Proposed

Species at Risk Act
Action Plan Series

Action Plan for the North Atlantic Right Whale (*Eubalaena glacialis*) in Canada

North Atlantic Right Whale

2020

Canada

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For copies of the action plan, or for additional information on species at risk, including Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports, residence descriptions, recovery strategies, and other related recovery documents, please visit the Species at Risk Public Registry.

Cover illustration: The cover illustration depicts a female North Atlantic Right Whale known as Arpeggio, catalogue number 2753. Born in 1997, Arpeggio is a poster child for what Right Whales do, what they are exposed to, and what tools researchers use to learn about their life history and the threats facing their recovery. She has ranged from the calving ground along the coast of eastern Florida to the Bay of Fundy and the Gulf of St. Lawrence, and has been photographed in each year of her life in several different habitat areas. She was entangled briefly in 1999 at the age of 2½, and survived a hit by a small vessel at the age of eight. Arpeggio has been exposed to almost every type of research: tagging to learn about dive profiles and response to sound playback, skin sampling to learn about her genetic profile, and ultrasound measurements to assess her health. Arpeggio gave birth to her first calf in 2007 at the age of 11. She had her second calf in 2013. She was observed in Canada in the Gulf of St. Lawrence in 2016 and 2017, not in 2018. Arpeggio was seen close to the shore of Cape Breton Island, in September 2019, after being observed in the Gulf of St. Lawrence in July and August that year. In December 2019, she was sighted in the calving grounds off the southeast U.S. Illustration credit: Scott Landry, Provincetown Center for Coastal Studies.

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Statement on the Government of Canada's North Atlantic Right Whale initiatives

The North Atlantic Right Whale (Right Whale) was listed as Endangered under the *Species at Risk Act* (SARA) in 2005. Fisheries and Oceans Canada (DFO) works with its partners to plan and implement the recovery of this species, according to the requirements of SARA. A SARA recovery strategy was published in 2009, and an action plan addressing the threat of fishery interactions was nearing completion in 2016. In 2018, the scope of the action plan was expanded to include all threats to Right Whales identified in the SARA recovery strategy (DFO 2014).

Between 2017 and 2019, an unprecedented number of Right Whales were discovered dead or entangled in the Gulf of St. Lawrence. The Government of Canada responded in 2017 with increased and expanded surveillance for Right Whales, and with management measures designed to reduce entanglement risk and vessel collision risk to Right Whales. Since 2017, DFO and Transport Canada have continued to refine those measures with the input of scientists and partners in the fishing and marine transportation industries.

The Government of Canada has demonstrated its commitment to the protection and recovery of Right Whales through several investments in recent years. In 2016, the Government of Canada announced a $1.5 billion investment in the Oceans Protection Plan, which includes measures to address threats to marine mammals in Canadian waters. Budget 2018 included $167.4 million over five years to help protect and recover endangered whale species in Canada, specifically the North Atlantic Right Whale, the Southern Resident Killer Whale, and the St. Lawrence Estuary Beluga. This includes funding for science activities to help better understand factors affecting the health of these whale populations, as well as actions to help address the threats arising from human activities and enhance incident response capacity.

This SARA action plan is a detailed extension of the recovery strategy, identifying more specific measures needed to address threats to the Right Whale and achieve recovery. It is a forward-looking, holistic framework to guide and coordinate all internal and external recovery efforts for this species. SARA requires the Government of Canada to report on recovery implementation: recovery strategies must be reported on every five years, and action plans must be reported on five years following final publication.

For more information on the Government of Canada's work to monitor Right Whales and reduce threats to them in Canadian waters:

- Fishery Management measures to reduce risk of entanglement in fishing gear
- Measures to reduce risk of lethal vessel strike
- North Atlantic right whale detections and survey effort
- Canadian Science Advisory Secretariat
- North Atlantic Right Whale species profile

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of action plans for species listed as extirpated, endangered, or threatened for which recovery has been deemed feasible. They are also required to report on progress five years after the publication of the final document on the Species at Risk Public Registry.

The Minister of Fisheries and Oceans is the competent minister under SARA for the North Atlantic right whale and has prepared this action plan to implement the recovery strategy, as per section 47 of SARA. In preparing this action plan, the competent minister has considered, as per section 38 of SARA, the commitment of the Government of Canada to conserving biological diversity and to the principle that, if there are threats of serious or irreversible damage to the listed species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty. To the extent possible, this action plan has been prepared in cooperation with other federal government departments, provinces and territories, Indigenous groups, and stakeholders, as per section 48(1) of SARA.

As stated in the preamble to SARA, success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions and actions set out in this action plan and will not be achieved the Government of Canada, or any other jurisdiction, alone. The cost of conserving species at risk is shared amongst many groups. All Canadians are invited to join in supporting and implementing this action plan for the benefit of the North Atlantic right whale and Canadian society as a whole.

Under SARA, an action plan provides the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. The plan outlines recovery measures to be taken by Fisheries and Oceans Canada and other jurisdictions and/or organizations to help achieve the population and distribution objectives identified in the recovery strategy. Implementation of this action plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

Fisheries and Oceans Canada acknowledges the many individuals and organizations that have contributed to North Atlantic Right Whale recovery efforts, including the development of this action plan (Appendix B). Their continued commitment to Right Whale recovery is critical to the successful implementation of this action plan.

Executive summary

The North Atlantic right whale (*Eubalaena glacialis*) was listed as Endangered under the *Species at Risk Act* (SARA) in 2005. This action plan is part of a series of documents regarding the North Atlantic right whale that should be taken into consideration together, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report, the recovery potential assessment, the recovery strategy, and a five-year progress report on recovery strategy implementation.

The North Atlantic Right Whale is a large baleen whale that occurs in coastal and shelf waters along the eastern seaboard of North America, from Florida to Newfoundland and Labrador. Atlantic Canadian waters are important foraging grounds for the species, which feeds on the copepod *Calanus*.

This action plan outlines measures that provide the best chance of achieving the recovery goal and objectives for the species, including measures to be taken to address identified threats and monitor recovery. The recovery goal for the North Atlantic right whale is “to achieve an increasing trend in population abundance over three generations”. Seven recovery objectives support this goal, and address reducing anthropogenic mortality and injury, population monitoring, research, collaboration, education, and stewardship. Fifty-two recovery measures to meet those objectives are described in this action plan. For each measure, a priority level, status, timeline, and list of potential partners have been identified. The measures are organized in three tables reflecting the lead roles and/or partners involved.

In the recovery strategy for the North Atlantic right whale, critical habitat was identified to the extent possible using the best available information. The critical habitat is protected through a SARA Critical Habitat Order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of identified critical habitat. Any future changes or additions to identified critical habitat would occur through an amendment to the recovery strategy.

An evaluation of the socio-economic costs of implementing the action plan and the benefits to be derived from its implementation is provided in section 3.

Recovery of the North Atlantic right whale depends on the commitment and cooperation of many organizations that will implement the measures set out in this action plan.

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1 Recovery actions

1.1 Context and scope of the action plan

The North Atlantic right whale (*Eubalaena glacialis*) was listed as Endangered under the *Species at Risk Act* (SARA) in 2005. This action plan is part of a series of documents regarding the North Atlantic Right Whale (hereafter referred to as "Right Whale") that should be taken into consideration together, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report (COSEWIC 2013), the recovery potential assessment (RPA) (DFO 2007), the recovery strategy (DFO 2014), and a five-year progress report on recovery strategy implementation (DFO 2016). Under SARA, an action plan provides the detailed recovery planning that supports the strategic direction set out in a recovery strategy for the species. A recovery strategy also provides background information on the species and its threats, and information on its critical habitat. An action plan for Right Whale, specifically addressing the threat of fisheries interactions, was published as proposed on the Species at Risk Public Registry in 2016. The current action plan addresses all identified threats to the species and reflects the content of the 2016 action plan. This proposed action plan supersedes the 2016 action plan.

The Right Whale is a large baleen whale that occurs in coastal and shelf waters along the eastern seaboard of North America, from Florida to Newfoundland and Labrador. Occasionally observations are made outside of this range, such as near Norway (Jacobsen et al. 2004), Iceland (Knowlton et al. 1992; Kraus et al. 2007, Hamilton 2018) and in the Bay of Biscay off the coast of France (Pettis 2019), and Greenland (Mellinger et al. 2011). The species has been detected acoustically in Canadian waters year-round, with the fewest detections in the winter (DFO 201 9). The largest aggregations of Right Whales in Canadian waters occur during the summer and fall. The primary driver of Right Whale distribution in Canada is the density and availability of their copepod prey, *Calanus* copepods. (DFO 2019). The distribution of Right Whales in Canadian waters has shifted since 2010, and they are using previously predictable habitat areas, such as the Bay of Fundy, less frequently (Davis et al. 2017). Significant aggregations of Right Whales have been observed in the southern Gulf of St. Lawrence (DFO 2019).

Historically, commercial whalers targeted Right Whales and depleted the species. In the post-whaling era[1], threats to the species include entanglement in fishing gear, vessel collisions, contaminants, acoustic disturbance, vessel presence disturbance, and changes in food supply (COSEWIC 2013; DFO 2014). Entanglement and vessel strikes are the leading causes of human-induced serious injuries and mortalities (van der Hoop et al. 2013).

The "Recovery Strategy for the North Atlantic Right Whale (*Eubalaena glacialis*) in Atlantic Canadian Waters" (DFO 2014) (hereafter the "recovery strategy") defined the following recovery goal: "To achieve an increasing trend in population abundance over three generations." In the case of Right Whale, three generations is approximately 60 years.

The recovery strategy includes seven recovery objectives to support the recovery goal (DFO 2014):

[1] Hunting Right Whales was banned internationally in 1935.

1. reduce mortality and injury as a result of vessel strikes
2. reduce mortality and injury as a result of fishing gear interactions (entanglement and entrapment)
3. reduce injury and disturbance as a result of vessel presence or exposure to contaminants and other forms of habitat degradation
4. monitor population and threats
5. increase understanding of life history characteristics, low reproductive rate, habitat and threats to recovery through research
6. support and promote collaboration for recovery between government agencies, academia, environmental non-government groups, Aboriginal groups, coastal communities and international agencies and bodies
7. develop and implement education and stewardship activities that promote recovery

Under section 47 of SARA, the competent minister must prepare one or more action plans based on the recovery strategy. Action planning for species at risk recovery is an iterative process and the implementation schedule in this document (section 1.2.2) may be modified in the future to reflect progress towards recovery.

DFO prepared a science-based review of recovery activities for the Right Whale as part of Canada's Oceans Protection Plan (OPP) (DFO 2017). The review examined the degree to which activities underway or proposed directly contribute to abating threats to Right Whales. It concluded that the most effective recovery activities, which provide immediate and direct benefits to the species, are typically those that remove the threat from areas where Right Whales are present (that is, spatiotemporal avoidance). The report also emphasized the importance of indirect measures that support the implementation of such high-impact measures was emphasized as well. The DFO review informed the development of this action plan, and will continue to guide management actions moving forward.

Right Whales show a declining abundance trend since 2010 (Pace et al. 2017), and the best estimate of population size at the end of 2017 was 411 (Pettis et al. 2018a). Of particular concern is the disproportionate sex ratio, with females numbering far fewer than males (there were an estimated 272 males and 186 females in 2015) (Pace et al. 2017). Furthermore, only five new calves were recorded in the 2016/17 calving season (December to March) and none were recorded in the 2017/18 calving season (Pettis et al. 2018a). Seven calves were observed in the 2018/19 season.

In 2017, 17 Right Whale mortalities were recorded throughout their range and the United States (U.S.) National Oceanic and Atmospheric Administration (NOAA) declared an Unusual Mortality Event (UME) under the U.S. *Marine Mammal Protection Act* (Pettis et al. 2018b). Twelve of the deaths occurred in the Gulf of St. Lawrence, where five live entanglements also were recorded. Seven necropsies (Daoust et al. 2018), attributed four mortalities to vessel strikes and two to acute entanglement. The cause of death was inconclusive in one of the necropsies, and examination of five carcasses was determined not to be feasible.

In 2018, three Right Whales deaths were detected in their range, all in the U.S. Three entangled Right Whales were sighted in Canada. In 2019, eight Right Whale mortalities were confirmed in Canadian waters, with a potential ninth unconfirmed death, and one in the U.S., with another four Right Whales detected suffering injuries from entanglements in Canada. Five of the eight carcasses underwent necropsy, and four of five necropsies identified ship strike as the suspected, or probable cause of death (Bourque et al. 2020). Detailed examination of the other three carcasses was determined not to be feasible.

The Right Whale deaths in 2017 heightened concern for recovery of the species, and the Government of Canada implemented management measures to reduce the risk of entanglement and vessel strikes in Canadian waters. These management measures have been guided by peer-reviewed science advice, such as in DFO (2018a) and DFO (2019).

Right Whales are migratory animals that cross international boundaries, most notably between Canada and the United States. This action plan aims to address threats throughout the range of the species in Atlantic Canadian waters, while also contributing to international research and conservation initiatives.

1.2 Measures to be taken and implementation schedule

Successful recovery of Right Whales depends on the actions of many different jurisdictions, organizations, and individuals. It requires the commitment and cooperation of these groups to implement the measures described in this action plan.

This action plan describes the measures that provide the best chance of achieving the recovery goal and objectives for the Right Whale, including measures to be taken to address threats to the species and monitor its recovery. These measures will guide activities to be undertaken by Fisheries and Oceans Canada (DFO) and its partners. As new information becomes available, these measures and their priority level may change. DFO strongly encourages all Canadians to participate in the conservation of the Right Whale by undertaking measures outlined in this action plan.

In section 1.2.1, recovery measures are grouped according to responsibility in a three-table implementation schedule. Section 1.2.2 provides additional details on select measures.

1.2.1 Implementation schedule

Table 1 identifies the measures to be undertaken by DFO to support recovery of the Right Whale.

Table 2 identifies the measures to be undertaken collaboratively by DFO and its partners. Implementation of these measures will be dependent on a collaborative approach, in which DFO is a partner in recovery efforts, but cannot implement the measures alone.

As all Canadians are invited to join in supporting and implementing this action plan, table 3 identifies the remaining measures that represent opportunities for other jurisdictions, organizations, or individuals to lead. If your organization is interested in participating in one of these measures, please contact the Species at Risk Maritimes Region office at speciesatrisk.xmar@dfo-mpo.gc.ca or 1-866-891-0771.

Implementation of this action plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations. Federal funding programs for species at risk may provide opportunities to obtain funding to carry out some of the outlined activities. These programs include, but are not limited to, the Habitat Stewardship Program for Species at Risk, the Aboriginal Fund for Species at Risk, the Sustainable Fisheries Solutions and Retrieval Support Contribution Program and the Interdepartmental Recovery Fund. Each recovery measure has been assigned a priority level, based on national definitions, reflecting the degree to which the measure is expected to contribute directly to the recovery of

the species, or is an essential precursor to a measure that is expected to contribute to the recovery of the species. All measures included in this action plan are considered important, and they are included because of their expected contribution toward Right Whale recovery. The definitions of the priority levels are as follows:

- "high" priority measures are considered likely to have an immediate and/or direct influence on the recovery of the species
- "medium" priority measures are important but considered to have an indirect or less immediate influence on the recovery of the species
- "low" priority measures are considered important contributions to the knowledge base about the species and mitigation of threats

Each recovery measure listed in the implementation schedule is linked to one or more of the seven recovery objectives identified in the recovery strategy (section 1.1 of this document).

The status of each recovery measure is designated as either “not started” or “underway”.

One of four timelines is assigned to each recovery measure: <2 years; 2 to 5 years; >5 years; or continuous (that is, the activity is to be carried out on an ongoing basis or every time an opportunity arises, with no fixed completion date). Timelines should be interpreted based on the publication date of the action plan. For example, a measure with an assigned timeline of <2 years may be reasonably expected to be completed within two years of the publication of the action plan.

Partners identified in tables 2 and 3 are broad groups or specific organizations that have either a known or potential role in implementation of each measure. When a specific organization is named, it is not meant to be exclusive, but rather reflects a past or future commitment to an activity of the same or similar nature.

This action plan does not present specific work planning details for each measure, but is rather meant to guide more detailed work planning processes within DFO and its partner organizations by identifying actions that may be taken to advance the recovery of the Right Whale in Canada.

The following acronyms are used in the implementation schedule (tables 1 to 3):

CCG	Canadian Coast Guard
CMARA	Canadian Marine Animal Response Alliance
CNSOPB	Canada-Nova Scotia Offshore Petroleum Board
CWI	Canadian Whale Institute
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
GREMM	Group for Research and Education on Marine Mammals
IAA	Impact Assessment Act
IAAC	Impact Assessment Agency of Canada
IMO	International Maritime Organization
MARS	Marine Animal Response Society
MICS	Mingan Island Cetacean Study
MMARN	Maritime Marine Animal Response Network
NEAq	New England Aquarium
NGO	Non-government organization
OPP	Oceans Protection Plan

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ROMM	Réseau d'observation de mammifères marins
RQUMM	Réseau québécois d'urgences pour les mammifères marins
SLGO	St. Lawrence Global Observatory
TC	Transport Canada
WRS-NL	Whale Release and Strandings – Newfoundland and Labrador

Table 1. Measures to be undertaken by Fisheries and Oceans Canada.

#	Recovery measure	Priority	Recovery objective(s) addressed	Status / Timeline
1	Lead and provide administrative support to a Right Whale implementation and recovery network	Medium	6	Underway / Continuous
2	Develop and implement fishery management measures to reduce the risk of Right Whale mortality and serious injury from entanglement in fishing gear	High	2, 4, 5, 6, 7	Underway / Continuous
3	Continue and enhance the Marine Mammal Response Program to support the operation of incident response networks across Atlantic Canada	High	2, 4, 6	Underway / Continuous
4	Develop and implement robust internal protocols to facilitate effective response to Right Whale incidents and mortalities in Canadian waters, including necropsies	High	1, 2, 3, 4, 5	Underway / Continuous
5	Collaborate and coordinate with other countries on recovery planning, management, and research	Medium	6	Underway / Continuous
6	Facilitate regular meetings with internal and external scientists to coordinate field and analytical studies in Canadian waters (at least annually), and share information with interested parties	Medium	6	Underway / Continuous
7	Continue to implement the Schedule of Studies to identify and refine critical habitat as outlined in the recovery strategy	Medium	5	Underway / Continuous

Table 2. Measures to be undertaken collaboratively between Fisheries and Oceans Canada (DFO) and its partners.

#	Recovery measure	Priority	Recovery objective(s) addressed	Status / timeline	Partners (alphabetical order)
8	Develop and implement vessel traffic management measures to reduce the risk of Right Whale mortality or serious injury from ship strikes	High	1, 3, 5, 6, 7,	Underway / Continuous	DFO, Industry, NGOs, TC
9	Develop and implement acoustic monitoring and analysis programs to detect Right Whale calls/vocalizations and monitor anthropogenic noise levels in known or potential habitat areas	High	1, 2, 3, 4, 5	Underway / Continuous	Academia / DFO / TC
10	Record vocalizations, received sounds, and three-dimensional dive profiles using passive acoustic tags to monitor Right Whale behaviour	Medium	4, 5	Underway / 2 to 5 years	Academia / DFO / NGOs
11	Develop and implement visual surveillance programs (vessel-based and aerial) to detect Right Whales	High	1, 2, 3, 4, 5	Underway / Continuous	CWI / DFO / ECCC / NEAq / MICS / NOAA / TC
12	Provide training on whale species identification to DFO fishery officers, CCG personnel, marine mammal observers, and other mariners; collaborate with existing programs to avoid duplication and achieve consistency	Medium	4	Underway / Continuous	Consulting companies / DFO / NGOs
13	Promote regional free-swimming whale sightings phone lines and email addresses with ocean users	Low	4, 5, 7	Underway / Continuous	DFO / GREMM / ROMM / Other NGOs
14	Maintain and coordinate cetacean sightings databases	Medium	4	Underway / Continuous	CWI / Dalhousie University / DFO / GREMM / Industry / MICS / ROMM / SLGO
15	Ensure the ongoing operation and capacity of regional marine animal response organizations and networks, and 24-hour toll-free incident reporting hotlines	High	2, 4, 6	Underway / Continuous	DFO / MARS / MMARN / RQUMM / WRS-NL

#	Recovery measure	Priority	Recovery objective(s) addressed	Status / timeline	Partners (alphabetical order)
16	Produce and distribute outreach materials that promote reporting of entangled, dead, or injured whales	Low	4, 5, 7	Underway / <2 years	DFO / Response networks
17	Develop and refine Right Whale habitat suitability models to predict potential areas of occurrence	Medium	4, 5	Underway / Continuous	Academia / DFO / NGOs
18	Record broad-scale two-dimensional movements over periods of several months using safe and reliable tagging technologies to gather information on habitat use, migration, and other movement patterns	Medium	4, 5	Underway / 2 to 5 years	Academia / DFO / Industry / NGOs
19	Conduct visual health assessments of Right Whales (for example, assess body condition using photogrammetry) to monitor health trends at the individual and species level	Medium	4, 5	Underway / Continuous	Academia / DFO / NGOs / NOAA
20	Collect tissue, blow, and fecal samples to support hormonal and genetic studies of reproduction, reproductive health, nutritional state, and stress levels	Medium	4, 5	Underway / Continuous	Academia / DFO / NGOs
21	Conduct entanglement risk analyses for habitat areas where fishing activities and Right Whales co-occur, and use the resulting analyses to inform fisheries management decisions to mitigate entanglement risk; collaborate on entanglement risk analyses range-wide	High	2, 5	Underway / Continuous	Academia / DFO / Fishing industry / NGOs / NOAA
22	Explore, develop, and implement entanglement prevention and mitigation measures, including gear innovation or modified gear configurations	High	2	Underway / Continuous	DFO / Fishing industry / Provinces / NGOs / NOAA
23	Develop and implement effective gear marking and gear reporting systems	Medium	2	Underway / 2 to 5 years	DFO / Fishing industry / NOAA
24	Develop and implement protocols for retrieval, storage, analysis, and documentation of fishing gear from entangled Right Whales and coordinate with efforts range-wide	Medium	2, 5	Underway / <2 years	DFO / Fishing industry / NGOs / NOAA

#	Recovery measure	Priority	Recovery objective(s) addressed	Status / timeline	Partners (alphabetical order)
25	Examine the mechanisms of Right Whale entanglement to better inform prevention and mitigation measures	Low	2, 5	Underway / 2 to 5 years	Academia / DFO / Fishing industry / NGOs
26	Remove abandoned, lost, or otherwise discarded fishing gear (ALDFG) from Right Whale habitat to reduce risk of entanglement	High	2	Underway / Continuous	DFO / Fishing industry / NGOs
27	Conduct vessel strike risk analyses for areas where vessel traffic and Right Whales co-occur	High	1, 4	Underway / 2 to 5 years	DFO / Dalhousie University / TC
28	Improve and expand vessel-based Right Whale detection using new sensor technologies, passive acoustic monitoring, marine mammal observers, or other methods	High	1	Underway / 2 to 5 years	DFO / Industry / TC
29	Develop and implement a system for providing near real-time detection and notifications of Right Whale presence	High	1, 2, 3	Underway / 2 to 5 years	Academia / DFO / Industry / TC
30	Identify and implement measures to reduce vessel collision risk to Right Whales	High	1, 4	Underway / Continuous	DFO / IMO / TC / Shipping industry
31	Communicate proactively and regularly with mariners about management measures in place to reduce the risk of vessel strikes with Right Whales	High	1, 2, 7	Underway / Continuous	CCG (MCTS) / DFO / TC
32	Assess the impacts of anthropogenic noise on Right Whales	Medium	3, 4, 5	Underway / >5 years	Academia / DFO / Industry
33	Explore, develop, and apply noise mitigation measures to minimize impacts on Right Whales	Medium	3, 4, 5	Underway / Continuous	DFO / Industry / TC / Other regulators
34	Survey, monitor, and predict the locations of *Calanus* aggregations	High	1, 3, 4, 5	Underway / Continuous	Academia / DFO / NOAA
35	Determine and monitor contaminant levels in Right Whales and their *Calanus* prey, and identify potential sources	Low	3, 4	Not started / 2 to 5 years	Academia / DFO / NGOs

#	Recovery measure	Priority	Recovery objective(s) addressed	Status / timeline	Partners (alphabetical order)
36	Enhance regulatory capacity as needed to prevent and mitigate threats to Right Whales (for example, through statutory amendments or new regulations)	Medium	1, 2, 3	Underway / 2 to 5 years	DFO / TC
37	Conduct compliance monitoring and enforcement of mandatory threat prevention and mitigation measures, and monitor conformity with voluntary measures	High	1, 2, 3, 4	Underway / Continuous	DFO / CCG (MCTS) / TC
38	Develop and distribute educational materials for ocean user groups and the public on whale identification, critical habitat, and best practices in threat prevention and mitigation	Low	7	Underway / 2 to 5 years	DFO / NGOs / TC
39	Ensure Right Whales and their habitat are considered in all relevant regulatory review processes, such as those conducted under the *Impact Assessment Act*, *Fisheries Act*, and *Species at Risk Act*	High	1, 2, 3, 4	Underway / Continuous	IAAC / DFO / CNSOPB / NGOs / Other regulators
40	Consider Right Whales and their habitat in relevant marine protected area and marine spatial planning initiatives	Medium	1, 2, 3, 6	Underway / Continuous	DFO / Other government departments / Indigenous groups / Industry stakeholders / NGOs
41	Evaluate the effectiveness of existing management/mitigation measures and adapt them to reflect emerging scientific information, risk analyses, emerging threats, and international best practices	High	1, 2, 3	Underway / Continuous	Academia / DFO / industry / NGOs / Other regulators / TC
42	Complete a population viability analysis	Low	4, 5	Underway / <2 years	DFO / NGOs / NOAA / Other government departments (U.S.)
43	Conduct scenario planning to prepare for uncertain future environmental conditions and vulnerabilities	Medium	1, 2, 3	Underway / 2 to 5 years	DFO / NOAA

#	Recovery measure	Priority	Recovery objective(s) addressed	Status / timeline	Partners (alphabetical order)
44	Explore Indigenous Traditional Knowledge on Right Whale ecology and historic and current distribution	Medium	4, 5, 6	Not started / 2 to 5 years	DFO / Indigenous groups
45	Monitor, report, and respond to pollution incidents in Right Whale habitat areas	Medium	4	Underway / Continuous	CCG / DFO / ECCC / TC / Mariners / NGOs

Table 3. Measures that represent opportunities for other jurisdictions, organizations, or individuals to lead.

#	Recovery measure	Priority	Recovery objective(s) addressed	Status / timeline	Suggested jurisdictions / organizations
46	Maintain the North Atlantic Right Whale Consortium databases, including the sightings and identification (for example, photo, genetics) databases	High	4, 5	Underway / Continuous	NEAq / University of Rhode Island
47	Assess and monitor population size, age-sex structure, and trends	Medium	4, 5	Underway / Continuous	Academia / NEAq / NOAA / NGOs
48	Monitor scarring rates as an indicator of effectiveness in preventing and mitigating entanglement	Medium	2, 5	Underway / Continuous	Academia / NEAq / NGOs
49	Increase the scope of mandatory automatic identification system (AIS) use for Canadian vessels to facilitate Right Whale vessel strike risk analyses and mitigation measures	High	1, 3, 4, 5	Underway / <2 years	TC
50	Identify, test, and implement engineering, operational, and maintenance improvements for ships to reduce noise emissions	Medium	1, 3	Underway / >5 years	IMO / TC / Marine industry
51	Develop recognition programs or other incentives for industries to take steps to reduce their threats to Right Whales, including noise, collisions and entanglements	Low	1, 3	Underway / >5 years	DFO / IMO / industry NGOs / Port authorities / TC
52	Assess the impacts of anthropogenic noise on *Calanus*	Low	5	Not started / >5 years	Academia

1.2.2 Narrative to support the implementation schedule

The implementation tables (tables 1 to 3) contain 52 recovery measures that will contribute to meeting all seven recovery objectives for the Right Whale (section 1.1). Seven of the measures are in table 1, thirty-eight are in table 2, and seven are in table 3. The majority of measures are already underway. Implementation of several measures in this action plan will also benefit other species at risk, particularly other whales and sea turtles.

Selected recovery measures are explained further in this section where additional context, history, or information was deemed useful for interpretation. The inclusion of a narrative is not meant to imply a measure is of higher priority, nor is it meant to suggest that progress is more or less advanced than it is for a measure without a narrative. The narratives below are numbered in accordance with the numbers assigned in the implementation schedule (tables 1 to 3).

1. Lead and provide administrative support to a Right Whale implementation and recovery network

The Right Whale Recovery Network has provided a forum for information-sharing, feedback, discussion, and coordination of Right Whale recovery planning and implementation beginning in 2009; it succeeded the Right Whale Recovery Team that prepared the SARA recovery strategy (Brown et al. 2009). DFO co-chairs the Network, which has included representatives from federal and provincial government departments, the U.S. National Marine Fisheries Service (NMFS), First Nations and Indigenous groups, industry stakeholders, academia, and non-government organizations. Historically, the network focused largely on the Maritimes Region, because most Right Whale observations in Canadian waters were in and near the critical habitat areas. Some Gulf of St. Lawrence partners were involved, as occasional Right Whale sightings had been made in that area in previous decades. With shifts in the species' distribution since 2015, the structure and function of the Right Whale Recovery Network needs to be revisited to include interests and expertise from across Atlantic Canada and Quebec. The Network provides a mechanism to share information with interested and affected parties about research underway and resulting information, management measures, and initiatives undertaken by industry, among other kinds of information, in support of the Government of Canada's implementation of the SARA recovery program for Right Whales. The Canadian Recovery Network also will provide a forum to liaise with the Right Whale Implementation Teams in the U.S. The terms of reference for this group will be reviewed and updated accordingly.

3. Continue and enhance the Marine Mammal Response Program to support the operation of incident response networks across Atlantic Canada

DFO is responsible for supporting marine mammals in distress, including Right Whales. Under the umbrella of the Marine Mammal Response Program (MMRP), DFO collaborates with non-government organizations across the country to respond to marine mammal incidents, including dead, entangled, or otherwise injured (for example, from ship strike) whales. In addition to providing expert care and assistance to distressed animals, these response networks provide valuable data that can be used to help quantify threats to species at risk. DFO is committed to protecting endangered whales through ongoing programs and investments that will develop and maintain internal and external response capacity, to expanding disentanglement training, and to purchasing new equipment.

4. Develop and implement robust internal protocols to facilitate effective response to Right Whale incidents and mortalities in Canadian waters, including necropsies

Clear, concise, and systematic protocols for responding to reports of Right Whale incidents or mortalities are of critical importance. These protocols must identify all relevant contacts (internal and external), areas of expertise (for example, carcass drift analysis), and the availability and location of material assets (for example, vessels, satellite tags, specialized disentanglement equipment) that may be needed to respond. Roles and responsibilities must be clear, as should the lines of communication. Procedures for mobilizing resources and funding should be included. Response and necropsy protocols must be robust to changing scenarios (for example, response after-hours or on the weekend; equipment failure; inclement weather). Necessary training for affected DFO staff (for example, fishery officers, marine mammal coordinators) should be standardized, tracked, and regularly refreshed, with consideration given to training in Incident Command System principles. Cross-region jurisdictional cooperation and collaboration is needed, and common protocols should be adopted. Internal DFO response protocols should complement those used by external response networks. Significant progress has been made on internal protocol development and implementation since 2017, and is continuing (see DFO 2018b). These protocols support effective, timely, and safe response to marine mammal incidents and include regular collaboration between DFO and external partners.

When logistically and financially feasible, necropsies will be conducted on all deceased Right Whales in Canada regardless of the condition of the carcass. Valuable information can be gleaned from even highly decomposed individuals (see Moore et al. 2013; Sharp et al. 2019). Post-mortem examinations are the sole means of determining cause of death, and provide important information on population ecology and injuries. The results can help evaluate the effectiveness of management measures (see van der Hoop et al. 2015a). DFO will continue to work with expert response partners to establish and implement an incident response protocol that includes considerations such as suitable necropsy and disposal sites, the consistent application of existing sampling protocols (such as those used in the U.S., as seen in McLellan et al. 2004), sample storage, supply and equipment needs, and logistics. Collaboration with experienced partner organizations is vital to the success of necropsies. Identifying and following clear pathways of communication when incidents occur will support efficient and effective response to all incidents.

All protocols should be understood and accepted by affected DFO staff and external response partners. Response information should be consolidated into as few documents as possible, for consistency of approach, and reviewed on a regular basis.

5. Collaborate and coordinate with other countries on recovery planning, management, and research

DFO collaborates with the U.S. government, through several initiatives. The Canada-U.S. Transboundary Resources Steering Committee meets biannually to discuss integrated ecosystem management issues associated with the Gulf of Maine and Georges Bank. The Committee includes a Species at Risk Working Group that focuses on research and management initiatives related to transboundary species such as the Right Whale throughout its Canadian and U.S. range. In 2017, the U.S. and Canada Bilateral Cetacean Working Group was formed to increase coordination and collaboration on cross-border whale conservation issues, with an immediate focus on Right Whales.

DFO and U.S. National Marine Fisheries Service (NMFS) staff participate on each country's Right Whale recovery teams, scientific working groups, and other initiatives to share information and collaborate on projects. In 2020, Transport Canada (TC) joined DFO on the U.S. North East Implementation Team (NEIT), a multi-disciplinary advisory team that assists NOAA with the implementation of the North Atlantic Right Whale recovery plan.

Canada also shares a maritime border with Saint-Pierre and Miquelon, an overseas collectivity of France located off southern Newfoundland. DFO will continue to work with its counterpart department in Saint-Pierre and Miquelon to advance Right Whale recovery and monitoring.

The Government of Canada shares information and collaborates with international partners through the North Atlantic Right Whale Consortium. The consortium meets annually and includes more than 200 members from the U.S. and Canadian governments, academia, non-government organizations, and industry. DFO and TC will continue to participate in these and other collaborative bodies, as appropriate, to support Right Whale recovery.

6. Facilitate regular meetings with internal and external scientists to coordinate field and analytical studies in Canadian waters (at least annually), and share information with interested parties

Each year, DFO science staff host a coordination session for research organizations planning to undertake fieldwork on Right Whales in Canadian waters. Because collaboration is a vital part of Right Whale research, this provides an opportunity for information sharing about the timing and location of vessel- and aircraft-based projects, and how collaboration can be optimized. It supports collaboration among organizations undertaking sampling and analysis of live and dead Right Whales, helping ensure that collected data and samples are shared and distributed effectively, thus building understanding of the species' health, genetics and population structure.

7. Continue to implement the Schedule of Studies to identify and refine critical habitat as outlined in the recovery strategy

Roseway Basin and the Grand Manan Basin were identified as Right Whale critical habitat in the recovery strategy (Brown et al. 2009; DFO 2014) based on their features and attributes that support Right Whale functions of foraging, socializing, and calf-rearing. Right Whales were known to shift their relative use of these two areas over periods of several years, as prey availability changed (reviewed in DFO 2007).

When the identification of critical habitat for a species is not considered complete, SARA recovery strategies include a Schedule of Studies to outline the research needed to adequately identify critical habitat, including studies needed to refine existing critical habitat. The Schedule of Studies for Right Whale critical habitat includes an evaluation of their use of the Gaspé area in the Gulf of St. Lawrence, where sightings and acoustic data indicated the presence of Right Whales (Brown et al. 2009, DFO 2014). Since 2010, Right Whales have shifted their distribution in Canadian waters, appearing in greater numbers in the Gulf annually since 2015 (DFO 2019). The most likely reason for this is a change in the abundance and availability of their prey. Right Whale mother-calf pairs were seen in the Gulf in the summers of 2015, 2016, and 2019. Further studies are necessary to help understand whether this pattern of habitat use by Right Whales in the Gulf reflects the presence of characteristics that would be identified as critical habitat. Any future changes or additions to identified critical habitat, in the Gulf of St. Lawrence or elsewhere, would be made through an amendment to the recovery strategy.

9. Develop and implement acoustic monitoring and analysis programs to detect Right Whale calls/vocalizations and monitor anthropogenic noise levels in known or potential habitat areas

Acoustic detection of distinctive Right Whale calls is being used increasingly to infer the species' spatial and temporal distribution (see Durette-Morin et al. 2020). These acoustic monitoring methods have several advantages that complement visual surveillance efforts (recovery measure #9). Acoustic recorders also are used to monitor anthropogenic noise sources and levels in the marine environment.

The OPP includes a commitment to better understand and address the cumulative effects of shipping noise on marine mammals, including Right Whales, in Canada. DFO has developed a research plan that includes establishing a noise baseline and enhancing knowledge of the species' seasonal occurrence off eastern Canada using acoustic detection and other methods. The research program is building and expanding upon previous acoustic monitoring efforts, which have included bottom-mounted passive acoustic monitoring (PAM) systems and Slocum gliders equipped with near real-time acoustic sensors. All acoustic recordings collected will be analyzed for Right Whale calls. Currently, acoustic monitoring technologies can detect the presence of calling whales only; however, means of counting individual whales using acoustic techniques is also being explored outside of the OPP research program. In addition to monitoring the spatiotemporal occurrence of Right Whales, the soundscape (ambient noise plus anthropogenic contributions) in select known or highly suitable habitat areas will be measured, analyzed, and modelled. The initial focus of this work is on characterizing shipping noise, with an examination of other noise sources (for example, seismic surveys, sonar) to follow. These data layers and modelling tools are necessary to study the impact of noise on the species.

11. Develop and implement visual surveillance programs (vessel-based and aerial) to detect Right Whales

Visual surveillance from aircraft and vessels is used to monitor the location, abundance, and distribution of Right Whales throughout Atlantic Canada, including in special management zones, as well as to detect entangled, injured, and dead whales. The data collected can help answer research questions and inform management decisions such as fishery closures or vessel speed reductions. An effective visual surveillance program requires trained marine mammal observers and consistent data collection protocols. Each type of survey platform and survey design has strengths and weaknesses, suited to address different needs. Survey methods and coverage (spatial and temporal) should be designed to meet multiple objectives and information needs (DFO 2019).

Since 2017, visual surveillance efforts for Right Whales in Canada have increased significantly and become more coordinated. These efforts include dedicated whale surveys and collection of sightings from opportunistic platforms (for example, Canadian Coast Guard vessels, research vessels, DFO Conservation and Protection vessels and aircraft), which leverage the expertise and resources of multiple partner organizations. In addition to traditional aircraft, Transport Canada has also tested and evaluated the use of Remotely Piloted Aircraft Systems (RPAS) to support Right Whale monitoring efforts in the Gulf of St. Lawrence. Ongoing maintenance and capacity-building within the visual surveillance program is required. Other methods of detection, such as remote sensing, is also being explored.

14. Maintain and coordinate cetacean sightings databases

Ongoing maintenance, enhancement, and coordination of cetacean sightings databases is needed to ensure comprehensive and reliable sources of Right Whale data in Atlantic Canadian waters. There are currently three regional DFO databases, as well as several databases maintained by non-government organizations and academic institutions, that include systematic and opportunistic observations from multiple sources, such as DFO Conservation and Protection officers, fisheries observers, marine mammal observers, research scientists, and other mariners (for instance, through the free Whale Alert mobile phone app). Right Whale sightings are entered into WhaleMap, a web-based application managed by Dalhousie University that displays integrated Right Whale observation data from all sources in Canadian waters. A system for consolidating and standardizing diverse data streams into a centralized, national cetacean sightings database is needed, as are standard operating procedures for establishing formal data sharing agreements, and dedicated financial support for its maintenance.

15. Ensure the ongoing operation and capacity of regional marine animal response organizations and networks, and 24-hour toll-free incident reporting hotlines

Several marine mammal response organizations operate in eastern Canada, and while their regional roles and capacities vary, they coordinate with each other and work with DFO staff to respond appropriately to incidents including Right Whale entanglements and deaths. In addition to individual organizations, broader networks at the regional and national levels help coordinate activities, share information and educational materials, and support capacity-building. This collaboration supports consistent, timely responses to deaths and entanglements of Right Whales and other large whale species, which is important for understanding the causes of such incidents and ultimately trying to prevent them. Continuing support for response organizations and their participation in broader coordinating networks including the Canadian Marine Animal Response Alliance (CMARA) will help ensure that information derived from response to Right Whale incidents will contribute to ongoing research and measures to protect Right Whales.

17. Develop and refine Right Whale habitat suitability models to predict potential areas of occurrence

Habitat suitability models (HSMs) are statistical tools used to evaluate the relationship between species occurrence and oceanographic, ecological, or other environmental variables, and can be developed in specific ecosystems for cetacean species with limited distribution data (Redfern et al. 2006; Redfern et al. 2017). HSM outputs can help predict habitat use over broad areas and can support management measures. They are valuable tools in data-poor areas; for example, when whale density data is not available, an HSM can provide insight into where whales might be expected to aggregate. Gómez-Salazar and Moors-Murphy (2014) explored HSM methods to predict cetacean distribution on the Scotian Shelf using opportunistic sightings data. At the time, there were insufficient copepod data available to complete HSMs for Right Whale. Gomez et al. (2017) described an HSM method that was used to build an initial Right Whale HSM (Vanderlaan et al. 2020a), which integrated new prey data layers. Ongoing refinement of the HSM will be required as more data becomes available. HSM modelling in Atlantic Canada is currently limited to water depths greater than 50 metres due to a lack of inshore sightings and environmental data. An exploration of how these data gaps could be filled is required to determine Right Whale habitat suitability close to shore.

18. Record broad-scale two-dimensional movements over periods of several months using safe and reliable tagging technologies to gather information on habitat use, migration, and other movement patterns

Right Whales are highly migratory, and different demographic components of the population (for example, reproductive females, adult males, and juveniles) use different habitat areas at different times of year. While several critical habitat areas have been identified in the U.S. and Canada, the migratory pathways between them are not well known, and the whales' use of additional habitat areas is poorly understood. Understanding the movements, migratory pathways, and locations of Right Whales would be valuable for monitoring the species, understanding threats to them, and refining management measures to protect them.

Right Whales' anatomy and behaviour make the successful deployment of long-term tags to monitor the species' movements and migration a challenge. They lack a dorsal fin (which is an attachment point for tags on other cetacean species), and their highly tactile behaviour dislodges external tags fairly quickly. Implanted tags have been used, but the use of some of the most invasive models have been discontinued due to concerns about Right Whale health.

As technology continues to improve, the development and application of safe and reliable tracking technologies could provide longer term information about their foraging behaviour, vulnerability to ship strike and entanglement, as well as on their larger-scale movements and migration pathways.

19. Conduct visual health assessments of Right Whales (for example, assess body condition using photogrammetry) to monitor health trends at the individual and species level,

and

20. Collect tissue, blow, and fecal samples to support hormonal and genetic studies of reproduction, reproductive health, nutritional state, and stress levels

Many organizations based in Canada, the U.S., and elsewhere conduct research on Right Whales in Canadian waters, including studies to understand Right Whale health and rates of injury and mortality. This work supports several of the recovery objectives in the SARA Right Whale recovery strategy, and is necessary for measures such as 39, to evaluate the effectiveness of management measures designed to reduce risk to Right Whales. Organizations undertaking this work include universities, other research organizations, government scientists, and non-profit organizations including response organizations. All participate in the North Atlantic Right Whale Consortium (NARWC), an informal body that manages and shares data and facilitates collaboration.

21. Conduct entanglement risk analyses for habitat areas where fishing activities and Right Whales co-occur

To quantify and assess the risk to Right Whales from fishing gear entanglement, information is needed on (1) fishing gear types, configurations, and locations; (2) Right Whale distribution, density, movements and behaviour; and (3) gear types previously implicated in Right Whale entanglements. The above information is currently sparse for much of the species' range in Atlantic Canada. Some initial risk analyses have been completed (see Vanderlaan et al. 2011; Brillant et al. 2017; Vanderlaan et al. 2020b); however, more comprehensive analyses are

required. Inadequate Right Whale density data is currently the greatest barrier preventing broader analysis. Increased aerial and vessel-based survey effort, as well as acoustic monitoring, will contribute to filling these data gaps. In the longer term, understanding Right Whale behaviour including feeding behaviour, social interactions, mating and calf-rearing, in different areas and conditions, may help refine entanglement risk analyses. In the interim, an effort is underway to estimate entanglement risk across Atlantic Canada using a habitat suitability model in lieu of Right Whale density. Information on gear configurations is being gathered in the Maritimes Region through consultations with the fishing industry. Requiring gear marking (recovery measure #21) also could help inform the evaluation of relative risk across fisheries and possible mitigation measures.

Entanglement risk analyses should be repeated or updated as new information becomes available, or when there are significant shifts in Right Whale distribution, foraging habitat, and/or fishing effort. This work should coordinate with comparable efforts elsewhere in Right Whales' range, especially the northeast U.S.

22. Explore, develop, and implement entanglement prevention and mitigation measures, including gear innovation or modified gear configurations

Several measures can be taken to prevent (that is, stop from happening) or mitigate (that is, make less severe) Right Whale entanglements. These include enacting spatiotemporal fishery closures (static, seasonal or dynamic), adjusting fishing seasons, and modifying fishing gear configurations to reduce the amount of line in the water column (for example, more traps per trawl, reduced surface floating rope, sinking groundlines, ropeless gear) or reduce the severity of entanglement (for example, lower breaking strength ropes; Knowlton et al. 2015). Removal of vertical and floating surface lines from habitat areas when Right Whales are present is expected to be the most effective way to reduce risk (DFO 2017). Greater understanding of the potential risk of groundlines and lines in the vertical column also will be an important step in reducing entanglement risk (see Brillant and Trippel 2010; Hamilton and Kraus 2019), and measures in place in some fisheries in 2018 and 2019 reflected this by limiting the amount of groundline between traps in a trawl.

For dynamic management areas, the regulating authority establishes the criteria that will trigger a management response, and the size and location of the areas to be managed (for example DFO in the case of fisheries closures, or TC in the case of vessel speed restrictions; see recovery measure #28). This decision considers science advice, capacity, and risk tolerance levels. In 2018 and 2019, the whale density 'trigger' for closures (that is, one whale, three whales, or mother-calf pairs) was based on visual detections of Right Whales within a defined area and time (Ratelle et al. 2020). Acoustic detection triggers also should be explored, where similar certainty about the range of Right Whale presence can be demonstrated.

Dynamic management based on visual detections brings challenges that include weather conditions that limit or prevent visual surveillance, removing gear from the water safely and quickly, and movement of detected Right Whales out of the detection area. Both visual and acoustic detection methods have limitations, and combining them to support management measures may increase detection probability, as well as monitoring effectiveness and efficiency. Acoustic detection triggers should be considered, recognizing their limitations and strengths.

DFO introduced several new prevention and mitigation measures in 2018 to address Right Whale entanglement. These measures included, but were not limited to, a static closure area (that is, for the duration of the fishing season) in the southern Gulf of St. Lawrence for non-

tended fixed gear fisheries, dynamic closure protocols in the Gulf of St. Lawrence and the two critical habitat areas, a reduction in floating rope, mandatory reporting of lost gear, and mandatory reporting of accidental contact between a whale and fishing gear or a vessel. Entanglement risk reduction measures will continue to evolve with input from the scientific community and fishing industry, as well as with technological advancements. Design and testing of gear technology to reduce the risk of whale entanglement, including “ropeless” fishing gear, are underway in both the U.S. and Canada (see Myers et al. 2019). Several organizations, representing different fisheries and fishing areas, have received government funding to conduct pilot studies on the feasibility of innovative gear technologies such as ropeless and rope-on-demand gear technologies.

DFO is continuing to work with partners to identify and implement a combination of management approaches and fishing practices that maximize Right Whale recovery while minimizing potential socioeconomic impacts. The Department has undertaken multiple engagement sessions with the fishing industry on protecting Right Whales from entanglement, including roundtable meetings held in November 2017, October 2018, and November 2019. In addition, CSAS processes were held in fall 2018 and 2019 to review Right Whale information (include references/dates). This advice was then used to inform the development of management measures to be implemented during the 2019 and 2020 fishing seasons. (DFO 2019. Ongoing collaboration and consultation are needed to arrive at ecologically and economically sustainable solutions.

DFO will continue to engage provincial governments in the development and implementation of measures to reduce entanglement risk. Joint federal-provincial funding programs are in place that support innovation by industry and researchers, and provincial fishery departments have an important role in liaising with and supporting the fishing sector as well as other sectors that may be affected by measures, such as the tourism and transport industries. A gear innovation summit in February 2020 brought together government, Indigenous groups, and stakeholders to share information and discuss how to reduce the risk of Right Whale entanglement in fishing gear.

23. Develop and implement effective gear marking and gear reporting systems

Gear marking (for example, distinctive colour markings unique to individual fisheries) is used to trace the type of gear, origin, ownership, and/or position of fishing gear (He and Suuronen 2018). If effectively and widely implemented, a gear marking system would help maximize the learning potential from Right Whale entanglements across their range. This knowledge would help refine threat assessments and design better prevention and mitigation measures. In July 2018, the Food and Agriculture Organization (FAO) Committee on Fisheries endorsed the “Voluntary Guidelines on the Marking of Fishing Gear” (FAO 2018), which will be an important resource as Canada expands its gear marking systems. A coordinated approach across jurisdictional regions is needed. NOAA’s Atlantic Large Whale Take Reduction Team (ALWTRT), which currently includes a Weak Rope and Gear Marking Subgroup, has been implementing gear marking for several years (ALWTRT 2018). Gear marking regimes (specifically, sequential buoy numbering and coloured rope) were implemented in certain Atlantic Canadian fisheries in 2018 and are being explored in others, with DFO committed to requiring sequentially-marked buoys and fishery-specific gear marking for all fixed-gear fisheries by 2020. Because the origin of most Right Whale entanglements remains a mystery, effective gear marking will involve methods whereby the rope retains the marking, such that it is identifiable if it becomes part of an entanglement. This includes the durability of the marking

materials, and adequate quantity and placement of marks such that they will be retained if only part of the rope becomes involved in an entanglement.

Standardized gear reporting requirements (that is, information on when, where, and how much gear is being set) would facilitate more accurate entanglement risk assessments. High resolution locational data for all fisheries, rather than low resolution reporting polygons, are needed.

24. Develop and implement protocols for retrieval, storage, analysis, and documentation of fishing gear from entangled Right Whales and coordinate with efforts range-wide.

Fishing gear should be retrieved from entangled Right Whales in all cases when it is safe to do so, using standardized protocols. Retrieval and transport of the fishing gear must follow a chain of custody protocol that needs to be established and implemented throughout Atlantic Canada and Quebec. As soon as possible following retrieval of the gear by DFO Fishery Officers or DFO-authorized response organizations, ideally within 1 to 2 days, an initial examination should be conducted, including labelling and documentation of the gear. A dedicated storage space is required, meeting specifications (for example, temperature, and humidity) needed to preserve the gear for future analysis. A systematic cataloging protocol for the retrieved gear must also be developed. This work should be undertaken in close collaboration between DFO, response groups, and other relevant partners. NOAA has extensive experience in these areas and will continue to be a valuable partner as the Canadian protocols evolve. Because Right Whales are a transboundary species that transport gear across borders, the adoption of common procedures in both countries is optimal for maximizing efficiencies, data collection, and analysis.

Careful analysis of retrieved fishing gear is of critical importance to determine the type of gear and where it came from, how the entanglement occurred, and how future entanglements can be prevented (see Johnson et al. 2005; van der Hoop et al. 2015b). A multi-stakeholder working group, coordinated by DFO, consisting of whale scientists, fish harvesters, and other technical experts should be formed to examine fishing gear retrieved from entanglements occurring in Canada or suspected to be of Canadian origin. Collaboration with the U.S. is needed to enhance range-wide understanding of the entanglement threat and techniques to reduce it. Once an analysis is completed, a standardized report should be prepared and submitted to a centralized database.

25. Examine the mechanisms of Right Whale entanglement to better inform prevention and mitigation measures

Little is known about how Right Whales become entangled in fishing gear, including the specific behavioural factors that lead to wraps around the head, mouth, body, pectoral fins, tail, or some combination thereof. Howle et al. (2018) developed an interactive entanglement simulator to help determine the mechanisms of Right Whale entanglements. This tool was designed to reverse engineer entanglements and model the effects of new or modified gear types on the rate and severity of entanglements.

Gear marking (recovery measure #21) may contribute to understanding the mechanisms and relative risk of entanglement in certain fisheries and, when feasible, specific gear components (for example, endlines versus groundlines). This could help determine, for example, which elements of the fishing gear configuration pose most risk to Right Whales in a given area, and how best to mitigate these risks.

The factors influencing gear behaviour in certain oceanographic conditions have been studied in the past (see Brillant and Trippel 2010). Additional studies of this nature, as well as more information on the specific gear configurations used in Atlantic Canada, could further refine entanglement risk assessments and entanglement simulations.

26. Remove abandoned, lost, or otherwise discarded fishing gear (ALDFG) from Right Whale habitat areas to reduce risk of entanglement

While data suggest that known Right Whale entanglements have occurred in actively fished gear and not “ghost gear” (see Johnson et al. 2005, Asmutis-Silvia 2017, Henry et al. 2017), the removal of abandoned and lost fishing gear is an important component of removing debris and rope from Atlantic Canadian waters. DFO has committed to removing abandoned, lost, and discarded fishing gear from Right Whale habitat including migratory pathways, and to implementing initiatives to prevent such loss.

Canada led the development of the 2018 G7 Ocean Plastics Charter, within which signatories committed to accelerating implementation of the 2015 G7 Leaders’ Action Plan to Combat Marine Litter. That action plan included a commitment to make targeted investments to retrieve ALDFG, which includes ghost gear. An Ocean Plastic and Ghost Gear Action Plan is being developed by DFO, and will address the threat of ghost gear to marine species, such as the Right Whale. The Government of Canada is a participant in the Global Ghost Gear Initiative (GGGI). The Fundy North Fishermen’s Association, also a GGGI participant, has been retrieving ALDFG from the Bay of Fundy for several years. The Sustainable Fisheries Solutions and Retrieval Support Contribution Program will support industry in preventing fishery-related debris from entering the water, and in removing lost gear from the water.

An expansion of mandatory reporting of lost gear to DFO was recently implemented through conditions of licence for commercial fish harvesters. Timely reporting of lost gear increases the chances of re-location and retrieval before it can impact marine wildlife (for example, through entanglement). Reporting of retrieved gear that was previously reported lost will help estimate the amount of gear lost by the commercial fishing industry each year.

27. Conduct vessel strike risk analyses for areas where vessel traffic and Right Whales co-occur

Work is underway to evaluate the relative probabilities of vessel-whale encounters, and the likely lethality of those encounters, in the Gulf of St. Lawrence (Carr et al. 2020). This builds upon a similar study focused on the Bay of Fundy and Roseway Basin areas (Vanderlaan et al. 2008). Analyses will be completed using Automatic Identification System (AIS), Vessel Monitoring System (VMS), and Right Whale sightings data. Vessel strike risk in the Gulf of St. Lawrence will be compared to the risk in the Bay of Fundy and Roseway Basin, where critical habitat is identified for the species. Past and potential risk reduction strategies (for example, speed restrictions, re-routeing) will be evaluated and modelled to determine how effective they are in reducing the likelihood of (lethal) encounters. The frequency with which additional vessel strike risk analyses are completed will depend on shifts in whale distribution and/or vessel traffic patterns.

29. Develop and implement a system for providing near real-time detection and notifications of Right Whale presence

Near real-time (that is, within hours to days) detection and communication of Right Whale sightings can help inform decisions about dynamic threat prevention or mitigation measures. Continued development of near real-time detection capabilities within Atlantic Canadian waters, as well as the means of communicating that information to mariners is needed. This could play an important role in measures to reduce the risk of a lethal vessel strike (recovery measure #28), as well as increase vigilance among fish harvesters and other resource users conducting work in the marine environment. Priority areas for real-time detection should be those where Right Whales and human activities are known to co-occur.

Near real-time detection methods currently in use off eastern Canada include visual detection from various platforms and sources (for example, aerial surveys, vessel-based surveys, opportunistically-reported sightings) and acoustic detections from autonomous ocean gliders. The Whales, Habitat and Listening Experiment (WHaLE) project, part of the Marine Environmental Observation Prediction and Response (MEOPAR) Network, uses several autonomous Slocum gliders equipped with passive acoustic recorders that can detect Right Whale vocalizations and transmit detection data via satellite to a shore-based lab in near real-time, where they are validated. Under OPP, other real-time detection technologies are being tested by DFO and partners, including acoustic buoys and shore-cabled systems, as well as drones equipped with video cameras.

The WHaLE project is also working on developing, testing, and implementing a near real-time whale alert system to transfer information about Right Whale detections to mariners. Reimer et al. (2016) engaged the commercial shipping industry to determine their preferred communication format for receiving whale alerts. The majority of respondents preferred to receive communications via Navigational Telex (NAVTEX)[2] or Automatic Identification System (AIS). The latter option is more conducive to near real-time notifications in the commercial shipping industry, and plans are in place to test a whale alert system using an aid to navigation (AtoN) transceiver that would send the alerts as AIS messages. Other tools provide public access to verified Right Whale visual and acoustic detections in near real-time, such as WhaleMap (recovery measure #12).

30. Identify and implement measures to reduce vessel strike risk to Right Whales

A number of measures have been implemented within Canadian waters to reduce the risk of vessel strikes on Right Whales. All opportunities to reduce the risk of lethal encounters should be assessed. The measures taken to date fall broadly into two categories and align with those taken in other jurisdictions (see Leaper and Calderan 2015): (1) vessel re-routeing to avoid co-occurrence with whales and (2) vessel speed reductions.

Vessel re-routeing may be accomplished in a variety of ways, including measures implemented through the International Maritime Organization (IMO) (Silber et al. 2012). For example, the Bay of Fundy Traffic Separation Scheme was amended in 2002 to reduce the probability of interactions between ships and Right Whales. For similar reasons, the Roseway Basin Area to Be Avoided (ATBA) was adopted by the IMO in 2007 as a voluntary routeing measure. Adoption

[2] An automated direct-printing service used to deliver warnings, forecasts, and urgent marine safety information to ships.

of IMO-measures such as these takes time, usually more than five years. For example, alteration of traffic separation schemes in the Gulf of St. Lawrence would require extensive risk assessment before action would be considered. In the meantime, other voluntary options could be considered, such as recommended routes to avoid Right Whale aggregations.

The risk of a lethal ship strike increases with vessel speed and the probability of a vessel-whale encounter (Vanderlaan and Taggart 2007). Consequently, speed reductions to 10 knots or less in areas where whales and ships co-occur can help reduce the likelihood of lethal encounters. In 2017, 2018 and early 2019, mandatory speed restrictions for vessels over 20 metres in length were enacted in a large area of the Gulf of St. Lawrence and dynamic speed restrictions were applied to the shipping lanes north and south of Anticosti Island. In July 2019, TC expanded vessel traffic management measures to vessels greater than 13 meters in length, and increased the size of the management zones. In the U.S., NOAA established a “Final Rule Implementing Vessel Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales” that has been in effect since 2008. These regulations restrict vessel speeds in certain areas, and at certain times of the year, to 10 knots or less for vessels greater than 20 metres in length.

Improvements in the near real-time detection and communication of Right Whale sightings will allow for greater preparedness among mariners and managing authorities to make real-time management measures feasible. TC will work with the shipping industry to determine what is expected of vessels when they receive an alert about Right Whale detections outside of pre-defined management areas.

31. Communicate proactively and regularly with mariners about management measures in place to reduce the risk of vessel strikes with Right Whales

The Canadian Coast Guard’s (CCG) Marine Communications and Traffic Services (MCTS) are responsible for screening vessels entering Canadian waters and delivering information to mariners, such as special management measures mandated by TC. These measures might include, for example, mandatory vessel speed reductions like those implemented since 2017 in the Gulf of St. Lawrence to protect Right Whales. Management measures are communicated to industry using a variety of mechanisms, including Notices to Mariners (NOTMARs) and Navigational Warnings[3] (NAVWARNs). Large vessels (≥20 metres length) entering Canadian waters are notified of special management zones at least twice during their journey and often three times: during their security clearance, at their mandatory check-in upon arrival in Canadian waters, and one hour prior to arrival in a special management zone. This ensures applicable management measures are repeatedly conveyed to and acknowledged by the captain in real-time. MCTS monitors compliance with management measures and forwards infractions to TC for investigation.

There is currently no real-time communication with mariners about voluntary management measures, such as the Roseway Basin Area to Be Avoided (ATBA) in effect since 2008. If requested, MCTS could explore how to promote greater conformity with the ATBA and any other voluntary management measures.

The most effective means of engaging with operators of smaller vessel types including recreational vessels on voluntary management measures should be explored and implemented.

[3] Previously referred to in Canada as NOTSHIPs (Notices to Shipping)

32. Assess the impacts of anthropogenic noise on Right Whales

In conjunction with work being completed under recovery measure #7, the impacts of shipping noise on Right Whale communication space, health (including stress responses) and behavioural responses will be investigated by DFO and partners using a combination of field measurements, modelling, and analysis methods. The near-term research priority is shipping noise, but impacts from other anthropogenic noise sources (for example, seismic surveys, sonar) also need to be considered in the longer-term.

34. Survey, monitor, and predict the locations of *Calanus* aggregations

An understanding of the factors that aggregate Right Whale prey (*Calanus* spp., that is large, energy-rich copepod zooplankton) is necessary to monitor and predict changes in the species' food supply and related distributional shifts. Right Whale foraging habitat is characterized by high concentration layers of *Calanus*. These features develop in areas where relatively high *Calanus* abundances are further concentrated through interactions between vertical migration behaviour and local ocean circulation features. Robust, reliable models and operational tools for predicting Right Whale foraging habitat are needed to inform management decisions and help prevent threats to Right Whales by anticipating changes in foraging habitat availability across Atlantic Canada. Prey forecasting ability can be improved by coupled biological-physical models of regional-scale *Calanus* population abundance levels and local-scale *Calanus* aggregation mechanisms. Field and remote sensing observations are being used to build and ground-truth coupled models (see Brennan et al. 2018), providing both estimates of the supply of prey to potential Right Whale foraging areas, and a framework to examine population responses to future environmental changes (including in the context of scenario planning as per measure 43). These models also can be used to examine changes in prey quality, that is *Calanus* size and energy content. Local-scale observations and modelling are under development to predict where interactions between *Calanus* vertical migration behaviour and circulation features are likely to generate high concentration layers of *Calanus*. The ability to forecast the distribution, abundance, energy content, and seasonal timing of *Calanus* will become increasingly important as the climate changes. Right Whale bio-energetic modelling (see Gavrilchuk et al. 2020) has been used to determine prey requirements for population growth, providing complementary information needed to assess foraging habitat suitability.

36. Enhance regulatory capacity as needed to prevent and mitigate threats to Right Whales (for example, through statutory amendments or new regulations)

Several existing laws and regulations protect Right Whales and their habitat either directly or indirectly. There may, however, be opportunities to further modernize or expand those legislative tools to provide additional flexibility and capacity. Any regulatory gaps or barriers should be identified and addressed to the extent possible.

Amendments to the *Canada Shipping Act, 2001* were introduced in the *Budget Implementation Act 2018, No.2* (Bill C-86) and received Royal Assent in December 2018. These amendments will improve marine safety and environmental protection by strengthening the Government of Canada's ability to regulate marine vessels and navigation to protect the marine environment, including protecting endangered whale populations.

An amendment to section 27 of the *Fishery (General) Regulations* is being explored that would allow more flexibility in fishing gear identification. In certain circumstances, the use of a single

tag, float, or buoy to identify a string or trawl of multiple traps would be permitted once the amendment is implemented. This amendment is meant to help reduce the number of vertical lines in the water column and is needed before commercial use of ropeless fishing gear can occur. Increased flexibility must also be built into the *Atlantic Fishery Regulations* and the *Fishery (General) Regulations* to allow for the broad retrieval of ghost gear.

In 2019, major amendments to the *Fisheries Act* were approved by Parliament. These amendments created a fisheries management order power that allows for rapid responses to urgent and unexpected threats arising during a fishery (such as during the 2017 Right Whale mortality and entanglement event).

The 2018 amendments to the *Marine Mammal Regulations* clarified what it means to disturb a marine mammal and established a mandatory general approach distance of 100 metres for cetaceans, including Right Whales.

42. Complete a population viability analysis

Population viability analysis (PVA) includes a variety of assessment methods used to estimate the persistence of a species under future condition scenarios (Gerber and González-Suárez 2010). A PVA can help increase understanding of population dynamics, threats, and the potential outcomes of different management actions on the recovery or survival of a species. In 2018, NOAA established a Population Evaluation Tool (PET) Subgroup of the North Atlantic Right Whale Recovery Plan U.S. Implementation Team. The objective of the PET subgroup, with participation from DFO Science, is to develop a population viability analysis or other assessment tool to characterize extinction risk and evaluate under what conditions the population trajectory is likely to improve. This will include the development of demographically-based recovery criteria, which can be used to derive the demographic conditions indicating the level of extinction risk, or progress toward recovery. This work is expected to be available in 2020. If and when the PVA becomes obsolete (for example, model parameters or methodologies change significantly), it should be updated or redone to support recovery planning.

43. Conduct scenario planning to prepare for uncertain future environmental conditions and vulnerabilities

Scenario planning can be used as a framework for developing resilient management decisions in the face of short- and long-term uncertainties (see Peterson et al. 2003; Rowland et al. 2014). It is an iterative process that requires periodic revisiting as new information becomes available. This tool has proven valuable in conservation planning, leading to an increased understanding of uncertainties and better preparation for surprises. This is important, especially in light of climate change. NOAA recently developed a new initiative, conducting a scenario planning exercise for Right Whales, and the Agency is preparing a summary report. DFO also will explore how scenario planning could be used for similar purposes in Atlantic Canada, and in doing so will collaborate with NOAA. DFO should link scenario planning to critical habitat studies (measure 6) and habitat suitability modeling (measure 15).

50. Identify, test, and implement engineering, operational, and maintenance improvements for ships to reduce noise emissions

Commercial vessels are a well-recognized source of underwater noise, particularly low frequency noise (Hildebrand 2009). The IMO developed voluntary guidelines to reduce noise

levels and mitigate impacts on marine life, such as whales (IMO 2014). These guidelines include general considerations for ship design (propellers, hulls, etc.), onboard machinery, refits, maintenance (for example, propeller cleaning, underwater hull surface), and operations (selection of ship speed, routeing decisions, etc.). As the organization responsible for regulating shipping in Canadian waters, TC contracted Green Marine to produce a detailed report and recommendations on the issue of underwater noise and how to address it (Nolet 2017). Recommendations included:

- initiate or collaborate on efforts to understand how noise from commercial vessels relates to ship design (length, draft, number of hulls, hull form coefficients, etc.) and to ship operation and maintenance (service speed, cavitation inception speed)
- initiate or collaborate on efforts aimed at testing recognized mitigation measures known to reduce noise from vessels, for example compare radiated noise before and after hull and propeller maintenance

TC currently manages a research program on vessel quietening to address, in part, the recommendations above. For example, TC hosted two workshops on ship noise mitigation technologies, one in November 2018 with the Canadian Network for Innovative Shipbuilding, Marine Research and Training (CISMaRT), and one in January 2019 at IMO headquarters in London, UK.

The amendments to the *Canada Shipping Act, 2001* (see recovery measure #34) clarify and strengthen the Government of Canada's authority to make regulations concerning the design, construction, manufacture, and maintenance of vessels for the purpose of protecting the marine environment. While Canada can set design and construction requirements for Canadian vessels, the prevalence of international vessel traffic in Canadian waters requires the engagement of the IMO to see broader and widespread adoption of quiet vessel design in international fleets. TC will continue to pursue work at the IMO to this end.

Green Marine encourages the shipping industry to reduce their environmental footprint by offering an environmental certification program (Green Marine 2014). Reduction of underwater noise is one of the performance indicators for this program. Over 90% of Canada's domestic fleet are members of Green Marine.

2 Critical habitat

2.1 Identification of the species' critical habitat

Critical habitat is defined in SARA as "…the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species." [s. 2(1)]

Also, SARA defines habitat for aquatic species as "… spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced." [s. 2(1)]

Critical habitat for the Right Whale is identified to the extent possible in the recovery strategy (DFO 2014), which provides details about the geographic location (that is, Grand Manan Basin and Roseway Basin) and the biophysical functions, features, and attributes. The Schedule of

Studies to refine and identify critical habitat includes: evaluating prey distribution; evaluating Right Whale use of habitat areas outside of Grand Manan and Roseway basins; and determining Right Whale migratory routes. Right Whales' shift in habitat use to the southern Gulf of St. Lawrence is reflected in the Schedule of Study's recommendation to review additional critical habitat areas. DFO and its partners are continuing to collect information to support such a review and potential identification of additional Right Whale critical habitat. Any changes or additions to identified critical habitat will occur through an amendment to the recovery strategy. Right Whale foraging habitat is dynamic in nature and would benefit from continued monitoring and potential adaptation of critical habitat over time.

2.2 Activities likely to result in the destruction of critical habitat

Examples of activities likely to result in destruction of Right Whale critical habitat are described in section 1.9.5 of the recovery strategy.

2.3 Proposed measures to protect critical habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a final recovery strategy or action plan and included in the Species at Risk Public Registry. Right Whale critical habitat is protected by a SARA Critical Habitat Order made under subsections 58(4) and (5). The Order, which came into effect in 2017, invokes the prohibition in subsection 58(1) against the destruction of the identified critical habitat.

3 Evaluation of socio-economic costs and benefits

SARA section 49(1) requires that an action plan include an evaluation of the socio-economic costs and benefits to be derived from the implementation of the action plan. This evaluation attempts to address the incremental and non-incremental socio-economic costs of implementing the action plan within Canada as well as the social and environmental benefits that would occur if the action plan were implemented in its entirety, recognizing that not all aspects of its implementation are under the jurisdiction of the federal government. It does not address cumulative costs of species recovery in general, nor does it attempt a cost-benefit analysis of such. The intent of this evaluation is to inform the public and to guide decision-making on the implementation of the action plan by DFO and its partners.

3.1 Background

In Canada, the North Atlantic Right Whale was listed in 2005 as Endangered under Schedule 1 of SARA. As such, the species benefits from legal protection and mandatory recovery requirements which are administered by DFO.

Progress toward implementing the Right Whale recovery strategy has been made possible by collaborations among governments, Indigenous groups, industry, environmental organizations, universities, and other organizations/groups. Future recovery efforts, such as those detailed in this action plan, are dependent upon continued collaboration.

3.2 Methodology

This evaluation of socio-economic costs and benefits identifies the anticipated socio-economic impacts associated with the measures listed in tables 1, 2, and 3 of this action plan. The evaluation attempts to address the costs and benefits expected to occur if the action plan is fully implemented. It is not intended to be a detailed analysis of all costs and benefits. An order-of-magnitude estimate of potential costs and benefits is provided where sufficient information is available; otherwise, a qualitative statement regarding potential impacts is provided. This evaluation examines incremental and non-incremental actions separately.

Many of the measures listed in this action plan represent a continuation of current activities or responsibilities and commitments of DFO and/or other groups into the foreseeable future (that is, designated as underway). Given these activities would continue regardless of the action plan, they are considered non-incremental to the action plan and carry no incremental costs. In addition, measures that are currently in the planning phase may carry additional, but still non-incremental, costs in the future as the measures move into the implementation phase. For this evaluation, only the costs of measures not currently in the planning phase or underway are considered incremental.

An analysis of the incremental impacts associated with the protection of Right Whale critical habitat was completed as part of the regulatory process associated with the Critical Habitat Order (see section 2.3). As such, costs and benefits associated with the identification and protection of critical habitat for the Right Whale are not considered in this evaluation.

3.3 Socio-economic costs of implementing this action plan

Underway non-incremental costs

Many measures in the action plan have been initiated before the publication of this action plan (that is, are non-incremental) by governments, Indigenous groups, industry, environmental organizations, universities, and other organizations/groups to help protect and recover the Right Whale. Although a number of these actions are known to have a high cost associated with them (for example, in excess of $1 million each annually), the costs for a variety of others are currently unknown or unquantifiable but could also be significant. The cost to Canadians for those recovery measures that are underway and quantifiable is estimated to be in excess of $10 million per year. The total cost of all recovery measures underway is assumed to be significantly higher although the specific value is unknown. In addition, there may be impacts on Indigenous people and their communities associated with some recovery measures. DFO will continue to work with Indigenous groups, partners, and industry to analyze the costs associated with ongoing and future recovery measures. These underway costs are expected to continue and remain similar for at least the short-term.

The fishing and shipping industries, and the communities they support, are believed to have been significantly impacted by measures that have been taken to protect Right Whales since 2017, including dynamic and static area closures, vessel speed reductions, and changes to fishing gear. Some of these measures may have also had impacts on Indigenous communities and their fisheries. The costs of these actions for fishing-related industries in eastern Canada have yet to be fully quantified but are anticipated to be significant. For example, it is estimated that the Quebec lobster harvesting and processing sectors lost slightly under $3 million in revenue due to restricted catches in 2018. Also, preliminary estimates for the Quebec snow

crab fishery suggest nearly $3 million in lost revenue due to unharvested quota in 2018. Marine transportation industries and dependent communities have also seen impacts as a result of measures taken in 2017, 2018 and 2019 to reduce threats to Right Whales from ship strikes. The shipping industry experienced an increase in fuel and time costs, while some communities lost tourism revenues as cruise lines cited the speed restriction measures when canceling ports of call.

Of the ongoing measures where cost estimates were available, the most significant quantified cost is related to the vessel and aerial-based surveillance activities to detect the presence of Right Whales (that is, measure 11). Implementation of this measure is estimated to have a cost exceeding $3 million annually in fuel, maintenance and staffing costs, although some costs can fluctuate greatly depending on time and resources deployed (for example, planes and boats), and the price of fuel. There are certain measures where current costs are between $500,000 and $1 million annually. Most of these measures include key field research initiatives to detect, monitor, and study the Right Whale. Examples include research undertaken to study Right Whale presence and anthropogenic noise levels through acoustic monitoring (measure 9), and utilizing passive acoustic tags to monitor Right Whale behavior (measure 10). There are a number of measures that have current costs between $50,000 and $500,000 annually, where resources are allocated to conduct essential research (for example, measure 21) and perform preventative actions, such as the removal of ghost gear to mitigate risk to Right Whales (measure 26). There are also many recovery measures associated with the duties of DFO and its partners (measures 1, 4, 15, 39, etc.) that mainly involve administrative costs of less than $50,000 per year.

Many recovery measures in the action plan that are currently underway have costs that will continue into the future. These costs are expected to remain similar to current levels. There are some measures attached to funding that is set to expire in 2023 (measures 9, 18, 37, etc.) and further funding will need to be secured for these measures to continue.

In addition, some measures will result in additional costs over the next five years. However, some of these costs are not considered incremental as they are part of measures already underway or planned (for example, measures 4 and 28). The quantified, additional, non-incremental costs are anticipated to total less than $300,000 per year.

Still other measures with additional costs are anticipated but cannot be quantified at this time. Most of these measures are underway or are in their planning and developmental phases that is, non-incremental). Some of these measures are anticipated to result in future costs for industry because they may involve further area closures, adopting new fishing gear, and gear marking by industry.

Incremental costs

Other measures will have additional costs that are considered incremental as they have not yet started (for example, measures 35, 44 and 52) and would not be undertaken in the absence of the action plan. The quantified incremental measures mainly entailing scientific research and administrative costs (for example, measures 35 and 44) are anticipated to total less than $300,000 per year. Recovery cost for measure 52 is unknown and cannot be monetized at this time.

3.4 Benefits of implementing this action plan

The overall goal of the Right Whale recovery strategy is to achieve an increasing trend in population and abundance over three Right Whale generations (or 60 years). It is expected that the implementation of this action plan would make a contribution towards achieving this goal. Recovery of the Right Whale would be facilitated by meeting the seven recovery objectives outlined in section 1.1. The measures set out in this action plan (detailed in section 1.2) support each of the recovery objectives.

Many of the benefits derived from biodiversity conservation, including the protection and recovery of species at risk, are non-market commodities that are difficult to quantify but could be significant. SARA recognizes that “wildlife, in all its forms, has value in and of itself and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological, and scientific reasons.” A review of the literature confirms that Canadians place significant value on the preservation and conservation of species in and of themselves. Actions taken to preserve a species, such as habitat protection and restoration, are also valued. In addition, the more an action contributes to the recovery of a species, the higher the value the public places on such actions (Loomis and White 1996; DFO 2008). Self-sustaining and healthy ecosystems, with their various elements in place, including species at risk, contribute positively to the livelihoods and the quality of life of all Canadians.

The conservation of species at risk is an important component of the Government of Canada’s commitment to conserving biological diversity under the international Convention on Biological Diversity. The Government of Canada has also made a commitment to protect and recover species at risk through the Accord for the Protection of Species at Risk. Implementation of this action plan will contribute to meeting these commitments.

Efforts to mitigate whale interactions may have other positive benefits, such as continued or improved access to markets requiring certain standards to be met. This includes the U.S. marketplace, given their *Marine Mammal Protection Act* requires exporting nations to demonstrate equivalent protective measures for marine mammals.

3.5 Distributional impacts

As outlined in section 1.2, implementation of this action plan will require collaboration among many organizations and groups. The action plan includes contributions from government, Indigenous groups, non-governmental organizations, industry stakeholders, universities, and others. It is also possible that new groups would become involved in future recovery efforts. Probable partners for each measure are noted in tables 2 and 3. At this time it is not possible to determine the extent to which each of these groups would contribute (financially or otherwise) to the implementation of this action plan. Likewise, precise costs and benefits to individual groups cannot be estimated.

Given that the abundance and distribution of Right Whales in Canadian waters may shift over time, the costs incurred when implementing the recovery measures in this action plan may also change. The Government of Canada will monitor the impacts of these measures as efforts continue to protect this iconic species.

4 Measuring progress

The performance indicators presented in section 2.4 of the recovery strategy provide a way to define and measure progress towards achieving the population and distribution objectives (in the case of the Right Whale recovery strategy, this is a recovery goal and supporting recovery objectives). A report on the progress of recovery strategy implementation for the period 2009-2014 has been completed (DFO 2016).

Reporting on implementation of the action plan (under section 55 of SARA) will be done by assessing progress towards the recovery objectives and strategies.

Reporting on the ecological and socio-economic impacts of the action plan (under section 55 of SARA) will be done by assessing the results of monitoring the recovery of the species and its long-term viability, and by assessing the implementation of the action plan.

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Appendix A: Effects on the environment and other species

In accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals (2010), the *Species at Risk Act* (SARA) recovery planning documents incorporate strategic environmental assessment (SEA) considerations throughout the document. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy's (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general; however, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the action plan itself, but are also summarized below.

The potential for this action plan to inadvertently lead to adverse effects on other species or the environment was considered. Such adverse effects are not anticipated. Measures taken to protect and recover the North Atlantic Right Whale, particularly those reducing vertical and floating line in the water, are expected to benefit other at-risk species, such as the Leatherback Sea Turtle. The displacement of fishing effort resulting from spatiotemporal closures will need to be monitored to ensure it does not impact the rate of interactions with Right Whales or other species outside of those areas. Implementation of the Action Plan for the North Atlantic Right Whale is expected to contribute to achieving the following 2016 to 2019 FSDS goals:

- Healthy coasts and oceans: coasts and oceans support healthy, resilient and productive ecosystems

- Healthy wildlife populations: all species have healthy and viable populations

Appendix B: Record of cooperation and consultation

An early engagement workshop was held at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia on February 23 and 24, 2011 to discuss recovery measures addressing the threat of Right Whale entanglement in fishing gear. Input from the workshop has been considered in the development of this action plan. Invitations to attend the workshop were extended to government departments, First Nations and other Indigenous groups, industry, and non-government organizations. Workshop participants included representatives from the following groups:

Acadia University
Canadian Whale Institute
Canadian Wildlife Federation
Dalhousie University
Grand Manan Fishermen's Association
Grand Manan Whale and Seabird Research Station
Fundy North Fishermen's Association
Licence holders from Lobster Fishing Areas 34 and 36
Maritime Aboriginal Peoples Council
National Oceanic and Atmospheric Administration
New England Aquarium
Saint Mary's University
South Shore Gillnet Fisherman's Association
Trent University
World Wildlife Fund Canada

A second early engagement workshop was held at the Bedford Institute of Oceanography on January 26 and 27, 2016 to discuss recovery measures addressing the following threats: vessel strikes, acoustic disturbance, and changes in food supply. Input from the workshop has been considered in the development of this action plan. Invitations to attend the workshop were once again extended to government departments, First Nations and other Indigenous groups, industry, and non-government organizations. Workshop participants included representatives from the following groups:

Canadian Association of Petroleum Producers
Canadian Coast Guard
Canada-Nova Scotia Offshore Petroleum Board
Canadian Whale Institute
Canadian Wildlife Federation
Confederacy of Mainland Mi'kmaq
Dalhousie University
Defence Research and Development Canada
Encana
Grand Manan Whale and Seabird Research Station
Green Marine
Irving Oil Limited
JASCO Applied Sciences
Maliseet Nation Conservation Council
M – Expertise Marine
Marine Animal Response Society

Maritime Aboriginal Peoples Council
National Defence Canada
Natural Resources Canada
New England Aquarium
Nova Scotia Department of Energy
Shipping Federation of Canada
Transport Canada
World Wildlife Fund Canada

In addition, targeted consultation on the draft action plan was undertaken during June through August 2019, when DFO invited First Nations, Indigenous groups, industry partners, provincial governments, the U.S. government, and academic and other experts to provide comments on the draft action plan.