

ALIGNING SCIENCE AND POLICY FOR NORTH ATLANTIC RIGHT WHALE
(*EUBALAENA GLACIALIS*) RECOVERY: AN ANALYSIS OF PRESENTATIONS AT
THE NORTH ATLANTIC RIGHT WHALE CONSORTIUM AND CANADA-US
LEGISLATIVE FRAMEWORKS

By

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Abstract

The recovery of the critically endangered North Atlantic right whale (NARW) is governed by separate legislative frameworks in Canada and the United States. Two of the main legislations include the Canadian Species at Risk Act (SARA) and the U.S. Endangered Species Act (ESA). This paper analyzes the effectiveness of the North Atlantic Right Whale Consortium (NARWC) as a mechanism for science-policy integration across the transboundary range, evaluating its performance based on its ‘fit for purpose’: rebuilding of the endangered NARW population. An in-depth systematic analysis was conducted on 227 NARWC presentations from 2017-2023, examining the components of fit for purpose including credibility, relevancy and legitimacy, alongside the core analysis of legislative alignment between recommendations made by presenters at the NARWC and policy objectives. This analysis reveals that the system operates as a single loop knowledge system. It was found that science presented at the consortium is highly aligned with existing policy objectives, however, the system suffers from institutional and governance gaps, specifically concerning the inclusion of diverse knowledge and addressing emerging threats. The NARWC mandate and current function is as an effective information sharing venue but lacks the dedicated structure for effective knowledge brokerage necessary to challenge the foundations of SARA and ESA. Structural and institutional recommendations are provided to enhance synthesis and introduce brokerage roles to integrate diverse knowledge within the system and consider a move toward a double loop system.

Keywords: North Atlantic right whale, Science-policy Interface, Species at Risk Act, Endangered Species Act, Knowledge Brokering

List of Abbreviations Used

COSEWIC- Committee on the Status of Endangered Wildlife in Canada

CSA- Canada Shipping Act

CWF- Canadian Wildlife Federation

ESA- Endangered Species Act

Fisheries MMR- Marine Mammal Regulations under the Fisheries Act

GoC- Government of Canada

IRA- Inflation Reduction Act

MMPA- Marine Mammal Protection Act

MS (CFMA)- Magnuson-Stevens (Fishery Conservation and Management) Act

NARW- North Atlantic Right Whale

NARWC- North Atlantic Right Whale Consortium

NEPA- National Environmental Policy Act

NGO- Non-Governmental Organization

NOAA- National Oceanographic Atmospheric Administration

SAR- Species at Risk

SARA- Species at Risk Act

SPI- Science Policy Interface

UNDA- United Nations Declaration on the Right of Indigenous People's Act

USMCA- U.S-Mexico-Canada-Agreement

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Chapter 1: Introduction

The North Atlantic Right Whale

The North Atlantic right whale (*Eubalaena glacialis*) (NARW) is a critically endangered baleen whale species, with the current population estimate for NARW being approximately 384 individuals (+10/-9 confidence interval) (New England Aquarium, 2025). The majority of the species migrates seasonally, spending the warmer months in the waters off Atlantic Canada, and migrating as far south as Florida to calve in the winter months (NOAA, 2025a). The population was hunted to the brink of extinction in the 1890s and has not recovered to pre-whaling numbers, despite being a protected species (Koubrak, et al. 2021). In 1750, the NARW population was thought to be too low, due to the extreme hunting, to continue to make a profit, causing the species to be commercially extinct (Cramer, 2017). The exploitation of this species has prompted their continued low population status for almost 3 centuries, causing the species to be listed as endangered under both Canada's Species at Risk Act (SARA) and the U.S. Endangered Species Act (ESA).

The recovery of the North Atlantic right whale is largely impacted by anthropogenic threats, including entanglement in fishing gear, vessel strikes, and the effects of climate change (NOAA, 2025a). As a baleen whale, the NARW filter feeds by skimming for prey at or near the surface, and often diving close to the seafloor, which are behaviors that contribute to its vulnerability to both vessel strikes and entanglement. The vertical lines of pot fisheries, specifically lobster and snow crab traps are a primary cause of mortality and morbidity for the species (NOAA, 2025a). Entanglement in fishing gear is also a significant source of energy expenditure for the whales, which is believed to negatively impact reproduction (Corkeron, et al. 2018). Additionally, females with severe injuries from entanglement have been documented to have the lowest birth rates (Knowlton, et al. 2022).

Despite decades of recovery measures, the population's growth has been quite slow, only averaging about 2% per year over the past 25 years (Corkeron, et al. 2018). The slow recovery rate of NARW can in part be linked to adult female mortality, with

necropsy results indicating that anthropogenic threats are the primary cause of mortality, preventing the population from increasing at faster rates (Corkeron, et al. 2018). Additionally, the body condition of North Atlantic right whales has been declining, and studies have shown that periods of reduced calving success align with periods of poor overall health across the population (Corkeron, et al. 2018). The mass mortality event of 2017, which resulted in about 17 North Atlantic right whale deaths, was a substantial setback to recovery efforts, specifically due to the loss of adult females (Corkeron, et al. 2018).

Monitoring of the species since 1980 has shown that changes in prey availability due to climatic changes have also played a role in the population's slow recovery (Meyer-Gutbrod & Greene, 2017). A recent shift in the range of the whales' primary prey, the copepod (*Copepoda*, specifically *Calanus finmarchicus*) has potentially led to both decreased prey availability and a shift in NARW habitat and migratory patterns into waters that are not sufficiently protected (Meyer-Gutbrod & Greene, 2017). The future recovery of the North Atlantic right whale population will depend on management decisions that are informed by the best available information, specifically information based on long-term monitoring (Meyer-Gutbrod & Greene, 2017). This information can strengthen conservation measures by furthering the understanding of their ecology, threats, and how best to respond to these threats (Fisheries and Oceans Canada, 2025).

The North Atlantic Right Whale Consortium (NARWC), established in 1986, serves as a collaborative space for data exchange and information, bringing together individuals from NGOs, industry, government and technical experts (NARWC, 2025). At annual meetings, participants share “research, new techniques, and management strategies” through formal presentations and poster sessions, and discussions. The consortium’s mandate focuses on action to “eliminate human-caused mortality to right whales in critical habitats and migration corridors”, specifically, through reducing and eliminating mortality and injury from entanglements and ship-strikes, protecting right whale habitats, and assessing factors that reduce reproductive success. To achieve recovery, the consortium emphasizes the need for “essential resources and tools” including information based on credible science to address uncertainties, international and national leadership,

coordination and cooperation, political will at all jurisdictional levels, multi-year continuity in funding for research and monitoring and strong public and private partnerships and education. After every annual meeting, the consortium produces a “report card”, which aims to report on the status of right whales annually, contributing as an asset to “track the effects of research studies and management strategies over time.” (NARWC, 2025). While the results of the report card are not included in this analysis, it is important to address the existence of this contribution and its role in contributing to policy (NARWC, 2025).

In addition to the NARWC, The Ropeless Consortium is held annually as a collaborative space where stakeholders come together to advance, develop and implement ropeless gear technology (Ashored, 2025). It was established as a more direct, response and solution driven consortium space, as compared to the information sharing mandate of the NARWC consortium (Ropeless, 2020). It is not included in this analysis but is important to note the existence of this space.

The Science-Policy Interface in Conservation

Successful conservation policy that enacts positive change requires reliable and relevant information. The Government of Canada has recognized the need for evidence-based decision-making in their species at risk policy, highlighting “credible scientific and technical data, aboriginal traditional knowledge and community knowledge” as necessary to prevent the extinction of wildlife (GoC 2016, Principle 6). To serve that goal, government and academic scientists collect data specifically about biological information, scientific, community and Indigenous knowledge (Environment and Climate Change Canada, 2020). In Canada, a status report is written prior to the listing of any at risk species by an independent advisory panel, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), who analyze several indicators of population status including population abundance, trends life history and habitat (COSEWIC, 2013). Despite an increasing recognition of the importance of policy

informed by science, and a huge amount of data being collected on these species, we still see a decrease in the success of many species at risk (D'Amato, et al. 2025).

The challenge of bringing the “right” information to serve the needs of policymakers in a timely fashion are studied by interdisciplinary researchers in the field of science-policy studies. The science-policy interface (SPI) is a social space where evidence from science meets the needs and considerations of policymakers, government, industry, and society (van den Hove, 2007; D'Amato, et al. 2025). Information is fundamentally important for decision making because policies uninformed by evidence are often considered ineffective (Khomsi, et al. 2024). Furthermore, the SPI is essential for increasing the use of evidence-based decision-making in conservation, as it represents the space where the knowledge required to understand complex conservation issues is brought into the policy process. Within this interface, effective learning can be visualized through two key models, single loop and double loop systems (Mäkinen-Rostedt, et al. 2023). Single loop systems operate by resolving an issue within the existing systems rule, while double loop systems are adaptive, promoting the questioning of underlying assumptions and leading to transformative changes in the system itself (Williams & Brown, 2018).

Another crucial component for navigating the SPI is knowledge brokering. A knowledge broker is an individual or an institution that facilitates the exchange of knowledge between diverse stakeholders. They are essential for ensuring effective communication and promoting the successful integration of science into policy, often by tailoring scientific findings with digestive framing and terminology to meet the needs and contexts for policymakers (Karcher, et al. 2025).

A challenge that continues to face the SPI is the gap between available scientific evidence and its effective use in policy (Furnas, et al. 2025). This disconnect is often driven by a difference in objectives and timelines between researchers, who are focused on long-term research, and policymakers, who are constrained by short-term political cycles and priorities (Khomsi, et al., 2024). In addition to this, communication is a barrier as not all researchers possess the skills needed to translate scientific findings into clear

language that policymakers can fully grasp and integrate into legislation (Pulido-Salgado & Mena, 2021). This challenge is complicated by the influence of politics and disinformation, which can weaken the trust between actors and lead to selective use of science to support political agendas, rather than synthesizing all relevant evidence (Furnas, et al., 2025). An issue that remains prevalent within society is the distrust in science, and it requires action to ensure that this trust grows for solutions to be created (UNESCO, 2025).

Another important aspect of the SPI is the concept of science being “fit for purpose”, meaning that scientific information and advice are relevant, credible and legitimate for informing policy and management decisions (Cash, et al. 2003). Managing marine species, specifically species at risk, often means weighing complex social, environmental, and economic factors, necessitating the involvement of diverse stakeholders. This complexity can make evidence-based decision-making challenging. To be useful for policy purposes, transdisciplinary knowledge must be integrated in a way that makes information more digestible and understandable for general use, summarizing what is and what is not known (Gluckman, et al., 2021). The production of “fit for purpose” research and improved communication are key solutions to distrust in science and are critical for developing more evidence-informed policymaking (UNESCO, 2025). Recognizing the purpose of the research and its role in shaping policy is necessary for research aiming to have an impact on, or contribute to, recovery policy, specifically in the case marine species management.

Scientific information is likely to be effective in influence social perceptions and responses to conservation issues, to the extent that the information is credible, relevant and legitimate (Cash, et al. 2003). The SPI is not linear, but rather a complex and dynamic process where information travels through multiple channels, engaging a range of actors beyond just science and policy. This exchange between actors highlights that science and policy continuously influence one another and evolves over time (Figure 1) (Effective Coastal and Ocean Management, p. 27). When communication is primarily flowing from one way (i.e. government or academia), or when stakeholders feel left out of the conversation, the effectiveness of the SPI dwindles, and stakeholders may question

the legitimacy of the information (Cash, et al. 2003). It is essential that to be perceived as legitimate, the SPI must bring together knowledge and widespread participation from stakeholders to ensure effective and sustainable outcomes (Wagner, et al. 2024).

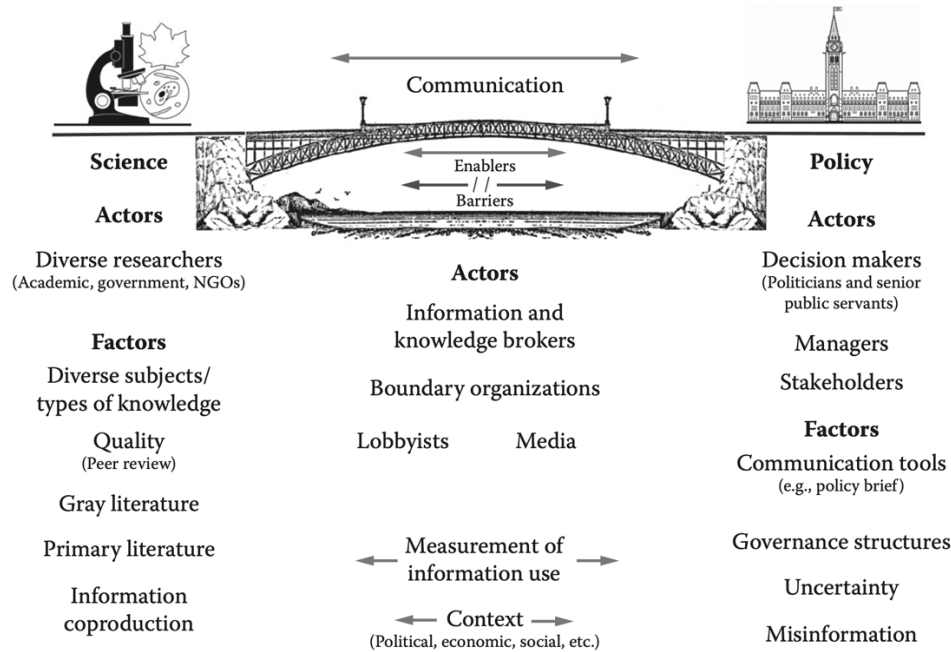


Figure 1 Science-policy interface (*Effective Coastal and Ocean Management*. 2016. p. 26, Figure 2.1)

The need for fit for purpose information is especially necessary in the case of highly mobile and transboundary species, such as the North Atlantic right whale. Despite the implementation of legislative frameworks, such as the *Species at Risk Act* (SARA) in Canada and the *Endangered Species Act* (ESA) in the United States, the NARW population has yet to recover. The lack of recovery is driven by anthropogenic threats including vessel strikes, entanglement in fishing gear, and challenges to reproductive health (Moore, 2023). While existing management measures, such as time-area closures, vessel slowdowns, and monitoring, have been enacted, they have not been sufficient in reducing anthropogenic induced mortality (Koubrak, et al., 2021).

The marine management problem addressed by this paper is the effective integration of knowledge into policy and action for NARW recovery. To address this

complex, multi-jurisdictional issue, key stakeholders rely on science-policy interface mechanisms, such as the North Atlantic Right Whale Consortium (NARWC). The consortium is a long-standing body that brings together hundreds of scientists, academics, industry and other stakeholders from both the U.S. and Canada. Its annual meeting serves as the primary venue for presenting recent scientific findings, population statistics and discussing recovery strategies (NARWC, 2025). While there is an abundance of research on the threats facing the NARW, this study hypothesizes that this research may not be effectively translated within the SPI, preventing a sustainable population increase. This project addresses this gap by using the NARWC annual meeting as a case study to assess the alignment between the science being presented and official recovery objectives.

To address the gap, this research is guided by several questions:

1. How do the scientific contributions from the North Atlantic Right Whale Consortium (NARWC) align with the recovery objectives outlined in the Canadian Species at Risk Act (SARA) and the U.S. Endangered Species Act (ESA)?
2. Do the recovery objectives in SARA and ESA reflect the recommendations made by scientific contributions provided at the NARWC, and does the usage of these recommendations differ between Canada and the U.S.?
3. What characteristics make scientific information “fit for purpose” or useful, for NARW policy and the development of effective recovery actions?

To answer these questions, this project first analyzed scientific contributions presented at the NARWC from 2017 to 2023 to assess the “fit for purpose” status of the existing landscape of the NAWRC. An analysis of the policy objectives within both SARA and ESA frameworks to identify actionable recommendations for improvement of knowledge exchange between scientists and policymakers in the NARWC was then conducted.

The structure of this paper is designed to comprehensively explore these objectives. Section 1 outlines the background, significance, and problem statement. Section 2 details the Legislative and Regulatory Frameworks for NARW recovery, examining species protection legislation, SARA and ESA. Section 3 presents the Methods, focusing on the importance of SPI and the “fit for purpose” criteria and their application. Section 4 provides the Analysis of Scientific Contributions and Policy Alignment (Results), covering the alignment of scientific output with recovery objectives, the evaluation of scientific credibility, relevancy, and legitimacy, and temporal shifts in science. The final sections include a discussion and recommendations section, synthesizing the findings, proposing recommendations for strengthening the SPI, and suggesting improvements for transboundary management.

Chapter 2: Legislative and Regulatory Frameworks for North Atlantic Right Whale Recovery

Legislation in Species Protection

Both Canada and the United States are recognized as global leaders in species protection legislation, an increasingly large responsibility given the accelerating global biodiversity loss (Mason, et al. 2020). The United States initially led this effort by enacting the *Endangered Species Act* (ESA) in 1973, which established a federal program to conserve the ecosystems and habitats of endangered and threatened species (NOAA, 2023a).

Canada passed the *Species at Risk Act* (SARA) in 2002. This piece of legislation aims to “prevent the extirpation or extinction of native species, provide for the recovery of those already at risk, and encourage the management of other species to prevent them from becoming threatened” (Government of Canada, 2019). Given the shared border and the movement of species such as the NARW, it is essential to analyze these Acts and their combined impact on shared biodiversity. In 2023, a US-Mexico-Canada Agreement (USMCA) on the transboundary North Atlantic right whale recovery was introduced to promote recovery across the species range, though this agreement does not have directly contribute to SARA or ESA (NOAA, 2023b).

The two pieces of legislation that are primarily addressed in this work sit within a broader management context and are a small piece of the legislative landscape (Table 1). For this study, the overarching recovery objectives that were the most comparable and clearly defined for the NARW were the focus within the legislative context.

Table 1 Comparison of Canadian and U.S. legislation and regulations relevant to NARW conservation and management (Allan, K. 2024. Dalhousie University. Table 2).

	Canada	United States
Endangered Species	SARA	ESA
Fisheries Management	Fisheries	MS(CFM)A
Marine Mammal	Fisheries MMR	MMPA
Ocean	Oceans	
Environmental Impacts		NEPA
Shipping	CSA	
Funding		IRA
Indigenous rights	Constitution	
	UNDA	

Canada's Species at Risk Act (SARA)

Enacted in 2002 as Bill C-5, Canada’s SARA supports Canada’s commitments under the United Nations Convention on Biological Diversity. The act is part of a collaborative strategy for wildlife protection, with shared responsibilities among federal, provincial, and territorial governments, though the federal government typically oversees species in federal waters (CPAWS, 2025; Government of Canada, 2019). SARA defines recovery as “the process of arresting or reversing a species’ decline and removing or reducing threats to ensure its long-term persistence in the wild” (Government of Canada, 2009). For listed species, federal ministers are responsible for creating action plans and reporting on progress every five years (Figure 2) (Government of Canada, 2021). For the NARW, listed under Schedule 1 since 2005, the Minister of Fisheries and Oceans and the Canadian Coast Guard is the competent authority (Government of Canada, 2020). The species' recovery strategy (Brown, et al. 2009; Fisheries and Oceans Canada, 2014) and action plan (Fisheries and Oceans Canada, 2021) outlines the overall goal to achieve an increasing population trend over three generations, supported by seven key objectives (Table 2).

Table 2 Comparison of SARA and ESA recovery objectives for NARW

Species at Risk Act (SARA) (Canada)	Endangered Species Act (ESA) (U.S.)
Mitigate mortality and injury resulting from vessel strikes	Address vessel strikes
Reduce fatalities and injuries from fishing gear interactions	Address fishing gear entanglements
Minimize injury and disturbance from vessel presence, contaminants, and habitat degradation.	Address potential and emerging threats
Systematically monitor the population and its threats	Monitor population and health
Enhance understanding of life history, reproductive rates, habitat, and threats through targeted research.	Monitor threats
Foster robust collaboration among government agencies, academia, environmental NGOs, Indigenous partners, and international bodies.	Monitor effectiveness of conservation
Develop and implement public education and stewardship activities to promote recovery	N/A

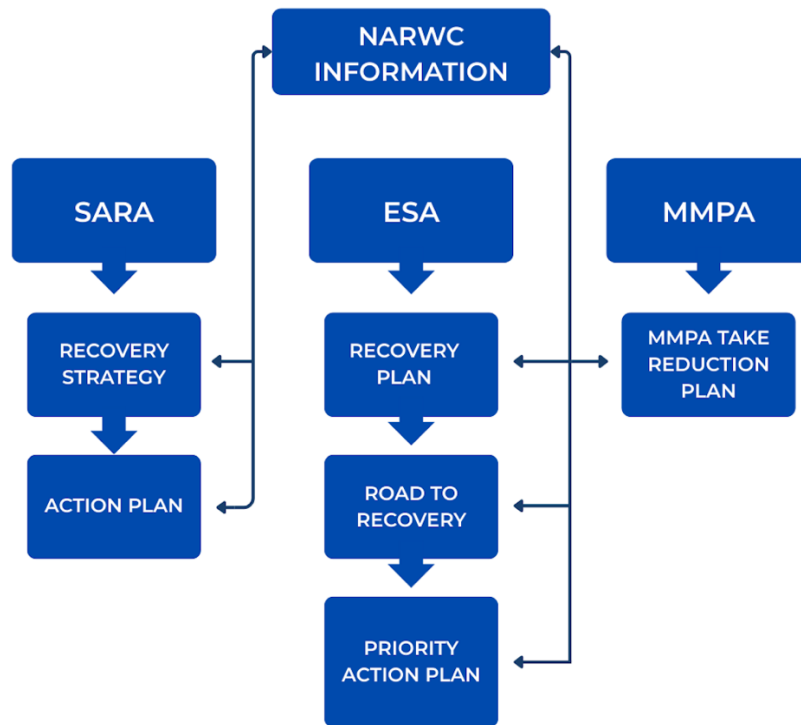


Figure 2 Flowchart visualizing NARW management under SARA, ESA, and the MMPA.

United States' Endangered Species Act (ESA)

The ESA aims to fulfill international treaty obligations and mandates that all federal departments and agencies actively work to conserve endangered and threatened species (NOAA, 2023a). The North Atlantic right whale is currently listed as endangered under the ESA and is also protected as a depleted stock under the *Marine Mammal Protection Act* (MMPA) (NOAA, 2025b). NOAA Fisheries is responsible for creating and executing action plans, with the goal of recovering the species. To achieve this, NOAA Fisheries has developed a recovery plan, which outlines the long-term strategy for recovery, and the *North Atlantic Right Whale Road to Recovery*, a strategy that outlines two primary goals with supporting objectives to address threats and monitor recovery progress (Table 2) (Figure 2). The Road to Recovery plan considers the efforts under ESA and MMPA, and “complements” the North Atlantic right whale 2021-2025 Priority Action Plan by highlighting the specific goals and objectives that aim to promote the recovery of the species (NOAA, 2025a).

As part of the recovery strategy for NARW under NOAA, the Road to Recovery objectives highlight the key efforts taking place to protect NARWs and promote their recovery under both the ESA and MMPA. The MMPA's primary role is to prohibit the take and importation of marine mammals in U.S. waters, as well as the killing or injuring of marine mammals (NOAA, 2025b). The MMPA also develops stock assessment reports and determine the status of marine mammals and decide if they are in need of a conservation plan (the MMPA Take Reaction Plan) (Figure 2) (NOAA, 2025b). Compared to ESA, the MMPA does not focus on the recovery of the NARW, but the active protection of, therefore the ESA Road to Recovery objectives is the primary focus of this research. The Road to Recovery Plan is a roadmap that promotes collaboration with the Marine Mammal Commission, as well as the Canadian government to reduce the impacts of human threats to the NARW and monitor the population with technological innovation (NOAA, 2025a).

Chapter 3: Methods

This project adopted two approaches to better understand the interaction between scientific research and policy development for NARW conservation. First, reports from the NAWRC meetings were analyzed using a systematic assessment. The objective was to identify the alignment between NARW science and policy objectives.

The analysis examined consortium presentations from 2017 to 2023 (Appendix 1). The NARWC meetings generate annual reports and presentations that contain the latest scientific updates, including population estimates, calving rates, mortality events, and the effectiveness of conservation efforts (NARWC, 2024). These reports are publicly available on the NARWC website. To ensure that the presentation data was consistent, a selection process was used to determine useable entries for the systematic assessment. First, only formal presentations were included in the analysis. Poster presentations, discussions/breakout groups and other formats that were not consistently available across all years were excluded from the analysis. Second, any works, such as opening remarks or updates, that were untraceable back to a specific research project were not included. Duplicated presentations that had the same title and author that appeared in multiple years, only the first presentation was included to avoid data duplication. Finally, presented papers were tracked by author and title to identify any corresponding published works (i.e., the study's lifespan) (Appendix 1).

Table 3 shows the number of useable entries for each year of the consortium displaying the scope of the analysis. The analysis was based on the abstract, presentation or associated published work (e. government documents), and the works themselves are not cited, but analyzed based on their defined "fit for purpose" indicators. Most abstracts/presentations are open access through the consortium website.

Table 3 Useable entries from consortium.

Year	Presentations	Useable Entries
2017	17	13
2018	38	29
2019	44	27
2020	43	32
2021	51	36
2022	44	37
2023	49	

Systematic Assessment Framework

The systematic assessment analysis used three defining factors (credibility, relevancy, and legitimacy) to assess which of the presented consortium works were fit for right whale recovery policy (Table 4, 5 and 6). The categorization process recorded the year of presentation (2017-2023) and the three main categories and subcategories.

Cash, et al. (2003) defines credibility as the scientific adequacy of evidence and arguments and is defined here as the degree to which scientific evidence, research, and methodologies are rigorous and precise (Cash, et al. 2003). The sector (Appendix 2) and method (Appendix 3) categories were standardized into broader categories. Based on this definition, the following subcategories were analyzed:

Table 4 Credibility subcategories, definitions, and examples.

Subcategory	Definition	Examples
Sector	Primary employment or sector of the lead individual or researcher. Contextualizes perspective and potential biases	Academic, NGO, Government, Industry

Who (Lead author education)	Education status of the lead individual or researcher who presented the work or conducted the study.	PhD, Masters, Bachelors
Methods	Primary method used in the study or presented work	Ecosystem Model, Genetics, Literature Review, Secondary Use, Field Study, Engagement
Lifespan	Traces the lifespan of the presented work (e.g. published paper, government document, etc.)	Link to the traceable work
Peer Reviewed	Peer reviewed article under an academic journal	Yes, No

Relevancy is defined as the applicability and value in addressing specific policy needs and informing decision-making, ensuring scientific advice is intellectually and directly useful (Cash et al. 2003). Cash, et al. (2003) identifies relevance as meeting the needs of decision makers in research, therefore being intellectually and directly useful to policy. Based on this definition, the following subcategories were analyzed:

Table 5 Relevancy subcategories, definitions, and examples.

Subcategory	Definition	Examples
Time (Data Use)	Assesses the temporal scope and duration of the study.	Single time/ Short term (less than a year/one-off study), One year, Multi Year, Multi Decade
Place	Identifies the geographical focus of the study. Determines direct	Canada, U.S., Canada and the U.S.

	applicability to specific policy contexts.	
Management Recommendations	Assesses whether the presentation or study proposes specific actions or changes for policy makers.	Yes, No
Open Access	Indicates if the paper/presentation is accessible to the general public.	Yes, No

Cash, et al. (2003) defines legitimacy as the production of information being respectful of stakeholders and Rightsholders differing values, unbiased and the work is conducted fairly (Cash, et al. 2003). Here, the definition is expanded to define legitimacy as information that is fair and appropriate to the issue, unbiased, and warrants acceptance by most stakeholders. The paper respects multiple perspectives and values. The following subcategories were analyzed:

Table 6 Legitimacy subcategories, definitions, and examples.

Subcategory	Definition	Examples
Policy Alignment	Demonstrates an awareness of the policy environment. Research acknowledges existing policies or regulations.	Yes, No
Transdisciplinary	Evaluates whether the study acknowledges or demonstrates the involvement of multiple stakeholder and	Yes, No

	Rightsholder groups (e.g., industry, government, NGOs, Indigenous communities)	
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Based on the findings of the systematic assessment, any management recommendations (taken from the lifespan/following paper or the consortium abstract if the lifespan is untraceable) were extracted and categorized. The recommendation findings were sorted into five inductive recommendation categories, identified by management recommendations of NARWC presentations (Appendix 4). Additionally, the frequency of the recommendation type across all years (2017-2023) was analyzed (Appendix 5).

The categorized fit for purpose data was visualized using two primary methods: a series of bar charts and a line chart to analyze temporal trends, and an alluvial plot to map the flow of scientific recommendations into policy (Figure 3, 4, 5 and 6).

Aligning Science and Policy

To measure the alignment between scientific effort and policy goals, an alignment analysis was conducted to map the management recommendations derived from the NARWC presentations to the recovery objectives outlined in the respective legislative frameworks. The analysis was built on the three data sets which serve as the axes in the plot. The three data sets include the SARA recovery objectives outlined in the SARA recovery plan for NARW, the ESA recovery objectives outlined in the ESA Road to Recovery, and the recommendations identified from the 2017-2023 NARWC presentations, which were sorted into broad categories (Appendix 4).

To begin the analysis, a data table that incorporated the three axes and a fourth column for quantification: SARA objectives, recommendation type, ESA objective and the weight, was created. A flow pattern was created by mapping each recommendation to all relevant SARA and ESA objectives (Appendix 6). For example, if a recommendation addressed five SARA objectives and four ESA objectives, then twenty unique data rows

(5x4) were created to represent every possible flow path, ensuring a comprehensive visual of the linkages. The intensity of scientific effort associated with each flow path was quantified using its weight. The weight assigned to a specific path was defined as the total frequency that the corresponding recommendation type was presented across all consortium meetings from 2017 to 2023 (Appendix 5).

An alluvial plot was then created by this complete, weighted data structure, allowing for a quantitative comparison of scientific priorities against recovery objectives. The plot was created in R studios with the ggalluvial package. SARA and ESA objectives formed the outer axes, and the thickness of the connecting lines (flow) represented the weight, or the amount of scientific effort directed at each objective (Figure 6).

Chapter 4: Results

Systematic Assessment

Temporal Trends in Fit for Purpose

In this section, the findings from the systematic assessment applied to the North Atlantic Right Whale Consortium (NARWC) presentations from 2017 to 2023 are presented. It's noted that the abstracts and presented works at the consortium are generally presented prior to peer-review, with the exception that all abstracts are reviewed by the NARWC board (Table 3). The analysis provides a quantitative assessment of the scientific outputs alignment with policy needs, focusing on its credibility, relevancy and legitimacy. This section also includes an analysis of policy alignment using the results from the generated alluvial plot, visualizing the flow of scientific recommendations into the objectives of SARA and ESA. The systematic assessment reveals how NARW research has shifted across the seven-year period. The 2021 update to the SARA action plan, as well as the 2021-2025 NOAA "Species in the Spotlight" plan for the NARW was considered as a potential factor influencing the frequency or priority shift of recommendation topics.

Multiple bar charts and a line chart were created to visualize the distribution of credibility, relevancy, and legitimacy from 2017- 2023, displaying temporal changes in research. Selected results were included in this analysis, the distribution of the "sector" category under credibility was analyzed to determine the most prominent contributors in NARWC presentations and research (Figure 3). This was done by determining the percentage of presentations given each year by each sector and presented as a bar chart. The "place" column was analyzed under the relevancy category to determine transboundary relevancy over time (Figure 4). This was done by determining the percentage of presentations given each year by each country and displayed in a bar chart. Finally, a line chart was used to determine the percentage of presentations that showed "transdisciplinary involvement" column under the legitimacy category to reveal any trends in transdisciplinary science over the years (Figure 5).

Credibility

The analysis of presentation frequency by sector (Figure 3), indicates the institutional influences shaping the science available to policymakers. The academic sector (dark blue) and the government sector (light blue) are the most significant contributors to the NARWC presentations, leading research contributions over the 2017-2023 period. Government primarily led the contributions in most years (2017 2022, and 2023), with NGOs (navy) maintaining a consistent presence across all years.

The presence of the government sector showed an increase over time, specifically in the latter half of the study period (Figure 3). Following the 2017 “unusual mortality events” and the subsequent SARA and ESA action plan updates around 2021, the government sector demonstrated significant dominance in 2022 (47%) and 2023 (40%). This increase may suggest a direct policy-driven research response and a greater institutional investment from government bodies in right whale science.

Contributions from the industry sector (grey) were the lowest across all years, consistently falling below 10% of total presentations and displaying a clear gap in direct industry contributions at the consortium (Figure 3). The absence of industry in 2017 transitioned to a consistently low presence in the following years.

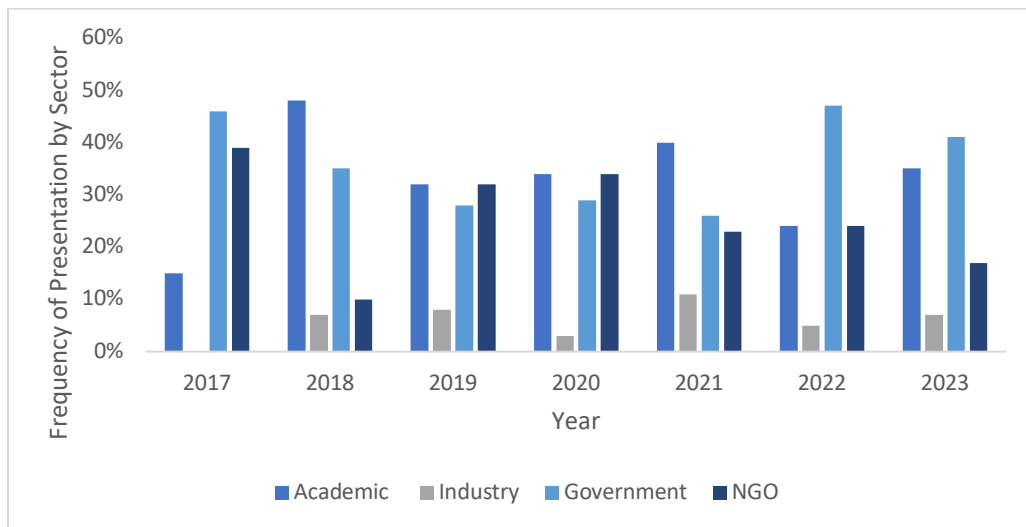


Figure 3 Frequency of NARWC Presentations by Sector from 2017 to 2023.

Relevancy

The geographical focus of the research was analyzed as an indicator of its relevancy to transboundary policy objectives (Figure 4). Overall, research remains primarily focused on the U.S. (dark blue), reflecting a historical concentration of research effort in the region. U.S. focused presentations consistently had the largest contributions across the study period, being the lowest in 2017 with 31% and peaking at 59% in 2022.

The presentations focused on both U.S. and Canada (light blue) were presented the least, peaking in 2017 at 38%, and but showing general inconsistency over time, reaching its lowest point in 2021 at 11% (Figure 4). This inconsistency may suggest limited sustained transboundary integration in research efforts.

Canadian focused research (grey) remained generally consistent across the study period but peaked most recently in 2021 and 2023 (40%, respectively), potentially indicating a growing national research investment in right whale conservation (Figure 4).

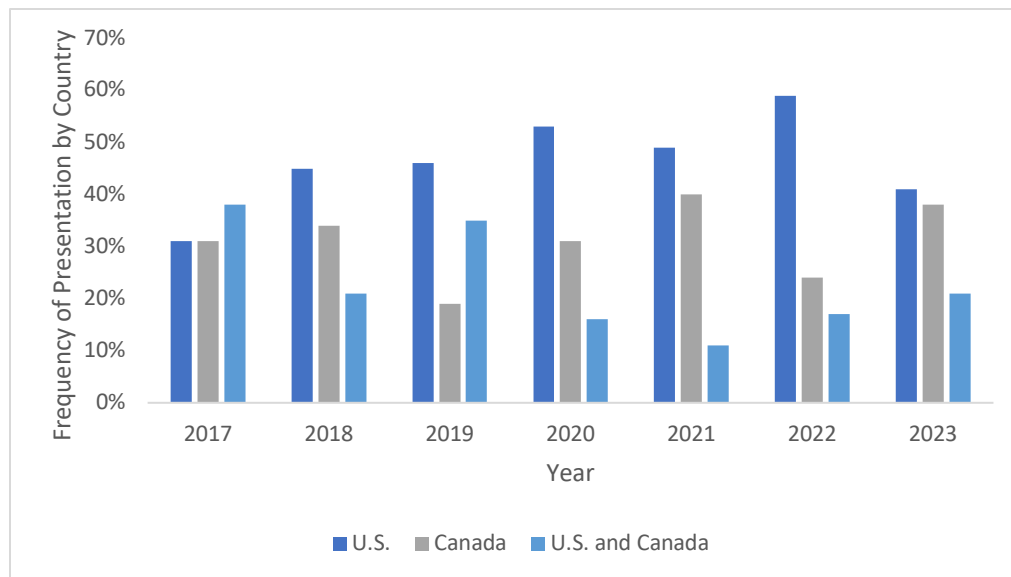


Figure 4 Frequency of NARWC presentations by country from 2017 to 2023.

Legitimacy

Legitimacy was measured by the percentage of presentations that demonstrated transdisciplinary involvement, under the assumption that those involving academic and non-academic actors would be deemed more legitimate. Transdisciplinarity was generally present in about half of the presentations (Figure 5). The percentage of transdisciplinary presentations (indicated by “yes”, light blue line), showed no clear trend, despite peaking in 2022 (63%) and the lowest point being in 2018 and 2020 (38%). Transdisciplinary involvement increased significantly from 2020 to 2022, and despite a slight downturn in 2023, the majority of presentations over the last three years (2021-2023) still had transdisciplinary involvement.

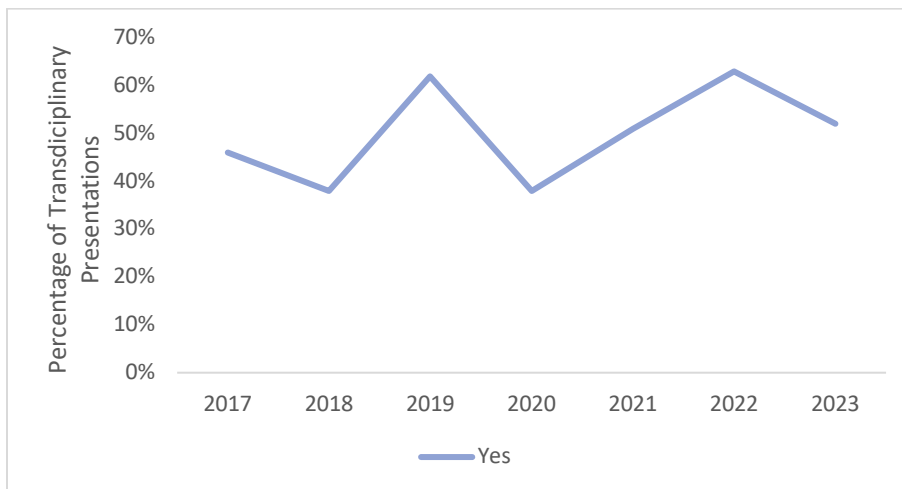


Figure 5 Frequency of transdisciplinary NARWC presentations from 2017 to 2023.

Alignment of Scientific Output with Legislative Objectives

Recommendation categories were inductively extracted based on management recommendations present in the NARWC presentations analyzed. These include Population Ecology; Population Monitoring; Entanglement; Vessel Strike; Noise; Policy Change and Dynamic Management; Collaboration; Climate Change; and Critical Habitat (Appendix 4). The alluvial plot (Figure 6) visualizes the relationship between the weight of scientific effort (recommendation type) and the policy objectives in the SARA and

ESA frameworks. The thickness of the bands represents the total frequency of the recommendation type presented between 2017 and 2023.

The thickest bands flowing consistently through all three axes (SARA objectives, recommendation type, and ESA objectives) demonstrate areas of strong overlapping research interest and legislative consistency on key threats. The recommendations dominated by population monitoring, policy change and dynamic management, vessel strike, entanglement, and population ecology, showed the strongest and most consistent flows, indicating a shared transboundary focus on these core threats and management needs. Overall, the scientific output is dominated by policy change and dynamic management, and population monitoring. This trend reinforces the legislative focus on both proactive (dynamic management) and reactive (monitoring threats) measures.

The recommendations with the most limited flow, or where scientific effort (middle node thickness) is thin, may indicate areas where policy gaps or limited scientific priority exist. Recommendations for noise and climate change showed limited flow, suggesting these are not currently a primary focus of NARWC presentations, despite their growing importance, specifically climate change. Recommendations regarding critical habitat and collaboration also showed limited flow. The analysis of flow patterns can reveal disparities between SARA and ESA, such as noise only being displayed on the SARA objectives, but not ESA objectives.

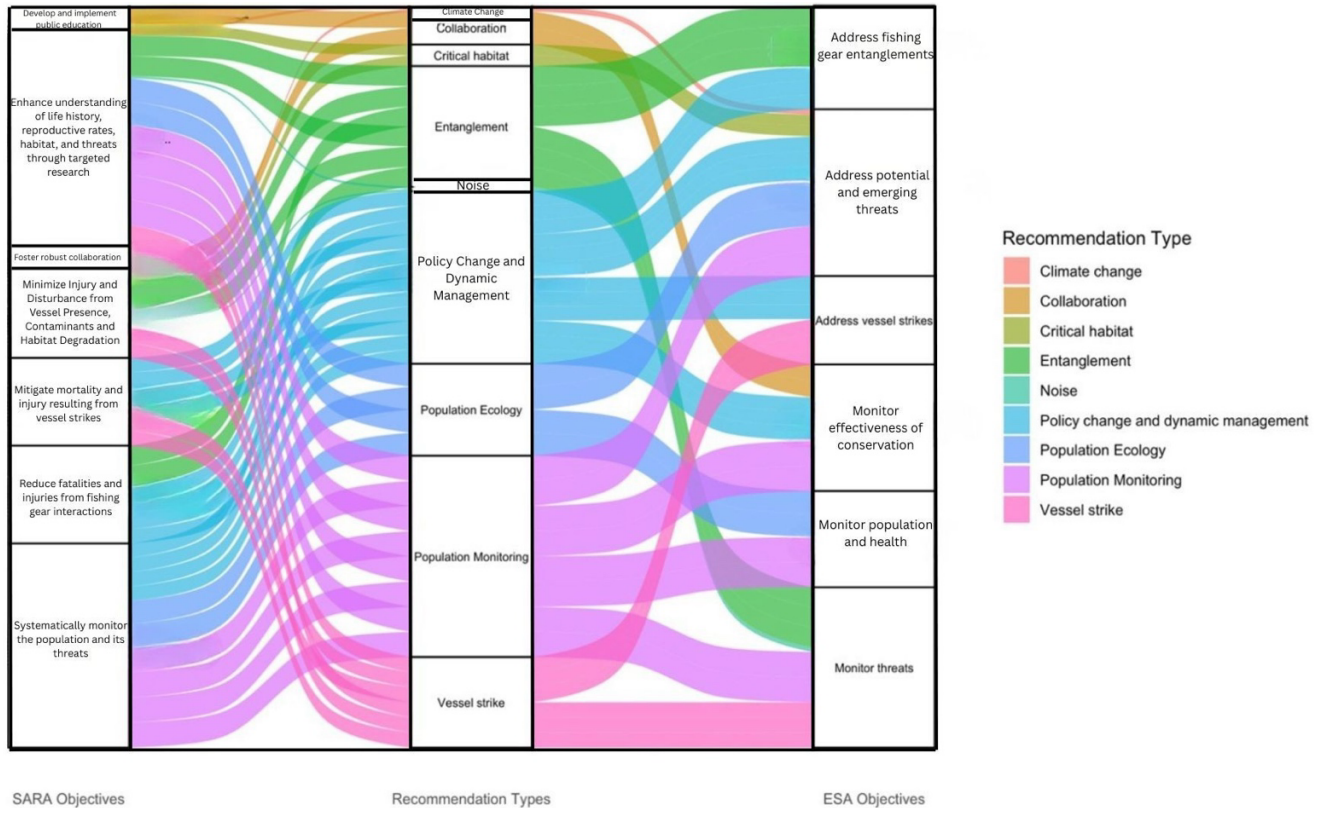


Figure 6 Alluvial plot displaying the alignment of NARWC recommendations with U.S. and Canadian recovery objectives.

Chapter 5: Discussion

This section evaluates the efficacy of the NARWC as a mechanism for science-policy integration in NARW recovery. Overall, this systematic assessment reveals a successful system that provides strong scientific legitimacy to conservation policy. The results demonstrate that the research community is covering a significant amount of critical management issues, with a high degree of policy alignment (Figure 6) and credibility (Figure 3). These findings are positive from an evidence-based policy perspective, indicating that the scientific input addresses the legislative requirements of the ESA and SARA. This strong consensus and flow of information, specifically in areas such as population monitoring which are becoming increasingly important, provides the scientific foundation for developing and implementing management actions. However, despite these strengths, a closer look shows that the system's operational framework displays characteristics of a single loop system, which presents underlying barriers to achieve unified transboundary recovery.

The NARWC as a Single-Loop Knowledge System

This section evaluates the findings from the systematic assessment to evaluate the efficacy of the NARWC as a mechanism for science-policy integration. Overall, the analysis reveals that the system provides strong scientific legitimacy to conservation policy. The results show that researchers are covering a range of critical management issues, aligning strongly with policy (Figure 6). While scientific output is credible and increasingly aligned with key policy objectives, the system does show characteristics of a single loop system, leading to barriers in achieving comprehensive and unified transboundary recovery. Single loop systems involve solving problems by applying what is already known, rather than questioning any underlying assumptions (Williams & Brown, 2018). This contrasts double loop systems which question the underlying logic and assumptions, monitor the results and adjust as needed (Williams & Brown, 2018). The dominance of single loop characteristics, such as reinforcing established policy methods, rather than reviewing and adjusting the foundation of the policy, create these barriers.

The key drivers showing that the NARWC operates as a single loop knowledge brokerage system are apparent in the results for credibility (Figure 3) and policy alignment (Figure 6). Specifically, the alluvial plot (Figure 6) reveals a strong flow of scientific recommendations, particularly those related to vessel strikes and population monitoring, that align strongly with the objectives in both SARA and ESA. This alignment shows a high consensus and points to an internal validation loop where science reinforces existing policy measures, and vice versa. Following the 2017 “unusual mortality event”, the government sector’s contribution to the NARWC reached its peak at 47% in 2022 (Figure 3), coinciding with action plan updates from SARA and ESA in 2021 (Government of Canada, 2025a). This increase suggests a direct policy-driven response to high mortality, where science is commissioned to support existing policy decisions, such as using whale presence detections to enforce time-area closures under SARA. This is the definition of single loop systems, which applies current knowledge to implement a solution (McElroy, 2025).

This single loop tendency is reinforced by the systems credibility (Figure 3), where government and academic sectors are the dominant leaders in presented research. The limited input from stakeholders (such as industry) may limit the introduction of new perspectives or questions that challenge the systems underlying assumptions. By reinforcing established mechanisms, the system fails to ask the questions of double loop, such as why low-consensus issues (i.e., climate change) (Figure 6) have minimal flow into policy. Instead of asking, “is the focus on vessel speed regulations the right, long-term strategy for preventing vessel strikes?” the system only asks, “are the speed regulations correct based on the latest sightings data?” (McElroy, 2025). True double loop systems may ask if recovery plans are even the right path forward towards right whale conservation. Recovery plans may be doing exactly what they set out to do, but this may not be what society meant as a goal or envisioned for recovery. We should be asking what the direct indicators of conservation of the species would ideally look like, such as seeing whales not impacted by anthropogenic threats (i.e., no more entanglements), or it may look like the species being downlisted from being an endangered species under COSEWIC or the IUCN red list. The current system limits

innovation and may risk political bias (Nyboer, et al. 2024) and prevents the transformative change necessary for proactive and dynamic management responses (McElroy, 2025).

Stakeholder Integration in Policy

The results of the legitimacy analysis indicates that the system is making an effort towards inclusivity, but there may be an underlying exclusionary policy paradigm present in the NARWC structure overall. The low contribution from the industry sector, which never exceeded 11% (Figure 3), indicates that there may be limited legitimacy. Industry stakeholders, specifically the fishing and shipping sectors, and Rightsholders carry vast knowledge and are crucial for compliance within policy. The lack of industry contributions compromises transparency across the knowledge production and exchange within the system (Cvitanovic, et al. 2021). For research to be impactful, trust in the process of how knowledge is generated is required (Kapoor, et al. 2024). A policy, such as time-area closures, being developed without inclusive stakeholder involvement, may not be seen as legitimate, or trustworthy to all stakeholders and Rightsholders.

Despite a slight increase in transdisciplinary involvement from 2021 to 2023 (Figure 5), the system suffers from an evidence hierarchy. Since policymakers primarily rely on peer-reviewed natural sciences, evidence presented by local fishermen or Indigenous groups may be neglected (Nyboer, et al. 2025). This generates power imbalances and undermines that goal of using diverse information sources (Nyboer, et al. 2025). It is important to note that industry is often present at industry focused meetings, such as at workshops and advisory meetings. Overall, the positive trend towards transdisciplinarity is necessary but currently insufficient for effective SPI without transformative changes in how diverse evidence is considered in the policy-making process.

Barriers to Effective Transboundary Integration

The findings under relevancy (Figure 4) and the NARWC's institutional design highlight the constraints that may be preventing a unified North American recovery

effort. The relevancy results (Figure 4) highlight that research remains U.S. dominated, with U.S. and Canada combined research being the overall lowest contributors (Figure 4). The narrow research contributes to the challenges of achieving transboundary management. For example, the alluvial plot (Figure 6) shows that critical habitat has limited consensus and flow between SARA and ESA. This divide between legislation is sustained by the lack of consistent, integrated research effort focused specifically on the shared, transboundary threats or joint efforts of recovery actions. The limited integrated research prohibits policymakers to facilitate the lateral diffusion of knowledge and strengthen collaboration across the border (Burns, et al. 2022). While Canadian contributions to the NARWC peaked in 2023 (Figure 4), this may suggest a growing national investment in NARW recovery efforts. The inconsistency of U.S. and Canada driven research suggests a barrier to sustained transboundary integration. To achieve this, dedicated mechanisms that go beyond single projects would be required to build deep social relationships and trust in the organizations in both countries (Kapoor, et al. 2024).

Despite the lack of transboundary integration overall, the NARWC serves as a critical information sharing venue, but may not be optimally designed for the demands of knowledge brokerage that drives unified policy change. Knowledge brokering is a career in and of itself, requiring those within it have specific interpersonal skills to build trust, enable co-creation, and tailor communication to different audiences (Karcher, et al. 2025., Auld, et al. 2022). The NARWC is currently primarily structured around formal presentations, limiting informal conversations (although discussion groups are present at consortiums) that are key to knowledge co-creation (Taddese, 2025). This highlights the need for a knowledge broker institution or synthesizers to bridge the gap in communication between scientists and policy makers (Karcher, et al. 2025).

The NARWC provides the necessary scientific inputs, but it lacks the institutional mechanism to synthesise these inputs into actionable advice that can challenge the existing SARA and ESA frameworks. The transition from a static information sharing venue to a dynamic knowledge brokerage team may allow for the consortium to actively shape policies. By addressing the minimal stakeholder involvement, the consortium,

going forward can ensure that decision making becomes more equitable and therefore, resilient (Taddese, 2025).

Chapter 6: Recommendations

The analysis shows that the NARWC is an essential information sharing venue, but its current structure is insufficient for driving double loop system and transboundary policy change required for North Atlantic right whale recovery. The following recommendations target the institutional gaps, i.e. synthesis, brokerage and legitimacy, to transform the consortiums scientific outputs into resilient, integrated policy outcomes.

Enhancing Knowledge Synthesis and Brokerage

To break the single loop validation cycle and address the issue of policymakers struggling with the oversaturation of information, dedicated mechanisms for synthesis and interpretation are critical (Nyboer, et al. 2025). High-quality evidence is being produced, but an oversaturation of information can make it difficult for policymakers, therefore concise synthesis can help lay out the necessary steps for action (Nyboer, et al. 2025).

The current NARWC annual report cards, while comprehensive, are quite long and summarize numerous findings, which may not be as conducive to knowledge brokering or contributing to policy as a more direct and summarized briefing note would be. The NARWC should consider mandating the formal production of concise policy briefs immediately following the annual consortium. These documents should be designed to synthesize the year's key findings and policy implications specifically for SARA and ESA policymakers. The formation of a dedicated "synthesis team" (involving academics, policy analysts, government, NGOs and industry) to distill the consortiums research into a concise, non-technical document would help map scientific recommendations directly to regulatory opportunities and risks.

While the NARWC function well as an information-sharing venue, it may not be in a position to transition into a full knowledge brokerage institution itself. However, to ensure that the "best available science" guiding the precautionary approach to SARA recovery is used, a dedicated voice is needed at the policy table (Government of Canada, 2021). In Canada, policy decisions are often directly informed by a Technical Working

Group comprised of harvesters, right whale experts, and departmental officials (Government of Canada, 2025b). Currently, there is no official NARWC representation at these meetings, therefore, the implementation of a dedicated knowledge broker, either internal (a board member/volunteer), or external (a partner NGO), is essential not just for translation, but for active advocacy. This broker would present the synthesized findings to this working group, ensuring the information makes it into the policy development stream, which is currently a significant disadvantage. For example, the Canadian Wildlife Federation (CWF) often works as an institution that can deliver actionable recommendations to the Canadian government to inform on policy decisions, specifically concerning ropeless gear (Government of Canada, 2023). Additionally, promoting U.S. representation at these Canadian technical meetings would be essential to bolster transboundary management and unified action. By integrating a dedicated honest broker role, it can ensure that the synthesis is not just written, but actively communicated and integrated into political decision making (Karcher, et al. 2025)

Strengthening Legitimacy and Transboundary Integration

To address the findings on the low involvement of industry and the inconsistency of U.S. and Canada integrated research, the system could benefit from fostering equitable stakeholder and Rightsholder integration and improve the transboundary governance structure. To address the limited legitimacy due to the minimal contribution from industry (Figure 4), a formal “Stakeholder Advisory Panel” at the NARWC to represent sectors, such as fishing, shipping, and Indigenous communities, this could move the system away from consultation or a simple seat at the table, and towards equitable engagement. Their participation in the synthesized policy briefs would greatly benefit the legitimacy of this report, giving these groups a larger voice to represent their diverse epistemologies and ontologies (Nyboer, et al. 2025). In addition, the presence of a stakeholder panel at the technical working group meetings would be extremely beneficial to policy. By working together with diverse groups to co-create defined problems and solutions, this will ensure all types of evidence are considered, which is essential for credible and legitimate policy outcomes (Nyboer, et al. 2025).

In addition to this, the continued reinforced research and policy priorities necessitates an institutional change that goes beyond government level collaboration. By utilizing the recent 2023 U.S.- Canada-Mexico agreement (USMCA) on transboundary North Atlantic right whale recovery, which seeks to promote right whale recovery across their range, this could act as a potential political channel (NOAA, 2023b). This agreement presents an opportunity to map the NARWC's synthesized advice, which may bypass the internal policy loop of SARA and ESA, and strengthen governability. By using the USMCA, the consortium could become a foundational piece of a unified North American legislative structure, therefore addressing systemic barriers to transboundary integration.

Chapter 7: Conclusion

The objective of this research project was to determine how the North Atlantic Right Whale Consortium (NARWC) functions as a mechanism for science-policy integration to promote transboundary recovery under the SARA and ESA frameworks. The findings show that while the NARWC presents credible and well-aligned scientific information, the institutional system itself may be limited. The consortium operates as a single-loop knowledge system, where the increase in government-led science post 2017 demonstrates the existing legislative priorities, such as vessel strike mitigation, entanglement mitigation, and population monitoring. This single-loop system prevents the system from engaging in the double-loop system which is necessary to question the foundation in which SARA and ESA functions.

The limited U.S. and Canada integrated research and the lack of contributions from the industry sector demonstrates a governance gap. This gap is not a lack from the science itself, but of institutional design. Without a systemic shift towards the inclusion of diverse, transdisciplinary, and transboundary actors, policies risk being neither equitable nor fully effective (Nyboer, et al. 2025). In addition to this, widespread trust of the government system, which is required on all levels may continue to be limited (Cvitanovic, et al. 2021).

Overall, the NARWC currently functions as an effective information sharing venue, not a knowledge brokerage institution. For more effective science policy integration, a shift towards implementing dedicated knowledge broker roles and the creation of synthesized policy briefs post consortium will help to ensure that scientific consensus is effectively translated into actionable regulatory language, bridging any communication gaps. In addition to this, moving past consultation with stakeholders, and allowing space for more equitable stakeholder involvement, including industry and Indigenous groups, will ensure that policies are co-created, leading to higher investment from stakeholders and the public, promoting more resilient conservation (Taddese, 2025).

By addressing these gaps, the NARWC can shift towards a system that drives the structural and transformative change necessary to promote NARW recovery across its range.

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Appendices

Appendix 1 Systematic Assessment

Year Presented	Title	Sector	Who (Lead)	Credibility			Relevancy				Legitimacy	
				Methods	Lifespan	Peer Review	Time (Data U)	Place (Focus)	Management	Open Access	Policy Alignm	Transdisciplinary
2017	Unexpected	NGO	PhD	Secondary U	N/A	No	Multi Year	U.S and Cana	Yes	Yes	Yes	No
2017	North Atlant	NGO	Masters	Literature Rev	N/A	No	One Year	U.S and Cana	Yes	Yes	Yes	Yes
2017	North Atlant	Government	PhD	Secondary U	https://royal	Yes	Multi Decade	U.S.	Yes	Yes	Yes	No
2017	Right Whale	Government	Masters	Secondary U	https://www	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	No
2017	Historical Ov	NGO	Masters	Secondary U	https://www	Yes	Multi Decade	U.S and Cana	Yes	Yes	Yes	No
2017	Preventing E	NGO	Masters	Field Study	N/A	No	Single Time	U.S.	Yes	Yes	Yes	Yes
2017	Mitigation of	Government	PhD	Statistical Mo	https://www	Yes	Multi Decade	Canada	Yes	Yes	Yes	Yes
2017	Assessing Sp	Academic	PhD	Spatial-Temp	N/A	No	Multi Decade	U.S.	Yes	Yes	Yes	Yes
2017	Current Effo	Academic	PhD	Field Study	https://publi	No	Multi Year	U.S and Cana	Yes	Yes	Yes	No
2017	North Atlant	NGO	PhD	Field Study	https://publi	Yes	Single Time	Canada	Yes	Yes	Yes	No
2017	Department	Government	PhD	Field Study	https://archi	No	One Year	Canada	No	Yes	Yes	Yes
2017	Fisheries and	Government	Masters	Literature Rev	https://www	No	Multi Year	Canada	Yes	Yes	Yes	Yes
2017	NOAA Fish	Government	PhD	Literature Rev	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2018	North Atlant	NGO	Masters	Secondary U	N/A	No	Single Time	U.S.	No	Yes	No	No
2018	North Atlant	NGO	Bachelors	Field Study	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2018	U.S. manager	Government	PhD	Engagement	https://medi	No	One Year	U.S.	Yes	Yes	Yes	No
2018	Pedigree-Int	Academic	PhD	Genetics	https://librar	No	Multi Decade	U.S and Cana	Yes	Yes	Yes	No
2018	Gauging man	Government	PhD	Statistical Mo	https://www	Yes	Multi Decade	U.S.	Yes	Yes	Yes	No
2018	The recovery	Government	PhD	Population M	https://royal	Yes	Multi Decade	U.S.	No	Yes	Yes	No
2018	Gross and H	Academic	DVSc	Secondary U	https://publ	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	No
2018	Right Whale	Government	PhD	Population M	https://wave	No	Multi Year	Canada	Yes	Yes	Yes	No
2018	An assessme	Academic	PhD	Spatial-Temp	https://www	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes
2018	Integrating th	Government	PhD	Field Study	https://www	Yes	Single Time	U.S.	Yes	Yes	Yes	No
2018	Relative Vess	Academic	Masters	Spatial- Temp	https://curre	No	One Year	Canada	Yes	Yes	Yes	No
2018	Mitigating the	Industry	PhD	Literature Rev	https://waves	No	One Year	U.S and Cana	Yes	Yes	Yes	Yes
2018	Co-existing in	Industry	P.Eng	Field Study	https://publi	No	Multi Year	Canada	Yes	Yes	Yes	Yes
2018	Development	Academic	Masters	Field Study	https://www	No	Multi Year	U.S.	No	No	Yes	Yes
2018	Looking to C	NGO	Bachelors	Literature Rev	https://www	No	Single Time	U.S.	No	No	Yes	No
2018	Catching up	Government	PhD	Spatial-Temp	https://www	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	Yes
2018	Mapping Migr	Academic	Masters	Spatial-Temp	https://www	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	Yes
2018	Probability of	Academic	PhD	Field Study	https://hans	No	Single Time	U.S.	No	Yes	No	Yes
2018	Low amplitud	Academic	PhD	Field Study	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	No
2018	Right whale r	Government	PhD	Field Study	https://www	No	Multi Year	Canada	No	Yes	Yes	Yes
2018	A brief histor	Academic	Masters	Literature Rev	https://scisp	No	Single Time	U.S.	Yes	Yes	Yes	Yes
2018	Foraging rate	Academic	PhD	Field Study	https://marin	Yes	One Year	Canada	No	Yes	Yes	No
2018	Summertime	Academic	PhD	Field Study	https://www	Yes	Multi Decade	Canada	No	no	Yes	No
2018	Population s	Government	PhD	Field Study	https://publi	No	Multi Year	Canada	No	No	Yes	No
2018	Investigation	Government	PhD	Field Study	https://www	No	Multi Year	U.S and Cana	N/A	Yes	Yes	No
2018	DFO update	Government	PhD	Literature Rev	https://wave	No	Multi Year	Canada	Yes	Yes	Yes	No
2018	Follow up of	Academic	PhD	Field Study	https://apps	Yes	One Year	Canada	Yes	Yes	Yes	Yes
2018	An interactive	Academic	PhD	Population M	https://onlin	Yes	Single Time	Canada	No	No	Yes	Yes
2018	Computation	Academic	PhD	Computation	https://www	Yes	Single Time	U.S.	No	Yes	No	No

2019	North Atlant	Academic	Masters	Literature Rev	N/A	N/A	One Year	U.S and Cana	No	Yes	Yes	Yes	Yes
2019	NARW Mortal	NGO	DVSc	Field Study	https://www	No	Single Time	Canada	Yes	Yes	Yes	Yes	Yes
2019	North Atlant	NGO	Bachelors	Field Study	https://www	No	Multi Year	U.S and Cana	No	Yes	Yes	Yes	No
2019	Whale release	NGO	Bachelors	Field Study	https://dai.m	No	One Year	Canada	No	Yes	No	Yes	Yes
2019	An update of	NGO	Masters	Literature Rev	https://conb	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2019	MLA withdraw	Industry	N/A	Engagement	https://medi	No	Single Time	U.S.	Yes	Yes	No	Yes	Yes
2019	Scientists res	Academic	PhD	Engagement	https://www	No	Single Time	U.S.	Yes	Yes	Yes	Yes	Yes
2019	Estimating la	Government	PhD	Statistical Mo	https://www	Yes	One Year	U.S.	No	Yes	Yes	Yes	No
2019	Are there few	NGO	PhD	Statistical Mo	https://www	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2019	Quantifying f	Academic	PhD	Population M	https://www	No	Single Time	U.S and Cana	No	Yes	No	No	No
2019	Evaluating th	Academic	PHD	Literature Rev	https://www	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2019	Decisions to	NGO	Masters	Ecological Md	https://acade	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes	Yes
2019	Functional Be	Government	Bachelors	Field Study	N/A	N/A	Single Time	U.S.	Yes	Yes	Yes	Yes	Yes
2019	An assessme	Government	PhD	Population M	https://www	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes	Yes
2019	Fishers helpi	Industry	PhD	Engagement	https://www	No	Single Time	Canada	No	Yes	Yes	Yes	Yes
2019	An assessme	NGO	N/A	Secondary U	https://riwha	No	Single Time	U.S.	Yes	Yes	Yes	Yes	Yes
2019	Estimating u	Academic	PhD	Population M	https://conb	Yes	Single Time	U.S and Cana	Yes	Yes	Yes	Yes	No
2019	Fisheries and	Government	N/A	Population M	https://wave	No	Multi Year	Canada	Yes	Yes	Yes	Yes	No
2019	U.S. Navy ma	NGO	Masters	Field Study	https://www	No	Multi Year	U.S.	No	No	Yes	Yes	No
2019	Genetic and	Academic	PhD	Genetics	https://www	Yes	Single Time	U.S and Cana	Yes	Yes	No	No	No
2019	An update of	Government	PhD	Statistical Mo	https://www	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2019	Density Surf	Academic	PhD	Population M	https://www	Yes	Multi Decade	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2019	Predicting rig	Academic	PhD	Secondary U	https://tos.o	No	Multi Decade	U.S.	Yes	Yes	Yes	Yes	No
2019	"The Calvine	NGO	N/A	Engagement	https://www	No	Single Time	U.S.	No	Yes	No	Yes	Yes
2019	Year of the rig	NGO	Masters	Engagement	https://www	No	Single Time	U.S.	No	Yes	No	Yes	Yes
2019	Why don't pe	NGO	Bachelors	Engagement	N/A	No	One Year	U.S.	No	Yes	No	No	No
2019	Weep no mor	Academic	Masters	Literature Rev	https://schol	No	Multi Decade	U.S.	Yes	Yes	Yes	Yes	No
2019	PAM monitor	Government	PhD	Spatial- Temp	https://pmc.	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes	Yes
2019	Near real-tim	Academic	PhD	Field Study	https://besjo	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes	Yes
2019	Using sonob	Academic	Masters	Field Study	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes	Yes
2019	report of the	Government	PhD	Population M	https://repos	No	Single Time	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2019	Blubber horn	NGO	Masters	Field Study	https://acade	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	Yes	No
2019	Noise dosaga	Government	PhD	Literature Rev	https://publ	Yes	Single Time	U.S and Cana	Yes	Yes	Yes	Yes	No
2019	Using techn	Industry	Bachelors	Secondary U	https://www	No	Single Time	U.S.	No	Yes	No	Yes	Yes
2019	Developing a	Government	PhD	Field Study	https://www	Yes	One Year	U.S.	No	Yes	Yes	Yes	No
2019	Surveying rig	Academic	PhD	Ecological Md	https://wave	No	Multi Year	Canada	N/A	N/A	Yes	Yes	Yes
2019	From compet	Government	Masters	Ecological Md	https://pmc.	Yes	Single Time	U.S.	Yes	Yes	No	No	No

2020	Fisheries and	Government	PhD	Literature Rev	https://wave	No	Multi Year	Canada	Yes	Yes	Yes	Yes	No
2020	Ropeless Co	NGO	PhD	Engagement	https://ropel	No	Single Time	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2020	Simulated pe	NGO	Masters	Field Study	https://www	No	Single Time	U.S.	No	Yes	Yes	Yes	Yes
2020	Right Whales	Industry	PhD	Secondary U	N/A	No	Single Time	U.S.	No	Yes	Yes	Yes	No
2020	Automatic wh	Academic	PhD	Field Study	https://journ	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes	No
2020	Protected Sp	Academic	Masters	Literature Rev	https://www	No	Single Time	U.S.	No	Yes	Yes	Yes	No
2020	Multi-agency	NGO	PhD	Field Study	https://www	No	Single Time	U.S.	No	No	Yes	Yes	Yes
2020	Effectiveness	NGO	N/A	Compliance	https://riwha	No	Single Time	U.S.	Yes	Yes	Yes	Yes	Yes
2020	Incorporating	Academic	PhD	Statistical Mo	https://www	Yes	Multi Decade	U.S.	Yes	Yes	Yes	Yes	No
2020	Estimation of	Government	Masters	Ecological Md	https://zslpu	Yes	Multi Decade	U.S.	Yes	Yes	Yes	Yes	Yes
2020	Estimating th	Government	PhD	Literature Rev	https://www	No	One Year	U.S.	Yes	Yes	Yes	Yes	No
2020	Stable isotop	Academic	Masters	Ecological Md	https://www	Yes	Multi Year	Canada	Yes	No	Yes	Yes	No
2020	Oceanograph	Academic	PhD	Secondary U	https://tos.o	Yes	Single Time	U.S and Cana	Yes	Yes	Yes	Yes	No
2020	North Atlant	Academic	Masters	Field Study	https://www	Yes	Multi Decade	U.S and Cana	Yes	Yes	Yes	Yes	Yes
2020	In plane sight	Government	PhD	Secondary U	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes	Yes
2020	North Atlant	NGO	Masters	Field Study	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes	No
2020	Projecting res	NGO	PhD	Population M	https://onlin	Yes	Multi Decade	U.S.	Yes	Yes	Yes	Yes	No
2020	Listening for	Government	Masters	Field Study	https://www	Yes	Multi Year	U.S.	No	Yes	Yes	Yes	No
2020	Characterizin	Government	Masters	Field Study	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes	No
2020	Optimizing re	NGO	Masters	Field Study	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes	No
2020	Evidence of s	NGO	PhD	Field Study	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes	Yes
2020	Quantitative	Academic	Masters	Ecological Md	https://conb	Yes	Single Time	Canada	Yes	Yes	Yes	Yes	No
2020	North Atlant	Academic	PhD	Genetics	https://pmc.	Yes	Single Time	U.S.	No	Yes	No	No	No
2020	North Atlant	Academic	Masters	Ecological Md	https://www	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes	No
2020	Variations in	Government	PhD	Field Study	https://acade	Yes	Single Time	Canada	Yes	Yes	Yes	Yes	No
2020	Variation in t	Academic	Masters	Secondary U	https://www	Yes	Multi Year	Canada	No	Yes	Yes	Yes	No
2020	Ocean circula	Government	PhD	Ecological Md	https://www	Yes	Multi Year	Canada	Yes	No	Yes	Yes	No
2020	Entangled	NGO	Filmmaker	Documentary	https://entar	No	Single Time	U.S and Cana	N/A	No	Yes	Yes	No
2020	The Urban W	NGO	Filmmaker	Documentary	https://lasto	No	Single Time	U.S and Cana	N/A	No	Yes	Yes	Yes
2020	New method	Academic	Masters	Field Study	https://www	Yes	Multi Year	U.S.	Yes	Yes	No	Yes	Yes
2020	Ship Speed V	NGO	Bachelors	Secondary U	https://ocear	No	Multi Year	U.S.	Yes	Yes	Yes	Yes	Yes
2020	Right Whale	Government	Masters	Population M	https://link.s	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes	Yes

2021	North Atlant	Government	Masters	Literature Rev	https://medi	No	Single Time	U.S.	Yes	Yes	Yes	Yes
2021	DFO science	Government	PhD	Literature Rev	https://waves	No	Single Time	Canada	Yes	Yes	Yes	Yes
2021	Last of the R	NGO	Filmmaker	Documentar	https://hitpl	No	Single Time	U.S and Cana	N/A	No	Yes	Yes
2021	Fisheries and	Government	N/A	Literature Rev	https://www	No	Single Time	Canada	Yes	Yes	Yes	No
2021	Implementati	Government	Masters	Literature Rev	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2021	A multi-state	Government	PhD	Population M	https://esajo	Yes	Multi Decade	U.S.	Yes	Yes	Yes	No
2021	The entangle	Academic	Masters	Engagement	https://digita	No	Single Time	U.S.	Yes	Yes	Yes	Yes
2021	Shiny tools f	Government	PhD	Secondary U	https://joss.t	No	Single Time	U.S.	Yes	Yes	Yes	No
2021	Conservator	Industry	Engineer	Field Study	N/A	No	Multi Year	Canada	Yes	No	Yes	Yes
2021	Whales and f	Industry	PhD	Field Study	https://cdns	Yes	Multi Year	Canada	Yes	No	Yes	Yes
2021	Quantifying t	NGO	Masters	Ecological M	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes
2021	Elevations of	NGO	Masters	Field Study	https://www	Yes	One Year	Canada	Yes	Yes	Yes	Yes
2021	Quantifying r	NGO	Masters	Secondary U	N/A	No	Multi Year	Canada	Yes	No	Yes	Yes
2021	Documented	NGO	Masters	Field Study	N/A	No	Single Time	Canada	No	No	Yes	Yes
2021	Marine Aquac	NGO	Masters	Literature Rev	https://www	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes
2021	Evaluation of	Academic	PhD	Ecological M	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	No
2021	Navy Maritim	Industry	Masters	Field Study	https://osm2	No	Multi Year	U.S.	No	Yes	Yes	No
2021	How should	Academic	PhD	Genetics	https://royal	Yes	Multi Decade	U.S and Cana	Yes	Yes	Yes	Yes
2021	Multi-state m	Academic	PhD	Ecological M	https://www	Yes	Multi Decade	U.S.	Yes	Yes	Yes	No
2021	North Atlant	NGO	PhD	Field Study	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	No
2021	Impacts of C	Academic	PhD	Field Study	https://dec.n	Yes	Multi Year	U.S.	Yes	No	Yes	Yes
2021	Ambient acou	Academic	Masters	Field Study	https://pubn	Yes	One Year	Canada	No	No	Yes	No
2021	The value of i	Industry	PhD	Field Study	https://pubs	No	Single Time	Canada	No	Yes	Yes	No
2021	Detecting and	Academic	PhD	Field Study	N/A	No	Single Time	U.S.	No	No	Yes	No
2021	A compariso	Government	Masters	Secondary U	N/A	No	Single Time	U.S.	No	No	Yes	No
2021	Repatriation	NGO	Masters	Secondary U	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	No
2021	Predicting en	Academic	PhD	Ecological M	https://www	Yes	Multi Year	U.S and Cana	Yes	Yes	Yes	No
2021	Predicted dis	Academic	PhD	Ecological M	https://www	Yes	One Year	U.S.	Yes	Yes	Yes	No
2021	Matrilines and	Academic	Masters	Secondary U	https://schol	Yes	Multi Decade	Canada	Yes	Yes	Yes	No
2021	Residency, d	Academic	PhD	Secondary U	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes
2021	Observations	Academic	PhD	Field Study	https://www	Yes	Multi Year	Canada	No	Yes	Yes	No
2021	Variation in r	Government	PhD	Field Study	https://www	Yes	Single Time	Canada	Yes	Yes	Yes	No
2021	Biogeochemi	Academic	PhD	Secondary U	N/A	N/A	Multi Decade	U.S.	No	No	Yes	Yes
2021	Health indica	Academic	PhD	Risk Assesme	https://resea	Yes	Single Time	U.S and Cana	Yes	Yes	Yes	Yes
2021	Development	Government	PhD	Field Study	N/A	N/A	Multi Year	Canada	Yes	Yes	No	Yes

2022	Redefining N	Academic	PhD	Secondary U	https://astop	Yes	Multi Decade	U.S and Can	Yes	Yes	Yes	No
2022	Decadal-scal	NGO	PhD	Population M	https://onlinelibrary.wiley.c	No	Multi Decade	U.S.	Yes	Yes	Yes	Yes
2022	Forecasting r	Government	Masters	Population M	https://besjo	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes
2022	Abundance a	Government	PhD	Field Study	https://publi	No	Multi Year	Canada	Yes	Yes	Yes	No
2022	Vulnerability	Government	N/A	Field Study	N/A	N/A	Multi Year	Canada	No	N/A	Yes	No
2022	From top to	Government	PhD	Field Study	N/A	N/A	Multi Year	Canada	No	N/A	Yes	No
2022	Didn't we jus	NGO	Masters	Field Study	N/A	N/A	One Year	Canada	No	N/A	Yes	Yes
2022	North Atlant	Academic	N/A	Population M	https://medi	No	Multi Decade	U.S and Can	No	Yes	Yes	Yes
2022	Incorporating	Academic	PhD	Ecological M	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	Photogram	Academic	PhD	Secondary U	https://www	Yes	Multi Decade	U.S.	Yes	Yes	Yes	Yes
2022	Including ser	NGO	DVM	Secondary U	https://www	No	Multi Year	U.S and Can	Yes	Yes	Yes	Yes
2022	Genomic esti	Academic	PhD	Genetics	https://pubn	Yes	Multi Decade	U.S and Can	Yes	No	Yes	No
2022	Skin transcri	NGO	PhD	Genetics	https://www	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes
2022	Drone-based	Academic	PhD	Field Study	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	Near real-tim	Academic	PhD	Field Study	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	Adaptable, o	Academic	PhD	Ecological M	https://www	Yes	Multi Year	U.S and Can	Yes	No	No	Yes
2022	Fisheries and	Government	PhD	Field Study	https://publi	No	Multi Year	Canada	Yes	Yes	Yes	No
2022	NOAA Fisher	Government	Masters	Literature Re	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2022	Building the	Government	PhD	Field Study	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2022	An approach	NGO	Masters	Secondary U	N/A	N/A	One Year	U.S and Can	Yes	N/A	Yes	No
2022	Collaboration	NGO	Masters	Field Study	https://frsn	N/A	One Year	Canada	Yes	N/A	Yes	Yes
2022	How effective	NGO	Masters	Field Study	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes
2022	Entanglemen	NGO	Bachelors	Field Study	https://coast	No	Single Time	U.S.	Yes	Yes	Yes	Yes
2022	Grappling wit	Academic	Masters	Field Study	https://sanct	No	Single Time	U.S.	Yes	Yes	Yes	Yes
2022	Whales and f	Industry	PhD	Field Study	https://www	Yes	Multi Year	Canada	Yes	No	Yes	Yes
2022	Bycatch Solu	Industry	N/A	Literature Re	https://www	No	Single Time	U.S.	Yes	Yes	Yes	Yes
2022	NOAA's Rope	Government	PhD	Literature Re	https://medi	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	Atlantic Large	Government	N/A	Secondary U	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	Abandoned s	Government	N/A	Field Study	https://www	No	Single Time	U.S.	Yes	Yes	Yes	No
2022	Transport Ca	Government	Masters	Engagement	https://tc.car	No	Multi Year	Canada	Yes	Yes	Yes	Yes
2022	Assessing th	Government	PhD	Ecological M	https://repos	No	Single Time	U.S.	Yes	Yes	Yes	No
2022	Proposed arr	Government	PhD	Secondary U	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2022	U.S. Army Co	Government	Masters	Field Study	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	Impact of co	NGO	PhD	Literature Re	https://admi	No	Single Time	U.S.	Yes	Yes	Yes	No
2022	How is NOAA	Government	PhD	Engagement	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	NMFS offsho	Government	Masters	Engagement	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2022	NEFSC rese	Government	PhD	Field Study	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2023	Report on th	Government	Masters	Engagement	https://digit	No	Single Time	U.S and Can	Yes	Yes	Yes	Yes
2023	A Manager	Government	PhD	Population M	https://repos	Yes	Multi Year	U.S and Can	Yes	Yes	Yes	Yes
2023	A new statist	Academic	PhD	Secondary U	N/A	N/A	Multi Decade	U.S.	No	N/A	Yes	Yes
2023	Estimating th	Academic	PhD	Secondary U	https://resea	Yes	Multi Decade	U.S and Can	Yes	No	Yes	Yes
2023	Effects of fis	Government	Masters	Secondary U	https://zspu	Yes	Multi Decade	U.S and Can	Yes	Yes	Yes	Yes
2023	Investigating	Academic	PhD	Genetics	https://royal	Yes	Multi Decade	U.S and Can	Yes	Yes	Yes	Yes
2023	What's in a b	Government	PhD	Field Study	N/A	N/A	Multi Year	U.S and Can	Yes	N/A	Yes	Yes
2023	Identifying N	Government	N/A	Field Study	N/A	N/A	Single Time	Canada	No	N/A	Yes	Yes
2023	Autumn acou	Academic	PhD	Field Study	https://www	No	Single Time	U.S.	Yes	No	Yes	Yes
2023	Current NAR	Government	Masters	Secondary U	https://passi	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2023	Detection ran	Academic	PhD	Field Study	https://www	Yes	Single Time	Canada	Yes	Yes	Yes	Yes
2023	Using synthe	Academic	Masters	Field Study	https://pubn	Yes	Multi Year	Canada	No	No	Yes	No
2023	A comprehen	Academic	PhD	Secondary U	https://www	Yes	Multi Decade	U.S.	Yes	Yes	Yes	No
2023	More than jus	Industry	N/A	Field Study	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2023	Incorporating	Academic	PhD	Secondary U	https://www	Yes	Multi Year	U.S.	Yes	Yes	Yes	No
2023	Assessing No	Academic	PhD	Secondary U	https://proj	Yes	Multi Year	U.S.	Yes	No	Yes	No
2023	Where the wh	Government	PhD	Field Study	N/A	N/A	One Year	U.S.	No	No	Yes	Yes
2023	Dive behavio	Government	Masters	Field Study	N/A	N/A	One Year	U.S.	Yes	No	Yes	Yes
2023	Understanding	NGO	PhD	Secondary U	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	No
2023	The southern	Government	PhD	Field Study	https://publi	No	Multi Year	Canada	Yes	Yes	Yes	No
2023	High variabil	NGO	PhD	Field Study	N/A	N/A	Multi Year	Canada	Yes	No	Yes	No
2023	Diel patterns	Academic	PhD	Field Study	N/A	N/A	Multi Year	Canada	No	No	Yes	No
2023	Abundance a	Government	PhD	Field Study	https://publi	No	Single Time	Canada	Yes	Yes	Yes	No
2023	A glider-mou	Academic	Masters	Field Study	https://unbs	No	Single Time	Canada	Yes	Yes	Yes	Yes
2023	Increasing wh	Academic	PhD	Field Study	N/A	N/A	One Year	Canada	Yes	Yes	Yes	Yes
2023	Satellite dete	Academic	PhD	Field Study	https://onlin	Yes	Multi Year	U.S and Can	Yes	Yes	Yes	Yes
2023	Development	Industry	N/A	Secondary U	https://www	No	Single Time	U.S.	Yes	Yes	Yes	No
2023	Recommend	NGO	PhD	Field Study	https://agu.c	No	Single Time	U.S.	Yes	Yes	Yes	No
2023	From wind to	Academic	PhD	Secondary U	https://tos.o	Yes	Single Time	U.S.	Yes	Yes	Yes	Yes
2023	Exploring ove	Academic	PhD	Secondary U	https://heart	No	Multi Decade	U.S.	Yes	Yes	Yes	Yes
2023	North Atlant	NGO	PhD	Secondary U	N/A	N/A	One Year	U.S and Can	Yes	Yes	Yes	No
2023	Quantifying e	NGO	PhD	Field Study	https://www	Yes	Multi Year	Canada	Yes	Yes	Yes	Yes
2023	Habitat use o	Industry	PhD	Field Study	N/A	N/A	Multi Year	Canada	Yes	Yes	Yes	Yes
2023	The effects o	NGO	Masters	Secondary U	https://dalsp	No	Multi Year	Canada	Yes	Yes	Yes	No
2023	Fisheries and	Government	Bachelors	Engagement	N/A	N/A	Multi Year	Canada	Yes	Yes	Yes	Yes
2023	A decision su	Government	PhD	Ecological M	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2023	Assessment	Government	PhD	Ecological M	https://pubn	Yes	Multi Year	U.S.	Yes	Yes	Yes	No
2023	The probabili	Government	PhD	Secondary U	https://www	Yes	Multi Year	U.S and Can	Yes	Yes	Yes	No
2023	Modeling cha	NGO	Masters	Secondary U	https://blog	No	Multi Year	Canada	Yes	Yes	Yes	No
2023	Recommend	Government	Masters	Secondary U	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	Yes
2023	NOAA Fisher	Government	PhD	Secondary U	https://www	No	Multi Year	U.S.	Yes	Yes	Yes	No
2023	Transport Ca	Government	N/A	Field Study	https://tc.car	No	One Year	Canada	Yes	Yes	Yes	No

Appendix 2 Broad Sector Categories and Examples

Sector	Examples Within Sector
Government	Lead by a government department, agency, or is publicly funded, i.e. Department of Fisheries and Oceans Canada, NOAA Fisheries, Florida Fish and Wildlife Commission, Massachusetts Division of Marine Fisheries, Georgia Department of Natural Resources
Academia	Lead by researchers affiliated with a university, or academic institution, i.e. Dalhousie University, University of North Carolina, Wilmington, Duke University, Syracuse University, etc.
NGO	Lead by a non-profit organization or advocacy group, i.e. Anderson Cabot Center for Ocean Life at the New England Aquarium, Center for Coastal Studies, Canadian Wildlife Federation, Woods Hole Oceanographic Institute, Canadian Whale Institute, etc.
Industry	Lead by a private company, industry association, for profit consulting firm, i.e., Maritime Information Systems, M-Expertise Marine Inc., etc.

Appendix 3 Broad Method Category and Examples

Broad Method Category	Examples Within Category
Ecosystem Model	Development of model simulating ecological processes and interactions, etc.

Genetics	Genetic analysis, DNA sequencing, population genetics, etc.
Literature Review	Reviewing and /or synthesizing existing literature or policy.
Field Study	Direct observation, data collection, experimentation, etc.
Engagement	Gathering input, perspectives or feedback from stakeholders.
Secondary Use	Use of existing data, such as the NARWC Catalog to generate new information.

Appendix 4 NARWC Management Recommendations

Recommendation Category	Specific Recommendations
Vessel Strikes	Vessel speed limits, speed restricted areas, speed zones
Entanglement	Weak links, ropeless gear, ghost gear
Population Monitoring	Passive acoustic monitoring (PAM), aerial and visual surveys, photo-id, health assessments
Critical Habitat	Identifying calving and feeding grounds, protection from degradation
Policy Change and Dynamic Management	Dynamic management areas, amendments to policy, real-time management
Noise	Limit noise from vessels, placement of surveys in critical habitat
Population Ecology	Calving rates, disease, reproductive health, prey distribution, stress
Climate Change	Changing temperatures, adaptive fisheries management, shifting distribution
Collaboration	Transboundary management, stakeholder engagement, co-creation of knowledge

Appendix 5 Recommendation Types Across 2017-2023

Recommendation Type	Total (2017-2023)
Population Ecology	32
Population Monitoring	35
Entanglement	28
Vessel Strike	21
Noise	3
Policy Change and Dynamic Management	20
Collaboration	23
Climate Change	4
Critical Habitat	15
Total	181

Appendix 6 Unique Flow Paths Between Recommendation Type, SARA Objectives, ESA Objectives, and their Weight

SARA Objective	Recommendation Type	ESA Objective	Weight
Enhance understanding of life history...	Population Ecology	Address potential and emerging threats	32
Systematically monitor the population and its threats	Population Ecology	Address potential and emerging threats	32
Enhance understanding of life history...	Population Ecology	Monitor population and health	32
Systematically monitor the population and its threats	Population Ecology	Monitor population and health	32
Enhance understanding of life history...	Population Monitoring	Address potential and emerging threats	35
Enhance understanding of life history...	Population Monitoring	Monitor population and health	35
Enhance understanding of life history...	Population Monitoring	Monitor threats	35
Enhance understanding of life history...	Population Monitoring	Monitor effectiveness of conservation	35
Systematically monitor the population and its threats	Population Monitoring	Address potential and emerging threats	35

Systematically monitor the population and its threats	Population Monitoring	Monitor population and health	35
Systematically monitor the population and its threats	Population Monitoring	Monitor threats	35
Systematically monitor the population and its threats	Population Monitoring	Monitor effectiveness of conservation	35
Minimize injury and disturbance from vessel presence...	Entanglement	Address fishing gear entanglements	28
Minimize injury and disturbance from vessel presence...	Entanglement	Monitor threats	28
Reduce fatalities and injuries from fishing gear interactions	Entanglement	Address fishing gear entanglements	28
Reduce fatalities and injuries from fishing gear interactions	Entanglement	Monitor threats	28
Enhance understanding of life history...	Entanglement	Address fishing gear entanglements	28
Enhance understanding of life history...	Entanglement	Monitor threats	28
mitigate mortality and injury resulting from vessel strikes	Vessel strike	Address vessel strikes	21
mitigate mortality and injury resulting from vessel strikes	Vessel strike	Monitor threats	21

Minimize injury and disturbance from vessel presence...	Vessel strike	Address vessel strikes	21
Minimize injury and disturbance from vessel presence...	Vessel strike	Monitor threats	21
Enhance understanding of life history...	Vessel strike	Address vessel strikes	21
Enhance understanding of life history...	Vessel strike	Monitor threats	21
Minimize injury and disturbance from vessel presence...	Noise	Monitor threats	3
Enhance understanding of life history...	Noise	Monitor threats	3
mitigate mortality and injury resulting from vessel strikes	Policy change and dynamic management	Address fishing gear entanglements	20
mitigate mortality and injury resulting from vessel strikes	Policy change and dynamic management	Address vessel strikes	20
mitigate mortality and injury resulting from vessel strikes	Policy change and dynamic management	Address potential and emerging threats	20
mitigate mortality and injury resulting from vessel strikes	Policy change and dynamic management	Monitor effectiveness of conservation	20
Reduce fatalities and injuries from fishing gear interactions	Policy change and dynamic management	Address fishing gear entanglements	20

Reduce fatalities and injuries from fishing gear interactions	Policy change and dynamic management	Address vessel strikes	20
Reduce fatalities and injuries from fishing gear interactions	Policy change and dynamic management	Address potential and emerging threats	20
Reduce fatalities and injuries from fishing gear interactions	Policy change and dynamic management	Monitor effectiveness of conservation	20
Systematically monitor the population and its threats	Policy change and dynamic management	Address fishing gear entanglements	20
Systematically monitor the population and its threats	Policy change and dynamic management	Address vessel strikes	20
Systematically monitor the population and its threats	Policy change and dynamic management	Address potential and emerging threats	20
Systematically monitor the population and its threats	Policy change and dynamic management	Monitor effectiveness of conservation	20
Foster robust collaboration among government agencies...	Collaboration	Monitor effectiveness of conservation	23
Develop and implement public education and stewardship activities...	Collaboration	Monitor effectiveness of conservation	23
Minimize injury and disturbance from vessel presence...	Climate change	Address potential and emerging threats	4

Enhance understanding of life history...	Climate change	Address potential and emerging threats	4
Minimize injury and disturbance from vessel presence...	Critical habitat	Address potential and emerging threats	15
Enhance understanding of life history...	Critical habitat	Address potential and emerging threats	15