



# ASSESSMENT OF SOFTSHELL CLAM STOCKS IN QUÉBEC COASTAL WATERS



S. Brulotte, DFO, Québec Region, 2012.

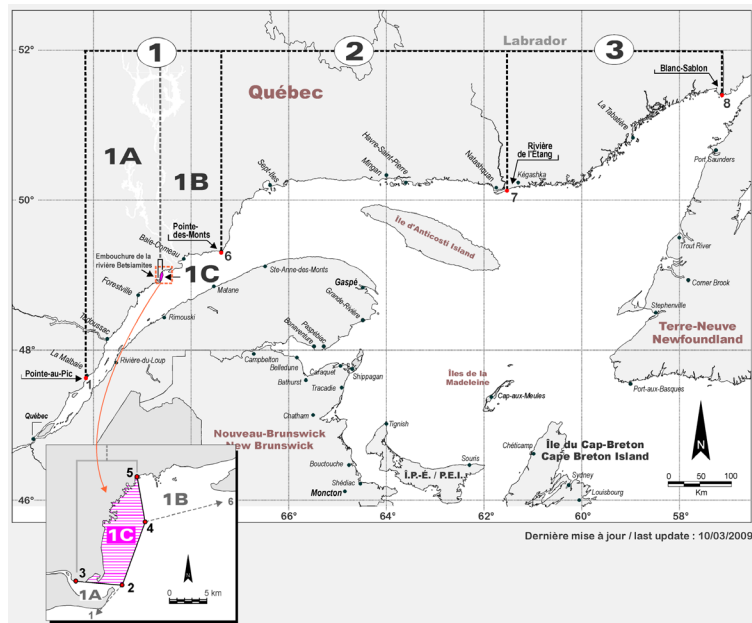


Figure 1. North Shore softshell clam fishing areas.

## Context:

Softshell clams are found along most of Québec's shoreline. Recreational harvesting of softshell clams has a long history in Québec, but this activity is poorly documented. Landings from the commercial fishery are known by region since 1917. This fishery has been practised mainly on the North Shore since the early 1970s and almost exclusively on the Upper North Shore since 1993. Québec commercial landings reached a peak of 1,207 t in 2000.

Upper North Shore commercial activities are regulated by the number of licenses, a minimum legal size, a season and a landings quota by shellfish harvest area. For recreational harvesting, management tools include the season, the minimum legal size and the number of softshell clams harvested per day. Only hand tools are permitted for softshell clam harvesting. The main indicators used for monitoring stocks are landings, fishing effort, demographic structure and results of clam surveys conducted from 2016 to 2019.

This Science Advisory Report is from the meeting of February 25, 2020, on the Assessment of Québec inshore waters softshell clam. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

## SUMMARY

- Softshell clams are exploited by commercial and recreational harvesters. There is no commercial fishery in the Gaspé Peninsula and the Lower St. Lawrence. Landings from the Îles-de-la-Madeleine are low (< 3 t) and little information is available to assess the status of the resource. There is no recommendation for this region.
- Landings reached a maximum of 1,173 t in 2000 on the Upper North Shore but averaged only 26 t over the last three years (2017-2019). Total allowable catches (TACs) were not met due to the low effort deployed. Since 2010, commercial landings have come mainly from ten shellfish areas.
- Since 2017, the average size of clams landed has been between 65 and 74 mm in the six sectors sampled on the Upper North Shore. The proportion of sublegal size clams (< 51 mm) in the landings is very low.
- Twenty-three shellfish areas on the Upper North Shore were surveyed from 2016 to 2019. Eight of these sectors had already been surveyed from 2002 to 2014. The commercial density increased significantly in five of these eight sectors. However, the area currently covered by a few beds is much smaller than that measured during surveys conducted from 1967 to 1977.
- The biomass of legal-size clams was calculated for each of the areas surveyed. In order to protect the reproductive potential of each shellfish area, it is suggested that the exploitation rate be limited to a maximum of 5% of the commercial biomass.
- Some sectors may be more vulnerable to a 5% exploitation rate. It is therefore suggested that this rate be adjusted downwards for these sectors. Thus, the rate should be minimal for sectors with a harvestable area of less than 0.05 km<sup>2</sup> and about 2.5% for sectors where the density of 20-50 mm softshell clams is less than 15 clams/m<sup>2</sup>.
- Suggested exploitation rates apply to all harvesting (commercial and recreational). The impact of recreational harvesting, an activity valued by coastal communities, remains unknown. It would be important to quantify the effort and harvesting of this activity, which is also a source of mortality among juveniles.

## BACKGROUND

### Biology

Softshell clams, *Mya arenaria*, are bivalve molluscs found in North American and European coastal waters. This shellfish is found throughout Québec mainly in river estuaries and bays and lives buried in soft sediments of mud and sand. It is a sedentary species living in beds or aggregations of greater or lesser importance. Clams feed on plankton and suspended particles in the water. As a species that lives in the intertidal zone, it is generally tolerant of wide variations in temperature and salinity. Temperatures below -2°C or above 28°C are lethal in adults. In Québec, clams take five to seven years to reach the minimum legal size of 51 mm and their size can exceed 110 mm.

Clam sexes are separate and the sex ratio is usually even. The mean size at which 50% of individuals are sexually mature is 38-39 mm in Québec. There is only one spawning period per year that occurs mainly in June and July. Gametes are released into the water and fertilization occurs outside the shell. After a pelagic larval phase of about five weeks, the clam transforms, takes on its adult form and becomes established on the sea bed.

Harvesting activities and the action of waves and storms can deplete sub-legal size clams. Tank and field tests showed that the time clams require to bury themselves is primarily influenced by the size of the clams and water temperature. For example, at 20 °C, a 15-20 mm clam takes approximately 1 hour to bury itself completely, while at 5°C, it takes over 7 hours. Juveniles (< 10 mm) bury themselves in the top few centimeters of sediment. Experiments conducted on sandy and silty flats show that the rate of dispersal (or loss) is greater for small clams (15-20 mm) buried in sandy sediments.

Softshell clam populations in the Estuary and northern Gulf of St. Lawrence are genetically different from those in the Îles-de-la-Madeleine and the southern Gulf, but the origin of recruitment from each bed remains unknown.

### **General description of the fishery**

Softshell clam harvesting is very popular among people in the maritime regions of Québec, because the resource is easily accessible and can be harvested without the use of specialized equipment. Commercial and recreational harvesting take place on the same coastal territory. These two activities are practised at low tide, primarily during spring tides. Maritime Québec is divided into three large regions: the North Shore, Gaspé–Lower St. Lawrence and the Îles-de-la-Madeleine. The North Shore is divided into three fishing areas: area 1 (sub-areas 1A, 1B and 1C) corresponds to the Upper North Shore, area 2 to the Middle North Shore and Area 3 to the Lower North Shore (Figure 1).

Coastal zones are divided into shellfish areas. In Québec, as everywhere in Canada, shellfish areas are managed by the Canadian Shellfish Sanitation Program, which annually determines the classification in each area. Approved shellfish beds are open to clam harvesting, and those conditionally approved are closed from June 1<sup>st</sup> to September 30<sup>th</sup>. No harvesting is permitted in the areas with restricted or prohibited status.

In 2019, the Upper North Shore included 66 shellfish areas, including 18 approved areas, 5 conditionally approved areas, 1 approved area with a conditional management plan, the other sectors having a restricted or prohibited status (Figure 2). For the other regions, there were 31 approved or conditionally approved shellfish areas in the Îles-de-la-Madeleine, 6 in Gaspé–Lower St. Lawrence and 20 in the Middle North Shore and Lower North Shore.

In Québec, the minimum legal size is 51 mm for clams regardless of the type of harvest. Harvesting is done exclusively using hand tools (clam fork, shovel, etc.), except in the Middle North Shore where there are two commercial hydraulic dredge harvesting licences (inactive for several years). In addition, recreational harvesters cannot harvest more than 300 clams per day (between 5 and 15 kg). Commercial harvesting is permitted only in the Upper North Shore and the Îles-de-la-Madeleine.

Starting in 2004, management measures have been implemented gradually to control the commercial manual harvest. To the minimum legal size and type of fishing gear authorized were added a maximum number of licenses, a fishing season, a participation clause and the requirement to wear a safety vest and keep a logbook. A total allowable catch (TAC) for commercial harvesting was implemented in 2015 in 20 shellfish areas (Table 1). Since 2009, the Baie des Chevaux, Banc Marie-Marthe, Baie Didier Sud, Baie des Plongeurs and Cran à Gagnon have been reserved exclusively for commercial harvesting. Since 2015, the Baie des Petites Bergeronnes area (situated in the Saguenay–St. Lawrence Marine Park) is open for a spring recreational harvest that lasts a few weeks. In the Îles-de-la-Madeleine, commercial harvesting is managed by a fishing season and the obligation to fill out a logbook.

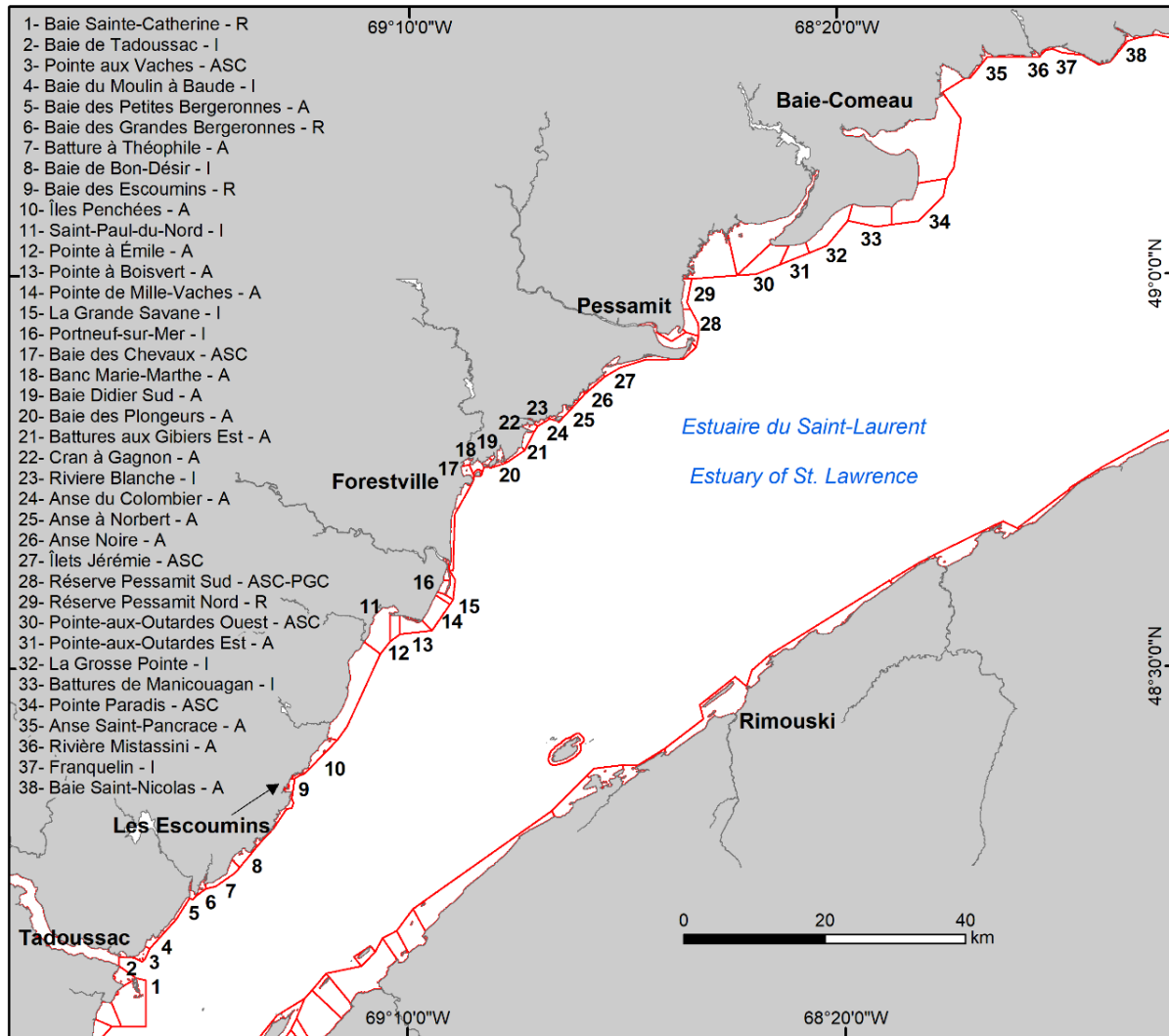


Figure 2. Location of the main shellfish areas on the Upper North Shore and their status in 2019 (A = approved, ASC = conditionally approved, ASC-PGC = conditionally approved with conditional management plan, R = restricted et I = prohibited).

Commercial fishery statistics are quite well documented and known for all shellfish harvesting areas since 2002, whereas the quantities harvested recreationally are not documented. The indicators used to assess the status of softshell clam stocks by shellfish area are: commercial landings (t), fishing effort (in vendor-days), average size (mm) of landed clams, proportion (%) of sub-legal size clams in landings, harvestable area (km<sup>2</sup>) of beds, average density (number/m<sup>2</sup>) of 20 to 50 mm clams in the entire bed, density of legal size clams in the harvestable area and biomass (t) of legal size clams in the harvestable area. The latter four indicators come from surveys conducted from 2016 to 2019 in several areas on the Upper North Shore. The harvestable area is defined by a minimum of three contiguous stations, with an average density of legal-size clams of  $\geq 16$  clams/m<sup>2</sup>. Typically, high density stations are found at the same location on the bed. However, this area can occasionally include isolated stations with smaller densities, providing for continuity of harvestable areas.

**Québec Region**

**Assessment of Softshell Clam Stocks in Québec Coastal Waters**

*Table 1. Softshell clam commercial landings (t, live weight) from 2002 to 2019 and TACs (t, live weight) in 2019 by sub-area and shellfish area in the Upper North Shore and cumulative landings by region (Upper North Shore and its sub-areas and Îles-de-la-Madeleine) and for Québec as a whole.*

Sub-Area, Area or region	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	TAC
1A- Baie des Petites Bergeronnes	16	32	26	115	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
1A- Baie des Grandes Bergeronnes <sup>1</sup>	-	22	100	-	75	28	14	18	-	-	-	-	-	-	-	-	-	-	-
1A- Batture à Théophile	< 0.1	-	-	-	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4
1A- Baie des Escoumins <sup>1</sup>	-	-	-	-	-	62	11	22	-	-	-	-	-	-	-	-	-	-	-
1A- Îles Penchées	5	5	7	2	6	-	-	-	-	-	-	-	-	-	0.3	-	-	-	5
1A- Pointe à Émile	-	2	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1A- Pointe à Boisvert	125	49	24	21	12	4	1	0.5	-	-	0.1	-	-	-	-	-	-	0.4	20
1A- Pointe de Mille-Vaches	32	137	62	20	8	2	0.1	-	-	-	-	-	-	-	-	-	-	-	20
1A- Baie des Chevaux	82	59	45	27	10	4	5	3	1	0.7	2	2	0.6	2	11	3	2	3	20
1A- Banc Marie-Marthe	233	118	49	11	13	11	13	12	1	0.7	0.3	1	2	16	19	3	1	0.9	30
1A- Baie Didier Sud	3	19	12	8	5	2	0.2	0.7	F <sup>2</sup>	F	F	F	F	F	2	-	0.7	0.4	4
1A- Baie des Plongeurs	30	17	27	32	18	4	0.5	-	F	F	F	F	F	F	3	1	4	0.2	10
1A- Battures aux Gibiers Est	2	3	0,5	-	-	-	0.4	-	-	-	-	-	-	-	1	F	F	-	0.5
1A- Cran à Gagnon	27	14	7	3	2	2	1	0.1	-	-	< 0.1	< 0.1	0.4	8 <sup>3</sup>	5 <sup>3</sup>	1	0.4	0,1	5
1A- Rivière Blanche <sup>1</sup>	-	24	5	-	-	13	11	11	-	-	-	-	-	-	-	-	-	-	-
1A- Anse du Colombier	10	17	23	22	5	4	3	2	-	-	-	< 0.1	0,1	2	4	0.5	0.5	< 0.1	10
1A- Anse à Norbert	13	0.4	1	0.2	2	0.6	0.2	-	0.1	-	-	0,1	0,1	-	1 <sup>3</sup>	-	-	-	1
1A- Anse Noire	4	2	4	4	2	1	< 0.1	0.2	-	-	-	-	-	< 0.1	1 <sup>3</sup>	-	-	-	1
1A- Îlets Jérémie	31	23	30	35	9	12	8	11	9	-	0.1	< 0.1	0.4	0.1	6	-	-	-	15
1B- Pointe-aux-Outardes Ouest <sup>4</sup>	150	154	136	60	62	24	14	8	-	7	6	6	18	17	19	17	23	16	30 <sup>4</sup>
1B- Pointe-aux-Outardes Est <sup>4</sup>	-	-	-	19	9	7	12	20	9	3	3	8	2	5	7	-	0.3	0.2	-
1B- Rivière Mistassini	4	3	2	5	5	-	-	0.1	-	-	-	-	-	-	-	-	-	-	3
1B- Baie Saint-Nicolas	10	15	10	17	9	-	-	-	-	-	-	1	0.1	-	0.1	-	-	-	1
1C- Réserve Pessamit Sud	154	129	304	214	100	98	80	82	38	-	0.5	-	-	21	5	-	-	-	50
1A et 1B- Autres secteurs <sup>5</sup>	-	15	10	-	1	0,6	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper North Shore	930	859	886	614	354	279	176	190	57	11	12	19	23	72	85	26	32	21	-
Sub-area 1A	613	499	318	299	92	46	34	29	11	1	2	3	4	29	53	8	9	5	-
Sub-area 1B	163	172	148	101	87	31	26	27	9	10	9	15	19	22	27	17	23	16	-
Sub-area 1C	154	129	304	214	100	98	80	82	38	-	0.5	-	-	21	5	-	-	-	-
Depuration <sup>1</sup>	-	59	115	-	75	103	36	51	-	-	-	-	-	-	-	-	-	-	-
Îles-de-la-Madeleine	-	-	-	0.1	0.4	0.5	1.0	0.5	0.9	0.1	0.8	1.2	1.3	0.8	0.7	0.9	2.8	2.3	-
<b>Québec<sup>6</sup></b>	<b>1,028</b>	<b>883</b>	<b>886</b>	<b>615</b>	<b>354</b>	<b>280</b>	<b>177</b>	<b>190</b>	<b>58</b>	<b>11</b>	<b>13</b>	<b>20</b>	<b>24</b>	<b>73</b>	<b>86</b>	<b>27</b>	<b>35</b>	<b>24</b>	<b>-</b>

<sup>1</sup> Restricted or prohibited status area (depuration from 2002 to 2009).

<sup>2</sup> F = Shellfish area closed for conservation.

<sup>3</sup> TAC reached.

<sup>4</sup> The Pointe-aux-Outardes area was split into Pointe-aux-Outardes Ouest and Est in 2005. There is a combined TAC of 30 t for both areas since 2015.

<sup>5</sup> Baie Sainte-Catherine (depuration), Saint-Paul-du-Nord, La Grosse Pointe and Franquelin (depuration).

<sup>6</sup> Include all commercial landings in Québec (North Shore, Gaspé – Lower St. Lawrence and Îles-de-la-Madeleine).

## ASSESSMENT

### Commercial harvesting

Since 1971, commercial harvesting has been done mainly on the North Shore (Figure 3). In the Îles-de-la-Madeleine, landings have been low (< 3 t) for several years and it is difficult to assess the status of this resource. There has been no commercial harvest in the Middle North Shore, the Lower North Shore, the Lower St. Lawrence or Gaspé since 2008.

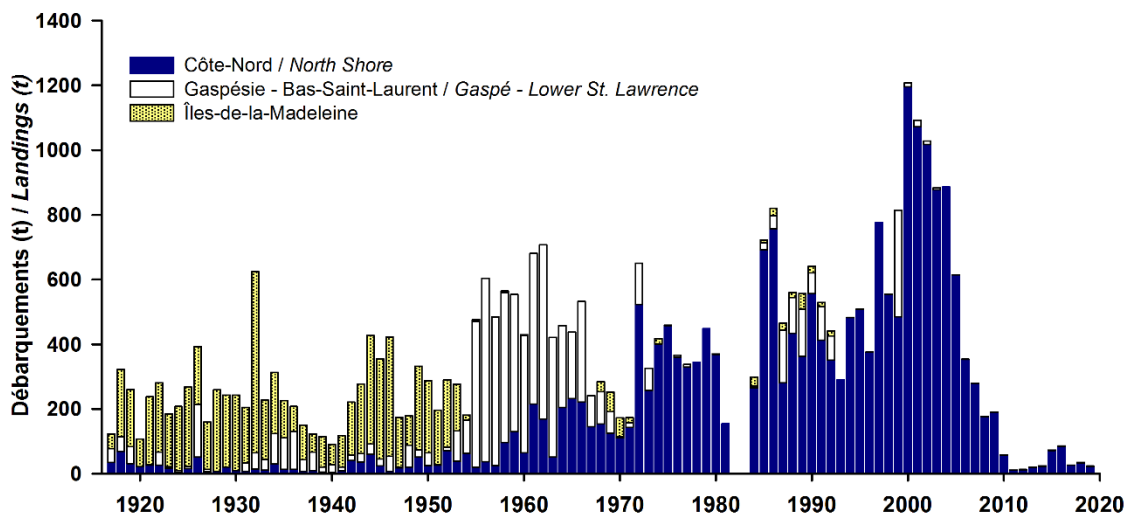


Figure 3. Annual Softshell clam commercial landings by Québec region.

Commercial softshell clam harvesting expanded to the North Shore in the 1960s and 1970s and it has taken place primarily on the Upper North Shore since 1993 (Figures 3 and 4). From 1993 to 1999, landings on the Upper North Shore fluctuated between 289 and 745 t. They reached a peak of 1,173 t in 2000 and declined sharply afterwards. The decrease in landings is due primarily to the reduction in yields (declining resource) and, in turn, to the lack of interest by harvesters in this fishery. This has led to the closure of two softshell clam processing plants on the Upper North Shore. The low landings ( $\leq 85$  t) over the last 10 years (Table 1) can be explained by the lack of processing plants from 2010 to 2014 and since 2017<sup>1</sup>. Average landings from 2017 to 2019 totalled 26 t. Since their introduction, the TACs have not been fully taken, except in one shellfish area in 2015 and in three shellfish areas in 2016 (Table 1).

Since 2010, Softshell clam landings have come mainly from 10 shellfish areas: Baie des Chevaux, Banc Marie-Marthe, Baie Didier Sud, Baie des Plongeurs, Cran à Gagnon, Anse du Colombier and Îlets Jérémie in sub-area 1A, Pointe-aux-Outardes Ouest and Pointe-aux-Outardes Est in sub-area 1B and Réserve Pessamit Sud in sub-area 1C.

After heavy exploitation of Upper North Shore clam populations from 1997 to 2005, landings from several significant areas, including Pointe de Mille-Vaches, Pointe à Boisvert, Baie des Chevaux, Banc Marie-Marthe, Réserve Pessamit Sud and Pointe-aux-Outardes (Ouest and Est) continued to decline sharply (Table 1), suggesting that the beds were overexploited.

<sup>1</sup> One plant was open from the spring of 2015 to the fall of 2016 in Forestville.

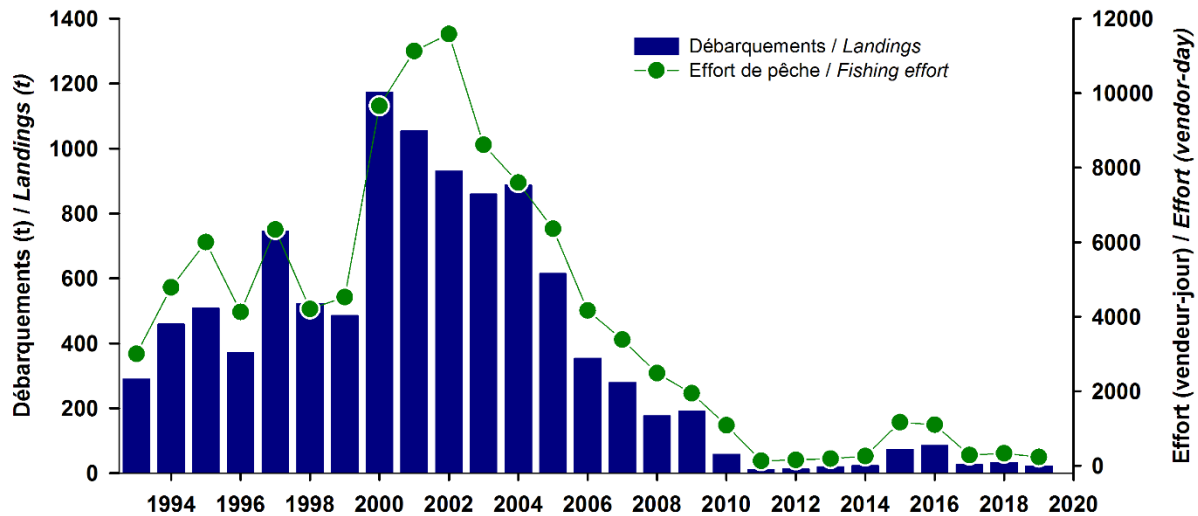


Figure 4. Annual commercial landings of softshell clams and fishing effort for all of the Upper North Shore.

There is generally a relatively good relationship between fishing effort and landings on the Upper North Shore (Figure 4). However, the interpretation that overharvesting occurred in the early 2000 is supported by the fact that the decline in landings that began in 2001 clearly preceded the sharp decline in fishing effort that began in 2003. The fishing effort continued to gradually decline, from 11,586 vendor-days in 2002 to 1,942 vendor-days in 2009. The decline in effort and landings is attributable to the ongoing decline in the number of commercial harvesters involved. Average effort from 2017 to 2019 was 283 vendor-days.

The average size of clams landed for six surveyed area from 2017 to 2019 ranged from 65 to 74 mm (Table 2). The number of samples per sub-area is sometimes limited given the low fishing effort in recent years (Table 2). A high proportion of sub-legal size clams (< 51 mm) in the landings would be a likely indication that the quantity of legal size clams is low and that harvesters are switching to smaller clams. However, this proportion has been low over the last three years and has remained below 5%.

### Surveys on clam beds from 2016 to 2019

A number of surveys were conducted on softshell clam beds from 2016 to 2019. All open shellfish areas<sup>2</sup> (approved and conditionally approved) on the Upper North Shore were surveyed, for a total of 23 shellfish areas.<sup>3</sup> These surveys provide information on the area of the bed (km<sup>2</sup>), harvestable area (km<sup>2</sup>), distribution of clams on the bed, population structure, density (number/m<sup>2</sup>) of recruitment to the fishery (clams of size 20–50 mm) on the entire bed, and density, yield (kg/m<sup>2</sup>) and biomass (t) of legal-size clams on the harvestable area.

<sup>2</sup> With the exception of Anse Saint-Pancrace, the only approved shellfish area that was not surveyed.

<sup>3</sup> Pointe aux Vaches, Baie des Petites Bergeronnes, Batture à Théophile, Îles Penchées, Pointe à Émile, Pointe à Boisvert, Pointe de Mille-Vaches, Baie des Chevaux, Banc Marie-Marthe, Baie Didier Sud, Baie des Plongeurs, Battures aux Gibiers Est, Cran à Gagnon, Anse du Colombier, Anse à Norbert, Anse Noire, Îlets Jérémie, Réserve Pessamit Sud, Pointe-aux-Outardes Ouest, Pointe-aux-Outardes Est, Pointe Paradis, Rivière Mistassini and Baie Saint-Nicolas (Figure 2).

Table 2. Average size (mm) of clams landed from 2005 to 2019 and average size (Avg) for the 2004-2018 period by shellfish area for the Upper North Shore and number of samples measured by sub-area.

Shellfish area	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Avg
<b>Sub-area 1A</b>																-
Petites Bergeronnes	-	-	-	59	-	-	-	-	-	-	-	-	-	-	-	59
Îles Penchées	-	-	-	-	-	-	-	-	-	-	-	58	-	-	-	58
Pointe à Boisvert	59	61	60	58	-	-	-	67	-	-	-	-	-	-	-	60
Pointe de Mille-Vaches	69	57	66	58	-	-	-	-	-	-	-	-	-	-	-	63
Baie des Chevaux	62	58	59	59	56	-	-	67	-	-	60	65	-	72	-	61
Banc Marie-Marthe	60	60	64	62	62	-	-	-	-	-	65	65	67	74	73	64
Baie Didier Sud	-	50	53	-	52	-	-	-	-	-	-	61	-	72	71	57
Baie des Plongeurs	53	50	54	50	-	-	-	-	-	-	-	64	69	71	-	58
Battures aux Gibiers Est	-	-	-	-	-	-	-	-	-	-	-	64	-	-	71	64
Cran à Gagnon	-	49	57	60	58	-	-	-	-	-	59	62	-	-	-	57
Anse du Colombier	-	57	-	53	57	58	-	-	-	-	58	58	-	-	-	57
Anse à Norbert	-	-	-	52	-	-	-	-	-	-	-	60	-	-	-	55
Anse Noire	-	-	-	-	-	-	-	-	-	-	-	58	-	-	-	58
Îlets Jérémie	-	-	-	55	56	64	-	-	-	-	-	61	-	-	-	61
<b>Sub-area 1B</b>																-
Pointe-aux-Outardes Ouest	73	73	74	78	71	75	74	69	64	66	69	72	66	65	67	71
Pointe-aux-Outardes Est	-	64	65	66	71	65	-	-	66	-	66	67	-	-	-	66
Rivière Mistassini	-	57	-	-	-	-	-	-	-	-	-	-	-	-	-	57
Baie Saint-Nicolas	53	53	-	-	-	-	-	-	-	-	-	60	-	-	-	55
<b>Sub-area 1C</b>																-
Réserve Pessamit Sud	62	65	61	58	59	62	-	-	-	-	65	74	-	-	-	64
<b>Number of samples</b>																-
Sub-area 1A	18	33	30	36	28	5	0	2	0	0	41	48	4	9	3	-
Sub-area 1B	24	27	15	18	15	18	2	5	6	7	14	16	8	5	6	-
Sub-area 1C	15	20	24	22	21	23	0	0	0	0	20	1	0	0	0	-

The area of the beds varies significantly from one area to the next, ranging from 0.004 km<sup>2</sup> at Battures aux Gibiers Est to 5.96 km<sup>2</sup> at Pointe-aux-Outardes Ouest, for an average of 0.85 km<sup>2</sup> (Table 3). The harvestable area defines the area with a sufficient density of clams  $\geq 51$  mm for commercial harvesting of the beds. These areas may favourably affect reproductive success given the proximity of sexually mature clams. Four of the areas— Pointe aux Vaches, Pointe à Boisvert, Battures aux Gibiers Est and Pointe Paradis—do not have harvestable areas, as the maximum density of legal-size clams is below 16 clams/m<sup>2</sup> (Table 3). Two areas, Batture à Théophile and Anse Noire, have a harvestable area of less than 0.05 km<sup>2</sup>, the minimum size considered acceptable for commercial harvesting, The other areas have a harvestable area of between 0.12 and 2.37 km<sup>2</sup>.

The second indicator is the average density of softshell clams of size 20–50 mm. This indicator describes the status of pre-recruitment to the fishery. In order to support the clam fishery, it is important to ensure that there is a certain quantity of clams present on the beds to ensure the renewal of the commercially harvestable clam population. The average minimum density has been set at 15 clams/m<sup>2</sup>. There are four shellfish areas in which the density of clams of size 20–50 mm did not meet that criterion, namely Pointe aux Vaches, Battures aux Gibiers Est, Pointe-aux-Outardes Ouest and Pointe-aux-Outardes Est (Table 3). In addition, there were two shellfish areas in which the density slightly exceeded the criterion, namely Banc Marie-Marthe at 16.5 clams/m<sup>2</sup> and Pointe Paradis with 16.6 clams/m<sup>2</sup>. Values in the other shellfish areas range from 23.9 to 276.5 clams/m<sup>2</sup>.

The other variables presented concern average density, average yield and biomass of clams  $\geq 51$  mm on the harvestable area. The average density ranges from 22.0 to 81.2 clams/m<sup>2</sup> and the shellfish areas with the highest values are Îlets Jérémie and Réserve Pessamit Sud



(Table 3). The average yield ranges from 0.43 to 2.81 kg/m<sup>2</sup> (Table 3). Higher yields are generally associated with high densities of legal-size clams. Lastly, the commercial biomass on the harvestable area is highly variable from one shellfish area to the next, as it depends on the yield and area, with values ranging from 9 to 3,650 t (Table 3). The shellfish areas with the highest biomass are Pointe-aux-Outardes Ouest, because of its large size, and Réserve Pessamit Sud, because of its high yields and its size.

Eight areas had already been surveyed between 2002 and 2014, namely Baie des Petites Bergeronnes (2008), Pointe à Émile (2003), Baie des Chevaux (2002), Cran à Gagnon (2007), Anse Noire (2003), Pointe-aux-Outardes Ouest (2003-2004), Pointe-aux-Outardes Est (2004) and Réserve Pessamit Sud (2005, 2010 and 2014). The average density and average yield of clams  $\geq 51$  mm increased significantly compared to previous surveys in the Baie des Petites Bergeronnes, Pointe à Émile, Cran à Gagnon, Anse Noire and Réserve Pessamit Sud shellfish areas. In contrast, the density of softshell clams of size 20–50 mm was lower in the most recent survey compared to the previous survey in the Baie des Chevaux, Pointe à Émile and Pointe-aux-Outardes Est shellfish areas.

The majority of softshell clam beds of commercial interest on the Upper North Shore were also surveyed from 1967 to 1977. The interest of those surveys was to assess any changes in the location and extent of the beds and to allow for a comparison of the densities and yields obtained at that time with current figures. With respect to the shellfish areas surveyed in the period 2016 to 2019, the location of the beds has generally remained unchanged. However, the beds in the Batture à Théophile, Pointe de Mille-Vaches and Pointe Paradis shellfish areas are much smaller than they were at the time of the 1967-1977 surveys. In contrast, other beds appeared to be larger in 2016-2019 than in the 1967-1977 period, including Baie des Petites Bergeronnes and Pointe-aux-Outardes Ouest. There are ten shellfish areas where densities and/or yields were higher in 1967-1977 than in 2016-2019, namely Îles Penchées, Pointe à Émile, Pointe à Boisvert, Pointe de Mille-Vaches, Baie des Chevaux, Banc Marie-Marthe, Anse à Norbert, Pointe-aux-Outardes Ouest, Pointe-aux-Outardes Est and Pointe Paradis.

### **Exploitation rate**

The 2017 Science Advisory Report indicated that annual removals should not exceed 10% of the legal size biomass for the Upper North Shore softshell clam populations. As previously mentioned, the high level of commercial landings observed from 2000 to 2005 is not sustainable for these populations. The objective should therefore be removals below that level. With an exploitation rate of 10%, authorized removals would, for several areas, be equal to or greater than the maximum landings observed up until 2005 by shellfish area (Table 3). An exploitation rate of 5% or less is therefore recommended. This maximum exploitation rate is particularly important given that removals in the recreational clam fishery are not taken into account. In addition, the harvestable area and density of clams of size 20–50 mm, when too low, should result in a downward shift in the harvest rate.

Table 3. Results of surveys conducted from 2016 to 2019 on certain Upper North Shore shellfish areas: area of beds (km<sup>2</sup>), harvestable area (km<sup>2</sup>), average density (number/m<sup>2</sup>) of clams of size 20–50 mm on all beds and average density (number/m<sup>2</sup>), average yield (kg/m<sup>2</sup>) and biomass (t) of clams ≥ 51 mm on the harvestable area. Maximum commercial landings (t) observed between 2002 and 2005, the 2019 TAC (t) and potential removals (t) calculated with harvest rates of 10, 5 and 2.5% are also provided for each shellfish area.

Shellfish areas	Area of beds	Harvestable area	Density 20-50 mm	Density ≥ 51 mm	Yield ≥ 51 mm	Biomass ≥ 51 mm	Maximum landing	1019 TAC	10%	5%	2.5%
<b>Sub-area 1A</b>											
Pointe aux Vaches	0.09	<b>0<sup>1</sup></b>	<b>5.8<sup>1</sup></b>	0	0	0	0	-	0	0	-
Baie Petites Bergeronnes	0.60	0.55	30.6	39.2	1.24	682	115	-	68	34	-
Batture à Théophile	0.23	<b>0.02<sup>1</sup></b>	146.5	22.0	0.43	9	0,9	0,4	1	0	-
Îles Penchées	0.45	0.15	47.2	26.7	0.74	111	7	5	11	6	-
Pointe à Émile	1.16	0.27	23.9	24.7	0.65	176	2	1	18	9	4
Pointe à Boisvert	1.03	<b>0<sup>1</sup></b>	28.0	0	0	0	125	20	0	0	-
Pointe de Mille-Vaches	0.54	0.16	25.2	35.6	0.91	146	137	20	15	7	-
Baie des Chevaux	1.43	0.47	118.8	61.3	1.70	799	82	20	80	40	-
Banc Marie-Marthe	0.48	0.32	16.5	39.2	1.57	502	233	30	50	25	13
Baie Didier Sud	0.51	0.17	78.6	56.5	1.72	292	19	4	29	15	-
Baie des Plongeurs	0.50	0.31	178.0	47.8	1.34	415	32	10	42	21	-
Battures aux Gibiers Est	0.004	<b>0<sup>1</sup></b>	<b>0<sup>1</sup></b>	0	0	0	3	0,5	0	0	-
Cran à Gagnon	0.38	0.22	71.0	48.0	1.59	350	27	5	35	17	-
Anse du Colombier	0.15	0.12	276.5	49.2	1.29	155	23	10	15	8	-
Anse à Norbert	0.17	0.12	49.5	33.3	0.94	113	13	1	11	6	-
Anse Noire	0.10	<b>0.04<sup>1</sup></b>	99.6	40.4	1.10	44	4	1	4	0	-
Îlets Jérémie	0.42	0.26	120.3	81.2	2.17	564	35	15	56	28	-
<b>Sub-area 1B</b>											
Pointe-aux-Outardes Ouest	5.96	2.37	<b>8.9<sup>1</sup></b>	38.3	1.54	3,650	~100	] 30	365	182	91
Pointe-aux-Outardes Est	1.82	0.34	<b>2.8<sup>1</sup></b>	26.2	0.86	292	~50		29	15	7
Pointe Paradis	1.38	<b>0<sup>1</sup></b>	16.6	0	0	0	0	-	0	0	-
Rivière Mistassini	0.37	0.17	40.0	35.3	1.09	185	5	3	19	9	5
Baie Saint-Nicolas	0.35	0.16	122.5	37.7	1.00	160	17	1	16	8	-
<b>Sub-area 1C</b>											
Réserve Pessamit Sud	1.34	0.82	24.0	79.5	2.81	2 304	304	50	230	115	-

<sup>1</sup> Values in bold and red identify areas where the indicators are below the minimum criteria, i.e. a harvestable area of 0.05 km<sup>2</sup> and a clam density of 20-50 mm of 15 clams/m<sup>2</sup>.

## Sources of uncertainty

Sharing the territory between commercial and recreational harvesters, combined with the lack of information from the recreational component, makes it difficult to assess the landings and total effort on the various beds in the Upper North Shore. It would be important to quantify the effort and harvesting of recreational fishery, which is also a source of mortality among juveniles.

There was a certain level of uncertainty in the calculation of fishing effort expressed in vendor-days and consequently in the catch per unit of effort (kg/vendor-day). The actual number of harvesters involved is unknown. In addition, the harvester/seller ratio may have changed over the years, primarily between the period of the early 2000s when fishing was intensive, and recent years. In this case, the CPUE could reflect performance or the number of harvesters and not the status of the resource. It is essential to make stakeholders in this fishery aware of the

importance of having a real picture of the fishing effort deployed. The effort presented is, however, a minimum estimate of the real effort.

Environmental variations (weather conditions or abnormal tidal ranges) can also affect some fishery indicators, such as fishing effort. In addition, the increasing frequency of storm surges, shoreline erosion and reduced ice cover are also variables that could have a negative impact on softshell clam populations, on the recovery of certain beds, especially those in sandy sediments, and on recruitment to the population.

## CONCLUSIONS AND ADVICE

Since 2010, landings and fishing effort on the Upper North Shore have been low, due in part to the closure of processing plants. In most shellfish areas, the TACs have not been fully taken since 2015 (Table 1). The decline in harvesting seems to have enabled stock recovery in some shellfish areas, as shown by the results of recent surveys. However, caution must continue to be exercised. In a context of environmental change, the return of favourable harvesting conditions in some areas, such as Pointe à Boisvert, appears to be more problematic. Frequent sediment agitation on the flats, particularly those with sandy sediments, makes it more difficult for young clams to settle and burrow and can compromise recruitment to the population and, in turn, recruitment to the fishery on these beds.

In addition, in the absence of specific information on the source of recruitment to the population on various beds, it is recommended to protect the reproductive potential of each shellfish area.

In this context, the exploitation rate should be minimal for areas with a harvestable area less than 0.05 km<sup>2</sup>. According to the results of recent surveys, these areas are Pointe aux Vaches, Batture à Théophile, Pointe à Boisvert, Battures aux Gibiers Est, Anse Noire and Pointe Paradis.

The exploitation rate should be limited to a maximum of 2.5% for areas where the density of 20-50 mm softshell clams over the entire bed is less than 15 clams/m<sup>2</sup>. The two areas affected are Pointe-aux-Outardes Ouest and Pointe-aux-Outardes Est. However, the Banc Marie-Marthe area, with a density of 16.5 clams/m<sup>2</sup>, could also fall into this category.

Finally, the exploitation rate should be limited to a maximum of 5% for the other areas, namely Baie des Petites Bergeronnes, Îles Penchées, Pointe à Émile, Pointe de Mille-Vaches, Baie des Chevaux, Baie Didier Sud, Baie des Plongeurs, Cran à Gagnon, Anse du Colombier, Anse à Norbert, Îlets Jérémie, Rivière Mistassini, Baie Saint-Nicolas and Réserve Pessamit Sud. The Pointe à Émile and Rivière Mistassini areas could benefit from a reduction in their exploitation rate to 2.5%, since application of the 5% rate would result in higher removals than those observed prior to 2006, which led to bed overexploitation.

These exploitation rates should apply to all commercial and recreational harvesters.

Also, to mitigate the incidental mortality caused by the fishery, it is recommended to prohibit any harvesting when the air temperature is  $\leq 0$  °C.

## OTHER CONSIDERATIONS

The recommended conservation measures for clams are aimed at preserving the capacity of each bed to regenerate itself. Any approach aimed at maintaining or even increasing the reproductive potential of each shellfish area, either by leaving more adults on the bottom or by creating refuge areas, will have a positive impact on resource conservation. In addition, as the production of gametes is proportional to the length of the clam cubed, there will be a net gain in productivity by allowing individuals to grow.

Finally, timely environmental events (e.g. breaking waves, storms) and shoreline erosion can have a major impact on the clam beds and completely reshape their habitat. These effects may also differ from one bed to another. The acidification of the water and changes in salinity could also affect the survival of larvae, juveniles and adults. It would be appropriate to monitor the status of the ecosystem, to detect any changes that could affect directly clam populations.

### Assessment schedule

The softshell clam in Québec's coastal waters is assessed and managed on a three-year cycle. Given the low fishing effort deployed and in accordance with the resource management, no update is planned in the intervening years.

The softshell clam is one of the species listed in Bill C-68. This means that, in the more or less long term, a precautionary approach will have to be developed for this species.

## LIST OF MEETING PARTICIPANTS

Name	Affiliation
Belley, Rénaud	DFO Science
Boudreau, Mathieu	DFO Science
Bourdages, Hugo	DFO Science
Brassard, Claude	DFO Science
Brulotte, Sylvie	DFO Science
Bruneau, Benoît	DFO Science
Chabot, Denis	DFO Science
Couillard, Catherine	DFO Science
Cyr, Charley	DFO Science
Desgagnés, Mathieu	DFO Science
Desjardins, Christine	DFO Science
Dubé, Sonia	DFO Science
Gauthier, Johanne	DFO Science
Goudreau, Patrice	DFO Science
Juillet, Cédric	DFO Science
Lacasse, Olivia	DFO Science
Lévesque, David	DFO Science
Loboda, Sarah	DFO Science
Munro, Daniel	DFO Science
Ouellette-Plante, Jordan	DFO Science
Pinette, Majoric	Pessamit Innu Council
Sainte-Marie, Bernard	DFO Science
Sean, Anne-Sara	DFO Science
Tamdrari, Hacène	DFO Science

## SOURCES OF INFORMATION

This Science Advisory Report is from the meeting of February 25, 2020, on the Assessment of Québec inshore waters softshell clam. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada Science Advisory Schedule](#) as they become available.

Abgrall, M.-J., Bastien-Daigle, S., Miron, G. et Ouellette, M. 2010. Potential interactions between populations of softshell clams (*Mya arenaria*) and eastern oysters (*Crassostrea virginica*) in temperate estuaries, a literature review. Can. Tech. Rep. Fish. Aquat. Sci. 2892 : vii + 88 p.

- Brulotte, S. 2011. [Assessment of softshell clam stocks of Québec's coastal waters](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2011/044. x + 53 p.
- Brulotte, S. 2018. [Assessment of softshell clam \(\*Mya arenaria\*\) of Québec's coastal waters in 2016 – Methodology and Results](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2018/004. ix + 60 p.
- Brulotte, S., and Giguère, M. 2007. Reproduction et taille à la maturité sexuelle de la mye commune (*Mya arenaria*) au Québec. Rap. tech. can. sci. halieut. aquat. 2698: viii + 40 p.
- CSSP. 2020. [Canadian Shellfish Sanitation Program](#). Government of Canada, (updated March 2020).
- DFO. 2017. [Assessment of Softshell Clam Stocks in Québec Coastal Waters](#). DFO Can. Sci. Advis. Sec., Sci. Advis. 2017/024.
- Giguère, M., Brulotte, S., Boudreau, M. and Dréan, M.-F. 2008. Évaluation de huit gisements de mye commune (*Mya arenaria*) de la rive nord de l'estuaire du Saint-Laurent de 2002 à 2008. Rapp. tech. can. sci. halieut. aquat. 2821 : x + 91 p.
- Lamoureux, P. 1974. Inventaire des stocks commerciaux de myes (*Mya arenaria* L.) au Québec : 1971-1973. MICQ, D.G.P.M., Cahiers d'information N° 62. 24 p.
- Lavoie, R. 1969. Inventaire des populations de myes communes (*Mya arenaria* L.) de Grandes-Bergeronnes à Portneuf-sur-Mer, été 1968. Station biologique marine Grande-Rivière. Rapport annuel 1968. p. 103-118.
- Lavoie, R. 1970. Inventaire des populations de coques (*Mya arenaria*) de Forestville à Papinachois, été 1969. Station biologique marine Grande-Rivière. Rapport annuel 1969. p. 107-125.
- Lavoie, R. 1970. Inventaire des populations de coques (*Mya arenaria*) de Papinachois – Baie St-Ludger, été 1970. MICQ, rapport interne. 21 p.
- Mercier, Y., Lamoureux, P. et Dubé, J. 1978. Nouvelle estimation des stocks commerciaux de myes (*Mya arenaria* L.) de la région de rivière Portneuf sur la côte nord du Saint-Laurent en 1977. MICQ, D.G.P.M., Cahiers d'information N° 87. 20 p.
- St-Onge, P., Sévigny, J.-M., Strasser, C et Tremblay, R. 2013. Strong population differentiation of softshell clam (*Mya arenaria*) sampled across seven biogeographic marine ecoregions: possible selection and isolation by distance. Mar. Biol. 160: 1065-1081.

**THIS REPORT IS AVAILABLE FROM THE:**

Centre for Science Advice (CSA)  
Québec Region  
Fisheries and Oceans Canada  
Maurice Lamontagne Institute  
P.O. Box 1000 Mont-Joli, Québec  
Canada G5H 3Z4

Telephone: 418-775-0825

Email: [bras@dfo-mpo.gc.ca](mailto:bras@dfo-mpo.gc.ca)

Internet address: [www.dfo-mpo.gc.ca/csas-sccs/](http://www.dfo-mpo.gc.ca/csas-sccs/)

ISSN 1919-5087

© Her Majesty the Queen in Right of Canada, 2020



Correct citation for this publication:

DFO. 2020. Assessment of softshell clam stocks in Québec coastal waters. DFO Can. Sci. Advis. Sec., Sci. Advis. 2020/032.

*Aussi disponible en français :*

*MPO. 2020. Évaluation des stocks de mye des eaux côtières du Québec. Secr. can. de consult. sci. du MPO, Avis sci. 2020/032.*