STOCK ASSESSMENT ON SCALLOPS OF THE INSHORE WATERS OF QUEBEC IN 2006

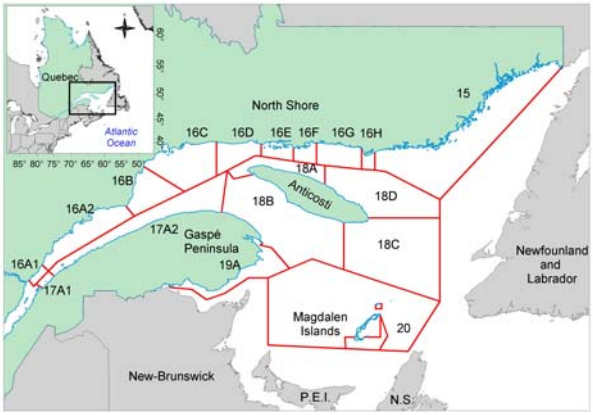

Figure 1: Scallop management areas in Quebec.

Context

The commercial scallop fishery in Quebec began in the late 1960s. It is an inshore fishery that targets two species indiscriminately, namely sea scallop (Placopecten magellanicus) and Iceland scallop (Chlamys islandica). Catches are landed mostly as meat (muscle), but the proportion landed in the shell has been growing since the late 1990s. The region is divided into 18 management units (Figure 1) with 80 permanent fishing licences and 2 exploratory licences. Fishing effort is controlled in all units, while catches are controlled in some units on the North Shore and around Anticosti Island. The North Shore region has posted the largest scallop landings in Quebec since 1985.

The resource is assessed every three years to determine whether changes that have occurred in stock status require adjustments to the conservation approach and management plan. The main indicators used for this assessment are taken from fishery statistical data, sampling of commercial catches and research surveys.

SUMMARY

- The current science advisory report is effective for the 2007-2009 seasons unless there is a significant change in stock status.
- In 2006, Quebec scallop landings totalled 120.3 t of meat, down 15% from 2005. Fishing effort also decreased by 11%. The North Shore sector accounted for 79% of the landings, the Magdalen Islands for 15% and the Gaspé for 6%.

- In several Management Areas, preventive quotas (TAC) were set randomly at the beginning of the fishery. These preventive quotas are usually far superior to the highest recorded landing values. It is therefore recommended that they be lowered to more realistic levels.

North Shore

Scallop Management Areas 16E, 16F and 18A

- A new management method was tested in Areas 16E, 16F and 18A in replacement of catch control. In 2006, the fishery was managed by controlling the effort by limiting the number of harvesting days in the season and the number of harvesting hours per day. The change in management method did not lead to an increase in fishing effort or landings in accordance with the conservation objectives.

- A small drop in catch per unit of effort (CPUE) has been recorded in Areas 16E and 16F since 2003 and 2004 respectively, while Area 18A appears to have remained stable. Results from the 2005 research survey indicate an abundance of scallops under 70 mm that is above average for Area 16E.

- Because of the pilot project's positive results in 2006, it is recommended that scallop harvesting management in Areas 16E, 16F and 18A continues through controlling the fishing effort. Total fishing effort should be kept at the same level in 2007, 2008 and 2009.

Scallop Management Area 15

- Landings and fishing effort have increased in Area 15 in 2005 and 2006 but have remained below the average of the last ten years.

- Catches per unit of effort (CPUEs) have been constantly increasing since 2002 and are now above average.

- The potential fishing capacity, i.e. the high number of unused permits, likely considerably exceeds the stocks' capacity to support exploitation. In order to avoid eventual over-fishing, it is recommended that the potential fishing effort be reduced in Area 15.

Scallop Management Areas 16A2, 16B, 16C, 16D, 16G, 16H, 18D

- Few fishers are active in Areas 16A2, 16B, 16C, 16D, 16G, 16H and 18D, where fishing effort has been very low, almost nil. Commercial indices do not provide enough information to assess the status of the resource in these Areas.

- Preventive TAC are far too high compared with landings. It is recommended that they be reduced to prevent over-exploitation that could occur if all permit holders exercised a sustained and maximum fishing effort.

Île Rouge (Scallop Management Areas 16A1 and 17A1)

- Since 2003, there has been little fishing effort on the Île Rouge bed. Catch per unit of effort (CPUE) were similar between 2003 and 2006, but lower to those recorded at the beginning of the exploitation between 1999 and 2001.

- The exploitation strategy on the Île Rouge bed has changed since 2003. The fishery's geographic range has changed because larger individuals are now targeted over volume.

- Preventive TAC are far too high compared with recent landings. It is recommended the current quota be reduced to prevent over-exploitation that could occur if all permit holders exercised a sustained and maximum fishing effort.

Gaspé

Scallop Management Area 19A

- The first signs of improvement of the resource status can now been seen in Area 19A. This progress is the result of having reduced the fishing effort by around 60% since 2002. Catches per unit of effort (CPUEs) and landings have constantly been increasing since 2002 and 2004 respectively.

- There is no spatial-time overlap between the scallop and lobster fisheries in Chaleur Bay. Accidental lobster catches during the scallop harvesting season (May to September) are very limited. However, the scallop fishery is carried out in a habitat that the lobster uses in a transitional fashion during its fall deep water migration. The impact of this overlap is unknown. However, it would be preferable not to harvest scallop during the fall lobster migration period.

Scallop Management Areas 17A2, 18B and 18C

- There has been very little fishing effort in Areas 17A2, 18B and 18C in 2006. Commercial fishery indices are insufficient to assess the status of the resource.

- Preventive TAC are far too high compared with landings. It is recommended that they be lowered to prevent over-exploitation that could occur if all permit holders exercised a sustained and maximum fishing effort.

- Area 18B is made up of two fishing sectors, the first at Anticosti Island and the second on Gaspé's north shore. Because they are different beds separated by the very deep water in the Laurentian Channel, it is recommended that this Area be divided into two management units.

Magdalen Islands

- The Magdalen Islands wild scallop population appears to have been declining for about twenty years and in 2006, its abundance is very low. In addition, the shutdown of aquaculture seeding sites since 2003 has led to a large drop in reproductive potential, which had grown over a few years with the contribution of scallops from seeding sites.

- With these conditions, it is recommended to significantly reduce scallop exploitation in Area 20 and adopt a series of measures to help restore the stock:

  - It is recommended to reduce the fishing effort by at least 60% compared to the annual average effort of the past five years. A similar action that was implemented in Gaspé (Area 19A) has already yielded positive results.

  - In order to maximize performance by recruits and minimize incidental mortalities, Areas where juveniles are very abundant should be closed to harvesting until commercial size has been reached.

  - It is recommended to maintain the closure of the refuge Area (20E).

  - It is recommended to increase scallop minimum catch size to 100 mm as soon as possible.

INTRODUCTION

Species Biology

There are two indigenous species of scallops in Quebec: the sea scallop (*Placopecten magellanicus*) and the Iceland scallop (*Chlamys islandica*). These two species are found mainly on gravel, shell or rocky bottoms, generally at depths of 20 to 60 metres. Iceland scallops occur along the North Shore, around Anticosti Island and off the north coast of the Gaspé Peninsula, but are virtually absent from the southern Gulf. In contrast, sea scallops are found primarily in the southern Gulf, including the Magdalen Islands and Chaleur Bay, and occasionally along the Lower North Shore. Scallops are sedentary and live in aggregations known as “beds”. This aspect of their biology needs to be taken into account when developing conservation strategies and management plans.

Sea scallops grow in length more rapidly than Iceland scallops. Their growth rate varies from one Area to another and is affected by habitat quality and environmental conditions. In the Gulf of St. Lawrence, Iceland scallops reach commercial size at about age 8 (70 mm) and sea scallops at about age 6 (95 mm).

Scallops have separate sexes and are broadcast spawners. The spawning period is short and does not occur at the same time throughout the Gulf. The number of eggs that a female scallop produces is roughly proportional to its size cubed, with successful fertilization depending *inter alia* on the proximity of other scallops. Along the North Shore and around Anticosti Island, spawning occurs between mid-July and late August, depending on the sector. Sea scallops spawn in August in Chaleur Bay and in late August around 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 in proximity to the adults. Scallop beds are generally 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 juvenile settled on the bottom, it is recommended that scallop beds not be dragged 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, and drops to its lowest point during the spawning period, and starts rising again in the fall.

The Fishery

In the Gulf of St. Lawrence, the scallop fishery is an inshore fishery. The Digby drag is the most widely used. The commercial fishery is targeted at both species of scallops. Catches are landed mostly as meat (muscle). 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 in the Gulf of St. Lawrence, and catches in any one Area usually consist of just one species.

Since the late 1990s, landings of scallops in the shell have been fluctuating. Because of the mixed nature of the landings (as meat or in the shell), a conversion factor (8.3) has to be applied to quantify the catch under one form.

Quebec waters are divided into 18 Management Areas, which are grouped into three sectors, namely the North Shore (Areas 15, 16A1, 16A2, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 18A, 18D), the Gaspé (Areas 17A1, 17A2, 18B, 18C, 19A) and the Magdalen Islands (Area 20) (Figure 1). Few fishers are active in Areas 15, 16A2, 16B, 16C, 16D, 16G, 16H and 18D, and there has been little fishing effort there, if any, of late. In 2006, 80 regular licences and 2 exploratory licences were issued. Separate management plans were developed for each Area, based on the following factors: vessel length, drag size (< 7.31 m), fishing season and hours, and individual and overall quotas or number of fishing days permitted (Table 1).

In 2006, landings totalled more than 120 t of meat, down by 15% from 2005 (Figure 2). The North Shore accounted for 79% of the landings, followed by the Magdalen Islands with 15%, and the Gaspé with 6%. Fishing effort slightly decreased by 1,5% during the same period.

RESOURCE ASSESSMENT

The assessment of the status of scallop populations is based mainly on an analysis of commercial indices derived from logbooks or from sampling activities at sea or at dock-side. For scallop beds in the Mingan sector (Area 16E) and the Magdalen Islands, it also incorporates indices derived from the research surveys that are carried out periodically. In addition, an exploratory survey was conducted in Area 15 in 2006.

Table 1. Management measures for scallop in 2006.

Area	Number of licences	Quota (t meat or day-at-sea)	Season (day/month)	Daily schedule	Coverage for dockside weighing	Hail out	Hail in	At-sea observers (% of trip)	VMS[1]	Limit size; Meat count
15	33 + 2[2]		01/04 - 31/12							
16A1	1	13.6 t	01/04 - 30/11				100 %	5 %		
16A2	1	9.1 t	01/04 - 30/11				100 %			
16B	2		01/04 - 15/11							
16C	2	17.2 t	12/05 - 28/10		100 %	100 %	100 %	10 %		
16D[3]		22.2 t	18/04 - 30/10				100 %			
16E	7	273 days	27/06 - 04/09	6h - 16h		100 %	100 %	10 %	100 %	
16F	9	162 days	10/05 - 26/06	6h – 16h		100 %	100 %	10 %	100 %	
16G	5	35.8 t	25/04 - 30/10				100 %			
16H	8	30.8 t	18/04 - 30/10				100 %			
17A1	1	13.6 t	01/04 - 30/11				100 %	5 %	100 %	
17A2	1	9.1 t	01/04 - 30/11				100 %		100 %	
18A	9	267 days	10/05 - 30/10	6h – 21h		100 %	100 %	10 %	100 %	
18B	3	49.9 t	01/04 - 30/11				100 %		100 %	
18C	3		01/04 - 30/11		100 %		100 %		100 %	
18D[4]			02/05 - 30/10				100 %			
19A	3		01/05 - 15/08 16/08 - 30/09	Day[5] and hour			100 %		100 %	100 mm; 30 sca. / 454 g
20	23		10/04 - 28/07 10/04 - 31/10	Day and hour		100 %	100 %			85 mm; 35 sca. / 500 g

[1] = Vessel Monitoring System (VMS).
[2] = Exploratory licence for Iceland scallops.
[3] = Open to fishers residing between Sept-Îles and Pointe-Parent.
[4] = Open to fishers residing between Tadoussac and Pointe-Parent.
[5] = Depending of days of week.

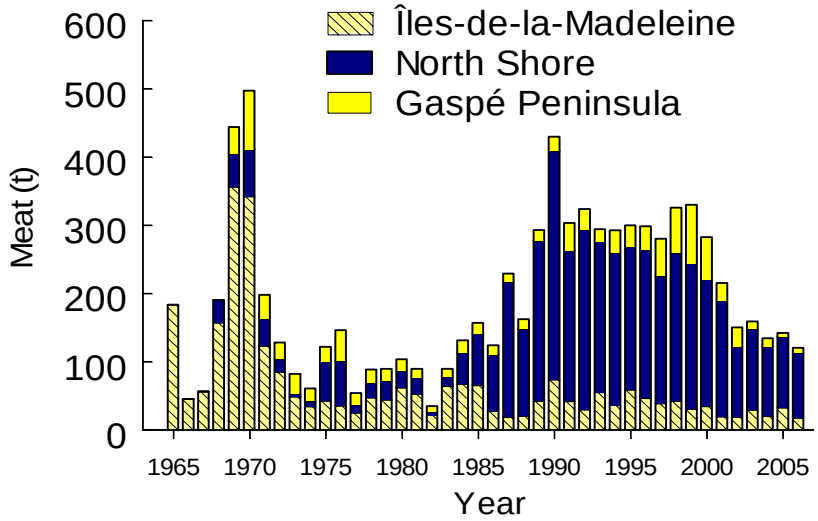

Figure 2. Scallop landings in Quebec.

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 subdivided into 12 fishing Areas located between the mouth of the Saguenay River and Blanc Sablon. Landings on the North Shore totalled around 95 t of meat in 2006, down 8% from 2005. Since the late 1980s,

scallop landings on the North Shore have always accounted for more than 65% of the Quebec catch, with most of the landings coming from the waters around the Mingan Archipelago and Anticosti Island (Areas 16E, 16F and 18A).

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

Landings in these Areas, which roughly constitute the Upper North Shore, totalled about 1.4 t in 2006 and consisted entirely of Iceland scallop (Figure 3). These areas are harvested by five fishers. Fishing effort is low and controlled by the number of licences issued and quotas set in Areas 16A1, 16A2 and 16C.

The situation in Area 16A1 is discussed above in the section "Île Rouge (Scallop Management Areas 16A1 and 17A1)".

In 2006, there was no fishing in Areas 16B and 16C and limited fishing effort in Area 16A2. Landings in these Areas vary widely and depend on the intensity of fishing effort. Landings in Area 16A2 in 2006 were below the average for the previous 10 years (Table 2).

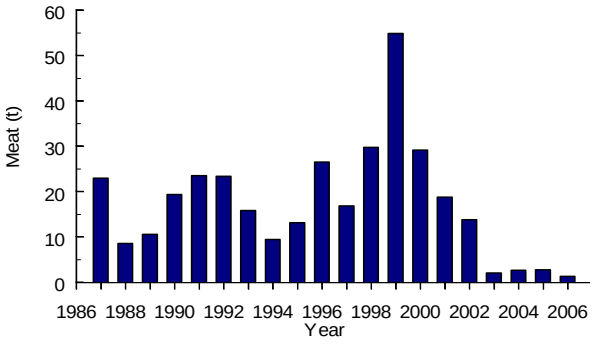

Figure 3. Landings of scallops from Areas 16A1, 16A2, 16B and 16C.

Table 2. Catch per unit effort (kg of meat per hour of fishing and meter of drag width) estimated from commercial samples or logbooks.

Year	16A1	16A2*	16B*	16C*
1996			1.00	7.86
1997		3.11		5.28
1998			1.84	8.99
1999	18.99		1.32	4.48
2000	28.69	2.17	3.06	6.37
2001	14.14	2.90	2.32	3.02
2002	62.65			8.00
2003	6.59		1.16	
2004	8.80	0.95	0.74	
2005	10.03	1.92		
2006	6.02	0.41		

* Logbooks

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

Seven fishing licences were issued for Area 16E, nine for Areas 16F and 18A, four for Area 16G, and all Middle North Shore scallop fishers have access to Area 16D. Each Area is regulated by a quota, and there are daily and seasonal restrictions on fishing effort. This is the most productive scallop region in Quebec; it is also the one with the strictest management measures. Landings from the Middle North Shore reached 89 t in 2006, a drop of 6% compared with 2005 (Figure 4).

Along the shoreline from the Manitou River to the Île aux Perroquets (Area 16D), there was no fishing effort in 2006. Since 1996, landings and yields have been low because of the sporadic nature of the fishing effort in this Area.

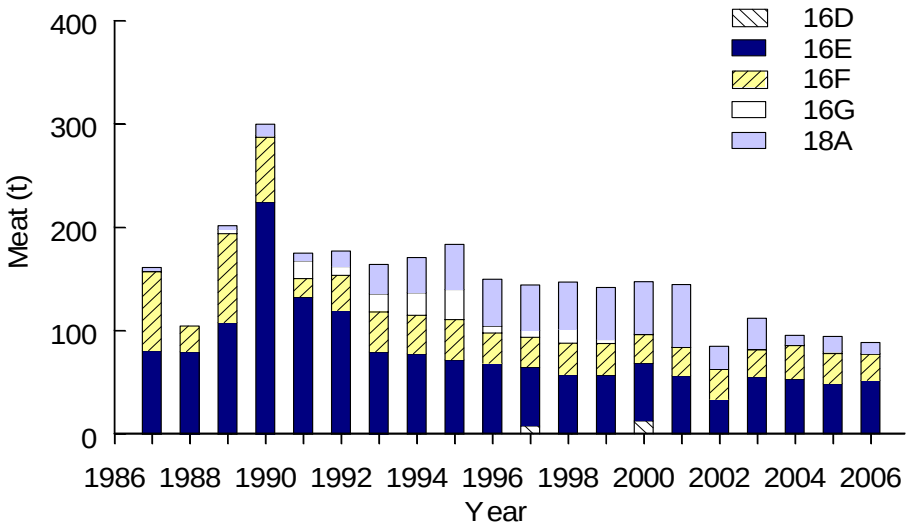

Figure 4.Landings of scallops from Areas 16D, 16E, 16F, 16G and 18A.

A new management system was tested in 2006 in Areas 16E, 16F and 18A. In this pilot project, the fishery was managed by controlling effort, i.e. by a restricted number of fishing days for the season and fishing hours per day. In addition, because fishermen have access to more than one fishing Area, offshore fishing activities were monitored by a vessel monitoring system (VMS). Because some beds were already being exploited at a maximum, it was important that the change in management strategy did not produce an increase in landings and did not unduly restrict harvesters.

Following the change in management strategy, the fishing effort did not increase significantly in 2006 in Area 16E. Landings totalled 51.6 t (Figure 5). Catches per unit of effort (CPUEs) based on logbooks have been relatively stable since 1998, while those recorded during the sampling of commercial catches have been dropping since 2003. Scallop modal size (Figure 6) as well as

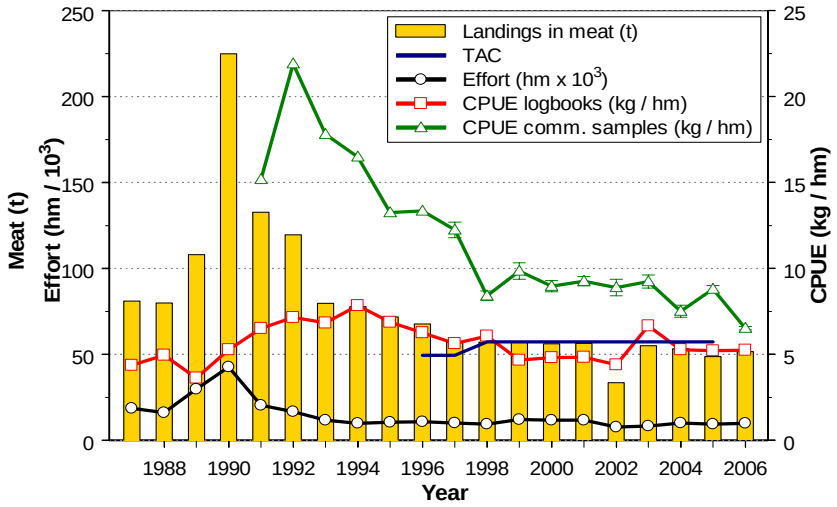

Figure 5. Scallop landings, fishing effort (by standardized fishing hour per meter of drag width) and catch per unit effort estimated from logbooks and commercial samples in Area 16E.

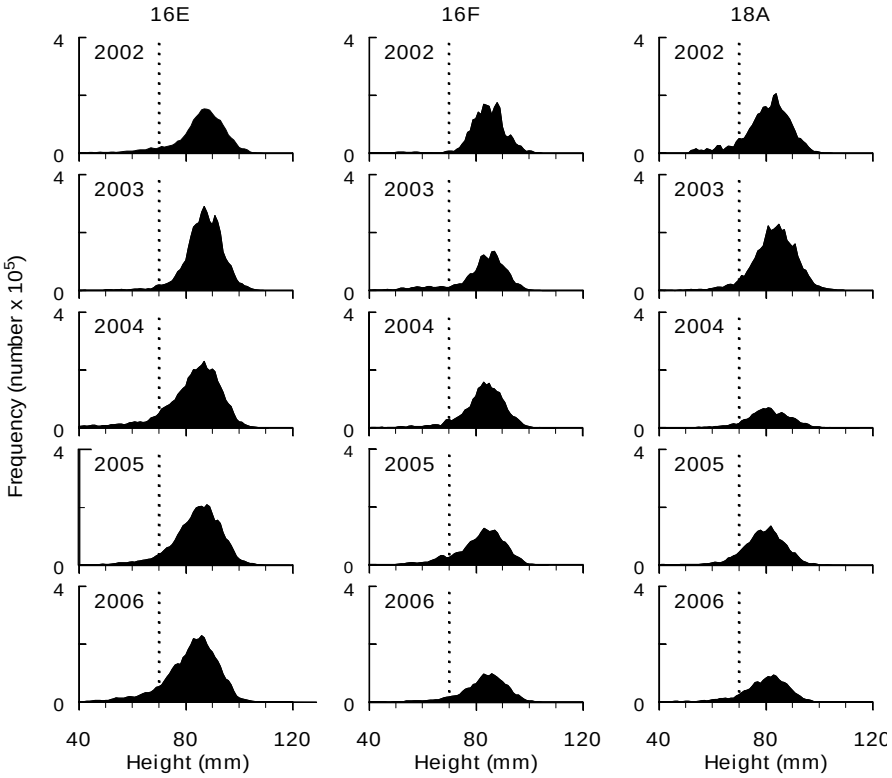

Figure 6. Size structures of Iceland scallops in Areas 16E, 16F and 18A, based on commercial samples. The dotted line at 70 mm separates the pre-recruits (< 70 mm) from the recruits (≥ 70 mm).

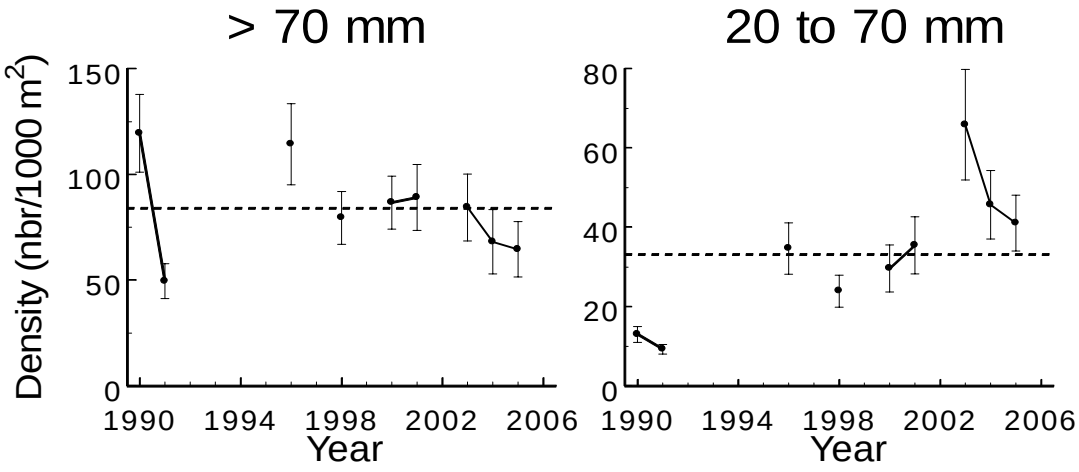

Figure 7. Density index of commercial (> 70 mm) and non commercial (20 to 70 mm) scallops based on research surveys in the Mingan sector, Area 16E (± standard error). The dotted line represents the average for the 1990-2004 series.

mean muscle weight of dockside landings are below the average for the previous 10 years. The 2005 research survey shows that the density of commercial size scallops is slightly lower than the 1990-2004 average and the density of non-commercial size scallops is higher than the average (Figure 7). A large number of scallops between 40 mm and 60 mm was recorded during this survey. They will be recruited into the fishery in the medium term (Figure 8).

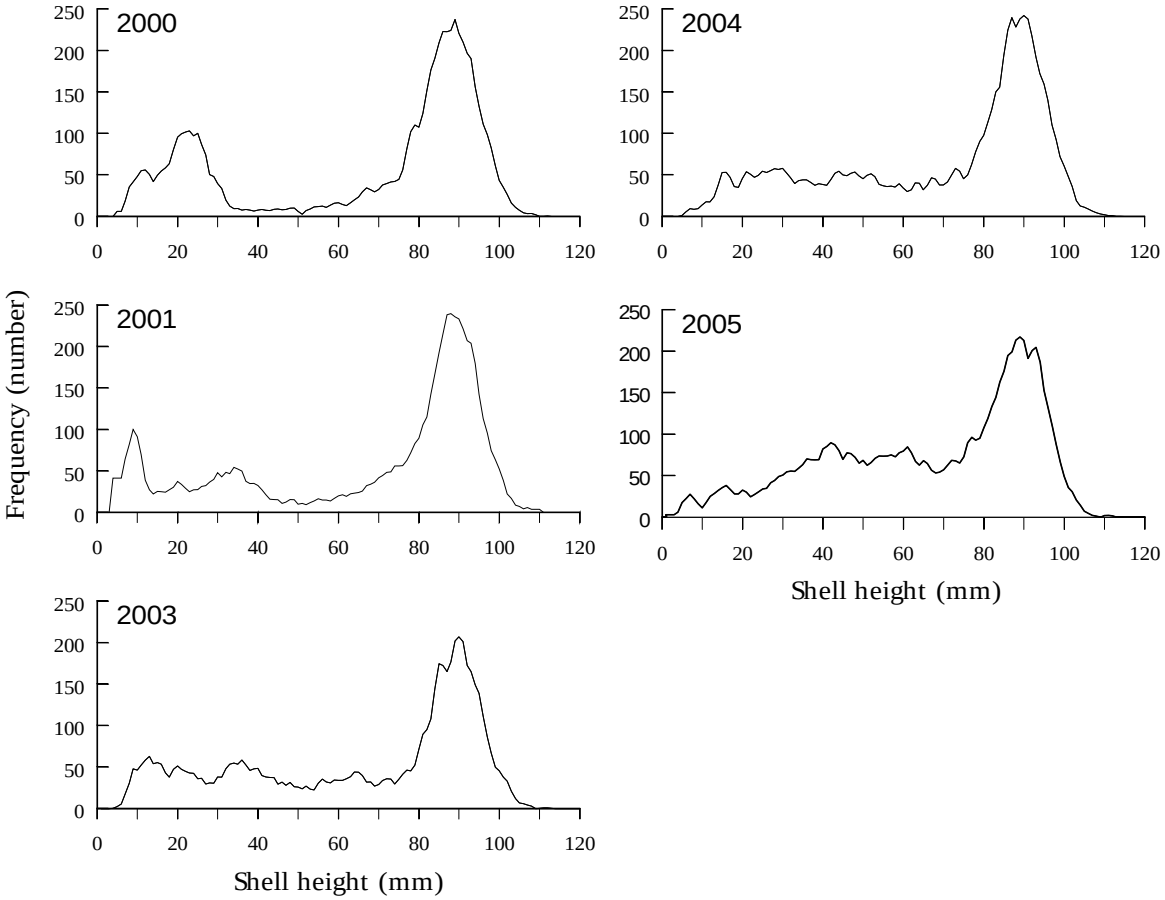

Figure 8. Size structure for Iceland scallop sampled outside the Mingan Archipelago (Area 16E) during the research surveys from 2000.

In 2006, landings in Area 16F dropped by 12% and totalled 25.8 t while the fishing effort increased by 9% (Figure 9). The CPUE based on logbooks and the sampling of commercial catches has been dropping since 2004 and 2002 respectively. The size of scallop being harvested is above the average for the previous 10 years while muscle weight upon landing is comparable to the average.

Landings, fishing effort and catches per unit of effort (CPUEs) tend to vary between Johan Beetz Bay and Natashquan in Area 16G (Table 3). There were no landings in 2006.

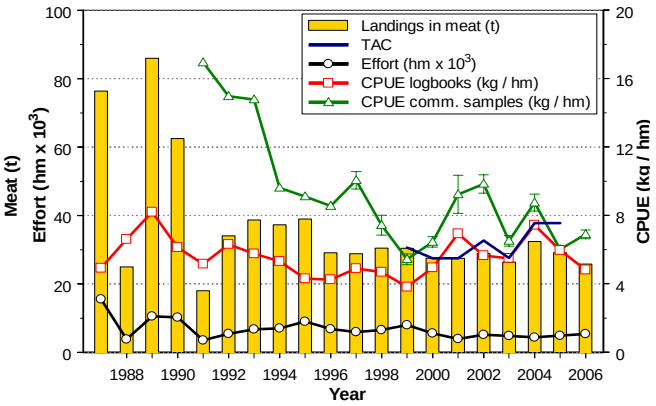

Figure 9. Scallop landings, fishing effort (by standardized fishing hour per meter of drag width) and catch per unit effort estimated from logbooks and commercial samples in Area 16F.

Tableau 3. Catch per unit effort (kg of meat per hour of fishing and meter of drag width) estimated from logbooks.

Year	16G	16H	15	
			west	east
1996	1.92	2.27		1.09
1997	1.58	2.64		1.42
1998	2.64	2.66	1.86	2.10
1999	3.76		3.63	2.16
2000	2.40		3.24	3.80
2001	1.45			1.64
2002				1.31
2003	3.63			1.64
2004	4.05	2.79		2.10
2005	3.95			2.04
2006				2.94

In Area 18A, fishing effort remained low in 2006. Landings were lower by 70% compared with the average for the previous 10 years and totalled 11.1t (Figure 10). The remoteness of the beds from Anticosti Island and the low market price for scallops may explain fishers' lack of interest in harvesting this area over the past two years. Catch per unit of effort (CPUE) has been stable since 2002. The size structure values for landed scallops are roughly average, and the mean muscle weight is below the average.

Lower North Shore (Scallop Management Areas 16H and 15)

In 2006, 8 scallop fishing licences were issued for Area 16H, and 33 regular and 2 exploratory licences were issued for Iceland scallop fishing in Area 15. Prior to 1992, most of the scallops landed on the Lower North Shore were sea scallops, but from 1992 to 1998, Iceland scallop landings from Areas 16H and 15 increased. Since 1998, landings of the two scallop species have fallen on the Lower North Shore, totalling only 4.9 t of meat in 2006 (Figure 11).

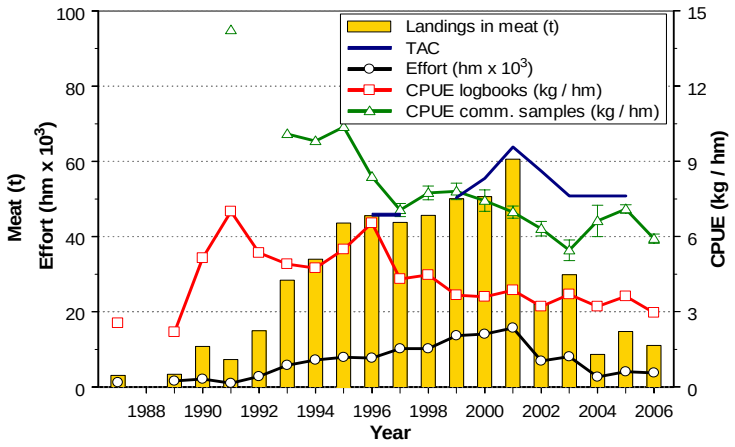

Figure 10. Scallop landings, fishing effort (by standardized fishing hour per meter of drag width) and catch per unit effort estimated from logbooks and commercial samples in Area 18A.

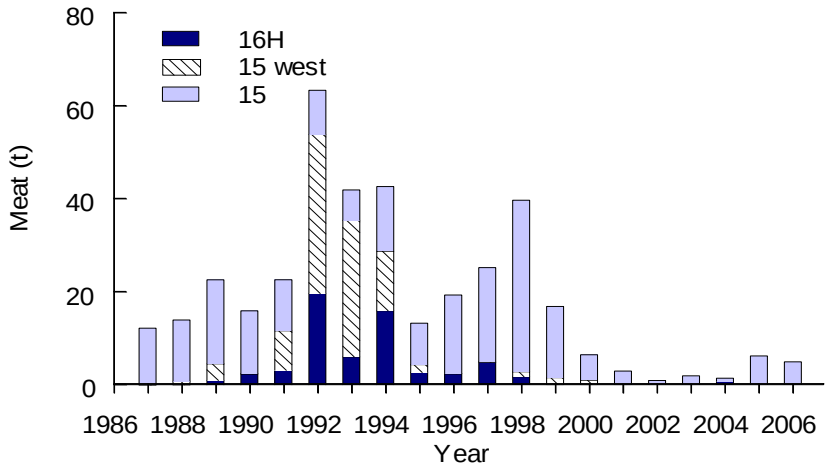

Figure 11. Scallop landings in Areas 16H and 15 of the Lower North Shore.

There was no fishing effort in Area 16H in 2005 and 2006. The steady catches per unit of efforts (estimated from logbooks) recorded in Area 16H since 1994 are inconsistent with the drop in landings since 1995 (Table 3).

In Area 15, fishing effort increased significantly in 2005 and 2006. Landings in this area rose from 0.8 t in 2004 to 6.1 t in 2005 and 4.9 t in 2006, but remain below the average over the last 10 years (Figure 11). In 2006, CPUE increased by 44% compared to 2005 (Table 3).

In the summer of 2006, an Iceland scallop exploratory survey was conducted on the Lower North Shore between Wolf Bay and Blanc Sablon. It was done under the Fisheries Science Collaborative Program (FSCP) and with the co-operation of the Polyvalent Fishermen's Association, Old Fort, Blanc Sablon. This survey was a follow-up of the one conducted in 2003. The findings indicate that Iceland scallop are distributed along the Lower North Shore at depths of 35 to 80 meters, but they are present in low densities (Figure 12).

Île Rouge (Scallop Management Areas 16A1 and 17A1)

In the St. Lawrence Estuary, the Île Rouge Iceland scallop bed straddles two fishing areas (Areas 16A1 and 17A1) managed by two separate administrative sectors (North Shore and Gaspé). As the bed likely constitutes a single biological entity, these areas are considered to be one and the same stock.

The Iceland scallop bed was first harvested in 1998. In 2000, quotas were set at 13.6 t of meat. Since 2001, no fishing has taken place in the southern part of the bed (17A1); the quota set for the northern part of the bed (16A1) has not been reached since 2003. The fishing effort has been weak in recent years.

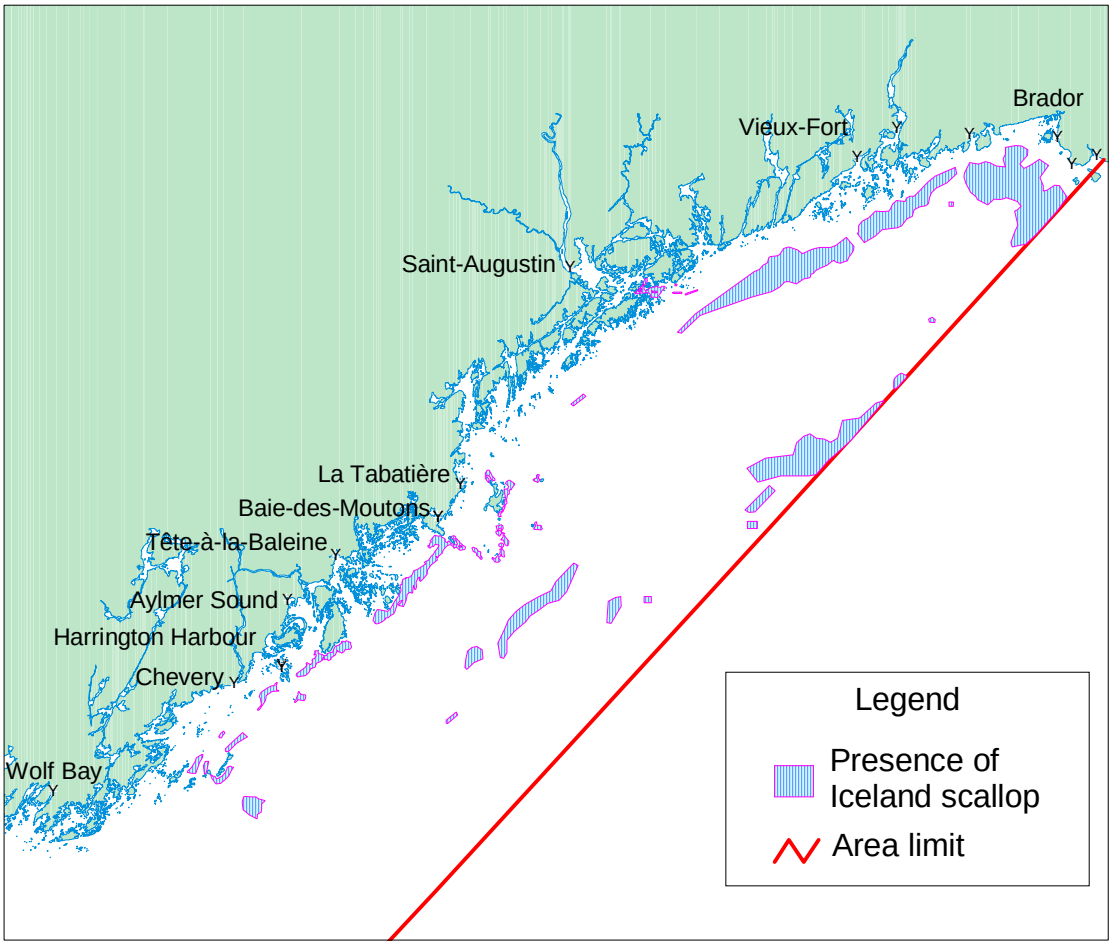

Figure 12. Distribution of Iceland scallop based on research surveys of 2003 and 2006 between Wolf Bay and Blanc-Sablon of the Lower North Shore.

Since 2003, landings have consisted of meat as opposed to scallops in the shell. The fishing strategy was modified : seabeds with more promising meat yields were harvested, while sites with high scallop densities but low meat yields were abandoned. The CPUEs observed based on commercial catch sampling and logbook data between 2003 and 2006 are lower than those recorded when the bed was first harvested (Table 2). This drop is attributable to fishing strategy. This finding is confirmed by the muscle weight of dockside landings and the modal size of harvested scallop, which has increased significantly since 2003 (Figure 13).

Gaspé (Scallop Management Areas 17A1, 17A2, 18B, 18C and 19A)

The Gaspé is composed of three fishing sectors: the St. Lawrence Estuary (17A1, 17A2), Anticosti Island (18B and 18C) and Chaleur Bay (19A). The number of licenses is limited in each Area. In 2006, only one licence was issued in Areas 17A1 and 17A2, three in Areas 18B and 18C and another three in Area 19A. Each area had its own fishing season, and quotas were set in Areas 17A1, 17A2 and 18B.

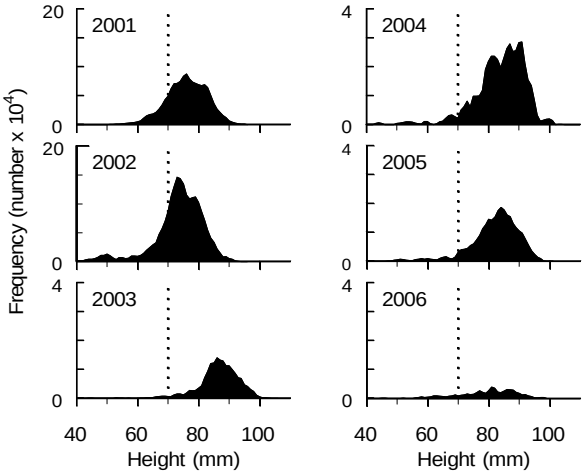

Figure 13. Size structures of Iceland scallops in Area 16A1 based on commercial samples.

Gaspé landings increased steadily between 1993 and 1999, when they reached an all-time high of about 80 t of meat. Since 1999, Gaspé landings have been on the decline, hitting a record low of 5.5 t in 2004 (Figure 14). Since 2004, Gaspé landings have slightly increased each year. They rose 29% from 2005, with fishing effort increasing by 87%.

The situation in Area 17A1 is discussed above in the "Île Rouge (Scallop Management Areas 16A1 and 17A1)" section.

No landings were made north of the Gaspé Peninsula (Area 17A2) in 2004 and 2005, but activities resumed in 2006. Catch per unit of effort (CPUE) estimated during sampling of catches at sea was 0.83 kg/hm in 2006, a drop of 75% compared with the average from the previous ten years.

Landings in Areas 18B and 18C remain lower than those made in the late 1990s. In 2005 and 2006, there was no fishing effort in Area 18C. In Area 18B, fishing effort has been concentrated since 2004 off the northern shore of the Gaspé Peninsula instead of around Anticosti Island, where large sea scallops, whose modal size is 118 mm, are harvested.

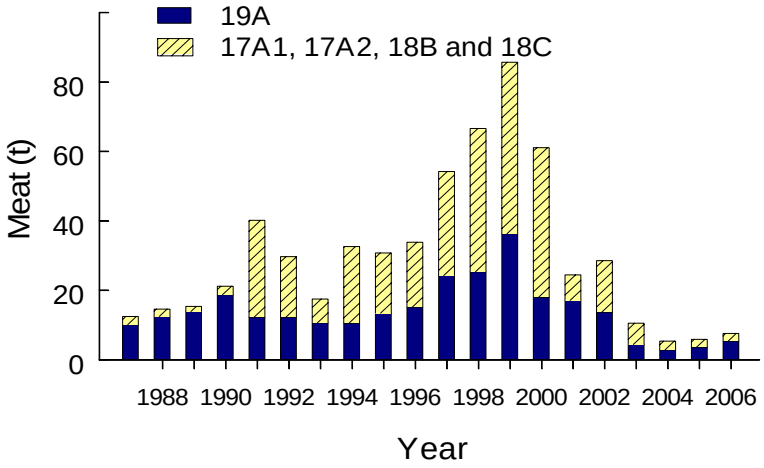

Figure 14. Scallop landings in Gaspé Peninsula.

Between 2001 and 2003, fishing effort in Chaleur Bay (Area 19A) dropped by more than 60%. This decrease in fishing effort was caused by the number of licenses issued, which dropped from 6 to 3 over this period. Following this drop in fishing effort, landings have been increasing steadily, totalling 6.4 t in 2006, 44% higher than in 2005. In addition, the estimated CPUE index during sampling at sea has been rising since 2002 in Area 19A (Table 4). Sea scallop size as well as average muscle weight landed in commercial catches dropped in 2006 (Figure 15).

Tableau 4. Catch per unit effort (kg of meat per hour of fishing and meter of drag width) estimated from commercial samples.

Year	17A1	17A2	18B	18C	19A
1996		3.76	0.63		1.22
1997		2.64	5.04		1.66
1998		3.48	6.70	4.90	0.73
1999	24.58	3.29		19.54	0.99
2000	28.48	4.61		42.33	1.17
2001		4.99			0.97
2002		2.60		13.65	0.70
2003		3.12	1.37	5.76	0.76
2004			4.87	5.57	1.08
2005			5.65		0.99

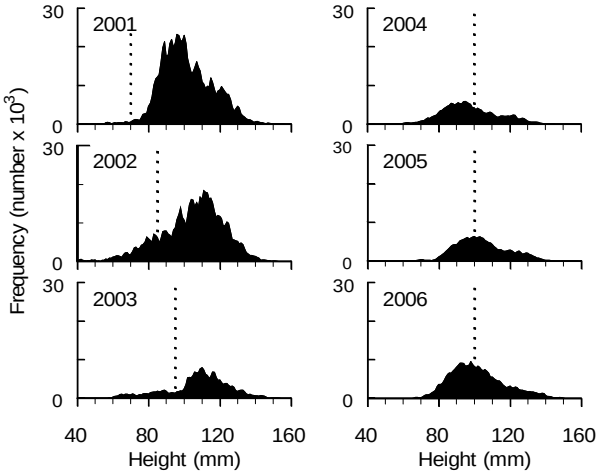

Figure 15. . Size structures of sea scallops in Area 19A based on commercial samples. The dotted line indicate the legal size.

Magdalen Islands (Scallop Management Area 20)

The Magdalen Islands comprise a number of concentrations of scallop, namely the following seabeds: Étang du Nord (Pointe-du-Ouest), Dix-Milles, Chaîne-de-la-Passe, Sud-Ouest, Île Brion and Banc de l'Est (Figure 16). Subarea 20E is closed to fishing year-round, as it is a refuge area for sea scallop. The Chaîne-de-la-Passe and part of the Étang du Nord seabeds are aquacultural sites reserved for scallop seeding. The last seeding occurred in 2003.

Following the end of the private seeding program, a resource integrated management plan was implemented combining a wild stock fishery and seeding activities. The authorized fishing effort was 115 days in 2006 and extra fishing days could be added on condition that seeding had occurred to compensate for the harvesting. The Chaîne-de-la-Passe and Dix-Milles seabeds were therefore closed to harvesting in 2006 because they were dedicated to seeding activities. In addition, the 2001 and 2002 cohorts were more abundant than normal. Because these scallops weren't of commercial size, this closure increased the survival and yield per recruit for these scallops until they reached commercial size.

Fishing effort in 2006 was 325 days in a more restricted area than usual. The fishery was mostly concentrated around Pointe-du-Ouest and, to a lesser extent, around the Banc de l'Est. Landings totalled 18 t in 2006, a drop of 39% compared with 2005 (Figure 17).

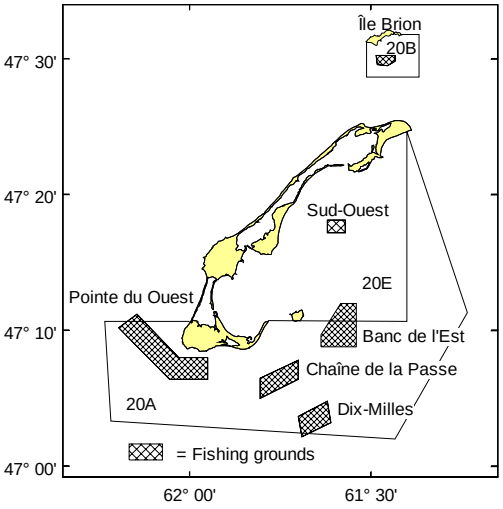

Figure 16. Sub-areas and main scallop fishing grounds in the Magdalen Islands

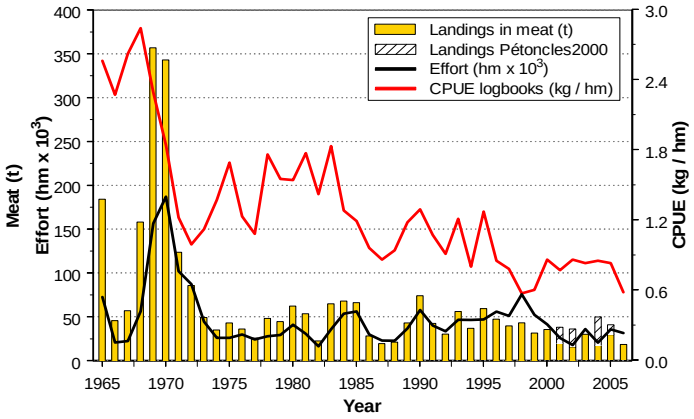

Figure 17. Scallop landings from fishing and private seeding (Pétoncles 2000),fishing effort (by standardized fishing hour per meter of drag width) and catch per unit of effort estimated from logbooks in Area 20.

According to data obtained from logbooks and commercial catch sampling, the estimated catch per unit of effort (CPUE) in 2006 was one of the weakest recorded in this fishery, 0.58 kg/hm, which is a 25% drop compared to the average for the 10 previous years.

The abundance of prerecruits, as measured in research surveys, was low in the mid-1990s, but has been equal to or greater than the average since 1999 (Figure 18). However, the abundance of commercial-size scallop remains relatively low. In 2005, the 2001 and 2002 cohorts appear to be more abundant than usual in the Dix-Milles seabed, as well as the 2002 cohort around Pointe-du-Ouest (Figure 19).

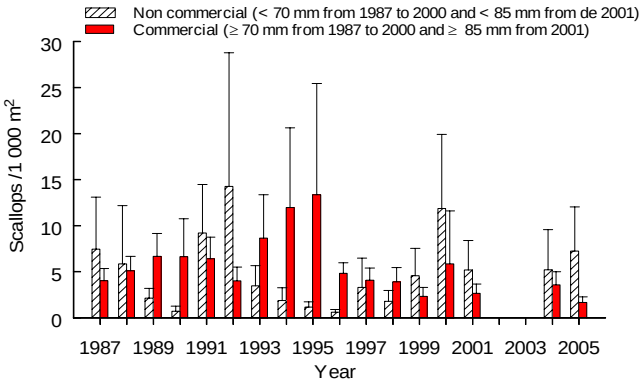

Figure 18. Density (± 2 standard errors) of sea scallops sampled in research surveys in the Magdalen Islands.

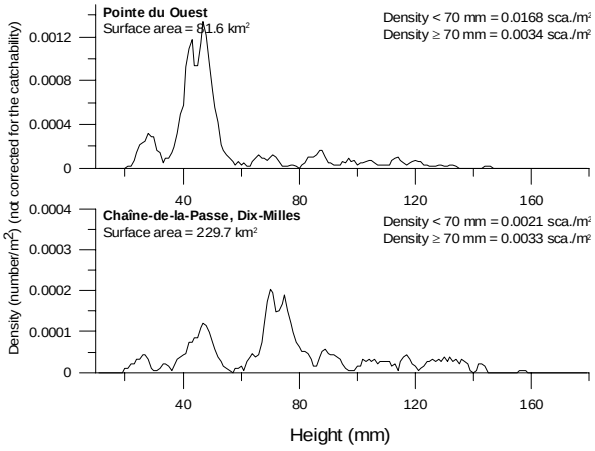

Figure 19. Size structure for sea scallops sampled in research surveys in the Magdalen Islands in 2005 in fishing ground.

Egg production was estimated based on the population structure derived from the research survey, taking into account fertilization success, which depends on the relative proximity of scallops on the seabed. Based on these estimates, in 2005, eggs originating in seeding sites and traditional beds were equivalent (Figure 20). In seeding sites, the potential fertilization success is better as fertilization is proportional to the density of scallops on the seabed.

In September 2005, an experiment on the selectivity of the Digby scallop dredge was conducted around the Magdalen Islands. The objective was to compare the catchability of scallops with a dredge built with 76 mm rings as opposed to one built with 89 mm rings. This experiment was conducted within the framework of the Fisheries Science Collaborative Program (FSCP) and with the help of the Magdalen Islands Scallop Fishermen's Association. The increase in ring diameter to 89 mm has helped reduce the harvesting of scallop smaller than 100 mm without reducing performance for scallop over 100 mm.

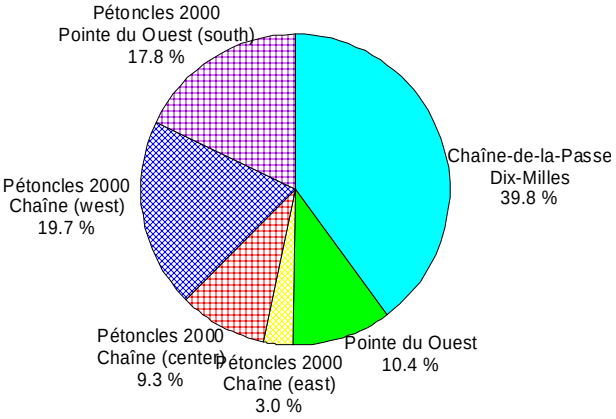

Figure 20. Eggs production estimated in different sectors of fishing and aquaculture sampled in research survey in the Magdalen Islands in 2005.

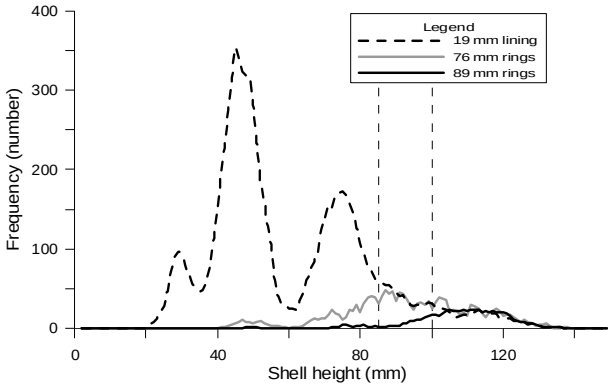

Figure 21. Selectivity of Digby dredges for different rings size. The dotted lines indicate the sizes of 85 mm and 100 mm.

Sources of Uncertainty

The current assessment is based on indices derived from logbooks and commercial catch samples at sea and dockside. In addition, in Areas 16E and 20, scientific surveys are conducted every two years. With no knowledge of exploitation rates, it is difficult to adjust the quotas or exploitation strategies other than with a cautious approach.

CONCLUSIONS AND ADVICE

Over the years, preventive quotas have been randomly set for certain fishery areas. In many cases the quotas were never or almost never reached. Because these quotas are far higher than landings, they do not provide a way to moderate exploitation in concerned areas. It is therefore recommended to lower them to more adequate levels in Areas 16A1, 16A2, 16C, 16D, 16G, 16H, 17A1, 17A2 and 18B.

North Shore

Scallop Management Areas 16A2, 16B, 16C, 16D and 16G

Few fishers are active in Areas 16A2, 16B, 16C, 16D and 16G and fishing effort has been limited, varying from year to year. Information on these areas is incomplete and insufficient, which does not allow for an adequate assessment of the resource status.

Scallop Management Areas 16E, 16F and 18A

A new exploitation strategy was successfully tested in 2006 in Areas 16E, 16F and 18A. Rather than controlling the fishery with quotas, it was controlled by closely monitoring the fishing effort, i.e. by a limited number of fishing days for the season and fishing hours per day. The objective was to avoid increasing exploitation intensity and it was successful and landings remained similar as in 2005. Harvesters and fishery management benefited from the new system, which proved to be less restrictive and less costly. Because of the pilot project's positive results, it would be preferable that the management of the scallop fishery around the Mingan Islands continue to be done by controlling the fishing effort.

The abundance of non-commercial size scallop was recorded in the last research surveys in Area 16E. The abundance of 40-60 mm size scallop is above average. These observations indicate that biomass could increase within the next few years.

Fishing effort around Anticosti Island (Area 18A) has been weak since 2002. This drop in effort can be explained mainly by a lack of interest for the scallop fishery in this area due to its low market value and higher exploitation costs inn this area.

Scallop Management Areas 16H and 15

For several years, landings on the Lower North Shore (Areas 16H and 15) have remained stable. The information on these areas is incomplete and precludes assessment of resource status.

In light of the sporadic recruitment patterns of both scallop species and the recurrent mass mortalities of sea scallops, the number of fishing licences and fishing effort may be too high relative to the productive capacity of the stocks. It is therefore recommended that potential fishing effort on the Lower North Shore be reduced.

Île Rouge (Scallop Management Areas 16A1 and 17A1)

Exploitation of the Île Rouge bed in the St. Lawrence Estuary began in 1998. Considering that the available series of commercial indices covers only a short period and that the fishing area is limited, a cautious approach is required in relation to the exploitation of this bed.

In addition, since small scallop attach themselves to the insides of the shells of dead scallops, it is recommended that empty shells be thrown back over the Île Rouge bed during at-sea sorting in order to favour the survival of prerecruits and preserve an environment conducive to their settlement on the seabed.

Gaspé (Scallop Management Areas 17A2, 18B, 18C and 19A)

North of the Gaspé Peninsula (Area 17A2), after two years without exploitation, the fishery resumed in 2006 and CPUEs were low. A cautious approach is required in this area.

There was no fishing effort south of Anticosti Island (Areas 18B and 18C) in 2005 and 2006. The remoteness and the small size of the scallops make these beds less appealing to fishers. However, there was some exploitation in Area 18B, on the north shore of Gaspe. Therefore, there are two possible exploitation areas in Area 18B, Anticosti Island and the north shore of Gaspé. Sea scallop are mostly targeted in this area. Because these beds include different species and are separated by the deep water of the Laurentian Channel, they represent distinct biological units, and consequently, they should be managed independently.

The measures that were adopted in 2001, such as the decrease in the number of fishers and the gradual increase in the minimum legal size to 100 mm in Chaleur Bay (Area 19A), were implemented with the aim of reducing fishing effort and preserving the stock's reproductive potential. The impacts are beginning to be felt as increases in landings and CPUEs have been observed. These measures must be maintained because they contribute towards improving the status of the resource.

Magdalen Islands (Scallop Management Area 20)

The Pétoncles 2000 seeding activities ended in 2006. Although all the effort invested in these activities, the anticipated results on wild populations fell short. Commercial fishery performance continued to decline and commercial scallop densities are still weak. Nevertheless, in 2005, non-commercial scallop densities were higher than average on the Dix-Milles and Pointe-du-Ouest seabeds.

The end of seeding activities should lead to lower reproductive potential in the short term due to the fact that the egg production from these seeded scallops was significant.

Because of the critical status of the scallop population, it is recommended to significantly reduce exploitation. A 60% drop in fishing effort could contribute towards improving the status of the resource. Its effect will not be visible before several years.

Furthermore, when areas are identified as having above average recruitment, as in 2005 around Dix-Milles, it would be beneficial to temporarily close these areas to commercial harvesting. During this period, incidental mortality caused by the dragging of dredges would be reduced and therefore survival and performance per recruit would be increased. These areas would be opened to the fishery when scallops have reached commercial size.

In order to increase performance per recruit and reproductive potential, it is recommended that the minimal catch size be increased from 85 mm to 100 mm. The use of a Digby type scallop dredge with 89 mm rings should help respect these objectives.

OTHER CONSIDERATIONS

Conservation Measures

The conservation measures recommended for scallops are intended to maintain the capacity of all the beds to replenish themselves and to ensure their sustainability. Any approach designed to boost reproductive potential, whether by leaving more adults on the seabed or by creating refuge areas for spawners, should have a positive effect on conservation of the resource. Moreover, because the number of eggs a scallop produces is roughly proportional to its size cubed, allowing the population to age and the scallops to grow more should result in a net gain in productivity, with the concomitant benefit of increasing the yield per recruit, and hence commercial profitability.

Scallops spawn in late summer, and juveniles settle on the seabed in the fall. Dragging 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. A halt in fishing during the spawning and settlement periods (August to November) would limit the adverse effects of dragging on the substrate and favour the survival of young scallops. A rotational fishing strategy would also reduce the mortality rate of prerecruits.

SOURCES OF INFORMATION

Giguère, M., S. Brulotte and P. Goudreau. 2000. Stock Assessment Report on Scallops of the Inshore Waters of Quebec in 2000. DFO Can. Stocks Assess. Sec. Res. Doc., 2000/086, xi + 46 p.

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