Jonah and Atlantic Rock Crab

Cancer borealis, Cancer irroratus

Canada: Northwest Atlantic

Pots

Report ID 661

September 6, 2022

Seafood Watch Standard used in this assessment: Fisheries Standard v3

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered, or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function, or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard.Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught, farmed or managed.

Avoid/Red: Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report provides analysis and recommendations for Jonah crab (*Cancer borealis*) and Atlantic rock crab (*Cancer irroratus*) in the Canadian Northwest Atlantic Maritime Provinces and in the Scotia-Fundy, Gulf, and Quebec regions. Both species are exclusively harvested with trap/pot gear that is landed in direct fisheries and as by-catch in the Canadian American lobster fishery.

There are no biological reference points or reference points for fishing mortality for either *Cancer* species, both of which are considered moderately vulnerable. Due to the uncertainty regarding abundance and fishing mortality, impacts on each species are considered a moderate conservation concern.

Traps used in commercial crab fisheries are highly selective; however, data are lacking on the nature and quantity of by-catch. There is little information on discards and mortality for the crab fisheries, but overall mortality rates are considered low compared to other gear types. Of greatest concern are the interactions between the fisheries' gear and potential entanglement with endangered leatherback turtle and North Atlantic right whale; these interactions drive the low rating for impacts on other species.

Fishery management strategy incorporates effort controls and size and sex restrictions. There are concerns regarding the lack of data (fishery-independent data to determine abundance and fishing mortality levels in relation to reference points, and by-catch composition information). Though by-catch in lobster fisheries is relatively low, a number of species at risk are likely caught. In particular, although there are no known interactions between rock crab, Jonah crab, or lobster fisheries in Canada, the impact of fisheries on North Atlantic right whale far exceeds the potential biological removal for the species and is dominated by impacts from unknown fisheries, of which Canadian crab and lobster fisheries may be a part. Therefore, by-catch management is considered ineffective at reducing the impact of fishing on nontarget species.

Jonah and Atlantic rock crabs are fished with trap gear, which have a moderate to low impact on benthic habitats. The impact of fisheries on seabed habitats is managed through the Sensitive Benthic Areas policy. Impacts on the habitat and ecosystem are considered a moderate concern because more research is required to understand ecosystem dynamics.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Atlantic rock crab | Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence	2.644	1.000	1.000	3.000	**Avoid (1.678)**
Atlantic rock crab | Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence	2.644	1.000	1.000	3.000	**Avoid (1.678)**
Jonah crab | Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy	2.644	1.000	1.000	3.000	**Avoid (1.678)**
Jonah crab | Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine	2.644	1.000	1.000	3.000	**Avoid (1.678)**

Summary

Fisheries for Jonah crab and Atlantic rock crab in Canada are rated an Avoid because of the high risk these fisheries pose to endangered and threatened species, specifically the North Atlantic right whale, and the ineffectiveness of management measures to reduce the impact of fisheries to a level that will allow recovery of the species.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

Best Choice/Green = Final Score >3.2, and no Red Criteria, and no Critical scores

Good Alternative/Yellow = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores

Avoid/Red = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report provides analysis and recommendations for Jonah crab (*Cancer borealis*) and Atlantic rock crab (*Cancer irroratus*) in the Canadian Northwest Atlantic Maritime Provinces and in the Scotia-Fundy, Gulf, and Quebec regions. Both species are exclusively harvested with trap/pot gear that is landed in direct fisheries and as by-catch in the Canadian American lobster fishery.

Species Overview

Jonah crab (*C. borealis*) and Atlantic rock crab (*C. irroratus*) have been landed as by-catch in American lobster (*Homarus americanus*) fisheries and in intermittent directed fisheries in the Canadian Maritime Provinces since the 1960s {Robichaud & Frail 2006}. In the southern Gulf of St. Lawrence, Atlantic rock crab has been harvested since the 1960s as by-catch in the lobster fishery, and then in a directed fishery that was established in 1974 (Rondeau et al. 2014).

Jonah crab and Atlantic rock crab are native to the North Atlantic coast of North America, ranging from Newfoundland to Florida {Robichaud & Frail 2006}. Populations of both species were discovered in 2006 in Iceland, most likely transported there as invasive species from ballast water, and have since reproduced and expanded in the region, but commercial fisheries have yet to be established (Gíslason et al. 2013). Though physically similar, the two species differ in size and preferred habitats (Reardon 2006). Jonah crab is larger than Atlantic rock crab and more commonly found at depths from nearshore to 300 m and up to 800 m {Robichaud & Frail 2006}. Atlantic rock crab is smaller and distributed in shallower inshore waters ranging from 6 to 456 m (Stehlik et al. 1991), most commonly at depths of less than 20 m (Krouse 1980)(Robichaud et al. 2000). In the southern Gulf of St. Lawrence, male Atlantic rock crab mature at a size of 48.8 mm carapace width (CW) (50% maturity) (Rondeau et al. 2014).

The Jonah and Atlantic rock crab fisheries are managed by Canada's Department of Fisheries and Oceans (DFO) currently under the 2016 Integrated Fishery Management Plan (IFMP) for Offshore Lobster and Jonah crab and the 2011 inshore lobster IFMP (DFO 2011)(DFO 2016) (see Table 1 for commercial fishing regions/areas and Figure 1 for map of Lobster Fishing Areas [LFAs]). Management regulations for the directed fisheries include minimum size limits, no take of females, limited entry, fishing area closures, trap limits, and catch limits (total allowable catch [TAC] and individual transferable quotas [ITQ]) (regulations vary by region; see Criterion 3.1 for details). The bait and by-catch crab fishery is regulated through the lobster IFMP and reporting is required through lobster fishery logbooks. As a condition of the lobster license, no person shall use rock crab smaller than 102 mm CW as bait (DFO 2020k)(DFO 2022d). Fishers with a valid lobster license are allowed to land male Atlantic rock crab in all LFAs for sale, they can use male rock crab with a minimum carapace width of 102 mm as bait, and male Jonah crab may be landed and sold or used as bait in LFAs 34–38 {Robichaud and Frail 2006}. In the southern Gulf of St. Lawrence and Scotia-Fundy regions, the directed rock crab fishery occurs in a different season than the lobster fishery from which rock crab are retained as bait and by-catch (DFO 2013).

Table 1: Canadian commercial fisheries regions for Jonah and Atlantic rock crabs			

Region/Fishing Area	Jonah Crab	Atlantic Rock Crab	Body of Water
Scotia-Fundy (LFAs 34–38)	Directed, by-catch	By-catch	Southwest Nova Scotia & Bay of Fundy
Offshore (LFA 41 [4X–5Zc])	By-catch	By-catch	Gulf of Maine
Quebec (rock crab fishing areas: 12 E–Z, 12 A–C, 12 D-17, 16B, 16D, LFAs 15–22)	N/A	Directed, by-catch	Northern Gulf of St. Lawrence
Southern Gulf of St. Lawrence (LFAs 23–25, 26A–B)	N/A	Directed, bait, by-catch	Southern Gulf of St. Lawrence

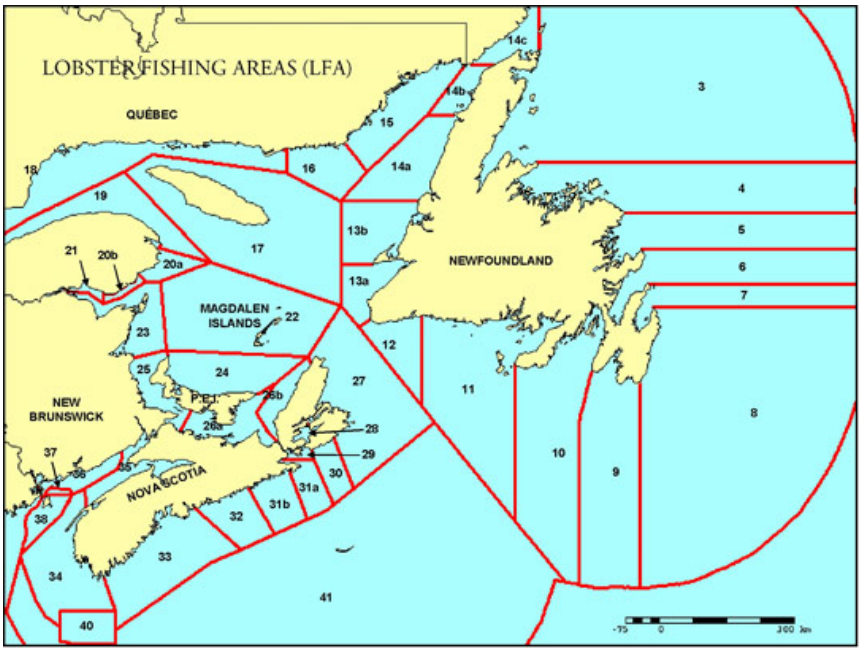

Figure 1: Canadian Lobster Fishing Areas (LFA) (DFO 2015)

Production Statistics

Canada and the United States are the sole producers of Jonah crab and Atlantic rock crab, and neither species is commercially farmed. Both Jonah crab and Atlantic rock crab landings in Canada have declined in the last decade, due to low effort (many licensed fishers are not harvesting crab) and unfavorable market conditions, and do not reach TAC limits. In 2018, Canada produced 4.6% (439 t) of global Jonah crab (unpublished data DFO 2020) while the United States produced the majority (95.4%; 9,136 t (NMFS 2021)). In 2018, Canada produced the majority of Atlantic rock crab at 66% (2,642 t) while the United States produced 34% (1,351 t) (NMFS 2021). The directed rock crab fishery in the Gulf of St. Lawrence region catches the most crab by weight of the assessed fisheries (Figure 2), followed by the directed rock crab fishery in Quebec.

In 2019, Jonah crab landings were 65 mt in Scotia-Fundy (LFAs 34–38) (unpublished data DFO 2021).

In 2019, Atlantic rock crab landings were 2,112 mt in the southern Gulf of St. Lawrence and 667 mt in Quebec and the northern Gulf of St. Lawrence directed fisheries (unpublished data DFO 2020).

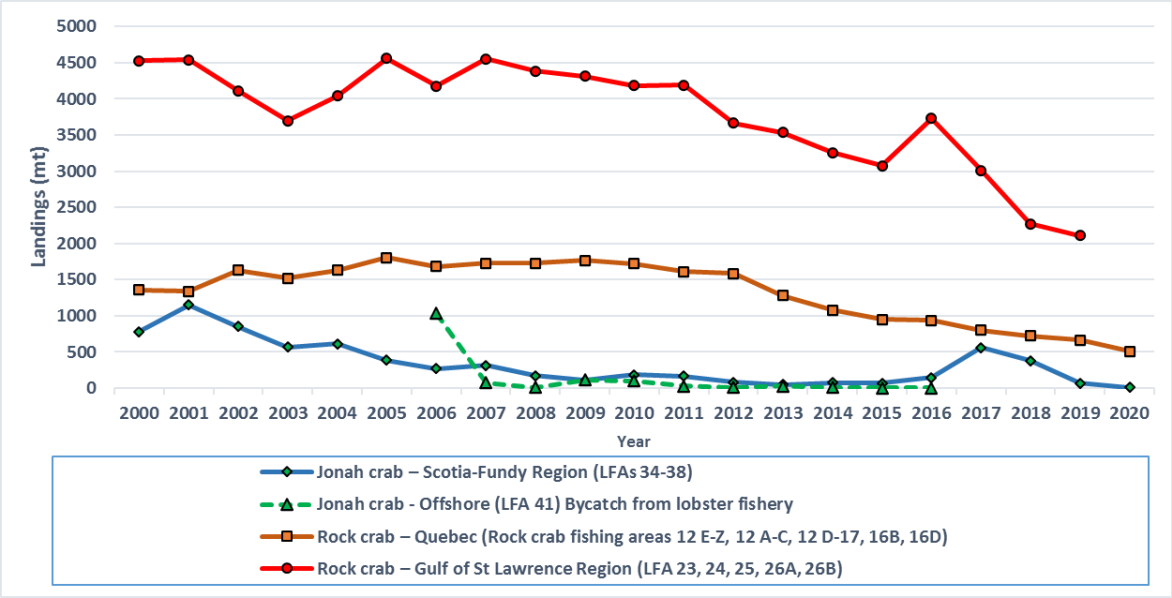

Figure 2: Landings for Jonah and Atlantic rock crab fisheries in Eastern Canada. Data sources: (Cook et al. 2020) and (unpublished data DFO 2021); data for rock crab in LFAs 23–26 for 2020 not yet available.

Importance to the US/North American market.

Specific information is not available for Jonah crab or Atlantic rock crab imports/exports.

Common and market names.

Jonah crab:
Common Name: Jonah crab
Acceptable Market Name: Crab, Jonah

Atlantic Rock Crab:
Common Name: Atlantic rock crab
Acceptable Market Name: Crab, rock
Vernacular Name: Sand crab

Primary product forms

Primary product forms for Jonah crab include live, fresh, and frozen (whole cooked, meat [also pasteurized], whole claw and arm, cocktail claws, and snap-n-eat claws). Primary product forms for Atlantic rock crab are fresh or frozen cooked picked meat.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

ATLANTIC ROCK CRAB			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

JONAH CRAB			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Criterion 1 Assessments

SCORING GUIDELINES

Factor 1.1 - Abundance
Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

Atlantic rock crab

Factor 1.1 - Abundance

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence

Moderate Concern

There are no biological reference points for Atlantic rock crab in Quebec and the northern Gulf of St. Lawrence (nGSL). The most recent stock assessment for Atlantic rock crab in the Quebec region was conducted in 2018 (inclusive of data up to 2016) using fishery-based indicators including landings and catch per unit effort (CPUE) from logbooks, and the percentage of license holders that reached their individual allocation (DFO 2018). Data on size structure are collected through dockside sampling, and fisheries-independent data on abundance and recruitment are obtained from an annual trawl survey conducted in the southern part of the Magdalen Islands since 1995. In the Magdalen Islands, yields have decreased in all fishing areas since the mid-2000s, size structure has deteriorated, and average size has reached a historic low. In the Gaspe Peninsula, size-structure and average size remained stable, with fishery abundance indicators decreasing in the north and sub-areas 12EP while stable or increasing in the other regions. Little is known about

rock crab growth, which limits the interpretation of size-structure data. Overall, landings data indicate a decline since 2009 (see Figure 3), with decreases in 2012 attributed to a quota reduction and decreasing fishing effort. There are no estimates of absolute abundance due to several sources of uncertainty: landings in recent years in the by-catch fishery (unreported since 2011) are unknown, little is known about changing spatial harvest strategies that may influence CPUE, and understanding of recruitment dynamics and natural mortality of Atlantic rock crab is poor (DFO 2018). Recent increases in abundance of lobster, which preys on rock crab, have also potentially contributed to population declines in some regions (DFO 2018). There is no reliable estimate for abundance and thus no evidence that the stock is either above or below a sustainable level. Because abundance in relation to reference points and conservation goals is unknown and the species has a medium vulnerability (PSA = 2.68; see table), stock status is rated a moderate concern.

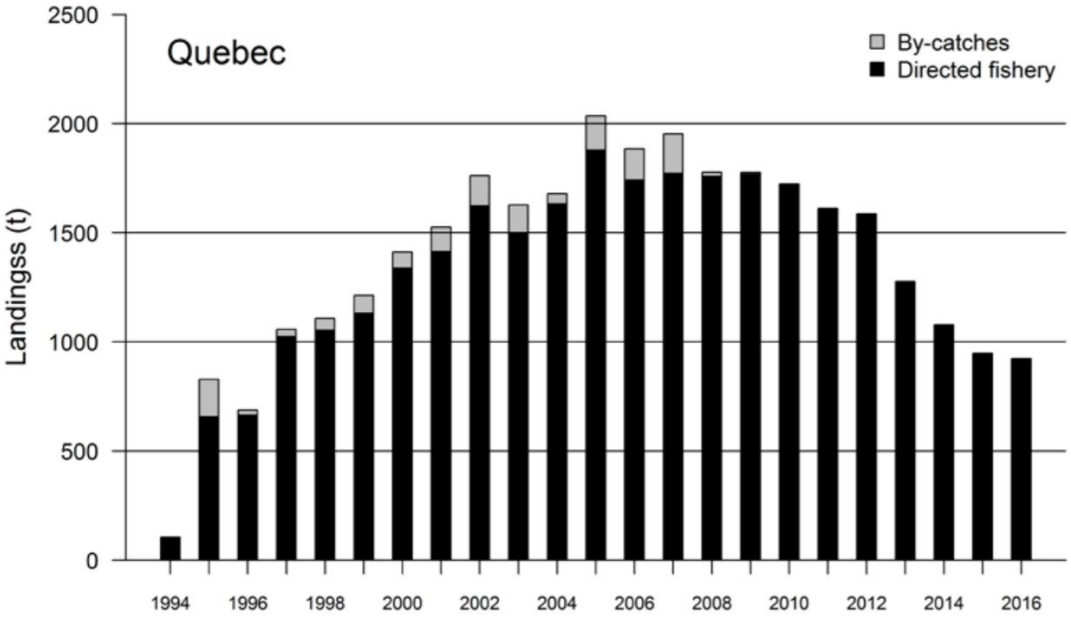

Figure 3: Rock crab landings (t) in Quebec from 1994 to 2016 from the directed fishery, and by-catch (unreported since 2011) from the lobster fishery (DFO 2018).

Atlantic rock crab has medium vulnerability (PSA score = 2.68).

Productivity Attribute	Relevant Information	Score
Average age at maturity	1–4 years	1
Average maximum age	8 years	1
Fecundity	300,000 (47,130 to 1.8 million eggs)	1
Reproductive strategy	Egg brooder	2
Trophic level	2.5	1
Density dependence	Unknown	2

References for productivity table: (Bigford 1979){Campbell & Eagles 1983}(Shields 1991)(Steneck et al. 2004)

Susceptibility	Relevant Information	Score
Areal overlap	Default score, sufficient data not available	3
Vertical overlap	Default score, sufficient data not available	3
Selectivity of fishery	Species is targeted and/or by-catch but FMP requires escape gaps	2
Post-capture mortality	Retained species or used as bait	3

References for susceptibility table: (DFO 2013)(DFO 2018)

Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

Moderate Concern

There are no biological reference points for Atlantic rock crab in the southern Gulf of St. Lawrence (sGSL). The most recent stock assessment for Atlantic rock crab in the sGSL was conducted in 2013 (inclusive of data up to 2011) using fishery-based indicators including landings, catch per unit effort (CPUE), and the percentage of license holders that reached their individual allocation (Rondeau et al. 2014). An update to fisheries status indicators was conducted in 2019, and limited fishery-independent data (from a 2008–2018 rock crab settlement index) were also utilized (DFO 2019c). The fishery is only permitted to land males, with a minimum legal size of 102 mm carapace width (CW), well above the size for 95% maturity of 73 mm CW (Rondeau et al. 2014). Logbooks are mandatory for the directed rock crab fishery, and there are requirements for reporting bait and by-catch in lobster fishery logbooks. Before 2000, only data for combined directed and by-catch fishery landings are available, which increased overall from 1985 to 2000. Directed and by-catch fishery landings each decreased since 2000, with the by-catch fishery comprising a minority of landings and only 1% of combined fishery landings in 2017 (see Figure 4; (DFO 2019c)). Decreases in the by-catch fishery are likely due to increases in the size of escape vents in the lobster fishery, but may also be due to allocation of by-catch to bait rather than sale. Landings are unknown in the bait fishery and there is uncertainty regarding the accuracy of logbook and sales records from the by-catch fisheries. The directed fishery has mandatory dockside monitoring of all landings (DFO 2019c). Overall landings are thought to be related to fishing effort and due to limits placed on catches, so they are not a suitable proxy for abundance. Because of data uncertainty, there is no reliable estimate for abundance and thus no evidence that the stock is either above or below a sustainable level. Because abundance in relation to reference points and conservation goals is unknown and the species has a medium vulnerability (PSA = 2.68; see table), stock status is rated a moderate concern.

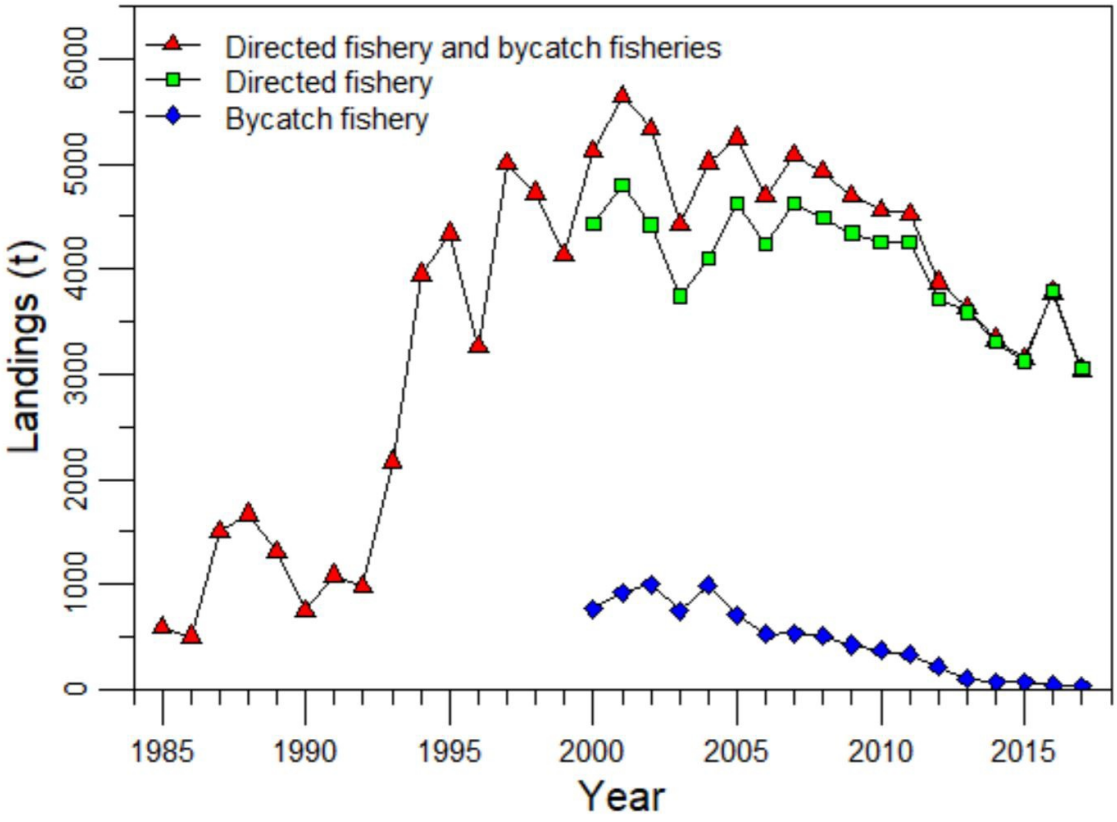

Figure 4: Rock crab landings in the southern Gulf of St. Lawrence from 1985 to 2017. Before 2000, only combined directed and by-catch landings are available (DFO 2019c).

Atlantic rock crab has medium vulnerability (PSA score = 2.68).

Productivity Attribute	Relevant Information	Score
Average age at maturity	1–4 years	1
Average maximum age	8 years	1
Fecundity	300,000 (47,130 to 1.8 million eggs)	1
Reproductive strategy	Egg brooder	2
Trophic level	2.5	1
Density dependence	Unknown	2

References for productivity table: (Bigford 1979){Campbell & Eagles 1983}(Shields 1991)(Steneck et al. 2004)

Susceptibility	Relevant Information	Score
Areal overlap	Default score, sufficient data not available	3
Vertical overlap	Default score, sufficient data not available	3
Selectivity of fishery	Species is targeted and/or by-catch but FMP requires escape gaps	2
Post-capture mortality	Retained species or used as bait	3

References for susceptibility table: (DFO 2013)(DFO 2018)

Factor 1.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence

Moderate Concern

There are no known estimates for fishing mortality for Atlantic rock crab in Quebec and the northern Gulf of St. Lawrence (nGSL). There is a high degree of uncertainty associated with landings data due to ties to fishing effort, uncertainty in logbook accuracy, and missing data from the by-catch and bait fisheries, which are thought to potentially be a significant quantity (DFO 2018). Individual allocations are not based on stock status or biomass estimates. The 2018 stock assessment (inclusive of data through 2016) indicated that CPUE in some regions in the Magdalen Islands is declining (see Figure 5), as is population size structure, which is attributed to harvest levels and an increase in lobster abundance (the primary predator of Atlantic rock crab) (DFO 2018). DFO stock assessors recommended a reduction in fishing limits in the directed fishery and documentation and control of the by-catch fishery. Because fishing mortality relative to reference points is unknown, it is considered a moderate concern.

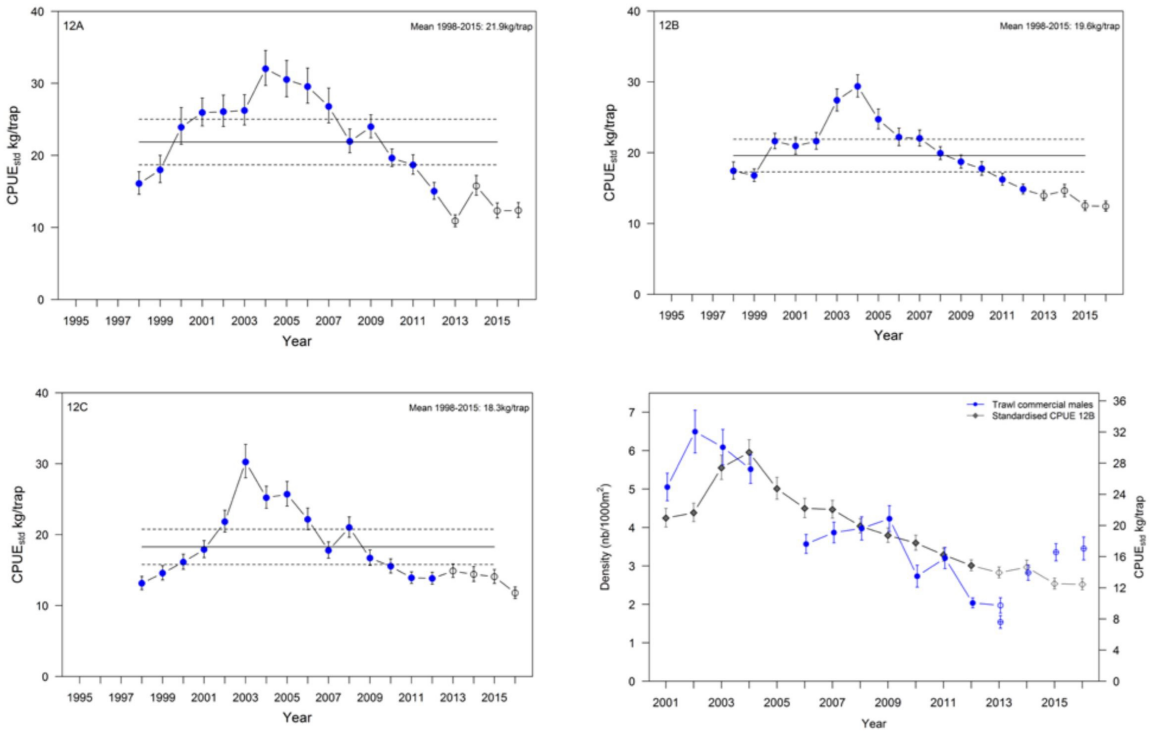

Figure 5: Estimated rock crab catch rates (CPUEs) (kg/trap) in the Magdalen Islands (regions 12 A–C) based on logbook data. Catch rates from 12A–C were standardized (CPUEstd) to account for both types of traps. The straight solid line indicates the average for the 1998–2015 period, and the dotted lines represent a 0.5 standard deviation from the average. The figure on the lower right shows (CPUEstd) for region 12B and rock crab density in numbers per 1000 m^2 from the trawl survey, 2001 to 2016 (DFO 2018).

Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

Moderate Concern

There are no known estimates for fishing mortality for Atlantic rock crab in the southern Gulf of St. Lawrence (sGSL). Landings data have consistently been below the total allowable catch (TAC) since 1985; however, there is a high degree of uncertainty associated with these data due to ties to fishing effort, uncertainty in the lobster logbook accuracy for reporting by-catch and bait, and missing data from the bait fishery (DFO 2019c). Landings from the by-catch fishery are minor, contributing <2% of total rock crab landings in the region in recent years (see Figure 6; (Criquet et al. 2019)). Individual allocations are not based on stock status or biomass estimates. The directed rock crab fishery, contributing to most of the rock crab catch, is a male-only fishery, with the legal minimal carapace width set at 102 mm, well above the male carapace width for 95% sexual maturity of 73 mm (Rondeau et al. 2014). Lobster license conditions state: "No person shall use as bait in a lobster trap, rock crab of a width less than 102 mm. When using rock crab for bait, the rock crab must be identifiable by sex and width. The crushing or otherwise manipulation of the rock crab where sex or width cannot be readily determined is prohibited" (DFO 2021b). Because fishing mortality relative to reference points is unknown, it is considered a moderate concern.

Justification:

Year	Rock crab landings during lobster fishery (mt)						Total landed during rock crab directed fishery (mt)	Fishing trips	% of total rock crab landings coming from the lobster fishery
	23	24	25	26A	26B	Total			
2017p	*	*	1.8	31.6	*	33.7	3,009	2,273	1.12%
2018p	*	*	1.4	30.4	*	31.8	2,268.5	2,077	1.38%

**Confidential: landings from less than 5 harvesters*

Figure 6: Comparison of recent landings from the directed rock crab fishery in the sGSL and rock crab retained as by-catch from the lobster fisheries in the same region (Criquet et al. 2019).

Jonah crab

Factor 1.1 - Abundance

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy

Moderate Concern

There are no biological reference points or current stock assessments for Jonah crab in the Maritimes Region Scotia-Fundy fisheries (LFAs 34–38). There are no reliable estimates for abundance and thus no evidence that the stock is either above or below reference points. Based on catch rates and catch per unit effort (CPUE) from a 2006 study, Jonah crab in LFA 34 experienced significant declines beginning in 2000, although this may be partly attributed to a shift in fishing location {Robichaud & Frail 2006}. There are uncertainties with the CPUE and landings data due to several variables, including environmental changes and market volatility. Because abundance in relation to reference points and conservation goals is unknown and the species has a medium

vulnerability (PSA = 2.68; see table), stock status is rated a moderate concern.

Justification:
This species has a moderate vulnerability (PSA = 2.68).

Productivity	Relevant Information	Score
Average age at maturity	1–4 years*	1
Average maximum age	8 years*	2
Fecundity	800,000 eggs (300,000 to 1,600,000)	1
Reproductive strategy	Egg brooder	2
Trophic level	2.5	1

* Best available estimate using a proxy in the same genus *Cancer* spp.—based on Atlantic rock crab life history

References for productivity table: (Bigford 1979){Campbell & Eagles 1983}(Shields 1991)(Steneck et al. 2004)

Susceptibility	Relevant Information	Score
Areal overlap	Default score, sufficient data not available	3
Vertical overlap	Default score, sufficient data not available	3
Selectivity of fishery	Species is targeted and/or by-catch but FMP requires escape gaps	2
Post-capture mortality	Retained species or used as bait	3

References for susceptibility table: (DFO 2016)(DFO 2020f)

Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Moderate Concern
Jonah crab is caught as by-catch in the Maritimes Region offshore fisheries (LFA 41), and currently, the directed fishery is inactive in this region. The stock was last assessed in 2009 based on fishery-dependent logbook and dockside monitoring data (including catch, effort, and location data) (Pezzack et al. 2011). Because of data uncertainty, there is no reliable estimate for abundance and thus no evidence that the stock is either above or below a sustainable level. Catch per unit effort (CPUE) data indicated an overall declining trend in abundance (1999–2006; see Figure 7), which could be due to fishing pressure during the initial years (beginning in 1995) of the fishery; however, these data are uncertain because they may have been affected by factors that were not evaluated, including temperature, molt state, and movements of the fishing fleet. Additional abundance indices are acquired from DFO RV surveys, but little is known about the behavior of Jonah crab and its ability to redistribute, which would be required to provide robust abundance estimates from these data (Pezzack et al. 2011). Because abundance in relation to reference points and conservation goals is unknown and the species has a medium vulnerability (PSA = 2.68, see table), stock status is rated a moderate concern.

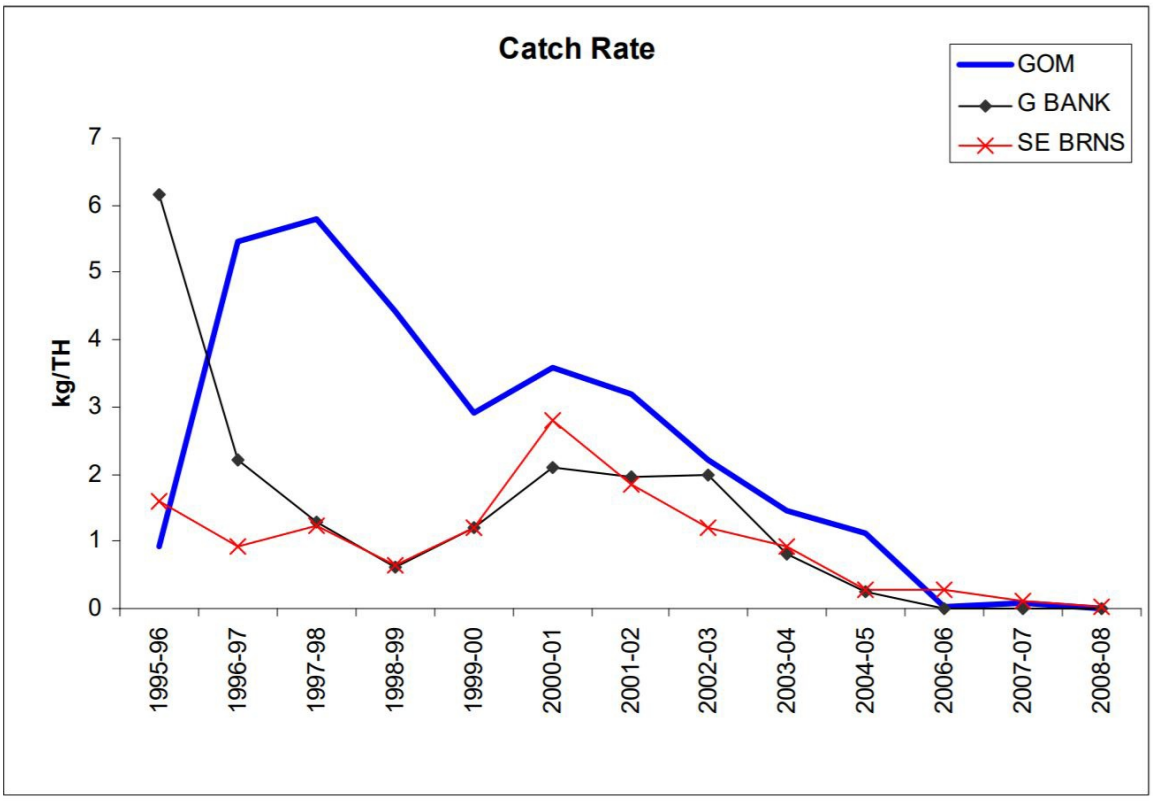

Figure 7: Jonah crab CPUE (kg/TH) and for fishing areas in LFA 41: GoM, SE Browns, and Georges Bank (Pezzack et al. 2011).

This species has a moderate vulnerability (PSA = 2.68).

Productivity	Relevant Information	Score
Average age at maturity	1–4 years*	1
Average maximum age	8 years*	2
Fecundity	800,000 eggs (300,000 to 1,600,000)	1
Reproductive strategy	Egg brooder	2
Trophic level	2.5	1

* Best available estimate using a proxy in the same genus *Cancer* spp.—based on Atlantic rock crab life history

References for productivity table: (Bigford 1979){Campbell & Eagles 1983}(Shields 1991)(Steneck et al. 2004)

Susceptibility	Relevant Information	Score
Areal overlap	Default score, sufficient data not available	3
Vertical overlap	Default score, sufficient data not available	3
Selectivity of fishery	Species is targeted and/or by-catch but FMP requires escape gaps	2
Post-capture mortality	Retained species or used as bait	3

References for susceptibility table: (DFO 2016)(DFO 2020f)

Factor 1.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Moderate Concern

There are no estimates of fishing mortality relative to reference points for Jonah crab in the Bay of Fundy inshore fisheries (LFAs 34–38) or the Gulf of Maine offshore fishery (LFA 41). In the 2017/2018 season, 210 mt of Jonah crab were landed as retained by-catch in the inshore lobster fishery, with the majority (75%) of Jonah crab landed in LFA 34 (DFO 2020f)(Criquet et al. 2021). Jonah crab is the most commonly encountered by-catch species in the offshore lobster fishery (LFA 41) (Cook et al. 2020). In recent years, by-catch levels have declined in this fishery overall, and the average by-catch of crab species combined in the offshore lobster fishery (LFA 41) for 2015–2017 was 2 mt (Knapman et al. 2019). Catch per unit effort (CPUE) data from the 2010 stock assessment in LFA 41 indicate that the original total allowable catch (TAC) (720 t; implemented 1995 through 2010, when it was reduced to 540 t) was not sustainable and that population declines began at the inception of the Jonah crab fishery in 1995; however, there are uncertainties associated with these data. Fluctuations in CPUE relative to oceanographic conditions, molt state, and movement were not evaluated. The current TAC for Jonah crab in LFA 41 is 270 t (since 2017) (DFO 2020g). Because fishing mortality relative to reference points (based on biological information) is unknown, it is considered a moderate concern.

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

ATLANTIC ROCK CRAB			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence	1.000	1.000: < 100%	Red (1.000)
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence	1.000	1.000: < 100%	Red (1.000)

JONAH CRAB			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy	1.000	1.000: < 100%	Red (1.000)
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine	1.000	1.000: < 100%	Red (1.000)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

NORTHWEST ATLANTIC | POTS | CANADA | MARITIMES BAY OF FUNDY			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Leatherback turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
North Atlantic right whale	1.000: High Concern	1.000: High Concern	Red (1.000)
Cusk	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Fin whale	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Atlantic cod	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Wolffish (unspecified)	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Jonah crab	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHWEST ATLANTIC | POTS | CANADA | MARITIMES GULF OF MAINE			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Leatherback turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
North Atlantic right whale	1.000: High Concern	1.000: High Concern	Red (1.000)
Cusk	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Fin whale	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Atlantic cod	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Wolffish (unspecified)	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Jonah crab	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHWEST ATLANTIC | POTS | CANADA | QUEBEC GULF AND NORTHERN GULF OF ST. LAWRENCE			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Leatherback turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
North Atlantic right whale	1.000: High Concern	1.000: High Concern	Red (1.000)
Fin whale	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Atlantic cod	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Wolffish (unspecified)	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Atlantic rock crab	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHWEST ATLANTIC | POTS | CANADA | SOUTHERN GULF OF ST. LAWRENCE			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Leatherback turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
North Atlantic right whale	1.000: High Concern	1.000: High Concern	Red (1.000)
Fin whale	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Atlantic cod	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Wolffish (unspecified)	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Atlantic rock crab	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Traps used in the Jonah crab and Atlantic rock crab fisheries, and in the lobster fisheries from which these species are retained as by-catch, are considered highly selective. Because data are lacking on the nature and quantity of by-catch, especially in the directed crab fisheries, assessed by-catch species were based on the proportion and composition of by-catch in the lobster fisheries in the inshore and offshore Maritimes Region. Finfishes incidentally caught in the lobster fishery, including red hake, shorthorn sculpin, spiny

dogfish, haddock, and redfish, were not assessed because they are encountered in low numbers (<5% of by-catch). Species designated with conservation status concerns under the Species at Risk Act (SARA) and/or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as "Endangered" (North Atlantic right whale, northern bottlenose whale [offshore fishery only], leatherback turtle, Atlantic cod, cusk, and white hake) and as "Special Concern" or "Threatened" (fin whale and wolffish) that may interact with the fisheries were also included.

There are concerns regarding entanglements of the North Atlantic right whale (NARW) in the Canadian Atlantic, typically with pot/trap gear. As a precaution, Seafood Watch considers interactions with NARW in all trap fisheries in the region. The score for Criterion 2 is driven by interactions of the fishery with endangered North Atlantic right whale and endangered leatherback turtle.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	Factor 2.3 score
<100%	1
>=100	0.75

Atlantic cod

Factor 2.1 - Abundance

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

High Concern
Atlantic cod in the Southern designatable unit (DU), the Laurentian north DU, and the Laurentian south DU (see Figure 8) were assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2010 (COSEWIC 2010). The DUs are under consideration for listing under the Species at Risk Act (SARA). Because of Atlantic cod's endangered species status, abundance is rated a high concern.

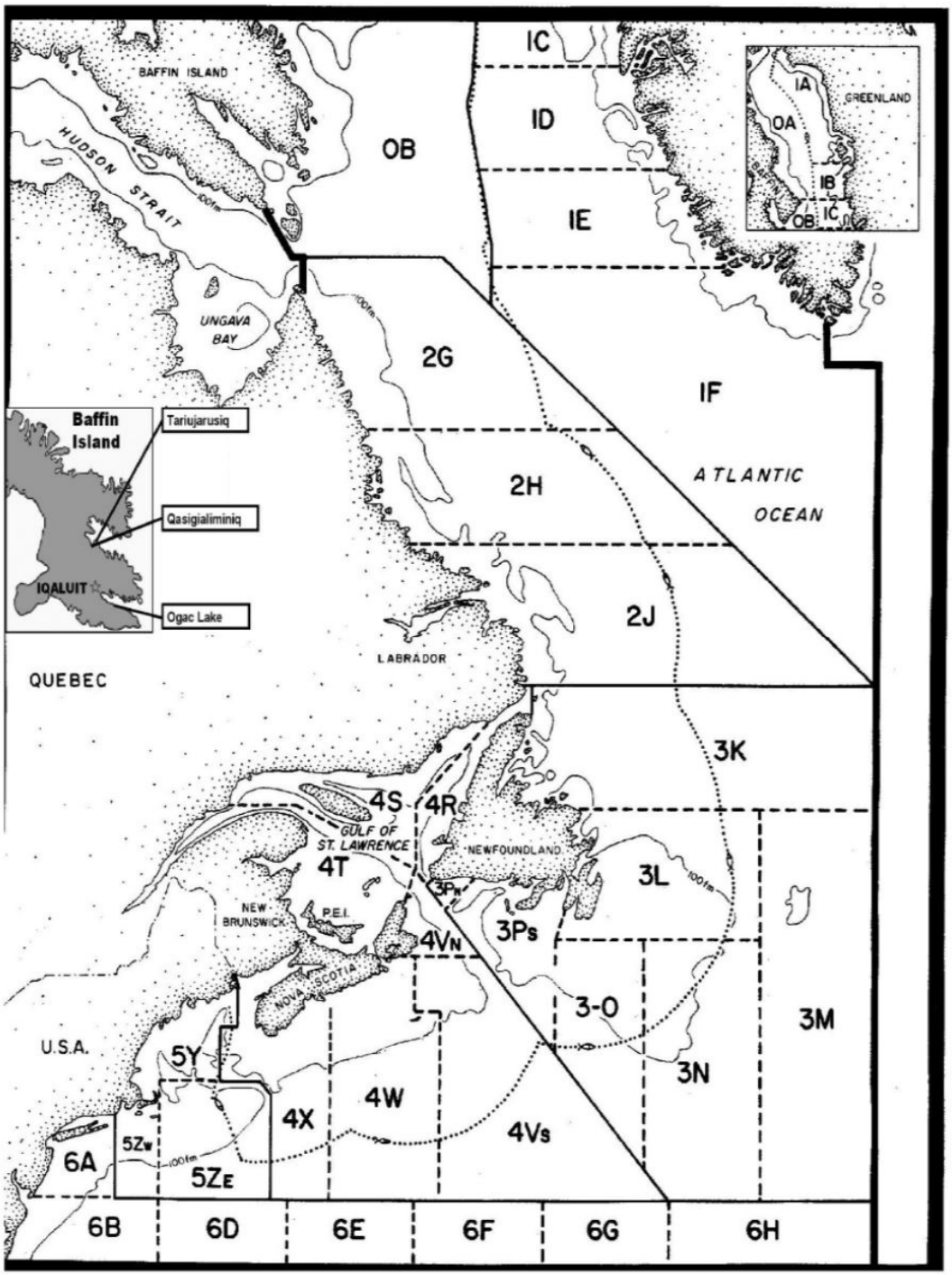

Figure 8: Map of Northwest Atlantic Fishery Organization Divisions used to identify Atlantic cod stocks (COSEWIC 2010). The Laurentian north DU includes NAFO 3P and 4RS, the Laurentian south DU includes NAFO 4TVW, and the Southern DU includes NAFO 4X and the Canadian portions of Divisions NAFO 5Y & 5Z.

Factor 2.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

Low Concern

In the Atlantic cod Laurentian north DU, the primary source of mortality is overfishing, while in the Laurentian south DU, the natural mortality of older cod, which may have increased due to changes in environmental conditions and species interactions, is greater than fishing mortality (COSEWIC 2010). By-catch of Atlantic cod in several fisheries is thought to contribute significantly to population decline; however, the magnitude of total by-catch is largely unknown (COSEWIC 2010) {Worcester et al. 2009}. Pot/trap gear is considered to contribute less to total mortality compared to other gears, and recent studies have shown that lobster traps catch Atlantic cod infrequently (<1% of observed trap hauls (den Heyer et al. 2010) and <5% of total catch weights (Criquet et al. 2015)). Because the Jonah crab and Atlantic rock crab fisheries are not considered substantial contributors to Atlantic cod fishing mortality, particularly relative to other sources and gears, fishing mortality is rated a low concern.

Justification:

In the southern Gulf of St. Lawrence (sGSL), the majority of the lobster fisheries and rock crab-directed fisheries occur in waters less than 20 fathoms (Rondeau et al. 2014). Cod is rarely present at these depths. By license condition, the license holder/operator is required to forthwith return all incidentally caught fish of all species to the water and place from which it was taken; and where it is alive, in a manner that causes it the least harm.

Cusk

Factor 2.1 - Abundance

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

High Concern

Cusk was assessed as "Endangered" by COSEWIC in 2012 due to population declines since the 1970s that resulted in an 85% reduction of the mature fish population (COSEWIC 2012b), and it is under consideration for listing as an endangered species under SARA. Because it is an endangered species, abundance is considered a high concern.

Factor 2.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Moderate Concern

Based on landings records and discard estimates, groundfish longline and lobster pot fisheries are considered to be the greatest threats to the cusk population (DFO 2014)(DFO 2020c). Cusk may be landed in some longline fisheries but may not be retained in the crab and lobster fisheries,

although a significant proportion of post-release mortality can occur due to injuries from barotrauma. Based on a time series of cusk catch per unit effort (CPUE) in the Industry-DFO Halibut Fixed Station Longline Survey, which has fluctuated without trend since 1999, managers consider population abundance to be stable and fishing mortality to be at a sustainable level in NAFO 4X5YZ (Harris et al. 2018)(DFO 2020c). The 3-year geometric mean (17.7 kg per 1000 hooks, 2017–2019) was above the limit reference point (LRP) (13.3 kg per 1000 hooks); however, this is in the cautious zone, and reductions in fishing mortality may be needed for population recovery (considered to be at the upper stock reference point of 26.6 kg per 1000 hooks, 80% of the maximum sustainable yield [MSY] proxy based on historic catch rates). There are not reliable estimates for absolute cusk abundance or historic cusk abundance, so available data are not adequate to determine the quantity of human-induced mortality that cusk can sustain without impeding recovery {Harris & Hanke 2010} (Harris et al. 2018). Because fishing mortality relative to appropriate reference points for cusk is largely unknown, fishing mortality is rated a moderate concern.

Fin whale

Factor 2.1 - Abundance

Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

High Concern

The best abundance estimate available for the western North Atlantic fin whale stock is 6,802, with a minimum population size of 5,573 (Hayes et al. 2021). This is the estimate derived from the sum of the 2016 NOAA shipboard and aerial surveys and the 2016 Canadian Northwest Atlantic International Sightings Survey (NAISS) (Hayes et al. 2021). The surveys do not overlap, so the estimates from the two surveys were combined (Hayes et al. 2021), extending the range of the survey from Newfoundland to Florida and resulting in a significant increase in the population estimate relative to the 2011 NOAA survey (Hayes et al. 2021). The status of this stock relative to the optimum sustainable population (OSP) in the U.S. Atlantic EEZ is unknown, as are population trends (Hayes et al. 2021). The International Union for the Conservation of Nature (IUCN) Red List classifies fin whale as "Vulnerable" to extinction, the Endangered Species Act (ESA) lists it as "Endangered" (Cooke 2018b)(USFWS 2017), and it is listed on CITES Appendix I (NOAA 2017a) and as MMPA "Depleted" throughout its range (NOAA 2017b). Because of the IUCN, ESA, and MMPA listings, abundance is considered a high concern.

Factor 2.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

Moderate Concern

From 2014 to 2018, the minimum annual rate of human-caused mortality and serious injury to fin whale (2.35 per year total, inclusive of 1.55 due to fisheries interactions comprised of 0.6 in Canadian waters and 0.95 unknown but first reported in United States waters) did not exceed the potential biological removal (PBR) (11 individuals per year) (Hayes et al. 2021). It is difficult to quantify entanglements due to limited observer coverage and it is recognized that these values are biased low, with uncertainty regarding the magnitude of the bias. Entanglement rates for fin whale are expected to be higher than currently reported because traditional reporting relies upon vessel-based photography, which may not identify entanglement scars for species that do not show their flukes as often (for example, fin and blue whales compared to humpback whale) (Ramp et al. 2021). The management plan for fin whale in Atlantic Canada lists fisheries entanglement as a low to moderate severity threat to the population (DFO 2016b). But, there is evidence to suggest that mortalities are higher than currently quantified. In 2017, at least five carcasses were spotted in the southern Gulf of St. Lawrence (during aerial surveys looking for North Atlantic right whale) and one was entangled in fishing gear; these carcasses do not appear to have been considered in the most recent marine mammal stock assessment {COSEWIC 2019}(Hayes et al. 2021). Although cumulative fisheries mortality is <50% of PBR, there is substantial uncertainty regarding the true level of entanglement and subsequent serious injury and mortality, so fishing mortality is considered a moderate concern.

Leatherback turtle

Factor 2.1 - Abundance

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence

High Concern

Leatherback turtle in the Atlantic population was designated "Endangered" under Canada's SARA in 2003 (SARA 2021)(COSEWIC 2012). Because of the endangered species status, abundance is rated a high concern.

Factor 2.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence

High Concern

Leatherback turtle mortality is affected by multiple sources including entanglement in fisheries gear (longline and fixed gear), egg poaching, resource development and changes to nesting beaches, vessel strikes, ingestion of marine debris, and climate change (COSEWIC 2012)(DFO 2013b). Entanglement in fishing gear is thought to be the primary threat to leatherback turtle in Atlantic Canada (Fisheries and Oceans Canada 2020). Robust data on leatherback turtle mortality attributed to interactions with fishery gear are lacking due to limited observer coverage, and the magnitude of injury and mortality due to fisheries interactions has been historically underestimated (Hamelin et al. 2017){Fisheries & Oceans 2020}. In a study of visible injuries to leatherback turtles in the Northwest Atlantic (2012–2015), 19% were found to have had likely entanglement interactions {Archibald & James 2018}. From 1998 to 2017, 47.7% of entanglement records (105 instances) were attributed to pot fisheries in general (inclusive of lobster, snow crab, rock crab, hagfish, and whelk fisheries) (DFO 2020d). Based on limited data, between 1998 and 2014 in Atlantic Canada, 205 leatherback turtle entanglements were documented, with 31 attributed to the inshore lobster fisheries and 10 to rock crab fisheries (Hamelin et al. 2017). Most of the entangled turtles (84.9% of the entangled turtles attributed to all sources) were released alive and, although interactions correspond with a range of different fisheries and reporting biases make it challenging to derive patterns from the data, Hamelin et al. (2017) concluded that fisheries were interacting with leatherback sea turtles and that the rate of entanglement was likely underestimated (Hamelin et al. 2017). A rough estimate of overall post-release mortality after interaction with fixed gear fisheries in general is considered to be 20–70%, depending on the severity of the injury and the influence of the tidal cycle on drowning (DFO 2012). Fishers that encounter turtles during fishing activities are required to report the entanglement in their logbook and return the turtle to the sea with "least harm" as a condition of their fishing license. Fishers are also required to mark all vertical lines to identify the management area and target species (DFO 2021).

Because cumulative fishing mortality levels are unknown, with fishing considered to be a primary threat to population sustainability, and the contributions of the crab fisheries are uncertain but have the potential to be significant contributors to fishing mortality, fishing mortality is rated a high concern.

North Atlantic right whale

Factor 2.1 - Abundance

Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy

High Concern

North Atlantic right whale (NARW) is a highly vulnerable endangered, threatened, or protected (ETP) species that migrates annually from calving grounds in the southeastern United States to feeding grounds in the northeast United States and southeast Canada during the spring, summer, and fall months (NOAA 2020e)(DFO 2020c). Known feeding grounds include the Gulf of St. Lawrence (GSL) and the Maritimes Region (Figure 14, (NOAA 2020e)). Acoustic data and visual surveys describe an increase in annual North Atlantic right whale presence in the GSL starting in 2015 (Simard et al. 2019)(DFO 2020c)(Bourque et al. 2020). Feeding activities by North Atlantic right whale in the Maritimes Region may have decreased, based on acoustic data (available in 2004–2005 and since 2013) and sightings data (available for 21 years) (Figures 9 and 10) (Bourque et al. 2020)(DFO 2020c). The two figures also show the high density of NARW in the Gulf of St. Lawrence, which typically occurs during the summer months in recent years. Observations of NARW in the Maritimes Region and around Newfoundland are lower than in the Gulf of St. Lawrence; however, observation survey effort (both visual and acoustic) is much lower in these regions. Following the introduction of passive acoustic monitoring in the region, this species has been detected off Newfoundland, particularly Placentia Bay, in 2017, 2018, and 2019 (DFO 2020c). The inclusion of the 10-fathom and 20-fathom contours in the Figure 9 shows that NARW observations are greatly reduced in shallow water. A recent study found that, even though systematic surveys had not identified NARW in waters shallower than 20 fathoms in 2019, the species had been reported in waters that were shallow in 2019 (DFO 2020c). In 2017, at least 17 North Atlantic right whale mortalities occurred (12 in Canadian waters), and in 2018, there were 3 mortalities (all in United States waters) (NOAA 2020f). Fishery entanglements and ship strikes were the two identified causes for these mortalities (Daoust et al. 2017)(NOAA 2020f).

The NARW population has been declining in recent years (Figure 11) (Pettis et al. 2021). Minimum abundance from the most recent stock assessment was estimated at 364 individuals (best estimate 368) (Hayes et al. 2022), while the best estimate of the population from the North Atlantic Whale Consortium was 336 individuals at the end of 2020 {Pettis et al. 2022}. There are fewer reproductive females producing fewer calves each year, with experts estimating that there are 88 or fewer reproductively active females remaining {Pettis et al. 2022}{NOAA 2022c}. In 2020, North Atlantic right whale was downgraded to "Critically Endangered" by the IUCN (Cooke 2020).

Because the North Atlantic right whale is listed as "Endangered" by SARA, COSEWIC, and ESA, and as "Critically Endangered" by the IUCN, abundance is considered a high concern.

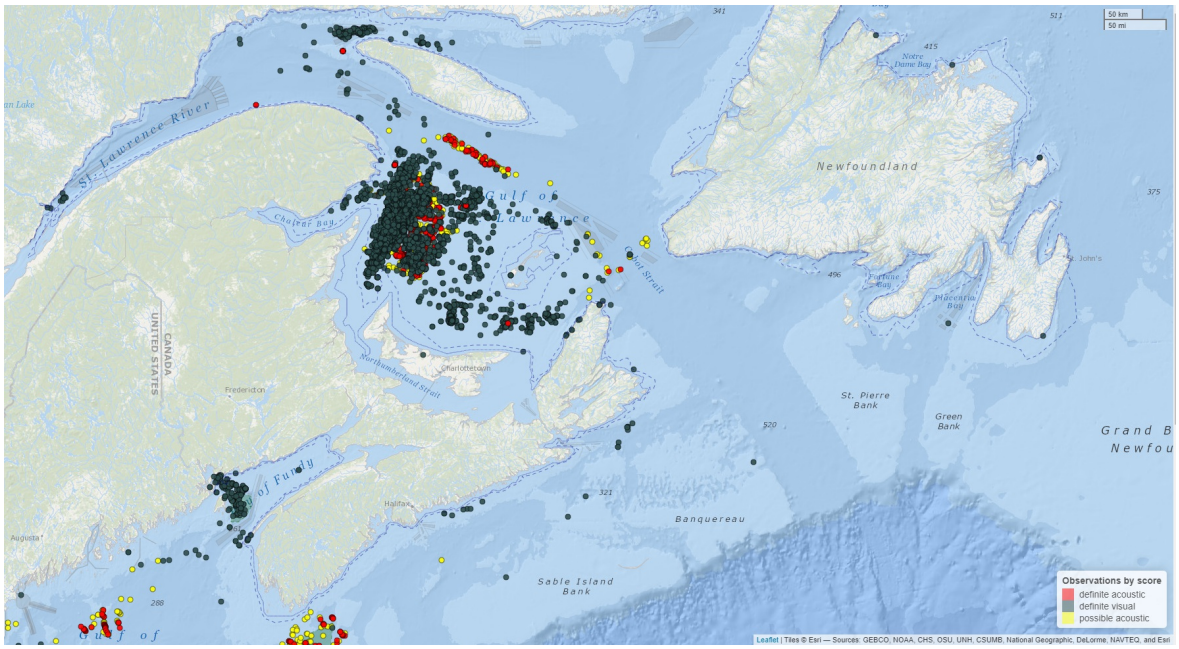

Figure 9: North Atlantic right whale observation in Atlantic Canada from February 1, 2017 to January 31, 2022 as displayed on Whale Map. Definite acoustic (red dots), possible acoustic (yellow dots), and definite visual (green dots) observations are shown, along with the 10-fathom contour (solid line) and 20-fathom contour (dashed line). From https://whalemap.org/WhaleMap/

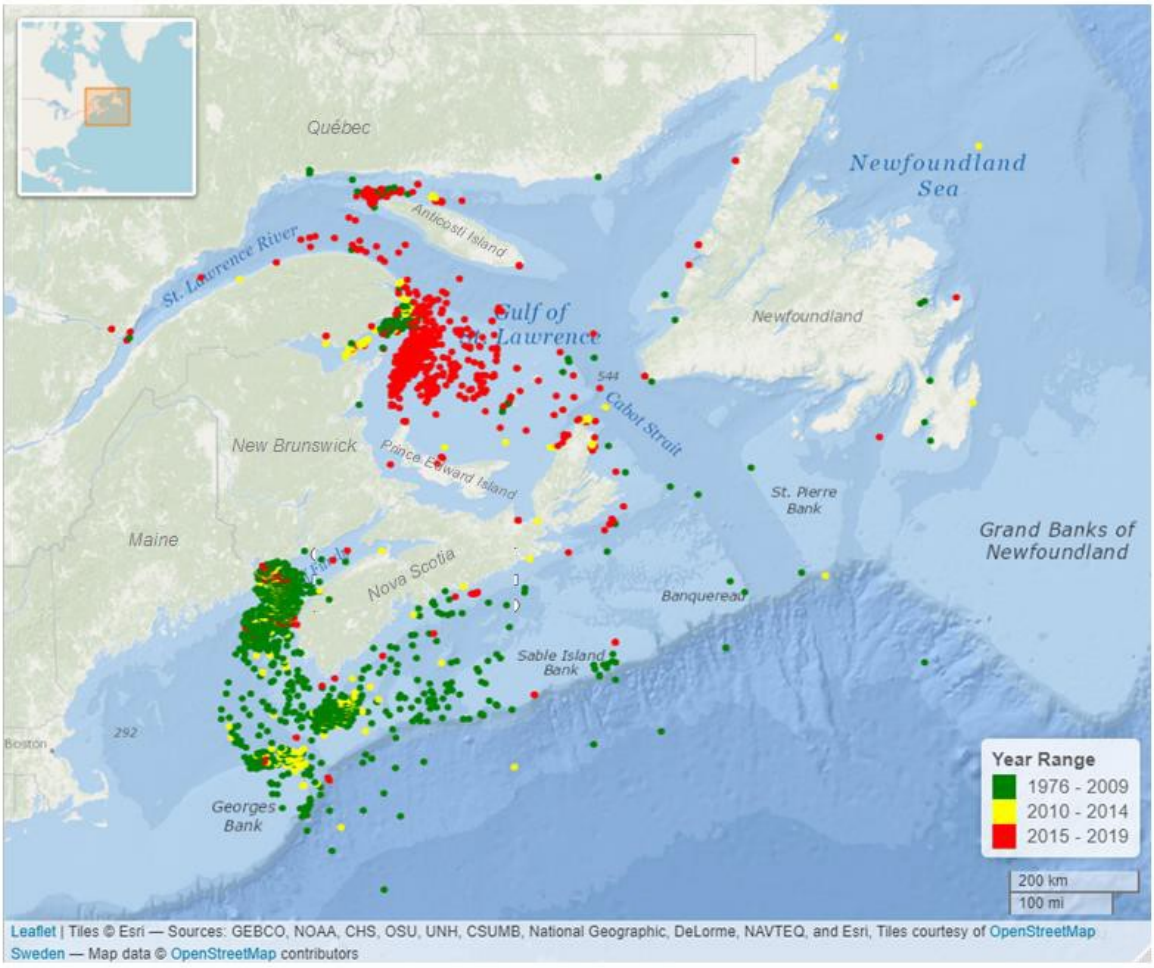

Figure 10: North Atlantic right whale sightings in the Gulf of St. Lawrence and Bay of Fundy from 1976 to 2009 (green dots), 2010 to 2014 (yellow dots), and 2015 to 2019 (red dots) (Bourque et al. 2020). Sightings are based on the North Atlantic Right Whale Consortium Sightings Database 03/04/2020 (Anderson Cabot Center for Ocean Life at the New England Aquarium, Boston, MA). Disclaimer: it is not known whether areas of the map without sightings are because of whale absence or lack of surveillance. This map does not include right whale acoustic detections.

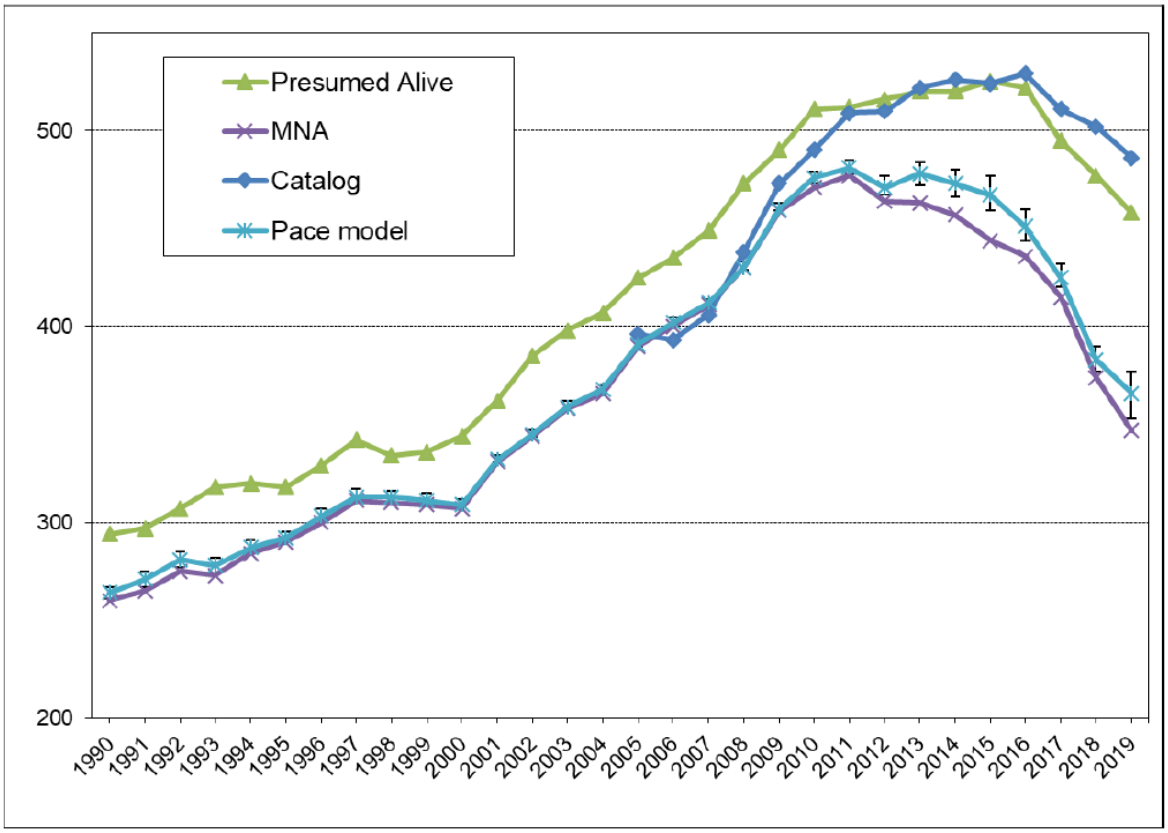

Figure 11: North Atlantic right whale population estimates using four different models, 1990–2019 (Pettis et al. 2021).

Factor 2.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy

High Concern

The Western Atlantic stock of the North Atlantic right whale is considered a strategic stock because annual serious injury and mortality (SIM) (7.7 from all sources; 5.7 attributed to fisheries entanglement from 2015 to 2019) exceeds the potential biological removal (PBR)* (0.7 whales) (Hayes et al. 2022). From 1980 to 2018, a total of 1,617 entanglement events, based on scarring or attached gear, have been documented in North Atlantic right whale; however, only 130 of these events had attached gear (Knowlton et al. 2012)(Hamilton et al. 2020). Because of a lack of information from these attached gear cases, it is often not possible to assign entanglements to a specific fishery or country. Documented entanglements from 2015 to 2019 involving pot/trap gear or unidentified gear are all attributed to unknown fisheries, which the Jonah and Atlantic rock crab fishery may be a part of. Annual SIMs attributed to entanglements in pot/trap gear in Canadian fisheries were 1.95 (279% of PBR), while none were attributed to pot/trap gear in United States fisheries (Hayes et al. 2022). Serious injuries and mortalities first seen in the United States but not attributable to country were 2.65 (379% of PBR), and those first seen in Canada but not

attributable to country were 1.05 (150% of PBR) (Hayes et al. 2022).

In Atlantic Canada between 2008 and 2014, there were 18 recorded interactions between North Atlantic right whale and fishing gear. In most cases (78%), the gear type could not be identified; however, 11% of the interactions were known to be with pot/trap gear (DFO 2016e). The estimated injury rate for this time series, based on opportunistic sightings data and considered to be biased low, exceeds the PBR for the period (0.9 whales). In 2017, 12 dead North Atlantic right whales were identified in the Gulf of St. Lawrence and, of the 7 necropsies performed, 2 were determined to have died due to entanglement in fishing gear (Daoust et al. 2018). In 2019, a total of nine North Atlantic right whales were found dead in Canadian waters (Bourque et al. 2020). Necropsies were performed on five of these whales, determining that four died due to vessel strikes while one cause was undetermined (Bourque et al. 2020). There were no entanglement-related mortalities identified in Canadian waters in 2020 or 2021; however, a whale (#4615) was seen entangled in the Gulf of St. Lawrence in 2021 and this incident is currently listed as a serious injury {NOAA 2022}.

North Atlantic right whale is not uniformly distributed across Canadian waters and is more likely to be found at depths greater than 20 fathoms (37 m) (DFO 2020j), so interactions are considered to be more likely in some areas than others; for example, there are few sightings in the Newfoundland and Labrador and East Cape Breton regions. But, these areas have relatively lower levels of surveillance and monitoring (likely due to low levels of historical abundance), and there are concerns that, as the distribution of whales changes both spatially and temporally, the occurrences of whales and their interactions with fishing gear will not be identified. Observed numbers of whales around Newfoundland are low, but they have been identified in these waters and are within the range of their preferred prey, *Calanus finmarchicus* (Durette-Morin 2021). Although whales may not be found as frequently in shallower waters, they have been reported there and may transit through shallow waters to access deeper foraging areas; and, even though occurrence may be lower, this does not create an absence of risk because risk is a product of whale occurrence and fishing activity (DFO 2019d). In the eastern Gulf of Maine, North Atlantic right whale distribution shifts appear driven by climate change and correlated with altering prey distribution (Record et al. 2019). Since approximately 2010, there have been decreased North Atlantic right whale sightings in the Bay of Fundy and Roseway Basin south of Nova Scotia and increased sightings in the Gulf of St. Lawrence. There are concerns that, in most years, the foraging habitat in the Gulf of St. Lawrence may have insufficient prey biomass for successful North Atlantic right whale reproduction (Kershaw et al. 2020)(Gavrilchuk 2021). Under the Species at Risk Act (SARA) in Canada, it is illegal to "kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species" (SARA 2021).

Vessel strikes and entanglement (from pot/trap and anchored gillnet fisheries) are the two leading causes of mortality and serious injury to North Atlantic right whale, with entanglements increasing over the past decade (Moore 2019). Rope strengths have increased in recent decades due to manufacturing changes, leading to reduced escape/breakaway success from entangling gear (Knowlton et al. 2016). Due to limited observation coverage, it is likely that the number of entanglements is severely underestimated (Kraus et al. 2019). Based on mark-recapture studies

through photo identification, <50% of entanglement-related mortality is estimated to be detected, with these same studies demonstrating that 59% of North Atlantic right whales have been entangled more than once (83% at least once), and new scars from entanglement are observed annually for at least 26% of the observed population (Knowlton et al. 2012).

More than 90% of entanglements (based on 2010–2016 and partial data for 2016/2017) are not identifiable to gear (7.8% of entangled North Atlantic right whale carry gear) and only 12% of those are identifiable to location (Knowlton et al. 2012){Knowlton et al. 2019}(Kraus et al. 2019). Fisheries interactions with North Atlantic right whale have been documented with gillnet fisheries (15% of entanglements attributed to gillnets from 1984 to 2016) (Kraus et al. 2019). An entanglement that results in gear remaining attached to the whale places an energetic strain that can compromise overall fitness and reproductive success (van der Hoop et al. 2016). Also, a new paper shows that whale lengths have been decreasing due to fishing gear entanglements and vessel strikes since 1981, possibly leading to reduced reproductive success and increased probability of the lethality of entanglements (Stewart et al. 2021). Challenges in identifying the fishery involved in an entanglement occur due to ineffective gear marking (gear recovered from an entanglement does not carry a mark identifying the gear type, target species, and/or location) or the inability to recover gear from the entangled whale. A recent study estimated that, from 2010 to 2017, the carcass detection rate (how many whale deaths were identified) was 29% (Pace et al. 2021). Pace et al. (2021) also concluded that, of the cryptic mortalities, the majority were likely caused by entanglement rather than blunt force trauma from vessel strikes.

An Unusual Mortality Event is in effect (since June 2017) for North Atlantic right whale, which includes 34 mortalities (21 in Canada, 13 in the United States, based on the location of stranding, not the location of mortality) through December 2021 (NOAA 2021). Mortalities are attributed to a combination of human interactions including vessel strikes and rope entanglement (final results are pending; however, preliminary investigations list 11 suspected as vessel strikes, 9 suspected as entanglement, 13 as pending or unknown causes, and 1 as perinatal mortality) (NOAA 2021) (see Figure 12).

Cumulative SIMs far exceed PBR and entanglements due to unknown fisheries are considered a significant contributor. Until there is more specific information available regarding which fisheries are responsible for the unattributed entanglements, Seafood Watch considers that all relevant fisheries that may overlap with NARW pose risks. Based on the available information and the significant risks to NARW, the Jonah and Atlantic rock crab fisheries cannot be considered sustainable, and fishing mortality is scored a high concern.

Justification:
Distributional shifts in the abundance of North Atlantic right whale (NARW) across its range may lead to shifts in regional fisheries interactions and entanglement risks. Based on data from passive acoustic monitoring (2004–2014), North Atlantic right whale is highly mobile and has a year-round presence across its geographic range {Davis et al. 2017}. In recent years (2010–2014), there has been a distributional shift, with presence increased in the Southern New England and mid-Atlantic regions and decreased in the Scotian Shelf and greater Gulf of Maine. Visual surveys in Canadian waters reported increased presence farther north in the Gulf of St. Lawrence, which may be related

to increased fisheries interactions with North Atlantic right whale in Canada {Meyer-Gutbrod et al 2018}. A recent study of individual whales identified in the Gulf of St Lawrence found that there was a high return rate from year to year, indicating that this is an important feeding area for a specific group of NARW (Crowe et al. 2021). The study also found that, in 2019, a total of 137 individual NARW were estimated to have visited the Gulf of St. Lawrence (Crowe et al. 2021), which was 38% of the estimated 356 NARWs alive at the end of 2019 (Pettis et al. 2021). Although this identifies the Gulf of St. Lawrence as an important foraging area for a significant proportion of the population, it does raise uncertainty regarding the location of the remaining individuals and the concern that they may be in areas that are offered less protection (Crowe et al. 2021).

In 2017, an Unusual Mortality Event for North Atlantic right whale was observed in the region (NOAA 2022a). It is unclear if distributional shifts are due to environmental or anthropogenic effects; however, warming temperatures and shifting prey distributions are thought to play a part in the change {Meyer-Gutbrod et al 2018}. The primary prey (*Calanus finmarchicus*) of the North Atlantic right whale currently remains in highest abundance in the western Gulf of Maine (Record et al. 2019).

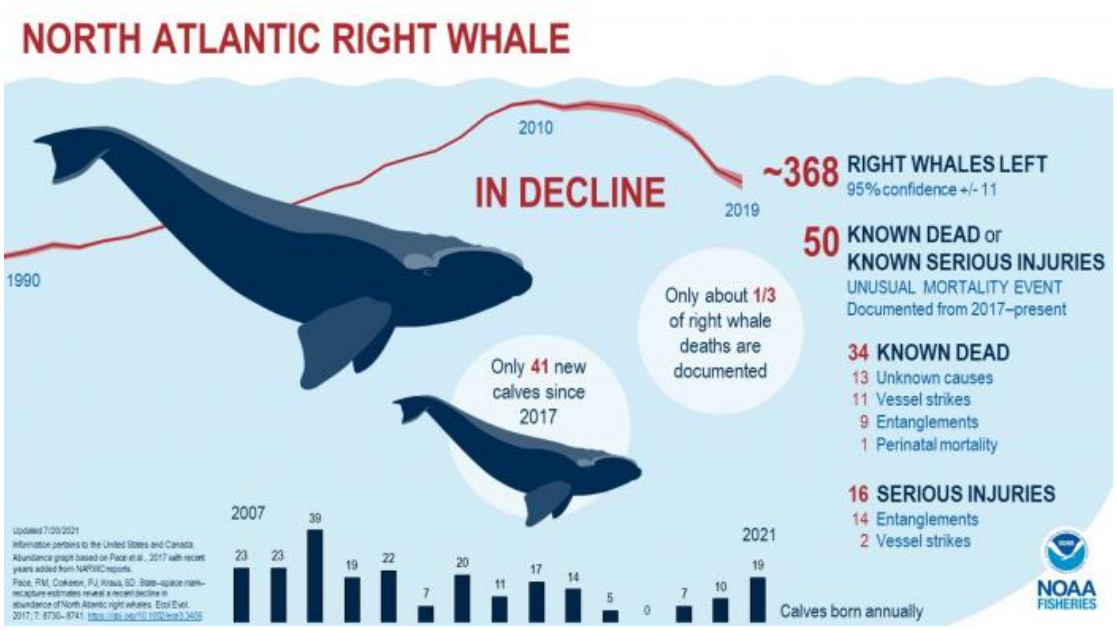

Figure 12: An infographic showing best estimates of current North Atlantic Right Whale population numbers and causes of death during the current Unusual Mortality Event, 2017-present. (NOAA 2021)

* PBR (Potential Biological Removal) is defined by the U.S. Marine Mammal Protection Act as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." Although it has no relevance to Canadian law, it is used as an indicator of impact in Seafood Watch assessments, per the Seafood Watch Standard for Fisheries.

Wolffish (unspecified)

Factor 2.1 - Abundance

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

High Concern

Three species of wolffish that may interact with fisheries are found in the region. Northern wolffish and spotted wolffish are designated as "Threatened" under the Species at Risk Act (SARA), while the Atlantic wolffish is considered a species of special concern (DFO 2018f). Because of their protected status under SARA, the abundance of wolffish species is considered a high concern.

Factor 2.2 - Fishing Mortality

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

Low Concern

There are no directed fisheries for wolffish in the Canadian Atlantic and, although data are lacking regarding the magnitude of fisheries interactions, by-catch (in several fisheries and gear types) is considered the leading cause of human-induced mortality (DFO 2013b)(Fisheries and Oceans Canada 2020b). All wolffish that are caught must be released; however, the proportion of post-release mortality is uncertain. There are no robust estimates of fishing mortality for wolffish inclusive of all fisheries interactions (Kulka et al. 2007). Documented wolffish fisheries interactions data are further confounded by species identification issues, because they are commonly confused with the non-ETP (endangered, threatened, or protected) ocean pout (*Zoarces americanus*) that is quite abundant in the region (Criquet et al. 2019). The Greenland halibut fishery is considered a substantial contributor to wolffish by-catch mortality because there is a high degree of overlap between fishery effort and areas of high density wolffish abundance, whereas documented interactions with pot and trap fisheries are <1% of fishing mortality by weight (Kulka et al. 2007). Because the crab fisheries are not considered to be substantial contributors to wolffish fishing mortality, it is rated a low concern.

Factor 2.3 - Discard Rate/Landings

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine
< 100%

Data are lacking regarding bait use and discards in the directed Jonah crab and rock crab fisheries. Mortality rates for Jonah crab, based on preliminary data from laboratory studies, were 19% in control crab, 56% with one claw removed, and 74% when both claws were removed (Carloni et al. 2016). But the ratio of by-catch to landings has not been studied, so the dead discard amount is uncertain. The average discard rate for crustacean fisheries is estimated at 12.4% (Kelleher 2005). Some information is available for lobster fisheries, from which Jonah and rock crab are retained. In LFAs 27–38 (Maritimes Region), bait use in 2012 represented 52% of lobster landings (mackerel 20%, herring 19%, and rock crab 13%) (Criquet et al. 2015b)(Criquet and Brêthes 2016). Although more robust research is required, it is likely that dead discards plus bait use relative to total landings <100%.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy	Moderately Effective	Ineffective	N/A	N/A	N/A	**Red (1.000)**
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine	Moderately Effective	Ineffective	N/A	N/A	N/A	**Red (1.000)**
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence	Moderately Effective	Ineffective	N/A	N/A	N/A	**Red (1.000)**

Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence	Moderately Effective	Ineffective	N/A	N/A	N/A	**Red (1.000)**

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation
Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy
Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring
Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations
Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion
Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Moderately Effective

The Department of Fisheries and Oceans (DFO) Canada manages the Jonah crab fisheries and the lobster fisheries from which they are retained as by-catch. The fisheries are managed under regional Integrated Fishery Management Plans (IFMPs), including the Offshore Lobster and Jonah

Crab—Maritimes Region IFMP (DFO 2016), and the inshore Lobster Fishing Areas 27–38 IFMP (DFO 2020f). Management measurements intended to protect population sustainability include minimum size limits, prohibition of landing females and ovigerous females, and gear specifications. Effort is controlled through limited entry and, in some regions, with trap number limits, annual catch limits, and area and season closures (see table). Annual catch limits for crab are based on historical landings data or financial viability rather than biological information, due to data limitations for determining suitable reference points. The ability to measure the effectiveness of management measures is limited due to a lack of stock indicators for assessment (DFO 2013).

There are concerns (in LFAs 34 and 38) that minimum size limits for Jonah crab (121 mm carapace width [CW]) are not precautionary enough to effectively protect the reproductive potential of males, because limits were based on market demand and set lower than the size at 50% functional maturity (128 mm CW) {Robichaud & Frail 2006}(Moriyasu 2002).

Jonah crab can be landed in the offshore lobster fishery (LFA 41), and a total allowable catch (TAC) has been established, although landings have been minimal in recent years. The TAC was reduced in 2010 (from 720 t to 540 t) in response to reduced catch rates, and further in 2017 (to 270 t) (DFO 2016). The TAC reduction has not been in place long enough to determine if the current TAC is appropriate for population sustainability.

Management strategy and implementation is rated moderately effective because appropriate reference points have not been defined, but with management measures in place that exceed ineffective or critical scoring along with an inability to assess the effectiveness of management measures (either because of data limitations or the measures have not been in place long enough to evaluate their success).

Fishery	Minimum Size Limits	Prohibits landing females	Limited Entry	Trap Limits	Individual Allocation	Annual Catch Limits (TAC)	Area Closures	Seasonal Closures	Mandatory Logbooks	Dockside Monitoring
Maritimes Scotia-Fundy (LFAs 34–38, directed Jonah crab fishery)	Yes (121 mm CW)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Maritimes Offshore (LFA 41 (4X–5Zc), Jonah crab fishery)	Yes (130 mm CW)	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes

Moderately Effective

The rock crab fishery is limited to a 17-week season in the North Shore region of Quebec and an 18-week season in the Magdelen Islands; opening dates may vary from year to year and the season may be shortened through variation order (DFO 2022c). Access to the fishery is through a limited number of licenses in each sub-area, and there is a limit to the number of traps than can be used, which varies by sub-area (DFO 2022c). The size of traps is also regulated. The rock crab fishery utilizes conical traps and, in the North Shore region, the height of the trap must be between 381 mm and 508 mm, with a maximum lower diameter of 914 mm and a minimum upper diameter of 457 mm (DFO 2022c). In the Magdelen Islands sub-areas, two different sizes of trap may be used (see Justification), of which the numbers are limited to control fishing effort. Each trap must include a minimum of four escape vents, each of which is a circular opening no less than 65 mm in diameter (DFO 2022c). To manage and enforce trap limits, all traps must also bear a single annual tag with a unique identification number (DFO 2022c). Vessel size is limited to a maximum 15.24 m in overall length (DFO 2022c).

In the Magdelen Islands (sub-areas 12A, 12B, and 12C) fishery, a quota of 375,746 mt is in place, which is distributed through individual transferable quotas (ITQs) (DFO 2022c). Also, sub-areas 16B and 16D are managed through quotas (72 mt and 31 mt, respectively), where sub-area 16B has an ITQ system and 16D has a competitive system (DFO 2022c). Harvest is limited to male crabs with a carapace width (CW) of 102 mm or greater; all undersized and female crabs must be returned to the water immediately (DFO 2022c).

Biological reference points have not been developed and a precautionary harvest strategy has not been implemented, but the stock is assessed (most recently in 2018) (DFO 2018) using fishery-dependent indicators.

Management strategy and implementation is scored moderately effective because input and output controls are in place that are reasonably expected to protect the stocks of harvested species; however, a precautionary approach has not been implemented.

Justification:

Trap size limits for the Magdelen Islands sub-areas (from (DFO 2022c)):

Type 1:

- Height: minimum 381 mm; maximum 508 mm
- Lower diameter: 914 mm
- Upper diameter: 457 mm

Type 2:

- Height: minimum 508 mm; maximum 677 mm
- Lower diameter: 1,219 mm

- Upper diameter: 609 mm

Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence

Moderately Effective

The rock crab fishery in the Gaspe and southern Gulf of St. Lawrence region is limited to an 8-week season; opening dates may vary from year to year and the season may be shortened through variation order (DFO 2022c). Access to the fishery is through a limited number of licenses in each sub-area, and there is a limit to the number of traps than can be used, which varies by sub-area (DFO 2022c). The size of traps is also regulated. The rock crab fishery utilizes conical traps and, in the North Shore region, the height of the trap must be between 381 mm and 508 mm, with a maximum lower diameter of 914 mm and a minimum upper diameter of 457 mm (DFO 2022c). Each trap must include a minimum of four escape vents, each of which is a circular opening of no less than 65 mm in diameter (DFO 2022c). To manage and enforce trap limits, all traps must also bear a single annual tag with a unique identification number (DFO 2022c). Vessel size is limited to a maximum 15.24 m in overall length (DFO 2022c).

Also, sub-areas in this region are managed through quotas (see Justification): some have an individual transferable quota (ITQ) system and others have a competitive system (DFO 2022c). Harvest is limited to male crabs with a carapace width (CW) of 102 mm or greater; all undersized and female crabs must be returned to the water immediately (DFO 2022c).

Biological reference points have not been developed and a precautionary harvest strategy has not been implemented, but the stock is assessed (most recently in 2018) (DFO 2018) using fishery-dependent indicators.

Management strategy and implementation is scored moderately effective because input and output controls are in place that are reasonably expected to protect the stocks of harvested species; however, a precautionary approach has not been implemented.

Justification:

Quotas, access (number of licenses), and management regime for sub-areas in the Gaspe and southern Gulf of St. Lawrence region (from (DFO 2022c)).

Sub-areas	Access	Quotas (mt)	Management Regime
12D1 to 12D3	4	75	Competitive with TAC
12D4 to 12D7	4	148.5	Individual quota
12E to 12O	4	81.5	Competitive with TAC
12Q, 12W, and 12X	7	77.5	Competitive with TAC
12Y	7	61.5	Competitive with TAC
12Z	5	101.5	Competitive with TAC

Factor 3.2 - Bycatch Strategy

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Ineffective

Management measures are in place to reduce the impacts of the Canadian Jonah crab and Atlantic rock crab fisheries (and the lobster fisheries from which the species are retained as by-catch) on other species including finfishes, marine turtles, and whales. Trap gear is highly selective, so overall by-catch is low, with some uncertainty in catch composition due to limited by-catch studies and observer data. Risk to by-catch species is mitigated through trap size/material specifications, a requirement for escape vents and biodegradable panels, and limits on soak times (DFO 2013)(DFO 2016)(DFO 2018)(DFO 2020f). In rock crab fisheries, all incidental catch must be returned to the water immediately, except toad crab in sub-areas 12D–12Z and 17 (DFO 2022c).

Finfishes

Fisheries interactions with finfishes (including species of concern: wolffish [spotted and northern], cod, and cusk) are mitigated through the prohibition of landing and requirements for safe release.

Marine turtles

Trap lines in the upper water column overlap with leatherback turtle foraging areas (Hamelin et al. 2017). Mortality and serious injury due to entanglement in crab and lobster fisheries gear is mitigated through time, area, and/or effort restrictions, to minimize interactions with endangered leatherback turtles; however, some LFAs on the Scotian Shelf and LFA 25 remain open when leatherback turtle densities are high, coincident with reported entanglements (Hamelin et al. 2017). In some years, when turtles arrive early or leave the area late, more entanglements have occurred. The number of turtles killed by the fixed-gear fisheries is underestimated due to reporting bias and uncertainty regarding the frequency of post-release mortality. In a comparison of entanglement observations with SARA-mandated logbook data from coastal fixed-gear fisheries, logbook reporting appears to be low (Hurtubise et al. 2020). There is not enough evidence to show that current management is effective at sufficiently reducing the risk of interactions.

Whales

Entanglement in fisheries gear is considered to be a major threat to population persistence of the endangered North Atlantic right whale (NARW) (Moore 2019)(NOAA Fisheries 2021). Historic entanglement mitigation measures have included timing the fishing seasons to minimize the overlap with whale migration times; trap and license limits to minimize the number of entanglement lines in the water; mandatory reporting of endangered, threatened, and protected (ETP) species interactions; a recovery strategy; and an action plan addressing the threat of fisheries interactions {Fisheries and Oceans 2021}.

Despite these measures, there was an increase in NARW deaths in 2017 (12 in Canada attributed to vessel strikes, fisheries entanglement, and unknown sources). Some of the 12 North Atlantic right whale mortalities observed in the Gulf of St. Lawrence (GSL) in 2017 were confirmed to be

the result of entanglement in snow crab fishing gear (Daoust et al. 2017). Other entanglements and mortalities in recent years were attributed to unknown fisheries, because gear marking was not sufficient to identify the source of the entangling gear.

In response to the increase in the observed NARW entanglements, DFO has implemented a suite of measures since 2018 (see Justification below). These have been designed to:

- Improve understanding of impacts to improve mitigation strategies (e.g., increased surveillance via aircraft, drones, and underwater gliders and acoustic devices; reporting of lost gear and marine mammal interactions by fishers; gear marking)
- Reduce entanglement risk and impacts (e.g., through static and dynamic closures in the GSL snow crab fishery in 2018, later expanded to all fixed gear fisheries; funding and permitting ropeless gears and weak links; funding disentanglement efforts).

Few analyses have been conducted on the effectiveness of these measures to reduce fishing mortality to below the potential biological removal (PBR) of North Atlantic right whale. A NOAA study concluded that the closures in place in United States and Canadian fisheries by the end of 2018 were expected to be effective regionally but may not be sufficient to allow recovery of NARW {Hayes et al. 2018a}. A recent publication by (Cole et al. 2021) found that these same closures in the GSL snow crab fishery led to displacement of effort to areas outside the closed areas, producing a higher threat of entanglement in these new areas. The authors note that, although there was a lower quota and a reduced trap limit in 2018 than in 2017, fishing effort did not change. Most recently, a risk analysis commissioned by DFO (Cole and Brillant 2021) found an entanglement risk reduction of 61.3% in the GSL snow crab fishery from 2018 to 2021 (the authors did not evaluate other crab fisheries or the lobster fishery). The authors concluded that, even though the efforts and accomplishments to date are commendable, they are not enough to ensure the survival of North Atlantic right whale. The authors are currently working on a more comprehensive risk analysis of the GSL snow crab fishery, which will likely result in different risk reduction values than in the published report. They are also planning to expand the assessment to other fixed-gear fisheries in the future (pers. comm., Alexandra Cole, July 29, 2022).

In the meantime, there continue to be entanglements in Canadian fisheries (e.g., NARW #4615, which was entangled in the Gulf of St. Lawrence in 2021 and is currently listed as a serious injury) (NOAA 2022a) and mortalities due to entanglements in unidentified fisheries, which could originate in either Canadian or United States waters (e.g., NARW #1226 "Snake Eyes," which was seen entangled in the Gulf of St. Lawrence and later found dead off Long Island, NY in 2019) (NOAA 2022a). Currently, an average of 5.1 NARWs are known to be seriously injured or killed each year by unidentified fisheries (Hayes et al. 2021). Until it becomes clear which fisheries are responsible, all fisheries that overlap with North Atlantic right whale migrations and are known to entangle the species are potential sources of entanglements, which may result in mortalities.

Ghost gear

DFO has implemented a number of measures and efforts to mitigate the impacts of lost ("ghost") gear, as part of a broader government commitment to reduce the impacts of plastics in the oceans

(see Justification). Many of these are applicable to snow, lobster, and Atlantic crab fisheries, including requiring biodegradable panels, requiring that lost gear is reported, and conducting and funding efforts to reduce gear loss and retrieve gear when it is lost.

Although there are no known interactions between rock crab, Jonah crab, or lobster fisheries in Canada, the impact of fisheries on NARW far exceeds the potential biological removal for the species and is dominated by impacts from unknown fisheries, of which Canadian crab and lobster fisheries may be a part. By-catch management is therefore considered ineffective at reducing the impact of fishing on nontarget species.

Justification:
Measures to protect NARW by year (taken verbatim from (DFO 2022a)):

2018

- Introduced static and dynamic fishery area closures
- Introduced case-by-case measures to address sightings of three or more whales or a mother and calf anywhere in Atlantic Canada and Quebec
- Introduced new mandatory requirements for harvesters to report lost gear and all marine mammal interactions
- Introduced new measures to reduce rope and to better track buoys
- Introduced new gear marking requirements for harvesters in Crab Fishing Area 12
- Changed the Marine Mammal Regulations to ensure vessels stay at least 100 m from whales
- Invested in new whale detection technologies and new acoustic technologies, through the Oceans Protection Plan
- Supported industry-led pilot projects on new gear modifications to prevent entanglements
- Invested $1 million per year (permanent) to support marine mammal response activities
- Logged 2500 flight hours

2019

- Amended the static fishery closure area to cover an area where 90% of right whales were spotted in 2017
- Expanded the dynamic fishery closure area to cover the entire Gulf of St. Laurence
- Introduced new temporary fishery closure restrictions in shallow waters (less than 20 fathoms)
- Organized a gear retrieval operation in the Gulf of St. Lawrence, which removed over 100 traps and almost 10 km (6 miles) of rope
- Invested an additional $1.2 million over four years to support Marine Mammal Response activities
- Increased surveillance via aircraft, drones, and underwater gliders and acoustic devices.
- Logged 3,000 flight hours

2020

- Introduced a new season-long closure area protocol
- Expanded the dynamic fishery closure area into the Bay of Fundy
- Introduced mandatory gear markings for all fixed gear fisheries in Eastern Canada, rock crab fisheries identified by a green-blue mark.
- Authorizing ropeless gear trials in closed areas
- Created a $8.3 million Ghost Gear Fund, to assist in the retrieval and recycling of harmful ghost gear from the oceans. This program helped facilitate the removal of 63 tonnes of ghost gear in Atlantic Canada.
- Logged over 2,500 flight hours

2021

- Modified closure protocols for greater certainty on the continued presence of whales in closed areas
- Established a new technical working group for harvesters, right whale experts, and departmental officials
- Invested an additional $8.4 million in the Ghost Gear Fund, with a focus on ghost gear retrieval in the Gulf of St. Lawrence
- Invested an additional $8 million over 2 years through Nature Legacy to increase capacity to detect North Atlantic right whales in near real-time
- Launched the $20 million Whale Safe Gear Adoption Fund to help harvesters transition to whalesafe gear (i.e., weak breaking points or links) by 2023. This fund also supports ropeless/rope-on-demand technologies.
- Logged over 2,800 flight hours

2022

- Maintaining 2021 closure protocols
- Working with harvesters, fishery by fishery, to implement mandatory whalesafe gear requirements by 2023
- Increasing the number of near real-time acoustic devices for monitoring and detection

Canadian measures to reduce the impact of ghost gear (unless otherwise cited, the information below is from the DFO Ghost gear website (DFO 2020l):

- All snow crab, lobster and Jonah/Atlantic crab traps must use biodegradable twine in some portion of the pots' netting to reduce crab mortality in ghost gear (based on a review of all the available IFMPs for these fisheries).
- In 2018, the Canadian government joined the Global Ghost Gear Initiative.
- In 2019, the Canadian Coast Guard conducted a 3-day ghost gear retrieval operation in the GSL. The goal was to help prevent entanglements with marine mammals, and increase the sustainability of Canada's Atlantic fisheries. During this operation, 100 snow crab traps and 9 km of rope were removed (DFO 2020j); however, reports from participants in this effort indicate DFO did not permit all observed ghost gear to be collected upon request, and a North Atlantic right whale was entangled in the area shortly thereafter (pers. comm., Amy Knowlton, September 21, 2020).

- In 2019, DFO created the Canadian Ghost Gear Program, which runs from 2020 to 2022. To date, the program has funded 49 projects, for a total of CAN 16.7 million. Of these, 45 were located in Canada and 4 were international. A number of them focused on gear loss prevention and gear retrieval in crab and lobster fisheries in Atlantic Canada. As of April 2022, DFO reports that 7,342 units of gear with a total weight of 1,295 tonnes were retrieved from Canada's waters (East and West Coasts combined), in addition to 153 km of rope.
- Since 2020, reporting of lost and retrieval of previously reported lost gear has been mandatory in all Canadian commercial fisheries. Fish harvesters and authorized retrievers can use PDF forms or an online Fishing Gear Reporting System to report lost gear.
- In 2020, DFO hosted a Gear Innovation Summit with the aim of exploring whale-safe fishing technologies and strategies as well as methods designed to reduce and mitigate the risk of abandoned, lost, and discarded fishing gear (DFO 2020l). The summit was about raising awareness, and did not attempt to focus on solutions or recommendations.

Factor 3.3 - Scientific Research And Monitoring

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

N/A
In cases where either Factor 3.1 or 3.2 scores ineffective, Factor 3.3 is not scored because the overall score for Criterion 3 is a very high concern (1), regardless of how a fishery performs against Factor 3.3.

Factor 3.4 - Enforcement Of Management Regulations

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

N/A
In cases where either Factor 3.1 or 3.2 scores ineffective, Factor 3.4 is not scored because the overall score for Criterion 3 is a very high concern (1), regardless of how a fishery performs against Factor 3.4.

Factor 3.5 - Stakeholder Inclusion

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

N/A

In cases where either Factor 3.1 or 3.2 scores ineffective, Factor 3.5 is not scored because the overall score for Criterion 3 is a very high concern (1), regardless of how a fishery performs against Factor 3.5.

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**
Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management
Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*

- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Score: 3

The Jonah and Atlantic rock crab trap/pot fisheries and the lobster fisheries in which they are by-catch are carried out on a variety of benthic habitats, including complex, hard rocky bottoms and mud, sand, and gravel bottoms, and traps have contact with the seabed. Although single traps are generally accepted as low- to moderate-impact gear (Fuller et al. 2008), the sheer volume of traps being fished can have cumulative effects on bottom habitats (Smolowitz 1998). The impact of the crab and lobster traps is scored a 3.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Score: 0

Trap gear is generally considered to have a low to moderate impact on benthic habitats compared to mobile gear (such as trawl gear) and is deployed in less-vulnerable habitats (Fuller et al. 2008). Although DFO has measures in place to control fishing effort in the region, there is no specific mitigation of gear impacts on benthic habitats for the Jonah and Atlantic rock crab fisheries or the associated lobster fishery in which they are landed as by-catch. Conservation areas (marine protected areas and marine refuges) are in place to protect juvenile lobster habitat and coral communities, and to prevent fishing in deepwater habitat, but they do not cover a substantial portion of the lobster/crab fishing regions (DFO 2020b). Because management measures do not protect >20% of habitat from trap fishing, and gear modifications do not reduce direct impact to habitat, mitigation of gear impacts is rated a 0.

Factor 4.3 - Ecosystem-based Fisheries Management

Northwest Atlantic | Pots | Canada | Quebec Gulf and Northern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Southern Gulf of St. Lawrence
Northwest Atlantic | Pots | Canada | Maritimes Bay of Fundy
Northwest Atlantic | Pots | Canada | Maritimes Gulf of Maine

Moderate Concern

Ecological impacts of the fishery are managed through fishing effort reduction via trap limits and gear specifications (escape vents and biodegradable panels) to minimize impacts on food webs (DFO 2013)(DFO 2016)(DFO 2018)(DFO 2020f). Knowledge of the ecological interactions of Jonah crab and Atlantic rock crab (as predator and prey) is lacking for developing robust, ecological-based fisheries management. Atlantic rock crab is considered a keystone species (DFO 2018) and, based on data from the Gulf of St. Lawrence, has important roles in the food web and in energy cycling as both predator and prey (Hanson et al. 2014). Atlantic rock crab is eaten primarily by American lobster, small pelagic fishes (as larvae), and demersal fishes (DFO 2016). Atlantic rock crab cannibalize each other as well as prey upon fishes, shrimp, bivalves, and polychaetes. At smaller sizes, Jonah crab is preyed upon by fishes (sculpin, cunners, and skates), lobsters, and crabs. Jonah crab preys upon other invertebrates (shellfish, gastropods, barnacles, echinoderms, and polychaetes) and scavenges on dead fishes or lobsters. Although research is ongoing to determine how best to inform ecosystem-based fishery management, more data are needed regarding ecosystem functioning, predator–prey dynamics, and for incorporating ecosystem indicators to the stock assessment process (Bundy et al. 2017). Because the possibility of detrimental food web effects requires more research or stronger policies to fully protect the ecological role of harvested species, ecosystem-based management is rated a moderate concern.

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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