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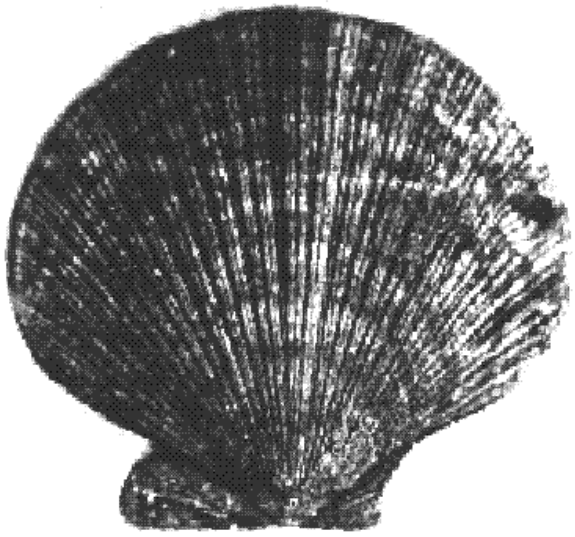

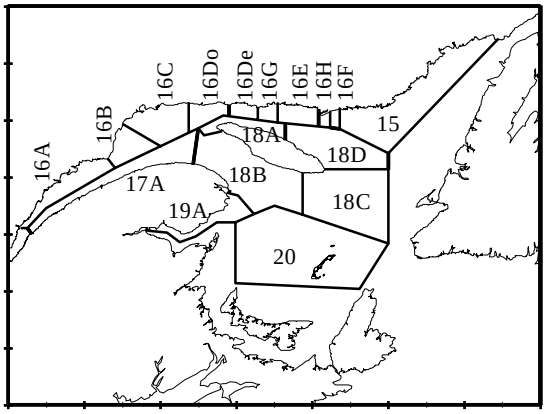

Scallops of the Inshore Waters of Québec

Summary

Two different scallop species are found in the Gulf of St. Lawrence, the sea scallop and the Iceland scallop. Sea scallops reach commercial size at about 5 years of age and Iceland scallops around age 8. The sexes are separate and fertilization of eggs occurs externally. The spawning period is short and does not occur at the same time throughout the Gulf. Larval development takes nearly five weeks. Scallops are sedentary and live in aggregations called "beds".

In Québec, commercial fishing for scallops began in the mid-1960s. The fishery is located inshore and targets both sea scallops and Iceland scallops indiscriminately. Catches are generally landed as muscle. The Laurentian Region is divided into 17 fishing areas for which there are currently 82 active fishing licences. All the areas are managed by controlling fishing effort, and an individual quota system exists as well on the Middle North Shore and Anticosti Island. The North Shore has been the most productive scallop region in Québec since 1980.

Overview of scallops

Biological context

There are two indigenous species in Eastern Canada, the sea scallop (*Placopecten magellanicus*) and the Iceland scallop (*Chlamys islandica*). In the Gulf of St. Lawrence, these two species are found mainly on gravel, shell or rocky bottoms, at depths of 20 to 60 metres. Geographic distribution is different for the two species. In the Gulf of St. Lawrence, the Iceland scallop occurs on the North Shore, around Anticosti Island and on the north shore of the Gaspé Peninsula, but is virtually absent in the southern Gulf. By contrast, the sea scallop is found primarily in the southern Gulf, including the Îles-de-la-Madeleine and Chaleur Bay, and occasionally appears on the Lower North Shore.

The sea scallop grows at a faster rate than the Iceland scallop. Growth varies from one region to another, and is chiefly influenced by habitat quality and environmental conditions. In the Gulf of St. Lawrence, commercial size is reached at about age 5 for the sea scallop and age 8 for the Iceland scallop.

In scallops, the sexes are separate and eggs are fertilized externally in the water. The spawning period is short and does not occur at the same time Gulf-wide. In the sector extending from Havre St Pierre to Johan-Beetz Bay, Iceland scallop spawn in July, whereas in the rest of the Middle and Lower North Shore and off 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 in the Îles-de-la-Madeleine region.

Larval development takes about 5 weeks, from fertilization until settlement on the bottom. The larvae seek to attach themselves to the seabed, in fairly close proximity to adult scallops. Certain conditions, such as the presence of filamentous organisms, are required for successful settlement. By limiting the use of scallop drags in the month before juvenile scallop settle and for a few weeks afterward, the negative effect of this gear on habitat could be reduced. This measure would help to favour the survival of juveniles during the settlement period.

Scallops are sedentary and live in aggregations called "beds". This fact is important to consider when developing conservation strategies and harvesting approaches. Since resource conservation measures are designed to ensure the sustainability of each bed, they must afford protection that allows the scallop population at each site to renew itself.

It is therefore reasonable to expect that an approach aimed at augmenting reproductive potential by leaving more adults on the bottom or by creating shelter areas would have a positive impact on resource conservation. Since female scallops produce eggs in proportion to their size, there would be a net gain in productivity by allowing individuals to grow and the population to age. This approach would offer the added benefit of increasing yield per recruit and hence commercial profitability.

The fishery

Commercial harvesting in Québec targets Iceland scallops and sea scallops indiscriminately. Catches are generally landed as meat (muscle) and occasionally as meat and roe (muscle and gonad) or in the shell (whole). It is not possible to visually distinguish the adductor muscle of the two species; the whole animal is needed to make this identification. However, the two species are not uniformly distributed in the Gulf of St. Lawrence, and catches in any one sector usually consist of just one species.

In 1996, the Québec Region comprised 17 fishing areas divided among three sectors, namely the Îles-de-la-Madeleine (Area 20), the Gaspé Peninsula (Areas 19A, 18B and 17A) and the North Shore (Areas 16A, 16B, 16C, 16De, 16Do, 16E, 16F, 16G, 16H, 15, 18A, 18C and 18D) (Figure 1). Areas 18C and 18D, however, have not yet been harvested. Last year a total of 82 regular licences were issued. Management plans varied depending on the area, based on the following factors: vessel length, drag size, fishing season and hours, and individual quota.

In the Gulf of St. Lawrence, the scallop fish-

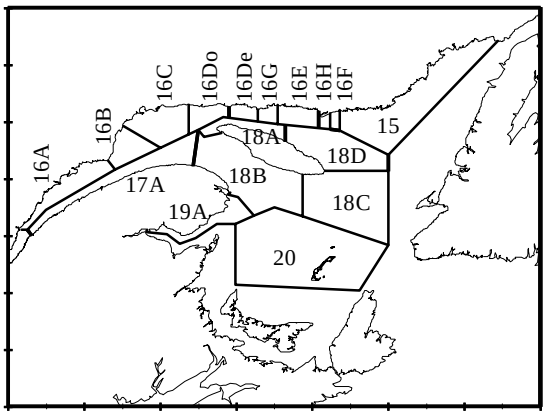

Figure 1. Scallop management units in Québec.

ery is essentially an inshore fishery. The Digby-type drag has been used since harvesting began in Québec. Over the years, there has been a significant increase in fishing effort, primarily as a result of the fleet's increased fishing capacity and effectiveness.

Landings in the Îles-de-la-Madeleine and on the North Shore have fluctuated widely since the beginning of the commercial fishery (Figure 2). The scallop stocks in those regions collapsed in 1971. Landings on the North Shore rose rapidly from 1984 to 1990. There has been a levelling off of catches since 1991 owing to the introduction of individual quotas on the Middle North Shore.

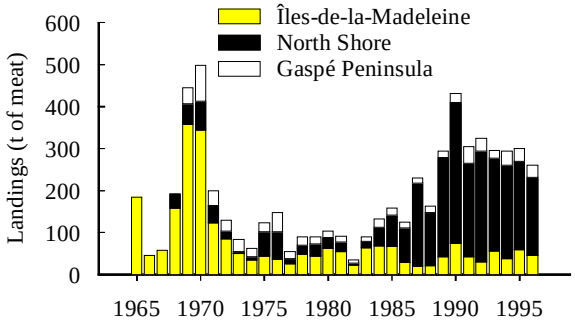

Figure 2. Scallop landings in Québec.

Landings in 1996, which totalled some 271 t of meat came from the North Shore (71%), the Îles-de-la-Madeleine (17%) and the Gaspé Peninsula (12%).

Assessment of the status of the scallop populations of the Gaspé Peninsula and the North Shore, except for Area 16De, is essentially based on commercial indices. The Îles-de-la-Madeleine population, and Area 16De, are evaluated on the basis of commercial indices too, as well as research survey indices.

In a case where no research index is available, the population status assessment is wholly dependent on the quality of the data furnished by the fishing industry. According to well-informed sources, unreported catches have been so large over the past few years that the reliability of analyses based on fishing statistics can be called into question.

Information specific to scallops in the Îles-de-la-Madeleine, Gaspé Peninsula and North Shore regions is presented in the following sections. Since it is not yet possible to provide advice for each of the small beds scattered along the Québec coast, this review is organized according to the management units. A group of scientists examined the data during the regional review of invertebrate stock status in Québec.

Îles-de-la-Madeleine (Area 20)

The Îles-de-la-Madeleine sector comprises three principal scallop concentrations, namely the fishing grounds of Étang-du-Nord, Dix-Milles and Chaîne-de-la-Passe (Figure 3). In 1996, these beds were open to the fishery from April 13 to September 30. However, the eastern part of Chaîne-de-la-Passe remained closed during the 1996 season. A fourth bed, located in the southwest, has been closed to harvesting since 1990. In 1996, 20 of the 23 issued licences were active.

Over 95% of the Îles-de-la-Madeleine

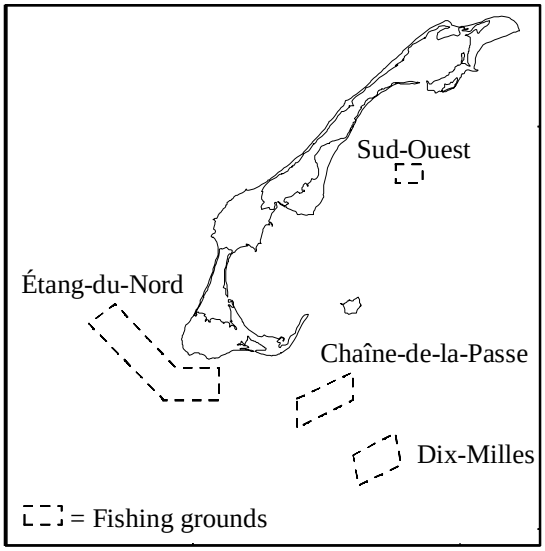

Figure 3. Principal fishing grounds for scallops in Îles-de-la-Madeleine.

catches generally consist of sea scallops, with Iceland scallops making up the remainder. Since 1990, landings have ranged from 29.9 t to 73.9 t (Table 1). From 1995 to 1996, muscle landings dropped about 24%, from 58.9 t to 44.9 t.

Table 1. Scallops landings (t of meat) and catch per unit effort (kg meat per hours of fishing and meter of drag) in Îles-de-la-Madeleine.

	1990	1991	1992	1993	1994	1995	1996[1]
Catch	73,9	42,2	29,9	55,6	36,7	58,9	44,9
CPUE	1,29	1,07	0,91	1,21	0,80	1,27	0,85

[1] preliminary data

The increase in catch per unit effort (CPUE) in 1993 was due to recruitment of the 1988 cohort, which was relatively abundant. This cohort was harvested intensively and exhausted within a few weeks. In 1994, catch per unit effort fell to an all-time low for the past ten years. However, in 1994 the Chaîne de la Passe bed, which contained the highest scallop densities, was closed to the fishery. The bed was re-opened and harvested for a few weeks in 1995, pushing up the catch per unit effort and landings. The poor recruitment in 1996 caused the CPUE values for all beds to drop to the 1994 level.

Size (shell height) structure varies annually depending on the recruitment level and on the cohorts targeted by the fishery. The progression of cohorts can be tracked using research survey data (Figure 4). In 1993, the 1989 cohort of scallops was visible, concentrated chiefly in the Chaîne-de-la-Passe sector, where the fishery was eventually closed in June 1993. This cohort, which was already perceptible in 1991 research surveys, began to be harvested on the other beds in 1994. In 1995 and 1996, and especially since the re-opening of the western part of Chaîne de la Passe, the 1989 cohort (100-110 mm shell height) made up a substantial proportion of the landings.

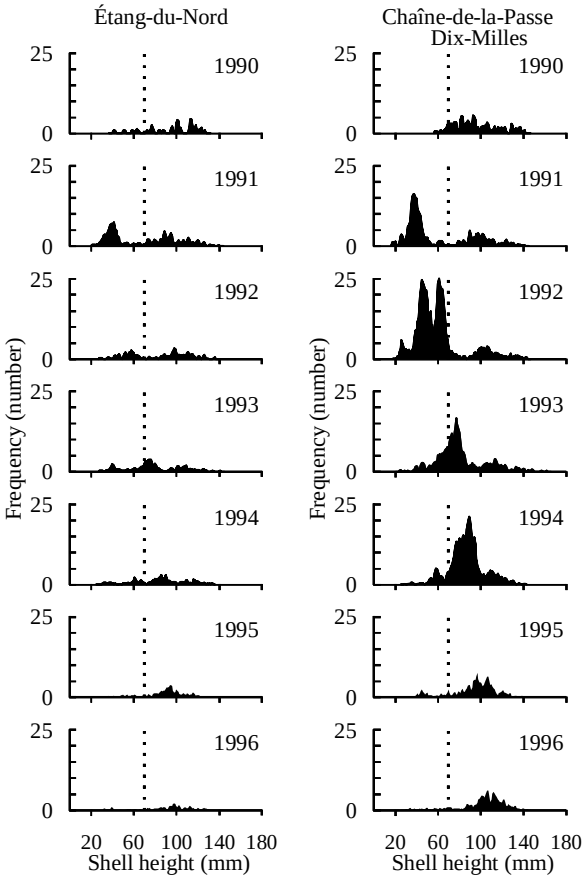

Figure 4. Shell height frequency distribution of sea scallops sampled during research surveys in Îles-de-la-Madeleine.

The research indices provide a clear picture of the fluctuations in prerecruitment, that is, scallops smaller than 70 mm, and in recruitment (scallops ≥ 70 mm) (Figures 4 and 5). Prerecruits peaked in 1992, then gradually declined until 1996. The abundance index for recruits followed a similar trend, but with a two-year delay, corresponding to the time it takes prerecruits to reach recruitment size. Very few prerecruits were present in 1995 and 1996.

An analysis of the age structure of the Îles-de-la-Madeleine scallop population reveals an increase in total mortality (Z) by age-class since 1993. Since natural mortality remained

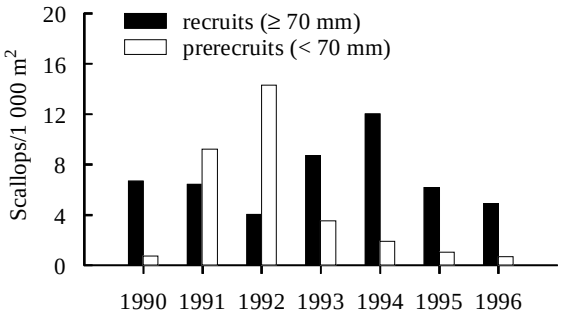

Figure 5. Density of sea scallops observed during research surveys in Îles-de-la-Madeleine.

low during this period, the rise in total mortality must be due to increased fishing mortality. Fleet capacity and harvesting intensity appear to be much too high for the scallop beds in the Îles-de-la-Madeleine. Concerns about the fleet's excessive capacity have been voiced repeatedly during the past decade.

The success of annual scallop reproduction is measured through the spat collection program, which began in 1986. Since then, annual spat collecting success has been highly variable off the Îles-de-la-Madeleine (Figure 6). In 1993, 1995 and 1996, the number of juvenile scallops per collector was above average. These results will eventually

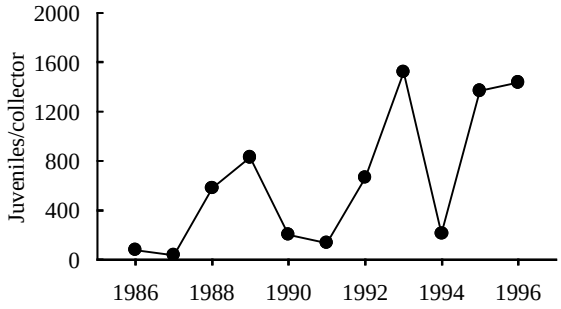

Figure 6. Mean number of scallop juveniles per collector in Îles-de-la-Madeleine.

be modelled to be able to predict recruitment to the fishery five years later. At present, however, the model is not sufficiently accurate.

Research survey data can be used to derive an abundance index of 2-year-old prerecruits, which can in turn help to predict the abundance of recruits that will be available to the fishery in three years, at age 5. According to the data series obtained so far, this is a reliable index for predicting recruitment (Figure 7). The small number of 2-year-old prerecruits identified in the 1994, 1995 and 1996 research surveys indicates that low recruitment will continue until at least 1999.

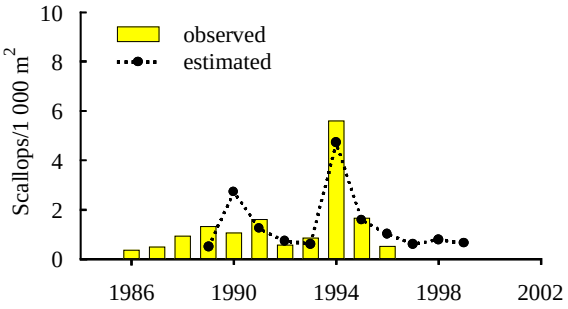

Figure 7. Density of 5 year-old recruits observed during research surveys and estimated from the number of 2 year-old prerecruits observed three years earlier during research surveys.

Prospects

The commercial fishery's catches per unit effort and abundance indices from research surveys show agreement, and reflect the comments made by fishermen. The fluctuations in landings over the last few years were caused by variations in recruitment to the population. In 1995, the majority of landings came from one site of a few square kilometres located in the western part of Chaîne de la Passe. In 1996, this bed was quickly depleted and the fleet had to spread out over the entire scallop fishing territory. The situation at the close of the 1996 fishing season is

worrisome, because all the beds have been decimated, except for the eastern part of Chaîne-de-la-Passe, which is still closed to harvesting.

Fishing capacity in the Îles-de-la-Madeleine greatly exceeds the available scallop resource. Chaîne de la Passe provides a good illustration of this situation, given that upon re-opening after a two-year close period, the bed was nearly depleted of scallops in just three weeks.

The management approach used for Chaîne de la Passe since 1993 is a concrete example of how the the yield per recruit can be increased. After a close period of only two years, the 1989 cohort was able to double its yield (and profits) over what it would have been if that cohort had been fished in 1993.

In 1997, only the eastern part of Chaîne de la Passe will still be able to suppport reduced fishing pressure. Since the recruitment indices do not suggest encouraging prospects until 1999, and the results of the initial restocking efforts will not contribute to landings to any great extent before the year 2000, fishing effort should be reduced to a minimum in order to decrease pressure on the stock. The spawning biomass will be very low until at least 1999, which raises serious concerns about the scallop stock's ability to reproduce sufficiently.

Futhermore, it may seem paradoxical to invest in restocking scallop beds while permitting overharvesting to continue and to jeopardize the reproductive potential of beds containing wild scallops. To allow the scallop population to rebuild, it would make more sense to provide adequate protection for concentrations of wild scallops. .

Gaspé Peninsula (Areas 19A, 18B, and 17A)

The Gaspé Peninsula comprises three separate harvesting units, Areas 19A, 18B and 17A. In 1996, Area 19A had six regular fishing licences. Fishing was permitted there from 5 am to 7 pm, Monday to Saturday, from May 1 to September 30. In Area 18B there were two licences with individual quotas. In Area 17A only one licence was issued. There is no fishing season or schedule in the latter two areas.

Landings in the Gaspé Peninsula come mainly from Chaleur Bay (Area 19A) and Anticosti Island (18B). Fishing in Chaleur Bay is chiefly directed at sea scallops, whereas off Anticosti Island and on the north shore of the Gaspé Peninsula, Iceland scallops are the targeted species.

North of the Gaspé (Area 17A), exploitation is stable but landings are low. Catches from the southwest sector of Anticosti Island (Area 18B) have been variable in the past few years. Harvesting in this area began recently and the fishery is still developing.

In Area 19A, catches have been relatively stable since 1991 (Figure 8). The occasional arrival of new fishermen (licence transfers) has been responsible for fluctuations in effort.

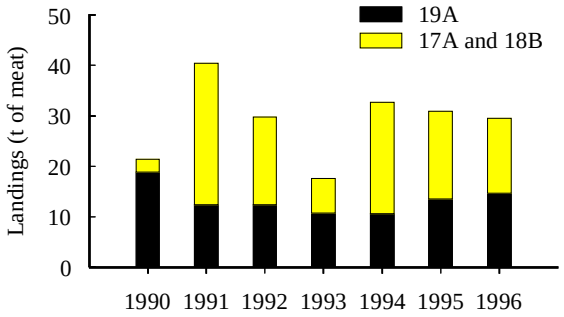

Figure 8. Scallop landings in Gaspé Peninsula.

There have also been moderate variations in catches per unit effort during this period (Table 2). Between 1993 and 1994, the CPUE in Area 19A fell sharply, possibly reflecting a deterioration in the stock's state. However, since 1994 CPUE has been low, albeit fairly stable.

Table 2. Catch per unit effort (kg of meat per hour of fishing and meter of drag) in Gaspé Peninsula.

	17A	18B	19A
1990	1,46		0,77
1991	1,07		0,88
1992	1,67	0,92	0,93
1993	1,51		0,96
1994	2,06	2,71	0,74
1995	1,57	0,98	0,73
1996	1,28	1,23	0,71

The size structure data for scallops in the commercial samples from Area 19A show that the modes contributing to the fishery have varied substantially over the years (Figure 9). In 1996, an even greater change in size structure is evident, with a dominant mode at a much smaller shell height size.

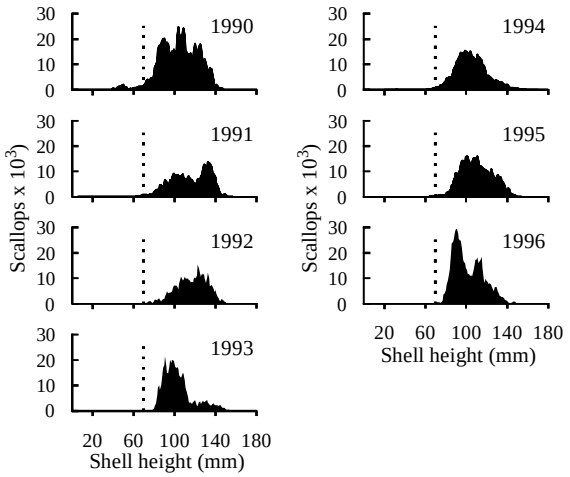

Figure 9. Shell height frequency distribution of sea scallops in commercial samples from area 19A.

This probably reflects the recent increase in fishing effort in Chaleur Bay. The indices of prerecruitment and natural mortality (clappers) have been fairly stable. In Areas 17A and 18B, the size structures and the prerecruitment and mortality (M) indices are stable.

Prospects

The recent fluctuations in scallop landings from the Gaspé Peninsula are chiefly explained by the *ad hoc* harvesting of Iceland scallops southwest of Anticosti Island. Landings from Chaleur Bay have been relatively steady; the few variations are attributable to changes in the fishing pattern and fluctuations in recruitment abundance. The low CPUEs and the absence of above-average recruitment since 1990 suggest that there will be no major changes in Chaleur Bay in the coming years.

However, given the drop in catches per unit effort since 1993, the reproductive biomass in Chaleur Bay may be cause for concern. Reducing the harvesting level would allow more scallops to reproduce before being harvested.

The situation in Areas 18B and 17A is not of immediate concern in view of the limited fishing pressure at these sites.

North Shore

The North Shore is divided into 11 fishing areas between the mouth of the Saguenay and Blanc Sablon. All of them are independently managed. North Shore landings are on the order of 194 t of meat, largely from the Middle North Shore. In 1996, the next largest landings came from the Upper North Shore and the Lower North Shore.

Areas 16A, 16B and 16C

Iceland scallops are caught in this sector. This fishery is exploited by only five fishermen, and fishing effort is limited. The areas are managed mainly by restricting the number of licences issued. Fishing in Areas 16A, 16B and 16C is unstable from one year to the next, and the harvesting pattern can be seen in the fluctuations in CPUEs, landings and effort (Figure 10; Table 3). The sector contains a few bed, which are visited alternately. Catch per unit effort increase when fishermen arrive at a site and drop when the beds are depleted.

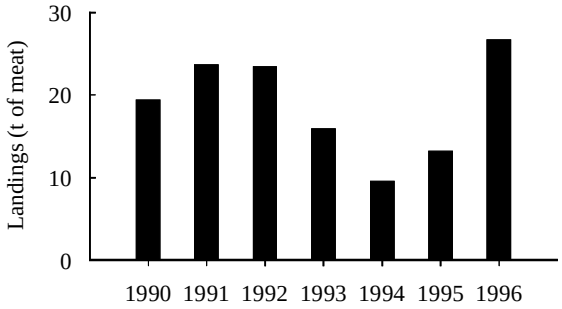

Figure 10. Scallop landings in areas 16A, 16B and 16C.

The discovery of a new bed in Area 16C explains the increase in landings and catches per unit effort in 1995 and 1996. As well, the sale of unshucked (live) scallops is partly responsible for the higher yields, given the time saved on shucking the catch aboard ship.

Table 3. Scallops landings (t of meat) and catch per unit effort (kg meat per hour of fishing and meter of drag) in areas 16A, 16B and 16C.

	16A	16B	16C
1990		2,45	3,89
1991		4,16	2,78
1992	0,80	2,25	4,34
1993	0,76	1,82	2,94
1994	1,23	2,80	1,89
1995		1,38	7,60
1996		0,97	8,21

The size structures of commercial samples are characterized by scallops with a shell height of about 80 mm.

Prospects

The findings of exploratory fisheries conducted in the past and the current status of the fishery suggest that areas 16A, 16B and 16C have limited potential. If the industry wants to ensure sustainable development of this resource, better control of fishing effort is in order.

Areas 16D, 16G, 16E and 18A

Seven fishermen have access to Area 16D, nine to 16G and 18A, and four to 16E. Each of these areas has a quota and is managed by fishing hours and a fishing season. Landings of Iceland scallops in this sector have risen sharply since the early 1980s. This is the most productive region in Québec.

The introduction of individual quotas in 1991 is responsible for the major drop in effort in Area 16D. In 1993, a new delimitation of the areas, the establishment of fishing seasons and the reduction of quotas in 16D resulted in a further drop in fishing effort in this area and a displacement of effort to Areas 16G and 18A. In 1996, Area 16D was subdivided into areas 16Do and 16De, and quotas were reduced in 16De and 16G and increased in 18A.

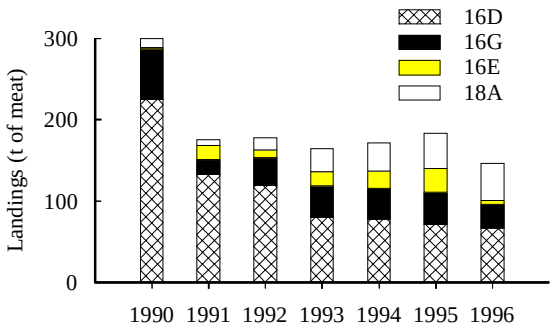

Figure 11. Scallop landings in areas 16D, 16G, 16F and 18A.

Landed volume reached an all-time high of nearly 300 t of muscle in 1990 (Figure 11). In 1991, actual landings declined substantially, especially in Area 16D. Between 1993 and 1995, landings in Areas 16D, 16G and 16E were relatively stable. In 1996, the nominal catches in the sector totalled 146 t of muscle, most of which came from Area 16D. The drop in landings in 1996 is attributable to the quota reduction of nearly 10% in 16D and 16G, coupled with the quota increase in 18A.

Catch per unit effort differ considerably among the areas on account of local variations in environmental productivity. There is a declining gradient in CPUE from west (16D) to east (16E) (Table 4). Whereas in 1995, catch per unit effort declined by over 10% in 16D and nearly 20% in 16G, in 1996 they levelled off in those areas.

The abundance index derived from the 1996 research survey in Area 16De is comparable to that of 1990 but a marked improvement over the 1991 index (Figure 12).

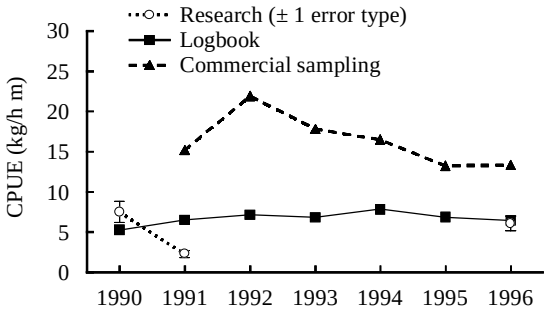

Figure 12. Catch per unit effot (kg of meat per hour of fishing and metre of drag) in area 16De, obtained from research surveys, fisher logbooks and commercial sampling at sea.

The mortality rate (% of clappers) calculated from commercial sampling data almost doubled between 1995 and 1996 in 16D and 16G. In five years, natural mortality has gone from 10% to nearly 40% in these two areas. At present, the causes of this worrisome trend remain unknown.

Table 4. Catch per unit effort (kg of meat per hour of fishing and metre of drag) in areas 16D, 16G, 16E and 18A.

	16D	16G	16E	18A
1990	5,27	6,13	2,76	5,14
1991	6,51	5,16	3,45	7,00
1992	7,15	6,31	4,16	5,35
1993	6,83	5,76	3,16	4,90
1994	7,84	5,31	3,01	4,74
1995	6,87	4,31	2,63	5,49
1996	6,41	4,22	1,93	6,50

The size structures of commercial samples are characterized by scallops of uniform size. The size of scallops taken during commercial sampling has been stable in recent years. However, there are notable differences among the areas, which are reflected in decreased mean shell height from west (16D) to east (16E) and from north (16D) to south (18A).

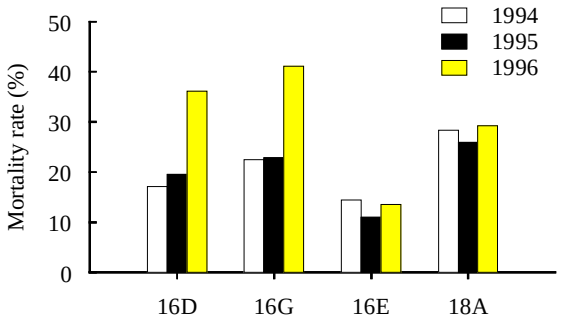

Figure 13. Natural mortality rate of Iceland scallops observed during commercial sampling in areas 16D, 16G, 16E and 18A.

Prospects

At present, it is not possible to precisely determine the situation of the fishery in each area. The reduction of fishing effort since the adoption of individual quotas in 1991, combined with the advent of many new fish-

ing areas, has caused fishing intensity to be distributed over a larger territory, a situation which has undoubtedly helped to prevent and limit local overfishing.

The downward trend that has been going since 1992 in Area 16G's catches per unit effort is worrisome**.** Harvesting of beds west of the Mingan Islands (16Do) has produced little in the way of results so far. The environmenal conditions in Area 16E appear to be less favourable for scallop growth, and weather conditions in the sector are not conducive to sustained fishing. Around Anticosti Island, the upturn in catch rates might be an indication of the healthy state of the beds in Area 18A. However, the results of the exploratory fishery conducted in Area 18D in 1996 were negative.

While the productivity of the scallop beds in the Mingan Islands seems clearly superior to that of the other North Shore sites, the beds in this region have nonetheless been affected by the intensive fishing that took place in 1989 and 1990. Hence, local overfishing of certain beds is a risk if fishermen end up harvesting more resources than the beds can produce. According to some information sources, unreported landings are quite high, a situation which casts doubt on the validity of fishery statistics based on logbook data, while also endangering the resilience of scallop stocks.

Prospects

Areas 16H, 16F and 15

Thirty-four licences have been issued east of Natashquan, all of them for Areas 15 and 16F. Six fishermen from Area 15 and two from Area 16E also have access to Area 16H. Historically, the sector's landings had mainly consisted of sea scallops; however, since 1992, catches of Iceland scallops from the western side of Area 15 and from 16F and 16H have increased by a large proportion.

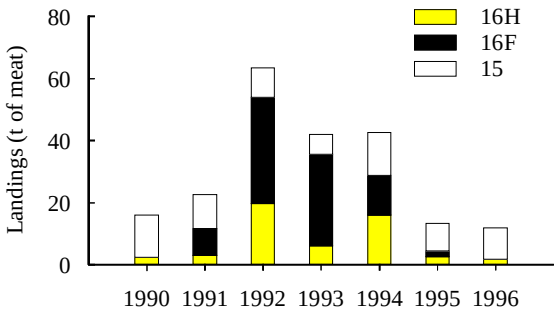

Figure 14. Scallop landings in areas 16H, 16F, and 15.

Catches increased from 1990 to 1992, and remained relatively high in 1993 and 1994 thanks to landings of Iceland scallops from Areas 16F and 16H. The decline in catches in Area 16F in 1994 and 1995, undoubtedly associated with the lower CPUEs, is worrisome (Figure 14; Table 5).

Table 5. Catch per unit effort (kg of meat per hour of fishing and metre of drag) in areas 16A, 16F and 15.

	16H	16F	15
1990			0,79
1991	5,64	4,51	0,67
1992	4,15	2,91	1,00
1993	2,58	2,75	1,14
1994	3,27	2,20	1,49
1995	2,15	1,40	1,12
1996	3,27		1,14

In 1996, landings from Area 16H dropped, a trend that is probably due to the reduction in fishing effort, given that catches per unit effort remained stable. In Area 15, catches per unit effort have been low but stable since 1992.

Prospects

The future of the scallop fishery in this sector remains uncertain. The only obvious way to improve the population's status is to suspend fishing operations for a few years.

For more information:

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