STOCK STATUS REPORT

LAURENTIAN REGION

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QUEBEC SCALLOPS

OVERVIEW OF SCALLOPS

Context

Scallops are of major economic importance in Canada. 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 chiefly to be found on bottoms of gravel, shells or rocks, at depths of between 20 and 60 metres. Geographic distribution is different for the two species. In the Gulf of St. Lawrence, the Iceland scallop is found on the North Shore, Anticosti Island and the north shore of the Gaspé Peninsula, but is virtually absent in the southern Gulf. The sea scallop, on the other hand, is primarily found in the southern Gulf, including the Îles-de-la-Madeleine and Chaleur Bay. This species occasionally appears on the Lower North Shore, which is its northern limit.

The sea scallop grows at a considerably 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 achieved after around five years for the sea scallop and after more than eight years for the Iceland scallop.

In scallops, the sexes are separate and eggs are fertilized outside the organism in the surrounding environment. The breeding period is short, and larval development is approximately five weeks, until metamorphosis and settling

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on the bottom. Scallop recruitment is crucial to ensuring the sustainability of the stocks. It is the outcome of a complex and little-known process which requires favourable environmental and biological conditions.

Among other factors, successful reproduction is probably related to the number of spawners on the bottom and the quantity of gametes released in the environment. For example, a high density of adults would increase the chances of successful reproduction and of high recruitment to the fishery a few years later. Consequently, it is advantageous to leave a large quantity of adult scallops on the bed.

The young scallops attach themselves to the bottom in approximately the same site as the adults. Certain conditions, such as the presence of filamentous organisms, are required to ensure that this process is successful. All measures to reduce fishing activity during spawning and the following months, when the juveniles are seeking bottoms on which to attach themselves, will stabilize the habitat and facilitate the young scallops' survival. From this perspective of resource conservation, the establishment of a fishing season based on the species' reproductive cycle and on juvenile settlement is an objective that is to be recommended.

The spawning period is not the same throughout the Gulf of St. Lawrence. According to available information, Iceland scallops spawn from mid-July to mid-August on the Lower North Shore, in the last two weeks of July between Havre Saint-Pierre and Baie Johan Beetz, in early August on Anticosti Island, and from mid-August to late August between Baie Johan Beetz and Kegaska. Sea scallops lay their eggs in August in Chaleur Bay and in late August in the Îles-de-la-Madeleine.

Scallops are sedentary and live in aggregations called "beds". This fact is important to consider when developing conservation strategies and harvesting scenarios. Since resource conservation measures are designed to ensure that each bed can be sustained, it is necessary to use them to ensure that each bed retains the ability to renew itself. The establishment of small fishing areas is fully consistent with the bed management approach.

Harvesting beds in a reasonable manner, leaving enough scallops to ensure reproduction, serves to protect reproductive potential and facilitate the beds' sustainability. At the moment, however, it is difficult to precisely estimate the optimum level of harvesting. Work is presently under way to provide a response to this question.

The fishery

Commercial harvesting in Quebec involves Iceland scallops and sea scallops indiscriminately. Catches are generally landed as muscle (meat) and occasionally as meat and roe (muscle and gonad) or as shells (whole). It is not possible to visually distinguish the muscles of the two species; the entire 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 1995, the Quebec Region comprised sixteen fishing areas divided among three sectors, namely the Îles-de-la-Madeleine (area 20), the Gaspé Peninsula or Gaspé (areas 19A, 18B, 17A) and the North Shore (areas 16A, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 15, 18A, 18C, 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.

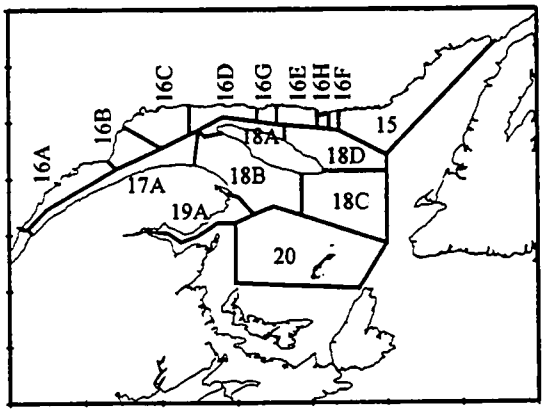

Figure 1. Scallop management units in Quebec

In the Gulf of St. Lawrence, the scallop fishery is essentially an inshore fishery. The Digby-type drag has been used since harvesting began in Quebec. There has been a significant increase in fishing effort over the years, primarily as a result of increased fishing power and improved positioning systems.

Landings have fluctuated greatly since the beginning of the commercial fishery (Figure 2). The Îles-de-la-Madeleine and Chaleur Bay scallop stocks collapsed in the early 1970s. North Shore landings saw a rapid increase from 1984 to 1990. The reduction of catches in 1991 and their subsequent stabilization are connected to the introduction of individual quotas. Landings in 1995, which totalled around 299 t of meat, were derived from, in order of importance, the North Shore (70 %), the Îles-de-la-Madeleine (20 %) and the Gaspé (10 %). Catches per unit effort were generally high on the Middle North Shore and low in the rest of the territory.

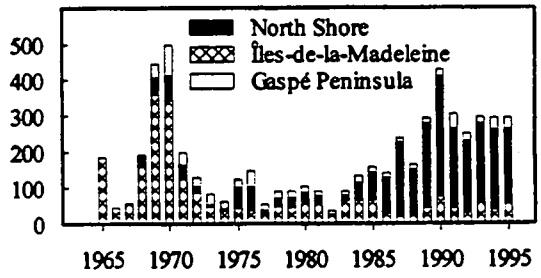

Figure 2. Scallop landings (t of meat)

Assessment of the status of the scallop populations of the Gaspé and the North Shore is essentially based on catch per unit effort and the shell height structures of commercial catches; assessment of the Îles-de-la-Madeleine population is based on these same commercial indices as well as on research indices such as abundance and recruitment.

Information specific to scallops from the Îles-de-la-Madeleine, Gaspé and the North Shore is presented in the following sections. Since it is not yet possible to formulate advise for each of

the small beds scattered along the Quebec coast, this review is organized according to the management units. This information has been reviewed by a group of scientists during the regional review of the status of invertebrate stocks in Quebec.

For more information:

Savard, L. (ed.). 1995. Status Report on Invertebrates in 1994: Crustaceans and Molluscs on the Quebec Coast, Northern Shrimp and Zooplankton in the Estuary and Gulf of St. Lawrence. Can. Man. Rep. Fish. Aquat. Sci. 2323: xi + 132 pp.

Shumway, S. (ed.). 1991. Scallops: Biology, Ecology and Aquaculture. Developments in Aquaculture and Fisheries Science, vol. 21. Elsevier, Amsterdam. 1095 pp.

ÎLES-DE-LA-MADELEINE (AREA 20)

The fishery

The Îles-de-la-Madeleine fishing territory comprises three principal scallop concentrations, namely the fishing grounds of Étang-du-Nord, Dix-Milles and Chaîne-de-la-Passe (Figure 3). The first two beds were open to the fishery between April 13 and September 30, 1995. Chaîne-de-la-Passe was accessible only between September 1 and 23. Twenty of the twenty-three licences issued for this area were active last year.

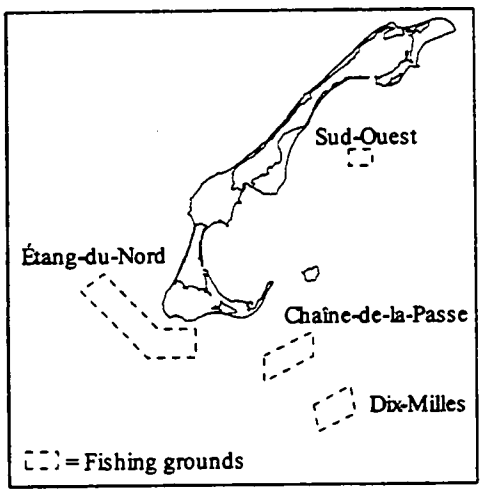

Figure 3. Main scallop fishing grounds on the Îles-de-la-Madeleine

Over 95 % of the Îles-de-la-Madeleine catches 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 1994 to 1995, meat landings rose from 36,7 t to 58,6 t, an increase of close to 60 %.

Table 1. Scallop landings (t of meat) and catch per unit effort (CPUE = kg of meat per hour of fishing and per metre of drag)

	1990	1991	1992	1993	1994	1995 [1]
Landings	73,9	42,2	29,9	55,6	36,7	58,6
CPUE	1,29	1,11	0,92	1,10	0,72	1,31

[1] preliminary

The increases in catch per unit effort in 1990 and 1993 were due to the arrival of newly recruited cohorts. These cohorts were intensively harvested and rapidly exhausted. In 1994, catch per unit effort fell to its lowest level in the past ten years. It should be noted, however, that in 1994 the Chaîne-de-la-Passe bed, which contained the highest densities of scallops, was closed to the fishery. In 1995 this concentration was once again harvested, and was responsible for the increase in catch per unit effort and landings.

The shell height structure normally reveals a number of modes which reflect the strength of the different year-classes. Shell height structure thus varies annually according to the cohorts targeted by the fishery and according to recruitment. In 1993 a cohort of scallops of about 70 mm was visible, concentrated chiefly on Chaîne-de-la-Passe. These recruits began to be harvested on the other beds in 1994, when they made up a significant portion of commercial catches. After the opening of Chaîne-de-la-Passe in 1995, this cohort (shell height of about 100 mm) was heavily fished.

The research indices clearly illustrate the fluctuations in the prerecruitment

(scallops < 70 mm) and recruitment (scallops ≥ 70 mm) of the Îles-de-la-Madeleine population (Figure 4). Prerecruits peaked in 1992, then gradually decreased up to 1995, whereas the abundance index for recruits increased between 1992 and 1994. The high abundance value in 1994 is a reflection of the high concentration of scallops, on the Chaîne-de-la-Passe bed, which was not commercially fished.

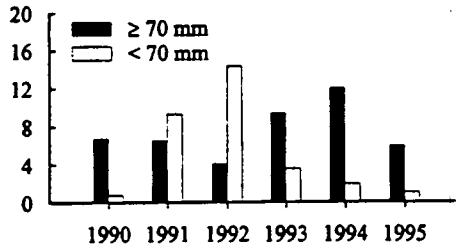

Figure 4. Abundance indices, i.e. number of scallops sampled per 1 000 m², as measured during research surveys

The abundance of recruits in the 1995 survey does not necessarily reflect the situation at the close of the fishing season, since the harvesting pattern was different that year with the opening of Chaîne-de-la-Passe. In the past, surveys had been done toward the end of the fishing season, when they were a good indicator of the situation that would prevail the following year. This does not apply to 1995, however, since most of the landings were fished after the research survey.

A dramatic decline in the density of small scallops since 1992 suggests low recruitment in the next few years. The shell height structures obtained from research surveys clearly illustrate this weakness in recruitment (Figure 5).

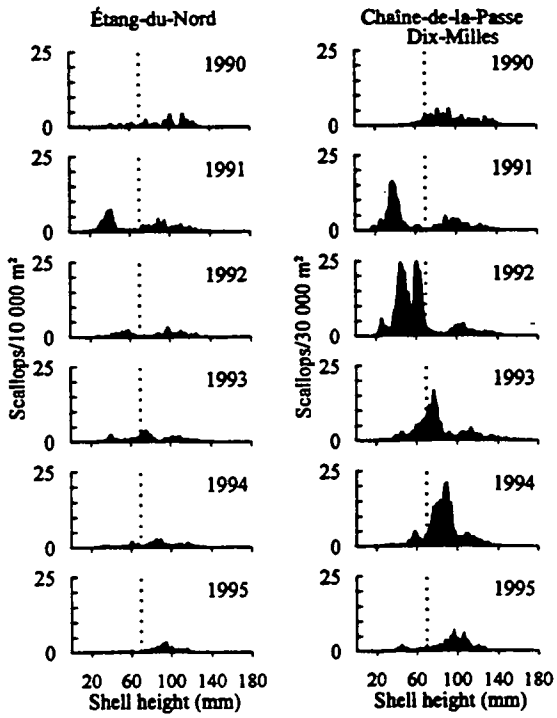

Figure 5. Shell height structures of scallops sampled during research surveys

The success of scallop reproduction is estimated by means of the spat collection program, which began in 1986. The annual collecting success has been highly variable off the Îles-de-la-Madeleine (Figure 6). In 1993 and 1995 the number of juvenile scallops per collector was above average.

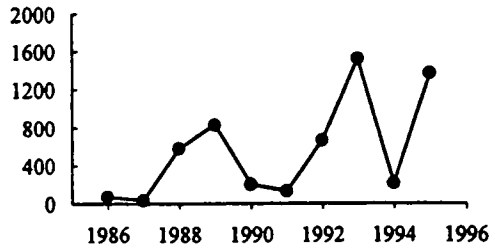

Figure 6. Number of scallop juveniles per collector

Recruitment to the fishery is estimated using an empirical model, based on the relationship between the success of spat collection and recruitment to the fishery five years later. This model predicts that recruitment to the fishery will be low in 1996, but high in 1998 and 2000 (Figure 7).

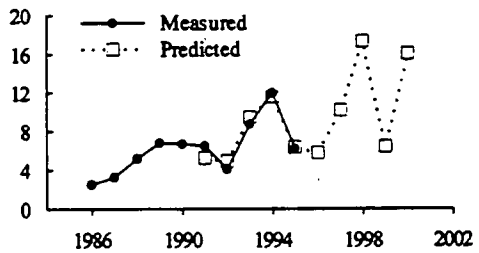

Figure 7. Relative density (recruits per 1 000 m^2) of scallops, measured on research surveys and estimated on the basis of spat collection success five years earlier

According to this model, the increase in recruitment should be perceptible in 1997. However, the weakness of prerecruit abundance in the 1995 research survey suggests that there will be no increase in 1997. The divergence of these indicators for 1997 suggests that successful reproduction is not necessarily a guarantee of successful recruitment. The impact of natural mortality between reproduction and recruitment to the fishery should not be overlooked.

Prospects

The commercial fishery's catches per unit effort and the research survey's abundance indices are consistent, and reflect the comments and fears raised by the fishers following the 1995 fishing season. The abundance fluctuations in recent years were caused by the variations in recruitment to the population. In 1993 and 1994, outside the closed area of Chaîne-de-la-Passe, catch per unit effort fell dramatically. In 1995, most landings came from one site of a few square kilometres located on Chaîne-de-la-Passe. In 1996 Chaîne-de-la-Passe will afford the only catch potential, since yields will be low out in all other beds. After the 1996 fishing season the situation will be tragic, because all the beds will be decimated.

For many years the success of this fishery has been closely tied to the success of annual recruitment. This strategy leads to major fluctuations in catches and endangers reproductive potential.

A reduction of fishing effort would help increase average age upon capture and optimize yield. **The management approach used for Chaîne-de-la-Passe since 1993 is a concrete example of how the yield per recruit can be increased. With a fishing suspension of only two years, the 1988 cohort was able to double its yield (and profits) over what it would have been if that cohort had been fished in 1993.**

The reproductive biomass will be very low in 1996 and 1997, creating serious concern for the reproductive potential of this scallop stock. It is therefore reasonable to expect that an approach aimed at **increasing reproductive potential by leaving more adults on the bottom would have a positive impact on resource conservation and sustainable development of the fishery.** The creation of shelter areas on the perimeter of the best fishing sites, where

the number of spawners would be high and where fishing would be banned, would have a positive impact on the safeguarding of reproductive potential. Active restocking of the beds would also help to boost reproductive potential.

Since scallops produce eggs proportionally to their volume, there would be a net gain in productivity by allowing individuals to grow and the population to age. Furthermore, this tactic would have the secondary effect of increasing yield per recruit and hence commercial profitability. Finally, **closing the fishery in the middle of August would allow better protection of spawners during egg laying, and would facilitate restoration of the fishing grounds before the juveniles attach themselves to the bottom.**

GASPÉ (AREAS 19A, 18B, 17A)

The fishery

The Gaspé comprises three separate harvesting units: areas 19A, 18B and 17A. In 1995, area 19A had six regular fishing licences. Fishing was permitted there from 5 am to 9 pm, Monday to Saturday, from April 1 to September 30. In area 18B there were two licences with individual quotas. In area 17A only one licence was issued. There was no fishing season in the latter two areas.

Landings for the Gaspé come mainly from Chaleur Bay (area 19A) and Anticosti Island (area 18B). Fishing in Chaleur Bay is chiefly oriented toward sea scallops, and off Anticosti Island and the north shore of the Gaspé Peninsula toward Iceland scallops. North of the Peninsula (area 17A), exploitation is stable but landings are low. Landings from southwest of Anticosti Island (area 18B) have varied. Harvesting of this area started only recently and is still in the development stage.

Catches have been relatively stable in Chaleur Bay since 1991. The occasional arrival of new fishers (licence transfers) has been responsible for fluctuations in effort. There have also been weak variations in catch per unit effort during this period (Table 2). Since 1993, however, the catch rate has diminished appreciably, possibly reflecting some deterioration in stock status.

The shell height structures of scallops in the commercial samples indicate that the modes contributing to the fishery have varied substantially over the years, and that indices of prerecruitment and natural mortality (clappers) are constant.

Table 2. Catch per unit effort (kg of meat per hour of fishing and per metre of drag)

	17 A	18 B	19A
1990	1,46		0,77
1991	1,07		0,88
1992	1,07	0,92	0,93
1993	1,51		0,96
1994	2,06	2,71	0,74
1995	1,73	1,35	0,72

Prospects

The recent fluctuations in scallop landings from the Gaspé are chiefly due to *ad hoc* harvesting of Iceland scallops southwest of Anticosti Island. Landings from Chaleur Bay have been relatively stable; the few variations are attributable to changes in the fishing pattern and fluctuations in recruitment abundance. **The noticeable decline in catch per unit effort and the absence of above-average recruitment since 1990 suggest that there will be no major changes in Chaleur Bay in the coming years.** This situation is fully consistent with the one described by the fishers. Their questioning of their fishery's future is probably justified. However, given the drop in catch per unit effort, there is cause for concern over the reproductive biomass in Chaleur Bay. Reducing the harvesting level would allow more scallops to reproduce before being harvested. **Areas 18B and 17A are not of immediate concern, in view of the limited fishing pressure at these sites.**

NORTH SHORE

The Quebec North Shore is subdivided into ten 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 200 t of meat, largely from areas 16D, 16G, 16E and 18A, which together approximate the Middle North Shore. Next in order of importance are the eastern sector of the North Shore (areas 16H, 16F, 15) and the extreme west (areas 16A, 16B, 16C).

NORTH SHORE (AREAS 16A, 16B, 16C)

Iceland scallops are caught in this sector. This fishery is exploited by only five fishermen, and fishing effort is weak. The areas are mainly managed through the number of licences issued.

This scallop fishery is unstable from one year to the next. The fluctuations in catch per unit effort, landings and effort reflect the fishers' exploitation pattern (Table 3). The sector supports a few beds which are visited alternately. Catch per unit effort increase when fishers arrive at a site and they decrease when the beds are exhausted.

Table 3. Catch per unit effort (kg of meat per hour of fishing and per metre of drag)

	16 A	16 B	16 C
1990		2,45	3,89
1991	0,58	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		1,51	7,41

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

Prospects

It might be advantageous to limit the level of harvesting. The beds' abundance and productivity might eventually increase as recruitment increases, provided that harvesting continues to be low. **However, the findings of a few exploratory fisheries conducted in the past and the current status of the fishery suggest that these areas have limited potential.**

NORTH SHORE (AREAS 16D, 16G, 16E, 18A)

Seven fishers have access to area 16D, nine to 16G and 18A, and four to 16E. Each of these areas has a quota and is governed 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 Quebec.

Landed volume reached a historical peak of close to 300 t of meat in 1990 (Table 4). After more restrictive individual quotas were introduced in 1991, reported landings declined significantly, especially in area 16D, and then stabilized. Nominal catches in 1995 reached approximately 183 t; most of these came from area 16D. Landings from areas 16D, 16G and 16E have been relatively stable since 1993. However, there has been a major increase in landings from area 18A.

Table 4. Scallop landings (t of meat)

	16D	16G	16E	18A
1990	224,9	62,5	1,7	10,8
1991	132,7	18,0	17,2	7,3
1992	119,6	34,1	8,7	15,0
1993	79,7	38,7	17,5	28,4
1994	77,8	37,3	21,9	34,0
1995 [1]	71,8	39,0	28,3	43,6

[1] preliminary

The introduction of individual quotas in 1991 is responsible for the major drop in effort in area 16D. In 1993, new delimitations of the areas, the establishment of fishing seasons and the reduction of quotas in 16D resulted in another drop in fishing effort in this area and a displacement of effort to areas 16G and 18A.

Catch per unit effort differs considerably among the areas on account of local variations in environmental productivity, which reflects in a gradual reduction in catch per unit effort from west to east (Table 5). What is more, in 1995 catch per unit effort decreased more than 10 % in 16D and close to 20 % in 16G.

Table 5. Catch per unit effort (kg of meat per hour of fishing and per metre of drag)

	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	4,34	2,85	5,49

The shell height structures of commercial samples are characterized by scallops of uniform size (unimodal distribution over a limited range). The commercial samples show great stability in scallop shell height structures over the years. However, there are notable differences among the areas, which are reflected in decreased average size from west to east and from north to south.

Prospects

The situation of the fishery cannot be determined precisely for each area. The reduction of fishing effort and catches since the adoption of individual quotas in 1991 and the creation of numerous areas have made it possible to distribute fishing intensity over a larger territory, and have no doubt helped to prevent and limit local overfishing. **However, the recent decline in catch per unit effort in areas 16D and 16G is a concern.** Harvesting of beds west of the Mingan Islands might help stabilize the development of this fishery.

Eventhough 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 been affected by the overfishing of 1989 and 1990. There is a risk of local overfishing of certain beds, in attempting to harvest more than they can produce. **It is therefore important to harvest all available beds in rotation over a period of 8 to 10 years, even if this may at times be less profitable in the short term.**

NORTH SHORE (AREAS 16H, 16F, 15)

Thirty-four licences have been issued east of Natashquan, all of which grant access to areas 15 and 16F. Six fishers from area 15 and two from area 16E also have access to area 16H. Lower North Shore landings had mainly consisted of sea scallops; since 1992, however, catches of Iceland scallops from the western end of area 15 and from 16F and 16H have grown significantly (Table 6).

Table 6. Scallop landings (t of meat)

	16H	16F	15
1990	2,3		13,6
1991	3,1	8,5	11,0
1992	19,6	34,3	9,5
1993	6,0	29,4	6,5
1994	15,9	12,8	13,9
1995 [1]	2,6	1,5	7,4

[1] preliminary

Catches increased from 1990 to 1992, and remained 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 is probably associated with a drop in catch per unit effort, which is a concern. In 1995, there seems to have been a significant reduction in landings, but since these are partial results, it is too early to draw any conclusions. Information acquired from fishers and observers of the commercial fishing show that in 1995 natural mortality was high for a second consecutive year, generally representing over 20 % of catches.

Prospects

The high natural mortality affecting the scallop stocks east of Natashquan is a concern. The intensive harvesting of these populations is amplifying the harmful impact of this natural mortality. Survival of the scallop fishery in this sector seems precarious. **The only apparent method of correcting this situation is to suspend fishing for a few years.**

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