Identification of tools for implementing an ecosystem-based approach to species recovery under the Species at Risk Act

By

Jenna Morissette

Submitted in partial fulfillment of the requirements for the degree

of
Master of Marine Management

at

Dalhousie University

Halifax, Nova Scotia

December 2020

Table of Contents

Acknowledgements

First, I would like to thank my graduate project supervisors, Dr. Jeffrey Hutchings and Anne Phelps, and my internship supervisor, Dr. Sarah Tuziak, for embracing and guiding this graduate project. Your constant support and understanding have been essential to its completion.

Thank you to Dr. Amanda Winegardner for agreeing to undertake the role of second reader of my graduate project.

I would like to thank Aimee Gromack, Sarah Deller, Ree Brennin Houston, and Elise Will for the additional input you all provided.

Thank you to the faculty of the Marine Affairs Program for giving me the opportunity to be part of this inspirational program and sharing your knowledge with me.

Lastly, thank you to all of my friends and family for supporting me through my academic pursuits over the past several years.

Thank you all for believing in me,

Jenna

List of Figures

List of Abbreviations

AMP – Australian Marine Parks

CA – Conservation Act

CESCC - Canadian Endangered Species Conservation Council

COSEWIC - Committee on the Status of Endangered Wildlife in Canada

CSA – Cobequid Salmon Association

CWDC – Canadian Wildlife Director's Committee

DAWE – Department of Agriculture, Water and the Environment

DFO – Department of Fisheries and Oceans Canada

DOC – Department of Conservation

DU – designable unit

EBA – Ecosystem-based approach

EBSA – Ecologically and Biologically Significant Areas

ECCC – Environment and Climate Change and Canada

EPBCA – Environment Protection and Biodiversity Conservation Act

ESA – Ecologically Significant Area

FA-CA – Fisheries Act in Canada

FA-NZ – Fisheries Act in New Zealand

FFHP – Fish and Fish Habitat Protection

FMA – Fisheries Management Act

HADD – harmful alteration, disruption or destruction of fish habitat

HSP – Habitat Stewardship Program

iBOF – inner Bay of Fundy

IFMP – Integrated Fisheries Management Plans

LGB – Live Gene Bank

MAPC – Maritimes Aboriginal Peoples Council

MCG – Mi'kmaq Conservation Group

MRA – Marine Reserves Act

MPA – Marine Protected Area

NACOSAR - National Aboriginal Council on Species at Risk

NGO – non-governmental organization

NMCA – National Marine Conservation Areas

NSPSAR - National Strategy for the Protection of Species at Risk

NSSA – Nova Scotia Salmon Association

OA – Oceans Act

PCA – Parks Canada Agency

PIT – Passive Integrated Transponder

PNS – Province of Nova Scotia

SAR – species at risk

SARA – Species at Risk Act

SARP – Species at Risk Program

SSA – single-species approach

UNCBD - United Nations Convention on Biological Diversity

UNEP - United Nations Environmental Program

WA – Wildlife Act

WUA – work, undertaking or activity

Morissette, J., 2020. Identification of tools for implementing an ecosystem-based approach to species recovery under the Species at Risk Act [graduate project]. Halifax, NS: Dalhousie University.

Abstract

The objective of the *Species at Risk Act* (SARA) is to protect and recover at-risk species and their habitat. However, limitations have been identified for its implementation with aquatic species. These include taxonomic biases, economic considerations, slow listing and plan development, and poor critical habitat protection. This study aims to assess if the utilization of alternative tools under an ecosystem-based approach (EBA) could strength conservation efforts in Canada, using the Stewiacke River in Nova Scotia as a case study, based on the objectives of SARA. Tools were identified in current processes in Canada, such as those resulting from the *Oceans Act* and *Fisheries Act*, and evaluated for potential use. Additionally, to help inform recommendations, the results of other countries such as Australia and New Zealand who have adopted EBAs in their conservation programs were evaluated for comparison. Overall, analysis of EBA tools in Canada displayed a potential to strengthen conservation efforts by providing more information about the species of interest, the identification of critical habitat, and the development of recovery measures. Secondly, data gaps were identified for the effectiveness of available tools in Australia and New Zealand, but similarities are presented when compared to Canadian tools. Additionally, there is an opportunity for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to draw upon the Australian threatened species listing framework to incorporate EBAs. Lastly, Ecologically Significant Areas (ESA) and provincial watershed planning were suggested as potential tools to mitigate threats of at-risk species in the Stewiacke River.

Keywords: Species at Risk Act, aquatic species at risk, ecosystem-based management, tool identification

Chapter 1 – Introduction to the Species at Risk Act

The current chapter will provide a background overview of the *Species at Risk Act* (SARA) by covering its history, purpose, roles, listing process, and aquatic species policies to provide the reader an understanding for SARA before expanding on its limitations for aquatic species in Chapter 2.

1.1 History

SARA was introduced in 2002 and came into force in 2004 to provide federal legislation to prevent the extirpation or extinction of wildlife species, conserve biodiversity, and to administer recovery strategies in Canada (Government of Canada, 2014, 2019b; SARA, 2002). The implementation of SARA completed Canada's National Strategy for the Protection of Species at Risk (NSPSAR) for working towards its commitments under the United Nations Convention on Biological Diversity (UNCBD) (Government of Canada, 2016a). The UNCBD is an international legally binding treaty part of the United Nations Environmental Program (UNEP) that came into force in 1993. Its main goals are the conservation and sustainable use of biodiversity at all levels (ecosystem, species, and genetic resources), and the fair and equitable sharing genetic resource benefits (UN, n.d.).

The other initiatives established that resulted from NSPSAR are the Accord for the Protection of Species at Risk in 1996 and the Habitat Stewardship Program in 2000 (Government of Canada, 2016a). The 1996 Accord outlined federal, provincial, and territorial commitments for the respective Ministers to designate species at risk (SAR), protect SAR habitat, develop recovery plans, and develop legislation, regulations, policies, and programs to complete these tasks. SARA is an example of a resulting legislation from the Accord commitments (Government of Canada,

2014). The Habitat Stewardship Program provides funding towards eligible projects that contribute to the recovery of listed SAR (Government of Canada, 2020).

1.2 Purpose

The general purpose of SARA can be found under section six of the Act stating: "The purposes of this Act are to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened." (SARA, 2002). This is applicable towards any terrestrial or aquatic species, subspecies, or distinct population that is native to Canada or its range extends into Canada (SARA, 2002, art. 2). In addition, the legislation of the Act must not interfere with existing Aboriginal or treaty rights of the Aboriginal Peoples of Canada (SARA, 2002, art. 3).

1.3 Roles

The competent Ministers involved with the administration SARA are: (1) The Minister of Parks Canada Agency in respect to species on federal lands like national parks and national historic sites; (2) The Minister of Fisheries and Oceans in respect to aquatic species; and (3) the Minister of the Environment and Climate Change in respect to all other species and the coordination of the overall federal species at risk strategy (Government of Canada, 2019a; SARA, 2002, art. 2). After consultation between the competent Ministers and the Canadian Endangered Species Conservation Council (CESCC), a Minister can enter a conservation agreement with any Canadian governments, organization, or person to take conservation measures for a SAR. This can include monitoring its status, increasing public awareness, developing and implementing recovery strategies, action plans, and management plans, protecting their habitat, and conducting recovery research (SARA, 2002, art. 11). Regarding the responsibility of allocating funds towards stewardship projects, the

Department of Environment and Climate Change Canada (ECCC) funds terrestrial stewardship projects and the Department of Fisheries and Oceans Canada (DFO) funds aquatic stewardships projects (Government of Canada, 2020).

The CESCC is made up of the Ministers previously listed and the Ministers of the respective province or territory responsible for conservation and wildlife management. Their role is to coordinate the activities of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and various governments, prepare recovery strategies, and implement action plans for the protection of SAR (SARA, 2002, art. 7).

The National Aboriginal Council on Species at Risk (NACOSAR) is made up of six Aboriginal Representatives appointed by the Minister of Environment and Climate Change whose function is to provide advice to Ministers regarding the Acts administration and to COSEWIC (Government of Canada, 2019a; SARA, 2002, art. 8).

COSEWIC is made up of experts appointed by the Minister of Environment and Climate Change, with consultation of the CESCC and with any experts and expert bodies that the Minister considers to have relevant expertise, who are not members of the public service (SARA, 2002, art. 16(1,2,4)). These experts can be drawn from federal, provincial, and territorial governments, wildlife management boards, Aboriginal groups, universities, museums, national non-governmental organizations (NGOs) and others with expertise in the conservation of wildlife species in Canada (Government of Canada, 2019a). The duty of COSEWIC is to assess and classify the status of wildlife species that are of concern to be at risk as extinct, extirpated, endangered, threatened, special concern, data deficient, or not at risk (SARA, 2002, art. 15(1)). This is conducted at "arm's length" from the government, meaning the process is to remain open, transparent, and impartial (Government of Canada, 2019a). The classification is made within a

year after COSEWIC receives a status report, then reassessed at least every ten years or earlier if COSEWIC has reason to believe that the status of the species has changed significantly, while prioritizing SAR of becoming extinct (SARA, 2002, art. 15(1), 23, 24). Additionally, COSEWIC provides advice to the Minister of Environment and Climate Change and the CESCC (SARA, 2002, art. 15(1)). Their decisions and advice must be based on the best available information, including from scientific, community, and Aboriginal traditional knowledge, which is utilized to form their status reports (SARA, 2002, art. 15(2), 21(1)).

1.4 Wildlife Species Listing Process

The Minister of Environment and Climate Change must respond to a COSEWIC assessment within 90 days describing how they intend to take action (SARA, 2002, art. 25(3)). Then within nine months after consulting with COSEWIC, the competent Ministers, and wildlife management boards, the Governor in Council (on the recommendation of the Minister of Environment and Climate Change) may accept the status provided by the COSEWIC assessment and add the species to the list of SAR under Schedule 1 of SARA, not add the species, or refer back to COSEWIC for more information or clarification (SARA, 2002, art. 27(1-3)).

If a decision is made to not list a species a compelling rationale must be provided stating the alternative approaches, the expected outcomes, and the benefits of not listing. After five years a report must be made on the status of the species to evaluate any work plans that were developed from the alternative approach (DFO, 2014a).

Under the circumstances of an emergency the Minister of Environment and Climate Change can recommend a species to be listed as endangered to the Governor in Council (SARA, 2002, art. 29(1), 80). If listed COSEWIC must then complete a status report for the species within

one year and recommend if the status should remain, be changed, or removed (SARA, 2002, art. 30(1)).

Once a species is listed under Schedule 1 of SARA no person shall kill, harm, harass, capture, take, possess, collect, buy, sell, or trade an individual of a wildlife species that is listed as extirpated, endangered, or threatened species (SARA, 2002, art. 32(1-2)). Additionally, the SARA protects the residence of species listed as endangered, threatened, or extirpated with the possibility of reintroduction from damage and destruction (SARA, 2002, art. 33). This is also applicable to critical habitats within 180 days after it is identified in a recovery strategy or action plan (SARA, 2002, art. 58(1, 5), 61(1)).

If a species is listed as extirpated, endangered, or threatened a competent Minister must prepare a recovery strategy for the species by addressing its threats to survival and identifying its critical habitat (SARA, 2002, art. 37(1), 41(1)). The strategy should be formed within one year from when a species is listed as endangered or within two years if the species is listed as threatened or extirpated (SARA, 2002, art. 42(1)). Based on the recovery strategy, a competent Minister must also make an action plan outlining the measures that will be taken to protect the species' identified critical habitat with a socio-economic evaluation (SARA, 2002, art. 47, 49(1)). The progress of the action plan must be assessed after five years of its implementation (SARA, 2002, art. 55).

On the other hand, if a species is listed as special concern, then within three years a management plan for the conservation of the species and its habitat must be made by a competent Minister (SARA, 2002, art. 65, 68(1)). Like an action plan, the implementation of the management plan is to be assessed every five years until its objectives are achieved (SARA, 2002, art. 72).

If applicable, recovery strategies and management plans have the option to address multiple species or use an ecosystem-based approach (EBA) (SARA, 2002, art. 41(3), 67). There is also a list of species under Schedule 2 and 3 of SARA that COSEWIC is expected to assess and classify but these species do not receive conservation measures like species under Schedule 1 (SARA, 2002, art. 130(1)).

1.5 SARA Policies Pertaining to Aquatic Species

Policies were developed to support the implementation of SARA utilizing the following principles: effectiveness, transparency, respect jurisdictions, stewardship, collaboration, evidence-based approaches, precautionary approach, and adaptability (Government of Canada, 2016d). There are three policies that are directly associated with aquatic species. *Fisheries and Oceans Canada Species at Risk Act Listing Policy and Directive for "Do not List" Advice* outlines the expectations and responsibilities of the DFO with the listing process (DFO, 2014a). *Fisheries and Oceans Canada Species at Risk Act Directive on the Application of Species at Risk Act Section 33 (Residence) to Aquatic Species at Risk* describes the DFO interpretation and implementation of section 33 of SARA by defining what is considered as a "residence" for an aquatic species and damage or destruction of a "residence" (DFO, 2015a). Lastly, *Fisheries and Oceans Canada Species at Risk Act Directive on the Identification of Critical Habitat for Aquatic Species at Risk* describes the DFO interpretation and implementation of the identification of critical habitat for an aquatic species (DFO, 2015b).

Chapter 2 – The limitations of the Species at Risk Act for aquatic species

As mentioned in Chapter 1, this chapter will cover the limitations of SARA and its execution of the SAR program (SARP) for aquatic SAR. Such limitations include resources, taxonomic biases, economic considerations, listing progress, and recovery measure development. The chapter will then conclude by discussing how these limitations result in a management problem and introduce the research question that will be addressed throughout the remaining chapters.

2.1 SARA Limitations

The SARP has worked towards improving the programs efficiency by streamlining recovery documents, using standardized templates, using online consultations, and prioritizing recovery efforts (ECCC, 2018).

2.1.1 Resources

Over time, the number of listed species has been increasing while resources for the program have remained generally constant, therefore underfunded considering inflation, making the ability of SARP to meet the requirements and timelines of SARA challenging (Bird & Hodges, 2017; ECCC, 2018). Between 2011 and 2016, the $444.2 million expended was distributed across the departments: 60% for ECCC, 27% for DFO, and 13% for Parks Canada Agency (PCA) (ECCC, 2018). This total was within 5% of the total budget for SARP. In all, the constant budget and its distribution affects the capacity at which consultations can occur, recovery activities can be implemented, and recovery plan progress can be evaluated (Bird & Hodges, 2017; ECCC, 2018).

2.1.2 Taxonomic Biases and Economic Considerations

Based on the literature, there is a taxonomic bias against listing aquatic species in Schedule 1 of SARA under the jurisdiction of DFO. According to Mooers et al. (2007), between 2004 and 2006 out of eight taxonomic groups, herpetofauna, plants, and birds were the most likely to be listed while aquatic species were less likely with marine fish on the bottom of the list. COSEWIC-assessed endangered and threatened marine fish receive the least protection, requiring approximately five years before a listing decision is made (ECCC, 2018; McDevitt-Irwin, Fuller, Grant, & Baum, 2015). As of 2015, 19.3% of marine fish assessed as at risk by COSEWIC were listed, 59.7% were under consideration, and 21% were denied listing (McDevitt-Irwin et al., 2015).

The explanation for the bias against aquatic species is typically attributed to the economic considerations of interfering with commercial interests and regional fisheries; a harvested species is less likely to be listed than non-harvested species (ECCC, 2018; Findlay, Elgie, Giles, & Burr, 2009; McDevitt-Irwin et al., 2015; Mooers et al., 2007; Schultz, Darling, & Cote, 2013). By not listing commercial species, DFO and wildlife management boards avoid additional responsibilities required by SARA (Mooers et al., 2007). This is often justified by the argument that legislative tools other than SARA, such as those available under the *Fisheries Act*, are sufficient for recovery purposes (Schultz et al., 2013). Additionally, socio-economic analysis before listing decisions favour commercial interests because there is a focus on short-term costs while benefits of species recovery to Canadian society are not adequately incorporated due to lack of data (Hutchings & Festa-Bianchet, 2009; Mooers et al., 2007; Rudd, 2009; Schultz et al., 2013). This is made evident by all marine species receiving listing when there are no anticipated costs (Mooers et al., 2007; Schultz et al., 2013).

2.1.3 Listing Progress

After receiving an at risk designation by a COSEWIC assessment, marine fish on average wait 4.34 years to be denied SARA listing or when listed, 4.77 years to obtain finalized SARA measures (McDevitt-Irwin et al., 2015). This five year wait for listing decisions is made possible by extending the consultation process between government and stakeholders. Plus, there is no legislative deadline between a finalized COSEWIC assessment and the Governor in Council receiving it (Hutchings, Stephens, & VanderZwaag, 2016), thereby allowing a delay of SARA-enacted responses. These delays can increase the probability of the listing decision being referred back to COSEWIC because more information about species status has likely been unveiled since the assessment. This can unduly extend the time between species assessment and recovery measure implementation (Hutchings & Festa-Bianchet, 2009; Hutchings et al., 2016).

2.1.4 Recovery Measure Development

Limitations have also been found in the later stages of the listing process in regard to the timeline of publishing recovery plans, action plans, and management plans. Despite the one- or two-year deadline for recovery strategies and three-year deadline for management plans set by SARA, they are often overdue (Dorey & Walker, 2018; ECCC, 2018; Hutchings et al., 2016). Since there is no set timeframe between releasing a recovery strategy and action plan, the implementation of conservation measures can be prolonged even further (ECCC, 2018; Hutchings et al., 2016). According to the horizontal evaluation of the SARP conducted by ECCC, the number of species between 2011-2017 with overdue recovery documents from DFO were 62 for proposed recovery strategies, 30 for proposed action plans, and 31 for management plans. During that time the number of species that did receive finalized recovery documents were 22 for recovery strategies, 7 for action plans, and 18 for management plans (ECCC, 2018). Additionally, between

the three departments, DFO is the least likely to develop recovery strategies (Bird & Hodges, 2017).

Another limitation in the later stages of the listing process is the identification of aquatic critical habitat in recovery strategies. Protecting critical habitats involves ministerial orders and departmental regulatory processes that are often met with legal scrutiny and regulatory restrictions which can cause the process to be drawn-out (ECCC, 2018). Furthermore, there is a taxonomic bias in critical habitat identification; plants and mosses are the most likely to have full or partial critical habitat designation while aquatic species have some of the lowest rates of designation. This results in DFO having the lowest rate of designation with 42.3% of recovery strategies having critical habitat identified. The shortfall of full designation is often explained by logistical challenges associated with aquatic species from lack of research, biological and/or ecological knowledge of the species, or concrete recovery goals (Bird & Hodges, 2017).

2.2 Management Problem and Research Question

As a result, these limitations are affecting the progress and effectiveness of recovery measures for Canadian aquatic SAR (Bird & Hodges, 2017; Dorey & Walker, 2018; EcoJustice, 2012; VanderZwaag, Engler-Palma, & Hutchings, 2011; WWF, 2017), meaning the current manner in which SARA is implemented is not as effective as it could be in meeting the Act's objectives. Other countries have moved on from single-species approaches (SSAs) that Canada currently adopts to mitigate similar limitations (CA, 1987; EPBCA, 1999; FA-NZ, 1996; Hutchings et al., 2016; MRA, 1971; WA, 1953). Support to increase the utilization of EBAs, when appropriate, to improve the efficiency of SAR recovery has been displayed by ECCC, CESCC, COSEWIC, and Canadian Wildlife Director's Committee (CWDC) (ECCC, 2018; Ambrose, personal communication, 2006; Brenning & Sullivan, personal communication, 2006; Hutchings,

personal communication, 2007). By applying more EBAs, common threats, priority places, biodiversity, and species groups can be addressed simultaneously in management models. Aforementioned tools are defined as followed:

1. A common threat tool would be a tool that regulates an activity without a focus on its location;
2. A priority place tool would regulate activities based on their location;
3. A biodiversity tool would regulate the impact of activities on the diversity of species present; and
4. A species group tool would regulate the impact of activities on specified species.

In addition, these recovery actions can then be monitored and allow adaptive management to occur for multiple species concurrently. However, the circumstances under which an EBA is adopted must be chosen carefully because the number of species, differing legislative timelines for recovery planning of multiple species, and the number of stakeholders can challenge the length of the process (ECCC, 2018).

Considering the interest in adopting more EBAs for SAR in Canada (ECCC, 2018), the following chapters will address the research question: Could conservation efforts for aquatic SAR be strengthened if tools to apply EBAs were utilized to accomplish the objectives of SARA?

The aim of the present study is to evaluate the results of other countries that have adopted EBAs to discuss the degree to which they have improved the effectiveness of their conservation programs. More specifically, there are three primary objectives to this study: Identify and compare the capability of Canadian and international EBA tools available to strengthen conservation and protection efforts for aquatic SAR, and assess the feasibility of the EBA tools previously identified

for the protection of at risk species of interest on the Stewiacke River. The timeline of this adoption is considered to see if enough time has passed to accurately analyze the results of this change. Then policy, regulatory or statutory tools in Canada (with the exception of one non-regulatory and one provincial tool) are identified that could be used to facilitate EBAs to discuss the benefits and consequences of such approaches and tools. If the results indicate that tools for an EBA would be beneficial to meet SARA objectives and alleviate the limitations discussed, recommendations of potentially useful tools will be explored.

Chapter 3: Methodology

3.1 Literature Review

In order to address the research question based on the management problem described in Chapter 2, a literature review was conducted. This analysis method was selected to focus on the prospective utilization of existing tools rather than the alteration of policy because amending SARA would be a lengthy process when there are likely existing options within current processes to implement EBAs. The literature review was conducted with three objectives: 1) Identify and evaluate international EBAs, 2) Identify and evaluate Canadian tools, and 3) Apply the lessons learned to a Stewiacke River case study.

3.2 Objective 1: International Ecosystem-Based Approaches

For the purpose of a more detailed analysis and due to time constraints, a limited number of countries was selected for an evaluation of the effectiveness of their EBAs towards SAR. Countries were selected based on the availability of information on their programs and being internationally recognized for EBA implementation at a federal level. This resulted in the selection of two countries: Australia and New Zealand. After each country was selected, their governmental webpages were reviewed to determine which departments are responsible for the protection of species at risk. Furthermore, their departmental webpages and relevant government documents were reviewed to identify the EBA tools utilized and identify internal evaluation documents of said tools. The results of this literature review objective were compiled and are discussed under Chapter 4.

3.3 Objective 2: Canadian Tools

Similarly to objective 1, approaching objective 2 began with identifying departments under the Government of Canada that are responsible for the protection of aquatic SAR. Then the

departmental webpages and relevant government documents were reviewed to identify the EBA tools available. The results of this literature review objective were compiled and are discussed under Chapter 5. Additionally, the results of objective 1 and 2 were used to discuss how conservation efforts may be strengthened based on lessons learned in Chapter 6 and inform any selection preferred tools for EBAs in Canada for the benefit of aquatic SAR by potentially alleviating the limitations of SARA identified in Chapter 2.

3.4 Objective 3: Stewiacke River Case Study

Lastly, a case study was selected as an example area in Canada that may benefit from an EBA for conserving aquatic SAR. The Stewiacke River was selected because of restoration interest in the area from the local and Indigenous communities due to the presence of COSEWIC and SARA listed species. This is made evident by a number of stewardship projects in the area. Using government department or organization webpages/documents and primary literature, the following information was collected regarding the Stewiacke River: 1) ecological information of Atlantic salmon (*Salmo salar*), American eel (*Anguilla rostrata*), striped bass (*Morone saxatilis*), and brook floater (*Alasmidonta varicosa*); 2) ecological and anthropogenic threats; and 3) current conservation and stewardship initiatives. Then based on the information available and presented on the Stewiacke River, it was determined whether the Stewiacke River would be appropriate for an EBA and, if so, what tool(s) might be suitable for the benefit of aquatic SAR present. These results are presented in Chapter 7.

Chapter 4 - International Ecosystem Based Approaches

The present chapter will go over the EBA tools that Australia and New Zealand utilize to conserve and protect aquatic species at risk in their areas of jurisdiction. The chapter aims to analyze the potential of such tools and whether their application and lessons learned can inform Canadian processes.

4.1 Australia Tool Outlines

In Australia, the federal conservation efforts are administered by the Department of Agriculture, Water and the Environment (DAWE). This is allowed by the primary piece of legislation for conservation, the *Environment Protection and Biodiversity Conservation Act* (EPBCA). Its objective is to protect the environment by promoting ecologically sustainable development, conservation of biodiversity, a co-operative approach, and the involvement of Indigenous Peoples' and their knowledge of biodiversity (EPBCA, 1999, art. 3(1)). The classification of each tool as a common threat, priority place, biodiversity, and/or species group EBA tool type can be visualized in Appendix A.

4.1.1 Regulation: Environment Protection and Biodiversity Conservation Act

4.1.1.1 Threatened Species Listing

Similarly to Canada, Australia has a program under which species at risk are listed under a status of extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent (EPBCA, 1999, art. 178(1)). However, unlike Canada, this process is also applicable towards ecological communities (can be listed as critically endangered, endangered, or vulnerable) and the threatening processes towards species and ecological communities (EPBCA, 1999, art. 181(1), 183). This makes the tool a priority place, species group, and biodiversity based

EBA tool. The listing process for species and ecological communities, called the Common Assessment Method, follows an assessment period during which the Minister compiles a list of items to be assessed based on determined conservation themes, nominations, and lists from the Scientific Committee. After the Scientific Committee provides the assessment of the finalized list, the Minister decides if the item is added to the threatened species, threatened ecological community, or threatening process list (DAWE, n.d.-b, n.d.-a, 2009; EPBCA, 1999, art. 194A). When an item is listed, a recovery team is formed to develop and coordinate the implementation of a recovery plan, conservation advice (local or regional on-ground activities, e.g. local - site monitoring and threat prevention on private property, regional - protection area and management plans (DAWE, n.d.-a)), or programs in collaboration with government agencies, NGOs, scientists, industry and the broader community (DAWE, n.d.-h, n.d.-d).

4.1.1.1.1 Recovery Plans

If deemed necessary, a recovery plan can be made for listed threatened species and ecological communities within 90 days of listing considering consultations with the appropriate Minister, the advice of the Threatened Species Scientific Committee, and public comments (DAWE, n.d.-c; EPBCA, 1999, art. 267). They are to outline research and management objectives with a framework for relevant stakeholders for the long term survival of threatened species or ecological communities (DAWE, n.d.-c). Additionally, the registered critical habitat of listed threatened species and ecological communities is to be considered when forming regulations regarding their protection, conservation, and survival (EPBCA, 1999, art. 270A(1)).

4.1.1.1.2 Threat Abatement Plans

If deemed feasible, effective, and efficient a threat abatement plan can be made for key threatening processes within 90 days of listing (DAWE, n.d.-f; EPBCA, 1999, art. 267). With consultation of the Scientific Committee, the plan can be made by the minister alone or with State or Territory initiatives (EPBCA, 1999, art. 267). The plans include research and management actions for the long term survival of threatened species or ecological communities by reducing the impact of key threatening processes (DAWE, n.d.-f).

4.1.1.1.3 Wildlife Conservation Plans

Wildlife conservation plans can be implemented for the protection, conservation, and management of one or more listed migratory species, listed marine species, species of cetacean, and conservation dependent species (EPBCA, 1999, art. 285(1), 297). The contents of conservation plans include its objectives and its achievement criteria, the actions to achieve them, the identified habitats of the species requiring protection, the identified affected interests, who will evaluate the plan, and the benefits towards the affected species (EPBCA, 1999, art. 287(2)).

4.1.1.2 Marine Bioregional Plans

A bioregional plan can be prepared for any bioregion within the commonwealth marine area with provisions regarding biodiversity distribution and conservation, and economic, social and heritage values (EPBCA, 1999, art. 176(1), 176(4)). Therefore, bioregional plans are a biodiversity and priority place focus EBA tool. Plus, these plans include objectives, strategies, implementation, and monitoring measures (EPBCA, 1999, art. 176(4)). There are four marine bioregional plans in Australia representing the South-west, North-west, North, and Temperate East for the protection of marine biodiversity and the sustainable use of marine resources (DAWE, n.d.-

b). These marine bioregional plans are intended to support environment legislation decision-making, support efficient administration of the EPBCA, and provide a framework for strategic intervention and investment (DAWE, n.d.-b).

4.1.1.3 Listed Migratory and Marine Species

The EPBCA includes a list of migratory species that are native to Australia and list of marine species (sea-snakes, eared seals, "true" seals, crocodiles, dugong, marine turtles, leatherback turtles, seahorse, sea-dragons, pipefish, ghost pipefish, and birds) that occur in a Commonwealth marine area (EPBCA, 1999, art. 209(1), 209(3), 248, 250(1b)). Marine species can be added to their respective list, if considered necessary for their long-term conservation, with the advice of the Scientific Committee (EPBCA, 1999, art. 250(1a), 251). When included in their list, these species are protected against anthropogenic actions based on the regulations of its subsection. This includes killing, injuring, taking, and trade unless a permit is issued (EPBCA, 1999, art. 211, 211B, 211D, 215, 254, 254B, 254D, 258). These lists are therefore a species group EBA type.

4.1.1.4 Australian Whale Sanctuary

The Australian Whale Sanctuary aims to protect and manage the cetaceans present within the Exclusive Economic Zone (EEZ) of Australia, waters over the continental shelf, and prescribed coastal waters of a State or Territory (EPBCA, 1999, art. 225(1), 225(2)). This makes the tool a priority place and species group EBA tool type. Any area within the Australian Whale Sanctuary can be declared to be important cetacean habitat subject to regulations for the protection of cetaceans (e.g. killing, injuring, taking, trade, and possession), however, permits can still be issued (EPBCA, 1999, art. 228A(1), 229, 229B, 230, 238).

4.1.1.5 Ramsar Wetlands

A Ramsar wetland is a declared wetland with ecological characteristics under threat while holding (or is likely to hold) international significance due to ecological, botanical, zoological, limnological, or hydrological reasons (EPBCA, 1999, art. 17A). This encourages sites to be selected for representing rare or unique characteristics or for the conservation of biological diversity. Thus, it can be considered a biodiversity and priority place EBA tool type. Ramsar wetlands can include swamps, marshes, billabongs, lakes, salt marshes, mudflats, mangroves, coral reefs, fens, peat bogs, or other bodies of water (DAWE, n.d.-e). For each Ramsar wetland, a management plan for protection and conservation must be made and reviewed every 5 years in co-operation with the relevant States and Territories (EPBCA, 1999, art. 325, 331).

4.1.1.6 Commonwealth Marine Reserves - Marine Parks

Commonwealth marine reserve, or marine parks, are designated areas to conserve marine habitats and the reliant species within them while supporting recreational activities and industries such as fishing and tourism. As such, they can be considered a biodiversity and priority place EBA type tool (AMP, n.d.-a; EPBCA, 1999, art. 344). While an area is awaiting assessment to be included as a commonwealth reserve, conservation zones can be created to protect the biodiversity in the area by regulating activities (EPBCA, 1999, art. 390B). There are 58 marine parks in Australia covering 36% of their oceans that are categorized into five networks (North, North-west, South-west, South-east, and Temperate East) and the Coral Sea, each category having its own management plan (AMP, n.d.-a). Also, there are seven management programs that include national and regional actions: (1) communication, education, and awareness program, (2) tourism and visitor experience program, (3) Indigenous engagement program, (4) marine science program, (5) assessments and authorizations program, (6) park protection and management program, and (7)

compliance program (AMP, n.d.-c). Within a marine park there are three types of zones that dictate what activities are allowed. Green zones have high levels of protection for conservation, yellow zones allow activities like fishing and diving as long as the seafloor is not harmed, and blue zones allow a wider range of activities which includes commercial industries (AMP, n.d.-b).

4.1.2 Regulation: Fisheries Management Act

4.1.2.1 Fishery Plans of Management

Fishery plans of management are established under the *Fisheries Management Act* (FMA) from 1991. The plans are made in consultation with, according to the Australian Fisheries Management Authority, people engaged in fishing. These plans can dictate the measurement of fishing capacity, the area to fish, fishing methods, kind and quantity of equipment, prohibit/regulate recreational fisheries and fishing for scientific purposes (FMA, 1991, art. 17(1), 17(6)). This makes fishery plans of management a common threat and species group EBA type tool.

4.1.3 Effectiveness

In 2009 an independent review of the EPBCA itself was published, including submissions from a diverse group stakeholders and individuals (DAWE, 2009a). Of the tools previously discussed, the review primarily examines the listing of threatened species and ecological communities. At the time of the review, the listing of threatened species and ecological communities had separate lists for the Commonwealth, States, and Territories, thereby creating regulatory inefficiencies that could be streamlined by integrating the listings across jurisdictions for a single national list to better coordinate legal and administrative processes and recovery action prioritization (DAWE, 2009a). The review stated that this change could potentially: reduce

assessments costs, reduce assessment timeframes, reduce inconsistencies in conditions, introduce data and knowledge of States and Territories into Commonwealth listing, and promote sharing information between the three (DAWE, 2009a). Other suggestions for the process included better integration of planning around future threats and how they evolve over time for mitigation purposes. Primary issues to address under this concept are climate change adaptation, invasive and exotic species, genetically modified organisms, and emerging technologies (DAWE, 2009a).

In 2015, Australia launched the Threatened Species Strategy with 26 targets for 2020 regarding mammals, birds, and plants conservation (DAWE, 2016). With a five-year Action Plan, the strategy sets out to mitigate feral cats, creating a safe haven for species at most risk, improving habitat to support threatened species recovery, and avert extinctions. The strategy and its reports are terrestrial focused, however, this can provide insight regarding Australia's effectiveness in conservation efforts. By 2020, the targets specifically regarding threatened species aim to improve population trajectories for 20 threatened mammals, 20 threatened birds, and 30 threatened plants, and to improve recovery practices (e.g. common assessment methodology, ensuring recovery plans and conservation advices) (DAWE, 2016).

In its first year, an agreement to adopt the common assessment method was achieved between jurisdictions, thereby addressing the concerns of the independent review previously mentioned (DAWE, 2016). The third-year report of the strategy provided insights on how these efforts are progressing. Of the 21 year-three targets, 12 were met, four were partially met, and six were not met (DAWE, 2019). Within these targets, the improvement of the trajectory of the priority species for neither mammals nor birds was met. Only eight of the 20 priority mammal species and six of the 21 priority bird species are estimated to have an improved trajectory. However, all twenty bird and mammal priority species have received up-to-date conservation advices or recovery plans

(DAWE, 2019). It was unreported if the trajectories of priority plant species improved because the strategy did not have a specified year-three target. To reach their 2020 targets the Australian Government planned continue to supporting the recovery of the identified species through partnership programs and projects to improve threatened ecological communities, Ramsar wetlands, and World Heritage sites (DAWE, 2019).

Another document displaying the effectiveness of Australian efforts is the *Australian State of the Environment 2016: Biodiversity* report which outlines the status of species and ecological communities, and management effectiveness (Cresswell & Murphy, 2017). Since 2011, the number of threatened species and ecological communities had increased, however, this was primarily attributed towards an increase in knowledge on threatened species and the improved efficiency of the listing process (Cresswell & Murphy, 2017). Between 2011 and 2015, there were 30 new listings of threatened ecological communities, including two freshwater and three coastal/marine ecosystems. In total this made 74 threatened ecological communities, 31 of which were listed as critically endangered. In the same time frame, the number of listed threatened species increased by 44, making 1808 species listed in total (Cresswell & Murphy, 2017). Australia's area-based targets have been met for the National Reserve System, however aquatic ecosystems were deemed to be poorly represented and 50% of critically endangered and 30% of endangered listed communities have less than 5% of their area represented (Cresswell & Murphy, 2017). Overall, the condition of aquatic ecosystems and species was generally considered poor to moderate across the jurisdictions. The condition of the marine environment was also deemed poor to moderate because of increasing numbers of pressures on species and ecosystems (Cresswell & Murphy, 2017). The effectiveness of recovery planning and investments in biodiversity and threatened species management was deemed variable because of a lack of data and information from long-

term monitoring and because of irregular implementation of recovery plans (Cresswell & Murphy, 2017).

4.2 New Zealand

The conservation efforts of New Zealand are administered by the Department of Conservation (DOC). Unlike Australia, instead of one large piece of legislation, New Zealand has multiple for different tools. They do have a single species listing system called the New Zealand Threat Classification system where the DOC and an expert panel decide if a species/subspecies/varieties/forma is to be listed as data deficient, not threatened, at risk (declining, recovering, relict, naturally uncommon), threatened (nationally critical, nationally endangered, nationally vulnerable), or extinct (Townsend et al., 2008). However, their conservation efforts primarily focus on EBAs. The classification of each tool as a common threat, priority place, biodiversity, and/or species group EBA tool type can be visualized in Appendix B.

4.2.1 Tools

4.2.1.1 Conservation Areas

The implementation of conservation areas for conservation purposes of terrestrial and aquatic environments is authorized under the *Conservation Act* (CA) (CA, 1987, art. 7(1A), 7(1B)). These areas are managed through the implementation of general policies, conservation management strategies (general policies with established objectives for the integrated management of natural and historic resources), conservation management plans (conservation management strategies with establish detailed objectives for the integrated management of natural and historic resources), and freshwater fisheries management plans (general policies with establish detailed objectives for the management of freshwater fisheries) detailed under the CA (CA, 1987, art. 17A-

E, J). Also, if deemed necessary a conservation area is able to later become a reserve, sanctuary, refuge, or national park (discussed under section 4.2.1.4) (CA, 1987, art. 8).

There are five types of conservations areas (CA, 1987, art. 19-23): (1) Conservation parks - are managed to protect natural and historic resources (CA, 1987, art. 19(1)); (2) Wilderness areas - preserve indigenous natural resources, prevents the construction of infrastructure, and presence of livestock and transportation vehicles (CA, 1987, art. 20(1)); (3) Ecological areas - managed to protect the values by which it was established to protect (CA, 1987, art. 21); (4) Sanctuary areas - managed to preserve its natural state for scientific purposes (CA, 1987, art. 22); and (5) Watercourse areas - managed to protect its wild, scenic, and natural or recreational characteristic (CA, 1987, art. 23(5)). Conservation areas are therefore a priority place EBA tool type.

4.2.1.2 Fisheries Sustainability Measures

Fisheries sustainability measures are authorized by the *Fisheries Act* (FA-NZ) (FA-NZ, 1996). The Act has environmental principles regarding the use of fisheries resources to ensure sustainability. These include: (1) associated or dependent species should be maintained above a level that ensures their long-term viability, (2) biological diversity of the aquatic environment should be maintained, and (3) habitat of particular significance for fisheries management should be protected (FA-NZ, 1996, art. 9). Article 11 of the Act outlines the implementation of sustainability measures that can be utilized for one or more stocks (FA-NZ, 1996, art. 11(1)). These sustainability measures can relate to: (1) catch limit/total allowable catch, (2) size, sex, biological state of any fish, aquatic life, or seaweed, areas, (3) areas from which any fish, aquatic life, or seaweed of any stock, (4) fishing methods, and (5) fishing season (FA-NZ, 1996, art. 11(3)). Making this tool a common threat and species group focused EBA tool.

4.2.1.3 Marine Protected Areas

The *Marine Reserve Act* (MRA) is the authorizing legislation for marine reserve areas in the territorial sea and internal water of New Zealand (MRA, 1971, art. 2). Marine reserve areas are considered to be a type 1 marine protected area (MPA) as it offers the highest level of marine protection (DOC, n.d.-a, n.d.-d). Of which there are 44 in New Zealand (DOC, n.d.-d). Their purpose is to preserve the presence of underwater scenery, natural features, or marine habitats/life, that is considered to have a distinctive, typical, beautiful, unique quality from alteration for national interest and the scientific studies (e.g. comparative studies) of marine life (DOC, n.d.-d; MRA, 1971, art. 3(1)), therefore it is a biodiversity and priority place EBA tool type. Objectives for the marine reserve areas are outlined following management strategies and plans from the CA (MRA, 1971, art. 7, 8).

Type 2 MPAs are created outside of the MRA but meet the MPA Protection Standard policy because of its protections against the negative effects of fishing (DOC, n.d.-e). These include fisheries closures, submarine cable closures, fiordland marine area, marine parks, and Te Whaka a Te Wera Mataitai Reserve (DOC, n.d.-b). The third type is considered as other marine protection tools because their level of protection does not meet the Protection Standard policy standard. These include tools such as Benthic Protection Areas, Seamount Area Closures, Marine mammal sanctuaries, and customary management. (DOC, n.d.-c).

4.2.1.4 Wildlife Sanctuaries, Reserves, and Management Reserves

The remaining tools, wildlife sanctuaries, refuges, and management reserves, are authorized by the *Wildlife Act* (WA) and are applicable for both terrestrial and aquatic animals (WA, 1953, art. 2, 3). All species in these designated areas are subject to the act (WA, 1953, art.

3), unless they are listed on one of five schedules (WA, 1953, art. 4-7): (1) Schedule 1 – game purposes (WA, 1953, art. 4); (2) Schedule 2 – partially protected, meaning any wildlife causing injury or damage on occupied land can be hunted or killed on the land (WA, 1953, art. 5); (3) Schedule 3 – may be hunted but subject to conditions imposed by the Minister (WA, 1953, art. 6); (4) Schedule 4 – wildlife that are not protected by the act unless under specified condition (i.e. periods of no killing or hunting can be established) (WA, 1953, art. 7); and (5) Schedule 5 - wildlife that are not protected by the act unless under specified conditions (WA, 1953, art. 7).

Wildlife sanctuaries, refuges, and management reserves can be established after an area has been declared a conservation area under the CA (WA, 1953, art. 9(1), 14(1), 14A(1)). Within wildlife sanctuaries conditions/prohibitions/restrictions can be imposed regarding (1) right of entry, (2) hunting, killing, taking, disturbing, or introduction of any living creature, of the eggs or spawn of any such creature, or with vegetation of any description in the sanctuary, (3) burning or clearing, (4) camping, (5) lighting of fires, (6) use of boats, (7) aircraft disturbance, (8) firearms of explosives, (9) possession of wildlife, (10) garbage/litter, (11) cutting, construction, or maintenance of access or communication into the sanctuary, (12) pollution, and (13) other matters for the protection of wildlife and vegetation (WA, 1953, art. 9(1)). In wildlife refuges prohibitions/restrictions can be made regarding pollution by means of garbage, sewage, industrial water, mining debris sawmill refuse, or any other means (WA, 1953, art. 14(1)). Lastly, for wildlife management reserves any prohibitions or restrictions imposed can be absolute or conditional if approved by the Minister (WA, 1953, art. 14A(3)). In these areas conservation management strategies and plans are made to set wildlife management objectives (WA, 1953, art. 14D, 14E). Overall these tools are priority place and species group focused EBA type tools.

4.2.2 Effectiveness

New Zealand also has an environmental reporting series entitled *Environmental Aotearoa* comprised of data between the Ministry for the Environment and StatsNZ (Ministry for the Environment & StatsNZ, 2019). Similar to Australia, the report states that there are insufficient data to describe the entirety of an ecosystems health but it does include many statistics of species trends (Ministry for the Environment & StatsNZ, 2019). Overall in the past 15 years the trends and status of 86 species have declined, however, with management initiatives, 26 have improved in the past 10 years (Ministry for the Environment & StatsNZ, 2019). Specifically in freshwater environments, species, habitats, and ecosystems are declining due to development, agriculture, obstructions, and invasive species. Of the native freshwater fish, 39 of 51 (79%) species were considered threatened or at risk of extinction in 2017 and 1,758 of lakes (46%) have poor or very poor ecological health in 2020 (Ministry for the Environment & StatsNZ, 2020). Marine biodiversity and habitat condition was also deemed to be in decline since habitats, estuaries, and species that create new habitats/support other species are decreasing or threatened (Ministry for the Environment, 2019).

The statistics regarding species trends are further broken down under StatsNZ. The assessment of indigenous land species included 9,323 species in 2019. Of that 27% (2,519), mainly lichens and invertebrates, were considered data deficient and 79% (174/220) of assessed vertebrate species are threatened or at risk of extinction (StatsNZ, 2019a). Between assessments some species groups had improved: 12 bird species (2012-2016) (with the help of conservation management), 2 vascular plant species (2012-2017), and 1 bat species (2012-2017) (StatsNZ, 2019a). However, some have worsened: 61 vascular plants (2012-2017), five terrestrial birds (2012-2016), three

reptiles (2012-2015), and ten terrestrial invertebrates (2005-2015 – varies for each) (StatsNZ, 2019a).

The latest statistics regarding indigenous marine species was also released in 2019. 90% of seabirds (86 of 96 species), 80% of shorebirds (12 of 15 species), 22% of indigenous marine mammals (10 of 45 species), and 9% of sharks, rays, and chimaeras (10 of 107 species) were assessed as threatened or at risk of extinction (StatsNZ, 2019b). While 39% of sharks, rays, and chimaeras (42 species), and 67% of marine mammals (30 species), 15% of marine invertebrates (60 species) were assessed as data deficient (StatsNZ, 2019b). Evaluations concluded improvements for the southern right whale and New Zealand sea lion (2016–2019), two shorebirds (2012-2016), and seven seabirds (2012-2016) between assessments. Although, the status of four of these bird species is predicted to decline if conservation management initiatives end (StatsNZ, 2019b). On the other hand, two seabird species (2012–2016), and one marine invertebrate (2009-2013) worsened (StatsNZ, 2019b).

Lastly, the latest indigenous freshwater species statistics were released in 2020. 76% of indigenous fish (39/51 species) and 26% of indigenous invertebrates (177/670) were assessed as threatened or at risk of extinction, and 27% (178 species) of freshwater invertebrates were assessed as data deficient (StatsNZ, 2020). Between assessment periods only one species was evaluated to have improved, longjaw galaxia (Waitaki River, 2013-2017). Though two species worsened, one freshwater fish (southern flathead galaxias) (2013-2017) and one freshwater invertebrate (tadpole shrimp) (2013-2018) (StatsNZ, 2020). Additionally, two species (lowland longjaw galaxias (Kakanui River) and Canterbury mudfish) classified as threatened – nationally critical were expected to be extinct if it were not for conservation management initiatives (StatsNZ, 2020).

Chapter 5 - Available Ecosystem Based Management Tools in Canada

An evaluation of the available conservation and protection tools is required to support stakeholder initiatives aimed to conserve and protect the species at risk. EBA tools that are focused on either common threats, priority place, biodiversity, and/or species group are identified and evaluated. Their application could have the potential to bring benefits for the discussed species at-risk simultaneously and fill gaps where the current initiatives are primarily single-species focused. The classification of each tool as a threats, priority place, biodiversity, and/or species group EBA tool type can be visualized in Appendix C.

5.1 Non-regulatory tools

5.1.1 Ecologically and Biologically Significant Areas

Ecologically and Biologically Significant Areas (EBSAs) are a non-regulatory tool which can be applied in all aquatic communities (DFO, 2004, 2011). The original framework of the tool was introduced in 2004 by DFO outlining how a potential EBSA is to be identified (DFO, 2004). Later, the UNCBD released their own similar framework (CBD Secretariat, 2009). The original EBSA frameworks were developed for the marine environment and validation of their use in freshwater environments is underway (DFO, 2004).

An EBSA is an area within the aquatic ecosystem that, when compared to the surrounding ecosystem, has been deemed to have significant biological or ecological characteristics. In Canada, the DFO EBSA process is accomplished through a formal scientific assessment where ecological and human use data and knowledge are used to evaluate the dimensions of uniqueness, aggregation, fitness consequences, resilience, and naturalness of the investigated area (DFO, 2016). It should be noted that a species or community property cannot fulfill criteria for ecological

significance if the negative consequences of disrupting the species or community property is solely towards humans (DFO, 2006).

When an area is identified as an EBSA, the intent is to draw attention to significant ecosystem components within the area for decision-making processes, which makes the tool a priority place, species group, and biodiversity based EBA tool. However, the limitation of EBSAs is that they do not inherently provide protection measures, thus other conservation and protection tools are required if further protection is needed. EBSAs also inform and guide conservation planning, project-specific or regional environmental assessments, operations of industries, submarine cable projects, Integrated Oceans Management, guidelines around marine-based activities, and the identification of Areas of Interest that may become MPAs (Government of Canada, 2016b).

5.2 Policy

5.2.1 Integrated Fisheries Management Plans

Integrated Fisheries Management Plans (IFMP) are a policy-based resource management tool for fishery species in all aquatic environments originating from the *Sustainable Fisheries Framework* introduced by DFO in 2009 (DFO, 2009). The goal of the framework is to support the conservation and sustainable use of fishery resources by using precautionary and ecosystem-based approach to maintain healthy fish stocks, protect biodiversity and habitats, and maintain productive fisheries (DFO, 2020f). In one sense, IFMPs can be thought of as a common threat, species group, and biodiversity based EBA type tool. In collaboration with stakeholders, the management actions set out in an IFMP for a particular fishery are selected using an overview of the fishery, the stock assessment and status, socio-economic profile of the fishery, management issues for depleted species, habitat and gear, access and allocation elements, short- and long-term sustainable fisheries

objectives, management measures (total allowable catch, fishing seasons and areas, control and monitoring, decision rules, licensing, SARA considerations, and habitat protection measures), the compliance plan, and the performance review of the management objectives. The order in which a fishery receives a plan depends on prioritization based on factors such as gaps across similar fisheries, eco-certification requirements, domestic and international commitments, personnel and funding capacity, and industry readiness (DFO, 2009).

5.2.2 National Marine Conservation Areas

National Marine Conservation Areas (NMCAs) are a policy-based tool introduced by PCA in 1986 that is authorized by the *National Parks Act* and the *National Marine Conservation Act*. The purpose of establishing NMCAs is to represent the 29 marine regions of Canada and to manage the area to reach ecological sustainability (PCA, 2018, 2020). Also, the area is intended to be of benefit to Canadians and others by offering enjoyable experiences, educational opportunities through promoting awareness and understanding, and other benefits for Indigenous Peoples and coastal communities (PCA, 2020). NMCAs can be considered a priority place and biodiversity-focused EBA tool.

NMCA establishment is guided by the National Marine Conservation Area System Plan to provide descriptions of the marine regions and an Action Plan that is updated to describe the necessary actions to complete the representation of the 29 marine regions (PCA, 2018). Designation of NMCAs can be applied towards lakes, wetlands, estuaries, islands, coastal areas, and the ocean to protect and conserve the seabed, subsoil, and overlying water column of the designated area (PCA, 2018, 2020). The general process involves five steps. The first is to identify marine representative areas that demonstrate geological, oceanographic, biological, and ecosystem diversity that is representative of a marine region or Great Lakes region not yet adequately

represented in the system. In addition, the area must be healthy, natural, or, if stressed or degraded, the restoration/maintenance must be feasible. Secondly, out of the marine representative areas identified, potential NMCAs are selected based on their importance, potential value and opportunities, threats to long-term sustainability, conflict with marine resource use, and complimentary given other marine objectives. Thirdly, the potential NMCAs are assessed for their feasibility. Fourthly, agreements of establishment are made with the relevant provincial or territorial government, federal departments and agencies, and Aboriginal organizations. Lastly, the NMCAs are established through an amendment of the National Parks Act. In addition, the process of establishing a NMCA requires public consultation and intergovernmental cooperation throughout because their support and cooperation is essential (PCA, 2018).

Within a NMCA, zones are defined by management actions and regulations to designate the levels of protection needed throughout. Based on the objectives of each zone, human activities are then managed to prevent conflicts between activities and stakeholders (PCA, 2018).

5.3 Provincial Policy

5.3.1 Nova Scotia Watershed Planning: Nova Scotia's Water of Life

The watershed planning tool in Nova Scotia is a provincial policy entitled *Nova Scotia's Water of Life*. The tool is non-regulatory and its purpose is to manage water resources and the effects of human activity on watersheds and ecosystems and is therefore a priority place and common threat EBA type. This is summarized into five overall goals: (1) human health through safe and secure water for consumption, recreation, and livelihoods, (2) economic prosperity through sustainable and beneficial use, (3) ecosystem integrity by protecting, conserving, and enhancing water resources, (4) preparedness for water-related emergencies and hazards, and (5) better understand the provinces water resources through monitoring and knowledge collection. It

is administered by the provincial government of Nova Scotia with a multi-department Water Advisory Group. The group also consists of external stakeholders including academics, industry representatives, and municipality representatives to provide advice (PNS, 2010).

5.4 Regulatory: Fisheries Act

5.4.1 Ecologically Significant Areas

Unlike EBSAs, ESAs are a legislative tool outlined in the *Fisheries Act* (FA-CA) under the Fish and Fish Habitat Protection and Pollution Prevention provisions. Article 35.2 of the FA-CA allows for an ESA to be established to conserve and protect fish and fish habitat in any aquatic community that meets the criteria of sensitive, highly productive, unique, or rare (FA-CA, 1985), which makes the tool a priority place, species group, and biodiversity based EBA tool.

Based on the objectives of the ESA, regulations can be put in place to prohibit or require enhanced regulation (i.e., require an authorization for a WUA (work, undertaking or activity) with prescribed conditions) of any WUAs, except fishing, under DFO's jurisdiction, unless authorized and the project meets the conservation objectives of the ESA (FA-CA, 1985, art. 35.2(1)). When a WUA is authorized, proponents are required to submit all documentation as prescribed by the regulations and to monitor effects of the WUA on fish and fish habitat. A fish habitat restoration plan can be prepared to help meet conservation and protection objectives (FA-CA, 1985, art. 35.2(3)).

5.4.2 Fisheries Management Orders

Fisheries Management Orders are another legislative tool under the FA-CA implemented by DFO that conserves and protects any targeted fishery of interest, making it a species group and common threat EBA tool type. If considered necessary, article 9.1 from the FA-CA allows a

Fisheries Management Order to be made if a threat to the management of fisheries and the conservation is needed to be addressed. Measures under such an order can include: (1) the prohibition of fishing one or more species, populations, assemblages, or stocks (also known as a fishery closure), (2) the prohibition of fishing gear, equipment, or vessel, (3) the limitation of what size, weight, or quantity at which any species, populations, assemblages, or stocks can be fished, and (4) the implementation of any fishing requirements (FA-CA, 1985, art. 9.1(1)). These are applicable towards people who utilize the particular methodology, equipment, or vessels identified and/or a holder of a particular license that is relevant (FA-CA, 1985, art. 9.1(3)).

5.4.3 Marine Refuges

Marine refuges are established through ministerial regulations that are authorized by the competent Minister under the FA-CA within the Biodiversity Protection Provisions (DFO, 2019b; FA-CA, 1985, art. 43.3). It is considered an other effective area-based conservation measure towards marine conservation targets as it has similar mechanisms to MPAs concerning the regulation of human activities (DFO, 2019b, 2020c). Marine Refuges can be established in any ocean area that is governed and managed by DFO to conserve and improve the present biodiversity, making it a priority place, biodiversity, and species group EBA tool type (DFO, 2020d). It protects biodiversity by restricting activities, such as specific fishing gear or practices, that may threaten what the area was established to protect (DFO, 2019b, 2020d).

5.4.4 Other Fish and Fish Habitat Protection Provisions

Under the Fish and Fish Habitat Protection provisions (FFHP) of the FA-CA, there are other tools outlined besides ESAs that are applicable to all aquatic communities. The purpose of the provisions itself is to conserve and protect fish and fish habitat resources using a risk-based

approach for future generations making it a common threat, species group, and priority place EBA tool type (DFO, 2019d, 2020g). The relevant provisions outlined in the Act and the accompanying policy are: (1) the prohibition of the death of fish by means other than fishing, (2) the prohibition of the harmful alteration, disruption or destruction of fish habitat (HADD), which includes in the designation of projects and ESAs, (3) a requirement to ensure the free passage of fish or the protection of fish or fish habitat from obstructions, and (4) the ability to designate a fish habitat bank – an area to create, restore, or enhance fish habitat through conservation projects (i.e. for the purposes of offsetting - conservation actions taken to compensate for environmental features that are lost or reduced as a result of a WUA (Government of Canada, 2016c)) (DFO, 2019c; FA-CA, 1985, art. 34.1-34.4, 42.02). For the implementation of these provisions to be successful DFO must work with partners to gain support regarding project investments and economic development, identify sensitive areas and sustainable threats, establish management objectives, gain expert advice for mitigation and conservation measures, and up-to-date reporting (DFO, 2019c).

5.5 Regulatory: Oceans Act

5.5.1 Integrated Management Plans

Integrated management plans are a requirement of the *Oceans Act* (OA) administered by DFO that focuses on priority areas. Integrated management plans are developed in collaboration with provincial or territorial governments, Aboriginal organizations, coastal communities, and other affected stakeholders regarding human activities in estuaries, coastal waters, and/or marine waters (DFO, 2002; OA, 1996, art. 31-32). Integrated management plans are built on the principles of ecosystem-based management, sustainable development, the precautionary approach, conservation, shared responsibility, flexibility and inclusiveness (DFO, 2002). The process of establishment includes six stages: (1) define and assess the management area, (2) engage affected

and interested stakeholders, (3) develop the integrated management plan, (4) receive endorsement from decision-making authorities, (5) implement the plan, and (6) monitor and evaluate the outcomes (DFO, 2002).

5.5.2 Marine Protected Areas

MPAs are a legislative tool administered by DFO from the OA. The purpose of an MPA is to conserve and protect fishery resources, marine species and their habitats, unique habitats, areas of high biodiversity and productivity, other marine resources or habitat, and/or areas for ecological integrity. MPAs would be defined as a priority place, biodiversity, and species group EBA tool type. They can be established within the internal waters of Canada, the territorial sea (12nm), and the EEZ (200nm) (OA, 1996, art. 35(1)).

The process of creating a new MPA involves: (1) selecting an area of interest; (2) conducting an ecological and socio-economic assessment of the potential area; (3) using the available science, traditional, and local knowledge to propose MPA designs and regulations (at this point consultations occur with the affected and interested parties); (4) drafting regulations and publishing the designated MPA in Canada Gazette, Part II; and (5) finalizing an adaptive MPA management framework, including conservation objectives, management plan, monitoring plan, compliance, enforcement, public education and outreach (DFO, 2020b).

In these regulations, zones can be created to distinguish the areas where specific activities can be allowed (OA, 1996, art. 35(3)). A list of activities that are allowed must be made for each MPA, but activities listed as allowed can still be later prohibited for the management, conservation, or protection of fishery resources. Any activity that does not fall onto the list of allowed activities

or disturbs, damages, destroys, or removes ecosystem components being protected is therefore prohibited (OA, 1996, art. 35.1(2)).

5.6 Regulatory: Species at Risk Act

5.6.1 SAR Critical Habitat Orders

SAR critical habitat orders comprise a legislative tool enabled by SARA in 2002. Critical habitat orders are implemented by all three departments, ECCC, DFO, and PCA (SARA, 2002). It is a species group and priority place focused EBA tool because critical habitat is the area listed in a recovery strategy or action plan of a SARA-listed species, which it requires for survival or recovery (e.g. nursery areas, feeding grounds, and migration areas (DFO, 2020a; SARA, 2002, art. 2(1)) (DFO, 2019e; SARA, 2002). In regard to aquatic species, the orders are applicable in all aquatic communities for species at risk listed as threatened, endangered, or extirpated and includes their habitat (SARA, 2002).

The order itself provides the legal protection of the critical habitat as required by the SARA (DFO, 2019e). When the order is implemented it then becomes prohibited to destroy any part of the species critical habitat and restrictions can be made regarding future development and construction projects (DFO, 2019f, 2020a; SARA, 2002, art. 58(1)).

Chapter 6 - Implications and recommendations for SARA objectives

Each of these tools offers ways in which EBA can be used to protect and conserve aquatic SAR. Furthermore, because of their relationship with EBA, many of them offer the potential to alleviate SARA limitations while working towards the conservation objectives of SARA under the appropriate circumstances. The exceptions to this would be: 1) SAR Critical Habitat Orders because it is currently a SARA tool, and 2) NS watershed planning because it is a provincial tool, meaning that federal departments do not have any influence. Nonetheless, it must be taken into account that in order for any of the outcomes of these tools to be useful to the SARA program there must be species-specific information available to contribute towards SARA legislative objectives.

6.1 Reaching objectives

The tools offer different mechanisms by which they can help achieve SARA objectives to prevent the decline of Canadian wildlife and providing recovery for species that are at risk. They have the ability to provide more information about the species of interest. For example, during the listing process, a previously identified EBSA or ESA may help inform/quicken the listing progress or the development of recovery measures. An EBSA could provide information on identified threats to a species, while an ESA could provide information regarding addressed threats because of the required risk-assessment analyses regarding the effects of WUA on fish and fish habitat. Also, an ESA can help reach SARA objectives of protecting and recovering SAR indirectly before the listing process is completed by reducing the impacts of industry operations, preventing further fishery disruption or harmful practices, regulating activities causing disruption from humans, protecting fish habitat (specifically with activities involved with habitat alteration/contamination), protecting critical habitat for species of special concern that would not have this legal requirement

(e.g. brook floater), and initiate conservation projects to help the recovery efforts. An EBSA may not necessarily reduce these impacts but an EBSA could influence management decisions that would.

6.2 Alleviate limitations

Overall, the EBA tools discussed have some potential to alleviate SARA limitations, such as listing progress and recovery measure implementation, rather than resources and taxonomic biases/economic consideration. However, the possibility in accelerating the listing and recovery process would inherently reduce resources required in SARP, as work would be accomplished by other conservation planning and establishment processes. For example, the information collected for EBSA identification or ESA establishment could help inform the research and identification of critical habitat. Secondly, management measures could be implemented by any of the tools (within their capacity) before or during the listing process is completed and help inform the listing recommendation and identify potential recovery measures. However, it is necessary to clearly state how the measures specifically impact the species under consideration.

6.3 Improve efficiency

Many of the tools involve stakeholder engagement in management, which could help in increasing efficiencies with consultation planning during listing processes. Distribution lists for initiating consultation are not readily available. For example, their development can be a lengthy process, involving the identification of stakeholders, using several lists sought out from fish harvesters, NGOs, provinces and territories. If there are stakeholder committees or groups established through EBA tool establishment and the species under consideration for listing falls with the boundaries, less time would need to be spent creating lists so more time could be spent connecting with stakeholders. In addition, there is the potential to collect information and metadata

from stakeholders during engagement, which can provide an opportunity to fill data gaps or to support previously collected data, thus increasing clarity. For example, this might include identification of which at-risk species are impacted by similar threats and information on multi-trophic level interactions with SAR of interest. Therefore, measures could be designed to be beneficial for multiple at-risk species indirectly and/or simultaneously instead of taking an SSA. For example, tools that regulate fishing gear can implement regulations regarding gear types that threaten multiple species whether the intent is for targeted SARA species or bycatch.

6.4 Other considerations

The evaluation of effectiveness of international efforts towards species at-risk conservation using EBA tools is unclear and requires further evaluation. There is a data gap in the internal evaluations previously discussed in Chapter 4 as they give little to no connection to the available management tools. Additionally, both Australia and New Zealand report variability regarding ecosystem health due to a lack of data. Therefore, there is not enough information to make specific EBA tool recommendations for accomplishing SARA objectives based on the international evaluations. Nonetheless, many of the Australian and New Zealand tools previously discussed have equivalents in Canada and each country has respective tools that can address common threats, biodiversity, priority place, and/or species group. For example, Fishery Plans of Management from Australia, Fishery Sustainability Measures for New Zealand, and Fisheries Management Orders from Canada have similar purposes and execution. Each country also establishes MPAs or, in the case of Australia, Marine Parks. Another example would be the bioregional plans from Australia and EBSAs from Canada, as both are intended to help inform management decisions.

Another consideration between SARA efforts and EBA tools is SARP's dependence and ties to the COSEWIC process. Under the current system, the commencement of the SARA listing

process should start as soon as possible after a COSEWIC assessment, thereby initiating the legislative timeline, including the timelines associated with recovery measure requirements. Since COSEWIC also adopts an SSA, the format and timelines add difficulty to the coordination of multi-species efforts permissible under SARA, despite the possibility of having assessments, research, and consultations occur simultaneously. If COSEWIC is not considering EBAs, specifically multi-species EBAs, then the SARA process remains limited in this capacity. A suggestion that may help remedy this would be to add a similar COSEWIC assessment process based on location and/or threat, which could align with SARA only if there are sections within it that include information regarding single species to fulfill SARA objectives. A place-based assessment would allow COSEWIC to create more comprehensive reports based on precise locations (e.g. Stewiacke River) and/or threats (e.g. Fishing method) to which information on impacted species can be added and edited. If this were to be pursued, there is an opportunity to draw upon the Australian threatened species listing framework, as it lists threatened ecological communities and threatening processes towards species and ecological communities.

Chapter 7 – Case Study: The Stewiacke River

The Stewiacke River is located in Nova Scotia on the eastern side of the Cobequid Bay through its connection with the Shubenacadie River (Figure 1). The Stewiacke River is within the Inner Bay of Fundy (iBoF) Atlantic Salmon designable unit (DU). The location was selected for this study on the application of EBA tools because of its historical productivity and diversity of fish and fish habitat, and its cultural, recreational, and economic significance to the surrounding communities, which includes the Indigenous communities, like Millbrook First Nation who have lived along Salmon River (MCG, n.d.-a; Millbrookband, n.d.; Town of Stewiacke, n.d.; Woodford, 2020). However, a combination of anthropogenic and ecological threats (e.g. contamination, passage barriers, and changes in environmental condition) have caused changes to the ecosystem, which may have reduced productivity and fish survival (DFO, 2008). There has been growing interest in the area to recover the Stewiacke River to its historical status, which is made evident by the number of stakeholders, including DFO, that have invested resources into restoration and stewardship projects.

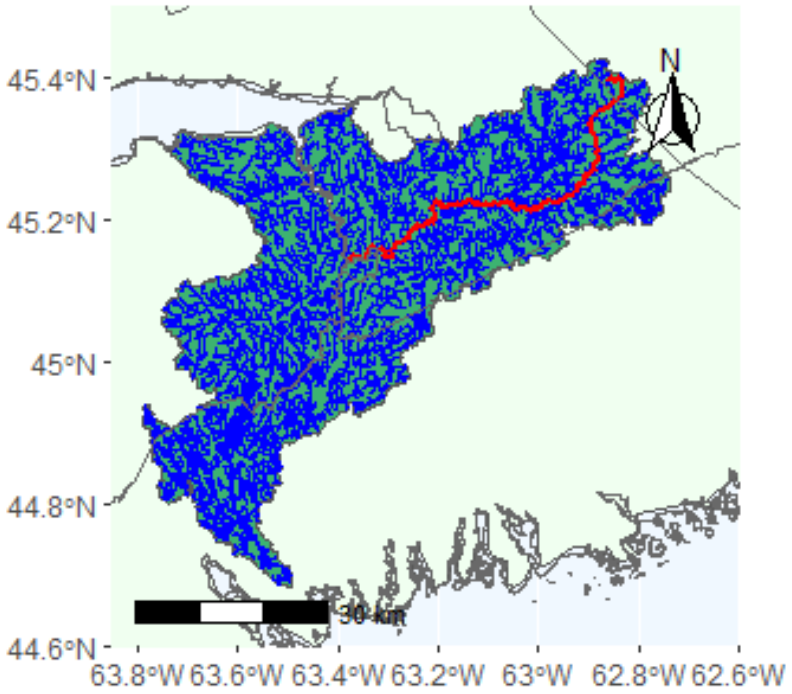

Figure 1. Map of the Shubenacadie/Stewiacke Watershed in Nova Scotia. Red line: Stewiacke River, dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

In this case study, we focused on the following SARA-listed and COSEWIC-assessed aquatic SAR with cultural and ecological significance in the Stewiacke River: American eel (threatened, COSEWIC-assessed), Atlantic salmon (endangered, SARA-listed), brook floater (special concern, SARA-listed) and striped bass (endangered, COSEWIC-assessed). There are other aquatic and semi-aquatic species present in the system that are listed as at-risk by SARA or the province of Nova Scotia and assessed by COSEWIC. For example, under SARA Blandings turtle (*Emydoidea blandingii*) is listed as endangered, wood turtle (*Glyptemys insculpta*) and Eastern ribbonsnake (*Thamnophis sauritus*) are listed as threatened, and the water-pennywort (*Hydrocotyle umbellate*) is listed as special concern. Also, Ram's Head lady slipper (*Cyprepedium arietinum*) is provincially listed as endangered. The following chapter will review the presence of

the four focus SAR in the Stewiacke River including their significance, ecological indicators, ecological and anthropogenic threats, and recovery initiatives. Appendix D lists these threats categorically to visualize the shared threats between the species. The available information will then be analyzed to determine whether the Stewiacke River would be appropriate for an EBA and, if so, what tool(s) might be suitable for the recovery aquatic SAR present.

7.1 American Eel

The American eel are diadromous fish displaying a catadromous lifecycle, where they occupy both marine and freshwater habitats. Marine habitats are used during their growth phase and migrations to and from the Sargasso Sea for spawning. As larvae in the Sargasso Sea, they disperse westward to the continental shelf where they metamorphose to "glass eels", then develop into "elvers" as they move inshore. At this point, they begin migration to their freshwater habitats, where they mature into "silver eels", in lakes and rivers or waters with a high-water mark of at least 10 m depth (COSEWIC, 2012a).

The American eel is an at-risk species that has been assessed as threatened by COSEWIC and is currently under consideration for listing with SARA (COSEWIC, 2012a; SARA, 2002). The American eel holds significance in fisheries including commercial, recreational, and Aboriginal subsistence, but due to their decline its management plan has included a 50% reduction in anthropogenic mortality (COSEWIC, 2012a). Anthropogenic threats that affect American eel survival include climate change and fisheries, which typically target pre-spawners. Other anthropogenic factors that threaten American eel populations include migration barriers, poor water quality, chemical contamination, invasive species (e.g. Swim bladder nematode (DFO, 2012)), and the loss of habitat (deforestation, agricultural practice, and overfishing) (COSEWIC, 2012a). Additionally, of the four species discussed, the American eel has the least amount of

available information regarding their presence in the Stewiacke River. There is a data gap regarding the locations of American eel nursery grounds and without this knowledge the use of SSAs specifically becomes more difficult because of the uncertainty of which locations to focus single species recovery efforts.

7.2 Atlantic Salmon

Similar to American eel, Atlantic salmon are diadromous fish displaying an anadromous lifecycle. Adult salmon spawn in freshwater habitats that are typically clear, cool, well-oxygenated, and have gravel, cobble, and boulder substrates which aid in the production of redds, gravel nests where eggs are incubated. Spawning females deposit eggs in redds to be fertilized during the fall and hatch the following spring (COSEWIC, 2010). The alevins then live off of yolk sacs for several weeks until it is fully absorbed when they exit the gravel becoming parr. The parr remain in the freshwater habitat for one to eight years before undergoing behavioural and physiological transformations allowing them to migrate to their sea habitats as smolt. Smolt undergo their growth phase at sea for up to two years (depends on the population), when they finally return to their natal rivers to spawn after their winter migration (COSEWIC, 2010).

The iBoF population is listed as endangered under SARA and the Stewiacke River is designated as critical habitat (SARA, 2002). Critical habitat was identified in the Stewiacke as it contains riffles and runs in the upper watershed providing opportune locations for adults to form redds for egg deposition, as well as holding pools in the lower watershed to allow for thermal refuge and staging during their long-distance migration (DFO, 2010). Up to 43 km of the Stewiacke River is a considered a post-smolt area for the juveniles to build their tolerance of salt water before reaching the ocean (Figure 2) (Marshall, 2013). Given the aforementioned significant

habitat requirements found within the Stewiacke, implementation of conservation initiatives for the Stewiacke River is essential to aid in the recovery of the iBoF Atlantic salmon population.

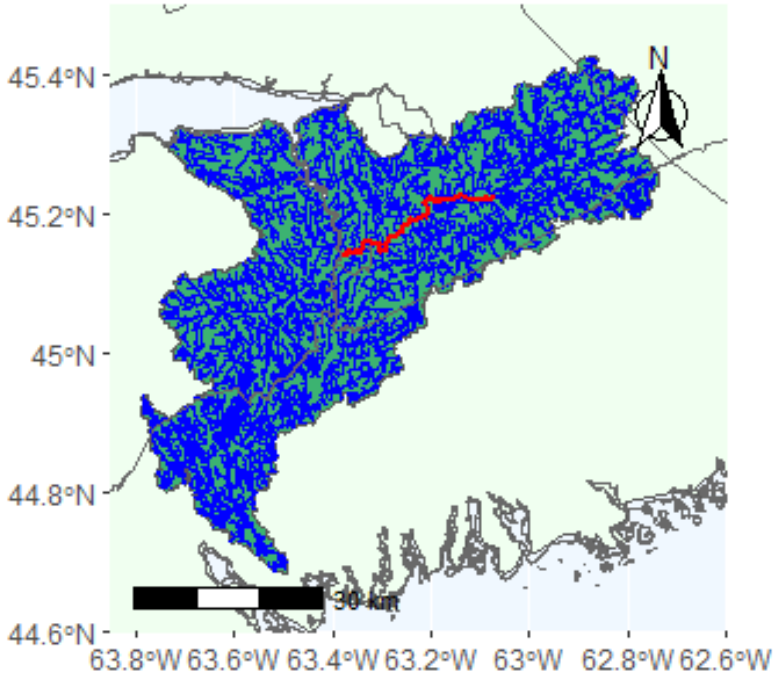

Figure 2. Red line: Post-smolt area of Atlantic salmon in the Stewiacke River (Marshall, 2013), dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

Atlantic salmon are a culturally and ecologically important species in Atlantic Canada. In particular, Atlantic salmon hold a great amount of cultural and spiritual significance for the Aboriginal Peoples, specifically in traditional and community feast (DFO, 2010). In 1990, the commercial and recreational fisheries of the iBOF salmon were closed due to a significant decline in the population (DFO, 2010).

Atlantic salmon are threatened by a number of ecological and anthropogenic pressures. Ecological threats include atmospheric changes resulting in increased ultraviolet radiation, climate change causing changes in physiological condition and premature smolt emigration as a result of

rising temperatures, and depressed population phenomena from low abundance and inbreeding (COSEWIC, 2010; DFO, 2010). Anthropogenic threats including tidal barriers (Figure 3) (COSEWIC, 2010), fisheries (commercial, recreational, bycatch), habitat alterations (e.g. sedimentation, run-off pollution, channelization, and hydrological regime changes) due to poor forestry practices, barriers, mining, and roads, chemical contamination from agriculture (DFO, 2010), and farmed salmon from aquaculture reducing the genetic fitness of wild populations (DFO, 2008).

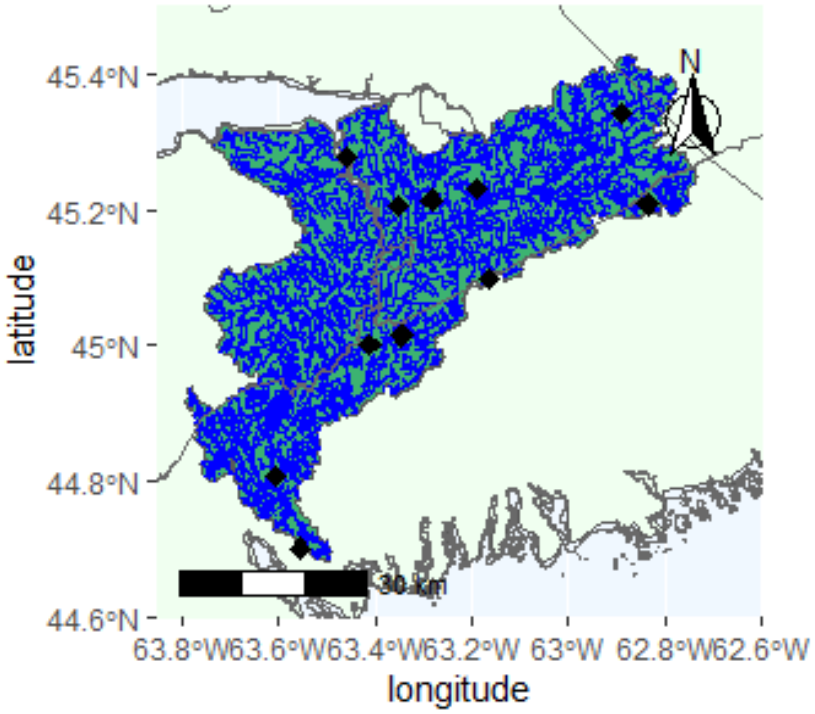

Figure 3. Black points: dated location of barriers previously located in the watershed (DFO, 2007), dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

7.3 Brook Floater

Under SARA the brook floater is listed as special concern (COSEWIC, 2009; SARA, 2002). The brook floater is a mollusk that inhabits shallow rivers or streams with moderate to high flowing water and sand or fine gravel substrates. Spawning occurs in the summer when the male releases sperm to be drawn into the female's mantle cavity. The larvae (glochidia) are released in the spring and attach to the gills or fins of host fish to continue developing into a juvenile (COSEWIC, 2009). These host fish are thought to include blacknose dace (*Rhynichthys atratus*), longnose dace (*Rhynichthys cataractae*), golden shiner (*Notemigonus crysoleucas*), pumpkinseed sunfish (*Lepomis gibbosus*), slimy sculpin (*Cottus cognatus*), and yellow perch (*Perca flavescens*), of which only the yellow and white perch, and the golden shiner have been documented in the Stewiacke region ("Canadian Rivers Institute: Golden Shiner, Notemigonus crysoleucas," n.d.; COSEWIC, 2009; DFO, 2018c). The juvenile eventually drop off the host fish to burrow into the bottom substrate and grow into an adult (COSEWIC, 2009). Initially, their presence between Middle and Upper Stewiacke River was only considered historical (COSEWIC, 2009; DFO, 2018c), but, recently, there have been a few sightings, which includes three samples found in a 2017 survey conducted by the Mi'kmaq Conservation Group (MCG) at the Stewiacke River and the Shubenacadie Tributary – Gays River site of the watershed (MCG, n.d.-b) (Figure 4).

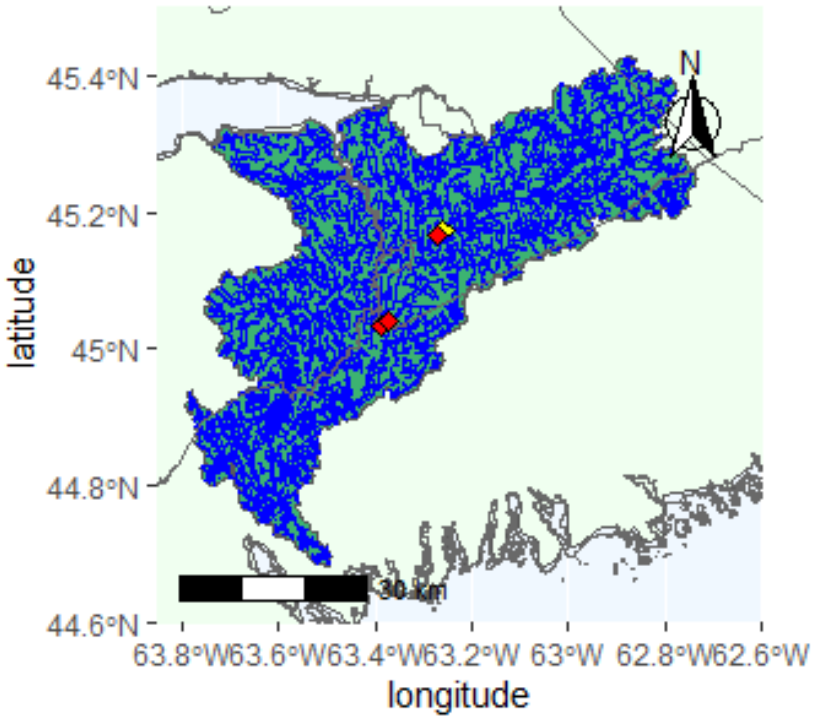

Figure 4. Yellow point: historical site of the brook floater (COSEWIC, 2009; DFO, 2018b), red points: brook floater sightings from MCG (MCG, n.d.-b), dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

The brook floater is threatened by non-native invasive species, such as chain pickerel and smallmouth bass, because they have increased predation pressure on brook floater host fish. This ultimately decreases their chance of survival due to their reliance on the host fish to develop into juveniles, but this threat is considered low concern (DFO, 2018c). The main threats of the brook floater are anthropogenic activities such as agricultural and forestry management, residential development, ATV stream crossings, dam operations, mining effluents, and road construction. All of which affect the habitat availability of the brook floater due to degradation and contamination

(DFO, 2018c). Notably between Middle and Upper Stewiacke, the historical location of the brook floater, there has been an increase in sod farming (COSEWIC, 2009).

7.4 Striped Bass

Similar to the Atlantic salmon, the striped bass is an anadromous fish. Adults spawn in freshwater or slightly brackish water where the fertilized eggs are suspended in the water column for two to three days before hatching. Juveniles remain in fresh or slightly brackish water during early life stages, but are able to quickly migrate to coastal, estuarine, and saltwaters for maturation in the summer. During the fall and winter they return to the estuaries or freshwater habitats and subsequently to their spawning sites in the spring (COSEWIC, 2012b).

The Bay of Fundy striped bass population is assessed as endangered by COSEWIC, and is under consideration for listing under SARA (COSEWIC, 2012b). The Stewiacke River is important for their recovery because striped bass are known to spawn 0-6 km from where the Shubenacadie River and Stewiacke River connect near the saltwater-freshwater interface, which is the only site known to be used annually (Figure 5). Additionally, the characteristics of the intertidal zone of Cobequid Bay is considered suitable for nursery sites with warm water, low salinity, and prey availability (COSEWIC, 2012b; DFO, 2014b). In the region the striped bass holds significance in ongoing recreational, commercial, and Aboriginal fisheries (COSEWIC, 2012b). Invasive species and directed overfishing, including by-catch capture and releases, have threatened the population along with dykes, contamination, and ecotourism/recreation by altering their habitat quality (COSEWIC, 2012b; DFO, 2014b).

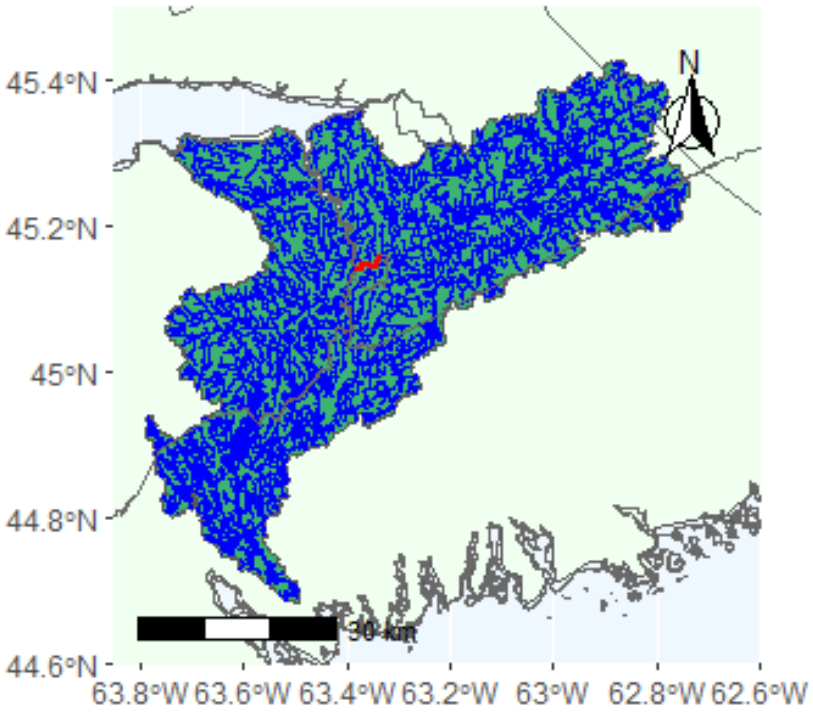

Figure 5. Red line: striped bass spawning area (COSEWIC, 2012b; DFO, 2014b), dark green: area of Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

7.5 Stewiacke River Initiatives

There are a number of environmental NGOs, First Nations and government agencies undertaking conservation and protection activities in the Stewiacke River watershed to support the fish and fish habitat within it. These can be subdivided into two initiative categories: habitat and population restoration, and fish and fish habitat characterization. These initiatives are primarily SSA focused on the SARA-listed species Atlantic salmon and brook floater; however, some of which have the potential to be beneficial to other species and the overall ecosystem.

7.5.1 Habitat and Population Restoration

The restoration initiatives on the Stewiacke River are completed by or in association with the Nova Scotia Salmon Association (NSSA) Adopt-a-Stream program with funding through the Habitat Stewardship program (HSP) administered and granted by DFO. The NSSA Adopt-a-Stream supports aquatic and riparian habitat restoration projects in wetlands, lakes, streams, rivers, and estuaries (NSSA, n.d.-b). Each of the projects focus on restoration to help the migration and survival of Atlantic salmon with improving access to habitat, food, and spawning areas.

7.5.1.1 Habitat Restoration

The NSSA themselves analyze habitat quality to determine if degradation of rearing habitat has occurred and sites of fish passage barriers to make restoration plans for two of the Stewiacke River tributaries: Little River and Rutherford Brook (Figure 6). Restoration techniques used to improve Atlantic salmon passage include installation of digger logs, deflectors, other hand constructed installations, and riparian zone plantings (MCG, n.d.-b).

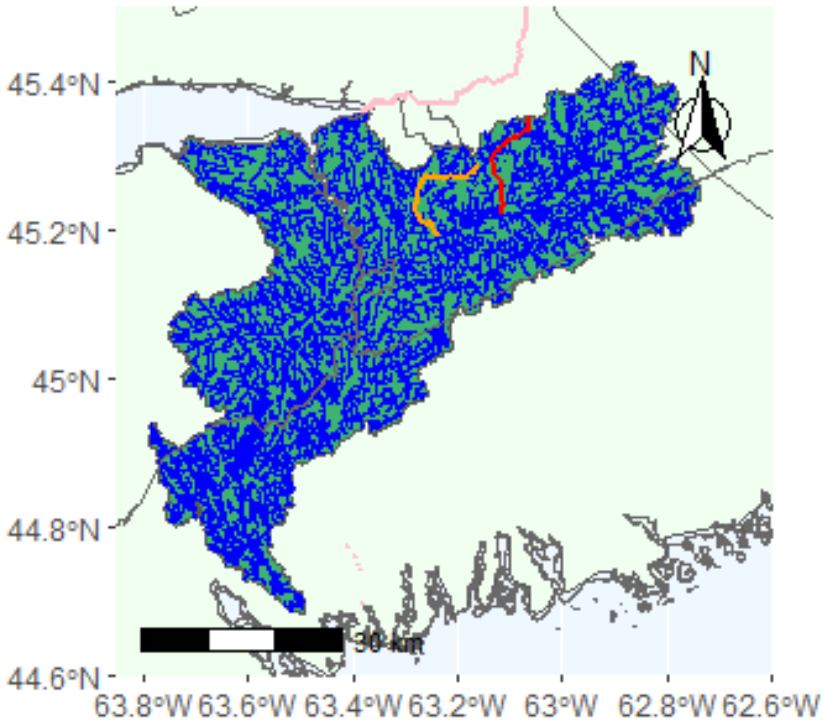

Figure 6. Red line: Rutherford Brook, orange line: Little River, pink line: Salmon River, dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

Secondly, the MCG works with NSSA Adopt-a-Stream to improve four stream crossing culverts on four tributary streams into the Stewiacke River (MCG, n.d.-b; NSSA, n.d.-c). These four sites were selected as priorities from their culvert database because of the amount and quality of upstream habitat. Their strategies for barrier remediation include using chutes, baffles, low-flow barrier, modification of tail control, debris removal, or complete culvert removal. Additionally, at one site a fish ladder was installed and fish passage will be monitored at two of the sites using Passive Integrated Transponder (PIT) tags to monitor their passage. Previous work in the water body similar to this on the remediation of 17 culverts has created 85.8 km of upstream habitat accessible (MCG, n.d.-b).

Lastly, the Cobequid Salmon Association (CSA) is working to improve the water flow in a tributary of the Stewiacke River, Creamery Brook (Little River), for Atlantic salmon movement by repairing digger logs that have been undercut, shifted, or changed level in the substrate due to foraging animals or landowners mowing (CSA, n.d.-b; NSSA, n.d.-a).

7.5.1.2 Population Restoration

Currently the only population restoration initiative in the Stewiacke River is the iBoF Live Gene Bank (LGB) program for Atlantic salmon. The program is led by DFO and has been in operation since 1998 completing three generations of captive breeding and rearing (DFO, 2019a; Jones et al., 2020; O'Reilly, Harvie, McWilliam, Lenentine, & Jones, 2019). The purpose of the LGB program is to conserve the genetic characteristics of the iBoF salmon population and reduce the impact of the depressed population phenomenon (DFO, 2019a), which is accomplished by collecting salmon based on their genotype for the corresponding mating plan who are then released after spawning, unless they contain a rare genotype, whereby they are maintained at a biodiversity facility to be used in future spawning events (Jones et al., 2020). The offspring are later released at the unfed fry stage within the broodstocks original river of capture or a neighbouring river (Figure 7). The collection and release of wild-exposed salmon is conducted along with Fort Folly First Nation, NSSA, Maritimes Aboriginal Peoples Council (MAPC), Millbrook First Nation, Sipekne'katik First Nation and MCG (Jones et al., 2020).

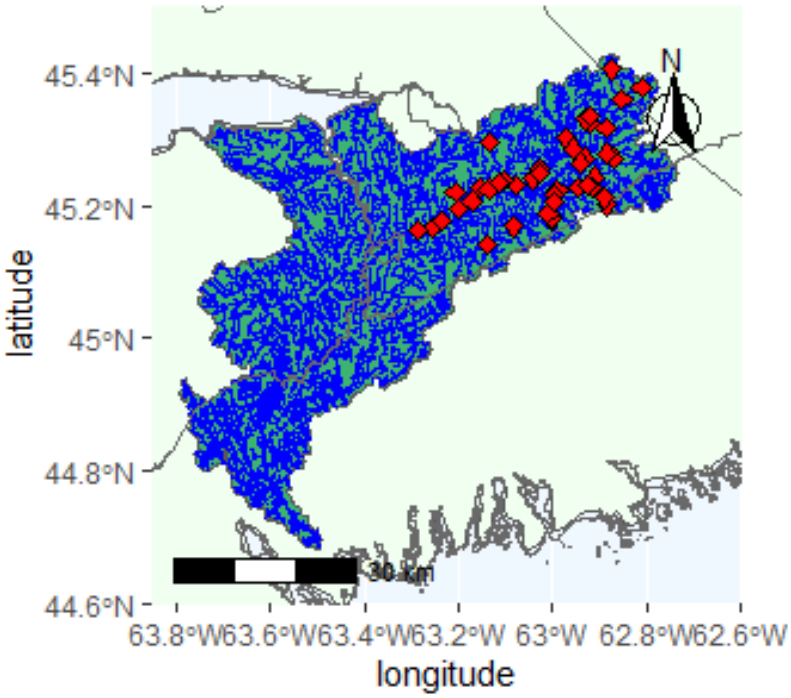

Figure 7. Red points: LGB release sites watershed (DFO, 2007), dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

The Cobequid Salmon Association (CSA) supports DFO with mature adult salmon releases to the Salmon River (Figure 6) (DFO, 2019a; Jones et al., 2020). Some salmon are implanted with telemetry tags to see if they remained in the river during the spawning period since they originated from the Stewiacke River and had not imprinted on the Salmon River. Their preliminary results supported that the adult salmon would remain in the river until after spawning (CSA, n.d.-a). While MCG, aids with the fry release at nine sites in the watershed (MCG, n.d.-b).

Additionally, part of the iBOF Live Gene Bank program includes electrofishing surveys with MAPC and Nova Scotia Power Incorporated and tissue analysis with MAPC and MCG to monitor the number of wild and LGB contributing to the population and the rate of genetic

variation (Figure 8) (DFO, 2019a; O'Reilly et al., 2019). While genes from other wild and farmed Atlantic salmon have integrated with the Stewiacke River iBoF salmon population minimal loss of genetic variation and inbreeding accumulation is anticipated (O'Reilly et al., 2019). Overall, the results of the program indicate if it were not for the program, the iBoF salmon would likely be extirpated (Gibson, Bowlby, Bryan, & Amiro, 2008; O'Reilly et al., 2019). Despite this, the marine survival of the released juveniles has been decreasing with each generation for unknown reasons (DFO, 2018b; Harvie, McWilliam, & O'Reilly, 2020).

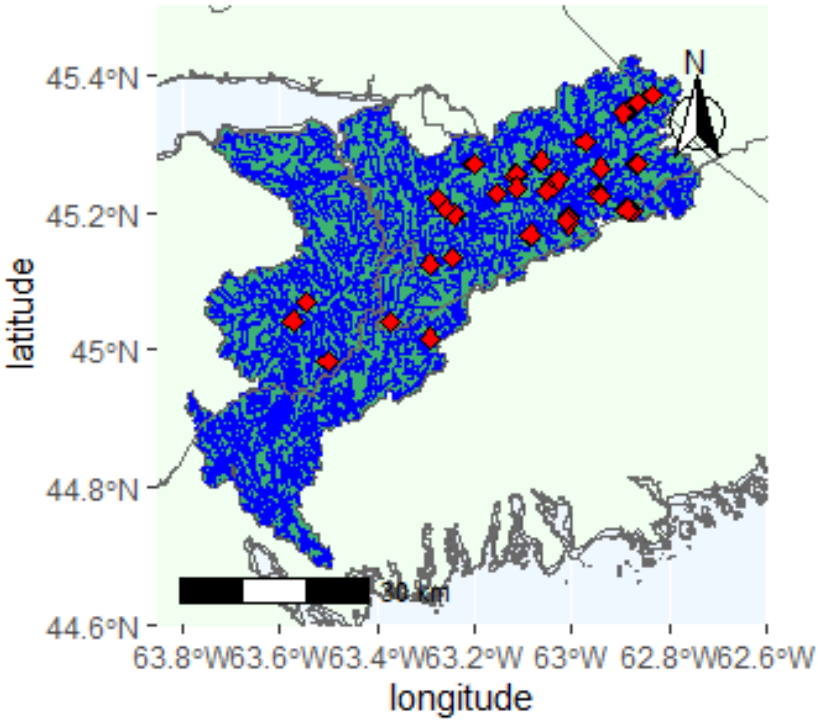

Figure 8. Red points: LGB electrofishing sites watershed (DFO, 2007), dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

7.5.2 Fish and Fish Habitat Characterization

Baseline ecological and physical data is required to develop management practices that will support conservation and protection of fish and fish habitat within the Stewiacke River.

7.5.2.1 Habitat Suitability Surveys

The MCG is conducting habitat suitability surveys, for the Atlantic salmon and brook floater with Adopt-A-Stream and Cape Breton University to create a spatial map of multiple habitat suitability measures (MCG, n.d.-b). In addition, while doing habitat suitability surveys, MCG are determining the presence of brook floater and invasive species with eDNA to determine the implications of chain pickerel on Atlantic salmon and the habitat/distribution of brook floater. Its purpose being to determine the capacity at which the river can support Atlantic salmon and brook floater under the best circumstances (MCG, n.d.-b). The NSSA also contributes by collecting thermal profile data throughout the Rutherford Brook and Little River watershed to compare year-to-year (MCG, n.d.-b).

7.5.2.2 Monitoring and Assessment

Lastly, MCG is monitoring and assessing Atlantic salmon and brook floater. Atlantic salmon survival and production are monitored using the rotary screw trap (smolt wheel) around 20 km above the river head to count and sample smolts (Figure 9). Also, since 2017 they have been conducting redd and adult salmon counts using a counting fence to assess the released fish and return rate. For the Brook floater they have been surveying the distribution, abundance, morphological variation, and critical habitat of the Brook floater since 2017 and eDNA sampling for their presence since 2019 (MCG, n.d.-b).

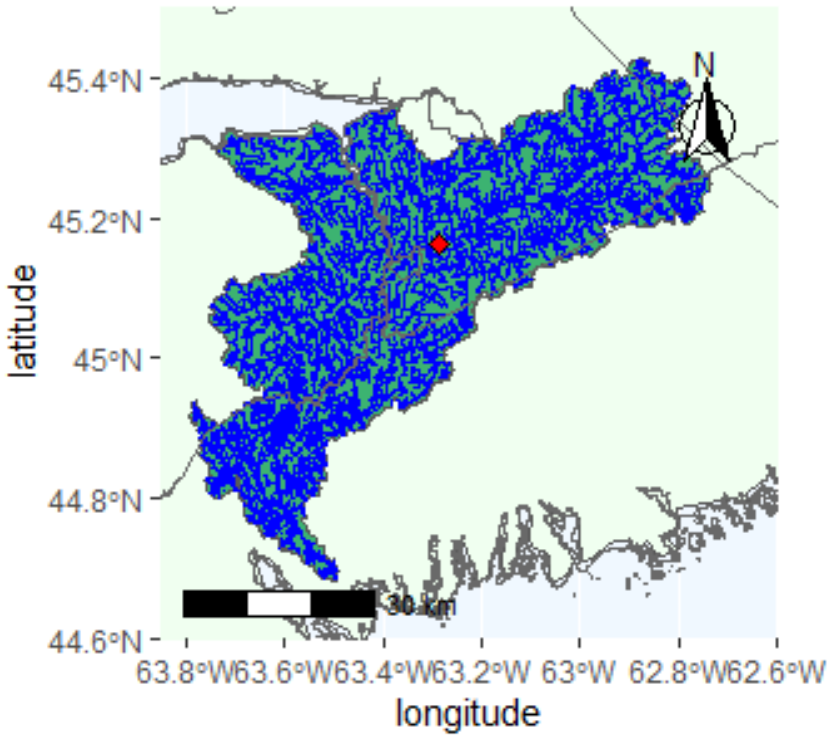

Figure 9. Red point: Location of a rotary screw trap, dark green area: Shubenacadie/Stewiacke watershed, blue lines: waterbodies in watershed, gray lines: county lines.

7.6 Application of Ecosystem-Based Tools to the Stewiacke River

Based on the information gathered regarding the American eel, Atlantic salmon, brook floater, and striped bass, the Stewiacke River would be a good candidate for EBA tools. The four species are exposed to a number of shared threats, reside in similar locations in the system, and rely on the system as a location for life history events, thus the Stewiacke would benefit from tools that are focused on common threats and priority places. Since the Atlantic salmon and brook floater have been listed under SARA, the timeline requirements of SARA may be irrelevant. However, recovery reporting efficiency is still slow and behind therefore requiring attention (ECCC, 2018). Alternatively, if the American eel assessment from COSEWIC is accepted to be listed as endangered under Schedule 1 of SARA then there would be only the constraints of planning EBA

efforts impacting the species around one legislative timeline in the implementation of a recovery strategy and action plan. In addition, EBA tools have the potential to help species that are not SARA-listed, plus species that at-risk species are dependant on for suitable habitat availability.

Of the tools considered, the Stewiacke River would be eligible for EBSA, ESA, fisheries management orders, IMFP, other FFHP provisions, SAR critical habitat orders, and NS watershed planning. While national marine conservation areas and integrated management plans could be a potential tool, they would only be applicable to estuarine areas of the watershed. Marine refuges and MPAs could not be used in the Stewiacke River because they are exclusively for ocean environments. The direct applicability of eligible EBA tools on threats of the aquatic SAR of interest in the Stewiacke River can be visualized in Appendix E.

The Stewiacke River would be eligible for EBSA designation because it fulfills resilience and fitness consequences requirements and ESA because it fulfills the sensitivity requirement based on the species-at-risk examined. These are justified because there is a presence of at-risk fish species in the area. In addition, the area contains habitat necessary for life history events such as spawning. If an EBSA were to be established, it would not directly mitigate threats, but the information gathered regarding the sensitivities of the area can inform projects to increase their effectiveness and industry operation regulations to reduce their impact. While if an ESA were to be established in the Stewiacke River, it would be beneficial for the species of interest because it can prohibit WUAs that are harmful to the fish and fish habitat to reduce the impacts of threats such as habitat degradation from barriers and chemical contamination. However, this would only apply to WUAs within ESA boundaries written, therefore land-based threats from agriculture and deforestation must be taken into account since these activities cannot fall into ESA boundaries because they cannot be regulated directly by federal conservation tools because it is provincial

jurisdiction. Based on the threats previously discussed prohibitable WUAs could include aquaculture, ecotourism/recreational activities, and anthropogenic barriers. Additionally, an ESA can provide protection for the critical habitat of the brook floater since it is listed as special concern, therefore its critical habitat does not require protection under SARA.

Tools directly related to fisheries (fisheries management orders, IFMP) can be applied to the Stewiacke River because of the presence of fisheries, in particular the American eel and striped bass fishery. Other fisheries in the Stewiacke River include Gaspereau, Atlantic Sturgeon, smelt, clam, and quahog (DFO, 2020j, 2020h, 2020k, 2020e). However, since such tools only address fishery-related threats (fishery closures and equipment/size restrictions with fisheries management orders and management actions to increase fishery sustainability with IFMP) it is more challenging for other threats to be addressed without the utilization of multiple tools overlaying a fisheries-specific conservation tool. Considering the biodiversity focus of IFMP and its capability to remove harmful fishing practices, there is a potential to benefit species beyond the targeted species, for example bycatch species, which can include SAR.

The other FFHP provisions (death of fish, HADD, free passage, and fish habitat bank) benefit the aquatic species at risk by allowing the implementation of regulations and/or prohibitions that would contribute towards protecting the fish and fish habitat of the species of interest. Specifically, protecting against activities involved with habitat alteration/contamination or the initiation of more conservation projects in the form of habitat banking initiatives to offset threats, conserve populations, and restore habitat, etc. The efforts and initiatives in the Stewiacke River mentioned in section 7.5 provide an example of the benefits of such projects through their accomplishments.

SAR critical habitat orders apply to species listed as threatened, endangered, or extirpated under SARA in which their critical habitat cannot be destroyed (although has the potential to be offset). Given that the American eel and striped bass are only COSEWIC-assessed, and not yet SARA-listed, this tool does not apply to these species, and is only relevant for Atlantic salmon because the brook floater is listed as special concern. Therefore, under current circumstances, SAR critical habitat orders would not be an effective tool for conserving multiple species unless the areas receiving protection from a critical habitat order happen to be ecologically important to other species as well.

Nova Scotia watershed planning is the only tool explored that is implemented provincially. Since the focus of the tool is on improving water quality primarily for human use its efforts would focus on the ecosystem itself rather than the species present. Applying Nova Scotia watershed planning as a tool for the Stewiacke River offers the ability of mitigating threats that are land-based, such as agriculture and forestry, that are not regulated by DFO. The possibility of improving water quality in such a way can benefit aquatic SAR through the improvement of habitat quality regardless of a human or aquatic species focus. However, for this tool to be considered beneficial towards and fulfill SARA objectives in the Stewiacke River it would need to include policies that explicitly identify benefits for listed species at risk.

NMCAs and integrated management plans under the OA can only be applicable to the low water mark and out, thus are not applicable to the Stewiacke River. Therefore, the use of other tools would be more effective for the conservation and protection of species at risk throughout the Stewiacke River.

Of the tools evaluated, an ESA and watershed planning used jointly are likely to be the most effective tools to implement in the Stewiacke River in order to address the threats of

aquaculture, ecotourism/recreational activities, and anthropogenic barriers. In regard to fisheries threats, there is an IFMP established for the commercial American eel fishery along with regulations for the American eel and striped bass recreational fishery (DFO, 2018a, 2020i, 2020l). An ESA's ability to regulate WUAs that are deemed harmful to fish and fish habitat in combination with regulating land-based threats with watershed planning can prevent and mitigate a variety of activities (i.e. threats) from occurring. Furthermore, regulated WUAs require authorization to occur and are subject to regular updates and monitoring to assess its impacts. In the meantime, the usage of other tools, such as the continued application of other FFHP provisions pertaining to HADD and death of fish, would be beneficial. Also, considering some of the threats have land-based sources it would be important to consider these by either allowing a land buffer zone in the riparian habitat when establishing boundaries to which the WUAs apply and/or building better collaborations with federal and provincial departments that have jurisdiction regarding land-based activities. Lastly, the consultation process, which includes stakeholders and Indigenous governing bodies, may be beneficial for the purpose of protecting and conserving SAR along with consulting about aquatic activities. Considering this evaluation only focused on four SAR species a more holistic analysis is necessary to conclude a definitive solution for the Stewiacke River as options may become more limited. Future analysis should include all ecosystem components present within the Stewiacke River (not only SAR species), the precise source and location of threats, and determining if the WUAs present are considered threats.

Chapter 8 - Conclusion

Overall, the analysis of ecosystem-based approach (EBA) tools available in Canada revealed ways in which they may strengthen conservation efforts by contributing towards SARA objectives and alleviating limitations, such as listing progress and recovery measure implementation. Of key importance is the potential for EBA tools to provide more information about the species of interest, the identification of critical habitat, and the development of recovery measures. Also, they could help indirectly by initiating conservation projects that benefit the recovery efforts of SAR and improve efficiency through the collection of stakeholder distributions lists. Nonetheless, in order for these elements to be helpful towards achieving the objectives of SARA, single-species information must be available and further analysis for socio-economic considerations should be conducted.

Secondly, in regard to the EBA tools in Australia and New Zealand, due to data gaps it is challenging to draw a connection between the effectiveness of available tools and resulting trends. For this reason, specific EBA tool recommendations for accomplishing SARA objectives cannot be made based on international evaluations. Nonetheless, there are similarities between tools in Australia, New Zealand, and Canada. For example, there is an opportunity for COSEWIC to draw upon the Australian threated species listing framework to incorporate location and/or threat-based processes. Due to the dependence of SARA on the COSEWIC process, the incorporation of EBAs could ease the difficulty of coordinating multi-species efforts.

Lastly, the Stewiacke River was deemed eligible for EBAs based on the information collected on the American eel, Atlantic salmon, brook floater, and striped bass. These species are exposed to a number of shared threats, reside in similar locations in the system, and rely on the system as a location for life history events. Joint application of processes associated with the

establishment of Ecologically Significant Areas (ESAs) and watershed planning were suggested as tools to implement in the Stewiacke system as an ESA would allow WUAs that are deemed harmful to fish and fish habitat to be regulated (e.g. aquaculture, ecotourism/recreational activities, and anthropogenic barriers), while watershed planning can mitigate land-based threats (e.g. agriculture and forestry). However, more research and a holistic analysis beyond the four focal species is necessary before finalizing any tool selection. Considering the limited number of federal freshwater tools to aid in conservation and protection efforts, additional analysis may further narrow the list of tools applicable to the Stewiacke River.

References

AMP. (n.d.-a). Australian Marine Parks. Retrieved from https://parksaustralia.gov.au/marine/

AMP. (n.d.-b). How we manage marine parks. Retrieved from https://parksaustralia.gov.au/marine/management/

AMP. (n.d.-c). Management Programs. Retrieved from https://parksaustralia.gov.au/marine/management/programs/

Bird, S. C., & Hodges, K. E. (2017). Critical habitat designation for Canadian listed species: Slow, biased, and incomplete. *Environmental Science & Policy*, *71*, 1–8. https://doi.org/10.1016/j.envsci.2017.01.007

CA. Conservation Act, Pub. L. No. 65, Parliamentary Counsel Office (1987). New Zealand: Parliamentary Counsel Office. Retrieved from http://www.legislation.govt.nz/act/public/1987/0065/latest/DLM103610.html?search=ts_act%40bill%40regulation%40deemedreg_conservation+act_resel_25_a&p=1

Canadian Rivers Institute: Golden Shiner, Notemigonus crysoleucas. (n.d.). Retrieved from https://www.unb.ca/research/institutes/cri/links/inlandfishesnb/Species/goldenshiner.html

CBD Secretariat. (2009). *Azores scientific criteria and guidance for identifying ecologically or biologically significant marine areas and designing representative networks of marine protected areas in open ocean waters and deep sea habitats*. Retrieved from https://www.cbd.int/marine/doc/azores-brochure-en.pdf

COSEWIC. (2009). COSEWIC Assessment and Status Report on the Brook Floater Alasmidonta varicosa in Canada. *Committee on the Status of Endangered Wildlife in Canada*, vii + 79 pp. Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/sr_brook_floater_0809_e.pdf

COSEWIC. (2010). COSEWIC assessment and status report on the Atlantic Salmon Salmo salar in Canada. *Committee on the Status of Endangered Wildlife in Canada*, xlvii + 136 pp. Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Atlantic_Salmon_2011a_e.pdf

COSEWIC. (2012a). COSEWIC assessment and status report on the American Eel Anguilla rostrata in Canada. Committee on the Status of Endangered Wildlife in Canada. *Committee on the Status of Endangered Wildlife in Canada*, xii–109. Retrieved from https://sararegistry.gc.ca/virtual_sara/files/cosewic/sr_anguille_amer_eel_1012_e.pdf

COSEWIC. (2012b). COSEWIC Assessment and Status Report on the Striped bass Morone saxatilis. *Committee on the Status of Endangered Wildlife in Canada*, iv + 82 pp. Retrieved from https://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_bar_raye_striped_bass_1213a_e.pdf

Cresswell, I. D., & Murphy, H. T. (2017). *Australia State of the Environment 2016: Biodiversity*. Canberra: Australian Government Department of the Environment and Energy. Retrieved from https://www.researchgate.net/profile/Ian_Cresswell/publication/315045059_Australia_state_of_the_environment_2016_biodiversity_independent_report_to_the_Australian_Government_Minister_for_the_Environment_and_Energy/links/58c8cec9aca2723ab17bf2a6/Australia-

CSA. (n.d.-a). IBoF recov pgm. Retrieved from https://www.cobequidsalmonassociation.ca/

CSA. (n.d.-b). Stream Work. Retrieved from https://www.cobequidsalmonassociation.ca/

DAWE. (n.d.-a). Conservation advices. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/conservation-advices
DAWE. (n.d.-b). Marine bioregional plans | Department of Agriculture, Water and the Environment. Retrieved from http://www.environment.gov.au/marine/marine-bioregional-plans
DAWE. (n.d.-c). Recovery plans. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/recovery-plans
DAWE. (n.d.-d). Recovery teams. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/recovery-teams
DAWE. (n.d.-e). The Ramsar Convention on Wetlands | Department of Agriculture, Water and the Environment. Retrieved from https://www.environment.gov.au/water/wetlands/ramsar
DAWE. (n.d.-f). Threat abatement plans | Department of Agriculture, Water and the Environment. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/threat-abatement-plans
DAWE. (n.d.-g). Threatened ecological communities. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/communities
DAWE. (n.d.-h). Threatened species under the EPBC Act | Department of Agriculture, Water and the Environment. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/species
DAWE. (2009a). The Australian Environment Act: Report of the Independent review of the Environment Protection and Biodiversity Conservation Act 1999 - Final report. Retrieved June 28, 2020, from http://www.environment.gov.au/resource/australian-environment-act-report-independent-review-environment-protection-and
DAWE. (2009b). Threatened Marine Ecological Communities Workshop Report | Department of Agriculture, Water and the Environment. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/publications/threatened-marine-ecological-communities-workshop-report
DAWE. (2016). Threatened Species Strategy - Year One Report | Department of Agriculture, Water and the Environment. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/publications/threatened-species-strategy-year-one-report
DAWE. (2019). Threatened Species Strategy - Year Three Progress Report. Retrieved June 13, 2020, from http://www.environment.gov.au/biodiversity/threatened/publications/threatened-species-strategy-year-three-progress-report
DFO. (2002). Canada's Oceans Strategy Our Oceans, Our Future - Policy and Operational Framework for Intergrated Management of Estuarine, Coastal and Marine Environments in Canada. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/264678.pdf
DFO. (2004). *Identification of Ecologically and Biologically Significant Areas*. *Ecosystem Status Report 2004/006*. Retrieved from https://dfo-mpo.gc.ca/csas-sccs/Publications/ESR-REE/2004/2004_006-eng.html
DFO. (2006). *Identification of Ecologically Significant Species and Community Properties Canadian Science Advisory Secretariat Science Advisory Report 2006/041*. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/326968.pdf
DFO. (2007). *SPATLAS Version 1.0*.
DFO. (2008). Recovery potential assessment for Inner Bay of Fundy Atlantic salmon. *Canadian Science Advisory Secretariat Research Document 2008/050*. Retrieved from https://waves-

vagues.dfo-mpo.gc.ca/Library/335147.pdf
DFO. (2009). Application of the sustainable fisheries framework through the integrated fisheries management planning process. Retrieved from https://www.dfo-mpo.gc.ca/reports-rapports/regs/sff-cpd/ifmp-pgip-back-fiche-eng.htm
DFO. (2010). Recovery Strategy for the Atlantic salmon (Salmo salar), inner Bay of Fundy populations. *Species at Risk Act Recovery Strategy Series*, xiii + 58 pp. Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/plans/rs_atlantic_salmon_ibof_0510a_e.pdf
DFO. (2011). *Ecologically and Biologically Significant Areas - Lessons Learned Canadian Science Advisory Secretariat Science Advisory Report 2011/049*. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/344558.pdf
DFO. (2012). *Occurrences of Anguillicoloides crassus, an invasive parasitic nematode, infecting American eel (Anguilla rostrata) collected from New Brunswick and Nova Scotia Rivers: 2008-2009 Canadian Science Advisory Secretariat Research Document 2012/082*. Retrieved from http://canadianeel.org/wp-content/uploads/2014/12/2013Occurrences-of-Anguillicoloides-crassus-an-invasive-parasitic-nematode-infecting-American-eel-Anguilla-rostrata-collected-from-New-Brunswick-and-Nova-Scotia-Rivers-2008-2009.pdf
DFO. (2014a). *Fisheries and Oceans Canada Species at Risk Act Listing Policy and Directive for "Do not List" Advice*. *Fisheries and Oceans Canada*. Retrieved from https://www.canada.ca/content/dam/eccc/migration/sara/a80a98bb-c24b-4308-a9bc-7375fbc654bb/policy-politique-eng.pdf
DFO. (2014b). *Recovery Potential Assessment for the Bay of Fundy Striped Bass (Morone saxatilis) Designatable Unit Canadian Science Advisory Secretariat Science Advisory Report 2014/053*. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/364418.pdf
DFO. (2015a). *Fisheries and Oceans Canada Species at Risk Act Directive on the Application of Species at Risk Act Section 33 (Residence) to Aquatic Species at Risk*. *Fisheries and Oceans Canada*. Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/policies/Directive-Residence-v00-2016Sep12-Eng.pdf
DFO. (2015b). *Fisheries and Oceans Canada Species at Risk Act Directive on the Identification of Critical Habitat for Aquatic Species at Risk*. *Fisheries and Oceans Canada*. Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/policies/Directive-CriticalHabitatIdentification-v00-2016Sep12-Eng.pdf
DFO. (2018a). Elver integrated fisheries management plan (evergreen) Maritimes Region. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/elver-anguille/index-eng.html
DFO. (2018b). *Review of the Science Associated with the Inner Bay of Fundy Atlantic Salmon Live Gene Bank and Supplementation Programs. Canadian Science Advisory Secretariat Science Advisory Report 2018/041*. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/40726241.pdf
DFO. (2018c). Species at Risk Act Management Plan Series Management Plan for the Brook Floater (Alasmidonta varicose) in Canada. *Species at Risk Act Management Plan Series*, iv + 42 pp. Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/plans/Mp-BrookFloater-v00-2018Mar-Eng.pdf
DFO. (2019a). Action Plan for the Atlantic Salmon (Salmo salar), inner Bay of Fundy population in Canada. *Species at Risk Act Action Plan Series*, vii-59 pp. Retrieved from https://wildlife-

species.canada.ca/species-risk-registry/virtual_sara/files/plans/Ap-SaumoniBoFSalmon-v00-2019Sept-Eng.pdf
DFO. (2019b). Biodiversity Protection Provisions (s.43.3 of the Fisheries Act). Retrieved from https://www.dfo-mpo.gc.ca/acts-lois/rules-reglements/rule-reglement28-eng.htm
DFO. (2019c). Fish and fish habitat protection engagement and partnerships. Retrieved from https://www.dfo-mpo.gc.ca/pnw-ppe/partnerships-partenaires-eng.html
DFO. (2019d). Fish and Fish Habitat Protection Policy Statement August 2019. Retrieved from https://www.dfo-mpo.gc.ca/pnw-ppe/policy-politique-eng.pdf
DFO. (2019e). Orders for the critical habitat of aquatic species listed under the Species at Risk Act. Retrieved from https://www.dfo-mpo.gc.ca/acts-lois/rules-reglements/rule-reglement03-eng.htm
DFO. (2020a). Critical habitat for aquatic species. Retrieved from https://www.dfo-mpo.gc.ca/species-especes/sara-lep/act-loi/habitat-eng.html
DFO. (2020b). Establishing new Marine Protected Areas. Retrieved from https://www.dfo-mpo.gc.ca/oceans/aoi-si/index-eng.html
DFO. (2020c). Guidance on other measures. The origins of "other effective area-based conservation measures." Retrieved from https://www.dfo-mpo.gc.ca/oceans/oeabcm-amcepz/guidance-eng.html
DFO. (2020d). Oceans management decision making. Retrieved from https://www.dfo-mpo.gc.ca/transparency-transparence/mtb-ctm/2019/binder-cahier-1/1F3-oceans-eng.htm
DFO. (2020e). Shellfish and Invertebrates - Clam & Quahog. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/recreational-recreative/maritimes/invert-eng.html#clam-quahog
DFO. (2020f). Sustainable Fisheries Framework. Retrieved from https://www.dfo-mpo.gc.ca/reports-rapports/regs/sff-cpd/overview-cadre-eng.htm
DFO. (2020g). The Fish and Fish Habitat Protection Program. Retrieved from https://www.dfo-mpo.gc.ca/pnw-ppe/ffhpp-ppph-eng.html
DFO. (2020h). Tidal and freshwater (Diadromous) - Atlantic sturgeon. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/recreational-recreative/maritimes/diadrom-eng.html#sturgeon
DFO. (2020i). Tidal and freshwater (Diadromous) - Eel. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/recreational-recreative/maritimes/diadrom-eng.html#eel
DFO. (2020j). Tidal and freshwater (Diadromous) - Gaspereau. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/recreational-recreative/maritimes/diadrom-eng.html#gaspereau
DFO. (2020k). Tidal and freshwater (Diadromous) - Smelt. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/recreational-recreative/maritimes/diadrom-eng.html#smelt
DFO. (2020l). Tidal and freshwater (Diadromous) - striped bass. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/recreational-recreative/maritimes/diadrom-eng.html#bass
DOC. (n.d.-a). Marine: Habitats. Retrieved June 24, 2020, from https://www.doc.govt.nz/nature/habitats/marine/
DOC. (n.d.-b). New Zealand's marine environment: Marine and coastal conservation. Retrieved June 24, 2020, from https://www.doc.govt.nz/nature/habitats/marine/new-zealands-marine-environment/
DOC. (n.d.-c). Other marine protection tools: Marine. Retrieved June 24, 2020, from https://www.doc.govt.nz/nature/habitats/marine/other-marine-protection/
DOC. (n.d.-d). Type 1 Marine Protected Areas - Marine reserves. Retrieved June 24, 2020, from

https://www.doc.govt.nz/nature/habitats/marine/type-1-marine-protected-areas-marine-reserves/
DOC. (n.d.-e). Type 2 Marine Protected Areas: Marine protected areas. Retrieved June 24, 2020, from https://www.doc.govt.nz/nature/habitats/marine/type-2-marine-protected-areas/
Dorey, K., & Walker, T. R. (2018). Limitations of threatened species lists in Canada: A federal and provincial perspective. *Biological Conservation*, *217*, 259–268. https://doi.org/10.1016/j.biocon.2017.11.018
ECCC. (2018). *Horizontal Evaluation of the Species at Risk Program*. *Environment and Climate Change Canada*. Retrieved from http://publications.gc.ca/collections/collection_2018/eccc/En4-345-2018-eng.pdf
EcoJustice. (2012). *Failure to Protect: Grading Canada's Species At Risk Laws*. Retrieved from https://www.ecojustice.ca/wp-content/uploads/2014/08/Failure-to-protect_Grading-Canadas-Species-at-Risk-Laws.pdf
EPBCA. Environment Protection and Biodiversity Conservation Act, Pub. L. No. 53 (1999). Australia: Federal Register of Legislation. Retrieved from https://www.legislation.gov.au/Series/C2004A00485
FA-CA. Fisheries Act, Pub. L. No. F-14, i (1985). Canada: Minister of Justice. Retrieved from https://laws-lois.justice.gc.ca/PDF/F-14.pdf
FA-NZ. Fisheries Act, Pub. L. No. 88, Parliamentary Counsel Office (1996). New Zealand: Parliamentary Counsel Office. Retrieved from http://www.legislation.govt.nz/act/public/1996/0088/latest/DLM394192.html?search=qs_act%40bill%40regulation%40deemedreg_Marine+Reserve+Act_resel_25_h&p=1#DLM395396
Findlay, C. S., Elgie, S., Giles, B., & Burr, L. (2009). Species Listing under Canada's Species at Risk Act. *Conservation Biology*, *23*(6), 1609–1617. https://doi.org/10.1111/j.1523-1739.2009.01255.x
FMA. Fisheries Management Act 1991, Pub. L. No. 162, Australian Government (1991). Australia: Federal Register of Legislation. Retrieved from https://www.legislation.gov.au/Details/C2004A04237
Gibson, A. J. F., Bowlby, H. D., Bryan, J. R., & Amiro, P. G. (2008). *Population viability analysis of Inner Bay of Fundy Atlantic Salmon with and without Live Gene Banking. Canadian Science Advisory Secretariat Research Document 2008/057*.
Government of Canada. (2014). Species at risk conservation: national framework. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding/conservation-national-framework.html
Government of Canada. (2016a). About the Species at Risk Act. Retrieved from https://www.canada.ca/en/environment-climate-change/services/environmental-enforcement/acts-regulations/about-species-at-risk-act.html
Government of Canada. (2016b). Ecologically and Biologically Significant Areas. Retrieved from https://open.canada.ca/data/en/dataset/d2d6057f-d7c4-45d9-9fd9-0a58370577e0
Government of Canada. (2016c). *Species at Risk Act Permitting Policy [Proposed]. Species at Risk Act: Policies and Guidelines Series.* Ottawa. Retrieved from https://registrelep-sararegistry.gc.ca/virtual_sara/files/policies/Permitting_EN.pdf
Government of Canada. (2016d). Species at Risk Act Policy Principles. Species at Risk Act: Policies and Guidelines Series. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/policies-guidelines/policy-principles-

2016.html
Government of Canada. (2019a). Species at risk: the act, the accord and the funding programs. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html
Government of Canada. (2019b). Species at Risk Act: description. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding/act-description.html
Government of Canada. (2020). Habitat Stewardship Program for Species at Risk. Retrieved from https://www.canada.ca/en/environment-climate-change/services/environmental-funding/programs/habitat-stewardship-species-at-risk.html
Harvie, C., McWilliam, S., & O'Reilly, P. T. (2020). *Effects of Three Generations of Captive Breeding and Rearing on Survival, Growth, and Other Phenotypic Traits in Inner Bay of Fundy Atlantic Salmon (Salmo salar). Canadian Science Advisory Secretariat Research Document 2018/042*. Retrieved from http://publications.gc.ca/collections/collection_2020/mpo-dfo/fs70-5/Fs70-5-2018-042-eng.pdf
Hutchings, J. A., & Festa-Bianchet, M. (2009). Canadian species at risk (2006–2008), with particular emphasis on fishes. *Environmental Reviews*, *17*, 53–65. https://doi.org/10.1139/A09-003
Hutchings, J. A., Stephens, T., & VanderZwaag, D. L. (2016). Marine Species at Risk Protection in Australia and Canada: Paper Promises, Paltry Progressions. *Ocean Development and International Law*, *47*(3), 233–254. https://doi.org/10.1080/009083.2016.1194092
Jones, R. A., Ratelle, S. M., Tuziak, S. M., Harvie, C., Lenentine, B., & O'Reilly, P. T. (2020). *Review of the Inner Bay of Fundy Atlantic Salmon (Salmo salar) Monitoring Activities Associated with the Live Gene Bank. Canadian Science Advisory Secretariat Research Document 2018/043*. Retrieved from http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2018/2018_043-eng.pdf
Marshall, T. L. (2013). *Inner Bay of FUndy (iBoF) Atlantic Salmon (Salmo salar) Marine Habitat: Proposal for Important Habitat. Canadian Science Advisory Secretariat Research Document 2013/071*. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/359764.pdf
McDevitt-Irwin, J. M., Fuller, S. D., Grant, C., & Baum, J. K. (2015). Missing the safety net: evidence for inconsistent and insufficient management of at-risk marine fishes in Canada. *Canadian Journal of Fisheries and Aquatic Sciences*, *72*, 1596–1608. https://doi.org/10.1139/cjfas-2015-0030
MCG. (n.d.-a). Current Projects. Retrieved from https://mikmawconservation.ca/programs-and-services/current-projects/
MCG. (n.d.-b). Mi'kmaw Conservation Group - Projects Overview. Retrieved from https://cmm-mcg.maps.arcgis.com/apps/AttachmentViewer/index.html?appid=8d220f3d181b4782be9c2393f0b981af&center=-63.0865%2C45.2392&level=11&attachmentIndex=0&selectedLayerId=debaa25bd2eb46fe9491e907dc51b100&defaultObjectId=6
Millbrookband. (n.d.). Culture & History. Retrieved from https://www.millbrookband.com/new-page-4
Ministry for the Environment. (2019). Our marine environment 2019 summary. Retrieved from https://www.mfe.govt.nz/publications/marine/our-marine-environment-2019-summary

Ministry for the Environment, & StatsNZ. (2019). *Environment Aotearoa 2019: New Zealand's Environmental Reporting Series*. Retrieved from https://www.mfe.govt.nz/sites/default/files/media/Environmental reporting/environment - aotearoa-2019.pdf

Ministry for the Environment, & StatsNZ. (2020). Our freshwater 2020 summary. Retrieved from https://www.mfe.govt.nz/overview-our-freshwater-2020

Mooers, A. Ø., Prugh, L. R., Festa-Bianchet, M., & Hutchings, J. A. (2007). Biases in Legal Listing under Canadian Endangered Species Legislation. *Conservation Biology*, *21*(3), 572–575. https://doi.org/10.1111/j.1523-1739.2007.00689.x

MRA. Marine Reserves Act, Pub. L. No. 15 (1971). New Zealand: Parliamentary Counsel Office. Retrieved from http://www.legislation.govt.nz/act/public/1971/0015/latest/DLM397838.html?search=ts_act%40bill%40regulation%40deemedreg_marine+reserve+act_resel_25_a&p=1

NSSA. (n.d.-a). Little River (Creamery Brook) Restoration Project. Retrieved from http://adoptastream.ca/projects/ little-river-creamery-brook-restoration-project

NSSA. (n.d.-b). NSSA Adopt A Stream. Retrieved from http://adoptastream.ca/about

NSSA. (n.d.-c). Remediation of Barriers to Atlantic Salmon Migration. Retrieved from http://adoptastream.ca/projects/remediation-barriers-atlantic-salmon-migration

O'Reilly, P. T., Harvie, C., McWilliam, S., Lenentine, B., & Jones, R. (2019). *Genetic Change in Inner Bay of Fundy Atlantic Salmon (Salmo salar) Across Three Generations of Captive Breeding and Rearing. Canadian Science Advisory Secretariat Research Document 2018/044*. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/40851746.pdf

OA. Oceans Act, Pub. L. No. 31 (1996). Canada: Minister of Justice. Retrieved from https://laws.justice.gc.ca/PDF/O-2.4.pdf

PCA. (2018). Part II - Activity Policies: National Marine Conservation Areas Policy. Retrieved from https://www.pc.gc.ca/en/docs/pc/poli/princip/sec2/part2b

PCA. (2020). National Marine Conservation Areas. Retrieved from https://www.pc.gc.ca/en/amnc-nmca

PNS. (2010). *Water for Life: Nova Scotia's Water Resource Management Strategy*. Retrieved from https://novascotia.ca/nse/water.strategy/docs/WaterStrategy_Water.Resources.Management.Strategy.pdf

Rudd, M. (2009). National values for regional aquatic species at risk in Canada. *Endangered Species Research*, *6*, 239–249. https://doi.org/10.3354/esr00160

SARA. Species at Risk Act, Pub. L. No. 29 (2002). Canada: Minister of Justice. Retrieved from https://laws-lois.justice.gc.ca/PDF/S-15.3.pdf

Schultz, J. A., Darling, E. S., & Cote, I. M. (2013). What is an endangered species worth? Threshold costs for protecting imperilled fishes in Canada. *Marine Policy*, *42*, 125–132. https://doi.org/10.1016/j.marpol.2013.01.021

StatsNZ. (2019a). Conservation status of indigenous land species. Retrieved from https://www.stats.govt.nz/indicators/conservation-status-of-indigenous-land-species

StatsNZ. (2019b). Conservation status of indigenous marine species. Retrieved from https://www.stats.govt.nz/indicators/conservation-status-of-indigenous-marine-species

StatsNZ. (2020). Conservation status of indigenous freshwater species. Retrieved from https://www.stats.govt.nz/indicators/conservation-status-of-indigenous-freshwater-species

Town of Stewiacke. (n.d.). Trails. Retrieved from https://www.stewiacke.net/trails.html

Townsend, A., de Lange, P., Duffy, C., Miskelly, C., Molloy, J., & Norton, D. (2008). *New Zealand Threat Classification System manual*. Retrieved from https://www.doc.govt.nz/documents/science-and-technical/sap244.pdf

UN. (n.d.). Convention on Biodiversity. Retrieved from https://www.un.org/en/events/biodiversityday/convention.shtml

VanderZwaag, D. L., Engler-Palma, M. C., & Hutchings, J. A. (2011). Canada's Species at Risk Act and Atlantic Salmon: Cascade of Promises, Trickles of Protection, Sea of Challenges. *Journal of Environmental Law and Practice*.

WA. Wildlife Act, Pub. L. No. 31, Parliamentary Counsel Office (1953). New Zealand: Parliamentary Counsel Office. Retrieved from http://www.legislation.govt.nz/act/public/1953/0031/latest/DLM276814.html?search=ts_act%40bill%40regulation%40deemedreg_wildlife+act_resel_25_a&p=1

Woodford, Z. (2020). What's the deal with Alton Gas and the Shubenacadie River? Retrieved from https://www.thechronicleherald.ca/salt/whats-the-deal-with-alton-gas-and-the-shubenacadie-river-415975/

WWF. (2017). *Living Planet Report Canada: A National Look at Wildlife Loss*. Retrieved from https://wwf.ca/wp-content/uploads/2020/07/LPRC-Executive-Summary.pdf

Appendices

Appendix A – EBA classification of available tools in Australia

Tool	EBA classification			
	Common threats	Biodiversity	Priority place	Species group
Threatened Species Strategy	X		X	X
Bioregional Plans		X	X	
Australian Whale Sanctuary			X	X
Listed Migratory and Marine Species				X
Ramsar Wetland		X	X	
Commonwealth Marine Reserves – Marine Parks		X	X	
Fishery Plans of Management	X			X

Appendix B – EBA classification of available tools in New Zealand

Tool	EBA classification			
	Common threats	Biodiversity	Priority place	Species group
Conservation Areas			X	
Fisheries Sustainability Measures	X			X
Marine Protected Areas		X	X	
Wildlife Sanctuaries, Reserves, and Management Reserves			X	X

Appendix C – EBA classification of available tools in Canada

Tool	EBA classification			
	Common threats	Biodiversity	Priority place	Species group
EBSA		X	X	X
IFMP	X	X		X
NMCA		X	X	
NS Watershed Planning	X	X		
ESA		X	X	X
Fisheries Management Orders	X			X
Marine Refuges		X	X	X
Other FFHP	X		X	
Integrated Management Plans			X	
MPA		X	X	X
SAR Critical Habitat Orders			X	X

Appendix D – Threats of the aquatic species at risk of interest in the Stewiacke River

Threat	Species			
	American eel	Atlantic salmon	Brook floater	Striped bass
Fisheries	X	X		
Climate Change	X	X		
Barriers	X	X	X	X
Chemical contamination/Water quality	X	X	X	
Invasive species	X			X
Loss of habitat	X	X	X	X
Depressed population phenomena		X		
Aquaculture		X		
Road development		X	X	
Residential development		X	X	
Ecotourism/Recreation				X

Appendix E – Applicability of eligible EBA tools on threats of the aquatic species at risk of interest in the Stewiacke River

Threat	Tool					
	IFMP	NS Watershed Planning	ESA	Fisheries Management Orders	Other FFHP	SAR Critical Habitat Orders
Fisheries	X			X		
Barriers			X		X	X
Chemical contamination/Water quality		X	X		X	X
Loss of habitat			X		X	X
Aquaculture			X		X	X
Road development		X				
Residential development		X				
Ecotourism/Recreation			X		X	X