



SCALLOP STOCK ASSESSMENT IN QUEBEC COASTAL WATERS IN 2019



Source: DFO 2011

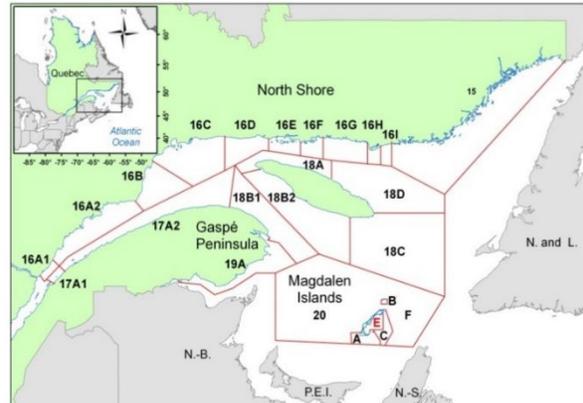


Figure 1. Scallop fishing areas in Quebec.

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 February 26, 2020 Stock assessment of scallop in Quebec inshore waters. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

SUMMARY

- From 2016 to 2019, Quebec's average annual scallop landings totaled 73.8 t of meat, a 16 % increase from 2013–2015. Fishing effort dropped by 5 % from 2013–2015. Sixty-six % of the landings were from the Magdalen Islands, 33 % from the North Shore and 1 % from the Gaspé Peninsula.

North Shore

- Landings, which consisted primarily of Iceland Scallops, increased by 65 % during 2016–2019 compared to 2013–2015, while fishing effort increased by 24 % as a result of the resumption of fishing in Area 16A1.
- From 2016 to 2019, there was no fishing effort in areas 16A2, 16D, 16G, 16H, 16I and 18D and very little in areas 15, 16B, 16C and 18A. Little information is available to assess the scallop status in these areas. There are no recommendations for these areas.
- In Areas 16E and 16F, landings have been historically low since 2013 in contrast with the high levels observed prior to 2007.
- Agence Mamu Innu Kaikuseth (AMIK) carried out two exploratory surveys in 2016 and 2018 in Areas 16E and 16F. Few locations with substantial densities of commercial-size scallop (≥ 70 mm) were found outside of known beds.
- A rebuilding plan is being developed for Areas 16E, 16F and 18A.

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. Since 2005, the average weight of meat landed has remained below the historical average.
- The latest research surveys show that the density of non-commercial-size scallop (< 70 mm) has been in sharp decline since 2016 and was well below the reference mean in 2019. The density of commercial-size scallops remains very low, below the reference mean. However, two cohorts of small scallop (< 30 mm) were observed within the islands in the 2019 survey.
- Maintaining fishing effort at the average level of the last four years and keeping the limit on bed D at 50% of the effort conducted across the entire area could help maintain current densities. Additional conservation measures will be required to help increase densities. In addition, minimizing fishing within the islands would favour the survival of the two cohorts of small scallop observed in 2019.

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 previous two research surveys showed that the density of commercial- and non-commercial-size scallops was below the series average in 2018 and close to the series average in 2019. Maintaining the level of fishing effort at the average level of the last four years could help maintain current densities.

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Area 16A1:

- The fishery in this area resumed in 2017, concentrating on the Île Rouge bed. The total allowable catch (TAC) of 10.9 t was exceeded slightly in 2018 and 2019. The weight of meat landed is close to the historical average. From 1998 to 2002, this bed was unable to sustain an annual exploitation level of about 10 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 and to receive smaller and less frequent inputs of larvae than beds in other areas.

Gaspé peninsula

- Landings consisted primarily of Sea Scallops. Landings reached more than 60 t prior to 2001, and then gradually declined to totals of less than 2 t per year from 2016 to 2019. Since 2014, the fishery in this region has been concentrated mainly in Area 19A.
- Scallop landings and fishing effort declined by 63 % during 2016–2019 compared to 2013–2015.
- From 2016 to 2019, there was no fishing effort in Areas 17A1, 17A2, 18B2, 18C and 18D, 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.
- In Area 19A, landings and fishing effort were very low between 2016 and 2019. Over the last six 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 four years is slightly below the historical average. The weight of meat landed has declined slightly and is 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 stable since then. Fishing effort is distributed evenly across all beds.
- The 2019 research survey indicates that densities of commercial-size scallop (≥ 100 mm) remain high and close to the maximum historical values. Densities of pre-recruit scallops measuring 70–84 mm and < 70 mm are slightly above the median of the historical series. However, the density of 85–99 mm pre-recruits is below the median of the historical series. The density of scallops available to the fishery is expected to be lower in 2020 than it was in 2019.
- 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 fishing effort needs to be reviewed annually after the indicators are updated. For 2020, the maximum fishing effort authorized for Area 20A is 305.5 days at sea.

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.

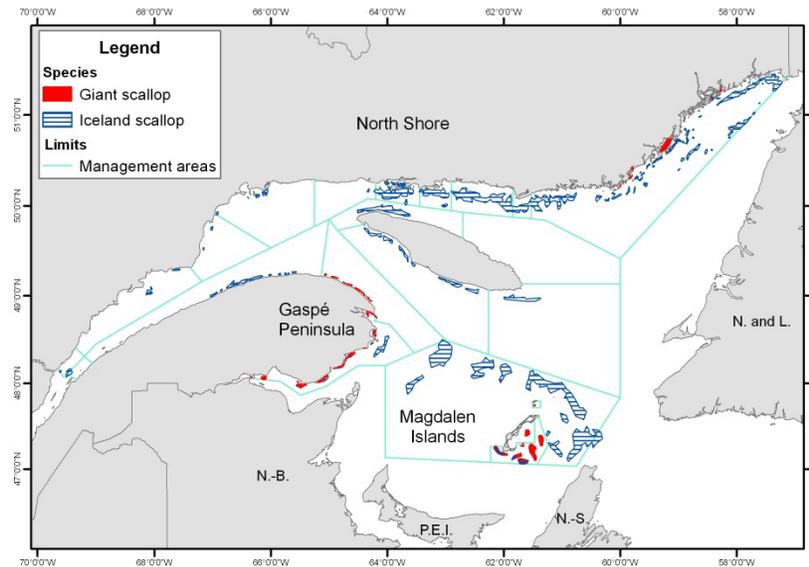


Figure 2. Known range of the Sea Scallop and Iceland Scallop in Quebec coastal waters.

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.

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 2019, 78 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 2016 to 2019, average annual landings totaled 73.8 t of meat, a 16 % increase from 2013-2015 (Figure 3). Landings, in decreasing order of weight, were from the Magdalen Islands (66 %), the North Shore (33 %) and the Gaspé Peninsula (1 %). During the same period, fishing effort, calculated in standardized fishing hours per metre of dredge width (hours • meter), decreased by 5 % in Quebec from 2013-2015 (Figure 4).

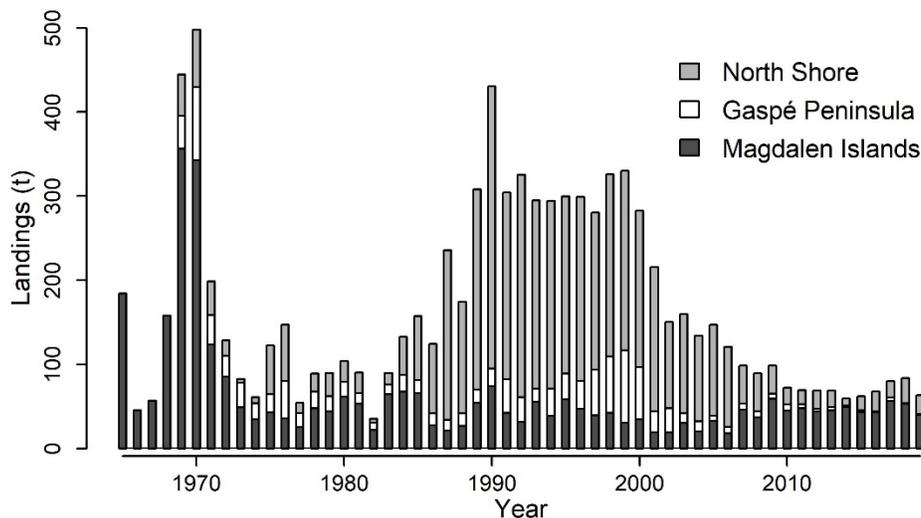


Figure 3. Scallop landings (t of meat) in Quebec.

Table 1. 2019 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 + 2 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%	-	-
16D ⁵	-	6.1 t	15/04 - 03/11	-	-	-	100%	-	-	-
16E	9	94 days ⁶	Sign ⁴ - 31/12	5 a.m. – 8 p.m.	Sporadic	100 %	100%	-	100%	-
16F	9	30 days ⁷	Sign ⁴ - 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	Sign ⁴ - 03/12	-	100%	-	100%	-	-	-
16I ¹⁰	-	-	Sign ⁴ - 03/12	-	-	-	-	-	-	-
17A1	1	10.9 t	01/04 - 30/11	-	-	-	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 ⁴ - 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%	-
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 ¹⁵	322 days	01/04 - 31/07	Day ¹⁴ , time	-	-	100%	-	100%	100 mm; 30
20B	22	-	01/04 - 31/07	Day ¹⁴ , time	-	-	100%	-	100%	100 mm; 30
20C	22	-	01/04 - 31/07	Day ¹⁴ , time	-	-	100%	-	100%	100 mm; 30
20E	Refuge Area									
20F	22	-	01/04 - 31/10	Day ¹⁴ , 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 = Beginning of the fishery from the signing of the Conservation Harvesting Plan (CHP).

⁵ = Open to all scallop licence holders residing between Sept-Îles and Pointe Parent.

⁶ = A total of 94 fishing days are allowed, with a maximum of 50 % of the days in bed D. Maximum of 10 hours per day.

⁷ = A total of 30 fishing days are allowed. Maximum of 10 hours per day.

⁸ = Open to fishermen in group A (Areas 16E, 16F and 18A)

⁹ = Open to 2 group A scallop licence holders from the Middle-North Shore and to 4 from zone 15 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 = Monday to Friday from 5 a.m. to 9 p.m.

¹⁵ = 1 holder has the double fishing days since the 2019 season.

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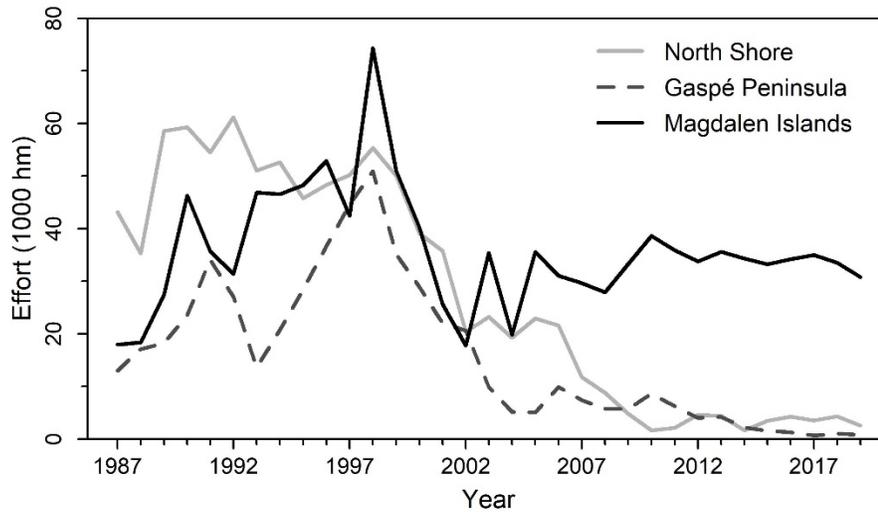


Figure 4. Fishing effort in Quebec expressed in standardized fishing hours per metre of dredge width.

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	16C	16E*	16F*	18A*	18B1	19A	20A	20B
2003	1.64	4.59	1.16	-	2.38	2.06	1.50	1.44	0.68	0.87	0.82
2004	2.09	3.36	0.74	-	1.89	2.35	1.44	2.31	0.72	0.87	0.62
2005	2.08	2.69	-	-	1.74	2.10	1.55	5.81	0.83	0.84	0.60
2006	2.34	1.14	-	-	1.57	1.65	1.27	2.03	0.85	0.60	0.51
2007	1.74	-	-	-	1.38	1.55	1.13	2.60	0.92	1.64	0.81
2008	-	-	-	-	1.82	1.61	1.06	2.38	1.12	1.37	0.53
2009	1.97	2.91	-	-	1.92	1.37	0.48	2.71	0.95	1.83	0.74
2010	1.73	-	-	-	1.83	-	-	2.91	0.81	1.24	0.58
2011	1.41	-	-	-	2.14	1.30	-	4.20	0.73	1.35	0.62
2012	1.25	-	-	-	1.66	1.38	2.12	0.99	0.64	1.32	0.92
2013	-	-	-	-	1.72	1.40	0.84	-	0.80	1.30	0.45
2014	-	-	-	-	1.34	1.59	-	-	0.65	1.44	0.60
2015	1.53	-	-	-	1.43	1.36	1.07	7.58	0.69	1.31	0.83
2016	0.88	-	4.02	-	1.76	1.81	1.69	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	1.47	2.02	2.27	-	-	0.92	1.59	0.32
2019	1.27	11.09	3.63	-	2.61	2.25	-	-	1.14	1.32	0.61
1992-2015 Average	1.71	6.05	1.87	5.92	1.74	1.74	1.27	2.38	0.91	1.08	0.72

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

**Stock assessment of Scallop in Quebec
coastal waters in 2019**

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

Year	Fishing Area							
	15	16A1	16E	16F	18A	18B1	19A	20A
2003	13.0	11.3	13.5	14.2	9.9	-	21.0	19.7
2004	-	7.9	13.0	12.0	8.0	29.3	19.9	21.7
2005	16.8	7.6	10.4	10.9	10.0	32.4	16.1	21.0
2006	12.9	7.5	11.5	11.2	7.7	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	8.1	34.5	20.9	24.8
2016	-	-	11.7	10.9	7.2	-	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
1992-2015 Average	14.4	7.5	13.0	11.4	9.8	34.1	18.7	20.6

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 24.5 t of meat between 2016 and 2019. Compared to 2013-2015, average annual landings from 2016 to 2019 increased by 65 %, for a 24 % increase in fishing effort. These increases are due to a recovery in activity in the Île Rouge sector in 2017. The landings came from the Île Rouge (Area 16A1), the Mingan Archipelago area (areas 16E and 16F) and the North Shore of Anticosti Island (Area 18A). A rebuilding plan is being developed for 16E, 16F and 18A 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 3.3 t, 11.9 t and 11.5 t of meat in 2017, 2018 and 2019, respectively. The total allowable catch (TAC) of 10.9 t was exceeded slightly in 2018 and 2019. Landings in the last two years have been relatively high at levels slightly below those observed in 1998–2002 (except in 1999, when the weight of meat landed totalled nearly 50 t) shortly before landings decreased sharply. Between 2016 and 2019,

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four additional days of fishing were conducted outside Area 16A1, i.e. one day each in Areas 16B and 16C in 2018, and two days in Area 16B in 2019.

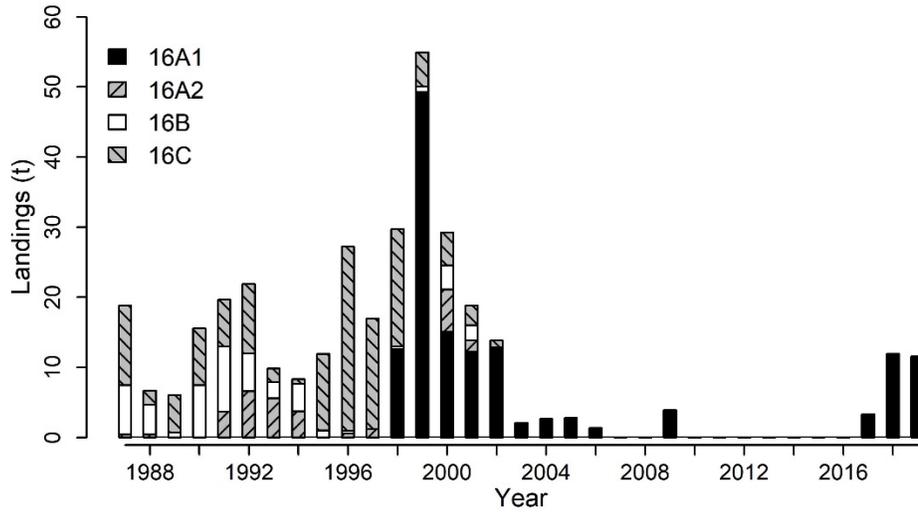


Figure 5. Scallop landings (t of meat) from Areas 16A1, 16A2, 16B and 16C.

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 regulated by a quota, and there are daily and seasonal restrictions on fishing effort. Middle North Shore landings for 2016, 2017, 2018 and 2019 were only 22.7, 18.9, 17.9 and 10.3 t of meat respectively. Landing levels from these areas remain very low compared to the numbers of the 1987-2006 period (Figure 6).

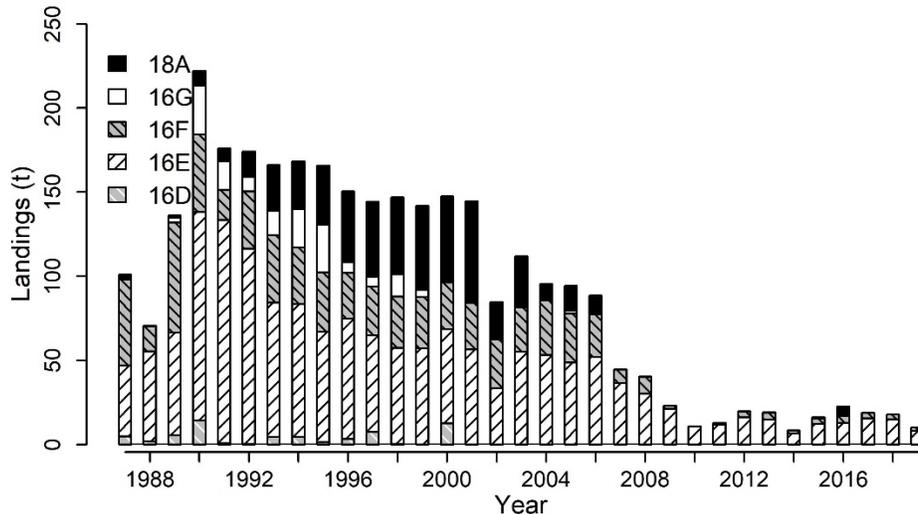


Figure 6. Scallop landings (t of meat) from areas 16D, 16E, 16F, 16G and 18A.

From the Manitous 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.

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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 2016, 2017, 2018 and 2019 were 12.9, 15.7, 15.1 and 8.2 t of meat respectively (Figure 6). These landings have seen an average increase of 16 % compared to the 2013-2015 period. Fishing effort dropped steadily from over 200 days at sea before 2008 to an average of 56 days for the 2016-2019 period out of an authorized total of 94 days in 2019. The fishing effort observed in this area increased slightly by 2 % relative to the level observed between 2013 and 2015 and accounted for 60 % 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 in the last four years. CPUEs from logbooks have been increasing since 2015 and those of the last four years are above the 1992-2015 average (Table 2). The average weight of meat landed from 2016 to 2019 is slightly lower than the 2013-2015 period and remains below the historical average (Table 3).

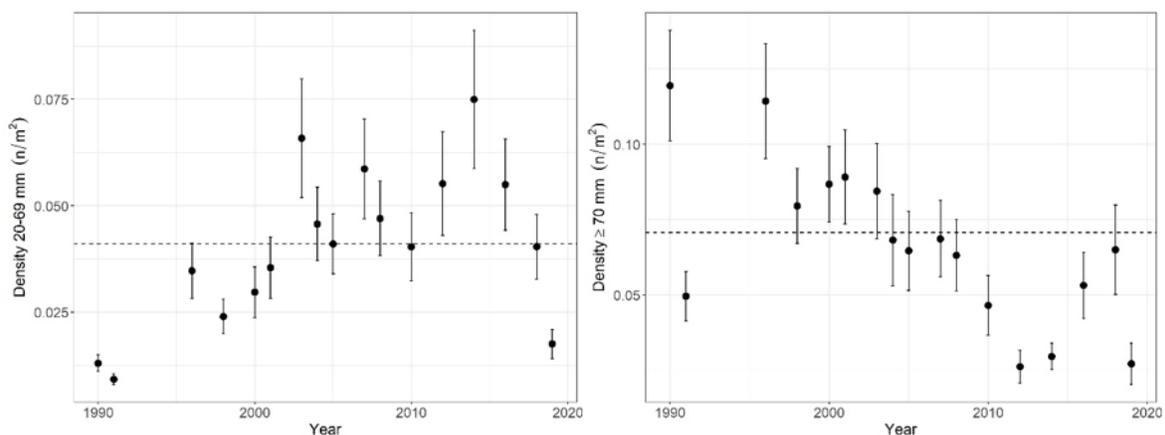


Figure 7. Density index of non-commercial (20 to 69 mm)(Left panel) and commercial (≥ 70 mm) (Right panel) scallops based on research surveys in the Mingan area, Area 16E (\pm standard error). The dotted lines represent the averages for the 1990-2014 series.

The 2019 research survey in the 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 during the 2016 survey, but has decreased significantly since then and is well below the reference average (Figure 7). However, the last research survey revealed two cohorts of small scallops (< 30 mm) within the islands (Figure 8). It is important to note that the 5–10 mm cohort was not taken into account when calculating the density of non-commercial-size scallop (20–69 mm) because it is generally less well sampled by the dredge. In addition, very few small scallops (< 70 mm) were caught in the outer part of the islands. Both of these elements explain why the research survey indicates a low density of non-commercial-size scallop (Figure 7), despite the two strong cohorts of small scallop (< 30 mm) within the islands (Figure 8).

The Agence Mamu Innu Kaikusseht (AMIK) conducted two exploratory surveys in Areas 16E and 16F in 2016 and 2018. From a commercial standpoint, few locations with substantial densities of commercial-size scallop (≥ 70 mm) were found outside of known beds.

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 2016–2019, landings and fishing effort in Area 16F decreased by 2 % and 8 %, respectively, compared to 2013–2015; on average, landings totalled 3.0 t (Figure 6)

and fishing effort stood at 15 fishing days per season out of an authorized total of 30 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 recent years (2016 and 2017; no data were available for 2018 and 2019), the average weight of meat landed declined slightly and was near the historical average (Table 3). The last two research surveys showed that densities of commercial- and non-commercial-size scallops were below the average of their respective series in 2018 and close to the average in 2019 (Figure 9).

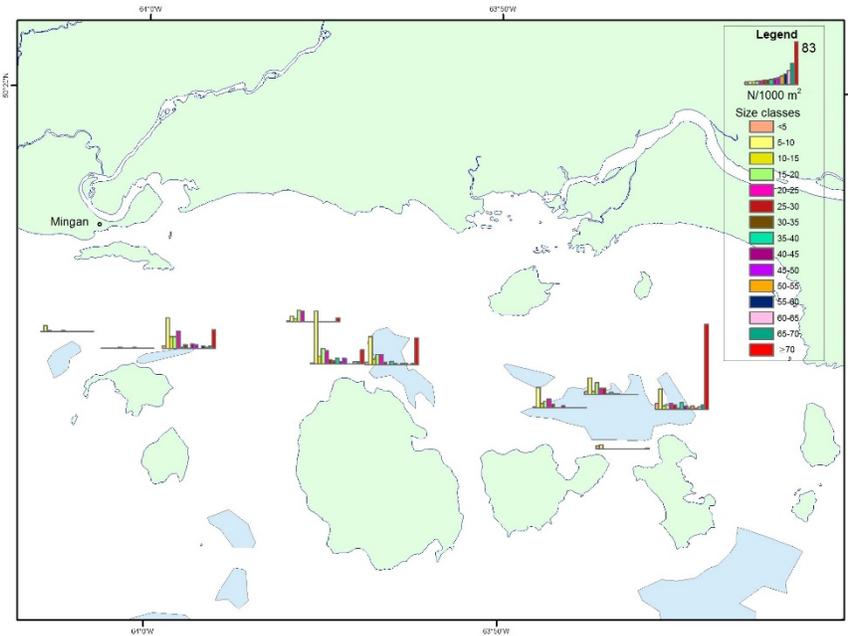


Figure 8. Scallop densities by size class within the Mingan Islands during the 2019 research survey conducted in Minganie, Area 16E.

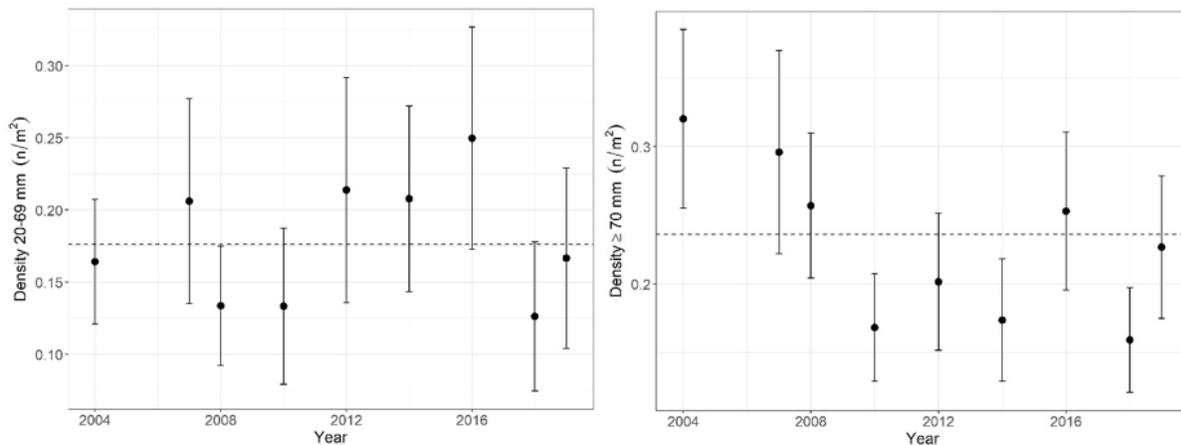


Figure 9. Density index of non-commercial (20 to 69 mm) (Left panel) and commercial (>70 mm) (Right panel) scallops based on research surveys in the Mingan area, Area 16F (\pm standard error). The dotted lines represent the averages for the 2004-2014 series.

Quebec Region

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 exploited only 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. For 2016, CPUE is above the average of the historical series (Table 2).

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

In 2019, 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 only 0.46 t of meat in 2019 (Figure 10). Area 15 landings have been low since 2007 and there hasn't been any fishing effort in 2018. There hasn't been any fishing in areas 16H and 16I since 2004 and 2005, respectively.

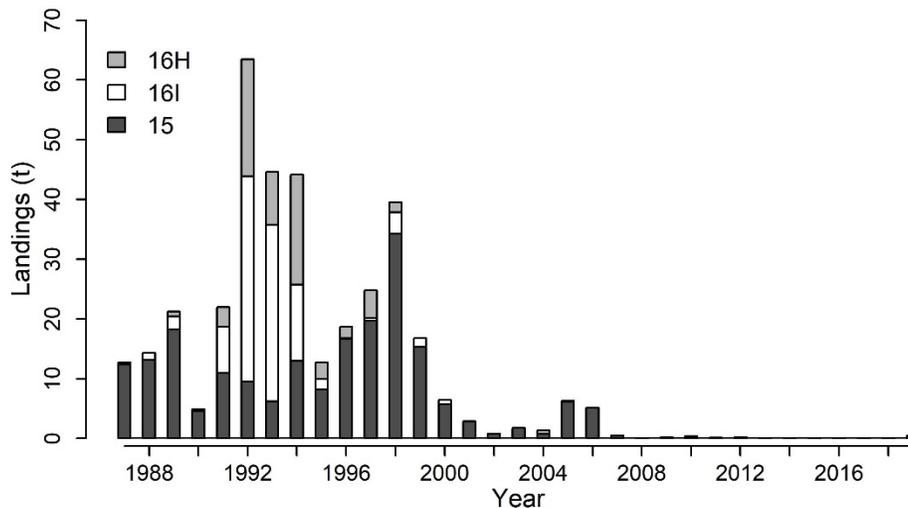


Figure 10. Scallop landings (t of meat) from Lower North Shore areas 15, 16H and 16I.

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 2019, only one licence was issued for areas 17A1 and 17A2, three in areas 18B1, 18B2 and 18C and one 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 (Figure 11). In 2019, landings in the Gaspé Peninsula totalled 1.0 t of meat and the lowest value of the historical series was reached in 2017 when 0.6 t of meat were landed. Both average annual landings and fishing effort from 2016 to 2019 declined by 63 % from 2013–2015. There was little or no fishing effort in areas 17A1, 17A2, 18B1, 18B2 and 18C during the 2016-2019 period.

Quebec Region

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 and continued to decrease thereafter (Figure 11). In 2019, landing and fishing effort values were still low at 1.0 t and 27 fishing days. In the last six 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 2019 was above the historical series average (Table 2). The average weight of Sea Scallop meat landed from 2016 to 2019 was slightly lower than the series average (Table 3).

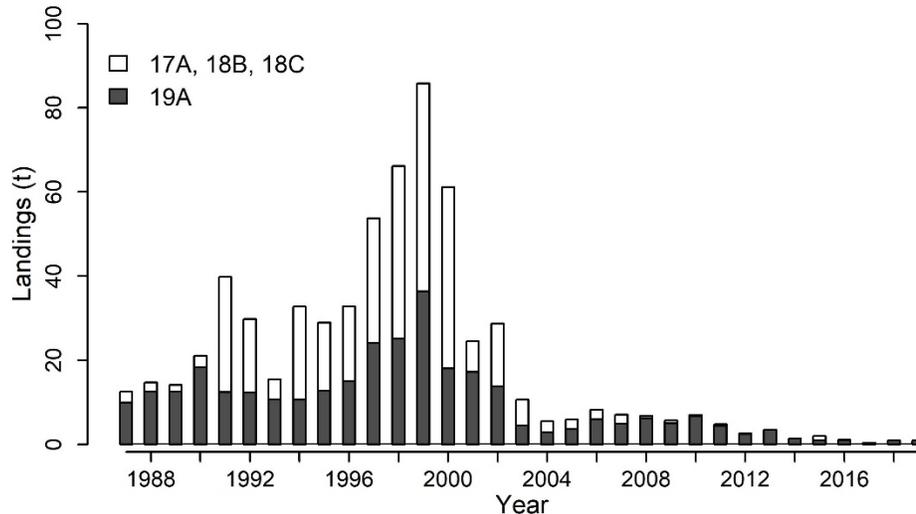


Figure 11. Gaspé Peninsula scallop landings (t of meat).

Magdalen Islands (Area 20)

There are several scallop beds in the Magdalen Islands. They are located at Pointe-du-Ouest, Dix-Milles, Chaîne-de-la-Passe, Sud-Ouest, Île Brion and Banc de l’Est (Figure 12). Sub-area 20E is closed because it is a Sea Scallop refuge area.

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. This maximum has been nearly reached every year. Annual fishing effort has been stable since 2005 and is slightly above the 1992-2015 series average. Landings increased significantly from 18 to 46 t of meat in 2007 and have been stable since then (Figure 13). 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.

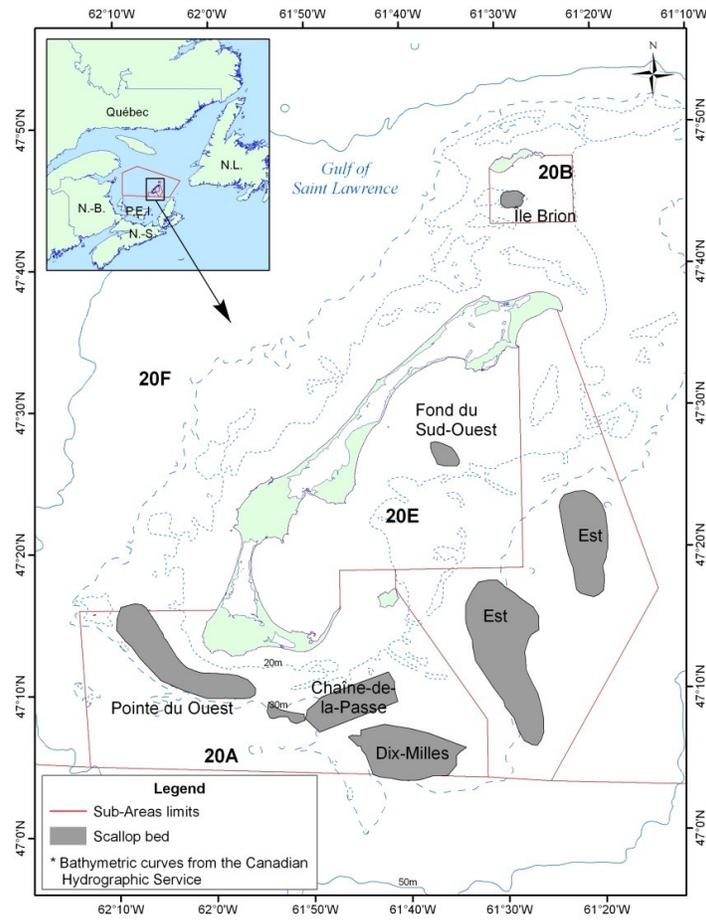


Figure 12. Sub-areas and main scallop fishing grounds in the Magdalen Islands.

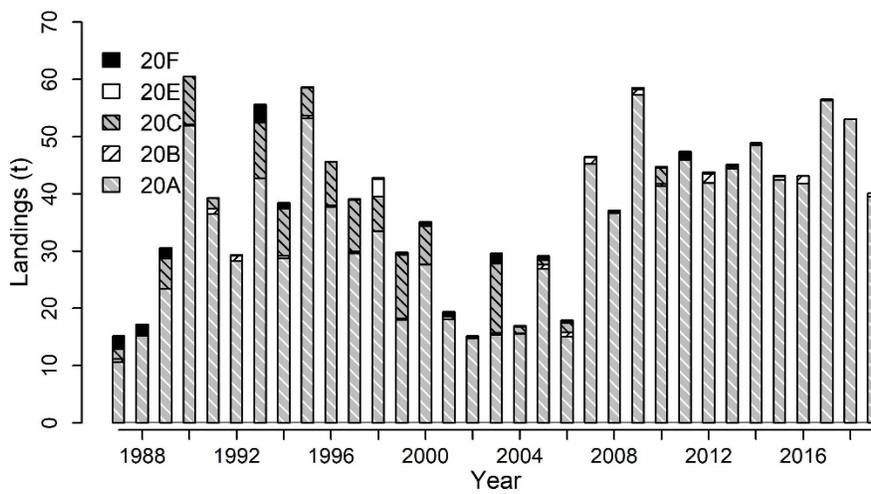


Figure 13. Scallop landings (t of meat) in the Magdalen Islands.

Quebec Region

Catches per unit effort estimated from logbooks has been relatively stable since 2007 and remain significantly higher than CPUEs in the early 2000s and slightly below the upper stock reference point (Figure 14).

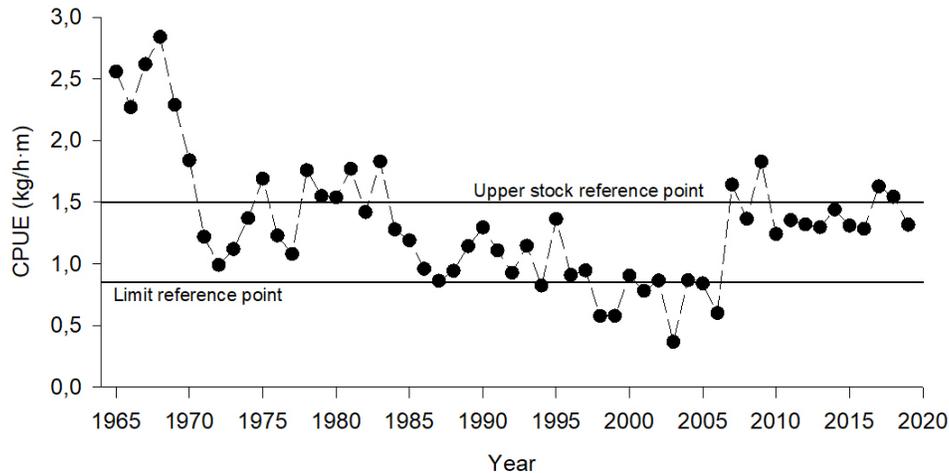


Figure 14. Catches per unit of (CPUEs) estimated from logbooks in Area 20A.

The 2019 research survey indicated that the density of commercial-size (100 mm and over) scallop remains high and close to historical maximum values (Figure 15). The density of 70-84 mm and < 70 mm pre-recruit scallop are slightly higher than the median of the historical series. However, the density of 85-99 mm pre-recruit is lower than the median of the historical series.

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 16 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 16. For the 2020 season, the maximum fishing effort is calculated at 305.5 days at sea in Area 20A. These decision rules and calculation methods are described in more detail in Trottier *et al.* (2017).

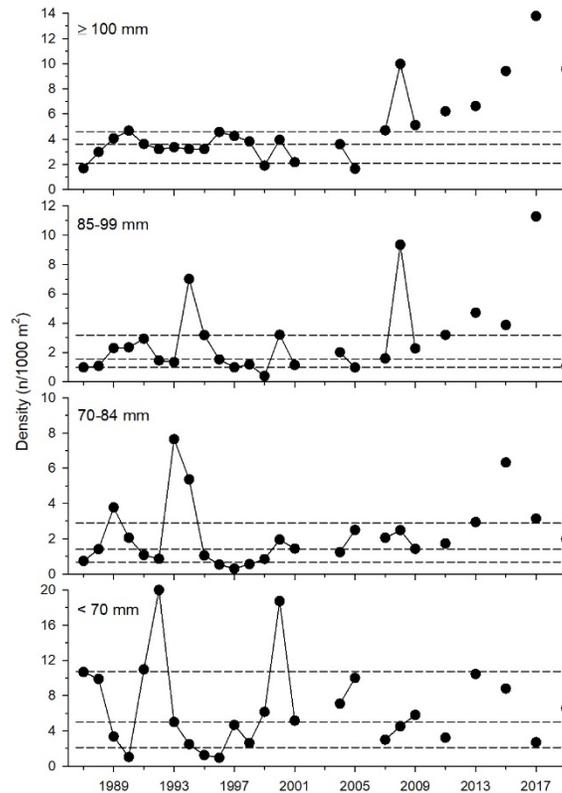


Figure 15. Density of Sea Scallops sampled in the Magdalen Islands during research surveys according to four size categories. The dotted lines indicate the 15th, 50th (median) and 85th percentiles of the 1987-2008 series.

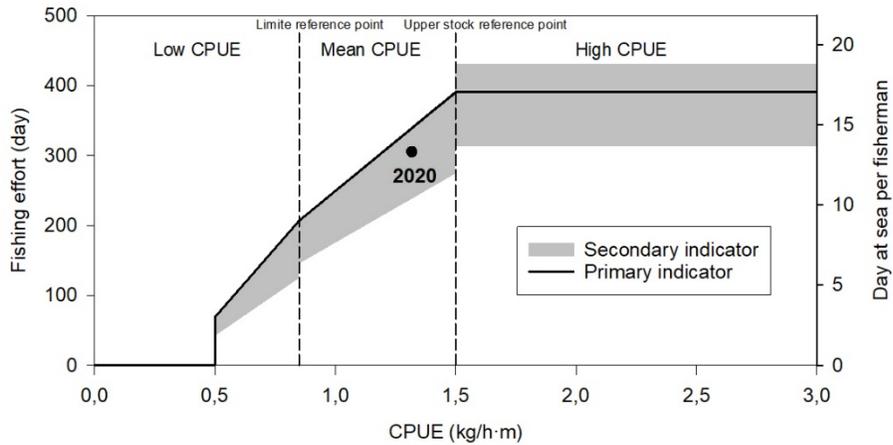


Figure 16. Calculation of fishing effort (days at sea) based on primary (CPUE) and secondary indicators (research survey indices) for Area 20A.

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.

In several management areas, fishing effort is zero or very low, which compromises the reliability of the indicators.

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 2016 and 2019, there was no fishing effort in Areas 16A2, 16D, 16G and 18D, and very little effort in Areas 16B and 16C. 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. Maintaining the fishing effort at the average level of the last four years and keeping the limit on bed D at 50% of the effort across the entire area could help maintain current densities. Additional conservation measures will be required to help increase densities. In addition, minimizing fishing within the islands would favour the survival of the two strong cohorts of small scallops observed in 2019.

In Area 16F, the last two research surveys indicated that the density of commercial- and non-commercial-size scallops was below the series average in 2018 and close to the series average in 2019. Maintaining the fishing effort at the average level of the last four years could help maintain current densities.

In the current assessment period, Area 18A was harvested only 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 2016 to 2019, 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 2019 was above the average of the historical series. In the last two years, scallops were primarily harvested from two beds, leaving many beds unharvested. There is a high probability that the current fishing effort on these two beds will be sustainable until the next assessment.

Magdalen Islands

In the short- and medium-term, recruitment levels are expected to be similar to what was observed during the previous assessment period (2013–2015). It is therefore likely that CPUEs will be similar to the values seen in recent years. 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 2020, the maximum authorized fishing effort recommended for Area 20A is 305.5 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 of 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.

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SOURCES OF INFORMATION

This Science Advisory Report is from the February 26, 2020 meeting on the Stock Assessment of Scallop in Quebec Inshore Waters. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada Science Advisory Schedule](#) as they become available.

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