Monterey Bay Aquarium
Seafood Watch

Environmental sustainability assessment of wild-caught northern quahog and softshell clam from Canada caught using hand implements



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Species:	Northern quahog (*Mercenaria mercenaria*) Softshell clam (*Mya arenaria*)
Location:	Canada: Northwest Atlantic
Gear:	Hand implements
Type:	Wild Caught
Author:	Seafood Watch
Published:	March 4, 2024
Report ID:	28259

Assessed using Seafood Watch 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 assesses the sustainability of northern quahog or hard clam (*Mercenaria mercenaria*) and softshell clam (*Mya arenaria*) caught in Canadian Atlantic waters with rakes, shovels, or picks. The ratings in this assessment cover virtually all landings of northern quahog and softshell clam in Canada. Softshell clam from Quebec receives a Green rating, while clams from other regions receive a Yellow rating.

Northern quahog is found in the Western Atlantic from the southern Gulf of St. Lawrence, Canada to Florida, United States as well as in the Gulf of Mexico as far south as the Yucatan Peninsula, Mexico. It begins life as male and changes to female as it grows, typically living for around 8 years. Softshell clam has a worldwide distribution. Along the North American Atlantic Coast, it ranges from Labrador, Canada to North Carolina, United States. Softshell clam may live for 10 to 12 years and grow to more than 11 cm.

In Canada, hard clam is commercially fished in the southern Gulf of St. Lawrence (Gulf Management Region) and the Maritimes Management Region, and softshell clam is fished in the Gulf, Maritimes, and Quebec Management Regions. The abundance of hard clam and softshell clam is uncertain in all regions, but several management regulations are in place, such as minimum size limits, softshell clam limits, and closed fishing seasons. The fisheries are managed by the Department of Fisheries and Oceans Canada (DFO).

Fishers use hand-held tools including rakes, shovels, and picks to capture clams. These fishing gears result in minimal bycatch, but cause low damage to bottom habitats.

Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Northern quahog | Northwest Atlantic | Canada | Hand implements | Gulf Management Region	2.644	5.000	3.000	3.000	**Good Alternative (3.303)**	Unknown
Northern quahog | Northwest Atlantic | Canada | Hand implements | Maritimes Region	2.644	5.000	3.000	3.000	**Good Alternative (3.303)**	Unknown
Softshell clam | Northwest Atlantic | Canada | Quebec | Hand implements	3.413	5.000	3.000	3.000	**Best Choice (3.520)**	10
Softshell clam | Northwest Atlantic | Canada | Hand implements | Gulf Management Region	2.644	5.000	3.000	3.000	**Good Alternative (3.303)**	Unknown
Softshell clam | Northwest Atlantic | Canada | Hand implements | Maritimes Region	2.644	5.000	3.000	3.000	**Good Alternative (3.303)**	Unknown

The Department of Fisheries and Oceans Canada does not separate landings data by species, and some data are suppressed for confidentiality reasons. The total reported landings for all clams in the Atlantic regions, including those landings that were confidential, were reported to be 47,685 MT in 2021 (DFO 2023b). Softshell clam is the only species/region to have regularly conducted stock assessments, the most recent of which reported 10.8 MT landed in 2022 (DFO 2023).

Summary

Northern quahog caught using hand implements in the Gulf Management Region and Maritimes Management Region and softshell clam caught using hand implements in the Gulf and Maritimes Management Regions receive a Yellow rating, because of uncertainty surrounding stock status, little to no bycatch, moderately effective management, moderate protection of the ecological role of these species, and the impacts of the fishing gear on the substrate. Softshell clam caught using hand implements in the Quebec Management Region receive a Green rating, because of greater understanding surrounding the stock status from regular monitoring, as well as little to no bycatch, moderately effective management, moderate protection of the ecological role of these species, and the impacts of the fishing gear on the substrate.

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 covers northern quahog (often referred to as bay quahog) or hard clam (*Mercenaria mercenaria*) and softshell clam (*Mya arenaria*) fisheries in Canadian Atlantic waters. The hard clam is commercially fished in the southern Gulf of St. Lawrence (Gulf Management Region) and Maritimes Management Region, while the softshell clam is fished in the Gulf, Maritimes, and Quebec Management Regions. The ratings in this assessment cover most landings of northern quahog and softshell clam in Eastern Canada. Fishers use handheld tools including rakes, shovels, and picks to capture clams.

Species Overview

Northern quahog is found in the western Atlantic from the southern Gulf of St. Lawrence, Canada to Florida, United States as well as in the Gulf of Mexico as far south as the Yucatan Peninsula, Mexico (Abraham and Dillon 1986)(DFO 2001). It primarily lives in estuaries or sheltered bays, and is found to a depth of 15 meters (m) on sandy, silty, and mud bottoms. It buries 5 to 10 cm below the sediment surface. Its distribution often overlaps with the eastern/American oyster. The hard clam has a thick white shell, with a shiny purple color on the edge of the anterior end (DFO 1996a)(DFO 1996e)(DFO 2001). It begins life as male and changes to female as it grows; it reaches maturity at 1 year, the typical lifespan is between 4 and 8 years, but it may live to 36 years without predation or harvest (Abraham and Dillon 1986). Fecundity increases with age and varies with size and condition, and ranges from 2 to 25 million eggs annually (Abraham and Dillon 1986). Fertilization is external, with both sperm and eggs expelled through the siphon ring during late spring and early summer (Rice 1992).

Softshell clam has a worldwide distribution. Along the North American Atlantic Coast, it ranges from Labrador, Canada to North Carolina, United States (DFO 2001)(DFO 2011). It lives in estuaries and sheltered bays with a muddy-sand substrate, and buries 20 to 35 cm below the sediment surface. The softshell clam has a long, thin, brittle white shell (DFO 2001)(DFO 2011). Softshell clam grows to more than 11 cm, and may reach 28 years of age (Abraham and Dillon 1986)(Maximovich and Guerassimova 2003)(DFO 2011).

In Canada, hard clam is commercially fished in the Gulf Management Region and Maritimes Management Region, while softshell clam is fished in the Gulf, Maritimes, and Quebec Management Regions (Figure 1). The fisheries are managed by the Department of Fisheries and Oceans Canada (DFO).

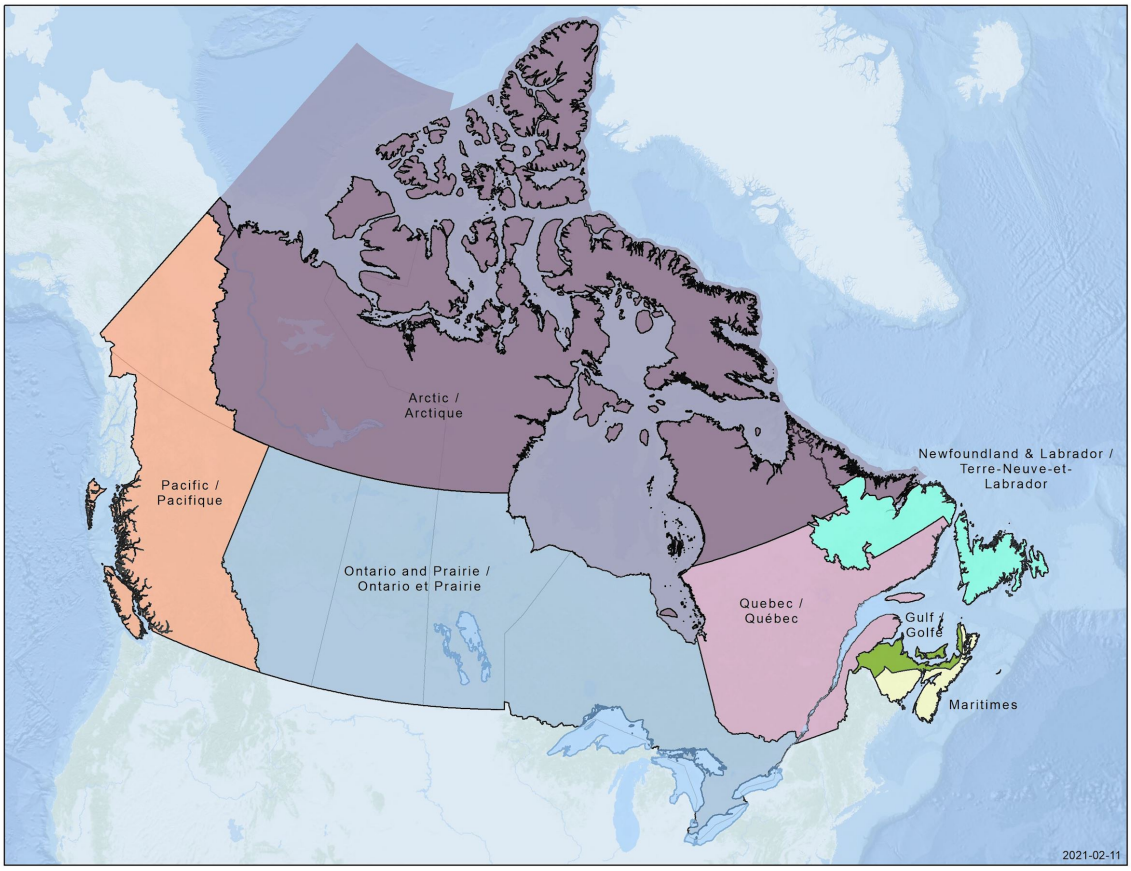


Figure 1: Map of the Department of Fisheries and Oceans Canada (DFO) Management Regions. Image from DFO.

Production Statistics

DFO does not separate landings data by species, except in the Quebec Region, and some data are suppressed for confidentiality reasons. The total reported clam landings in the Atlantic region, including confidential landings, were 47,685 MT in 2021 (DFO 2023b).

Gulf Region

Commercial clam catches [which include bar clam (*Spisula solidissima*), not included in this report] have been declining in the Gulf Region over the last decade. But updated landings information for this region is not available.

Maritimes Region

Commercial catches of clam in the Maritimes Region have fluctuated over the years. Landings of all clam species in the Maritimes Region (Nova Scotia; New Brunswick did not have reported landings) were approximately 25,394 MT in 2021 (DFO 2022).

Quebec Region

In Quebec, commercial catches of softshell clam have been historically low since 2010, with 10.8 MT

landed in 2022 (DFO 2023c).

Importance to the US/North American market.

Available import/export statistics for "clam" generally do not provide a species-level breakdown of data. Therefore, the following data are for all unspecified clams and not specific to the fisheries in this report. In 2022, the United States imported a total of 9,530 mt of prepared/preserved clams, 6,325 mt of boiled canned clams, 2,327 mt of live/fresh clams, and 3,013 mt of frozen/dried/salted/brined clams (NOAA 2023). The largest imports were from China (10,530 mt), followed by Canada (3,732 mt), Vietnam (3,344 mt), and Indonesia (1,271 mt) (NOAA 2023).

Common and market names.

Other common and market names for hard clam include bay quahog, northern quahog, cherrystone, and littleneck. Other common and market names for softshell clam include steamer or maninose clam.

Primary product forms

Hard clam/northern quahog is often served raw on the half shell (littlenecks), baked, or used in dishes such as clam chowder or clam sauces (cherrystone and chowder clams). Softshell clam is commonly served steamed or fried.

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

NORTHERN QUAHOG			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northwest Atlantic | Canada | Hand implements | Gulf Management Region	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northwest Atlantic | Canada | Hand implements | Maritimes Region	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

SOFTSHELL CLAM			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northwest Atlantic | Canada | Quebec | Hand implements	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northwest Atlantic | Canada | Hand implements | Gulf Management Region	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northwest Atlantic | Canada | Hand implements | Maritimes Region	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

In Canada, hard clam is commercially fished in the southern Gulf of St. Lawrence (Gulf Management Region) and the Maritimes Management Region, while softshell clam is fished in the Gulf, Maritimes, and Quebec Management Regions. Abundance and fishing mortality relative to sustainable levels are unknown in most regions; however, these clam species are not considered highly vulnerable to fishing. Overall, there is moderate concern for the impacts of the fisheries on the hard clam and softshell clam populations. Populations of softshell clams in Quebec are better studied, and conservation measures are in place to protect the exploited populations.

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.*

Northern quahog

Factor 1.1 - Abundance

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

Moderate Concern

There has been no formal population assessment of hard clam in the Gulf or Maritimes Management Regions, so abundance relative to target abundance goals is unknown. Declines in hard clam densities and landings were reported in the 1990s (DFO 1996a)(Landry et al. 2001)(DFO 2001). Recent abundance information is not available. Because abundance is unknown and hard clam is not highly vulnerable (vulnerability score = 2.73) to fishing, we have awarded a score of moderate concern.

Justification:

Productivity attribute	**Relevant Information**	**Risk (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	1 to 3 years (Abraham and Dillon 1986)	1
Average maximum age	8 years (Bricelj et al. 2017)	1
Fecundity	2 to 25 million (Abraham and Dillon 1986)(Rice 1992)	1
Reproductive strategy	Broadcast spawner (Rice 1992)	1
Trophic level	2.1 for mollusks {Jacobsen and Bennett 2013}; northern quahog is a primary consumer	1
Density dependence score	Depensatory dynamics (Allee effect) demonstrated or likely at low population sizes (Mann et al. 2005)	3
Habitat quality	Moderately compromised (DFO 2005)	2
Productivity score = 1.42		
Susceptibility Attribute	**Relevant Information**	**Risk (1 = low risk, 2 = medium risk, 3 = high risk)**
Areal overlap (considers all fisheries)	Most of the species concentration is fished, considering all fisheries	3
Vertical overlap (considers all fisheries)	Default score for target species	3
Selectivity of fishery	Default; conditions under "high risk" do not apply	2
Post-capture mortality (specific to fishery under assessment)	Default for retained species	3
Susceptibility score = 2.33		
Total vulnerability score = 2.73		

Factor 1.2 - Fishing Mortality

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

Moderate Concern

There has been no formal assessment of the hard clam population, so fishing mortality is unknown. Commercial catches of hard clam have declined considerably since the 1990s/early 2000s. From 1990 to 2005, hard clam catches averaged 850 mt (DFO 1996a) (pers. comm., DFO, Gulf

Region 2016b). In 2016, 730 mt of hard and softshell clams were landed in the Gulf Region, and 741 mt were landed in the Gulf Region during 2017 (DFO 2016d)(DFO 2017a). Because the sustainability of fishing mortality is unknown, we award a score of moderate concern.

Softshell clam

Factor 1.1 - Abundance

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

Moderate Concern

There has been no formal assessment of softshell clam in the Canadian Gulf Region or Maritimes Region, so abundance relative to target abundance goals is unknown. Declines in catches, particularly in eastern New Brunswick, were observed in the 1990s and 2000s, prompting concern over the health of the population. In 2006, scientists evaluated the status of the softshell clam resource in three areas of Eastern New Brunswick (Richibucto region, Tabusintac watershed, and Heron Island) by interviewing fishers, managers, and conservationists (Hicks and Ouellette 2011). The consensus was that the abundance of softshell clam was very low in the Richibucto region, stable in the Tabusintac watershed, and recovering in Heron Island (Hicks and Ouellette 2011). Further abundance information is not available for this region.

The last status reports for the softshell clam resource in the Maritimes were in 1996, which suggested that certain beds may have been in decline (DFO 1996d)(DFO 1996c), but this dated information is not used for scoring in this report. Abundance in the Maritimes is therefore considered unknown.

Because abundance is unknown, the status reports are over 20 years old, and this species has a medium vulnerability to fishing (vulnerability score = 2.89; see PSA scoring in Justification), we award a score of moderate concern for both regions.

Justification:

Productivity attribute	**Relevant Information**	**Risk (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	5 years (Ayers 1956)(Abraham and Dillon 1986)	2
Average maximum age	10 to 12 years (Abraham and Dillon 1986)	2
Fecundity	100,000 to 5 million (Jensen 2010)	1
Reproductive strategy	Broadcast spawner (Jensen 2010)	1
Trophic level	2.1 for mollusks {Jacobsen and Bennett 2013}	1
Density dependence score	Depensatory dynamics may limit recruitment (Glaspie et al. 2018)	3
Habitat quality	Moderately altered (DFO 2005)	2
Productivity score = 1.71		
Susceptibility Attribute	**Relevant Information**	**Risk (1 = low risk, 2 = medium risk, 3 = high risk)**

Areal overlap (considers all fisheries)	Most of the species concentration is fished, considering all fisheries	3
Vertical overlap (considers all fisheries)	Default score for target species	3
Selectivity of fishery	Default; conditions under "high risk" do not apply	2
Post-capture mortality (specific to fishery under assessment)	Default for retained species	3
Susceptibility score = 2.33		
Total vulnerability score = 2.89		

Northwest Atlantic | Canada | Quebec | Hand implements

Moderate Concern

Commercial fishing for softshell clam in the Quebec Region primarily takes place on the Upper North Shore. There are several data-limited assessment indicators for clams in this region; assessment methods are based on fishery-dependent data and on limited survey data. First, researchers use a measure of effort in vendor days (kg/vendor-day) to calculate catch per unit effort (CPUE) proxy and therefore monitor major clam beds (Figure 2). CPUE has varied significantly in recent years because of a sharp decline in effort, making it difficult to determine trends in these regions (DFO 2023c). The average size of clams landed between 2020 and 2022 was between 65 mm and 75 mm, and the proportion of sublegal size clams has been less than three percent in all beds (Figure 3) (DFO 2023c).

While these data-limited assessment methods suggest that the clam stock in the Upper North Shore may be stable, there is considerable uncertainty because scientific data on the total available biomass are limited. Because of this uncertainty and this species' medium vulnerability to fishing (see PSA), we have awarded a score of moderate concern.

Justification:

Sub-area, sector or region	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022				
1A- Bay of Petites Bergeronnes 1A-	78	86	91		96	-	-	-	103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bay of Grandes Bergeronnes 1A-	-	542	452		-	121	101	105	102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Batture à Théophile	-	-	-	-	-	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1A- Escoumins Bay 1A-	-	-	-	-	-	-	135	87	109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leaning Islands	68	63	72	53	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1A- Pointe à Émile 1A-	-	36	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pointe à Boisvert 1A- Pointe	52	56	63	68	52	49	32	76	-	-	21	-	-	-	-	-	-	-	-	-	39	31	40	29	
de Mille-Vaches 1A- Bay of	82	83	78	64	49	56	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Horses * 1A- Banc Marie-	110	101	106	97	84	87	73	109	76	63	55	94	67	94	88	109	66	134	107	242	41				
Marthe * 1A- South Didier	103	108	113	83	89	81	92	109	106	69	24	52	63	103	90	73	63	91	113	152	-				
Bay *	62	91	96	80	80	93	62	104	-	-	-	-	-	-	111	-	53	121	45	93	-				
1A- Baie des Plongeurs * 1A-	80	84	96	108	73	63	94	-	-	-	-	-	-	-	123	100	80	64	170	159	-				
Battures aux Gibiers Est 1A-	70	101	44	-	-	-	76	-	-	-	-	-	-	-	135	-	-	-	-	-	-				
Cran à Gagnon *	80	73	96	53	50	59	63	-	-	-	-	-	65	92	81	55	-	46	-	-	-				
1A- White River	-	205	240	-	-	98	99	107	-	-	-	-	-	-	-	-	-	-	-	-	-				
1A- Anse du Colombier	57	83	88	94	61	53	58	67	-	-	-	-	44	61	48	38	42	14	-	-	-				
1A- Anse à Norbert 1A-	95	100	83	81	63	60	59	-	-	-	-	-	24	-	41	-	-	-	-	-	-				
Anse Noire	86	69	83	99	60	58	-	22	-	-	-	-	-	-	102	-	-	-	-	-	-				
1A- Jeremie Islands	93	87	111	117	107	88	108	127	135	-	-	-	71	-	130	-	-	-	-	229	-				
1B- Pointe-aux-Outardes West	-	-	-	92	120	80	52	72	-	85	76	82	75	83	57	101	107	93	80	86	84				
1B- Pointe-aux-Outardes East	-	-	-	83	79	71	55	90	83	62	73	106	73	74	51	-	18	28	14	18	-				
1B- Mistassini River	98	145	173	110	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
1B- Saint-Nicolas Bay	114	99	106	107	143	-	-	-	-	-	-	84	39	-	45	-	-	-	-	-	-				
1C- South Pessamit Reserve	72	110	125	80	57	62	66	86	37	-	63	-	-	34	42	-	-	-	-	-	-				

Figure 2: Catch per unit effort (kg/vendor-days) by shellfish sector in the Haute-Côte-Nord from 2002 to 2022. Sectors marked with an asterisk (*) are reserved exclusively for commercial fishing (DFO 2023c).

Shellfish sector	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Subzone 1A																		
Little Bergeronnes	-	-	-	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leaning Islands	-	-	-	-	-	-	-	-	-	-	-	58	-	-	-	-	-	-
Pointe a Boisvert	59	61	60	58	-	-	-	67	-	-	-	-	-	-	-	-	-	-
Pointe de Mille-Vaches	69	57	66	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bay of Horses * Bench	62	58	59	59	56	-	-	67	-	-	60	65	-	72	-	-	-	75
Marie-Marthe *	60	60	64	62	62	-	-	-	-	-	65	65	67	74	73	74	74	67
Baie Didier Sud * Baie des	-	50	53	-	52	-	-	-	-	-	-	61	-	72	71	-	-	-
Plongeurs * Battures aux	53	50	54	50	-	-	-	-	-	-	-	64	69	71	-	-	72	67
Gibiers Est Cran à Gagnon	-	-	-	-	-	-	-	-	-	-	-	64	-	-	71	-	-	-
*	-	49	57	60	58	-	-	-	-	-	59	62	-	-	-	-	-	-
Anse du Colombier	-	57	-	53	57	58	-	-	-	-	58	58	-	-	-	-	-	65
Anse a Norbert	-	-	-	52	-	-	-	-	-	-	-	60	-	-	-	-	-	-
Anse Noire	-	-	-	-	-	-	-	-	-	-	-	58	-	-	-	-	-	-
Jeremie Islands	-	-	-	55	56	64	-	-	-	-	-	61	-	-	-	-	70	-
Subzone 1B																		
Pointe-aux-Outardes West	73	73	74	78	71	75	74	69	64	66	69	72	66	65	67	-	-	67
Pointe-aux-Outardes East	-	64	65	66	71	65	-	-	66	-	66	67	-	-	-	-	-	-
Mistassini River	-	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
St. Nicholas Bay	53	53	-	-	-	-	-	-	-	-	-	60	-	-	-	-	-	-
Subzone 1C																		
South Pessamit Reserve	62	65	61	58	59	62	-	-	-	-	65	74	-	-	-	-	-	-
Number of individuals measured																		
Subzone 1A	2,867	6,090	10,507	7,554	11,027	774	0	294	0	0	6,182	7,241	600	1,493	451	600	750	1,218
Subzone 1B	7,265	7,425	4,364	5,382	4,506	5,554	600	1,500	1,800	1994	4,956	4,654	1,200	1,050	900	0	0	308
Subzone 1C	2,446	3,036	3,618	3,321	3,191	3,547	0	0	0	0	3,032	150	0	0	0	0	0	0

Figure 3: Average size (mm) of clams landed by shellfish sector on the Upper North Shore and number of individuals measured by subzone from 2005 to 2022. Sectors marked with an asterisk (*) are reserved exclusively for commercial fishing (DFO 2023c).

Factor 1.2 - Fishing Mortality

Northwest Atlantic | Canada | Hand implements | Gulf Management Region

Moderate Concern

There has been no formal assessment of softshell clam in the Gulf Management region, so fishing mortality is unknown. Previous reports have suggested that overfishing may have occurred in the past (DFO 1996b)(DFO 2001)(Hicks and Ouellette 2011). In the Gulf, softshell clam is fished off the coasts of eastern New Brunswick and marginally in Nova Scotia and Prince Edward Island, but catches have historically been greater in eastern New Brunswick (DFO 1996b). Softshell clam has historically been the most important commercially exploited clam species in eastern New Brunswick, but catches have declined over time (Hicks and Ouellette 2011). Total softshell clam catches for the Gulf Region averaged 860 mt during the 1990s, 785 mt from 2000 to 2009, and 450 mt since 2010. The number of licensed fishers in the fishery has also declined. Recreational catches are not reported and there is likely underreporting of commercial catches (Hicks and Ouellette 2011). Declines in landings could be explained by socioeconomic factors, reduced productivity of clam populations, and habitat degradation (Hicks and Ouellette 2011). Because the sustainability of current fishing rates is unknown, we award a score of moderate concern.

Northwest Atlantic | Canada | Hand implements | Maritimes Region

Moderate Concern

There is no recent information on the status of the softshell clam resource in the Maritimes Region. Commercial catches have fluctuated over the years (Figure 4) and have averaged 1,200 mt from 2011 to 2015 (pers. comm., DFO, Maritimes Region 2016). Because fishing mortality relative to a

sustainable level is unknown, we award a score of moderate concern.

Justification:

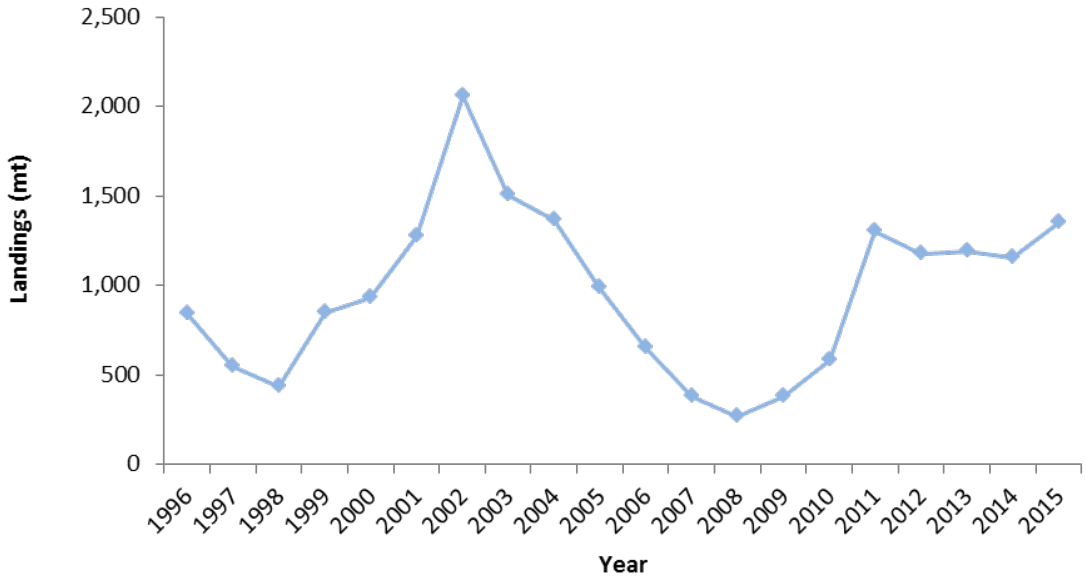


Figure 4: Commercial landings of softshell clam in the Maritimes Management Region from 1996 to 2015. Data from DFO Maritimes Region.

Northwest Atlantic | Canada | Quebec | Hand implements

Low Concern

Commercial catches of softshell clam in Quebec peaked at around 1,200 mt in 2000 but have since declined to less than 100 mt, and 10.8 mt in 2022 (Figure 5) (DFO 2023c). A total allowable catch (TAC) was set in 2015 for the Upper North Shore, which is currently the only area with a commercial softshell fishery. Individual TACs are set in different areas to maintain reproductive potential of each area; annual TACs are set so catches do not exceed 10% of the commercial biomass (DFO 2017a). The number of fishers participating in the fishery and fishing effort have declined, TACs have not been exceeded since implementation in 2015, commercial landings are typically around 50% of TACs, and there is no evidence to suggest that recreational landings are high. Fishing mortality is likely below sustainable levels, and we award a score of low concern.

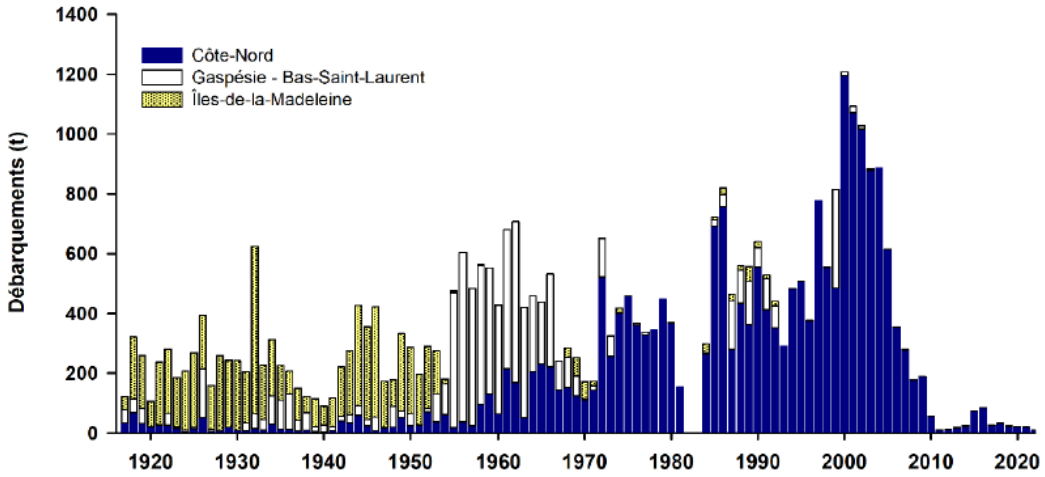


Figure 5: Annual commercial clam landings by region of Quebec through 2022 (DFO 2023c).

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.

NORTHERN QUAHOG			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Northwest Atlantic | Canada | Hand implements | Gulf Management Region	5.000	1.000: < 100%	Green (5.000)
Northwest Atlantic | Canada | Hand implements | Maritimes Region	5.000	1.000: < 100%	Green (5.000)

SOFTSHELL CLAM			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Northwest Atlantic | Canada | Quebec | Hand implements	5.000	1.000: < 100%	Green (5.000)
Northwest Atlantic | Canada | Hand implements | Gulf Management Region	5.000	1.000: < 100%	Green (5.000)
Northwest Atlantic | Canada | Hand implements | Maritimes Region	5.000	1.000: < 100%	Green (5.000)

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 | CANADA | HAND IMPLEMENTS | GULF MANAGEMENT REGION			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northern quahog	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHWEST ATLANTIC | CANADA | HAND IMPLEMENTS | GULF MANAGEMENT REGION			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Softshell clam	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHWEST ATLANTIC | CANADA | HAND IMPLEMENTS | MARITIMES REGION			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Softshell clam	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHWEST ATLANTIC | CANADA | HAND IMPLEMENTS | MARITIMES REGION			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northern quahog	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHWEST ATLANTIC | CANADA | QUEBEC | HAND IMPLEMENTS			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Softshell clam	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

Fishers use hand tools such as rakes, shovels, and picks to capture clams in shallow waters and mudflats. Surface marks on the substrate can help fishers identify areas where clams are present, allowing them to target those areas and avoid damaging areas without clams (Brown and Wilson 1997). As sediment is raked or dug, infaunal organisms are brought to the surface, but the fishers can easily identify and take the target species, while leaving behind nontarget species and undersized target species (Barnette 2001).

Although no bycatch is taken, concern has been raised that hard clam fisheries may affect oyster reefs because hard clam and oyster habitats often overlap (DFO 1996a)(Lenihan and Micheli 2000). In the southern Gulf of St. Lawrence, oysters and clams are harvested concurrently but by different fishers (DFO 1996a). Researchers and fishers have reported that clam raking can damage oysters by cracking their shells or burying them, but a study by Lenihan and Micheli found that harvesting clams alone does not reduce oyster density more than harvesting both species concurrently (Lenihan and Micheli 2000).

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

Northern quahog

Factor 2.3 - Discard Rate/Landings

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

< 100%

Fishers use hand tools such as rakes, shovels, and picks to capture clams in shallow waters and mudflats. These fishing methods allow fishers to be highly selective about their catch and to return unwanted species to the water alive. Because bycatch and dead discards are minimal, we have awarded the lowest score.

Softshell clam

Factor 2.3 - Discard Rate/Landings

Northwest Atlantic | Canada | Quebec | Hand implements
Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

< 100%

Fishers use hand tools such as rakes, shovels, and picks to capture clams in shallow waters and mudflats. These fishing methods allow fishers to be highly selective about their catch and to return unwanted species to the water alive. Because bycatch and dead discards are minimal, we have awarded the lowest score.

Factor 2.3 - Discard Rate/Landings

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region
Northwest Atlantic | Canada | Quebec | Hand implements

< 100%

Fishers use hand tools such as rakes, shovels, and picks to capture clams in shallow waters and mudflats. These fishing methods allow fishers to be highly selective about their catch and to return unwanted species to the water alive. Because bycatch and dead discards are minimal, we have awarded the lowest score.

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 | Canada | Hand implements | Gulf Management Region	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**
Northwest Atlantic | Canada | Hand implements | Gulf Management Region	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**
Northwest Atlantic | Canada | Hand implements | Maritimes Region	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**

Northwest Atlantic | Canada | Hand implements | Maritimes Region	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**
Northwest Atlantic | Canada | Quebec | Hand implements	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**

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 | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

Moderately Effective
Regulations for the Canadian hard clam and softshell clam fisheries are set by the Department of Fisheries and Oceans Canada (DFO). In the Maritimes and Gulf Regions, regulations are set under the Maritimes Provinces Fishery Regulations. Regulations include license restrictions, logbooks (except in Prince Edward Island, and parts of New Brunswick and Nova Scotia—Gulf regions), gear restrictions, a closed season from January 1 to March 31, a minimum size limit (which varies depending on the species and area), and a daily bag/catch limit for recreational fishing and some areas of commercial fishing (DFO 1996c)(DFO 1996d)(DFO 2011b)(DFO 2018c). Also, some clam beds may be closed to fishing for conservation purposes or for contamination reasons (DFO 2001) (Hicks and Ouellette 2011)(DFO 2011b).

There have been limited population assessments of clams in these regions and no reference points have been defined, though managers in Quebec have implemented conservation measures (DFO 2017a). Therefore, it is difficult to determine the effectiveness of these management measures. There are no current fishery management plans (FMPs) for the areas covered in this report (the eastern New Brunswick FMP expired in 2006) (DFO 2001). In some areas, there are concerns about low clam abundance and overfishing, but those concerns have not been quantitatively evaluated (Hicks and Ouellette 2011). Because management measures are in place but their effectiveness is unknown, and it is unlikely that the fishery is having serious negative impacts on clam populations, we award a score of moderately effective.

Justification:
Minimum size limits in millimeter (mm) by province and species (DFO 2011b)(DFO 2017a).

Nova Scotia (portion in the Gulf Region): Northern quahog (50 mm); softshell clam (50 mm)

Nova Scotia (portion in the Maritimes Region): Northern (Bay) quahog (38 mm); softshell clam (44 mm) other than as varied by order MAR-VAR-2017-054, which varies the minimum size limit of softshell clam to 50 mm in the Province, between Hartlen Point, Halifax County and the Canso Causeway.

New Brunswick (portion in the Gulf Region): Northern quahog (50 mm); softshell clam (50 mm)

New Brunswick (portion in the Maritimes Region): Northern quahog (38 mm); softshell clam (44 mm)

Prince Edward Island: Northern quahog (50 mm); softshell clam (50 mm)

Quebec: Softshell clam (51 mm)

Northwest Atlantic | Canada | Quebec | Hand implements

Moderately Effective

The Department of Fisheries and Oceans Canada (DFO) is responsible for the management of softshell clam. In the Quebec Region, regulations for the softshell clam fishery are set through a Conservation Harvesting Plan that is updated every 3 years. The commercial fishery is regulated through catch limits, number of licenses issued, a minimum size limit of 51 mm, and a season that normally runs from March 14 to October 31 (DFO 2017a). Also, commercial fishers are required to fill out logbooks (DFO 2014). The minimum size limit and season also apply to the recreational fishery, and there is a daily catch limit of 300 clams for recreational fishers (DFO 2011). Hand tools are the only gear permitted to harvest clams in this region. Some areas have been closed for conservation purposes, and some may also be closed for contamination reasons (DFO 2014).

Catch limits were put in place in 2015; the latest advice is to collect less than 5% of the commercial biomass annually (DFO 2017a). There are some indications that new management measures are effective (e.g., the percentage of sublegal clams in catches has declined and catch per unit effort [CPUE] has increased in some areas in recent years) (DFO 2017a), but these management measures have not been in place long enough to fully evaluate their success. Further, there is uncertainty in the interpretation of CPUEs, and it is unknown if low landings are due to a decrease in clam populations or to socioeconomic factors (DFO 2017a). The overall effectiveness of new management strategies is unknown, so we award a score of moderately effective.

Factor 3.2 - Bycatch Strategy

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region
Northwest Atlantic | Canada | Quebec | Hand implements

Highly effective

There are no bycatch species in this fishery.

Factor 3.3 - Scientific Research And Monitoring

Northwest Atlantic | Canada | Hand implements | Gulf Management Region

Moderately Effective

In the Gulf Region, there has been limited monitoring of hard clam and softshell clam populations. The last status update produced by the Department of Fisheries and Oceans Canada (DFO) for the Gulf hard clam was in 1996 (DFO 1996a). For softshell clam, DFO evaluated the state of the resource in three areas of eastern New Brunswick in 2006 by gathering information from local fishers, managers, and conservation organizations (Hicks and Ouellette 2011). The last status update on the softshell clam resource in Prince Edward Island was in 1996 (DFO 1996b). Evaluating clam populations is not considered cost-effective (DFO 2001). The Science Branch of the DFO has conducted a few biological studies on clam populations (DFO 2001). Commercial catch information

is collected, but there are concerns that catches are underreported {Hicks and Quellette 2011}. Recreational catch information is not collected (Hicks and Ouellette 2011). Although some data are collected, they are insufficient to ensure the long-term maintenance of these clam species, so a moderately effective score is awarded.

Northwest Atlantic | Canada | Hand implements | Maritimes Region

Moderately Effective

In the Maritimes Region, there has been limited monitoring of hard and softshell clam populations. The last status updates produced by the Department of Fisheries and Oceans Canada for the softshell clam resource in the Maritimes Region were in 1996 (DFO 1996c)(DFO 1996d). Evaluating clam populations is not considered cost-effective (DFO 2001). The Science Branch of the Department of Fisheries Oceans Canada (DFO) has conducted a few biological studies on clam populations (DFO 2001). Commercial catch information is collected, but there are concerns that catches are underreported. Recreational catch information is not collected. Although some data are collected, they are insufficient to ensure the long-term maintenance of the clam populations, so a moderately effective score is awarded.

Northwest Atlantic | Canada | Quebec | Hand implements

Moderately Effective

In Quebec, population assessments of softshell clam are conducted every 3 years; the assessments utilize information on commercial catches, fishing effort, catch rates, and the size structure of clams to evaluate the status of softshell clam populations (DFO 2017a). The data collected on fishing effort and catch rates are considered uncertain because there may have been more than one harvester per seller (DFO 2017a). Also, the amount of softshell clam caught by recreational fishers is not known. Since 2001, the Department of Fisheries and Oceans Canada (DFO) has conducted research surveys on several of Quebec's clam beds, which has provided further information on softshell clam abundance in some areas (DFO 2011). In addition, monitoring of bycatch is not needed/appropriate for this fishery because bycatch is minimal. Overall, though the fishery is regularly assessed, all relevant sources of fishing mortality are not included, resulting in a score of moderately effective.

Factor 3.4 - Enforcement Of Management Regulations

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

Highly effective

The Department of Fisheries and Oceans Canada (DFO) is responsible for enforcing management regulations through its Conservation and Protection program, and logbooks are required for commercial fisheries except those in the Gulf Management Region (DFO 2019c). Fishery officers throughout Canada conduct patrols on land, sea, and in the air to enforce regulations (DFO 2016c). The capacity for enforcement has increased in recent years through increased funding and improved information management, as well as through additional monitoring as part of the Canadian Shellfish Sanitation Program (CSSP), which closely monitors shellfish harvesting in the region (DFO 2019c)(DFO 2023d). Violations of regulations are also published on DFO's fisheries

enforcement webpage, where there are also opportunities to report suspicious fishing activities (DFO 2023c). There were numerous convictions of softshell clam fishery violations in 2018 (e.g., fishers retaining undersized clams, fishing without a license, and exceeding recreational quota) (DFO 2019b), indicating that regulations are actively being enforced. There are effective enforcement mechanisms in place appropriate to the scale of this fishery, and monitoring has resulted in successful convictions of illegal practices. Therefore, we award a score of highly effective.

Northwest Atlantic | Canada | Quebec | Hand implements

Highly effective

Logbooks are required for softshell clam fishers in Quebec, and the Department of Fisheries and Oceans Canada (DFO) is responsible for enforcing management regulations and issuing permits through their Conservation and Protection program (DFO 2017a)(DFO 2019c). Fishery officers throughout Canada conduct patrols on land, sea, and in the air to enforce regulations (DFO 2016c) (DFO 2016b). The capacity for enforcement has increased in recent years through increased funding and improved information management, as well as through additional monitoring as part of the Canadian Shellfish Sanitation Program (CSSP), which closely monitors shellfish harvesting in the region (DFO 2019c)(DFO 2023d). Violations of regulations are also published on DFO's fisheries enforcement webpage, where there are also opportunities to report suspicious fishing activities (DFO 2023c). There were several convictions for harvesting in closed areas and harvesting clams more than half an hour after sunset in 2018 (DFO 2019c). The Quebec softshell clam fishery has historically had issues in the enforcement of the minimum size limit, with the proportion of undersized clams in the catch often exceeding 15% (DFO 2011)(DFO 2017a). But the percentage of undersized clams landed has more recently been less than three percent (DFO 2023). There are effective enforcement mechanisms in place, monitoring has resulted in successful convictions of illegal practices, and the percentage of undersized clams in landings has decreased in recent years. Therefore, we award a score of highly effective.

Factor 3.5 - Stakeholder Inclusion

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region

Highly effective

Clam fishery management in the Gulf and Maritimes Regions is transparent and involves stakeholder input through a public consultation process (DFO 2018c). During the 1990s, clam fisheries regulations in the Gulf and Maritimes Regions of Canada were restructured with input from Regional Clam Advisory Committees (DFO 1996c)(DFO 1996d)(DFO 2001). For example, regional committees pushed for limited access licensing in the 1990s to better control fishing (DFO 1996c), and dive-fishing for clams was banned in eastern New Brunswick based on recommendations from fishers (DFO 2001). Stakeholder inclusion is therefore scored highly effective.

Northwest Atlantic | Canada | Quebec | Hand implements

Highly effective

The management process for the softshell clam fishery in Quebec is transparent and includes stakeholder input. In the Quebec Region, there is a liaison committee between DFO and the Quebec Harvesting Sector to promote dialogue and information exchange (DFO 2016a). DFO in the Quebec Region also developed a Consultation Calendar to "provide information to the public regarding upcoming consultation events organized by the Department" (DFO 2013). There are ample opportunities for stakeholder involvement, so stakeholder inclusion is scored highly effective.

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 | Canada | Hand implements | Gulf Management Region	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**
Northwest Atlantic | Canada | Hand implements | Gulf Management Region	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**
Northwest Atlantic | Canada | Hand implements | Maritimes Region	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**
Northwest Atlantic | Canada | Hand implements | Maritimes Region	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**
Northwest Atlantic | Canada | Quebec | Hand implements	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 | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region
Northwest Atlantic | Canada | Quebec | Hand implements

Score: 3

Rakes are known to impact bottom habitats and benthic infauna (Brown and Wilson 1997), and the resulting sediment disturbance can smother oysters and other sessile organisms (Lenihan and Micheli 2000). The rakes may puncture the shells of undersized or nontargeted shellfish (Kaiser et al. 2001). Soft-bodied organisms such as worms are extremely sensitive to sediment disturbance; their tubes and burrows may be destroyed by rakes, and as these organisms are raked to the surface, they may die from exposure to higher levels of oxygen than they can tolerate or may become exposed to opportunistic predators (Brown and Wilson 1997). In one study, shellfish raking, even at low intensities, reduced the abundance of three polychaete worm species by 54 to 77% (Brown and Wilson 1997). The recovery time of the raked communities depends on the size of the fished area, the type of sediment or substrate (e.g., sand, mud flats), natural disturbances to the habitat, intensity of the fishing effort, and successful spawning and recruitment of affected species (Kaiser et al. 2001). It is difficult to determine the long-term impacts to these communities and if they can be attributed primarily to fishing activities or more natural disturbances (Valdemarsen and Suuronen 2001), particularly in areas such as the Gulf Region that freeze in the winter and face substantial ice movement and sediment disturbance through storms. Overall, shellfish raking is considered to have a moderate impact on bottom habitats, and we award a score of 3.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region
Northwest Atlantic | Canada | Quebec | Hand implements

Score: 0

In the Gulf, Maritimes, and Quebec Regions, some clam beds are closed for conservation purposes (and some are closed for contamination reasons) (DFO 2017a)(Hicks and Ouellette 2011). Also, there is a closed season during the winter months (DFO 2001)(Hicks and Ouellette 2011)(DFO 2011b)(DFO 2014) and in areas where the federally protected Atlantic mud-piddock occurs (pers. comm., S. Arnold 2019). Although there are some fishing closures that could mitigate the impact of the fishing gear on the substrate, the area closed is not quantified. Some efforts have been taken to restrict fishing effort and intensity, but these measures do not meet the criteria for mitigation credit.

Factor 4.3 - Ecosystem-based Fisheries Management

Northwest Atlantic | Canada | Hand implements | Gulf Management Region
Northwest Atlantic | Canada | Hand implements | Maritimes Region
Northwest Atlantic | Canada | Quebec | Hand implements

Moderate Concern

DFO has committed to moving toward an ecosystem-based management approach through its Sustainable Fisheries Framework (DFO 2018b). But to date, there have been no efforts to fully assess the ecological impacts of the clam fisheries. Bivalves in dense aggregations can affect the abundance of phytoplankton, thus improving water quality and eutrophication control (Bricelj et al. 2017)(Alpine and Cloern 1992). Clam veligers are fed on by larval fishes; juvenile clams are eaten by gastropods, decapods, lobsters, various crabs, and birds (e.g., brants and herring gulls); and adults have fewer predators as they grow (MacKenzie et al. 2002)(DFO 2001)(DFO 2008a). The use of hand harvest to capture clams allows some nontarget species to be returned to the substrate alive, resulting in negligible bycatch of species that are important for ecosystem functioning. There are some spatial and temporal closures to protect spawning populations (Hicks and Ouellette 2011) (DFO 2011b). The fishery lacks policies to protect ecosystem functioning and account for ecological roles, but detrimental food web impacts are not likely. Therefore, we award a score of moderate concern.

Acknowledgements

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.

Seafood Watch would like to thank the consulting researcher and author of this report, Sarah Hayroyan from MBA.

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Appendix A: 2023 Update to Canada Atlantic Clam Assessment

This report was reviewed for any significant stock status and management updates to the fishery in May 2023. Relevant information, including a recent stock assessment for the Quebec Region and updated landings and size restrictions, was updated as necessary for Criterions 1, 3, and 4 (DFO 2023)(DFO 2023b)(DFO 2023c)(DFO 2023d)(DFO 2019c)(DFO 2022). The score for Factor 3.4 (Enforcement) was increased to highly effective for hard clam caught in the Gulf Management Region and for softshell clam caught in the Gulf and Maritimes Management Regions, although this has not resulted in any score or ratings changes for Criterion 3 or the overall fisheries, respectively. A rating for hard clam caught in the Maritimes Management Region was added to this assessment, earning a rating of Yellow.