in 1957 and Bayluscide (2', 5-dichloro-4'-nitrosalicylanilide) in 1963 (Applegate and Smith 1951 as seen in Miehl et al., 2020; Brant, 2019; Siefkes et al., 2012; Smith & Tibbles, 1980). With the advent of lampricides, the populations of sea lamprey have been reduced by 90% from peak levels throughout the Great Lakes by the 1980s (Christie & Goddard, 2003; Cornelius et al., 1995; Pearce et al., 1980; Siefkes et al., 2012; Smith & Tibbles, 1980). Due to their success and effectiveness at reducing sea lamprey populations, lampricides are now the primary sea lamprey control method employed by the GLFC (McDonald & Kolar, 2007). However, due to the high costs and public perceptions of pesticides, barriers were often used as an alternative to lampricides from the late 1960s onwards (Christie & Goddard, 2003; Lavis et al., 2003).

Indigenous involvement and voices were excluded from deliberations for the Convention on Great Lakes Fisheries and early sea lamprey stewardship because Indigenous Nations surrounding the Great Lakes were subjected to state/provincial/federal authority over their fisheries (in Canada driven by the *Fisheries Act* and the *British North America Act of 1867* for example) (Gaden et al., 2012; 2021b). As explained previously, some U.S. tribal organizations had their management authority recognized in the 1980s which opened the door for their involvement in committees and boards that direct fisheries and sea lamprey stewardship in the Great Lakes. This did not extend to First Nations in Canada for whom federal and provincial governments are presumed to act on the behalf of. This means that many First Nation and Tribal perspectives and worldviews are not represented in the crafting of GLFC fisheries and sea lamprey stewardship decisions, goals, and actions across Indigenous territories. This also ignores nuances in management authority amongst some First Nations. For example, First Nations like the SON

have been left out of holding official seats on Lake Committees, even though SON has a Substantive Commercial Fisheries Agreement with the Ontario government that demonstrates SON jurisdiction within their Traditional Territory (which covers a large portion of Lake Huron and the Georgian Bay) (Morencie, 2013; Substantive Commercial Fishing Agreement, 2011). It is important to have a range of Indigenous representation in sea lamprey stewardship decision-making spaces because different communities and Nations have different experiences and knowledges about sea lamprey and sea lamprey stewardship.

While this provides context for Tribal and First Nation involvement, or lack thereof, in sea lamprey stewardship it does not provide insight into their perspectives of invasive species control and sea lamprey. Academic literature specifically focusing on Indigenous partnership and perspectives in sea lamprey stewardship in the Great Lakes is lacking. There are calls for research that seeks to understand Indigenous perspectives on sea lamprey control and how to best engage with Indigenous communities in this domain (Gaden et al., 2021a). It is important to understand Indigenous perspectives because there is anecdotal evidence of lessening social acceptance of control methods from Indigenous communities, which would disrupt the GLFC's social license to operate. As well, climate change potentially poses serious challenges to the effectiveness of sea lamprey control which may require a re-thinking of control tactics. Indigenous perspectives and engagement would be important in both of these challenges that sea lamprey stewardship is facing.

2.2.2 Challenges in Sea Lamprey Stewardship

2.2.2.1 Social License

At present, the continued public acceptance of the sea lamprey control methods is not guaranteed. Gaden et al., (2021a) explore how the GLFC cannot take its social license to operate sea lamprey control methods for granted and argue that shifting baseline syndrome (when successive

generations become accustomed to changes that would have once seemed extreme; Pauly, 1995) means that the general public, fishery managers, and politicians may not remember the devastation wrought by sea lamprey in the mid-20th century. Future sea lamprey stewardship may therefore be a victim of its past success, as the public does not see the immediate need for lampricide and barrier construction or maintenance, which carry their own environmental risks and costs (Gaden et al., 2021a). For example, although minimal, there are impacts on non-target species mortality by both barriers and lampricides; and barriers block fish passage through waterways, as most native fish populations have limited jumping abilities, and cannot get over the fixed-crest barriers often used in sea lamprey stewardship (McDonald & Kolar, 2007; Zielinski & Freiburger, 2021). In general, social trends appear to not be in favour of barriers and chemical introductions into the environment, nor newer control methods such as genetic manipulation (Gaden et al., 2021a).

There is anecdotal evidence of opposition and skepticism from some Indigenous communities to lampricides and barriers which poses serious challenges to the continuation of these efforts in the short and long terms (Gaden et al., 2021a). There are concerns about the effects of certain sea lamprey control methods on water quality, fish passage, and the continued safety of the rivers and lakes for human use (Hume et al., 2021). In Ontario, lampricide applications to the Root River, Garden River, Echo River, and Mississagi River were deferred throughout the 2010's due to lack of support from the Garden River and Mississauga First Nations (Barber & Steeves, 2019; 2021; Dobiesz & Bence, 2018; Steeves & Barber, 2020). Dobiesz and Bence (2018) conducted modeling to determine the possible effects of delaying these lampricide applications on the Echo, Root, Garden, and Mississagi Rivers. The model predicted that stopping lampricide applications on the Mississagi River would result in the doubling of spawning lamprey in Lake Huron and with no control, this would likely lead to a doubling of attacks and fish mortalities in Lake Huron from sea lamprey (Dobiesz & Bence, 2018). It was not until 2019 and 2020 that applications of lampricide were applied to the Mississagi River and Garden River, respectively

(Barber & Steeves, 2021). These applications went forward because relationships were built with the communities. These relationships created an ethical space where community concerns, knowledge, and experience could be listened to and addressed.

There is little research on Indigenous perspectives and knowledges with respect to sea lamprey stewardship even though Indigenous views may differ considerably from other communities and agencies (Gaden et al., 2021a; Mattes & Kitson, 2021). Many Tribes in the U.S. have a different experience with sea lamprey stewardship than Indigenous Nations in Canada because of different levels of involvement in decisions and interactions with governments implementing the control methods. However, even within Tribes, there is a range of perspectives on what sea lamprey stewardship should look like from non-chemical control, better fish passage, eradication, to no intervention (Mattes & Kitson, 2021). There are remarks from First Nations' leadership around Lake Huron that demonstrate a need for invasive species stewardship methods that are holistic and are non-contaminate (Lauzon & Ryan, 2019). Using substances such as lampricides can be seen as an "easy way" out but it does not respect or account for Indigenous teachings in certain contexts or larger ecological implications (Lauzon & Ryan, 2019).

There are calls from Gaden et al., (2021a) and others for research to understand the range of Indigenous perspectives and knowledges in the Great Lakes to inform sea lamprey stewardship and improve the GLFC's engagement activities (Mattes & Kitson, 2021). However, Gaden et al., (2021a) do not clearly express considerations of Indigenous sovereignty to determine what happens on Indigenous lands and waters, but rather focus is placed on how Indigenous Knowledges and experience can be used to maintain the GLFC's social license to operate. Despite the GLFC's and others' mandate to implement sea lamprey stewardship, Indigenous sovereignty must be respected and their rights to deny the use of control methods on their lands and waters upheld (Mattes & Kitson, 2021). Indigenous Knowledge systems cannot be separated from Indigenous Peoples, their engagement requires active participation

from knowledge holders and carriers (McGregor, 2002). If an ethic of knowledge coexistence and equal partnership (that addresses power dynamics and decision-making power imbalances) is not built into sea lamprey stewardship practices with Indigenous Peoples, then such efforts may act as a form of assimilation and continue environmental injustices.

2.2.2.2 Climate Change

Climate change and other associated environmental disruptions to the Great Lakes leave the future of sea lamprey stewardship vulnerable. This is coupled with already aging sea lamprey control infrastructure and increasing public skepticism towards lampricides and barriers (Gaden et al., 2021a). The effects of climate change on sea lamprey are complex. Changing environmental effects on the Great Lakes (e.g. rising temperature, changing pH, nutrient loading, altered hydrology, sedimentation, etc.) may cause a reduction of suitable habitats for sea lamprey (Hume et al., 2020). However, this may also lead sea lamprey, in an effort to find suitable spawning locations, to enter more streams without barriers or are difficult to apply lampricide to (Hume et al., 2020). Also, climate change presents a major challenge to the existing sea lamprey control methods. Rising temperatures in streams may impact the toxicity of TFM making the larvae less vulnerable to the substance which may lead to the need for higher levels of lampricides to treat the streams (Hume et al., 2020; Lennox et al., 2020; Muhametsafina et al., 2019). Increases in precipitation levels and erratic precipitation events also impact the efficacy of lampricide applications (Hume et al., 2020).

Predicted increases to streamflow from precipitation events threatens the efficiency of barriers which are already under stress from degradation due to aging infrastructure, high cost of replacement, and shifting public acceptance (Hume et al., 2020; Miehl et al., 2020). Presently, most of the barriers that provide protection against migrating adult sea lamprey are natural or pre-existing structures with primary purposes other than sea lamprey control (Miehl et al., 2020). Some of the major challenges for barriers are deterioration (maintenance), inundation, poor fish passage, and risks to human safety - any

of these issues could warrant barrier removal without regard for their value in protection against sea lamprey spread (Lavis et al., 2003; Miehl et al., 2020).

It is vital to create a resilient sea lamprey stewardship system that can respond to the effects of climate change and efficacy of current sea lamprey control efforts while maintaining the trust of the peoples surrounding the Great Lakes. In order to create solutions to the challenges it is facing, the GLFC and its partners should establish a protocol for Indigenous partnerships in sea lamprey control methods that goes beyond stakeholder engagement and works with Indigenous Nations as partners in the decision-making process. However, given the historical and ongoing colonial management systems implemented across the Great Lakes and the role of GLFC and state/provincial/federal governments in these systems, there must be new frameworks and wise practices to guide partnerships with Indigenous communities to ensure the upholding of Indigenous rights, knowledges, and decision-making power. This is similar to how within fisheries and environmental stewardship there is recognition of the shortcomings of the current dominant system and calls for a more ecosystem-based approach (Holling & Meffe, 1996) that builds an ethic of knowledge coexistence (Reid et al., 2021).

2.3 Knowledge Coexistence and Two-Eyed Seeing

The complexity of environmental and related governance issues necessitates the need for a diversity of knowledge systems (e.g. Indigenous and Western Science) to understand and address these problems (Tengö et al., 2014). Tengö et al., (2014) recommends a multiple evidence base (MEB) approach to enhance understandings of ecosystems and environmental conditions which can help to support better stewardship decisions. A MEB approach can be used to create synergies across knowledge systems, that views knowledge systems in parallel, to generate new insights, knowledge, and innovations. This creates an enriched picture of understanding that jointly assess knowledges which can be used in further knowledge generation and decision-making. In this way there is no one dominant knowledge system acting as a validator, rather allowing each knowledge system to “speak for itself,

within its own context” (Tengö et al., 2014). To make this process beneficial to all involved, it is important to have a MEB approach rooted in collaboration where the different parties jointly set goals and agree on the ways to proceed while respecting different theoretical and methodological approaches.

Figure 2 illustrates the cyclical nature of the three phases of a multiple evidence base approach from Tengö et al., 2014. The three phases are identified as: (1) co-developing of questions, goals, and problem definition; (2) “bringing together knowledge on an equal platform” - documenting and mobilizing knowledges (see Appendix A for a more detailed illustration of phase 2); (3) co-producing insights and decisions (Reid et al., 2021; Tengö et al., 2014). The phases must be grounded in a collaborative partnership between parties that recognizes and respects differences while addressing unequal power dynamics. In this way an enriched picture is created by a range of diverse knowledge systems which provides a starting point for collaborative decision-making, further joint analysis, and

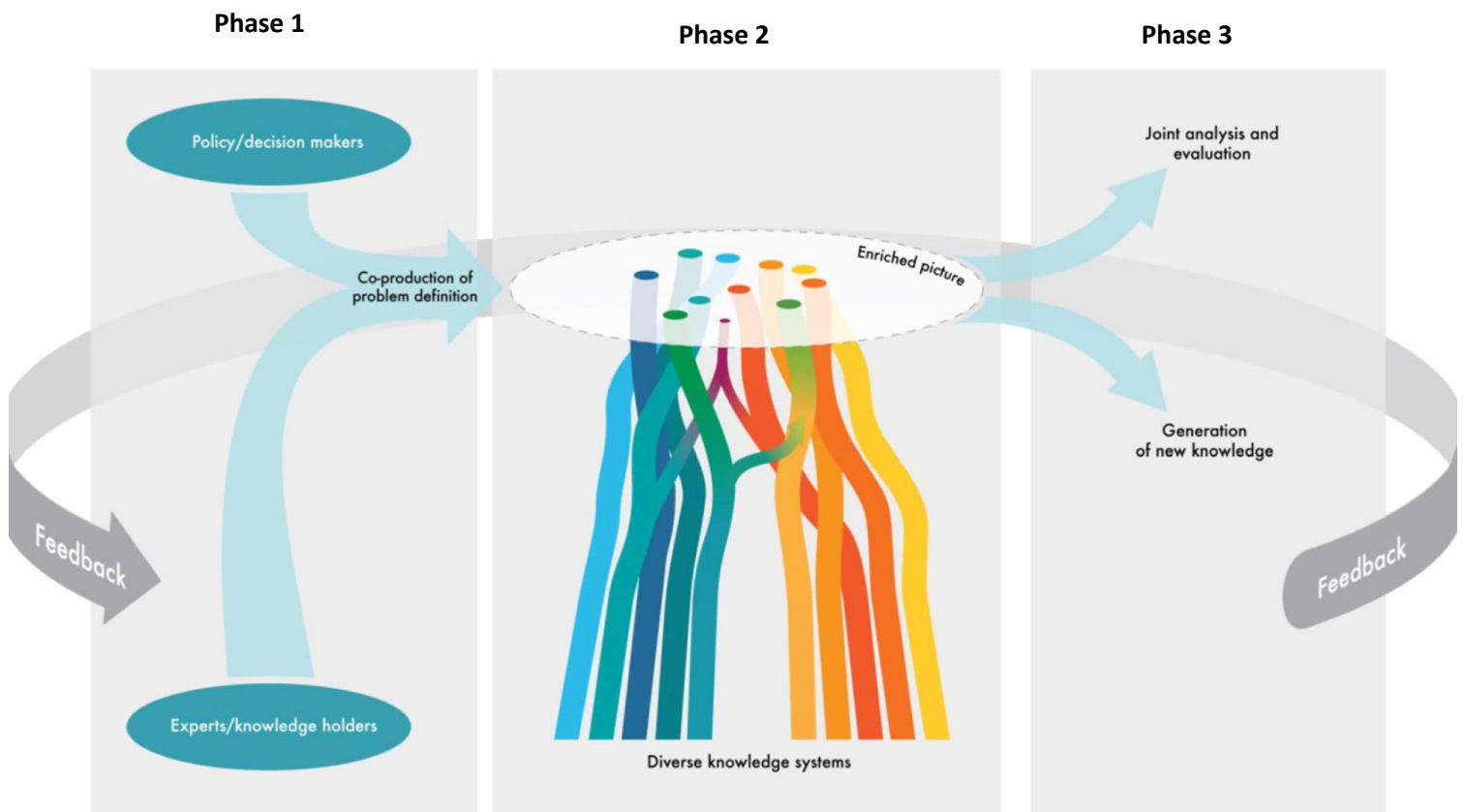


Figure 2. Phases of a multiple evidence base approach (Tengö et al., 2014) License CC BY

new knowledge generation. However, there is a need for new tools and approaches for the different MEB phases that respect difference, addresses power issues, and upholds diversity in knowledge systems (Tengö et al., 2014; Reid et al., 2021). Also, this requires a re-thinking of conventional models or frameworks for knowledge synthesis and understanding. These new procedures, methodologies, and approaches need to be co-designed by experts from the diverse knowledge systems (Tengö et al., 2014). A potential tool for this is Two-Eyed Seeing.

Two-Eyed Seeing is gaining traction as a guiding framework for equitable and sustainable fisheries research and stewardship (Mantyka-Pringle et al., 2017; Reid et al., 2021) that values and includes Indigenous voices and knowledges equally in discussions, decisions, and solutions that will affect Indigenous Peoples (Martin, 2012). Two-Eyed Seeing (Etuaptmumk in Mi'kmaq) is a term coined by Mi'kmaw Elder Albert Marshall, and is defined as, "learning to see from one eye with the strengths of Indigenous Knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing, and to use both these eyes together, for the benefit of all" (Bartlett et al., 2012, p. 335; Reid et al., 2021). Two-Eyed Seeing encourages plural coexistence of knowledge systems, complementarity knowledge generation, and it holds an imperative that "knowledge transforms the holder and that the holder bears a responsibility to act on the knowledge" (Reid et al., 2021, p. 1). There is an assortment of academic literature on Two-Eyed Seeing in resource stewardship (Abu et al., 2020; Bartlett et al., 2012; Mantyka-Pringle et al., 2017; Reid et al., 2021; Wilson et al., 2019) but little to no literature on the application of Two-Eyed Seeing to aquatic invasive species stewardship.

Martin (2012, p. 32) describes this framework as a way to create a more complete picture of the world where Indigenous Knowledge holds merit and is not 'greater or lesser' than Western scientific understandings, but simply different. It is a framework that utilizes an ethical third space where knowledge can be shared, coexist, and move beyond knowledge dichotomies (Martin, 2012). Ermine (2007) explains ethical space as a neutral zone between the worldviews of distinct societies when they

come together for engagement – where one society is not better or more correct than the other. The process of Two-Eyed Seeing helps to develop more adaptive solutions; as more information is available to inform decisions and various questions, concerns, and needs of groups, that would not have otherwise been considered or addressed. As well, the relationships built during a Two-Eyed Seeing process can be leveraged if issues arise post-project and adaptive solutions can be formed together.

Figure 3 is an illustration of the conceptual framework of knowledge coexistence/Two-Eyed Seeing as compared to status quo and knowledge assimilation. Knowledge coexistence/Two-Eyed Seeing bridges Indigenous Knowledge and Western Science in parallel to establish mutual understanding and

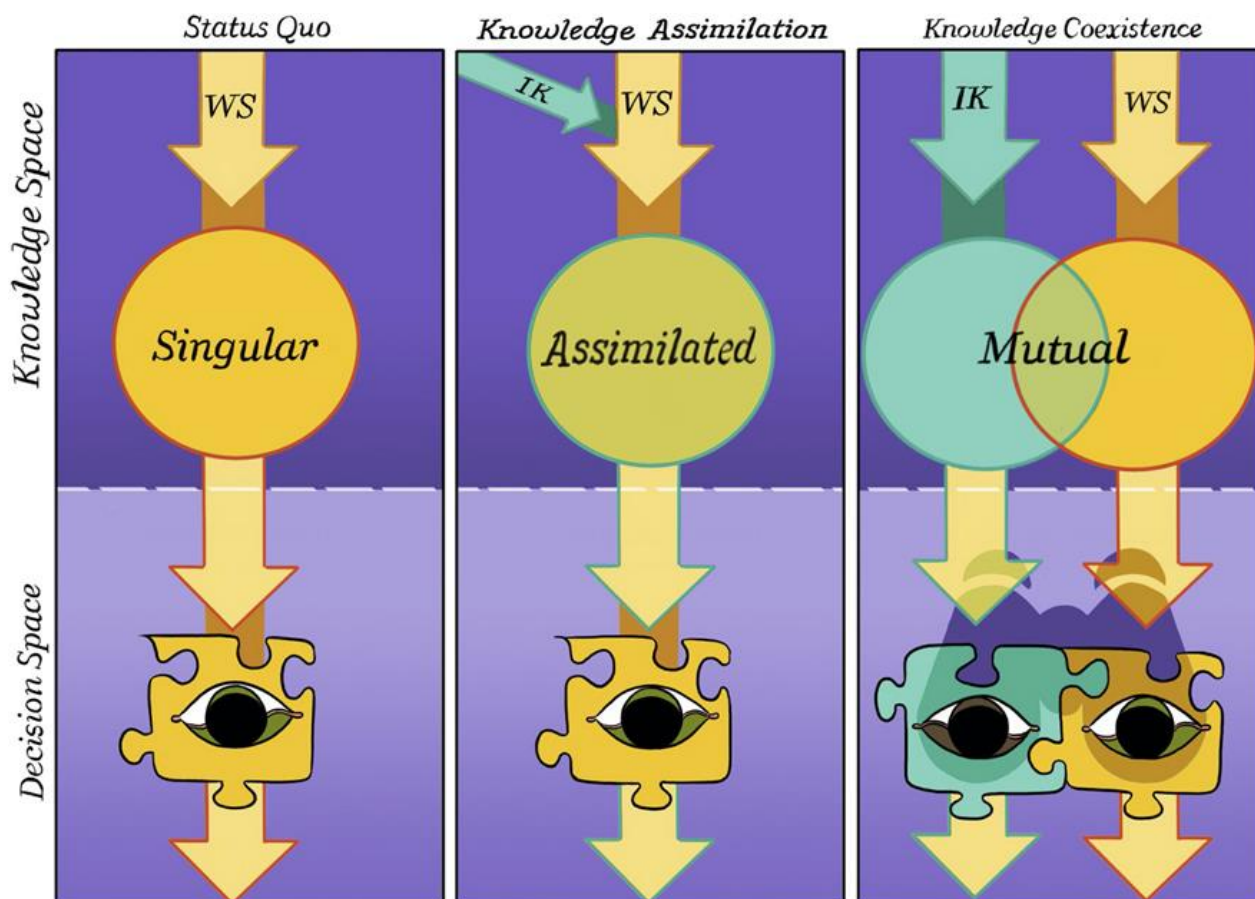


Figure 3. Conceptual framework of the flow of knowledge (IK, Indigenous Knowledge; WS, Western Science) (Reid et al., 2021)
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decisions. A key distinction of Two-Eyed Seeing to other knowledge coexistence frameworks is the requirement for action that comes out of the mutual understanding of the framework.

However, Two-Eyed Seeing does not come without challenges. It is difficult reconciling differences in perspectives of Western science (based on a reductionism and objectivism) and Indigenous Knowledge (derived from varied socio-cultural contexts and is more reflexive and agency-driven) which can lead to uncertainty (Mantyka-Pringle et al., 2017). That said, the goal of Two-Eyed Seeing is not reconciling knowledges, but rather holding both perspectives in consideration at the same time as an opportunity to learn. Other challenges include the Eurocentricity of Western Science, Western Science experts' misconceptions about Indigenous Peoples and Knowledges, and practical applications of Two-Eyed Seeing outside of theoretical and knowledge dialogue in research is argued to remain vague (Broadhead & Howard, 2021; Wright et al., 2019).

Moreover, Reid et al., (2021) reflect on a case study on fisheries stewardship between government bodies and the Mi'kmaq eel fisheries, and questions whether Two-Eyed Seeing is of great influence if the mutual understanding generated from it does not impact policy decision-making, which translates into how the fishery is understood and managed. Two-Eyed Seeing requires action so that policy and decision-making become part of the process – Two-Eyed Seeing is more than just listening (Reid et al., 2021). As well, Reid et al., (2021) raise questions of whether equitable inclusion of Indigenous Knowledge systems into policy decision-making is prevented by colonial sentiments (explicit or implicit) held by governments and officials; and, if Indigenous Knowledge systems are only valued if they are supported by Western Science (see also Nadasdy, 1999).

Despite these challenges, Two-Eyed Seeing still presents an opportunity for sea lamprey stewardship where Indigenous and non-Indigenous organizations work together to understand varying perspectives, address issues communities may have with control methods, and develop new or improve

control methods that are less impactful to native fish species and environments. Efforts should be made to combat the challenges of Two-Eyed Seeing with proper training of individuals participating in the process and equal decision-making power.

2.4 Conclusion

In conclusion, knowledge coexistence and Two-Eyed Seeing present an opportunity to facilitate respectful and meaningful engagement between diverse knowledge systems. This can help to develop new knowledge and insights which can help make better environmental stewardship decisions and uphold Indigenous rights. This is especially important because the complex environmental issues our world faces – including sea lamprey control – needs all kinds of different knowledges and peoples to work together to create solutions.

Within sea lamprey stewardship this may mean working with Indigenous Peoples across the Great Lakes Basin to develop strategies to address issues like the effects of climate change on control methods and the potential wavering of the social license to operate. Both of these issues pose serious threats to the current and future operation of the sea lamprey control program. The program also has systemic issues regarding the engagement of First Nations in Canada and their holding of positions of power in the decision-making spaces of sea lamprey stewardship and the Great Lakes fishery. Because of Indigenous Nations inherent rights to make decisions within their Territories, the GLFC and other sea lamprey control actors cannot treat them as mere stakeholders.

Moreover, other ways to better engage with Indigenous Peoples in collaborative environmental governance include: equaling the playing field by respectfully providing funding and capacity; going beyond legal requirements to consult; using culturally appropriate venues and protocols for engagement; education about Indigenous history and current realities to non-Indigenous representatives working in these spaces; early engagement which creates space for Indigenous input and decision-making at the beginning of the plan and throughout; respect and support for Indigenous

decision-making; and relationship-building. These recommendations are distinct for collaborative environmental governance with Indigenous Peoples, yet they echo similar sentiments for overall collaborative environmental governance as seen in Ansell and Gash's (2007) model for collaborative governance.

The literature has limited discussion and application of Two-Eyed Seeing in aquatic invasive species stewardship – in particular sea lamprey stewardship. Similarly, there is limited literature about Indigenous experience and perspectives in the sea lamprey control program. More widely, the literature about collaborative environmental governance should pay more attention to partnering with Indigenous Peoples and the unique opportunities and challenges this presents. In literature that does discuss this, there is limited acknowledgement of the issues that arise when working with diverse knowledge systems and the need for tools that can bridge these knowledges – not as a means for validation, but to hold knowledge systems in parallel for mutual understanding and decision-making. This research seeks to begin to address some of these gaps by analyzing the Denny's Dam rehabilitation as a means to develop lessons learned for partnership with an Indigenous Nation in sea lamprey stewardship and how such partnerships can facilitate knowledge coexistence/Two-Eyed Seeing.

3. The Case

This section provides background information about the Denny's Dam rehabilitation (DDR) case study. Figure 7 provides a timeline of the key events of the DDR. Information for this section was gathered from academic articles, SON's website, SON reports, GLFC reports, and research participants.

Since time immemorial the Saugeen Ojibway Nation (SON) have had relationships with the waters, lands, and non-human beings of a Territory encompassing 2 million acres of land and lakebed on the Eastern shores of Lake Huron in what is now known as Southwestern Ontario (Figure 4) (Chippewas of Nawash Unceded First Nation, 2020). The SON are Anishinaabek people of the Great Lakes region and comprised of two First Nations: Chippewas of Saugeen First Nation and Chippewas of Nawash Unceded First Nation. SON's Territory is the source of their cultural, spiritual, and economic survival and the sources of SON's rights and identity (Buell et al., 2020). Through a series of treaties, broken promises, and settler encroachment, the SON were driven off their land and forced into reserves. The SON fought to continue to uphold their relationships, rights, and responsibilities within this Territory (Buell et al., 2020). SON's fight to affirm their right to a fishery resulted in the 1993 court *Jones-Nadiwon* decision (R. v. Jones 1993) which recognized this right (Buell et al., 2020). This led to the SON forming a Substantive Commercial Fishing Agreement with the Crown that shares management of the fishery within SON Territory (Morencie, 2013; Substantive Commercial Fishing Agreement, 2011). SON's fishery continues to be of the utmost importance to the community. Within SON's territory is the Saugeen River which is one of the central waterways and holds great importance for commercial, cultural, and spiritual reasons (Ryan, 2017b).

Two kilometers from the mouth of the Saugeen River sits Denny's Dam which stretches between Saugeen First Nation and Southampton (Ryan, 2017b). In the 1870s, Denny's Dam was constructed for a sawmill (Lindsay, 2018), and almost 100 years later in 1970, it was rebuilt as a sea lamprey barrier by the NDMNRF because lampricide applications to the river would be too expensive (Ryan, 2017b; Schleen &

Klar, 2002). The Saugeen River was a huge producer of sea lamprey before control methods were implemented (Ryan, 2017b). In 2000, the dam was deemed unsafe and in the following years a plan for its rehabilitation was started (Ryan, 2017b). In 2006 the NDMNRF formed a steering committee which the Department of Fisheries and Oceans Canada (DFO) were a part of, but not the SON (Adair & Young, 2007; Ryan, 2017b). This steering committee's purpose was to formulate a strategy to repair Denny's Dam (Adair & Young, 2007). Sanchez Engineering was retained to design the rehabilitation (Ryan, 2017b). During this time, there were differing views of whether a meeting took place between the SON,

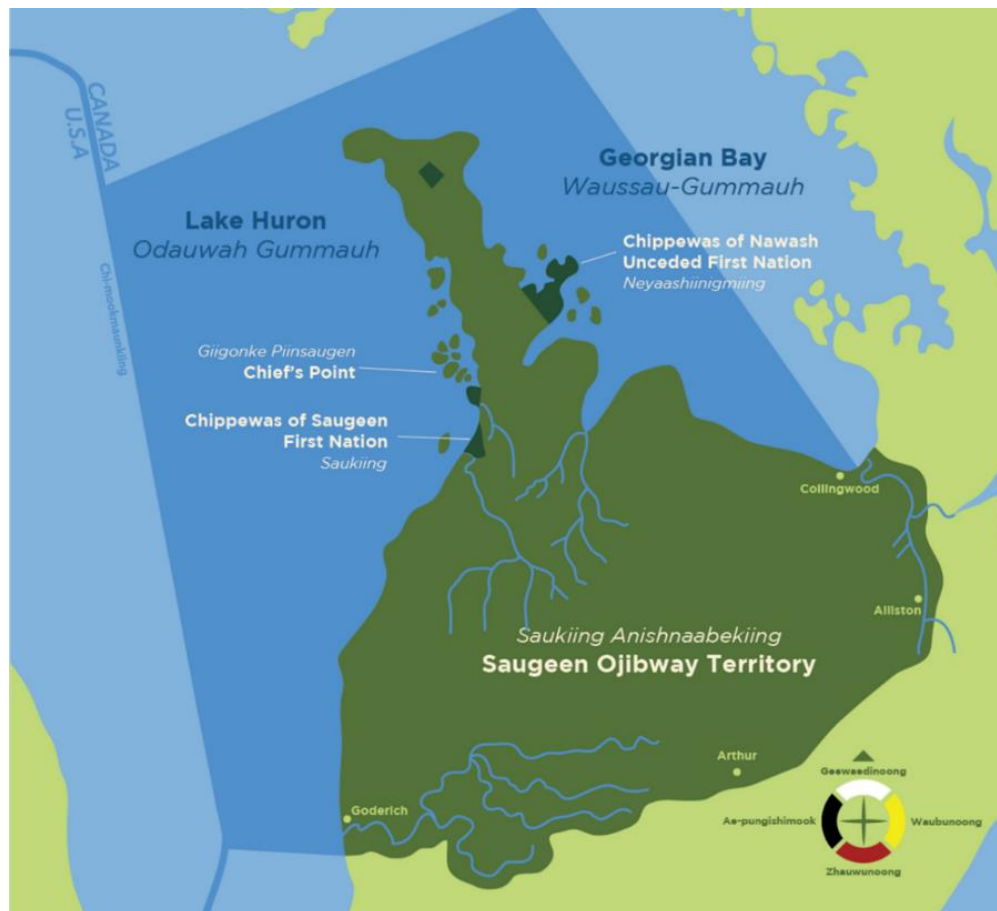


Figure 4. Saugeen Ojibway Territory (Saugeen Ojibway Nation Environment Office, 2021)

NDMNRF, and others about the project. SON representatives do not recall such meeting or being told about rehabilitation plans for Denny's Dam, while non-SON representatives remember one meeting in which they spoke with SON leadership and perceived there was overall positive reception to the rehabilitation.

The construction for the DDR was set to start in 2009 but due to issues with administration and permitting requirements it was delayed (Adair & Young, 2009; Ryan, 2017b). The project continued to be delayed until 2012 due to a variety of issues including funding. In 2011, the GLFC committed to funding a large portion of the costs of construction, and a memorandum of understanding between NDMNRF, GLFC, and DFO was signed to formalize this, with construction was expected to start in 2012 (Adair & Sullivan, 2013; Sullivan & Adair, 2012). Since the Saugeen River was a potential huge producer of sea lamprey, it was highly important to the GLFC that the dam was rehabilitated quickly. There was fear that the damage to the dam could lead to its eventual collapse, and the GLFC was highly aware and concerned about this because they hold the ultimate authority of sea lamprey control in the Great Lakes.

In 2012 the NDMNRF and DFO approached the SON about the project as they were about to begin the tendering process (Adair & Sullivan, 2013). This took the SON by surprise because they were not properly engaged with and only consulted at the end of the project when it was seeking approval. SON felt that they were only engaged with as a formality and the plan would proceed regardless of SON's input. This led the SON to write to the Ontario Minister of Natural Resources stating that proper consultation did not occur; and the SON were ready to implement legal and other means to prevent construction from happening. Following this, the project was put on hold pending proper consultation, but throughout the next couple years, little happened concerning the DDR.

It was not until 2015 when a GLFC Commissioner took the initiative to reach out to the SON that a relationship-building process began, and the DDR process started to move forward. After a couple of meetings between this Commissioner and SON representatives, a meeting between the GLFC and SON was scheduled for fall 2015 in Ann Arbor, Michigan (Sullivan et al., 2016). This meeting was seen as a turning point in the DDR process. In 2016, the SON and the GLFC co-signed an agreement which set out the parameters of the project and the responsibilities of each party (Aboriginal Consultation and

Accommodation Agreement, 2016; Mullett & Sullivan, 2017). Throughout 2016 and 2017, meetings were held between the SON and GLFC, and various studies were conducted to understand the Denny's Dam area and assess potential impacts from the project.

Construction for the rehabilitation started in the summer of 2017 and was officially completed in November 2018; construction was constricted to the summer months as per SON recommendations (Ryan, 2017b; Sullivan & Mullett, 2018; Barber & Steeves, 2019). In June 2019, a ribbon cutting ceremony was held at the Denny's Dam location to celebrate its rehabilitation. See Figures 5 and 6 for photos of the completed Denny's Dam.



Figure 5. Front photo of Denny's Dam in Fall 2021



Figure 6. Top photo of Denny's Dam in Fall 2021

Denny's Dam Rehabilitation Timeline

Time immemorial

SON live and hold relationships and responsibilities to the land, water, and creatures of Saukiing Anishnaabekiing

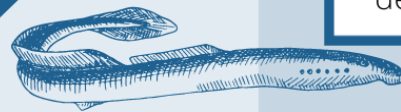
1763 - 1861

Many treaties signed with the Crown to limit settler encroachment, yet SON territory continued to shrink and SON land was limited to reserves



1930s - 1950s

Sea lamprey spread throughout the Great Lakes and contribute to the decimation of the fishery



1970

Denny's Dam rebuilt as a sea lamprey barrier on the Saugeen River



2000

Denny's Dam deemed unsafe and in need of rehabilitation



2006

OMNRF forms a steering committee, excluding SON



2012

After years of delay, the rehabilitation is set to start but proper consultation with the SON did not occur. Therefore, the project is put on hold



2015

The GLFC and SON build a relationship based on collaboration to rehabilitate the dam



2016

SON and GLFC Agreement signed. Regular meetings between the SON and GLFC occur



2017

Studies are conducted to determine potential impacts, and construction starts in the summer



2018 - 2019

Construction completed in November 2018 with an official ribbon cutting ceremony the following June

Figure 7. Denny's Dam rehabilitation timeline. *Saukiing Anishnaabekiing refers to SON Territory or "location of the Saukiing Anishnaabek"

4. Methodology

This section outlines the methodological approach taken in this research. First, the process of co-production with the SON is discussed which is followed by the description of the research philosophy that underpins this research. Second, the research strategy, sampling strategy, and data collection methods are discussed. The final two sections are analysis methods and techniques and the methodological limitations. A concluding summary is provided at the end of this chapter.

4.1 Research Co-Production with SON

Indigenous methodologies and social science approaches, in a process of co-production, guided this research. At the core of the research design is relational accountability (Wilson, 2008). In research with Indigenous Peoples, relational accountability means that methodologies need to be based in a community context (be relational) and demonstrate respect, reciprocity, and responsibility (be accountable as it is put into action) (Wilson, 2008, p. 107). Employing Indigenous methodologies involves working with Indigenous communities rather than on them – this means the Indigenous communities' research needs must shape the research topic, they must have direct access to the research project's decision-making, and the data collection methods should reflect their preferences (Wilson, 2008).

To carry out these responsibilities and to co-produce this research, a co-signed research agreement with the SON was created at the beginning of the research to set mutual expectations of the partnership and research process. The research agreement established that publications from this research (besides this thesis) would be co-produced, and [a video](#) would be made for the SON to share with the community and use according to their needs. Similarly, the research topic was co-created with SON employees, SON's Joint Fisheries Committee reviewed and approved of the research project, and data collection methods were developed with a SON employee. In addition, Indigenous data sovereignty and the First Nations Principles of OCAP (ownership, control, access, and possession) were followed in

this research – which resulted in the SON Environment Office having ownership over data associated with SON interview participants. This posed a challenge to the University of Ottawa’s Ethics Board, but we were able to bypass UOttawa protocol by clearly stating in the research agreement that we would work with the SON to access this data as needed. This would occur after the PI, Charity Nonkes’, graduation, once all SON data and non-SON data is deleted from her computer and archived by the SON Environmental Office and Dr. Nathan Young, respectively.

4.2 Research Philosophy

The specific research philosophy used was a constructivism research approach which asserts that reality and knowledge is generated through a person’s experience and reflection of those experiences (Adom et al., 2016; Honebein, 1996). In this approach, the researcher’s background and experiences are taken into account, and the data relies on participants’ perspectives on that situation of study (Mackenzie & Knipe, 2006). This is a rigorous research approach that uses inductive methodologies in an exploratory manner to generate a hypothesis rather than test one. A constructivist research paradigm is similar to an Indigenous ontology of there being multiple realities; however, in Indigenous ontology truth is not an external objective, rather truth or reality is a set of relationships, and knowledge is relational and shared amongst all creation (Wilson, 2008). In this way, the Nonkes’ background and experiences of being a white European-settler descendent in academia influences the relationships formed in this research and how the data was analyzed.

4.3 Research Strategy

A case study, in a research context, is understood as a multi-perspective exploration of an event, project, or other item of focus to develop a complex and unique understanding of it (Simons, 2009; 2020). There are different types of case studies including instrumental and intrinsic (Stake, 1995). Intrinsic case studies’ purpose is to understand one situation in particular, while instrumental uses a specific case study to gain insights into a wider issue (Simons, 2020; Stake, 1995). The approach taken in

this research is an instrumental case study. The Denny's Dam rehabilitation was used to gain wider insights into partnerships with Indigenous Nations in sea lamprey stewardship, however, there are elements of intrinsic case study incorporated into this approach. This case study took a cross-sectional approach by interviewing participants of the Denny's Dam rehabilitation at a particular time (October 2021 – March 2022).

4.4 Sampling Strategy

A non-probabilistic, directed sampling strategy was used in this research because it focused on a particular case study and required participants with specific knowledge and experience. Sampling targeted key decision-makers and people involved in the Denny's Dam rehabilitation from SON community, SON Joint Council, NDMNRF, DFO, GLFC, and other organizations. In total, 14 participants (n = 14) were individually interviewed. Within the results section of this thesis, the employment status of participants is provided for those who consented to sharing their name. This relates to their role during the Denny's Dam rehabilitation and does not reflect their current position and association with said organization. The initial potential participants were identified by staff at SON and the GLFC, and then a snowball sampling technique was employed to recruit other decision-makers and relevant participants. Potential participants were initially emailed an invitation to participate in the research with an information letter explaining what to expect. Participants then emailed Nonkes back determining their interest which was followed by a scheduling of the interview. Prior to the interview taking place a consent form was sent to each participant. Participants had the option of providing written or verbal consent. If written consent was chosen, a signed copy of the consent form was sent to me before the interview. If verbal consent was chosen, consent was recorded at the beginning of the interview. Following the interview honorariums of \$50 were offered to participants from SON or SON representatives as a thank you for participating in the research.

4.5 Data Collection Methods

There were two main sources of data: key reports made during the DDR and semi-structured interviews. Virtual semi-structured interviews took place with each individual participant which ranged from 45 minutes to 1 hour and 30 minutes long. Semi-structured interviews involve open-ended questions where some of the interviewer's questions are prepared in advance and others flow from the conversation (Wengraf, 2001). Semi-structured interviews as compared to fully structured interviews require more preparation, discipline, creativity, and time for analysis and interpretation of data and knowledge shared (Wengraf, 2001). Open-ended questions (co-produced with a SON employee) were used to guide discussion (see Appendix B for interview guide). Topics ranged from the logistics of the Denny's Dam rehabilitation, to how relationships between the different parties were created and maintained, to wider consideration of sea lamprey stewardship in the Great Lakes. These interviews took place virtually either through Microsoft Teams or Zoom. The interviews were audio-recorded using Microsoft Teams or Zoom internal recording software (depending on which platform the interview took place) and using Open Broadcaster Software as a back-up recording. After the interview the recording with the best audio quality was kept and all others were deleted. The audio was entered into Trint transcribing software which generated a transcript. Then the transcripts manually reviewed and corrected using the audio.

Once transcripts were complete, a summary of the key points of the interview was developed and both the summary and transcript were placed into a document. This document was sent back to participants who expressed interest in verifying and expanding on what was said in the interviews. This process is reflective of collaborative analysis which is an Indigenous methodological approach that requires continuous feedback from participants. This allows for authenticity and credibility because each person can elaborate on ideas and check the accuracy of the analysis (Wilson, 2008). After participants

verified and sent back the summary/transcript, their edits were incorporated into the final document which was then analyzed.

Three (n = 3) key reports were identified and collected by SON staff and then analyzed. These reports include the Aboriginal Consultation and Accommodation Agreement, the Land Use and Occupancy Study report, and the Fish Community Assessment Study report. Once collected, these reports were analyzed with the same process as the interview transcripts.

4.6 Analysis Methods and Techniques

Transcripts and reports were manually analyzed using a thematic analysis approach, specifically a codebook method with a general inductive approach in NVivo 12.0 qualitative data analysis software. Thematic analysis is an approach to identify, analyze, and report patterns which develop into themes from qualitative data (Braun & Clarke, 2006). A general inductive approach for analyzing data is a systematic procedure that is guided by research objectives while also using the raw data to derive themes as interpreted by the researcher (Thomas, 2006).

The analysis of the data incorporated Braun & Clarke's (2006) phases of thematic analysis and Thomas's (2006) process of inductive coding (Table 1). The first phase consisted of immersing in the data by reading and re-reading the data and summarizing the transcripts and reports to create familiarization (Thomas's phases 1-2 and Braun & Clarke's phase 1). The second phase included "generating initial codes" (Braun & Clarke, 2006). This initial codebook was created and applied to the documents, but it was flexible and new codes were generated throughout the first coding analysis which established several categories and sub-categories. The main categories were derived from the research questions and objectives as it appeared in the data with sub-categories developed from the text. This reflects Thomas' (2006) phase 3, "Creation of categories" where upper-level categories are derived from evaluation aims and lower-level categories are derived from the raw data. Once the initial coding was applied to all documents the codebook was finalized and then all documents were re-read and reviewed

with the final codebook to create consistency. Following this was theme identification which reviewed the codes, categories, and sub-categories to formulate candidate themes and sub-themes (Braun & Clark's phase 3). The next phase (Braun & Clark's phase 4) included reviewing the candidate themes and re-reading the extracts to make sure they were consistent and accurately represented the data which was followed by a re-reading of the documents to verify and solidify the identified themes. Following this, themes were defined and named (Braun & Clark's phase 5). This thesis is phase 6 – producing the report which “tells the complicated story of your data” (Braun & Clark's phase 6).

Phase	Braun & Clark (2006)	Thomas (2006)
Phase 1	Familiarization of data	Prepare raw data
Phase 2	Generating initial codes	Close reading of text
Phase 3	Searching for themes	Creation of categories
Phase 4	Reviewing themes	Overlapping coding and uncoded text
Phase 5	Defining and naming themes	Continuing revision and refinement of category system
Phase 6	Producing the report	

Table 1. Phases of analysis

4.7 The Methodological Limitations

Within the scope of this research are a few methodological limitations. First, not all key decision-makers in the Denny's Dam rehabilitation were interviewed. This was because they may not have been interested in participating and/or we were not able to identify or contact them. Second, the interviewee demographics is skewed to participants from the GLFC. This is partly due to the nature of the high involvement of the GLFC compared to other organizations; ideally the study would have had more representatives from the SON and NDMNRF. Third, due to COVID-19 virtual interviews were conducted instead of in-person interviews. This may have posed barriers to interviewing potential participants particularly from the SON community where in-person interviews would be more appropriate. Fourth, the nature of thematic and inductive analysis and constructivist research

approaches means that the results of this study are interpreted through the researcher's experiences, biases, and understandings. Therefore, it is unlikely that they would be exactly repeatable by others.

Many of these limitations were unavoidable due to the voluntary nature of participation in the study and COVID-19 restrictions. As well, the inability to identify other key decision makers (mainly from the NDMNRF) through a snowballing sample technique gives credence to their non-collaborative nature in the project. Despite these limitations, the study holds merit because of the relative diversity of the participants and the breadth and depth of answers provided by the variety of participants. The study's focus was on the relationship between the GLFC and SON and most of the participants in the study are representatives of either of these two groups. Lastly, while the results are interpreted through the lens of the researcher, this does allow for some flexibility that reflects the complexity and nuance of the data.

4.8 Conclusion

In conclusion, this research was co-produced with SON and used a constructivist research approach which set the foundation for the methods and techniques used. This research was a case study that utilized non-probability sampling of key decision-makers in the Denny's Dam rehabilitation. Participants were recruited through snowball sampling with a total of 14 participants with a variety from the GLFC, SON, DFO, NDMNRF, and other. Interviews were conducted virtually and were semi-structured. The audio was recorded with consent and transcribed. The transcripts and summaries were sent back to participants for verification. Key reports made during the DDR ($n = 3$) were collected. All transcripts and reports were put into NVivo 12.0 and analyzed with a combination of an inductive coding and thematic analysis approach.

5. Results

This results chapter presents the findings of interviews with Denny's Dam rehabilitation (DDR) key actors and from reports made during the project. These results focus on lessons from the DDR for partnership and knowledge coexistence in sea lamprey stewardship. Coding of the interview data resulted in the identification of four main themes, all of which contain several sub-themes. The four main themes are: *context & considerations for fisheries and sea lamprey stewardship in the Great Lakes*; *influential relationship-building factors*; *knowledge coexistence*; and *impact & legacy*. The following chapter breaks down the reports made during the DDR and each of the four main themes and related sub-themes are analyzed qualitatively with minor focus on quantitative analysis. However, before an in-depth qualitative analysis is provided, the main themes and reports made during the DDR are examined quantitatively and a brief overview of their representation in the data is provided below.

5.1 Themes and sub-themes Overview

The main themes and related sub-themes were, in part, developed based on their frequency in the data. The following analysis identifies the frequency of the main themes within the data and their distribution across participant groups and the DDR reports.

5.1.1 Main themes

The main themes have varying levels of representation in the data. Context & considerations, knowledge coexistence, and relationship-building factors relatively has similar representation in the data while impact has considerably less. Figure 8 displays the proportional frequency of each theme as a percentage of the total of references in the transcripts and reports. Discussion about relationship-building factors has the highest percentage of references (33%) with context & considerations for sea lamprey stewardship close behind (31%). References to knowledge coexistence had the third highest percentage (26%) with the impact of DDR representing 10% of the total amount of references in the data.

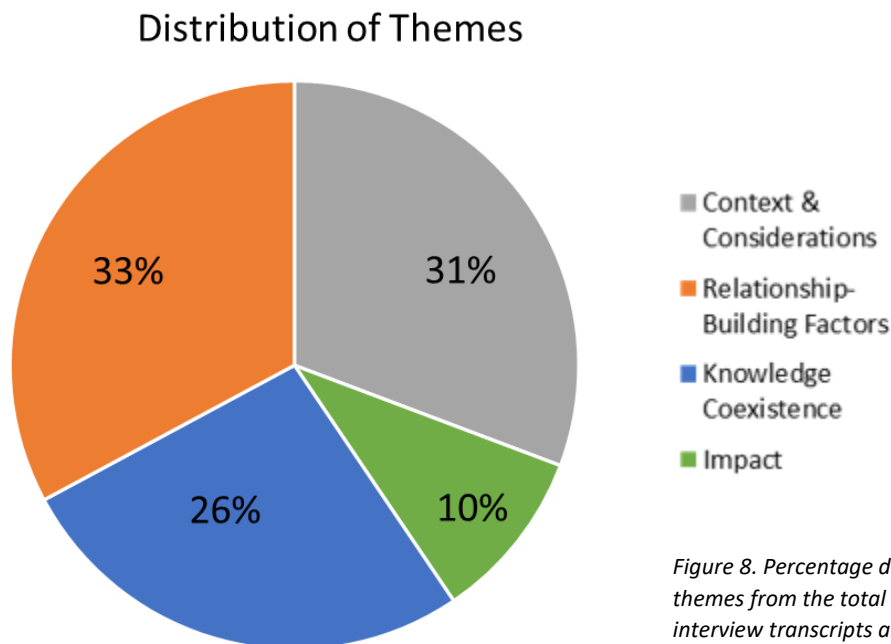


Figure 8. Percentage distribution of main themes from the total references given in the interview transcripts and reports

Additionally, an analysis of the distribution of the main themes amongst participant groups provides insight into these trends. The participants interviewed (n = 14) can be divided into five categories: GLFC (n = 6), SON (n = 4), DFO (n = 2), NDMNRF (n = 1), and other (n = 1). As well, the reports (n = 3) that were analyzed are classified as their own category. Figure 9 displays the average number of references about the main themes for each category. All of the main themes appeared in each category except the reports had no references to the impact of DDR. SON representatives had the highest average number of references to knowledge coexistence (26), reports (21.3) DFO (17.3), GLFC (9.5), other (8), and NDMNRF (6). DFO participants had the highest average of references to DDR impact (13.3) and relationship-building factors (28) followed by GLFC (20.2), SON (19.75), other (17), NDMNRF (12), and reports (8). NDMNRF had the highest average of references to context & considerations (25). A full breakdown of themes, sub-themes, and categories appears in Table 2 with the percent of interviews and reports they appeared in.

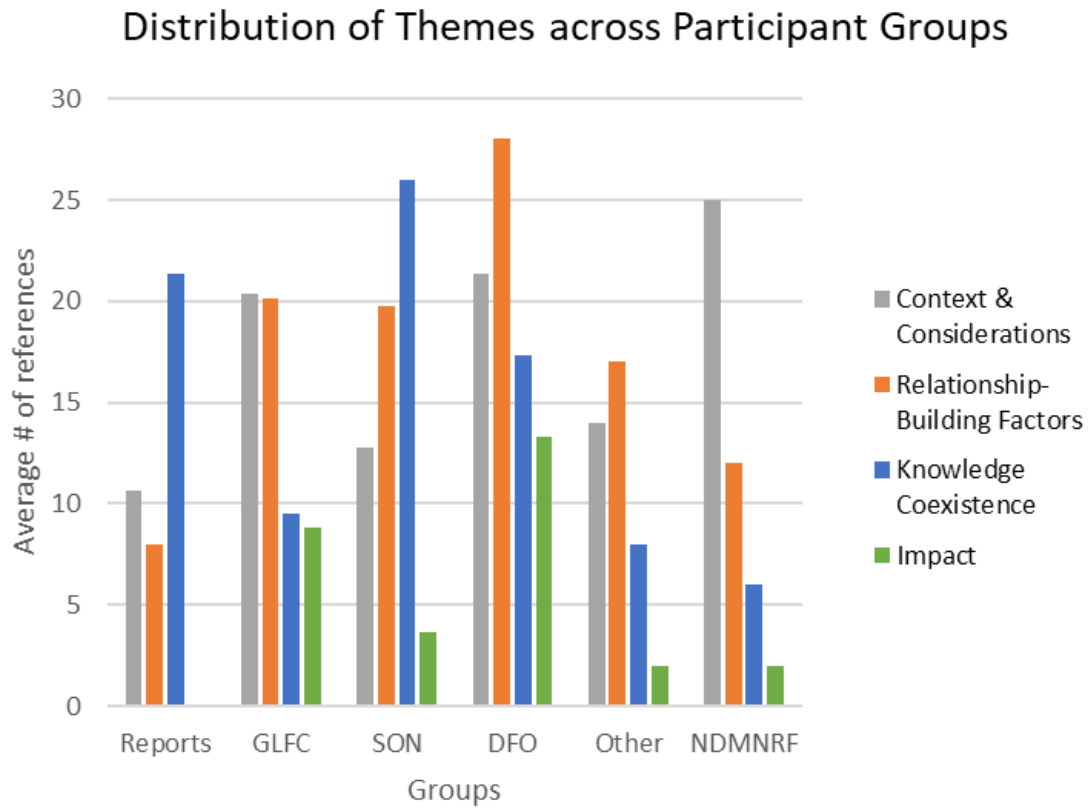


Figure 9. Distribution of themes across participant groups according to the average number of references each group made per theme

Theme	Sub-theme	Category	% of interviews	% of reports
Context & Considerations			100	100
	Challenges with sea lamprey control		86	33
		Social license	64	0
		Climate change	50	33
Influential Relationship-Building Factors			100	100
	Duty to consult considerations		86	0
	Early engagement		86	0
	Meaningful communication		100	100
		Failures in communication	79	0
		Collaboration	71	100
		Agreeing on the problem/mutual understanding of the importance of the dam	50	33
		Community Meetings to address questions, concerns, and build relationships	79	67
	Funding and capacity		86	67
Knowledge Coexistence			93	100
	Studies		86	100
		Land Use and Occupancy Study	71	100
		Fish Community Assessment	43	67
	Bridging knowledge systems		86	100
		Co-developing questions/project parameters	64	67
		Documenting/mobilizing knowledge	79	100
		Co-producing decisions/insights	71	100
		Two-Eyed Seeing		
Two-Eyed Seeing		36	0	
Impact & Legacy			93	0

Table 2. Break down of themes, sub-themes, and categories in interviews and reports. Note this table only shows key sub-themes and category discussed in the thesis, not all items present in the analysis are listed.

5.1.2 DDR Report Themes and Sub-Themes

The following analysis quantitatively examines the themes and sub-themes in the DDR reports – Aboriginal Consultation and Accommodation Agreement (hereafter referred to as the SON-GLFC Agreement), Land Use and Occupancy Study (LUOS), and the Fish Community Assessment – to understand the range and focus of the reports. There were strong associations between the three reports analyzed in this research and the theme of knowledge coexistence – particularly the sub-theme of bridging knowledges. Compared to the distribution of the main themes across the interviews, the reports had a higher emphasis on knowledge coexistence (22% versus +60%, respectively). As well, there was no mention in the reports about the DDR legacy and impacts since they were completed before the project was over, which is unlike the interviews with 11% of references being about legacy and impact. The reports' distribution of relationship-building factors and context & considerations varies. In each report, one of these two themes represents approximately 30% of references with the other representing approximately 7% (see Figures 11, 12, and 13). In the interviews these themes had relatively equal distribution where relationship-building factors consisted of 35% and context & considerations 31%.

Figures 10, 11, and 12 break down each of the three reports to see the percentage distribution of the themes and sub-themes. The data is displayed in a doughnut graph which can be understood as a series of pie graphs. The centre pie graph shows the distribution of the main themes in the reports, the second layer shows the distribution of the related sub-themes, and the third layer shows the composition of the bridging knowledges sub-theme. In the figures, the theme of bridging knowledges is broken down into three categories as discussed in the *bridging knowledges* section of this results chapter. In each of the reports, the theme of knowledge coexistence represents +60% of references, with bridging knowledges representing the largest sub-theme. The SON-GLFC Agreement has a fairly equal distribution of the three categories of bridging knowledges: co-developing questions/project

parameters, documenting/mobilizing knowledges, and co-producing decisions/insights. Whereas the LUOS and Fish Community Assessment both have a large percentage of examples and considerations of documenting/mobilizing knowledges.

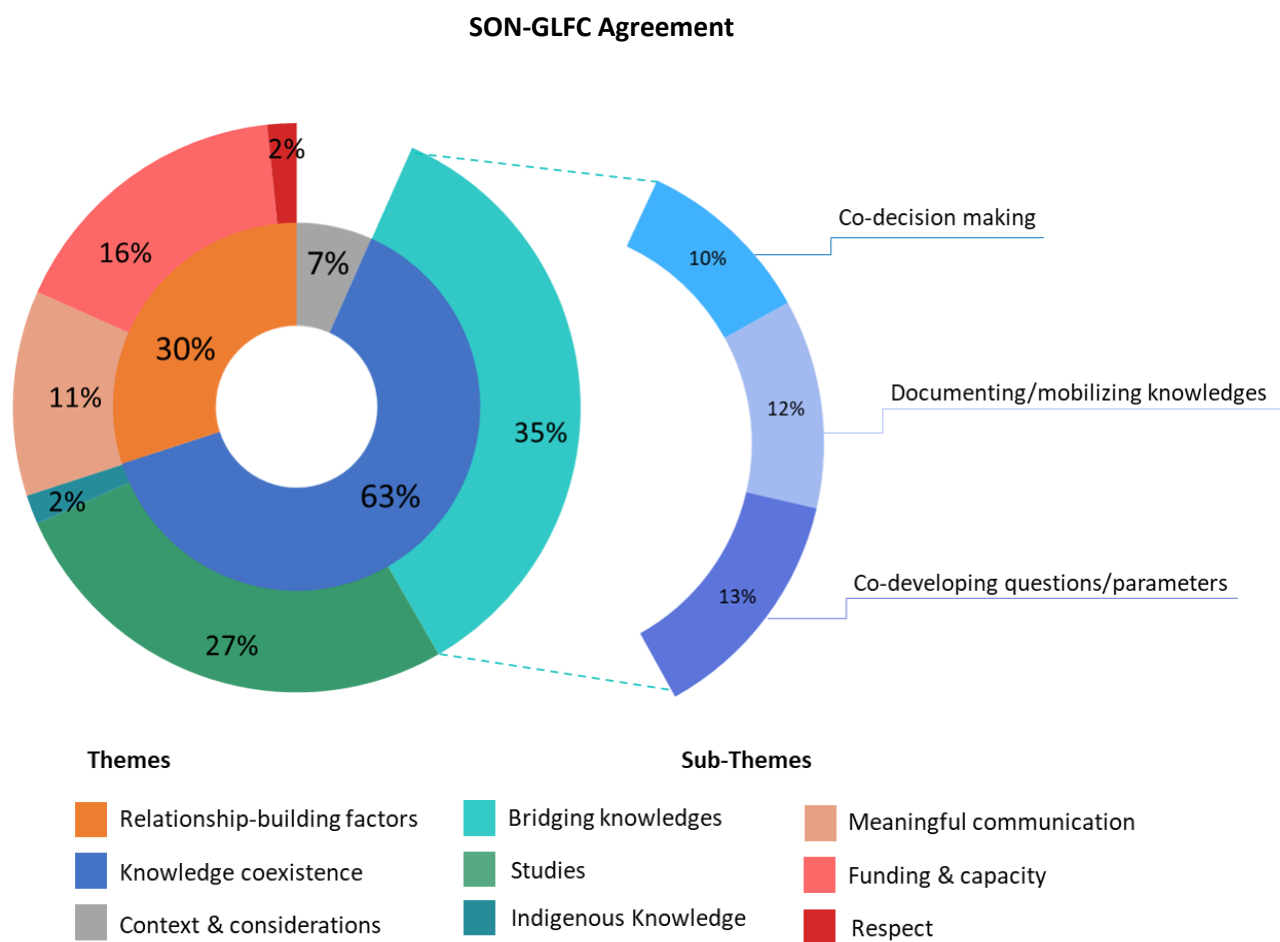


Figure 10. Themes and sub-themes distribution in the SON-GLFC Agreement

Doughnut graph of the distribution of the themes and sub-themes in the Denny's Dam rehabilitation SON-GLFC Agreement. The inner circle represents the main themes which is broken down into sub-themes in the outer circle.

Land Use and Occupancy Study

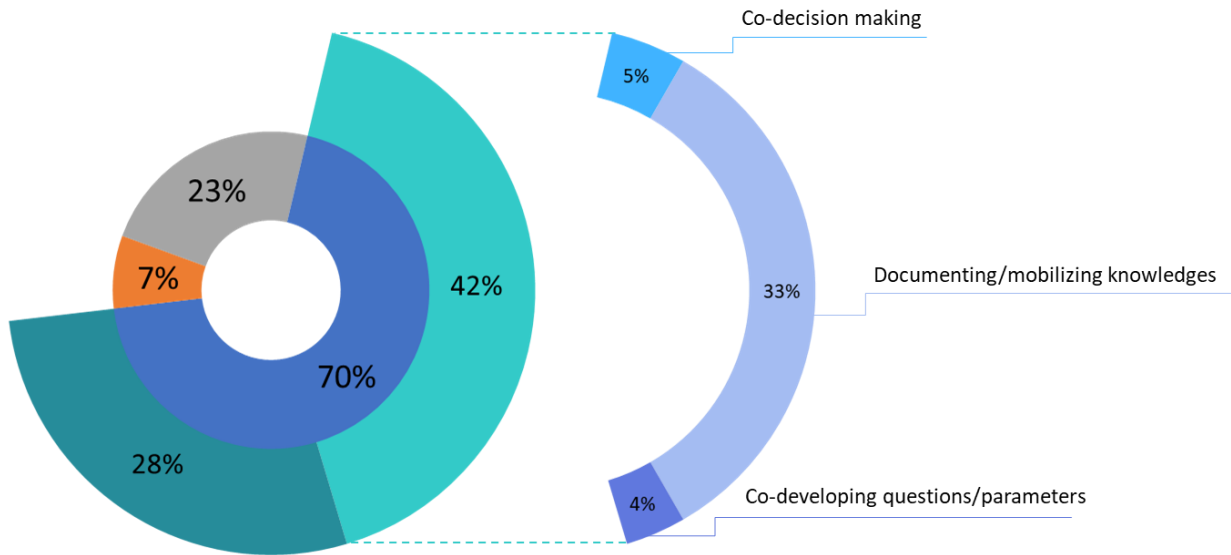


Figure 11. Themes and sub-themes distribution in the LUOS

Doughnut graph of the distribution of the themes and sub-themes in the Denny's Dam rehabilitation LUOS. The inner circle represents the main themes which is broken down into sub-themes in the outer circle.

Themes

- Relationship-building factors
- Knowledge coexistence
- Context & considerations

Sub-Themes

- Bridging knowledges
- Indigenous Knowledge

Fish Community Assessment

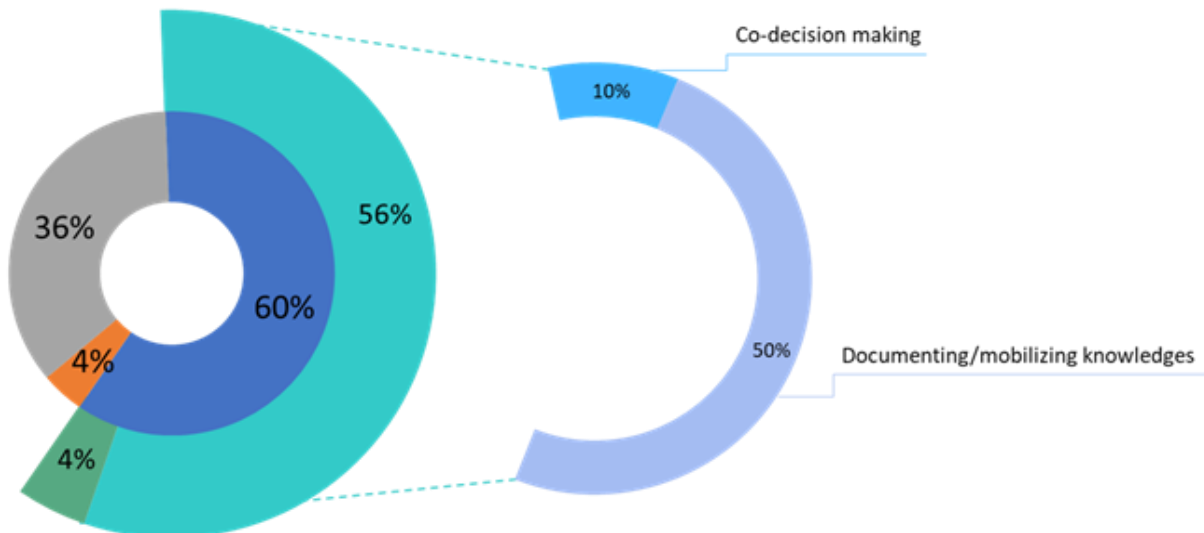


Figure 12. Themes and sub-themes distribution in the Fish Community Assessment

Doughnut graph of the distribution of the themes and sub-themes in the Denny's Dam rehabilitation Fish Community Assessment. The inner circle represents the main themes which is broken down into sub-themes in the outer circle.

Themes

- Relationship-building factors
- Knowledge coexistence
- Context & considerations

Sub-Themes

- Bridging knowledges
- Studies

The following sections qualitatively analyzes the four main themes (context & considerations, relationship-building factors, knowledge coexistence, and impact & legacy) and how they were discussed by participants. Direct quotes are used to illustrate common sentiments about the related theme, sub-theme, or category. Illustrative quotes are provided for certain themes, sub-themes, or categories to provide a distinct perspective which reveals nuances and insight but may not have been a common sentiment shared amongst participants. Participants positions and associations with organizations are listed during the time of the DDR and are not reflective of current associations or positions.

5.2 Context & Considerations for Fisheries and Sea Lamprey Stewardship in the Great Lakes

Discussion of the context & considerations for fisheries and sea lamprey stewardship in the Great Lakes relates to history and context about participants/organizations involvement in sea lamprey stewardship and the DDR, as well as wider considerations and challenges in the Great Lakes' fisheries and invasive species stewardship. There are two key sub-themes:

1. Considerations about the current and future challenges that the sea lamprey control program is facing. The main challenges to sea lamprey stewardship were shifts in the program's social license to operate and potential impacts of climate change on sea lamprey and control methods.
2. Specific context about the DDR which focused on tensions among SON, NDMNRF, and DFO before the GLFC became directly involved in the project. Overall, this theme appeared in 100% of interviews and 100% of reports with a total of 276 references. This is the second highest number of references as compared to the other main themes. In the data this theme was often co-coded/grouped with influential relationship-building factors (45%) and knowledge coexistence (25%).

5.2.1 Challenges with Sea Lamprey Control

The sea lamprey stewardship system is facing many challenges as mentioned by the majority of participants. Two main areas of concern are social license and climate change. The aging infrastructure of sea lamprey barriers was also mentioned as a challenge but will not be discussed below. Challenges with sea lamprey control were in 86% of interviews and 33% of reports.

5.2.1.1 Social License

Among officials in government agencies, there are concerns that the GLFC's and other organizations' social license to operate sea lamprey stewardship is lessening. There was worry that public sentiment towards sea lamprey control methods will become negative and that there will not be passive or active support for the key control measures. *"Our concern is that sooner or later, we're going to get more feedback from the anti-community about putting chemical in the water"* (McKane, GLFC, Commissioner). Particularly, there were concerns about Indigenous Nations' acceptance of the sea lamprey stewardship program. *"In a lot of cases there's a real range I find with the response of First Nations to efforts to control sea lampreys in the Great Lakes. Some are interested and highly supportive of the SLCP [sea lamprey control program] and have familiarity with it dating back to the 1960s. At the other end of the spectrum, some First Nations have significant concerns that continue to be addressed. It runs the whole gamut"* (Sullivan, DFO, Division Manager). Concerns over the social acceptance or social license to operate the sea lamprey stewardship program appeared in 64% of interviews and 0% of reports.

An illustrative quote about this is as follows: *"Because of our successes with this, the lamprey control program, really, that I think there's an almost a generational gap in recalling what the lakes were like prior to sea lamprey control in terms of Lake Trout populations and those sorts of things. So, I think that the full impact of sea lamprey in the Great Lakes in the absence of control isn't something that I've ever seen, isn't something necessarily that my parents have seen. So, we're going back several*

generations to get to that impact. And so we're kind of in a way... we're kind of victims of our own success in this case" (Anonymous).

5.2.1.2 Climate Change

Climate change and its impact on sea lamprey control methods was discussed by a number of participants as well as impacts climate change has on Great Lakes health and the health of the Saugeen River. Climate change was a large concern for the GLFC as it impacts fish populations, sea lamprey population dynamics, and effectiveness of control methods. *"As climate change warms waters and you have longer shoulder seasons, we have potential for changes in sea lamprey spawning behaviours and we're learning that we have to apply the chemistry, chemical analysis, differently to determine acceptable concentrations of lampricide as time goes on. We have had some incidental kills lately in areas where we've not really had issues before" (Lambe, GLFC, Executive Secretary).* As well, Indigenous communities are very concerned about climate change and its impacts on aquatic ecology and fisheries because they are witnessing the changes first-hand. *"Just about every conversation [with First Nations], its climate change, its invasive species, they're concerned about those because they've seen the impacts of that they can have on the fishery and its importance to their culture" (Lacroix, NDMNRF).* Issues with climate change and the future of sea lamprey stewardship appeared in 50% of interviews and 33% of reports.

5.2.2 DDR Context

In 2000, NDMNRF determined that the dam was unsafe and at risk of failure if it was not repaired. In 2006, NDMNRF created a technical committee to oversee the DDR (which included DFO but not SON) and after engineering surveys and designs were completed the construction was set to start in 2008. However, it was delayed until 2012 due to funding issues. At this time NDMNRF approached SON about starting construction and SON was taken aback as they were not properly consulted on the project. See 'The Case' section and Figure 7 for a DDR timeline.

Kahgee (Chippewas of Saugeen First Nation Chief) reflected on SON's interactions with NDMNRF, *"Their failure to engage us the way they should have and take the opportunity to build out a robust process that we would have confidence in, and we can move forward in a good way - they dropped the ball on that, and we had to call them out on that. And that ultimately led to things being suspended indefinitely."* SON insisted that construction for DDR could not start until proper consultation took place and they were ready to implement legal and other means to stop construction from occurring. *"The Chiefs voiced support for sea lamprey control, however, they stated that it was inappropriate and illegal for reconstruction to begin until proper consultation with SON had occurred. Further, if the contract tenders weren't withdrawn and construction proceeded, it would likely be met with resistance by the SON community and litigation"* (Sullivan, DFO, Division Manager).

Once the project was put on hold it remained so until GLFC got involved. It was very important for SON to be consulted about the project because of the significance the Saugeen River (which Denny's Dam sits on) to the SON people. *"It's all-important. It's all Saugeen – our home. To us, we've always been there. Whether it be out walking, hiking, fishing, swimming. Life. And that's culture – life. The whole area is important"* (SON community member as seen in the Land Use and Occupancy Study; Ryan, 2017b). Context for the DDR was offered by most participants with it mentioned in 93% of interviews and 100% of reports with a total of 111 references. It was often grouped with failures (30%) and duty to consult considerations (26%).

5.3 Influential Relationship-Building Factors

Influential relationship-building factors are practices, actions, and factors that acted as opportunities for partnership in the DDR. There were a myriad of relationship-building factors listed by participants and in reports. The following section breaks this theme into sub-themes: duty to consult considerations, early engagement, meaningful communication, and funding and capacity. Several of these sub-themes are further broken down into categories (see Table 3). This serves to provide

examples of the kinds of relationship-building and lack thereof that happened during the DDR and participants' perceptions of what acted as barriers or opportunities for partnership. Burkett (GLFC, Sea Lamprey Program Director) provided a list of reasons why the DDR was successful, *"Key reasons: personal relationships; trust; all participants spoke from their centers; any issues that arose were honestly vetted and directly addressed. I think there was an overall spirit of collegiality and working together to get a big job done. And I think there was a common understanding of why it was important."*

There are several factors that participants mentioned but will not be discussed in detail which includes personal relationships and key personnel in the DDR. The influential relationship-building factors theme appeared in 100% of interviews and 100% of reports with a total of 295 references. This is the highest number of references as compared to the other main themes. Amongst the other main themes, this was often coded with context & considerations for fisheries and sea lamprey stewardship in the Great Lakes (42%) and knowledge coexistence (43%).

Theme	Sub-themes	Category
Influential relationship-building factors	Duty to consult considerations	
	Early engagement	
	Meaningful communication	Failures in communication
		Collaboration
		Agreeing on the problem/mutual understanding of the importance of the dam
		Community Meetings to address questions, concerns, and build relationships
	Funding and capacity	

Table 3. Theme Breakdown: Influential Relationship-Building Factors

5.3.1 Duty to Consult Considerations

Duty to consult and accommodate considerations were widely discussed amongst participants. It was often discussed in the context of NDMNRF's failure to properly engage and consult SON during the first iteration of the DDR which led to the halting of the project. SON felt NDMNRF's engagement

with them was just to 'check a box' rather than meaningfully consult them on the project. Lauzon (Fisheries Biologist at the Chippewas of Nawash Fisheries Assessment Program) explained, *"basically, the impression that we were given was that basically they [NDMNRF] were meeting with us to check a little tick box. But really, at the end of the day, our involvement really wasn't key to this thing happening."*

Within the DDR between SON and GLFC, duty to consult obligations was less of an issue because GLFC was committed to go beyond consultation requirements and establish a partnership with SON, not because it was a 'duty', but because GLFC operates through collaboration. However, in initial conversations between GLFC and SON about DDR, SON heavily focused on the need for proper consultation to which the GLFC was surprised about. This focus on 'duty' and legalities was perceived as an insult on how the GLFC operates. This is because GLFC was committed to collaboration and saw consultation as the bare minimum. *"I gave the first presentation and I opened by saying that with all due respect, this whole duty to consult issue is an insult. The Commission operates with a collaboration, coordination, communication, cooperation. Those are our principles. None of those things are a duty. They're all, they're all just a way that we operate"* (Burkett, GLFC, Sea Lamprey Program Director).

GLFC explained they wanted to partner with SON on DDR and the two were able to work together without hyper-focusing on duty to consult requirements. *"We didn't use a lot of those words like duty to consult and consultation. We talked about collaboration, cooperation, etc. And that's what our agreement with Great Lakes Fishery Commission on from this project is built around"* (Ryan, SON, Environment and Regulatory Services consultant hired by SON). Duty to consult considerations appeared within 86% of interviews and 0% of reports with a total of 63 references. This was often coded with failures in communication (29%) and failures in relationship-building (29%).

Kahgee (SON, Chief) explained the situation and how SON responded to NDMNRF, *“The whole purpose of doing that [duty to consult] is so you can take the necessary time to build up the process in a way that the Nation is going to have confidence in to ensure it's going to address all substantive concerns and make sure that proper accommodations are in place. You can't do that if you're coming to us at the 11th and 12th hour, because then you just force us into a very precarious position where we are now very adversarial and we have to take all the necessary steps within our legal means to protect our rights and interests.”*

Moreover, Ryan (SON, Consultant) illustrated how the GLFC is uniquely positioned in contrast to Canadian governments so duty to consultation obligations were less of an issue, *“I think there is something different about working with a binational organization that's not part of, you know, the ongoing consultation battle that people have with the Canadian government bodies. There's something different about working with that organization than I've ever experienced, working with many of the actually, I will say, I have never experienced a process that seamless and not obsessing...about consultation. How is this consultation? How does this check consultation checkbox x, y, z? It wasn't about that, and it never seemed to be about that. It really was how is this process going to be meaningful and purposeful from SON's perspective?”*

5.3.2 Early Engagement

Early engagement was often referred to as a good practice in partnerships with Indigenous communities and helped the relationship between SON and GLFC to move forward. It was also referred to as a failure by NDMNRF because they did not engage with SON early or meaningfully in the first iteration of the DDR. During the first iteration of the DDR, Sullivan (DFO, Division Manager) shared a perspective common amongst participants, *“I think [NDMNRF] should have engaged SON more directly and more often. SON representatives should have been invited to participate in the technical committee meetings.”* Early engagement was cited as a practice essential for partnership and bridging of Indigenous

Knowledge systems and Western Science systems. It was evident that within the GLFC-SON relationship the early engagement (particularly the first meeting that took place in Ann Arbor, MI between SON and GLFC representatives) allowed the partnership to start in a good way and created space for SON's perspective, decision-making, and shaping of the project. Early engagement appeared in 86% of interviews and 0% of reports with 46 total references. It was often grouped with failures (33%), bridging knowledges (33%), co-developing questions/project parameters (26%), and meaningful communication (30%).

The importance of early engagement with Indigenous communities is illustrated by Ryan (SON, Consultant) who explained, *"if you want to do TEK, if you want an Indigenous community or a different knowledge system to be engaged in this, you better get together as soon as you identify the problem and talk about what that problem means to both people, how both parties look at the problem and the tools that both parties can bring to the table to address the problem."* Ryan goes on to say, *"...making sure as much as possible, you know, people are coming together at the beginning of the thing, whatever the thing is, to identify the problem together and identify the path to the solution together."*

5.3.3 Meaningful Communication

Meaningful communication encompasses several categories that range from failures in communication, collaboration, agreeing on the problem/importance of DDR, and community meetings to address questions, concerns, and build relationships. These categories were often grouped together in the data. *"Communication, collaboration, coordination and cooperation are all crucial, and we made a big point of that. That was the main point we made in that meeting and our desire to, you know, put aside past misgivings and to work towards creating an environment where we could develop trust and the capacity to work together to get that dam rehabilitated for the benefit of the fishery, for the benefit of the ecosystem, for the benefit of the Great Lakes, and for the benefit of the SON."* (Burkett, GLFC, Sea Lamprey Program Director).

“Another thing is just the amount of communication and partnerships that we built; I think this is just a good groundwork for moving forward. It's a great example and test case for how things can be done in the future, especially given kind of contentious nature of what we started with” (Hrodey, GLFC).

Examples or discussion of meaningful communication appear in 100% of interviews and 100% of reports with a total of 137 references. This was often associated with other sub-themes, mainly bridging knowledges (30%) and failures (28%).

5.3.3.1 Failures in Communication

Failures in communication refers to examples given by participants where there was miscommunication and areas for improvement. Failures in communication was most associated with conversation about the NDMNRF and SON relationship prior to the GLFC taking an active role in the DDR. SON felt that NDMNRF had not listened to or meaningfully communicated with them when first proposing the DDR. *“I always say talking to somebody and talking with someone, they're completely different things. And so, they [NDMNRF] were more vested in let's talk to you as opposed to let's talk with you. There is a difference” (Kahgee, SON, Chief).* This ultimately led to the project being delayed indefinitely. *“I think with [NDMNRF] there was the sense that they were just going to go ahead and do what they were going to do. SON's perspective or the way SON felt the project should go forward wasn't really factoring into that relationship” (Ryan, SON, Consultant).* Failures in communication appeared in 79% of interviews and 0% of reports. It was often associated with DDR context (52%).

5. 3.3.2 Collaboration

The project was rooted in collaboration which was often cited as a reason for its success and a foundation of the project. The first article of the SON-GLFC Agreement clearly outlined the commitment to collaboration, *“The Parties wish to build a strong, constructive, collaborative, cooperative and mutually respectful and beneficial relationship based on a common interest in the sustainable conservation of subsistence, ceremonial, social and commercial fisheries of the Saugeen River, Lake*

Huron, and Georgian Bay.” This collaboration meant there was an equitable relationship between SON and GLFC where SON had control in the process. “We used our normal due diligence to make sure that the project was sound, technically, but then the “how” we would go about implementing that was very much done hand in hand” (Lambe, GLFC, Executive Secretary).

Collaboration also includes discussion around GLFC acting as an intermediary between SON and DFO and NDMNRF as all parties collaborated with/through GLFC in order to get the project done. *“What was really successful was once we kind of got to the right people, we were able to use the Commission as a kind of intermediary to work with SON, DFO and the province to move things forward at a much faster rate” (Hrodey, GLFC).*

Sanchez (of Sanchez Engineering which oversaw the design of the DDR) explained the difference between the approach to collaboration with the SON that the GLFC and NDMNRF took. *“When the Great Lakes took it over as a lead agency, and they worked with SON very well. And the thing was... SON was part of the team, like in the first part we what we did in 2008 was we are doing all this work and then we presented what we had done. But the Great Lakes, essentially, they brought SON reps in, and they were part of that advisory technical committee. They participated in everything. So I think it's a big difference in that respect. And it was very helpful because they knew exactly what we were doing, and we knew what they were thinking at all times. That was very helpful. I like that method.”* The topic of collaboration appeared in 71% of interviews and 100% of reports and often grouped with bridging knowledges (27%).

5.3.3.3 Agreeing on the Problem/Mutual Understanding of the Importance of the Dam

There was agreement between the GLFC and SON that sea lamprey in the Saugeen River was a huge problem which created a mutual understanding that Denny’s Dam needed to be rehabilitated. For the SON, the dam was important for controlling sea lamprey because sea lamprey would stress SON fisheries and native species and the spread of sea lamprey would threaten SON culture, ceremony, and

food. SON's support for the DDR needed to occur in order for the project to go forward, so this agreement on the problem and mutual understanding of the importance of rehabilitating Denny's Dam was essential. Ryan (SON, Consultant) further explained this and provides an illustrative quote on why the process to rehabilitate Denny's Dam needed to happen. *"There was never a question do we need to rehabilitate it? Of course, we do. We don't want anything happening to the river and we don't want to see lamprey getting into the upper reaches of the Saugeen. So that was good, and we all agreed, at least on that point. It was just a matter of how we do the project in a way that upholds SON Aboriginal and treaty rights, which include that access to and way of life components."*

Before construction of the DDR could start there were concerns about the DDR and its impact on the Saugeen River ecology and SON community that needed to be addressed. The Land Use and Occupancy Study (LUOS) summarized typical sentiments about SON support of the DDR and questions about the project. *"In general, many participants supported the Project as they understand the value of rehabilitating the dam, the importance of the dam as a sea lamprey barrier, and the consequences if the dam were to collapse, both relative to sea lamprey, safety, and the potential release of silt from above the dam. However, most participants expressed concern regarding the proposed changes to occur directly below the dam, as well as regarding impaired access to the River, leaving many participants with outstanding questions and concerns about the Project."* Agreement on the problem and mutual understanding of the importance of the dam appeared in 50% of interviews and 33% of reports. It was often grouped with the following sub-themes: bridging knowledges (62%); co-developing questions & project parameters (43%); and, collaboration (29%).

5.3.3.4 Community Meetings to Address Questions, Concerns, and Build Relationships

There were a couple of community meetings between GLFC representatives, SON community members, SON Environmental Office staff, and others working on the project to explain what the DDR was, build relationships, and field questions about the project and its impacts on the Saugeen River. This

was a commitment laid out in the SON-GLFC Agreement to ensure the SON community could raise questions about the project and learn about what was happening. A community meeting to address concerns occurred after the LUOS and largely included participants from that study, *“Most participants had questions, concerns and recommendations for the Project to be addressed by GLFC at the community meeting” (LUOS)*. These community meetings were often a highlight for a number of the GLFC staff who attended, and they were important for building trust in the community and making sure that everyone’s concerns about the project were addressed before the project went forward. *“I think the community meetings definitely helped” (Hrodey, GLFC)*. *“It was very well handled that like it was a presentation from SON and us to the community rather than from us to SON and the community, which I think is very important, was very important in the success of the project” (Sanchez, Engineer)*.

Burkett (GLFC, Sea Lamprey Program Director) further explained, *“Over the course of that first public meeting, we made our presentation, we listened to and fielded all concerns. The whole thing started with a water ceremony where we were saged and there was a prayer. A Waterkeeper did a prayer for the project, for the river, for the fish, for us. It was good in our view because I think that as the project developed and with the communication that we had with the community, I think at least from our perspective at the Commission, from my personal perspective, a large degree of trust was developed. After we did our presentations and answered all of the questions, we then had a meal.”* Mentions of community meetings to address questions, concerns, and build relationships occurred in 79% of interviews and 67% of reports.

5.3.4 Funding and Capacity

The funding and capacity theme relates to the funding GLFC made available for SON throughout DDR in order to complete the project. Partly, the GLFC’s flexibility to fund meals or certain studies were seen as a unique aspect of the organization unlike governmental bodies that have more monetary restraints. As funding and capacity is an issue for all First Nations, including SON, it was essential that

funding, equipment, and capacity were provided in order to conduct studies and for SON to have experts review the work GLFC suggested. *“The GLFC said, we’ll pay for whatever you know, we’ll cover the costs of whatever is required to do this project and the way that it needs to get done” (Ryan, SON, Consultant).*

Likewise, GLFC saw funding of studies and other expenses related to SON knowledge and involvement as an investment because it was essential to the project. *“We could easily see how reimbursement for the First Nation was a good investment for us going forward and being able to use the traditional knowledge and perspectives that First Nations had to help inform how we would approach this project from many points of view” (Lambe, GLFC, Executive Secretary).* This promise of funding was built into the SON-GLFC Agreement which set the parameters for the project. *“As much as possible, involve members of the First Nation in the decision-making process, and if they lack capacity, make efforts to provide it. That was a key feature of the SON-GLFC Agreement, and it was a game changer” (Sullivan, DFO, Division Manager).*

Topics of funding and capacity appeared in 86% of interviews and 67% of the reports with a total of 60 references. It was often grouped with the other sub-themes of studies (32%), bridging knowledges (32%), documenting/mobilizing knowledges (27%), and SON-GLFC Agreement (25%).

Ryan (SON, Consultant) gave an illustrative quote about the importance of funding and the underfunding that First Nations experience when implementing projects; *“the way that First Nations governments are set up, the way that we operate, the way that we’re underfunded. The way that we have all and this is ubiquitous - I would say this is something that is not unique to SON, this is a shared experience - anyone trying to be deeply involved in the activities and projects in their territories is overwhelmed, underfunded, does not have the capacity in terms of people in the communities who*

would be capable, has the capabilities but not the funding, doesn't have the financial resources to support the level of work required to do all of this really well."

5.4 Knowledge Coexistence

Knowledge coexistence was a major theme that emerged from coding the data, as participants and reports provided latent and explicit examples of knowledge coexistence in the DDR, as well as wider considerations of knowledge coexistence in sea lamprey stewardship. *"I think there's a lot to be gained by including Indigenous perspectives in sea lamprey control, planning and delivery. We're working on that through agreements right now. But on a larger scale, making sure that perspectives and understandings are understood and embraced early in planning processes"* (Burkett, GLFC, Sea Lamprey Program Director).

Other typical statements about knowledge coexistence included how the DDR taught GLFC representatives to better bridge knowledge systems, *"I think the work that we did, the constant almost daily, certainly weekly work that we did with First Nation helped us understand how traditional knowledge can be applied in a different way than the traditional [Western scientific] methodologies that we had been applying to projects"* (Lambe, GLFC, Executive Secretary). The knowledge coexistence approach in the DDR showed the GLFC the importance of Indigenous Knowledge in sea lamprey stewardship. *"I think the lesson learned is that we have to recognize the need to treat First Nations as Nations and work and negotiate more directly with them and be prepared to understand the value of bringing the kind of knowledge that they can bring to the conversation as part of the solutions and how we do things sort of going forward. So it certainly increases your level of effort, but it's a great investment that pays big dividends once you figure out a way to find the resources to do that"* (Lambe, GLFC, Executive Secretary).

Understanding how knowledge coexistence was built into the DDR project development process and relationship-building helps to see how knowledge coexistence is a mechanism for partnership. For

example, a realization of knowledge coexistence can be found in the studies that were conducted during the DDR and how they used Indigenous Knowledge and western scientific data to make recommendations for the project. This section further explains how knowledge coexistence appeared in the DDR by first reviewing the DDR studies, providing examples of bridging knowledges in DDR, and then a brief discussion of Two-Eyed Seeing in the data (see Table 4). Knowledge coexistence appeared in 93% of interviews and 100% of reports with a total of 239 references. This is the third highest number of references as compared to the other main themes. It was often coded with influential relationship-building factors (54%) and context & considerations for fisheries and sea lamprey stewardship in the Great Lakes (29%).

Theme	Sub-themes	Category
Knowledge Coexistence	Studies	Land Use and Occupancy Study
		Fish Community Assessment
	Bridging knowledge systems	Co-developing questions/project parameters
		Documenting/mobilizing knowledge
		Co-producing decisions/insights
	Two-Eyed Seeing	

Table 4. Theme Breakdown: Knowledge Coexistence

Lauzon (SON, Fisheries Biologist) provided an illustrative quote about how knowledge coexistence in sea lamprey stewardship would improve decisions on a basin-wide level by saying, “*I think that by having First Nations there, as decision makers and partners to offer their knowledge...for one it’s going to be much more inclusive. For two, I think that there will be much better decisions made in the future with more perspectives. I think that there’s great things that can come from Western Science and Western philosophies, but there’s also some large holes that are left there that maybe we get too caught up in one particular perspective and narrative and are not looking at a broader picture that could*

really help us be better stewards of the lake and live in a way that's better for everybody, including each other and including the natural environment, the fish."

Burkett (GLFC, Sea Lamprey Program Director) provided an illustrative quote about the internal personal work needed when Western Science trained professionals engage in knowledge coexistence, *"I think if I use listening to the Waterkeeper as an example. My background is hardcore science training and then overlaid by years of management biology, administrative biology, policy biology, etc. And so, unloosening all of those bolts and really listening to the Waterkeeper, and then cross interpreting what was being said with my understanding of aquatic ecology and science and all of those things, I think that that internal translation series of events was probably the biggest personal learning."*

Lacroix (NDMNRF) offered an illustrative quote about knowledge coexistence and the need to find an ethical space to come together, *"To have that medium ground to understand that there's two knowledge systems and those two knowledge systems together are better than one singular."*

5.4.1 Studies

Several studies and reviews were conducted during the DDR to generate data to inform decisions about construction and mitigation measures. Two of the main studies were the LUOS (Ryan, 2017b) and the Fish Community Assessment (Ryan, 2017a). Other studies included an archaeology study, engineering review, and a review of important medicines and vegetation near the dam by an Indigenous Knowledge Holder. These studies were laid out in the SON-GLFC Agreement (Aboriginal Consultation and Accommodation Agreement, 2017) as necessary to gather the information needed for the SON and GLFC to make decisions about the project. The SON-GLFC Agreement was created between the SON and GLFC to set the parameters for the project and partnership. The SON-GLFC Agreement was not classified as a study in this research, but it was one of the three reports analyzed in this research and

discussion about its importance in the DDR appeared in 64% of interviews and 33% of reports and it was often grouped with bridging knowledges (63%) and co-developing questions (37%).

The LUOS and Fish Community Assessment were the other two reports analyzed for this research and are analyzed qualitatively below (see 'DDR Report Themes and Sub-themes' section for a quantitative analysis of the three reports). Overall studies conducted for DDR appeared in 86% of interviews and 100% of reports with a total of 145 references. Studies were often co-coded with bridging knowledges (86%), documenting/mobilizing knowledge (68%), and co-producing decisions (28%).

5.4.1.1 Land Use and Occupancy Study

The LUOS was often discussed by participants as being vital for the DDR and the partnership between the SON and GLFC. *"[If] that study had not been done. I don't believe the project would have been successful"* (Freiburger, GLFC, Sea Lamprey Control Program Manager). Within the LUOS members of SON were interviewed and asked about their knowledge and activity within the vicinity of the dam in order to map the use of the area. This included activities such as fishing, hunting, gathering/harvesting, and ceremonial/cultural/spiritual connections. Also, occupancy such as overnight uses were discussed. *"It was an interview process again with a lot of maps and that. And had me referring back to my old memories where I had started fishing, whereabouts I harvested, what species were there at the time, the evolution of climate change (things have shifted around- new species are coming in), and we just went back and forth for - about an afternoon was spent on that. It produced actually a pretty nice map, and when it was all done, it had place, times, dates, that sort of thing on it"* (Roote, SON, Community Member).

This study generated maps that were rich in data and was integral for mitigation measures. A total of 13 participants generated 800 features across the study area. *"The granularity of the information that came out of that [LUOS], the relationships that it established, the trust that it built were*

pretty amazing” (Burkett, GLFC, Sea Lamprey Program Director). This area was very important to the participants for fishing both for personal consumption, commercial, and cultural connection. The information, maps, and recommendations generated from the LUOS were used to inform DDR decisions. *“Basically what we did is we took the results of that land use and occupancy study and summarized into some sort of questions that community members had and recommendations that we formulated” (Ryan, SON, Consultant).* Some of these recommendations included: construction being limited to summer months; no blocking of access routes to the river; fish habitat below the dam must be rehabilitated; ensure the safety of the site for children; SON representatives monitoring construction; employment opportunities for SON members; and, post-construction monitoring, etc. These recommendations were implemented and the LUOS was seen as essential for this. *“Having that information and having that map was definitely vital to that and also just the replacement of things. If we did have to move something, having a map so that we could put it back, where it needed to go was, that stuff was very invaluable” (Hrodey, GLFC).* Discussion about the LUOS appeared in 71% of interviews and 100% of reports. It was often grouped with bridging knowledges (84%), documenting/mobilizing knowledge (71%), and co-producing decisions (26%).

5.4.1.2 Fish Community Assessment

The Fish Community Assessment study was done in partnership with SON and DFO while funded by the GLFC. It was a fish population assessment around Denny’s Dam with special attention to the area immediately below the dam. It used scientific instruments and methods (e.g. fyke nets and backpack electro-fishing survey techniques) to determine fish populations and to document the baseline condition in order to understand potential impacts from construction and create mitigation measures. *“They [DFO] did electro-fishing above and below this, and then we did our sampling techniques above and below the dam. We got some really good baseline data there about what the fish community and the state of the habitat was” (Ryan, SON, Consultant).*

DFO shared equipment and resources with the SON in order to conduct this study, and there were opportunities for SON youth to be involved. *“We did provide some opportunity for some youth that they'd hired, as well as to view some electro-fishing surveys so that their youth could get there, at least the experience of seeing them and then helping us process the fish as well, which was kind of cool” (Anonymous).*

A total of 1,808 fish were recorded representing 37 different species, two of which were species at risk. The area immediately below the dam was of concern because of its importance to fish habitat. The study's recommendations included: avoid filling pools below the dam; SON monitoring of the construction; post-construction monitoring program; and, that the construction design would not be finalized until the LUOS report was completed and discussed. The Fish Community Assessment was very important for the DDR as it provided scientific data to form a baseline condition which was necessary for the project to move forward. *“Given my knowledge of how it played out. There wasn't concurrence or there wasn't the ability to move forward with this project until the TEK was done, until the aquatic resource study was done, and so I would say... that it was of critical importance for that piece to be completed before a decision could be made” (Anonymous).* The Fish Community Assessment appeared in 43% of interviews and 67% of reports. It was often grouped with bridging knowledges (90%) and documenting/mobilizing knowledges (41%).

5.4.2 Bridging Knowledge Systems

Bridging knowledge systems role in knowledge coexistence is important because it brings knowledge systems together while keeping them distinct. It is not comparing the systems to one another to determine their validity but respecting what both brings and teaches. Within the interviews and reports, 'bridging knowledge systems' refers to explicit and latent discussion of bringing Indigenous Knowledge and Western Science together, while keeping each distinct, in order to make decisions, understand a problem, set the scope of the DDR, and more. References to bridging knowledges is

broken into three categories: co-developing questions/project parameters, documenting/mobilizing knowledge, and co-producing decisions/insights (see Reid et al., 2021 and Tengö et al., 2014). Bridging knowledges appeared in 86% of interviews and 100% of reports with a total of 174 references. It was often coded with LUOS (44%) and studies (71%).

Lauzon (SON, Fisheries Biologist) provided an illustrative quote about bridging knowledge systems in invasive species stewardship, *“I think that by solely focusing on the Western Science, management and control narrative and perspective, I think that there's some really important perspectives that have been left out that might shape a new way of looking at invasive species. And perhaps those kinds of new perspectives are needed to be able to adapt as our world changes.”*

5.4.2.1 Co-Developing Questions/Project Parameters

A part of bridging knowledge systems in co-produced projects includes the joint setting of the project parameters (Cooke et al., 2021). This could mean co-developing questions that the project would address and/or defining the problem that would be worked on together. This sets the stage for the documenting/mobilizing of knowledge because it asks the questions that need to be answered and how a partnership will function to carry out the task. For example, at the beginning of DDR, GLFC met with SON to determine how the project would be carried out, *“Then we did approach the SON leadership to try to understand more in detail what the issues were. They became great partners. They were very open about what the problems were and what needed to be done to try and get things back on track”* (Lambe, GLFC, Executive Secretary). A part of this was agreeing on the importance of rehabilitating Denny’s Dam because sea lamprey would be a problem if the dam failed. *“Then GLFC basically wanted to sit down with SON and figure out what would a good path forward for this project be considering that we all felt it was important to do the project because of the sea lamprey barrier”* (Ryan, SON, Consultant).

While there was agreement that Denny’s Dam needed to be rehabilitated there were many questions and information needs that were developed before a final decision and construction could

commence. *“We wanted a sea lamprey barrier in place. It was just the way that the project had to go forward to make sure that it was protecting both SON's rights and interests, but also protecting the integrity of the river, including ecological knowledge from Saugeen Ojibway Nation members and making sure that the project wasn't going to affect any access, I guess, to the river” (Ryan, SON, Consultant).* Moreover, Ryan stated *“The first thing we thought is we need to do a baseline inventory or a baseline fish community and habitat assessment in that area. So we know what's there and we know if there's any adjustments that need to be made for the project to ensure protection of sensitive species or sensitive life stages of species.”*

These discussions led to the signing of the SON-GLFC Agreement which laid out the project parameters. The SON-GLFC Agreement was created by SON and the GLFC to help answer the questions SON had about the project and to jointly set a path forward. In speaking about the SON-GLFC Agreement Sullivan (DFO, Division Manager) shared common sentiments, *“These discussions led to the signing of a Consultation and Accommodation Agreement between SON and the GLFC on June 22, 2016. It addressed many of SON's concerns, including engagement with the community and building capacity to conduct studies in the vicinity of the dam, including a fisheries and ecosystem study, and archeological investigations. It provided SON landholders and knowledge keepers with the opportunity to provide input on certain heritage issues, including the presence of medicinal plants in areas adjacent to the dam.”* Sullivan further explained, *“the agreement certainly entrenched the requirement for the use of traditional knowledge in making decisions around the reconstruction project. Its value can't be overstated, and the project wouldn't have gone ahead otherwise.”* Examples of co-developing questions/project parameters and defining the problem appeared in 64% of interviews and 67% of reports. It was often co-coded with documenting/mobilizing knowledge (53%), studies (50%), co-producing decisions (39%), communication (41%), and LUOS (26%).

Ryan (SON, Consultant) provided an illustrative quote on this process of working together to set project parameters, define the problem, and to co-develop questions by saying, *“I'm learning that the best way to do Two-Eyed Seeing or to build a successful process, which is what we did with GLFC, is to really sit down on the ground level and say, like, what are we trying to accomplish here? Or like, what is the project? What is the thing we're doing and then build it from there? How do we engage all these different things? How do they work together?”*

5.4.2.2 Documenting and Mobilizing Knowledge

Documenting and mobilizing knowledge refers to the process of collecting Indigenous Knowledge and Western Science and using it to inform decisions and insights (Tengö et al., 2014). It is the documenting of knowledge – either Indigenous Knowledge or Western Science – or the use of instruments to generate data. Examples of documenting and mobilizing knowledge mostly related to discussion about the LUOS and Fish Community Assessment which were studies that recorded scientific data and Indigenous Knowledge to inform decisions. Ryan, (SON, Consultant) explained, *“we really wanted to focus on people's use, current and past use of that area and the bits of knowledge they had about the ecology of that area that would help inform that snapshot in time with the scientific baseline data collection we did. That's why those things are so complimentary – is because DFO had done some work and then we said, oh, we got to quickly do a baseline here and we did it well, but then we're missing all of that in-between information, the richness and the depth information that we need about change over time.”* These information sources (LUOS and Fish Community Assessment) were mobilized to formulate recommendations, *“We used the baseline aquatic science report and the land use and occupancy study to formulate some recommendations of how we thought the project would best move forward”* (Ryan, SON, Consultant).

The Fish Community Assessment used Western Science methodologies and scientific instruments while the LUOS encompassed SON knowledge and experience in the DDR area. Lauzon

(SON, Fisheries Biologist) shared a typical perspective of how SON knowledge was used in the DDR and LUOS, *“I would say that SON's knowledge was largely used to determine what the impacts might be from the project and how to best mitigate those issues that would be, I would say, where SON knowledge largely came in.”* In relation to documenting/mobilizing knowledge many participants spoke about how experts should stick to their respective areas of expertise and then come together in a respectful way to learn and understand another's data. *“The way we kind of split up the project, I think that kept...the Indigenous Knowledge parts of the projects separate from the work I was doing, which I think was probably the way it should be”* (Anonymous). Examples of documenting/mobilizing knowledge appeared in 79% of interviews and 100% of reports. It was often grouped with studies (76%), LUOS (51%), co-producing decisions (37%), and co-developing questions (27%).

Ryan (SON, Consultant) further explained in this illustrative quote why it is so important to have both scientific data and Indigenous Knowledge, *“The people who are experts about the dam below the Saugeen River are the people that go there every day and have for the last 40 years of their lives, they know. I am an ecologist and I get stuff about fish, but I don't know that area, and I don't have a relationship, a deep relationship with that area in the same way that other people do.”*

5.4.2.3 Co-Producing Decisions/Insights

A part of bridging knowledges is the co-production of decisions or insights from the knowledge systems used. On a broad scale, co-decision making was present throughout the DDR, *“One of the most important or key decision that they probably made was that they put it in SON's hands and SON laid out the process and that was the one that the GLFC and SON followed”* (Lauzon, SON, Fisheries Biologist). This co-decision making and partnership at the beginning of the project set the foundation for other co-decision making throughout the project such as the implementation of mitigation measures as recommended by the studies. *“We worked with Great Lakes Fishery Commission and the engineer on the project in order to make sure that all of the sort of conditions or recommendations we had put forward*

[were implemented] - because when I say recommendations, they're really conditions. These were things that were not negotiable" (Ryan, SON, Consultant). Burkett (GLFC, Sea Lamprey Program Director) elaborated on this idea and encompassed how many non-SON participants spoke about how Indigenous Knowledge was used in decisions. "Principally when we went to restore the site after construction, that study [LUOS] drove that restoration. And also, during, I think that it resulted in relocation of traditional medicinal plants. Which was very important and also the archeology study helped us avoid some issues with respect to remains and things like that."

Sanchez (Engineer) explained another example of a co-produced decision that several participants talked about. *"The other part that the SON wanted us to do, and we had it in the first contract, was having a clause asking the contractor to make sure that they have SON contractors. Contractors who were a part of SON and that worked very well actually, and in the contract, there were a few crews that were and companies that were Native or run by members of SON. So that was, that was very good."*

The studies also helped inform SON leadership in order to make a final decision about the DDR. *"Basically, the land use and occupancy study and the work that the experts did that all kind of went to the Joint Chiefs and Councils and they essentially decided to move ahead with the project, providing that the mitigations and everything was taken into account so that the key things that SON was concerned about, those issues were addressed" (Lauzon, SON, Fisheries Biologist).* Examples of co-decision making and sentiments about the importance of making decisions together appeared in 71% of interviews and 100% of reports. It was often grouped with studies (65%), LUOS (38%), documenting/mobilizing knowledge (37%), and co-developing questions (41%).

5.4.3. Two-Eyed Seeing

While Two-Eyed Seeing was not explicitly discussed/asked about in most interviews, a few participants shared direct insights. Even though Two-Eyed Seeing was not a major sub-theme in the data

some of the quotes made by participants are displayed below to offer insight into its implementation in the sea lamprey control program. LaCroix (NDMNRF) described discussions around Indigenous Knowledge and Two-Eyed Seeing in GLFC Committees (e.g. Council of Lake Committees, Lake Huron Committee), *“I think the Commission themselves have to get their head wrapped around this idea [Two-Eyed Seeing] because it's... I'm not saying that it's new, but it's definitely a different way of managing things. And I think some of the scientists and academics have to get there. I guess they have to be schooled and be immersed in that culture a little bit to understand how it benefits the purpose of what you're trying to accomplish.”*

Ryan (SON, Consultant) provided insight into how to approach Two-Eyed Seeing and the importance of establishing it early in a project, *“The Two-Eyed Seeing to me is it's not only saying there's two knowledge systems, there [are] two sources of knowledge and how do we make a decision about this project based on two knowledge systems or two eyes. To me, it's more like, how are we changing the way that we're approaching these systems based on just getting this Two-Eyed thing?”*

“I think from this project what I learned is that the best way to do Two-Eyed Seeing or whatever, however you want to characterize it is to build it from the beginning in that way” (Ryan, SON, Consultant). Explicit mentions of Two-Eyed Seeing appeared in 36% of interviews and 0% of reports with a total of 15 references. It was often grouped with bridging knowledges (53%), documenting/mobilizing knowledge (47%), co-developing questions (40%), early engagement (27%), and co-producing decisions (27%).

5.5 Impact & Legacy

DDR was seen as a great example of a partnership with an Indigenous community by non-SON participants, *“Basically, bringing people together to get things done and in a way that respects all of their interests. I think that this interaction with the SON clearly was probably the best experience I ever had doing that from start to finish”* (Burkett, GLFC, Sea Lamprey Program Director). Because of this,

participants discussed how DDR contributed to changes in their organization or personal lives in how they approach sea lamprey stewardship with other Indigenous Nations. *“Our relationship and experience with SON on the Denny’s Dam project has led to, I think, positive outcomes with other First Nations” (Anonymous).* In addition to influencing how it approaches Indigenous Nations, the DDR led to a SON Elder sitting as an advisor in the GLFC Committee of Advisors. *“The relationships that were built for the project go well beyond the project and continue to foster how we work with Indigenous communities and not just projects in rivers, but how we approach coordinating fisheries management within the basin” (Lambe, GLFC, Executive Secretary).*

The impact of DDR on the fisheries organizations influenced how they approach and partner with other First Nations in sea lamprey stewardship. *“I’ve seen a shift in the way we work with First Nations and building those relationships since the work that we did with SON back starting around 2016 - definitely seen a big change in the way we operate” (Anonymous).* Burkett (GLFC, Sea Lamprey Program Director) also explained about a particular instance of how lessons learned from the DDR impacted a sea lamprey control project with other First Nations, *“I think that our experience, our overarching experience with SON helped very much with understanding where both Garden River and Mississauga were coming from and how to be much more effective in working with them to achieve mutually beneficial results.”*

At SON the impact & legacy of the DDR is more complex. A major goal of the DDR and the studies was to minimize impact to the environment and ecology around the dam and SON members’ use of the area. However, in the one interview with a participant of the LUOS, it was recorded that the area immediately below the dam was altered by the DDR. This had affected where fish gathered while population size was not observed to change. Roote (SON, Community Member) reflected on changes made to the area immediately below Denny’s Dam after the rehabilitation, *“there’s a big gravel area there now where the fish used to collect behind these boulders, and it was like a rest area before they took another run at the dam. So that’s gone now for the big part. So they’re collecting in different areas,*

so we have to kind of learn it all over again. Every year I go down and I knew I could catch them in one shadow area and there'd be fish living there." He went on to explain how this affected his use of the Denny's Dam area, *"because I started fishing the old deeper holes, I got away from the dam area."* He further explained about the changes, *"We had to adapt to it. We learned to fish other areas"*. However, SON Environment Office employees working on the DDR were not aware of this impact and thought there were no major changes.

As well, there are sentiments from SON representatives that the relationship between SON and GLFC has improved because of the DDR but there is still a lot of work needed to be done on a Great Lakes basin-scale to include First Nations' perspectives in sea lamprey stewardship. Lauzon (SON, Fisheries Biologist) provided an illustrative quote about the partnership between SON and GLFC and First Nation representation at the GLFC by saying, *"I would say that this whole process perhaps started the GLFC and Ontario towards maybe a different path that they had taken in the past. I foresee that First Nations are going to be very much more involved in a leadership role in the future and making decisions about what's called sea lamprey control and I don't think that there is any way that things are going to go back to the way that they used to be, where these kinds of organizations basically had all the power and made the decisions solely on their own."* Lauzon additionally stated, *"It seems like things are starting to slowly change within the culture of the GLFC. And then I would say that SON is still, or any First Nations are still, not decision makers within the GLFC by any means and still not part of that. But it seems like there is some initial thawing to the original complete exclusion and that perhaps there might be a different way forward, time will tell."*

The theme of impact & legacy appeared in 93% of interviews and 0% of reports with a total of 88 references. It was often grouped with influential relationship-building factors (63%), context & considerations for fisheries and sea lamprey stewardship in the Great Lakes (44%), and knowledge coexistence (39%).

5.6 Conclusion

The DDR was seen by interview participants as a successful partnership between the SON and GLFC that allowed this sea lamprey control method to be rehabilitated. This is significant because the DDR originally started with conflict as the provincial NDMNRF did not properly consult with SON which led to the project being delayed until the GLFC got directly involved and formed a partnership with SON. Influential relationship-building factors that contributed to this partnership include: meaningful communication, funding and capacity, duty to consult considerations, and early engagement.

As well, a knowledge coexistence approach to the DDR served as a mechanism for partnership because Indigenous Knowledge and Western Science were used to guide the project, conduct studies, and make decisions. Knowledge coexistence was built into the DDR which created an equal platform for SON and GLFC to bridge knowledges and work together. The LUOS, Fish Community Assessment, and the SON-GLFC Agreement were key documents made during the DDR, all of which are predominately made up of references to bridging knowledges such as co-producing questions/project parameters, documenting/mobilizing knowledge, and co-producing decisions and insights.

The legacy and impact of DDR resulted in changes to how the various fisheries organizations engage in sea lamprey control with other First Nations and it changed the dynamic of the SON-GLFC relationship. However, there are still concerns about the impact of DDR on fishing locations/fish habitat in the Saugeen River and the level of First Nations engagement and decision-making power in sea lamprey stewardship in the Great Lakes.

More widely, there are concerns about the impacts of climate change on sea lamprey stewardship and declining support of the social license of the program – especially amongst Indigenous Nations. These challenges, and others, are indicators that the GLFC and other organizations need to re-evaluate how they approach sea lamprey stewardship with Indigenous Nations. The lessons learned from the DDR on knowledge coexistence and relationship-building can serve as tools in this re-

evaluation and improve partnerships with Indigenous Nations in sea lamprey and other invasive species stewardship.

6. Discussion

Actors in invasive species stewardship need to engage and partner with Indigenous Nations and Indigenous Knowledge systems in order to respect Indigenous rights and use all relevant information available to make informed decisions. Specifically, sea lamprey stewardship in the Great Lakes needs to re-imagine how it engages and partners with Indigenous Nations and Indigenous Knowledge systems on a basin wide scale. The Denny's Dam rehabilitation (DDR) is an example of a successful partnership between the GLFC and the SON that can help guide future partnerships in sea lamprey stewardship and improve current ones. Likewise, lessons from the DDR in knowledge coexistence provides insight into the application of a Two-Eyed Seeing framework to sea lamprey stewardship projects.

Engagement with Indigenous Peoples is especially important in light of mounting imperatives in legal and political spheres to equitably engage Indigenous groups and Indigenous Knowledges in resource management (Ogar et al., 2020; Reid et al., 2021). Some of the legislative imperatives for Indigenous inclusion come from UNDRIP. UNDRIP is an international resolution adopted by the United Nations to establish a framework of minimum standards, "for the survival, dignity and well-being of the Indigenous Peoples of the world" (United Nations General Assembly, 2007). UNDRIP lays the foundation for Indigenous Knowledge holders to have a rightful place at the decision-making table, and to oversee how Indigenous Knowledges/Traditional Ecological Knowledge (TEK) is used, owned, and applied. Indigenous rights, as enshrined by UNDRIP, assert that fisheries stewardship and decision-making require the free, prior, and informed consent of Indigenous Peoples (Articles 19/25/26), and for Indigenous Peoples to participate meaningfully in decision-making, with full determination as to how (their) knowledges are interpreted and applied. For the GLFC and federal/state/provincial governments

active in sea lamprey stewardship this necessitates consent and shared decision-making from Indigenous Nations in control projects within their Territories.

The following discussion section seeks to answer the three research questions identified at the outset and make recommendations for the improvement of sea lamprey, other invasive species, and fisheries stewardship in the Great Lakes. First, the four main themes from the data and their relationships to each other will be discussed. Second, the first research question will be addressed individually to provide lessons learned about building relationships between Indigenous and non-Indigenous groups in sea lamprey stewardship. Third, the second and third research questions will be addressed together to provide insights from the DDR about knowledge coexistence and Two-Eyed Seeing in sea lamprey stewardship. Last, recommendations are provided.

6.1 Gears for Collaboration

Figure 13 displays the four main themes from the case study data as interconnected gears in a circular arrangement where context sets the stage for relationship-building factors which in turn influences knowledge coexistence. Knowledge coexistence influences impact & legacy which circles back to context & considerations. Elements of this model reflects aspects of Ansell & Gash's (2007) Collaborative Governance model (Figure 1). Starting conditions and variables (e.g. facilitative leadership, institutional design) influences the collaborative process (Ansell & Gash, 2007). Similarly, the context for DDR where NDMNRF failed to properly consult the SON, created an environment where the GLFC could come in as a third party and practice facilitative

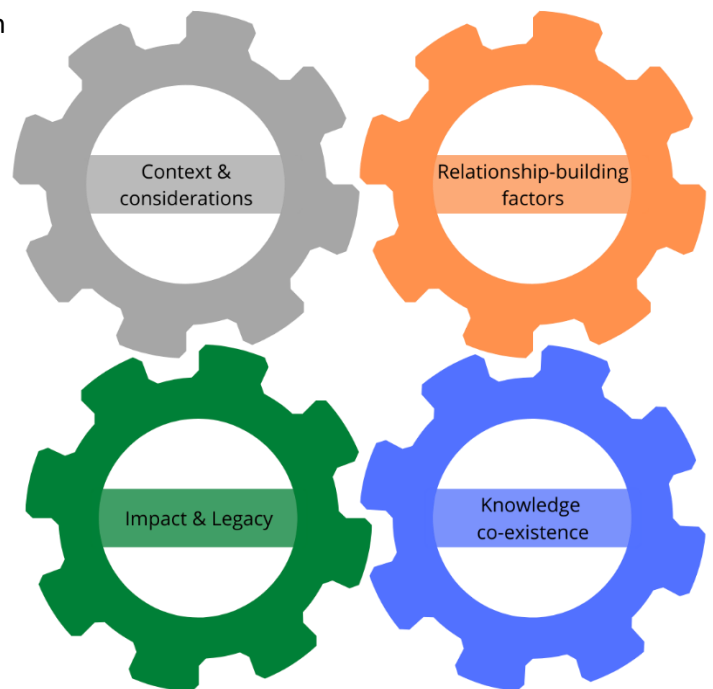


Figure 13. Gears for collaboration in sea lamprey stewardship as seen in the DDR case study. Source: the author

leadership to build a partnership with the SON to rehabilitate the dam. This context created the conditions and necessity for a relationship between the GLFC and the SON to form in order to rehabilitate the dam because it was in desperate need of repair.

Ansell and Gash's (2007) collaborative process is non-linear and can be simplified into stages of face-to-face dialogue, trust building, commitment to process, shared understanding, and intermediate outcomes. These stages echo different elements of the key relationship-building factors identified in the data (to be discussed more later). Relationship-building factors such as going beyond duty to consult obligations, early engagement, meaningful communication, and funding/capacity drove the partnership between the GLFC and SON and helped it to become mutually beneficial. This relationship laid the foundation for knowledge coexistence where SON knowledge and Western scientific data could be used in parallel to make decisions about the DDR. The relationship-building factors created an environment of respect and trust which helped to create an ethical space (Ermine, 2007) from which knowledge coexistence could be practiced.

While Ansell & Gash's (2007) model does not encompass the dynamics of a collaborative process involving different knowledge systems, Emerson et al., (2012) created an Integrative Framework for Collaborative Governance (see Appendix C) which includes knowledge as a part of the model under the element of capacity for joint action. The capacity for joint action is one component of their model's collaborative dynamic which in turn produces collaborative actions which serves the goals of the collaboration. In Emerson et al.'s (2012) model, knowledge is seen as the currency of collaboration where knowledge is generated, aggregated, and reassembled. In Tengö et al.'s (2014) multiple evidence base approach (see Figure 2 and Appendix A), an enriched picture of understanding is created when different knowledge is assessed equally. However, this must be based in collaboration that starts with the co-production of questions, goals, and problem definition before documenting and mobilizing knowledges for an enriched picture which is followed by the co-producing of insights and decisions (e.g.

joint analysis and evaluation, generation of new knowledge) (Tengö et al., 2014). Both of these models root the sharing or generation of knowledge within a collaborative process where there is trust and respect between parties.

In the DDR, the learnings from the relationship-building factors and knowledge coexistence resulted in changes to how the different sea lamprey control actors approached and worked with Indigenous Nations in other control projects. This set the context for other sea lamprey control projects and the GLFC-SON relationship. The impact & legacy of the DDR may also potentially influence sea lamprey control actors' response to some of the key challenges in sea lamprey control: climate change and social license. In the Tengö et al., (2014) model, feedback throughout the bridging knowledges process informs current and future processes. As well, in Emerson et al.'s (2012) model, adaption to impacts resulting from joint action is built into the model which can alter the general system context and the collaborative governance regime as new or different challenges arise. Likewise, the legacy and impact of the DDR changed the SON-GLFC relationship and influenced how DFO and GLFC approached other sea lamprey control projects with Indigenous Nations.

6.2 Lessons learned – Relationship-Building

In response to research question #1, the four relationship-building factors identified in the results – going beyond duty to consult obligations, early engagement, funding & capacity, and meaningful communication – signify lessons learned regarding relational aspects of the DDR. These factors significantly improved and maintained the partnership between the SON and GLFC. While the lessons learned are divided into sections according to the four relationship-building factors, they are interwoven amongst each other and the other themes: knowledge coexistence, context & considerations, and impact & legacy.

6.2.1 Going Beyond Duty to Consult Obligations

The first factor or lesson learned is the importance of going beyond duty to consult obligations to meaningfully partner and share decision-making power in a project. This is related to the second lesson learned – early engagement. Within the DDR, SON was brought into the process early in the planning stages of the project which allowed for SON and GLFC to work together to co-develop questions and set project parameters through the SON-GLFC Agreement. In this way, consultation was not just a legal obligation or ‘checking of a box’, it was deliberate and respectful collaboration. As well, this ensures there is free, prior, and informed consent and adherence to UNDRIP. This mirrors von der Porten’s et al.’s (2015) recommendation of not treating Indigenous Nations as mere stakeholders, rather upholding their inherent rights and decision-making power within their Territories.

However, given sentiments shared by GLFC representatives that consultation is not a ‘duty’ rather it is something that the GLFC just does, raises questions of whether the GLFC’s initial engagement was a result of the culture of how GLFC engages its stakeholders rather than recognizing the distinct and inherent rights of Indigenous Nations. GLFC’s focus on “collaboration, coordination, communication, and cooperation” means that engagement with ‘stakeholders’ may passively recognize Indigenous rights but it does not explicitly do so. SON representatives highlighted the need for the DDR to uphold SON Aboriginal and treaty rights and that this was worked into the project as seen in the SON-GLFC Agreement. Therefore, the DDR inherently went beyond duty to consult obligations, upheld SON’s rights, and built a partnership predicated on trust and collaboration; however, GLFC’s initial approach may not have been motivated by the need to uphold SON rights.

6.2.2 Early Engagement

As mentioned earlier, the second lesson learned is early engagement. This reflects Mattes & Kitson’s (2021) suggestion of beginning the consultation process early in sea lamprey stewardship projects. Moreover, the early engagement in the DDR correlates to some of Ansell and Gash’s (2007)

stages of the collaborative process; mainly face-to-face dialogue and trust-building. The first meeting in Ann Arbor was seen as a turning point in the project as it employed these principles and brought SON and GLFC representatives together in a good way. Early engagement sets the precedent for the project, and if done well, can establish a mutually beneficial project in which all parties are committed to. It is important that this early engagement goes beyond duty to consult obligations and is based on building a partnership where an Indigenous Nation has decision-making authority.

Within the DDR, the GLFC approached SON early in the process which created space for them to work together on determining the project parameters, co-developing questions, and defining the problem as a process of knowledge coexistence. This is related to the category of ‘agreeing on the problem/mutual understanding of the importance of the dam’ within the third relationship-building factor/lesson learned – meaningful communication. The early engagement in the DDR opened the door for the GLFC and SON to build a process together to rehabilitate the dam while respecting and responding to SON needs and rights. Early engagement and going beyond duty to consultation obligations were key strengths of the GLFC-SON relationship which allowed the DDR to go forward. In contrast, the failure to engage early, properly consult, and go beyond ‘check-boxes’ led to the initial DDR attempt by the NDMNRF to not succeed.

6.2.3 Meaningful Communication

The third lesson learned is the importance of meaningful communication. This is a multi-faceted lesson that encompasses collaboration; agreeing on the problem/mutual understanding of the importance of the dam; and community meetings to address questions, concerns, and build relationships. Each of these categories is interwoven amongst the other lessons as meaningful communication is necessary for each to be carried out in a good way. While collaboration goes beyond just communication, it is included because it was often grouped with communication in the data, and it includes how the GLFC acted as an intermediary in the DDR.

This is similar to Ansell & Gash's (2007) variable of facilitative leadership which "provides essential mediation and facilitation for the collaborative process." This is especially important when the parties involved do not trust each other so leadership must act as a 'honest broker' to bring groups together and address disputes as they arise (Ansell & Gash, 2007, p. 550). Within the DDR's context GLFC acted as an intermediary between SON and the other parties, since there was mistrust between the SON and NDMNRF, and DFO due to the previous failure of the DDR. Moreover, the DDR reflects Bodin's (2017) recommendation that environmental issues requiring a rapid-response would benefit from an ad hoc collaborative effort, rather than a wider and broader approach to collaborative environmental governance. The urgency of needing to rehabilitate Denny's Dam and the size of the project (both spatial and number of parties involved) meant that an ad hoc collaboration was the best approach.

Another component of meaningful communication was agreeing on the problem/mutual understanding of the importance of the dam. This was often cited by participants as being key for the project to go forward and aligns with Ansell & Gash's 'incentives for participation' and 'shared understanding' as a part of the starting conditions that influences collaborative governance and a step in the collaborative process. Both parties had incentives to participate in the rehabilitation since neither wanted the dam to break down and for sea lamprey to spawn in the Saugeen River. This helped the project to go forward and motivated both parties to work together which was further reinforced through meetings and the SON-GLFC Agreement. That established a shared understanding of what the problem was (Denny's Dam was structurally unfit which could lead to more sea lamprey in Lake Huron), a clear mission to resolve it (need to work together to rehabilitate the dam), and the identification of common values on how to work together (as established in the SON-GLFC Agreement) (Ansell & Gash, 2007). As mentioned previously, this category of meaningful communication is interwoven with early

engagement and knowledge coexistence's process of co-developing of questions, project parameters, and problem definition.

The last category of meaningful communication is community meetings to address questions, concerns, and build relationships. This allowed for the community to give their feedback about the project which helped to establish trust when their questions or suggestions were appropriately addressed. As well, it helped to give project leaders an idea of what the community thought about the project. This was a crucial step and helped to maintain communication directly with the community. The strength of these meetings is the informality and casualness that can nurture conversation and build relationships. In the DDR this meant sharing a meal together and participating in a Water Ceremony. These types of engagement helped to create a space for people to share about their personal lives, be humorous, and establish connections beyond the project at-hand. In the DDR these meetings took place in SON territory in a culturally appropriate venue and setting which von der Porten et al. (2015) recommends.

6.2.4 Funding and Capacity

The last relational lesson to be discussed is the need for adequate funding and capacity to equal the playing field. In the DDR funding from the GLFC helped the SON conduct studies, hire consultants, and be reimbursed for their work on the project. The importance of proper funding is highlighted throughout the literature (Bodin, 2017; Emerson et. al., 2012; von der Porten et al., 2015). In the DDR the funding by GLFC for the SON was often cited as critical for the project to move forward and allow the SON to partner on the project. As discussed in the interviews, there is systematic under-funding in First Nations which leads to limited capacity (rooted in the inequalities and acquisition of Indigenous lands through settler colonialism). This creates an environment that prevents First Nations from engaging in projects to the extent they may want to. This emphasizes the need for adequate funding

and capacity when Indigenous and non-Indigenous organizations partner together in sea lamprey and other invasive species or fisheries stewardship projects.

6.3 Lessons Learned – Knowledge Coexistence and Two-Eyed Seeing

The connection between the influential relationship-building factors and knowledge coexistence is intertwined. As mentioned earlier, the relationship-building factors created an environment from which knowledge coexistence could be practiced. Each of these ‘gears’ is made of various components/factors that influence each other (Figure 14). For example, the similarities between the relationship-building factor ‘agreement on the problem/mutual understanding’ and the knowledge coexistence sub-theme of ‘co-developing questions/project parameters/problem definition.’ The theme of knowledge coexistence will be further explored in this section as it helps to address research

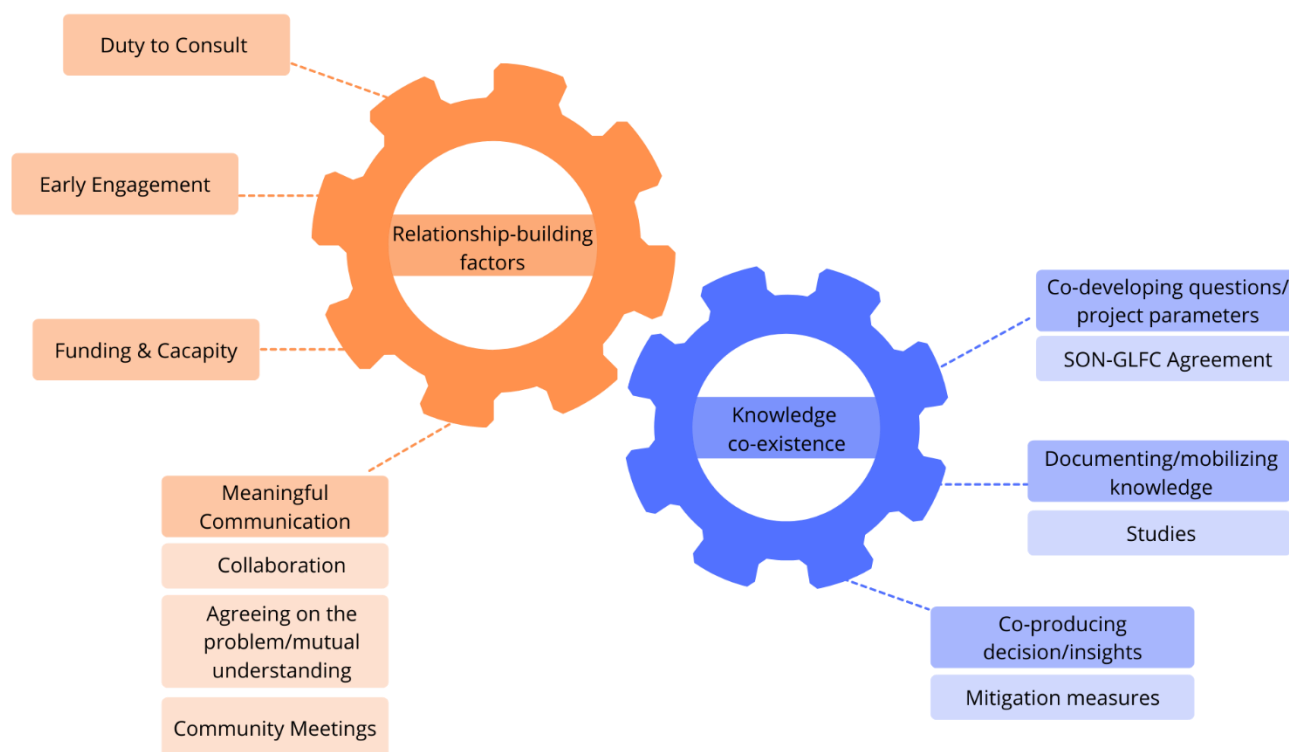


Figure 14. Interconnections between relationship-building factors and knowledge coexistence. Source: the author

questions 2 and 3 together. These questions are (2) how can the process that resulted in successfully

rehabilitating Denny's Dam inform equitable partnerships and knowledge coexistence (between Western Science and Indigenous Knowledge) in future sea lamprey, other invasive species, and fisheries stewardship projects in the Great Lakes Basin? (3) What aspects of the Denny's Dam rehabilitation process represent a Two-Eyed Seeing approach and how can these be applied to Two-Eyed Seeing in sea lamprey stewardship in the Great Lakes more broadly?

Two-Eyed Seeing is a type of knowledge coexistence framework. Unlike other knowledge coexistence frameworks, Two-Eyed Seeing explicitly calls for actions to come out of the bridging of knowledge systems (Reid et al., 2021). The other knowledge coexistence frameworks have principles of action-taking, but Two-Eyed Seeing's ultimate goal is to bridge knowledge systems in order to compel shared decision-making and action (Reid et al., 2021). Two-Eyed Seeing is a concept that enables the pairing of Indigenous and Western scientific knowledges for mutual understanding and equitable partnerships that generate actions to resolve problems, including prolonged fisheries stewardship issues (Reid et al., 2021). Two-Eyed Seeing is a potentially transformative approach to fisheries issues that ensures Western scientific approaches do not assimilate Indigenous Knowledge systems but pair with them to build a sustainable future (Reid et al., 2021). This allows for more adaptive solutions as more information is used to inform decisions, and more parties' questions, concerns, and needs are addressed during the process; and the on-going relationships can be leveraged if future issues arise.

The DDR used a knowledge coexistence approach, but they did not explicitly use Two-Eyed Seeing. However, elements of Two-Eyed Seeing exist throughout the DDR. For example, the knowledge coexistence approach in the DDR – specifically the studies that were conducted - resulted in mutual decision-making about mitigation measures and ultimately allowing the project to go forward. Both Western Science (Fish Community Assessment) and SON knowledge (Land Use and Occupancy Study) were used to make decisions between the SON and GLFC (e.g. no blocking of access routes to the river; construction being limited to summer months; rehabilitation of area right below the dam; construction

site safety precautions etc.). The DDR moved past only mutual understanding and also bridged the knowledges to make decisions; this action imperative is central to Two-Eyed Seeing. A part of Two-Eyed Seeing is the co-developing of questions, documenting and mobilizing of knowledges, and co-producing insights and decisions but this is not exclusive to it and is a part of other knowledge coexistence frameworks (e.g. MEB) (Reid et al., 2021; Tengö et al., 2014).

The DDR serves to help us learn about the application of Two-Eyed Seeing and knowledge coexistence more broadly. These principles could include the relationship-building factors explained above and the knowledge coexistence components of (1) co-developing questions, setting project parameters, and defining the problem; (2) documenting and mobilizing knowledges; and, (3) co-producing decisions and insights (Reid et al., 2021; Tengö et al., 2014). Examples from the DDR for each stage include:

1. The GLFC-SON Agreement which set out how the project would take place and how both parties would interact with another. This process and agreement set the foundation for the relationship and kept the parties accountable to each other to ensure a mutually beneficial project. Similar agreements could be made with First Nations when implementing a sea lamprey control method as a way to build a relationship from which a partnership is made. However, there were some concerns from participants about the logistics of forming agreements with each First Nation in Ontario where sea lamprey control occurs;
2. The studies that were conducted for the DDR are examples of the documentation and mobilization of knowledges. This step is important because it recognizes various types of knowledge as equal. From this pool of knowledge insights and decisions can be made together;
3. Lastly, mitigation measures were created from the findings of the studies and ultimately these findings gave both SON and GLFC the information needed to allow the DDR to go forward. This is an example of how co-producing insights from the knowledge coexistence approach can impact

decisions. In this way both Indigenous Knowledge and Western Science data were used to make decisions together and not in a way to verify another, but rather to use both in parallel to make decisions. Particularly, the insights and decisions developed from the Fish Community assessment and the LUOS (e.g. the bridging of Western Science and Indigenous Knowledge) played an important role in the project completion as cited by many of the participants.

This approach to knowledge coexistence and sea lamprey control can serve other control projects by setting an example of how to conduct multiple studies with Indigenous Nations that use Western Science and Indigenous Knowledge to make decisions. This is essential because it implies an action imperative that Two-Eyed Seeing calls for. This can be a circular process in which feedback from one process influences another. For example, using a knowledge coexistence approach – particularly a Two-Eyed Seeing framework – could help with creating solutions to the challenges that climate change presents to sea lamprey control as well as other invasive species and fisheries issues.

Given the challenges that the sea lamprey control program faces there is a need for multiple knowledge approaches and knowledge coexistence to allow for more learning and wisdom, which will render more insightful and impactful solutions (while also upholding Indigenous rights). As seen in the data these issues include wavering social acceptance and climate change. Within the literature there is some concern over the GLFC's social license (Gaden et al., 2021a) and within the data it was particularly a concern amongst GLFC participants. As well, the literature raises many questions in regard to the effectiveness of sea lamprey control methods, as climate change may cause higher water temperatures which may render lampricide less effective and cause changes in the sea lamprey's life-stages (Hume et al., 2020; Lennox et al., 2020; Muhametsafina et al., 2019). These challenges present opportunities for the reimagining of the sea lamprey program where program leaders listen to and learn from Indigenous Peoples surrounding the Great Lakes and their perspectives of sea lamprey and sea lamprey control in order to make more informed decisions together.

The impact of the DDR on other sea lamprey control projects is already being seen. Participants spoke about how the lessons learned from the DDR influenced how the GLFC approached the Garden River and Mississauga First Nations and their application of lampricide to tributaries. A knowledge coexistence approach was used in order to understand the First Nations perspectives of the application of lampricide and sea lamprey in order to make more informed decisions. This project is ongoing, but it did allow for the applications of lampricide to be implemented after years of delay and the First Nations not allowing the application to take place. Particularly, if the GLFC is concerned about its social license, especially amongst Indigenous Nations, this is a great example of how to navigate this. Listening to and learning from the First Nation and understanding their perspectives helps to address questions, build relationships, and create a partnership in which both parties could work together on a mutually beneficial project. GLFC participants spoke about how listening to Indigenous leaders and Elders from the SON during the DDR helped them understand the perspectives shared by members of the Garden River and Mississauga First Nations. As well, other participants shared how the DDR contributed to an organizational shift in how they approach First Nations in sea lamprey control (early engagement, relationship-building, inviting youth to participate, etc.). It is important to create a sea lamprey control program that is reflexive to the needs, experiences, and knowledges of the Indigenous Nations where the control methods occur. In this way, partnerships can be adaptive to the unique needs of each community while also following wise principles to guide the process.

Both DDR's successes and failures can provide lessons to guide Two-Eyed Seeing and knowledge coexistence in sea lamprey stewardship. Particularly, the failure to rehabilitate the area immediately below the dam is a major shortcoming for the project. A lot of effort, resources, and time was put into rehabilitating this area so that SON members' use of the area would not be changed. However, according to a SON member who was interviewed, the rehabilitation resulted in changes in the habitat of this area and fish are no longer gathering there like they used to. The LUOS had mechanisms in place

to monitor the area, but they failed to record this change. As well, participants of the LUOS were told to come forward if they noticed any changes after the dam was rehabilitated but no one did. Therefore, it would have been more appropriate for the SON staff to directly reach out to community members and ask if there were changes instead of waiting for them to be brought up. This is a lesson for future sea lamprey control programs; efforts should be made to follow-up with community members to see if there are any concerns or changes after the control project is completed. This feeds into an ongoing relationship that is adaptive and community-based.

More widely, lessons can be learned from the DDR for other invasive species and fisheries stewardship in the Great Lakes. Within the Great Lakes there is a myriad of aquatic invasive species such as zebra mussels (*Dreissena polymorpha*), quagga mussels (*Dreissena rostriformis bugensis*), rainbow smelt (*Osmerus mordax*), and invasive carp (*Hypophthalmichthys nobilis*, *Mylopharyngodon piceus*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*) which do not have the same level of control as sea lamprey and thus, to some, may present a more pressing issue (Brant, 2019). Control efforts for these species could apply a knowledge coexistence approach and learn from the DDR and other examples of Indigenous and non-Indigenous organizations partnering in invasive species stewardship.

There are many Indigenous Nations across North America actively working in the area of invasive species stewardship by bridging Western Science and Indigenous Knowledge systems – however, this work is not well represented in academic literature (Reo et al., 2017). Discourse around the human dimensions of invasive species largely neglects Indigenous Peoples or focuses on vulnerability and sociocultural impacts without mention of Indigenous agency in the invasive species field (Reo et al., 2017). Reo et al. (2017) conducted a survey of Indigenous Nations' staff in Canada and the U.S. (n = 106) and found ample examples of Indigenous Nations developing invasive species policies within their Nations and forming partnerships with non-Indigenous organizations and governments to co-determine invasive species policies (81% of respondents). This research reveals that many Indigenous

Nations are leveraging Indigenous Knowledge systems and protocols in addition to Western Science to actively prepare and respond to invasive and introduced species while protecting culturally significant plants and animals. Indigenous Nations are leading invasive species mitigation programs and bridging knowledge systems through these projects. However, this raises the question as to how differing knowledge systems can coexist in invasive species stewardship. As seen in the DDR, differing knowledge systems were documented and mobilized by separate studies. These studies were then used by the SON and GLFC to make decisions. This approach was rooted in a partnership based in accountability, respect, and collaboration.

These lessons for knowledge coexistence and Two-Eyed Seeing from the DDR could be applied to other invasive species and fisheries issues. However, a knowledge coexistence approach to invasive and introduced species stewardship needs to also consider the varying epistemologies and concepts of invasive species between Indigenous and Western Sciences. In Anishinaabe teachings, plants and animals are seen as persons that are assembled into Nations (Kimmerer, 2013; Reo & Ogden, 2018). Invasive species are seen as migrations of non-human Nations – the arrival of new plants and animals are natural processes (Reo & Ogden, 2018). Therefore, the term ‘invasive’ may not be appropriate to describe these beings as it also has nationalistic and militaristic implications (Bach & Larson, 2017). Reo & Ogden (2018) found, through interviews with Anishinaabe tradition-bearers (n = 22) from Michigan, that many, "feel strongly that nature finds its own balance, and people should not intervene using chemicals or other drastic management techniques" (p. 1448). There was more concern over the ‘invasive land ethic’ (as a product of settler colonialism) than the risks associated with invasive species. The invasive land ethic imposes colonial property ownership regimes, command and control environmental stewardship, and an ideology that separates people from nature (Reo & Ogden, 2018).

Moreover, a report from the 2018 Chiefs of Lake Huron Fisheries Forum explains that it is human actions that need to be governed, “Fish do not need governing – fish (and all non-human beings)

have their own governance systems – and have always governed themselves without human interference” (Lauzon & Ryan, 2019, p. 7). This is a different paradigm of interacting with the Great Lakes ecology – it is a shift from being managers of the Great Lakes fisheries to being in relationship with the Great Lakes ecology. It puts more emphasis on managing human behaviours in relation to the fisheries or invasive species rather than the non-human beings themselves (or ecologies). This seeks to address the root causes of issues that the Great Lakes are facing rather than the symptoms. In fact, invasive species may have something to offer the ecosystem and there may be an opportunity to build a positive relationship with these species (Lauzon & Ryan, 2019).

There are varying perspectives on the correct course of action to take regarding human-introduced invasive species. Indeed, invasive species can be a threat to Indigenous Peoples’ relationships with their lands and waters, ceremony, commerce, and the harvesting of foods (food sovereignty). Actions to limit the spread of invasive species can therefore be warranted in certain contexts, but they must be holistic and consider how to work with and see what these beings offer to the ecosystem (Lauzon & Ryan, 2019). Within the DDR context, there was agreement amongst the SON and GLFC that sea lamprey posed a risk and therefore a barrier was necessary. However, this may not be the same for all Indigenous Nations in the Great Lakes or concerning other invasive species. More research is needed to understand Indigenous Peoples’ range of experiences, knowledges, and perspectives on sea lamprey in the Great Lakes. There are many tribes in the U.S. that work closely with the GLFC and others in sea lamprey control (Brant, 2019), however, their perspectives are not representative of all Indigenous Peoples in the Great Lakes. It is possible that some communities/individuals may echo Reo & Ogden’s (2018) findings of preference for non-chemical or drastic intervention in sea lamprey stewardship.

The stewardship of aquatic invasive species in the Great Lakes needs to take into consideration the differing understandings of the Great Lakes and the beings living within their waters. Applying a

knowledge coexistence approach, specifically a Two-Eyed Seeing approach, would allow for more wisdom and learning about the invasive species. In this way, more dynamic and creative solutions could be formed to address the challenges they pose. Once established, the lessons learned from applying a knowledge coexistence approach to sea lamprey control on a systematic level could be extended into other fisheries issues and help to transform fisheries stewardship in the Great Lakes.

6.4 Recommendations

The following are summarized recommendations for the sea lamprey control program and other invasive species/fisheries stewardship partnerships with Indigenous Nations.

1. Start engagement with Indigenous Nations early so they can co-develop questions, set project parameters, and co-determine problem definition.
2. Go beyond duty to consult obligations and do not treat Indigenous Nations as just stakeholders, rather uphold Indigenous rights and decision-making power within their Territories.
3. Ensure meaningful communication that:
 - a. Builds collaboration into the project and coordinates actions between parties
 - b. Agrees on what the problem is and sets a mutual understanding of the project's importance
 - c. Holds community meetings to address questions, concerns, and build relationships in a culturally appropriate manner.
4. Ensure equitable funding and capacity for all parties involved – especially Indigenous Nations.
5. Use a knowledge coexistence approach that works with Indigenous Nations to:
 - a. Co-develop questions, project parameters, and problem definition
 - i. Create an agreement at the start of the project which sets projects parameters and ensures mutual accountability.
 - b. Document and mobilize knowledges
 - i. Conduct Western scientific studies in parallel with studies focusing on Indigenous Knowledge and experience.
 - c. Co-produce decisions and insights
 - i. Bridge both Indigenous Knowledge and Western scientific data to make decisions with Indigenous Nations.
6. Intentionally follow-up with community members to determine any changes or concerns after the project is completed.
7. Conduct and fund more research on Indigenous perspectives, experiences, and knowledges on sea lamprey and sea lamprey control in the Great Lakes.

7. Conclusion

In conclusion, the Denny's Dam rehabilitation exhibits lessons for building relationships between Indigenous and non-Indigenous groups and applying a knowledge coexistence approach to sea lamprey stewardship projects. These lessons for relationship-building include: (1) going beyond duty to consult obligations; (2) engaging early; (3) practicing meaningful communication that emphasizes collaboration, agreeing on the problem/importance of the project, and holding culturally appropriate community meetings; and, (4) ensuring adequate funding and capacity for all parties involved. Lessons for applying a knowledge coexistence approach (specifically Two-Eyed Seeing) include conducting studies that focus on Indigenous Knowledge and experience in parallel with Western scientific studies and using findings from both to inform decisions together.

Two-Eyed Seeing is bolstered by the creation of an ethical space (Ermine, 2007) where Indigenous Peoples, the GLFC, and other actors in the system can come together and collectively act on sea lamprey projects to the satisfaction of all parties while offering diverse solutions to new and existing issues (e.g. social license and climate change). The traditional method of solely using Western Science to address the complex issues sea lamprey stewardship is facing may not be effective at maintaining full public support for the control program, leading to the argument that a more holistic approach is needed. These challenges, however, present opportunities for the re-envisioning of sea lamprey stewardship whereby the GLFC, Indigenous Nations, and federal, provincial, and state governments implement a Two-Eyed Seeing framework to guide their policy and practical actions. The DDR provides examples of how to do this and a list of recommendations is provided to build and to apply Two-Eyed Seeing and knowledge coexistence approach to the sea lamprey stewardship program.

In closing, as it was in the Denny's Dam rehabilitation, it is integral that actions (e.g., shared decision-making) be part of a knowledge coexistence approach and such a framework is not used to just extract knowledge. In this way, new ideas, approaches, and solutions can be developed between

Indigenous and non-Indigenous groups while also upholding Indigenous rights and decision-making power. The Denny's Dam rehabilitation can serve as an example of relationship building and knowledge coexistence for other invasive species programs. Creating an environment in which Indigenous and Western knowledge systems can coexist in sea lamprey, fisheries, and invasive species stewardship is paramount for future work in the Great Lakes.

8. References

- Aboriginal Consultation and Accommodation Agreement. (2016). Saugeen Ojibway Nation – Great Lakes Fishery Commission.
- Abu, R., Reed, M. G., & Jardine, T. D. (2020). Using two-eyed seeing to bridge Western science and Indigenous Knowledge systems and understand long-term change in the Saskatchewan River Delta, Canada. *International Journal of Water Resources Development*, 36(5), 757–776.
- Adair, R., & Sullivan, P. (2013). *Sea Lamprey Control in the Great Lakes 2012*.
http://www.glfc.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2012.pdf
- Adair, R., & Young, R. (2007). *Integrated Management of Sea Lamprey in the Great Lakes 2006*.
[http://www.glfc.org/pubs/pressrel/2019 Great Lakes Fishery Commission Honors Saugeen Ojibway Nation.pdf](http://www.glfc.org/pubs/pressrel/2019%20Great%20Lakes%20Fishery%20Commission%20Honors%20Saugeen%20Ojibway%20Nation.pdf)
- Adair, R., & Young, R. (2009). *Integrated Management of Sea Lampreys in the Great Lakes 2008*.
http://www.glfc.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2008.pdf
- Adom, D., Yeboah, A., & Ankrah, A. K. (2016). Constructivism philosophical paradigm: Implication for research, teaching and learning. *Global Journal of Arts Humanities and Social Sciences*, 4(10), 1–9.
- Ansell, C., & Gash, A. (2007). Collaborative Governance in Theory and Practice. *Journal of Public Administration Research and Theory*, 18(4), 543–571.
- Bach, T. M., & Larson, B. M. H. (2017). Speaking About Weeds: Indigenous Elders’ Metaphors for Invasive Species and Their Management. *Environmental Values*, 26(5), 561–581.
- Barber, J., & Steeves, M. (2019). *Sea Lamprey Control in the Great Lakes 2018*.
http://www.glfc.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2018.pdf
- Barber, J., & Steeves, M. (2021). *Sea Lamprey Control in the Great lakes 2020*.
http://www.glfc.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2020.pdf
- Bartlett, C., Marshall, M., & Marshall, A. (2012). Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences*, 2(4), 331–340.
- Berkes, F. (2018). *Sacred ecology* (Fourth edi). Routledge.
- Bodin, Ö. (2017). Collaborative environmental governance: Achieving collective action in social-ecological systems. *Science*, 357(6352), 1.
- Brant, C. (2019). *Great Lakes Sea Lamprey: The 70 Year War on a Biological Invader*. University of Michigan Press.

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Broadhead, L.-A., & Howard, S. (2021). Confronting the contradictions between Western and Indigenous science: a critical perspective on Two-Eyed Seeing. *AlterNative: An International Journal of Indigenous Peoples*, 17(1), 111–119.
- Buell, M.-C., Ritchie, D., Ryan, K., & Metcalfe, C. D. (2020). Using Indigenous and Western knowledge systems for environmental risk assessment. *Ecological Applications*, 30(7), e02146.
- Bullock, R., Zurba, M., Reed, M. G., & McCarthy, D. (2020). Strategic Options for More Effective Indigenous Participation in Collaborative Environmental Governance. *Journal of Planning Education and Research*.
- Chippewas of Nawash Unceded First Nation. (2020). *Origins*. Nawash.Ca. <https://www.nawash.ca/about-chippewas-of-nawash/>
- Christie, G. C., & Goddard, C. I. (2003). Sea Lamprey International Symposium (SLIS II): Advances in the Integrated Management of Sea Lamprey in the Great Lakes. *Journal of Great Lakes Research*, 29, 1–14.
- Cooke, S. J., Nguyen, V. M., Chapman, J. M., Reid, A. J., Landsman, S. J., Young, N., Hinch, S. G., Schott, S., Mandrak, N. E., & Semeniuk, C. A. D. (2021). Knowledge co-production: A pathway to effective fisheries management, conservation, and governance. *Fisheries (Bethesda)*, 46(2), 89–97.
- Cornelius, F. C., Muth, K. M., & Kenyon, R. (1995). Lake Trout Rehabilitation in Lake Erie: A Case History. *Journal of Great Lakes Research*, 21, 65–82.
- Dobiesz, N., & Bence, J. (2018). *Modeling Sea Lamprey Abundance in Lake Huron After Stopping Lampricide Treatment on Specific Rivers*. <https://www.canr.msu.edu/qfc/publications/pdf-techreports/2017-techreports/T2018-01.pdf>
- Emerson, K., Nabatchi, T., & Balogh, S. (2012). An Integrative Framework for Collaborative Governance. *Journal of Public Administration Research and Theory*, 22(1), 1–29.
- Ermine, W. (2007). The Ethical Space of Engagement. *Indigenous Law Journal*, 6, 193–203.
- Fetterolf Jr, C. M. (1980). Why a Great Lakes Fishery Commission and Why a Sea Lamprey International Symposium. *Canadian Journal of Fisheries and Aquatic Sciences*, 37(11), 1588–1593.
- Gaden, M., Brant, C., Stedman, R. C., Cooke, S. J., Young, N., Lauber, T. B., Nguyen, V. M., Connelly, N. A., & Knuth, B. (2021a). Shifting baselines and social license to operate: Challenges in communicating sea lamprey control. *Journal of Great Lakes Research*.
- Gaden, M., Goddard, C., & Read, J. (2012). Multi-Jurisdictional Management of the Shared Great Lakes Fishery: Transcending Conflict and Diffuse Political Authority. In W. Taylor, A. Lynch, & N. Leonard

- (Eds.), *Great Lakes Fisheries Policy and Management: a binational perspective* (2nd ed., p. 305). Michigan State University Press.
- Gaden, M., O. Brant, C., & Lambe, R. (2021b). Why a Great Lakes Fishery Commission? The seven-decade pursuit of a Canada-U.S. fishery treaty. *Journal of Great Lakes Research*.
- Great Lakes Commons. (2014). *A Collection of First Principles*. Great Lakes Commons.
<https://www.greatlakescommons.org/first-principles>
- Holling, C. S., & Meffe, G. K. (1996). Command and Control and the Pathology of Natural Resource Management. *Conservation Biology*, 10(2), 328–337.
- Honebein, P. C. (1996). Seven goals for the design of constructivist learning environments. In *Constructivist learning environments: Case studies in instructional design*.
- Hudson, J. C., & Ziegler, S. S. (2014). Environment, Culture, and The Great Lakes Fisheries. *Geographical Review*, 104(4), 391–413.
- Hume, J. B., Almeida, P. R., Buckley, C. M., Criger, L. A., Madenjian, C. P., Robinson, K. F., Wang, C. J., & Muir, A. M. (2020). Managing native and non-native sea lamprey (*Petromyzon marinus*) through anthropogenic change: A prospective assessment of key threats and uncertainties. *Journal of Great Lakes Research*.
- Hunt, J. (2013). Engaging with Indigenous Australia: Exploring the Conditions for Effective Relationships with Aboriginal and Torres Strait Islander Communities. In *Issues paper No. 5. Produced for the Closing the Gap Clearinghouse*. Canberra: Australian Institute of Health and Welfare & Melbourne, Australian Institute of Family Studies.
- Kimmerer, R. W. (2013). *Braiding sweetgrass indigenous wisdom, scientific knowledge and the teachings of plants* (First edit). Milkweed Editions.
- Lauzon, R., & Ryan, K. (2019). *Chiefs of Lake Huron Fisheries Forum*.
- Lavis, D. S., Hallett, A., Koon, E. M., & McAuley, T. C. (2003). History of and advances in barriers as an alternative method to suppress sea lampreys in the Great Lakes. *Journal of Great Lakes Research*, 29(SUPPL. 1), 362–372.
- Lennox, R. J., Bravener, G. A., Lin, H.-Y., Madenjian, C. P., Muir, A. M., Remucal, C. K., Robinson, K. F., Rous, A. M., Siefkes, M. J., Wilkie, M. P., Zielinski, D. P., & Cooke, S. J. (2020). Potential changes to the biology and challenges to the management of invasive sea lamprey *Petromyzon marinus* in the Laurentian Great Lakes due to climate change. *Global Change Biology*, 26(3), 1118–1137.
- Lindsay, S. (2018, August 19). Interpretive plaque reveals rich history of Denny's Dam. *Saugeen Times*.
<https://saugeentimes.com/interpretive-plaque-reveals-rich-history-of-dennys-dam/>
- Lubell, M., Jasny, L., & Hastings, A. (2017). Network Governance for Invasive Species Management. *Conservation Letters*, 10(6), 699–707.

- Mackenzie, N., & Knipe, S. (2006). Research dilemmas: paradigms, methods and methodology. *Issues in Educational Research*, 16(2), 193–205.
- Mantyka-Pringle, C. S., Jardine, T. D., Bradford, L., Bharadwaj, L., Kythreotis, A. P., Fresque-Baxter, J., Kelly, E., Somers, G., Doig, L. E., Jones, P. D., & Lindenschmidt, K.-E. (2017). Bridging science and traditional knowledge to assess cumulative impacts of stressors on ecosystem health. *Environment International*, 102, 125–137.
- Martin, D. (2012). Two-eyed seeing: a framework for understanding Indigenous and non-Indigenous approaches to Indigenous health research. *The Canadian Journal of Nursing Research = Revue Canadienne de Recherche En Sciences Infirmières*, 44(2), 20–42.
- Mattes, W. P., & Kitson, J. C. (2021). Sea lamprey control in the Great Lakes: A Tribal/First Nations Representative's perspective. *Journal of Great Lakes Research*.
- McDonald, D. G., & Kolar, C. S. (2007). Research to Guide the Use of Lampricides for Controlling Sea Lamprey. *Journal of Great Lakes Research*, 33(2), 20–34.
- McGregor, D. (2002). Traditional ecological knowledge and the two—row wampum. *Biodiversity*, 3(3), 8–9.
- Miehls, S., Sullivan, P., Twohey, M., Barber, J., & McDonald, R. (2020). The future of barriers and trapping methods in the sea lamprey (*Petromyzon marinus*) control program in the Laurentian Great Lakes. *Reviews in Fish Biology and Fisheries*, 30(1), 1–24.
- Morence, M. J. (2013). Fisheries Agreement with Saugeen Ojibway Nation.
- Muhametsafina, A., Birceanu, O., Hlina, B. L., Tessier, L. R., & Wilkie, M. P. (2019). Warmer waters increase the larval sea lamprey's (*Petromyzon marinus*) tolerance to the lampricide 3-trifluoromethyl-4-nitrophenol (TFM). *Journal of Great Lakes Research*, 45(5), 921–933.
- Mullett, K., & Sullivan, P. (2017). *Sea Lamprey Control in the Great Lakes 2016*. http://www.gllfc.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2016.pdf
- Nadasdy, P. (1999). The Politics of Tek: Power and the “Integration” of Knowledge. *Arctic Anthropology*, 36(1/2), 1–18.
- Ogar, E., Pecl, G., & Mustonen, T. (2020). Science Must Embrace Traditional and Indigenous Knowledge to Solve Our Biodiversity Crisis. *One Earth*, 3(2), 162–165.
- Pauly, D. (1995). Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology & Evolution (Amsterdam)*, 10(10), 430.
- Pearce, W., Braem, R., Dustin, S., & Tibbles, J. (2011). Sea Lamprey (*Petromyzon marinus*) in the Lower Great Lakes. *Canadian Journal of Fisheries and Aquatic Sciences*, 37, 1802–1810.

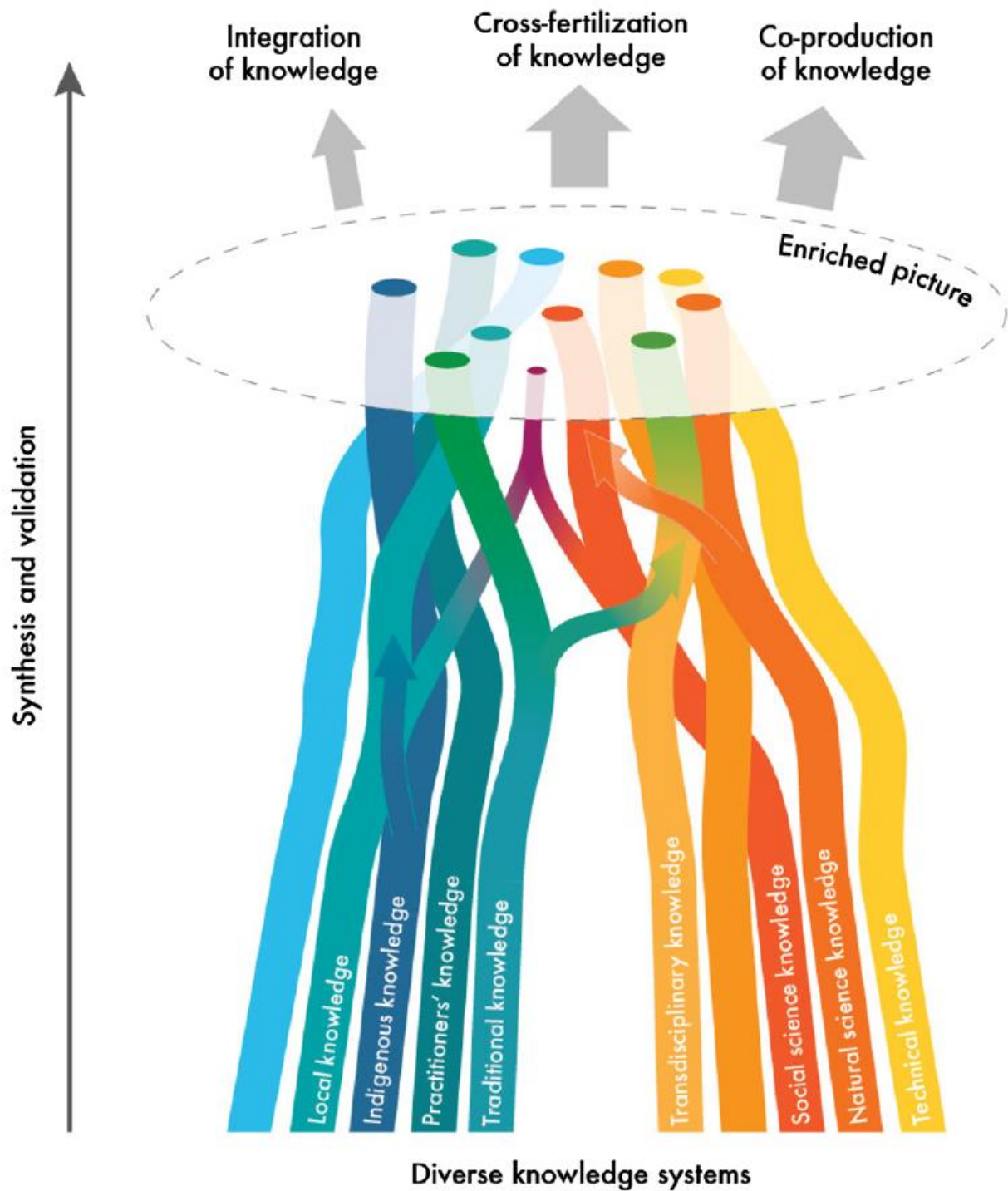
- Reid, A. J., Eckert, L. E., Lane, J., Young, N., Hinch, S. G., Darimont, C. T., Cooke, S. J., Ban, N. C., & Marshall, A. (2021). "Two-Eyed Seeing": An Indigenous framework to transform fisheries research and management. *Fish and Fisheries (Oxford, England)*, 22(2), 243–261.
- Reo, N. J., & Ogden, L. A. (2018). Anishnaabe Aki: an indigenous perspective on the global threat of invasive species. *Sustainability Science*, 13(5), 1443–1452.
- Reo, N. J., Whyte, K., Ranco, D., Brandt, J., Blackmer, E., & Elliott, B. (2017). Invasive Species, Indigenous Stewards, and Vulnerability Discourse. *American Indian Quarterly*, 41(3), 201–223.
- Ryan, K. (2017a). *Saugeen Ojibway Nation Environment Office Saugeen River Fish Community Assessment*.
- Ryan, K. (2017b). *Saugeen Ojibway Nation Environment Office Denny's Dam Rehabilitation Project Land Use and Occupancy Study*.
- Saugeen Ojibway Nation Environment Office. (2021). *Treaty History*.
<https://www.saugeenojibwaynation.ca/treaty-history>
- Schleen, L., & Klar, G. (2002). *Integrated Management of Sea Lamprey in the Great Lakes 2001*.
http://www.glf.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2001.pdf
- Siefkes, M. J., Steeves, T. B., Sullivan, P., Twohey, M., & Li, W. (2012). Sea Lamprey Control: Past, Present, and Future. In W. W. Taylor, A. J. Lynch, & N. J. Leonard (Eds.), *Great Lakes Fisheries Policy and Management: a binational perspective* (2nd ed., pp. 651–704). Michigan State University Press.
- Simons, H. (2009). *Case study research in practice*. SAGE publications.
- Simons, H. (2020). Case Study Research: In-Depth Understanding in Context. In P. Leavy (Ed.), *The Oxford Handbook of Qualitative Research* (2 ed.) (2nd ed.). Oxford University Press.
- Smith, B. R., & Tibbles, J. J. (1980). Sea lamprey (*Petromyzon marinus*) in Lakes Huron, Michigan, and Superior: history of invasion and control, 1936-78. *Canadian Journal of Fisheries and Aquatic Sciences*, 37(11), 1780–1801.
- Stake, R. E. (1995). *The art of case study research*. Sage Publications.
- Steeves, M., & Barber, J. (2020). *Sea Lamprey Control in the Great Lakes 2019*.
http://www.glf.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2019.pdf
- Substantive Commercial Fishing Agreement. (2011). Available at
<https://www.saugeenojibwaynation.ca/documents/substantive-commercial-fishing-agreement>.
- Sullivan, P., & Adair, R. (2012). Sea Lamprey Control in the Great Lakes 2011.
http://www.glf.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2011.pdf

- Sullivan, P., Adair, R., & Woldt, A. (2016). *Sea Lamprey Control in the Great Lakes 2015*.
http://www.glfci.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2015.pdf
- Sullivan, P., & Mullett, K. (2018). *Sea Lamprey Control in the Great Lakes 2017*.
http://www.glfci.org/pubs/slcp/annual_reports/ANNUAL_REPORT_2017.pdf
- Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P., & Spierenburg, M. J. (2014). Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple Evidence Base Approach. *Ambio*, 43(5), 579–591.
- Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, 27(2), 237–246.
- Tribes and First Nations of the Great Lakes Basin. (2004). *Tribal and First Nations Great Lakes Water Accord*.
<https://static1.squarespace.com/static/54ade7ebe4b07588aa079c94/t/54ea4fa3e4b06d2d72224dc0/1424641955323/Tribal-and-First-Nations-Great-Lakes-Water-Accord.pdf>
- TVO. (2016). *Indigenous Perspectives on the Great Lakes*. TVO. <https://www.tvon.org/video/indigenous-perspectives-on-the-great-lakes>
- United Nations General Assembly. (2007). *United Nations Declaration on the Rights of Indigenous Peoples, A/RES/61/295*. https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf
- von der Porten, S., de Loë, R., & Plummer, R. (2015). RESEARCH ARTICLE: Collaborative Environmental Governance and Indigenous Peoples: Recommendations for Practice. *Environmental Practice*, 17(2), 134–144.
- von der Porten, S., & de Loë, R. C. (2014). How Collaborative Approaches to Environmental Problem Solving View Indigenous Peoples: A Systematic Review. *Society & Natural Resources*, 27(10), 1040–1056.
- von der Porten, S., & de Loë, R. C. (2013). Collaborative approaches to governance for water and Indigenous Peoples: A case study from British Columbia, Canada. *Geoforum*, 50, 149–160.
- Wengraf, T. (2001). *Qualitative Research Interviewing*. SAGE Publications, Ltd.
- Wilson, N. J., Harris, L. M., Joseph-Rear, A., Beaumont, J., & Satterfield, T. (2019). Water is Medicine: Reimagining Water Security through Tr’ondek Hwech’in Relationships to Treated and Traditional Water Sources in Yukon, Canada. *Water (Basel)*, 11(3), 624.
- Wilson, S. (2008). *Research is ceremony: Indigenous research methods*. Fernwood Publishing.
- Wright, A. L., Gabel, C., Ballantyne, M., Jack, S. M., & Wahoush, O. (2019). Using Two-Eyed Seeing in Research With Indigenous People: An Integrative Review. *International Journal of Qualitative Methods*, 18, 1609406919869695.

Zielinski, D. P., & Freiburger, C. (2021). Advances in fish passage in the Great Lakes basin. *Journal of Great Lakes Research*, 47, S439–S447.

Appendix A: MEB Phase Two

Illustration of multiple evidence base approach from Tengö et al., 2014 (pp. 582) License CC BY



Appendix B: Interview Guide

Interview Script

Opening: Thank you for joining me today and agreeing to participate in this research. I really appreciate this opportunity and taking time out of your day for this. This research is being done in partnership with the Saugeen Ojibway Nation, and we are excited to learn more about Denny's Dam rehabilitation and the lessons it holds for sea lamprey stewardship. And a part of that is hearing and learning from you and your experience with rehabilitation. But before we get into that, I am going to tell you a bit more about myself, the research project, and then go over the consent form. After that we will jump into the interview. Before we begin do you have any questions?

My name is Charity Nonkes, and I am currently located in Kitchener, Ontario on the Haldimand Tract – land promised to the Six Nations. I grew up in the traditional territory of the Saugeen Ojibway Nation near the Maitland River – and most of family still lives there. And it is partly because I grew up in that area that I am interested in this work. I have spent countless hours in Lake Huron and its tributaries – and I care about its health. Also, for me, working with Saugeen Ojibway Nation is part of a journey of acknowledging my settler history and working towards better relations with the SON and with the land to build a sustainable and just future.

I have a Bachelors of Arts in Peace and Conflict Studies and a Diploma of Environmental Assessment from the University of Waterloo. Currently, I am a Masters student at the University of Ottawa. I am taking a Masters of Science in Environmental Sustainability, and this research project is the basis for my thesis work. My thesis supervisor is Dr. Nathan Young from the Faculty of Social Sciences at the University of Ottawa.

The start of this research project came out of conversations with SON employees at the Environment Office and work I was doing for another research project about Indigenous perspectives on sea lamprey and sea lamprey control. This research project which is entitled *Indigenous Partnership and Two-Eyed Seeing in Sea Lamprey Management: Lessons learned from Denny's Dam Rehabilitation with the Saugeen Ojibway Nation* is focusing on learning about the Denny's Dam rehabilitation – specifically the relationships between the various groups involved in the project. We are looking at what are some of the key lessons learned from the Denny's Dam rehabilitation for partnerships in sea lamprey stewardship, management, and understanding. As mentioned before, we are partnering with the SON on this project and working closely with Ryan Lauzon who is a Fisheries Assessment Biologist from the Chippewas of Nawash Unceded First Nation and working for the Saugeen Ojibway Nation Environment Office.

Our aim with these interviews is to talk to the people involved in the DDR and learn about the process and events that led to Denny's Dam being rehabilitated. Which has led us to you! You are the expert in your experience, and I am here to listen to you.

(SP) - I just want to mention we are very appreciative of your time and want to offer you a physical gesture of our gratitude which is a \$50 honourarium in thanks for contributing in this research project. I will go over more details about it in the interview.

Before I go over the consent, do you have any questions?

Consent Form Overview

- (If they already signed the consent form I will ask if they have any questions about it or want to go over it)
- (If they have not signed the consent form and want to give oral consent, I will go over the consent form)

Essentially, the purpose of this consent form and the principles we are following for this interview is to ensure that your participation is voluntary. It is your choice to participate or not, and we are taking direction from you and what you're comfortable with sharing. By participating, you are in no way giving up any rights, and at any time you can withdraw from this study (and in a little bit I will go over what that means if you do choose to withdraw). I am here to listen to you and make sure that your information remains safe. I want to work with you to determine how much of your information is shared.

First, during this interview I am recording the audio but not the video. This audio-record will later be transcribed so everything said between you and I will be typed up at a later date. We will use these transcripts for our research and read them to see if multiple interviewees said similar things and whatnot. There will be an opportunity for you to look over your transcript and a summary of what was said in the interview and make any changes, but I will go over that in more detail at the end of the interview.

You are in control of how much you tell me and what you share so you can choose to answer any questions. In the interview you can simply say you don't want to answer that, and we can move onto something else. Also, as mentioned you can withdraw from this study even after the interview. If you leave, we will delete any data we have associated with you – interview recording, transcript – and whatnot. And that won't be used in the results or any publication. However, if you decide to withdraw after we publish something we can not remove your data from what is already published, but we will remove your data from future publications. At the end of the interview, we can talk more about publications from this research.

You have the option to have your name appear in publications from this research or have it removed. If you choose to remain anonymous (remove your name), we will commit to keeping your identity in strict confidence. Your name will be removed from all your data (e.g., transcript of your interview), so you will not be identifiable by name. However, your role in the Denny Dam rehabilitation project will appear in the data (only the research team may see it), but it will not be in any publications or reports about the research project. If you choose to remain anonymous, only your connection with the SON, GLFC, or DFO may be mentioned in publications. If you are not comfortable with sharing your name but are okay with your role appearing in publications, just let me know and I will make a note of it.

You can choose to remain anonymous for certain questions in the interview. So, you can just say "for the answer I don't want my name associated with it" or you can say "I don't want my organization associated with this answer." You can also decide this later if you choose to review your transcript.

(SP) - All raw data, audio files, and transcripts will be stored by the SON Environment Office and accessed by myself and my supervisor Nathan Young for the duration of this research project. Your data

will be stored with me until my graduation from the Master's program in August 2022. After which all data will be deleted from my computer. Also, SON Environment Office will have a copy of your interview and transcript and will keep with information going forward. If you choose to remain anonymous your name will not be shared with the SON Environment Office but your role in the rehabilitation project will be listed.

(SP) The last thing is - there are little to no risks from participating in this study. However, we understand that talking about these issues may bring up memories that are upsetting, and we hope you reach out to people you feel comfortable talking with and get support. There are people in the SON communities who can help you find support if you need it, so feel free to call either the Mino Bimaadawasin Health Centre or the Kina Waa NoojmojigNanaweing Wellness Centre and ask them to find someone to provide counselling support.

We recognize that some questions about the Denny's Dam rehabilitation may be sensitive in nature and that you may not want certain information available to others. Your name will not appear on any publication without your consent. However, you should be aware that well-informed readers of publications from this research may be able to guess your identity from the content of quote or descriptions of your organization. To prevent this, you can tell me for any answer, that you wish to remain anonymous (your name and role removed) and your connection with the SON not listed. You can also choose for a particular answer that no direct quotes can be used in publications.

Do you have any questions or is anything unclear?

(Turn on recording) I am going to turn on the recording, and you can answer yes or no to the questions. First question: Do you _____ agree to participate in this research study conducted by the Saugeen Ojibway Nation, Charity Nonkes, and Nathan Young?

The second question is about sharing your name - I am doing to give you two options and you can say which one you choose – so do you choose to remain anonymous meaning your name will not appear in publication or raw data – OR do you choose to have your name appear in publications and the data?

The third question is about storing data – So do you consent to your data being stored by the SON and accessed by Charity Nonkes and Nathan Young for the duration of this research?

If you have any questions about the ethics of this study and want to talk to someone else about it, contact RYAN LAUZON from SON Environment Office - his contact details are on the consent form I sent you.

(OP) - All raw data, audio files, and transcripts will be stored on password protected computers with me until my graduation from the University of Ottawa in August 2022. Then all data will be transferred to Nathan Young and conserved for a minimum of 5 years after the completion of the study.

Do you have any questions or is anything unclear?

(Turn on recording) – I am going to turn on the recording, and you can answer yes or no to the questions. First questions Do you _____ agree to participate in this research study conducted by the Charity Nonkes and Nathan Young and in partnership with the Saugeen Ojibway Nation?

The second question is about sharing your name, I am doing to give you two options and you can say which one you choose – so do you choose to remain anonymous meaning your name will not appear in publications or raw data – OR do you choose to have your name appear in publications and the data?

If you have any questions about the ethics of this study and want to talk to someone else about you contact the University of Ottawa ethics department – contact details are on the consent form.

Before we begin, I just want to let you know that this is a semi-structured interview, so I'll ask a few questions to direct the conversation. However, this can be a casual conversation. At any time, you can ask me to clarify questions, decide not to answer a question, ask that no direct quotes be used for a question, or ask that you are anonymous for a specific question. Again, you are the expert in your experience with the Denny's Dam rehabilitation, and I am here to learn from and listen to you. There are no wrong answers, I just want to hear about your experience and thoughts.

Interview questions: See chart

Closing: Thank you so much for participating! I really appreciate the time you took for this interview and your thoughtful answers. Before I go over some closing remarks, is there anything you wanted to share that I haven't asked you about?

FOLLOW-UP TRANSCRIPT REVIEW - It is important to us that this research properly reflects what you said and is accurate. So, we are organizing for participants to review a summary of their transcript and a copy of their transcript to make sure we understood what you were saying. This is voluntary and gives you a chance to expand on your answers or make changes. If you are interested, we would send you a summary and copy of your transcript once all interviews are completed (probably sometime in early 2022). I would email you a copy and you would have two weeks to review it and get back to me with any comments, corrections, or further explanations on your answers. Would you be interested in this?

CLOSING QUESTIONS

- Is there anyone else you suggest I should interview for this research?
- Would you like to receive copies of any reports, scholarly articles, or other publications resulting from this research?
- I would like to send you a thank you card; is there an address I can send it to? If not, I can email you something.
- (SP) go over how they will be receiving the honourarium again – ask how they want it – e-transfer or mailing a thank you card. Ask if you can have their address to mail a thank you card.

PLAN WITH RESEARCH – Our plan for this research is to finish interviews by December and then in the new year start looking what all the participants said to see if there are themes amongst participants and try to create a bigger picture of what happened in the DDR and what we can learn from it. We are hoping to publish an article from this research (SP – we will touch base with you before its published), I will also be working with the data to write my graduate thesis to be defended and completed in the Summer of 2022. We are also working together to make a presentation for this research – potentially a video.

We want to share the results of the research because it has the potential to inform and improve future work in sea lamprey stewardship/management for both Indigenous communities and fisheries organizations in the Great Lakes. This research could help to outline how respectful, equitable, and sustainable relationships can be made between Indigenous communities and governmental and other fishery organizations. As well, this research can be shared with other Indigenous Nations as a guide to ensuring knowledge coexistence and equitable partnerships in their projects. We think that DDR can teach us about sea lamprey stewardship/management for the benefit of all and ultimately the health of the Great Lakes.

THANK YOU: Again, thank you so much for your time. If there is anything you would like to add in closing, please let me know. If not, it was a great meeting with you, and I will be in touch shortly.

Interview Questions

Research Question	Interview Question*	Prompt
1	Tell me about what happened in the DDR. (If we asked them to think about a timeline before the interview) Could you share about the DDR's timeline and what happened in the project?	How did you become/were involved in the project?
		How was (insert a particular event that they mentioned) for you?
		Can you tell me more about your roles/responsibilities in the project?
		In 2000/2001 it was suggested that the Denny's Dam would need to be repaired, and in 2006 a steering committee was formed to create a strategy to repair Denny's Dam. However, it wasn't until 2017 that construction started. Could you talk about what happened during these years?
		We understand that the project had different interactions throughout the last decade until it was completed. During these different attempts to get the project going, did you notice any changes or shifts in the relationships or how the different organizations worked together?
		Can you describe how the various groups worked together at the start of the DDR compared to how they worked together at the end of project – why do you think there were those changes?

	**From my understanding, in 2012 the SON raised concerns that they were not properly consulted on the Denny's Dam rehabilitation project. How did your organization respond to this/What led the SON to raise these concerns?	(OP)What actions did your organization take for the consultation? What worked/what didn't work? (SP)How you feel about the actions taken by GLFC, DFO, NDMNRF, etc. after concerns about the need for consultation were raised?
	(OP) How did [insert participant's organization] work amongst the other organizations to coordinate their approach to the project?	How were decisions made within your organization?
		Were there any decisions or actions made that were viewed at the time as risky – how did your organization weigh its options to decide on that?
	What went wrong/right during your time working on the DDR?	Could you give an example of something that went wrong – Was it resolved/how was it resolved?
		Why do you think it turned out that way?
		What are the reasons that worked out so well?
		Is there an event or an action someone took that sticks out in your mind that really improved the partnership or the opposite hindered collaboration?
	**In Fall 2015 there was a meeting between representatives from the SON and GLFC that resulted in a formal agreement to work together in partnership on the DDR. Can you describe the meeting?	How did you get to the spot where you could have this meeting? What actions were taken after the meeting to keep the momentum?
	What did you learn from the DDR?	What would you have done differently?
		What do you wish you knew at the start that you know now?
3	(SP) Do you feel like your voice was listened to/respected in decisions?	Who do you think had the most say in decisions?
	(SP)How was SON's knowledge (or IK) used in DDR?	How could have the DDR better respected IK?
	(OP)How did you work with IK in the project?	Was working with IK something new for you?
		What were some of the challenges (learning curves) for you when working with IK – how did you address this?

		(if example given) How was science used to inform that same decision?
	How did you (or your organization) address conflicts during the DDR?	This could be interpersonal conflicts, or conflict between IK or scientific data.
	How did the DDR work with IK and science in decisions?	Can you describe of a time when IK was used to make a decision in the project?
2	What can we learn from this experience to make sea lamprey stewardship/management better?	What are some of the strengths of the DDR – what are the weakness of the DDR?
		(OP) Did DDR change the way you approach other sea lamprey projects?
	(SP) What advice would you give GLFC or DFO when working with Indigenous Peoples and knowledge?	On fisheries projects?
		On invasive species projects?
	Ideally what do you want sea lamprey stewardship/management to look like in the future?	Can you tell me more about what ideally the relationships between Indigenous communities and the GLFC and other government departments would look like?
		What do you think are some of the most pressing challenges sea lamprey stewardship/management will face in the future – what do you think will help?

*Not all questions will be asked to all participants

DDR – Denny’s Dam rehabilitation

SP – SON participant

OP – Organizational Participant

IK – Indigenous Knowledge

Appendix C: Integrative Framework for Collaborative Governance

The integrative framework for collaborative governance by Emerson et al., 2021 pp. 6.

Figure 1
The Integrative Framework for Collaborative Governance

