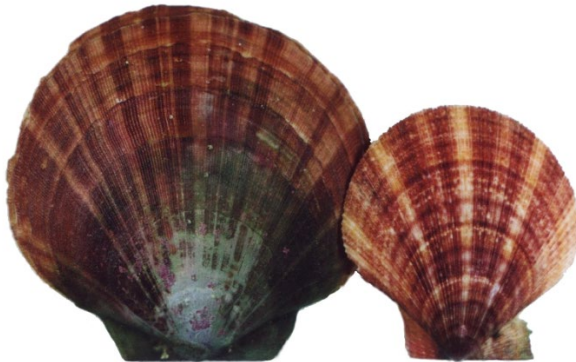




Quebec Region

SCALLOP STOCKS ASSESSMENT IN QUEBEC COASTAL WATERS IN 2022



Source: MPO 2011

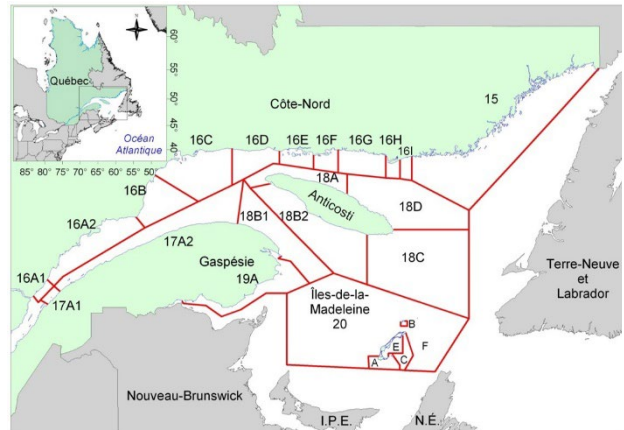


Figure 1. Scallop fishing areas in Quebec.

Context:

Two scallop species are fished commercially in the Gulf of St. Lawrence, namely the Sea Scallop (*Placopecten magellanicus*) and the Iceland Scallop (*Chlamys islandica*). A Digby dredge is used to harvest scallops near shore, and catches are landed mostly as meat (muscle). Given the difficulty to visually distinguish the meat of the two species, commercial fishing statistics are presented regardless of the species. However, scallops caught in one area are usually of the same species.

Quebec waters are divided into 24 fishing areas (Figure 1) where access is limited to a small number of fishermen. Fishing effort is also regulated by a fishing season, and catches are restricted by quotas or a limited number of fishing days.

The resource is assessed every three years, with some exceptions, to determine whether recent changes in the status of the resource may justify adjusting the conservation approach and management plan. The main indicators used in this assessment include landings, fishing effort, catch per unit effort, size structure, weight of muscle landed and density index from scientific surveys.

This Science Advisory Report is from the regional peer review of March 8-9, 2023, on Scallop stock assessment in Quebec coastal waters (management units 15 to 20). Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

SUMMARY

- From 2020 to 2022, Quebec's average annual scallop landings totaled 56.4 t of meat, a 26 % decrease from 2016–2019. Fishing effort dropped by 25% on the same period. Sixty-seven % of the landings were from the Magdalen Islands, 31% from the North Shore and 2% from the Gaspé Peninsula.

North Shore

- Annual landings averaged 17.2 t for the period 2020-2022 and consisted primarily of Iceland Scallops. They decreased by 32% compared to 2016-2019, while fishing effort fell by 44%.
- From 2020 to 2022, there was no fishing effort in areas 16A2, 16C, 16D, 16G, 16H, 16I, 18A and 18D and very little in areas 15 and 16B. Little information is available to assess the scallop status in these areas. There are no recommendations for these areas.

Area 16E

- Since 2013, landings have been less than 16 t compared to levels that were generally above 50 t prior to 2007. Since 2008, fishing has been concentrated mainly on bed D south of Grande Île where recruitment was very good in previous years. Average weight of meat landed has been slightly above the historical average for the last two years.
- The latest research surveys show that the density of non-commercial-size scallop (< 70 mm) remains below the reference mean despite an increase in 2022. More specifically, strong cohorts of small scallops were observed on bed "D" in 2022. The density of commercial-size scallops (≥ 70 mm) remains among the lowest values in the historical series and below the reference mean (1990-2019).
- Output from a new surplus production model indicates that the stock biomass has decreased, reaching 99.69 t in 2022, the lowest level ever recorded.
- A limit reference point has been set to 40% of the theoretical biomass maximum sustainable yield (B_{MSY}), or 182.8 t. The stock has been in the critical zone of the precautionary approach since 2008.
- The exploitation rate estimated by the model indicates that fishing effort would be greater than the level the stock has been able to withstand since 1990, with the exception of 2010 and 2014.
- Minimizing fishing effort on bed "D" would favour the survival of strong cohorts of small scallop observed during the survey in 2022.
- Since the stock is in the critical zone, a rebuilding plan is being developed for Area 16E.

Area 16F

- Since 2009, landings have been less than 5 t compared to levels higher than 25 t prior to 2007. Since 2011, fishing has been concentrated primarily on bed "C". The average weight of meat landed in the last few years has been close to the historical average.
- The 2022 research survey showed that the density of commercial- and non-commercial-size scallops were among the lowest and below the series average in their historical series.
- Reduced fishing effort in recent years does not appear to have led to an increase in densities. Based on the low recruitment observed in the research survey, an increase in

Quebec Region

densities of commercial-size scallops is not expected in the short term. A rebuilding plan is being developed for this area.

Area 16A1

- The fishery in this area resumed in 2017, concentrating on the Île Rouge bed. From 1998 to 2002, this bed was unable to sustain an annual exploitation level of about 10 t. The TAC has been adjusted to 8.72 t in 2020 to address this concern. Because the bed is located at the western edge of the known distribution of scallops and is geographically isolated, it is likely to be more vulnerable to overharvesting.
- Commercial catch per unit effort (CPUE) was relatively high in 2020 and 2022, reaching the reference mean in 2020 and exceeding it in 2022. The current fishing effort on this bed should be sustainable by the time of the next assessment.

Gaspé Peninsula

- Landings reached more than 60 t prior to 2001, and then gradually declined to totals below 2 t per year since 2018. Fishing effort has also declined and is now very low compared to what it was in the 1990s.
- Scallop landings have increased by 38% while fishing effort has decreased by 2% in 2020-2022 compared to 2016-2019.
- Since 2014, the fishery in this region has been concentrated mainly in Area 19A despite a modest resumption of fishing in area 18B1 in 2022.
- From 2020 to 2022, there was no fishing effort in Areas 17A1, 17A2, 18B2 and 18C, and very little effort in Area 18B1. Since little information is available to assess the status of the resource in these areas, there is no recommendation for these areas.

Area 19A

- Landings and fishing effort were very low between 2020 and 2022. Over the last nine years, fishing effort has been concentrated on two beds, leaving a number of beds unharvested.
- In 2017, the CPUE fell to the lowest value in the historical series, but it has been on the rise since then. The average CPUE for the past three years is above the historical average.
- The weight of meat landed is slightly below the historical average.
- There is a high probability that the current fishing effort on these two beds will be sustainable until the next assessment.

Magdalen Islands

- In Area 20A, Sea Scallop landings and CPUEs increased sharply in 2007 and have remained relatively high since then. Fishing effort is distributed evenly across all beds.
- The 2021 and 2022 research surveys indicate that densities of scallop of all size classes (commercial ≥ 100 mm, pre-recruit 85-99 mm, pre-recruit 70-84 mm and < 70 mm) are high and close to the maximum historical values.
- Decision rules for calculating the fishing effort have been in place since 2010. This effort is calculated using CPUEs derived from logbooks and density indices obtained from the research survey. The 2022 CPUE places the stock in the high CPUE zone, and the density indicators are all above the 85th percentiles of the historical series. For 2023, fishing effort is

Quebec Region

at the maximum level established under the decision rules for Area 20A, i.e., 430 days at sea.

- The short- and medium-term outlook for the stock in Area 20A is very encouraging. High abundances of 85-99 mm scallops were observed across all beds; these scallops will be available to the fishery in 2023. In addition, a strong cohort of 40-65 mm scallops has been observed in the Centre beds and will recruit to the fishery within 3-4 years. Some kind of protection would be beneficial for maximizing their survival.

INTRODUCTION

Biological context

Two scallop species are indigenous to Quebec, namely the Sea Scallop (*Placopecten magellanicus*) and the Iceland Scallop (*Chlamys islandica*). These two species mainly inhabit gravel, shell or rock substrates, generally at depths of between 20 and 60 metres. Scallops are sedentary and live in aggregations called beds. The main Iceland Scallop beds exploited are located along the North Shore, Anticosti Island and along the north shore of the Gaspé Peninsula (Figure 2), whereas the exploited Sea Scallop beds are located mostly in the southern Gulf, including the Magdalen Islands, Chaleur Bay, and occasionally, along the Lower North Shore and the northeast shore of the Gaspé Peninsula.

The Sea Scallop grows more quickly than the Iceland Scallop. Scallop growth rate varies between areas and is influenced by habitat quality and environmental conditions. In the Gulf of St. Lawrence, Iceland Scallops reach commercial size at about eight years (70 mm) and Sea Scallops at about six (100 mm).

For scallops, sexes are separate, and eggs are fertilized externally. A scallop's egg production is proportional to its size cubed, and successful fertilization depends on the proximity of other scallops. The spawning period is short and doesn't occur at the same time throughout the Gulf. Along the North Shore and around Anticosti Island, spawning occurs between mid-July and late August, depending on the area. Sea Scallops spawn in August in Chaleur Bay and begin in late August in the Magdalen Islands.

Larval development takes about five weeks from fertilization to settlement on the seabed. During this time, the larvae are dispersed throughout the water column. Juvenile scallops generally attach themselves to the seabed near adults. Scallop beds are usually found in areas where currents enhance larvae retention, but a good substrate is needed to ensure the successful attachment of juveniles. During the settlement period, juveniles are very sensitive to disturbance of the sediment by fishing gear. To ensure the survival of juveniles settled on the seafloor, it is recommended not to dredge scallop beds from August to November.

The meat yield by weight of a scallop of a given size varies over the reproductive cycle. Muscle weight peaks in spring just before gonad development, drops to its lowest point during the spawning period and starts rising again in the fall.

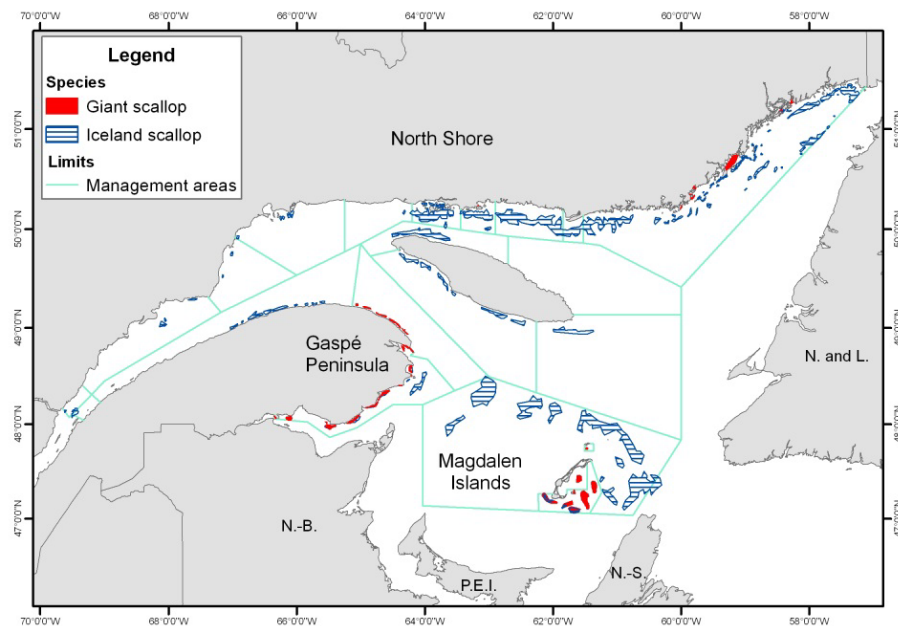


Figure 2. Distribution connue du pétoncle géant et du pétoncle d'Islande dans les eaux côtières du Québec.

Description of the fishery

The commercial scallop fishery in Quebec began in the late 1960s. Scallops are primarily harvested near shore using a Digby dredge. The commercial fishery targets both scallop species. Catches are generally landed as meat (muscle) and the statistics provided in this report are expressed as meat weight. The difficulty in visually distinguishing between the meat of the two species complicates the analysis of fishing statistics. However, the two species are not distributed uniformly throughout the Gulf of St. Lawrence, and catches in an area usually consist of just one species.

Quebec waters are divided into 24 fishing areas, which are grouped into three sectors, the North Shore (areas 15, 16A1, 16A2, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 16I, 18A, 18D), the Gaspé Peninsula (areas 17A1, 17A2, 18B1, 18B2, 18C, 19A) and the Magdalen Islands (areas 20A, 20B, 20C, 20E and 20F) [Figure 1]. Few fishermen operate in most of these areas and there has been little if any fishing effort there. In 2022, 79 regular licences and one exploratory licence were issued. Management plans were developed for each area, based on the following factors: vessel length, dredge size (<7.32 m), fishing season and hours, individual and overall quotas or number of fishing days allowed (Table 1).

A major change in fishery management methods in areas 16E, 16F and 18A occurred in 2006. Harvesting is now managed by regulating fishing effort, i.e. by limiting the number of fishing days for the season and fishing hours per day. Management based on the number of fishing days has also been applied to Area 20A of the Magdalen Islands since 2007, and decision rules have been used to calculate fishing effort since 2010.

From 2020 to 2022, average annual landings totaled 56.4 t of meat, a 26 % increase from 2016-2019 (Figure 3). Landings, in decreasing order of weight, were from the Magdalen Islands (67%), the North Shore (31%) and the Gaspé Peninsula (2%). During the same period, fishing effort, calculated in standardized fishing hours per metre of dredge width (hours • meter), decreased by 25% in Quebec from 2016-2019 (Figure 4).

Quebec Region

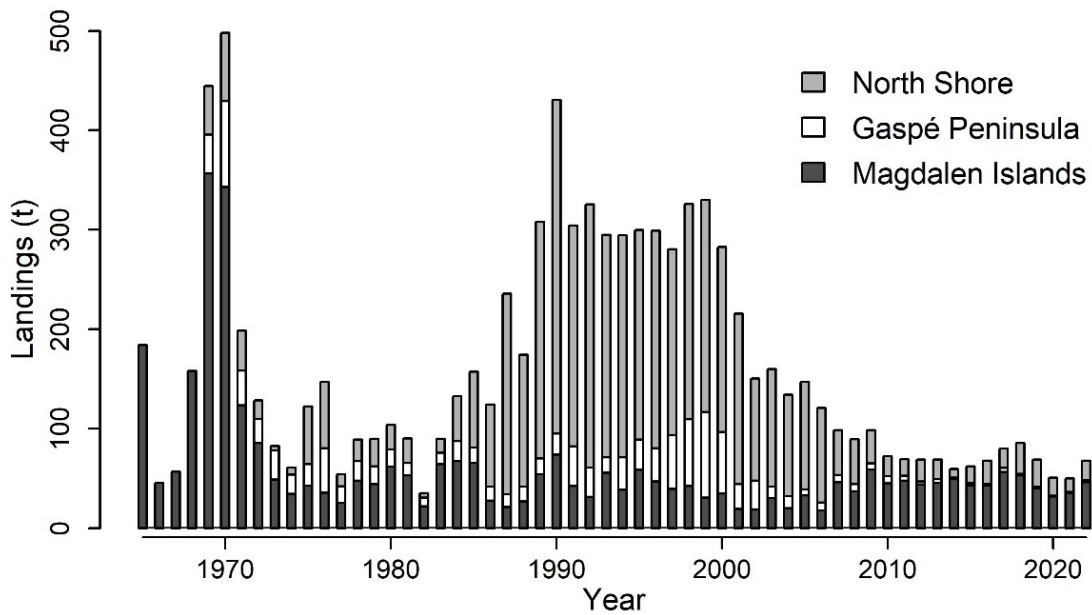


Figure 3. Scallop landings (t of meat) in Quebec by sector.

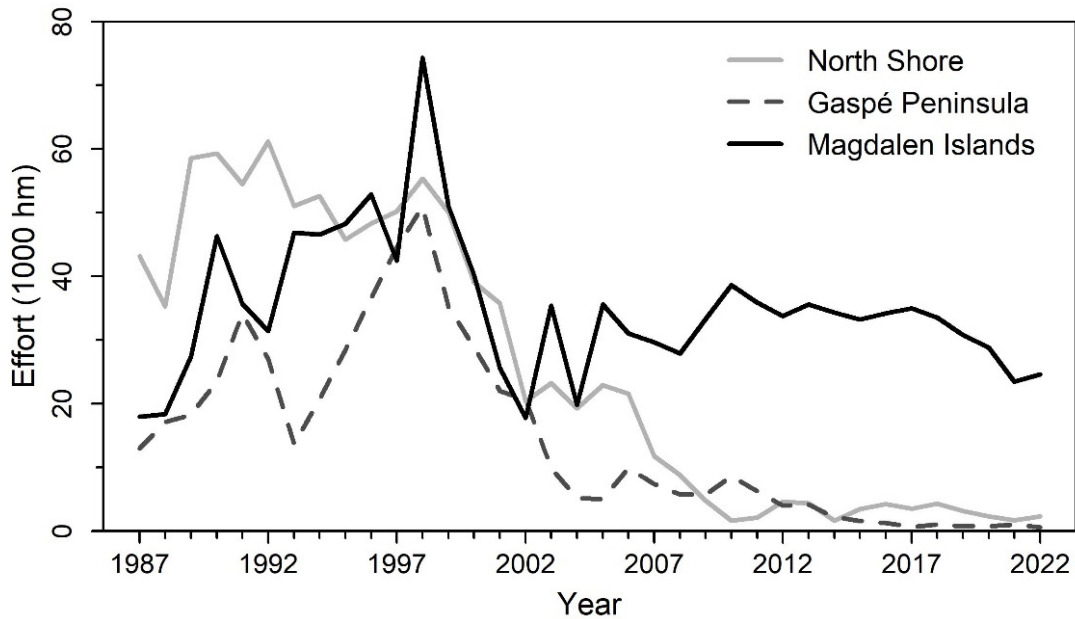


Figure 4. Fishing effort in Quebec expressed in standardized fishing hours per metre of dredge width by sector.

Quebec Region

Scallop Stocks Assessment in Quebec
Coastal Waters in 2022

Table 1. 2022 scallop fishery management measures.

Area	Number of Licences	Quota (t meat or days at sea)	Season (day/month)	Daily schedule	Dockside monitoring	Hail out	Hail in	At-sea Observers (% of trips)	VMS ¹	Size Limit and Meat Count ²
15	33 + 1 ³	-	Sign ⁴ - 03/12	-	-	-	-	-	-	-
16A1	1	10.9 t	15/04 - 01/12	-	-	100%	100%	5%	100%	-
16A2	1	3.8 t	15/04 - 01/12	-	-	-	100%	-	100%	-
16B	1	6.8 t	15/04 - 01/12	-	-	-	100%	-	-	-
16C	2	12.8 t	15/04 - 03/11	-	100%	100%	100%	5%	100%	-
16D ⁴	-	6.1 t	15/04 - 03/11	-	-	-	100%	-	-	-
16E	9	79 days ⁵	Sign ⁶ - 31/12	5 a.m. – 8 p.m.	Sporadic	100%	100%	-	100%	-
16F	9	25 days ⁷	Sign ⁶ - 31/12	5 a.m. – 8 p.m.	Sporadic	100%	100%	-	100%	-
16G ⁸	3	13.7 t	22/04 - 17/11	-	-	-	100%	-	-	-
16H ⁹	8	8.3 t	22/05 - 3/12	-	100%	-	100%	-	-	-
16I ¹⁰	-	-	22/05 - 3/12	-	-	-	-	-	-	-
17A1	1	10.9 t	01/04 - 30/11	-	-	100%	100%	5%	100%	100 mm ; 30
17A2	1	4.0 t	01/04 - 30/11	-	-	-	100%	-	100%	100 mm ; 30
18A	9	258 days	Sign ⁶ - 31/12	6 a.m. – 9 p.m.	Sporadic	100%	100%	-	100%	-
18B1	3	-	01/05 - 30/09	-	-	-	100%	-	100%	100 mm ; 30
18B2	3	16.0 t	01/04 - 30/11	-	-	-	100%	-	100%	100 mm ; 30
18C	3	11.0 t	01/04 - 30/11	-	100%	-	100%	-	100%	-
18D ¹¹	1	10.0 t	22/04 - 17/11	-	-	-	100%	-	-	-
19A	3 ¹²	-	01/05 - 30/09	Day ¹³ , time	-	-	100%	-	100%	100 mm ; 30
20A	22 ¹⁴	230 days	21/03 - 31/07	Day ¹⁵ , time	-	-	100%	-	100%	100 mm ; 30
20B	22	-	21/03 - 31/07	Day ¹⁵ , time	-	-	100%	-	100%	100 mm ; 30
20C	22	-	21/03 - 31/07	Day ¹⁵ , time	-	-	100%	-	100%	100 mm ; 30
20E	Refuge Area									
20F	22	-	21/03 - 31/10	Day ¹⁵ , time	-	-	100%	-	100%	100 mm ; 30

¹ = Vessel monitoring system (VMS).

² = Minimal legal size and meat count (maximum number of muscles in 500 g) for Sea Scallop.

³ = Exploratory licence for Iceland Scallop.

⁴ = Open to all scallop licence holders residing between Sept-Îles and Pointe Parent.

⁵ = A total of 79 fishing days are allowed (down 16% from the last CHP), with a maximum of 50% of the days in bed D. Maximum of 10 hours per day.

⁶ = Fishing begins as soon as the Conservation Harvesting Plan (CHP) is signed.

⁷ = A total of 25 fishing days are allowed (down 17% for the last CHP). Maximum of 10 hours per day.

⁸ = Open to scallop licence holders in group A

⁹ = Open to scallop licence holders in group A and to 4 from Lower North Shore under conditions.

¹⁰ = Open to all Area-15 scallop licence holders

¹¹ = Open to all scallop licence holders residing from Tadoussac to Pointe-Parent

¹² = 1 dredge licence and 2 tourist diving licences.

¹³ = Between Cap-Gaspé and the Port-Daniel lighthouse: Monday to Friday from 5 a.m. to 6 p.m. and Saturday from 5 a.m. to noon.

Between the Port-Daniel lighthouse and Miguasha: Monday to Friday from 5 a.m. to 6 p.m.

¹⁴ = 1 licence holder did not fish in 2022 and did not transfer any fishing days to sub-area 20A.

¹⁵ = Monday to Friday from 5 a.m. to 9 p.m.

ASSESSMENT

The assessment of the status of scallop populations is based mainly on an analysis of commercial indices derived from logbooks and sampling at sea or at dockside (Tables 2 and 3). It is also based on indices derived from research surveys conducted out every two years on scallop beds in the Mingan area (areas 16E and 16F) and the Magdalen Islands (Area 20A).

Table 2. Catch per unit effort (kg of meat per hour of fishing and metre of dredge width) estimated from logbooks.

Year	Fishing Area									
	15	16A1	16B	16E*	16F*	18B1	19A	20A	20B	20C
2006	2.34	1.14	-	1.57	1.65	2.03	0.85	0.60	0.51	0.46
2007	1.74	-	-	1.38	1.55	2.60	0.92	1.64	0.81	0.58
2008	-	-	-	1.82	1.61	2.38	1.12	1.37	0.53	0.70
2009	1.97	2.91	-	1.92	1.37	2.71	0.95	1.83	0.74	-
2010	1.73	-	-	1.83	-	2.91	0.81	1.24	0.58	0.63
2011	1.41	-	-	2.14	1.30	4.20	0.73	1.35	0.62	0.31
2012	1.25	-	-	1.66	1.38	0.99	0.64	1.32	0.92	-
2013	-	-	-	1.72	1.40	-	0.80	1.30	0.45	0.38
2014	-	-	-	1.34	1.59	-	0.65	1.44	0.60	1.15
2015	1.53	-	-	1.43	1.36	7.58	0.69	1.31	0.83	-
2016	0.88	-	4.02	1.76	1.81	2.51	0.74	1.28	0.82	-
2017	0.92	13.14	-	1.90	1.95	-	0.64	1.63	0.54	-
2018	-	12.62	4.11	2.02	2.27	-	1.06	1.59	0.32	-
2019	1.27	11.09	3.63	3.11	2.47	-	1.14	1.32	0.61	1.51
2020	-	8.16	-	2.49	2.82	-	1.11	1.11	0.88	-
2021	-	-	0.41	2.13	2.86	-	1.01	1.51	1.03	1.21
2022	2.39	16.78	-	2.11	2.36	4.84	1.28	1.94	0.98	-
1992-2019 Average	1.63	7.49	2.31	1.88	1.93	2.38	0.91	1.13	0.70	0.77

* : kg of meat per fishing tow and metre of dredge width

Table 3. Average weight of landed meat (g).

Year	Fishing Area							
	15	16A1	16E	16F	18B1	19A	20A	
2006	12.9	7.5	11.5	11.2	30.8	16.4	18.5	
2007	-	-	12.2	11.6	35.7	21.1	19.2	
2008	-	-	11.3	11.3	36.1	19.5	27.8	
2009	-	6.0	10.8	-	31.0	18.1	16.1	
2010	-	-	10.7	-	42.4	20.9	23.6	
2011	-	-	11.2	11.2	34.8	21.7	24.0	
2012	-	-	11.9	12.1	-	20.9	27.3	
2013	-	-	12.2	11.1	-	18.9	26.7	
2014	-	-	11.5	-	-	18.6	24.8	
2015	-	-	12.9	11.8	34.5	20.9	24.8	
2016	-	-	11.7	10.9	-	18.3	24.8	
2017	-	9.3	11.9	10.3	-	16.3	20.5	
2018	-	7.0	11.7	-	-	17.6	21.2	
2019	15.9	7.0	12.3	-	-	16.3	22.6	
2020	14.0	7.3	12.8	-	-	19.5	25.7	
2021	-	-	14.5	12.7	-	13.6	23.7	
2022	16.0	9.4	13.5	-	40.6	16.4	23.4	
1992-2019 Average	14.7	8.0	11.8	11.5	34.1	19.0	22.6	

Quebec Region

North Shore

Iceland Scallops are harvested along the entire North Shore of the Gulf of St. Lawrence, while Sea Scallops are taken only along the Lower North Shore. The North Shore is divided into 13 separate fishing areas located between the mouth of the Saguenay River and Blanc Sablon and along the north shore of Anticosti Island. From the late 1980s to the mid-2000s, scallop landings on the North Shore consistently accounted for more than 65 % of catches in Quebec. In recent years, this figure has dropped sharply owing to the depletion of certain beds and to socio-economic circumstances that have been unfavourable for the scallop fishery in this region. Consequently, the fishing effort on the North Shore has declined markedly and remains low compared to what it was in the early 2000s. Average North Shore landings were approximately 17.2 t of meat between 2020 and 2022, down 34% on the 2016-2019 period for a 47% decrease in fishing effort. These decreases were widespread across all fished areas, with the exception of Area 15, which saw an increase. The landings came mainly from the Mingan Archipelago area (areas 16E and 16F), the Île Rouge (Area 16A1), and the Lower North Shore (Area 15). A rebuilding plan is being developed for 16E and 16F areas due to the strong historical exploitation of these areas and the depletion of certain beds.

Upper North Shore (Areas 16A1, 16A2, 16B and 16C)

These areas are harvested by five fishermen, and fishing effort is regulated by the number of licences issued and quotas. The vast majority of landings on the Upper North Shore come from Area 16A1 where, after a complete cessation of fishing activities in 2010, harvesting on the Île Rouge bed resumed in 2017 (Figure 5). Landings in this area totalled 2.4 t and 4.5 t of meat in 2020 and 2022, respectively. Average landings for these two years (2.3 t) are lower than the average of the 2017-2019 period (6.7 t), representing a 66% decrease in landings. Between 2020 and 2022, only one fishing day was carried out outside Area 16A1, i.e. one fishing day in Area 16B in 2021.

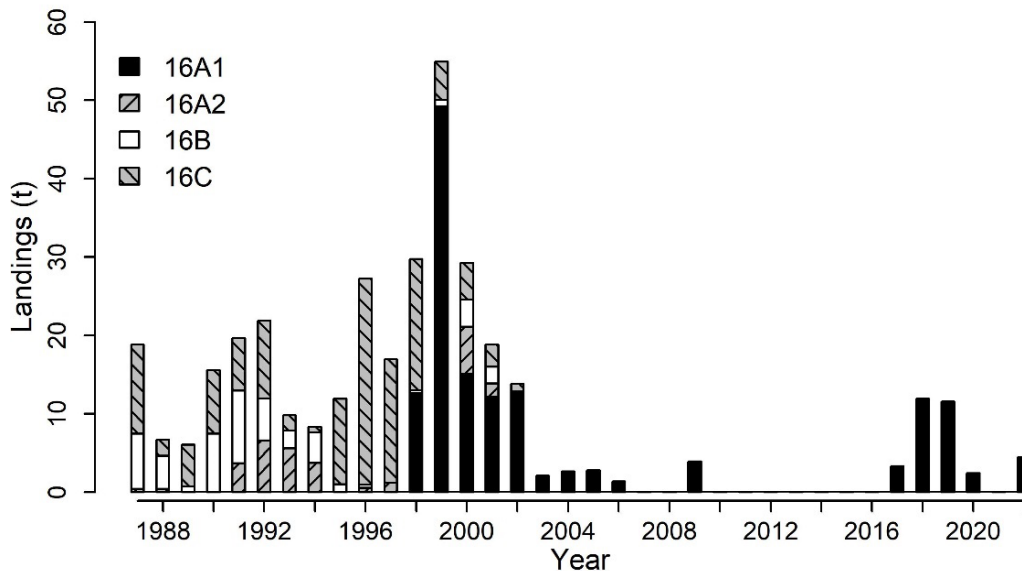


Figure 5. Scallop landings (t of meat) from Areas 16A1, 16A2, 16B and 16C.

Middle North Shore (Areas 16D, 16E, 16F, 16G and 18A)

Nine fishing licences provide access to areas 16E, 16F and 18A; three licences are for Area 16G, and all Middle North Shore scallop fishermen have access to Area 16D. Each Area is

Quebec Region

regulated by a quota, and there are daily and seasonal restrictions on fishing effort. Middle North Shore landings for 2020, 2021 and 2022 were only 15.4, 13.1 and 12.4 t of meat, respectively. Landing levels from these areas remain very low compared to the numbers of the 1987-2006 period (Figure 6).

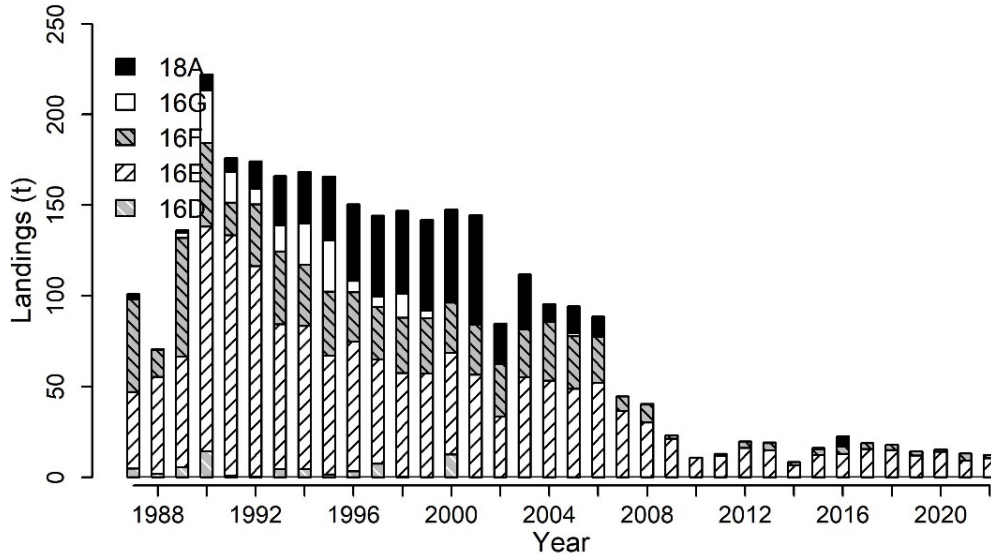


Figure 6. Scallop landings (t of meat) from areas 16D, 16E, 16F, 16G and 18A.

From the Manitou River to the Île aux Perroquets lighthouse (Area 16D), there hasn't been any fishing effort since 2005 except in 2015 when there was one day of fishing. Since 1996, landings have been low because fishing effort has been sporadic in this area.

In Area 16E, landings were generally greater than 50 t prior to 1997, and then decreased to levels below 16 t since 2013. Landings for 2020, 2021 and 2022 were 14.1, 9.2 and 10.6 t of meat respectively (Figure 6). These landings have seen an average decrease of 19% compared to the 2016-2019 period. Fishing effort dropped steadily from over 200 days at sea before 2008 to an average of 43 days for the 2020-2022 period out of an authorized total of 79 days in 2022. The fishing effort observed in this area accounted for 55% of the provisional maximum authorized effort. Since 2008, fishing effort has been primarily concentrated on a single bed: bed D south of Grande Île, where strong cohorts recruited to the fishery beginning in 2007. This strong recruitment had been previously identified since 2003 during research surveys. There were very few harvesting operations in the other beds, except bed A in the last four years. CPUEs from logbooks have been high and above the 1992-2019 average since 2017 (Table 2). The average weight of meat landed from 2020 to 2022 is higher than the 2016-2019 period as well as the historical average (Table 3).

The 2022 research survey in Area 16E indicated that the density of commercial-size scallops remained very low and below the reference average (Figure 7). The density of non-commercial-size scallops increased between the 2019 and 2022 surveys but is still below the reference average in 2022 (Figure 7). However, the last research survey revealed strong cohorts of small scallops (< 40 mm) on bed "D" in 2022 (Figure 8). It is important to note that these are the largest cohorts of small scallops that have been observed in research surveys since 2003 (Figure 8). Minimizing fishing effort on bed "D" would favour the survival of strong cohorts of small scallops observed during the survey in 2022.

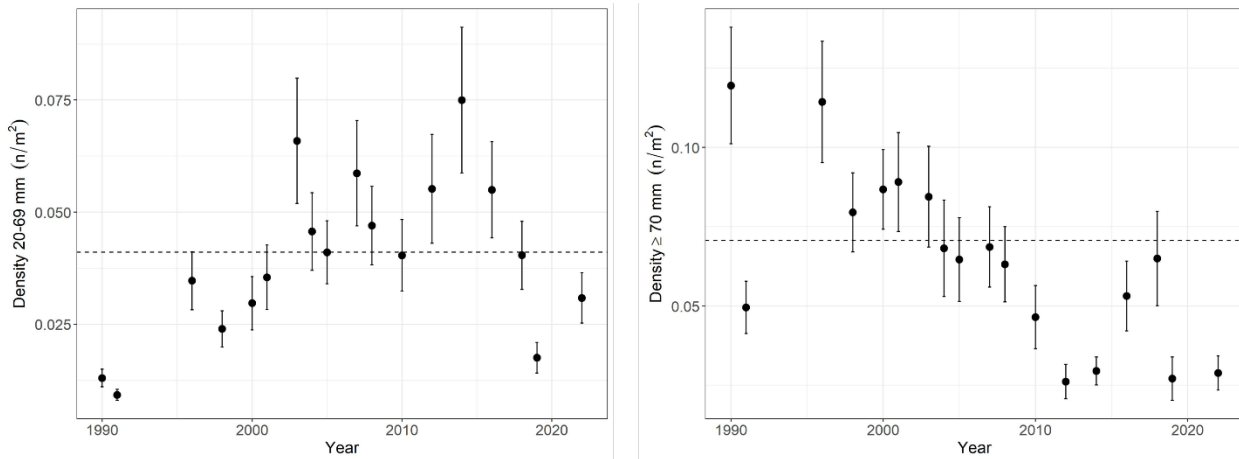


Figure 7. Density index of non-commercial (20 to 69 mm) and commercial (≥ 70 mm) scallops based on research surveys in the Mingan area, Area 16E (mean \pm standard error). The dotted lines represent the averages for the 1990-2019 series.

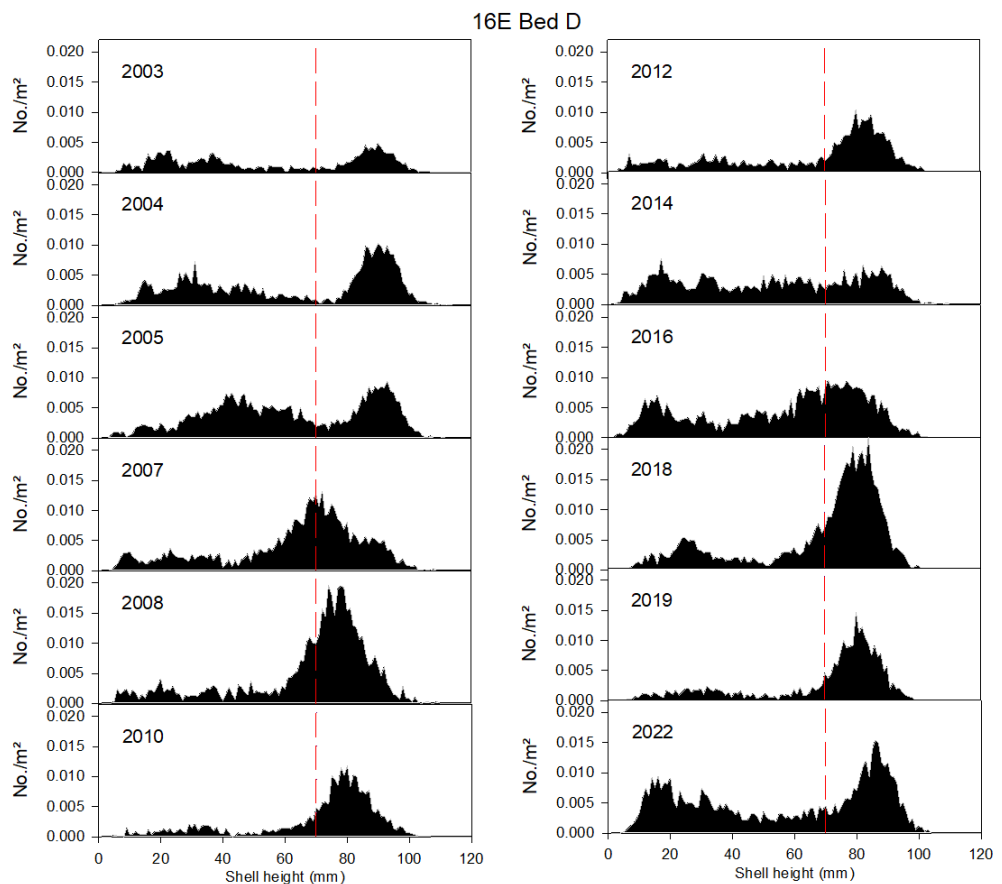


Figure 8. Scallop densities by size class on bed "D" during research surveys from 2003 to 2019 in the Mingan area, Area 16E.

A new surplus production model (JABBA, Winker et al. 2018) was presented and accepted at the peer review meeting. The model indicates that the stock biomass has decreased over time,

Quebec Region

reaching 99.69 t in 2022, the lowest level ever recorded (Figure 9). A limit reference point has been set to 40% of the theoretical biomass maximum sustainable yield (B_{MSY}), or 182.8 t. The stock has been in the critical zone of the precautionary approach since 2008 (Figure 9).

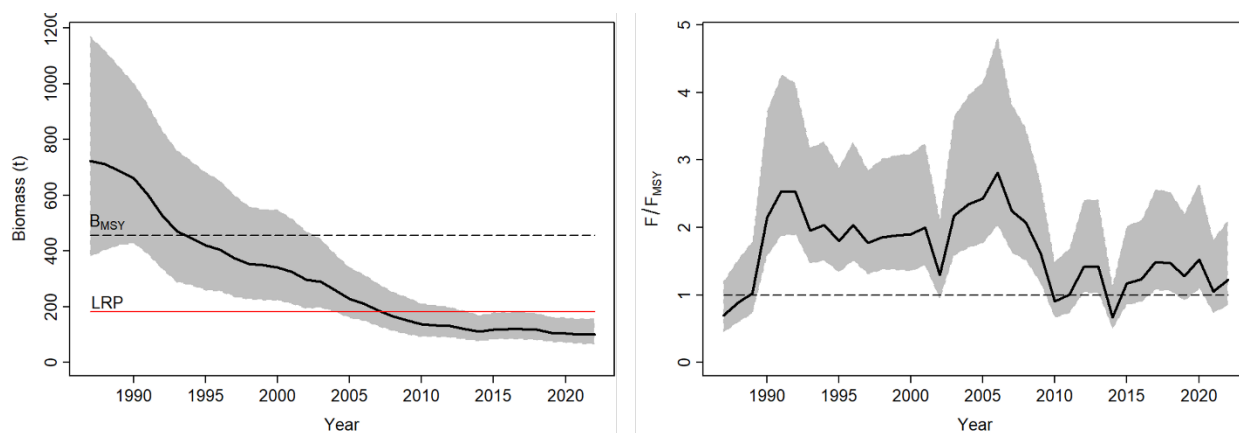


Figure 9. Iceland Scallop biomass estimated by the stock assessment model for the beds harvested in Area 16E (left panel). Intensity of fishing effort estimated by the same stock assessment model (right panel). Grey areas represent model-related uncertainty. B_{MSY} = Biomass maximum sustainable yield, LRP = Limit reference point (182.8 t) and F/F_{MSY} = Ratio of fishing in the last year to fishing at maximum sustainable yield estimated by the model.

The exploitation rate estimated by the model indicates that fishing effort would be greater than the level the stock has been able to withstand since 1990, with the exception of 2010 and 2014. Since the stock is in the critical zone, a rebuilding plan is being developed for Area 16E.

In Area 16F, landings have been less than 5 t per year since 2009 compared to levels higher than 25 t prior to 2007. In 2020–2022, landings and fishing effort in Area 16F decreased by 24% and 40%, respectively, compared to 2016–2019. On average, landings totalled 2.3 t (Figure 6) and fishing effort stood at 10.7 fishing days per season out of an authorized total of 25 days. Since 2011, fishing has been concentrated primarily on bed C. CPUEs derived from logbooks increased and were above the average of the historical series (Table 2). In 2021 (no data were available for 2020 and 2022), the average weight of meat landed increased and was above the historical average (Table 3). The last research survey showed that densities of commercial- and non-commercial-size scallops were below the average of their respective series in 2022 (Figure 10).

In Area 16G, between Johan Beetz Bay and Natashquan, landings, fishing effort and catches per unit effort varied until 2005 (Figure 6), and there have been no landings since then.

Despite a possibility of 258 days at sea annually, Area 18A was last fished in 2016 and 5.6 t of meat were landed (Figure 6) in 27 fishing days. Both landings and fishing effort had decreased significantly in 2002. This decrease in landings and CPUE continued until 2009.

Quebec Region

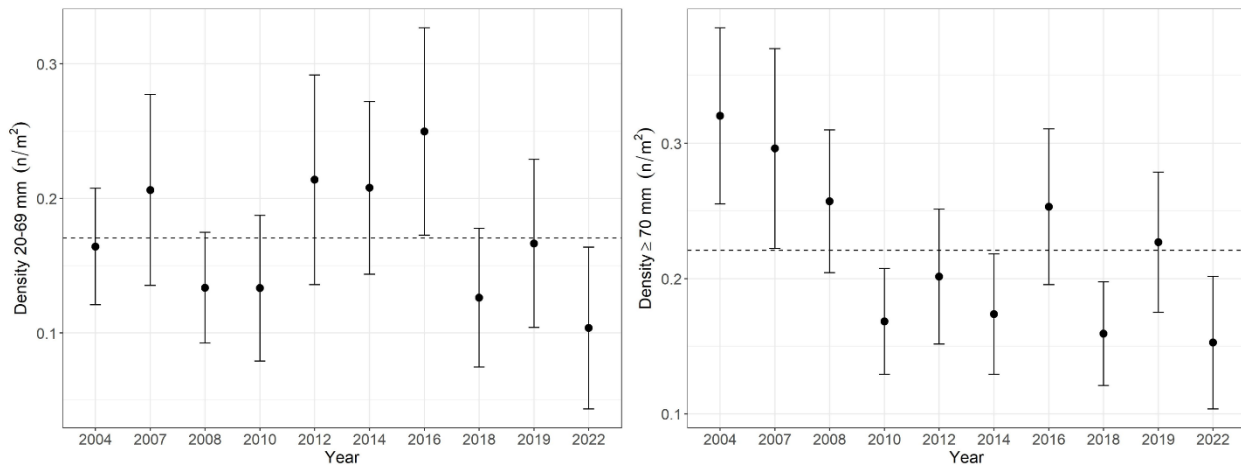


Figure 10. Density index of non-commercial (20 to 69 mm) and commercial (>70 mm) scallops based on research surveys in the Mingan area, Area 16F (\pm standard error). The dotted lines represent the averages for the 2004-2019 series.

Lower North Shore (Areas 16H, 16I and 15)

In 2022, eight scallop fishing licences were issued for Area 16H, and 33 regular and one exploratory licence were issued for Iceland Scallop harvesting in areas 15 and 16I. Prior to 1992, most of the Lower North Shore landings were Sea Scallop, but from 1992 to 1998, Iceland Scallop landings from areas 16H and 16I increased. Since 1998, Lower North Shore landings of both scallop species have dropped, totalling 2.9 t of meat in 2022 (Figure 11). Area 15 landings have been low since 2007. There hasn't been any fishing in areas 16H and 16I since 2004 and 2005, respectively.

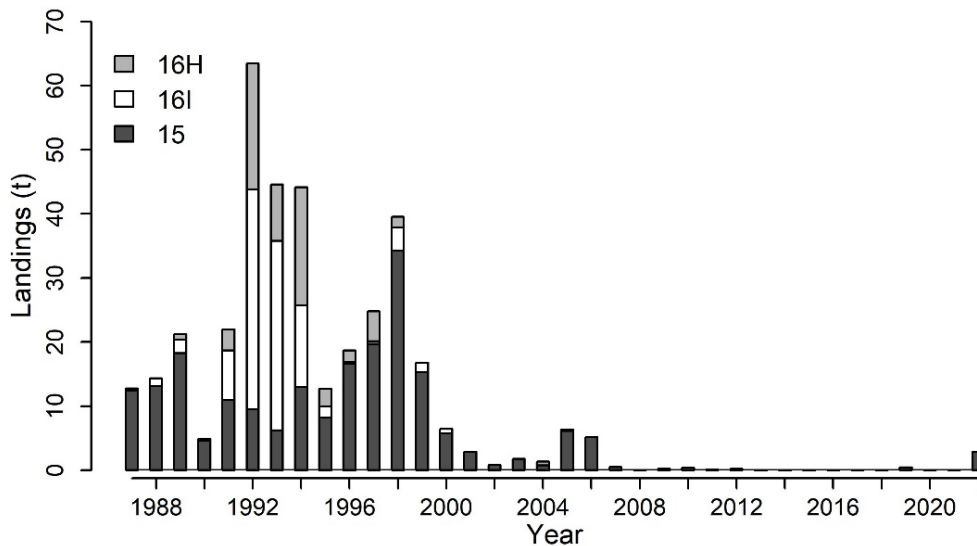


Figure 11. Scallop landings (t of meat) from Lower North Shore areas 15, 16H and 16I.

Gaspé Peninsula (Areas 17A1, 17A2, 18B1, 18B2, 18C and 19A)

The Gaspé Peninsula is divided into three fishing sectors: the St. Lawrence Estuary and the north shore of the Gaspé Peninsula (17A1, 17A2 and 18B1), southern Anticosti Island (18B2 and 18C) and Chaleur Bay (19A). The number of licences is limited in each area. In 2022, only

Quebec Region

one licence was issued for areas 17A1 and 17A2, three in areas 18B1, 18B2 and 18C and one commercial licence and 2 tourist diving licences in Area 19A. Each area had its own fishing season, and quotas were set in areas 17A1, 17A2, 18B2 and 18C.

Landings in the Gaspé Peninsula gradually started to increase in 1993, peaking at about 80 t of meat in 1999. Landings in the Gaspé Peninsula area dropped significantly in 2003 and have remained low since then, reaching the lowest value in the historical series in 2017 when 0.6 t of meat were landed (Figure 12). From 2020 to 2022, for all areas of the Gaspé Peninsula combined, average annual landings increased by 38%, but fishing effort remained stable when compared to the 2016-2019 period (Figure 4). A slight increase in fishing activities can be observed in Area 18B1 in 2022, which is partly responsible for the increased landings in the Gaspé Peninsula. There was no fishing in areas 17A1, 17A2, 18B2 and 18C in 2020-2022.

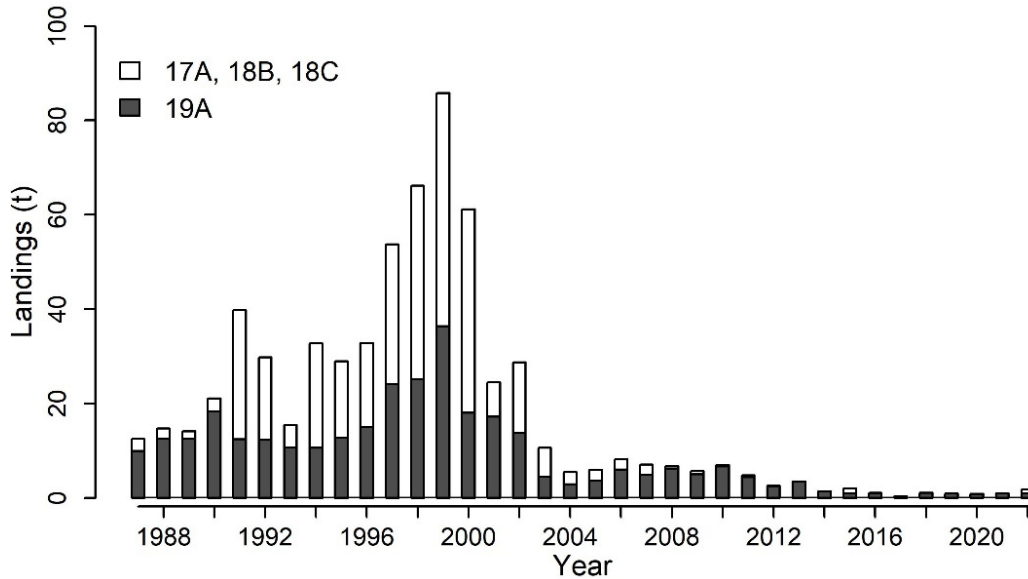


Figure 12. Gaspé Peninsula scallop landings (t of meat).

In the wake of reduced fishing effort in Area 19A in 2003, landings fell significantly and subsequently stabilized somewhat at a 5 t per year average in 2011 and both fishing effort (Figure 4) and landings continued to decrease thereafter (Figure 12). In 2022, landing and fishing effort values were still low at 1.0 t and 30 fishing days. In the last nine years, scallops were primarily harvested from two beds, leaving several beds unexploited. Catch per unit effort had been decreasing from 2008 to 2017, reaching its lowest value, but has been increasing since then. The CPUE in 2022 was above the historical series average, while remaining low compared to CPUE observed in most other areas (Table 2). The average weight of Sea Scallop meat landed from 2020 to 2022 was slightly lower than the series average (Table 3).

Magdalen Islands (Area 20)

There are several scallop beds in the Magdalen Islands: Dix-Milles, Chaîne-de-la-Passe (also known as the Centre beds), Pointe-du-Ouest, Sud-Ouest, Île Brion and Banc de l’Est (Figure 13). Sub-area 20E is closed because it is a Sea Scallop refuge area.

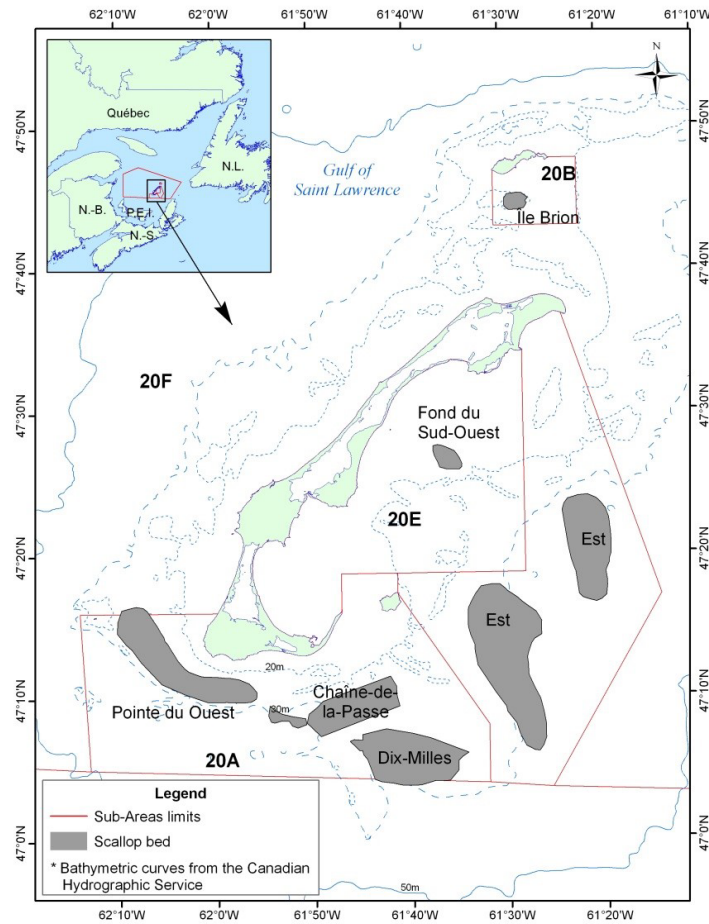


Figure 13. Sub-areas and main scallop fishing grounds in the Magdalen Islands.

Since 2007, fishing effort in Area 20A has been regulated by a total authorized number of days at sea, and areas 20B, 20C and 20F are regulated by a fishing season. Authorized effort in Area 20A was 322 days from 2013 to 2019, 299 days in 2020, and 230 days in 2021 and 2022. These maximums were nearly reached every year. Annual fishing effort has been stable since 2005 but is below the 1992-2019 series average for the 2020-2022 period due to the reduction in the number of authorized fishing days. Landings increased significantly from 18 to 46 t of meat in 2007 and have been stable since then (Figure 14). The fishing effort of the past four years has been well distributed over the three main beds in Area 20A (Pointe-du-Ouest, Dix-Milles and Chaîne-de-la-Passe), whereas annual fishing effort was low in areas 20B, 20C and 20F.

Quebec Region

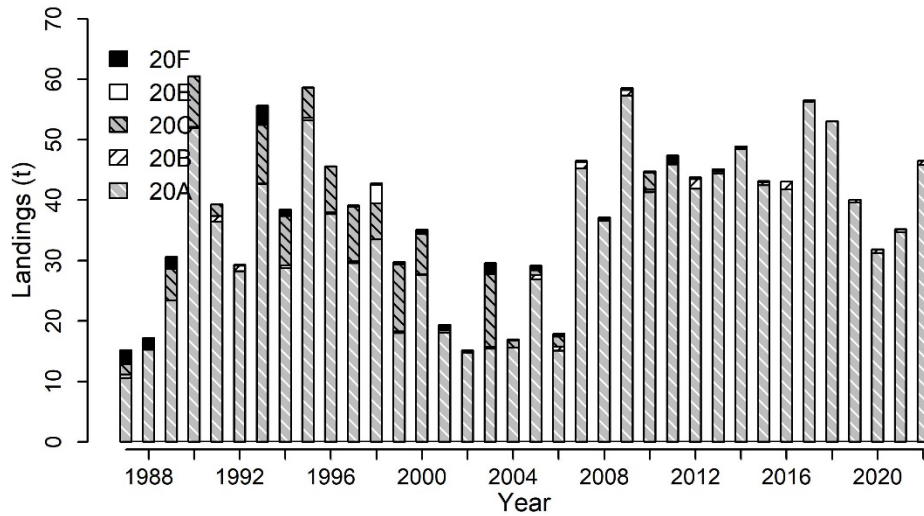


Figure 14. Scallop landings (t of meat) in the Magdalen Islands.

Catches per unit effort estimated from logbooks has been relatively stable since 2007 and remain significantly higher than CPUEs in the early 2000s and above the upper stock reference point (Figure 15).

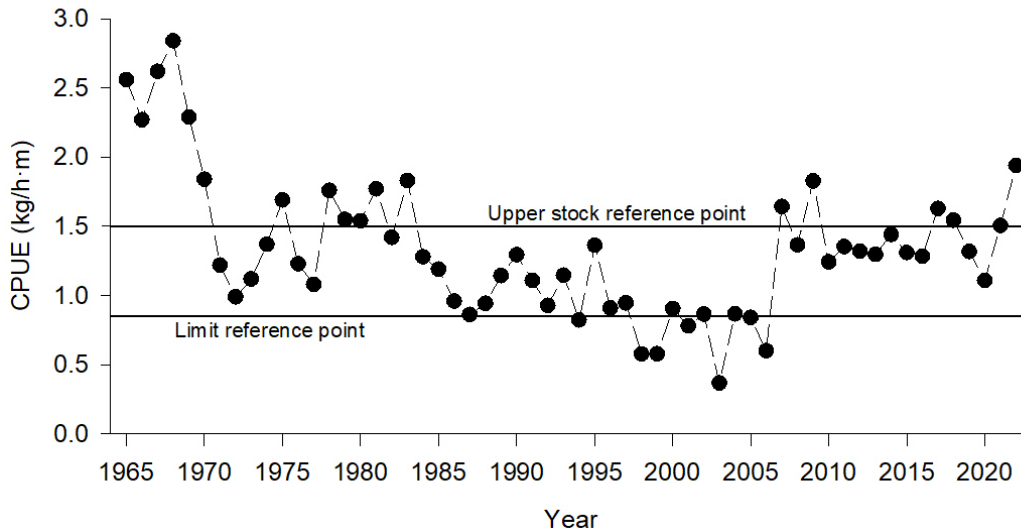


Figure 15. Catches per unit of (CPUEs) estimated from logbooks in Area 20A.

The 2021 and 2022 research surveys indicated that the density of commercial-size (100 mm and over) scallop remains high and close to historical maximum values (Figure 16). The density of 85-99 mm, 70-84 mm and < 70 mm pre-recruit scallop are also higher than the median (1987-2008) and close to the historical maximum values.

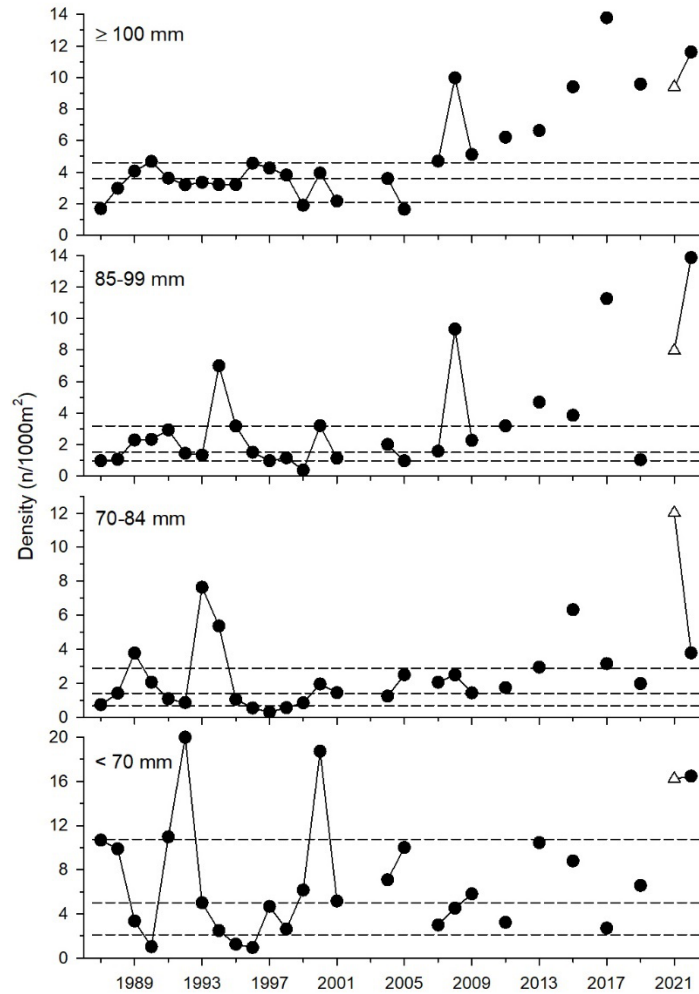


Figure 16. Density of Sea Scallops sampled in the Magdalen Islands during research surveys according to four size categories. The dotted lines indicate the 15th, 50th (median) and 85th percentiles of the 1987-2008 series. Triangles indicate data collected with a charter boat (*Mytilus*) different from the one normally used.

Decision rules have been used to calculate annual fishing effort in Area 20A since 2010. A primary indicator is calculated using CPUEs from the last two fishing seasons. If the CPUE of the last year's CPUE is higher than the previous year's CPUE, the average of the two values is used. Otherwise, only the CPUE of the final year is used. The decision rule detailed in Figure 17 is used to determine the fishing effort for the following year as suggested by the primary indicator. Second, the most recent research survey abundance results are used to adjust the fishing effort upwards or downwards within the grey area in Figure 17. For the 2023 season, the maximum fishing effort is calculated at 430.1 days at sea in Area 20A. These decision rules and calculation methods are described in more detail in Trottier *et al.* (2017).

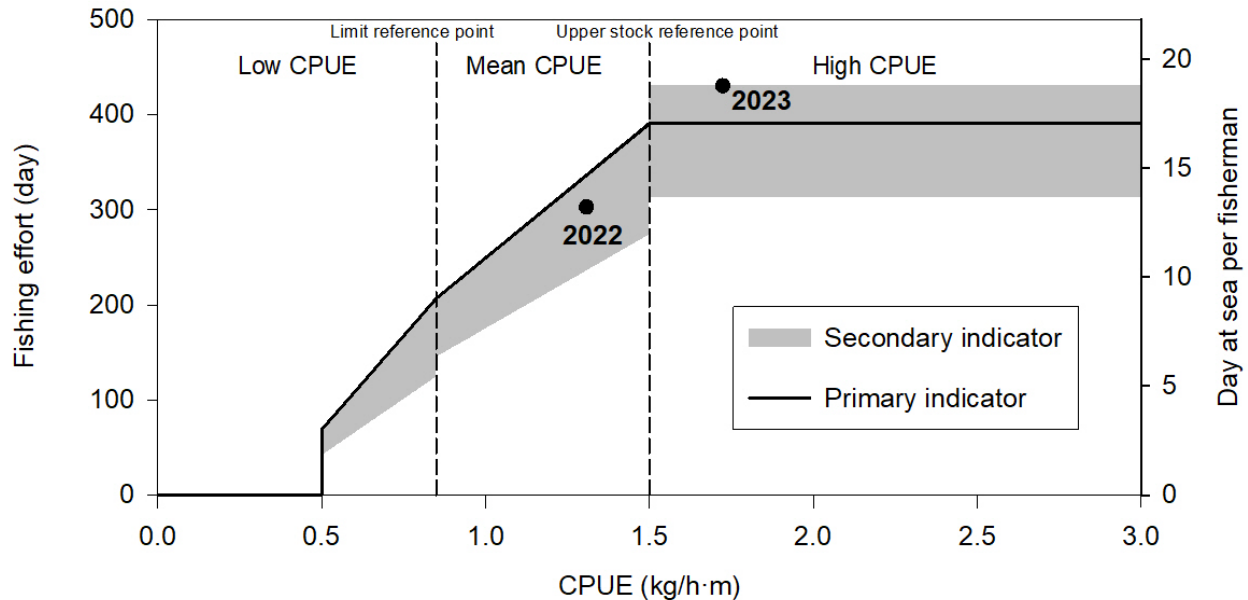


Figure 17. Calculation of fishing effort (days at sea) based on primary (CPUE) and secondary indicators (research survey indices) for Area 20A.

Sources of Uncertainty

The sustainable exploitation rates of the various beds remain unknown. Without knowledge of the sustainable exploitation rate, it is difficult to suggest quotas or specific exploitation strategies.

Although the indicators and the surplus production model for Area 16E are calculated for the entire area, fishing effort, recruitment, growth and survival rates, temporal trajectories of scallop densities, muscle weight per scallop, and the timing of spawning can differ between beds within a given area. Failure to consider the specific parameters for each bed could lead to overharvesting and localized depletions.

Environmental factors may impact stocks but were not considered in the assessment. Ocean acidification, rising water temperatures, changes in phytoplankton bloom phenology, infestations of barnacles and shell-boring worms, and changes in predation pressure could have an impact on various life stages. Studies are underway to examine the impact of environmental factors on scallops and to select indicators that can be used to monitor variations in the state of the environment and the biological effects on scallops.

In several management areas, fishing effort is zero or very low, which compromises the reliability of the indicators. In most management areas (except 16E, 16F and 20A), information on recruitment is not available.

CONCLUSIONS AND ADVICE

North Shore

Areas 16A1, 16A2, 16B, 16C, 16D, 16G and 18D

From 1998 to 2002, the Île Rouge bed was unable to sustain an annual exploitation level of about 10 t, except in 1999, when the weight of meat landed totalled nearly 50 t. Because the bed is located at the western edge of the known distribution of scallops and is geographically isolated, it is likely to be more vulnerable to overharvesting than the other beds and to receive smaller and less frequent inputs of larvae than the beds in other areas.

Between 2020 and 2022, there was no fishing effort in Areas 16A2, 16C, 16D, 16G and 18D, and very little effort in Areas 16B. Since little information is available to assess the status of the resource in these areas, there are no recommendations for these areas.

Areas 16E, 16F and 18A

The fishing effort management system, developed in 2006 for Areas 16E, 16F and 18A, is aimed at regulating the number of fishing days to maintain a constant exploitation rate in situations where the maximum fishing effort is reached. Constant effort can mean a constant exploitation rate, with annual landings fluctuating depending on the stock status. Since this system was introduced, the maximum level of effort has never been reached in any of the three areas.

Since 2008 in Area 16E, the fishery has been concentrated primarily on bed D, south of Grande Île, where recruitment was very good in previous years. Once again, strong cohorts of small scallops were observed on bed "D" in 2022. Reducing the fishing effort on bed "D", which had been limited to 50% of the effort over the entire area for several years, would favour the survival of these strong cohorts of small scallops observed during the 2022 survey.

The new surplus production model indicates that the stock biomass in Area 16E has decreased over time, reaching 99.69 t in 2022, the lowest level ever recorded. The limit reference point, set to 40% of the theoretical biomass maximum sustainable yield (B_{MSY}), is 182.8 t. The exploitation rate estimated by the model indicates that fishing effort would be greater than the level the stock has been able to withstand since 1990, with the exception of 2010 and 2014. The stock has been in the critical zone of the precautionary approach since 2008.

In Area 16F, the last research survey indicated that the density of commercial- and non-commercial-size scallops was below the average for their respective series in 2022. The reduction in fishing effort in recent years does not appear to have increased densities. The low recruitment observed in the scientific survey does not allow us to predict an increase in commercial size densities in the short term.

Area 18A was last harvested in 2016. Since little information is available to assess the status of the resource in this area, there is no recommendation.

Areas 16H, 16I and 15

For a number of years, landings on the Lower North Shore have remained low (Area 15) or nil (Area 16H and 16I). Since information on these areas is incomplete and insufficient, there are no recommendations.

Quebec Region

Gaspé Peninsula

From 2020 to 2022, there was no fishing effort in Areas 17A1, 17A2, 18B2 and 18C, and very little effort in Area 18B1. Since little information is available to assess the status of the resource in these areas, there are no recommendations for these areas.

In Area 19A, landings and fishing effort in 2017 represented the lowest values of the historical series. Since then, they have increased slightly but remain low. The CPUE also dropped to a record low value in 2017 but has been rising since then. The CPUE value in 2022 was above the average and among the highest of the historical series. Over the past nine years, scallops were primarily harvested from two beds, leaving many beds unharvested. The current fishing effort on these two beds should be sustainable until the next assessment. However, no information is available about whether any recruitment is occurring in the two beds that are currently exploited, and a sustained concentration of fishing effort on these beds could very well impact the survival of recruits.

Magdalen Islands

In the short- and medium-term, recruitment levels are expected to be higher to what was observed during the previous assessment period (2016–2019). It is therefore likely that CPUEs can be maintained above the upper reference level. However, the status of this population is still precarious given its strong dependence on recruitment. Maintaining and developing measures that facilitate the escape of pre-commercial-size scallop will be beneficial for the sustainability of this resource.

Decision rules to calculate fishing effort have been in place since 2010. For 2023, the maximum authorized fishing effort recommended for Area 20A is 430.1 days at sea.

OTHER CONSIDERATIONS

Conservation measures

The recommended scallop conservation measures are designed to ensure that each bed retains the ability to regenerate itself in order to ensure its sustainability. Any approach designed to boost reproductive potential, whether it involves leaving more adults on the seabed or creating refuge areas, will help conserve the resource. Also, because scallop egg production increases exponentially with shell height, allowing the population to age will result in a net gain in productivity. This strategy will increase the yield per recruit.

Scallops spawn between mid-July and the end of August, depending on the area, and juveniles settle on the seabed approximately five weeks later. Dredging the beds with fishing gear at this time of year reduces reproductive potential and stirs up the sediment, which can interfere with successful settlement of juveniles. Halting harvesting operations during the spawning and settlement periods (August to November) would limit the adverse effects of dredging on the substrate and favour the survival of juvenile scallops. A strategy for protecting the seabed where juveniles are very abundant should therefore be promoted. Subsequently, these areas could be closed to fishing until the cohorts have reached commercial size in order to maximize the yield per recruit and minimize incidental scallop mortality.

LIST OF MEETING PARTICIPANTS

Name	Affiliation	March 8	March 9
Arseneault, Line	Fisher North Shore	x	x
Arseneault, Lionel	Fisher North Shore	x	x
Belley, Rénaud	DFO – Science	x	x
Bermingham, Tom	DFO – Science	x	x
Bois, Samantha	ACPG	x	x
Boudreau, Mathieu	DFO – Science	x	-
Boudreau, Sophie	DFO – Science	x	-
Bourdages, Hugo	DFO – Science	x	x
Cervello, Gauthier	DFO – Science	x	-
Chlebak, Ryan	DFO – Science Ottawa	x	x
Couillard, Catherine	DFO – Science	x	x
Croussette, Yolaine	DFO – Fisheries Management	x	x
Cyr, Charley	DFO – Science	x	x
De Carufel, Valérie	DFO – Science	x	x
Desrosiers, Brigitte	DFO – Science	x	x
Dubé, Sonia	DFO – Science	x	x
Duplisea, Daniel	DFO – Science	-	x
Gianasi, Bruno	DFO – Science	x	-
Juillet, Cédric	DFO – Science	-	x
Lacasse, Olivia	DFO – Science	x	x
Nozères, Claude	DFO – Science	x	-
Parent, Geneviève	DFO – Science	x	-
Poitevin, Pierre	UQAR	x	x
Poulin, Jean-Michel	DFO – Fisheries Management	x	x
Roy, Marie-Josée	DFO – Fisheries Management	x	x
Sean, Anne-Sara	DFO – Science	x	x
Sean-Fortin, David	DFO – Science	x	x
Smith, Andrew	DFO – Science	x	x
Tamdrari, Hacène	DFO – Science	x	x

SOURCES OF INFORMATION

This Science Advisory Report is from the regional peer review meeting of March 8-9, 2023 on Scallop stocks assessment in Quebec coastal waters (management units 15 to 20). Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

DFO. 2021. [Scallop stock assessment in Quebec coastal waters in 2019](#). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/054.

Trottier, S., Bourdages, H., Goudreau, P. and Brulotte, S. 2017. [Évaluation des stocks de pétoncle des eaux côtières du Québec en 2015 : données de la pêche commerciale, des relevés de recherche et des pêches exploratoires](#). Secr. can. de consult. sci. du MPO. Doc. de rech. 2017/037. xvi + 175 p.

Winker, H., Carvalho, F. and Kapur, M. 2018. JABBA: Just Another Bayesian Biomass Assessment. *Fis. Res.*, 204, 275-288.

THIS REPORT IS AVAILABLE FROM THE:

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

E-Mail: dfo.csaquebec-quebeccas.mpo@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087

ISBN 978-0-660-49940-6 N° cat. Fs70-6/2023-034E-PDF

© His Majesty the King in Right of Canada, as represented by the Minister of the
Department of Fisheries and Oceans, 2023



Correct Citation for this Publication:

DFO. 2023. Scallop stocks assessment in Quebec coastal waters in 2022. DFO Can. Sci. Advis.
Sec. Sci. Advis. Rep. 2023/034.

Aussi disponible en français :

*MPO. 2023. Évaluation des stocks de pétoncles des eaux côtières du Québec en 2022. Secr.
can. des avis sci. du MPO. Avis sci. 2023/034.*