

## Scallops in Quebec inshore waters

### Background

*There are two species of scallop in the Gulf of St. Lawrence, the sea scallop and the Iceland scallop. Sea scallops reach commercial size at age 5, Iceland scallops at age 8. The sexes are separate, and fertilization takes place externally. The spawning season 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 known as "beds".*

*In Quebec, commercial harvesting began in the mid 1960s. This is an inshore fishery, taking both species without distinction. Catches are still landed mostly as meat (muscle), but the proportion landed in the shell is growing steadily. The Quebec inshore waters is divided into 16 areas (management units) and has 82 fishing licences. All of these areas are managed by controlling fishing effort, but most of the areas off the North Shore and Anticosti Island are also governed by quotas. Since 1980, the North Shore has been the most productive scallop region in Quebec.*

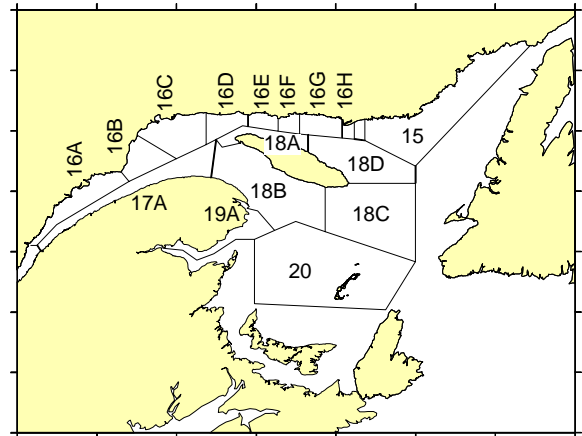


Figure 1. Scallop management units in Quebec.

### Summary

#### All areas

- Scallops spawn in late summer, and the juveniles settle on the seabed in the fall. During the settling period, the young are very sensitive to any disturbance of the sediment by fishing gear. The yield of meat weight varies with the reproductive cycle and is lowest at spawning time. It is therefore recommended that scallops not be taken during the spawning season or while the young are settling (August through November).
- The commercial scallop fishery in Quebec harvests two species, the sea scallop and the Iceland scallop. Landings are generally in the form of meat, but occasionally in the form of meat and roe (gonadal tissue). Over the past few years, landings in the shell (whole, live scallops) have assumed growing importance. The use of a single, constant factor to convert whole-shell landings into meat weight underestimates the catches by 15 to 20%.

### *Îles-de-la-Madeleine*

- In 1999, landings in the Îles-de-la-Madeleine totalled 31 t, 27% lower than the 1998 figure and 32% lower than the average annual total for 1990 to 1999. The value of the 1999 catch was only 8% that of the highest recorded catch, which took place in 1969.
- Fishing effort was 29% lower in 1999 than in 1998, but still 5% higher than the average for the past decade.
- The 1999 yields were 37% less than the average for the years 1990 to 1999.
- In 1999, the abundance of scallops larger than 70 mm (estimated after landing) was 40% lower than in 1998 and the lowest it had been since 1987. Despite this low abundance of spawners, the number of spats estimated from collector samples was 10% greater than the average for the past ten years.
- There was an increase in the number of prerecruits (< 70 mm) in the 1999 survey, compared with 1998. These prerecruits represent the 1995 and 1996 cohorts, which are concentrated mainly in the Étang-du-Nord fishing grounds and will not reach commercial size until 2000 and 2001, respectively. The yield of these cohorts could be increased through the imposition of a minimum catch size and/or the closing of part of the fishing grounds for 2 to 3 years.
- Since 1990, the exploitation rate index has ranged from 13 to 29%, and the stock has continued to decline. Under current circumstances, the sea scallop fishery around the Îles-de-la-Madeleine is threatening the conservation of this resource.

### *Gaspé Peninsula*

- The sharp increase in landings of Iceland scallops in area 17A in 1999 was due to harvesting in the new Rouge Island bed

in the western part of this area. Yields from this bed are high, but the scallops are small. In 1999, the exploitation rate index for this bed was 15%, which is too high for the Iceland scallop. In the eastern part of this same area, fishing effort was 46% lower than in 1998, and the yields remained stable.

- The fluctuations in landings and yields in areas 18B and 18C are typical of areas that are still in the development stage. The status of the resource in areas 18B and 18C is not a concern, given the limited fishing effort.
- In 1999, fishers in area 19A concentrated on Iceland scallops, because of the low abundance of sea scallops in their traditional fishing grounds. Little is known about the number and size of the Iceland scallop beds, but they are unlikely to be able to support current harvesting levels for any extended time.

### *North Shore*

- The Rouge Island bed extends into area 16A, and the outlook is therefore the same as just described for area 17A.
- The status of the resource in areas 16B and 16C seems stable, but we have little information to confirm this.
- Since the early 1990s, the abundance of the Iceland scallop in area 16E has decreased, and the quotas have been revised downward. The status of the resource stabilized in 1998 and 1999, but still requires close monitoring.
- In area 16F, yields have decreased by about 21% since 1994, and the average size of the scallops landed has been decreasing since 1995. We did not obtain enough information in 1999 to confirm the trends observed since 1994. But as a precaution, it is recommended that the allowable catch be reduced substantially for the 2000 season.

- The average size of the Iceland scallops in area 16G is small, so there is little interest in harvesting them. Fishing effort has therefore been decreasing for the past few years, despite the high densities of the scallops in these beds.
- In 1999, quotas and landings in area 18A were up by 10%. Yields and size structures have been relatively stable since 1996. The exploitation rate index was only 3%, but this low rate does not seem to have had any negative impact on the resource.
- The status of the resource in areas 16H and 15 appears stable, but is hard to interpret, because so few data are available.

### ***Biological context***

There are two indigenous species of scallops 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, generally at depths of 20 to 60 metres. The Iceland scallop is found along the north shore of the Gulf, around Anticosti Island, and off the north coast of the Gaspé peninsula, but is virtually absent from the southern part of the Gulf. In contrast, the sea scallop is found primarily in the southern Gulf, including the Îles-de-la-Madeleine and Chaleur Bay, and occasionally along the Lower North Shore. The scallops are sedentary and live in aggregations known as “beds”. This aspect of their biology should be considered when conservation strategies and harvesting scenarios are being developed.

Sea scallops grow in length more rapidly than Iceland scallops. Their growth rate varies from one area to another and is influenced by habitat quality and environmental conditions. In the Gulf of St. Lawrence, sea scallops reach commercial

size at about age 5, Iceland scallops at about age 8.

In scallops, the sexes are separate and eggs are fertilized externally. The spawning period is short and does not occur at the same time throughout the Gulf. Along the North Shore and around Anticosti Island, spawning occurs between mid-July and late August, depending on the area. Sea scallops spawn in August in Chaleur Bay and in late August around the Îles-de-la-Madeleine.

Larval development takes about 5 weeks, from fertilization until settlement on the bottom. During this time, the larvae are dispersed throughout the water column. The juvenile scallops generally attach themselves to the seabed in proximity to the adults. The scallop beds are generally found in areas where currents cause the larvae to be retained, but a good substrate is needed to ensure successful attachment. During the settlement period, the juveniles are very sensitive to disturbance of the sediment by fishing gear, so it is recommended that scallops not be harvested during the spawning season or while the young are settling (August through November).

The meat weight yielded by a scallop of a given size varies over the reproductive cycle. Meat weight peaks in spring (before the spawning season begins), drops to its lowest point during the summer spawning season, and starts increasing again in the fall.

### ***The fishery***

The commercial scallop fishery in Quebec targets Iceland scallops and sea scallops indiscriminately. Catches are generally landed as meat (muscle), but occasionally as meat and roe (muscle and gonadal tissue). Over the past few years, the proportion of landings in the shell (whole, live scallops) has also been growing. The impossibility of

visually distinguishing the muscle of the two species complicates analysis of fishing statistics. However, the two species are not distributed uniformly in the Gulf of St. Lawrence, and catches in any one sector usually consist of just one species.

As just stated, scallops are landed in various forms: meat, meat and roe, or whole in the shell. Hence a conversion factor must be used to express all landings in terms of meat weight, so that statistics can be standardized and quotas can be monitored. However, the use of a single, constant conversion factor generally underestimates the total Iceland scallop catch by 15 to 20% and results in the allowable catches' being exceeded.

In 1999, Quebec inshore waters were divided into 16 fishing areas grouped into three sectors: the Îles-de-la-Madeleine (area 20), the Gaspé Peninsula (areas 17A, 18B, 18C, and 19A), and the North Shore (areas 16A, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 15, 18A, and 18D) (Figure 1). areas 16D and 18D have still been fished very little, if at all. In 1999, a total of 82 regular licences were issued. A separate management plan was established for each area, based on the following factors: vessel length, drag size, fishing season and hours, and individual and overall quotas.

In the Gulf of St. Lawrence, the scallop fishery is an inshore fishery. The Digby-type drag is widely used. 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 sector have fluctuated widely since the commercial fishery began (Figure 2). The sea scallop stocks in this sector collapsed in 1971. Landings in the North Shore sector 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.

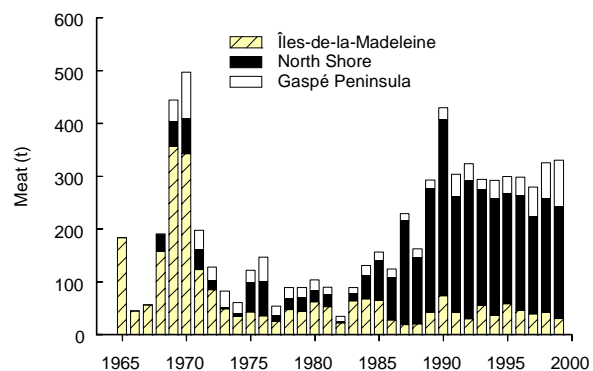


Figure 2. Scallop landings in Quebec.

In 1999, scallop landings in Quebec totalled close to 328 t of meat, coming, in descending order, from the North Shore (65%), the Gaspé Peninsula (26%), and the Îles-de-la-Madeleine (9%). Assessment of the status of scallop populations is based essentially on analysis of commercial indices. In areas 20 and 16E, it is also based on indices measured in research surveys. In 1999, an exploratory survey was also conducted in area 18A in co-operation with the fishers themselves.

Sometimes, the assessment of the status of populations of certain areas depends entirely on data supplied by the fishing industry (from logbooks and purchase receipts). Comparison of these data with those from the sampling program conducted at sea sometimes raises doubts about the reliability of the indexes based on logbooks. Given the relative inaccuracy of the logs, the value of advice based solely on their data might be questionable.

The following sections present more detailed information on the scallops taken in the Îles-de-la-Madeleine, Gaspé Peninsula, and North Shore sectors. Since it is not yet possible to provide advice for each of the small beds scattered along the Quebec coast,

this review of the stocks is organized according to management units.

**Îles-de-la-Madeleine (area 20)**

The Îles-de-la-Madeleine sector comprises several scallop concentrations, namely the fishing grounds of Étang-du-Nord (Pointe du Ouest), Dix-Milles, Chaîne-de-la-Passe, Sud-Ouest, Île Brion and Banc de l'Est (Figure 3). In 1999, 23 licences were issued. The fishery was open from April 1 to August 7 in sub-areas 20A et 20B and from April 1 to October 31 throughout the rest of this sector, except for sub-area 20E, which was closed to fishing for the entire year.

Scallop catches in the Îles-de-la-Madeleine generally consist over 95% of sea scallops, with the balance being Iceland scallops. In 1999, landings totalled 31 t, which was 27% lower than in 1998 and 32% lower than the average for the past ten years (Figure 4). Fishing effort was down 29% from 1998, but still 5% higher than the average for the past ten years.

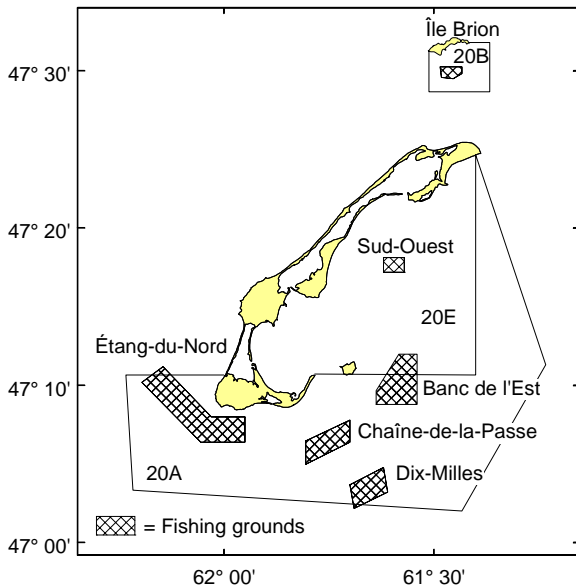


Figure 3. Sub-areas and principal scallop fishing grounds in the Îles-de-la-Madeleine sector.

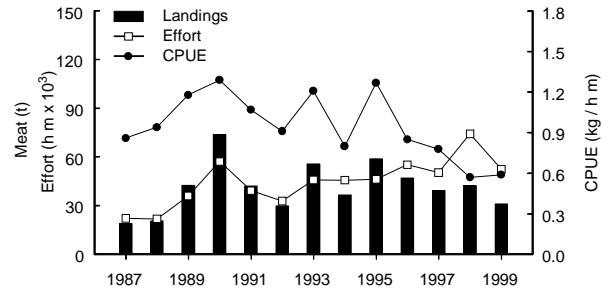


Figure 4. Scallop landings, fishing effort (by fishing hour and metre of drag width), and catch per unit effort for the Îles-de-la-Madeleine sector.

Since the late 1980s, catch per unit effort in this sector has experienced ups and downs. Peak effort has generally been proportional to the size of the cohorts being recruited into the fishery. The last large cohorts those born in 1984, 1988, and 1989 were recruited into the fishery in 1990, 1993, and 1994. But starting in 1994, certain parts of the Chaîne-de-la-Passe bed were closed to fishing to increase and optimize the yield from the 1989 cohort. These closed sites were finally fished in 1995 and 1996. From 1995 to 1997, yields fell because of low recruitment. Yields stabilized at about 0.59 kg/h m in 1998 and 1999. For the past two years, yields have fallen to all-time lows.

The abundance of prerecruits (scallops smaller than 70 mm) measured in the research surveys peaked in 1992, because of the presence of the 1988 and 1989 cohorts. It then fell gradually until 1996 (Figures 5 and 6). Since 1997, the prerecruit abundance index has increased with the emergence of the 1995 and 1996 cohorts, which are concentrated chiefly in the Étang-du-Nord bed. Though these cohorts are abundant, they are still much smaller than those of 1984, 1988, and 1989.

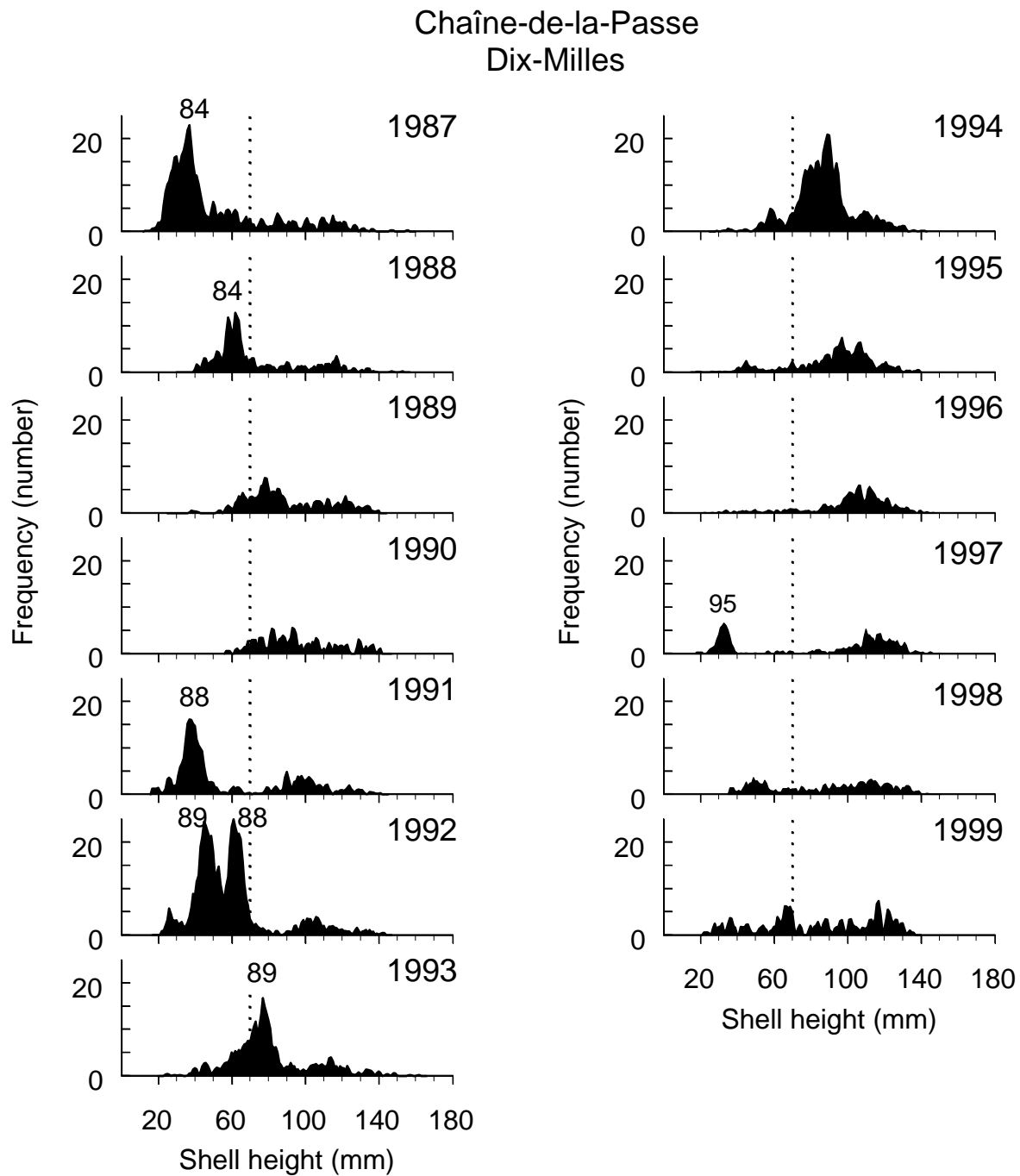


Figure 5. Size structures of sea scallops sampled in research surveys in the Îles-de-la-Madeleine sector. The number shown above certain modes represents the year of birth of these dominant cohorts. The dotted line separates the prerecruits (< 70 mm) from the recruits ( $\geq 70$  mm).

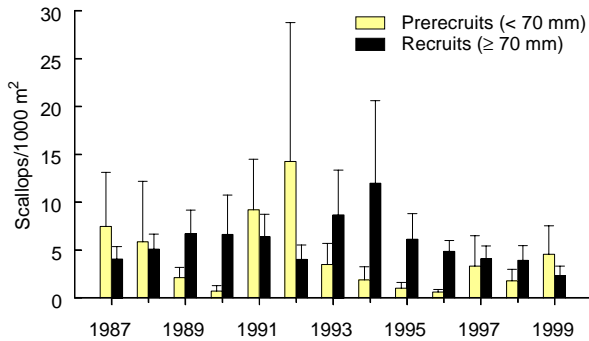


Figure 6. Density ( $\pm 2$  standard error) of sea scallops sampled in research surveys in the Îles-de-la-Madeleine sector.

The variations in the abundance index of recruits (scallop  $\geq 70$  mm) are similar to those for prerecruits, but with a two-year lag, corresponding to the time needed for prerecruits to reach recruitment size. In 1999, the abundance of recruits estimated after fishing was 40% lower than in 1998 and the lowest it had been since 1987.

For the past several years, an abundance index for 5-year-old recruits has been estimated from the corresponding index for 2-year-old prerecruits (Figure 7). This index can be used to project abundance of recruits to the fishery three years hence. This index, which has proven reliable so far, indicates that recruitment will be slightly higher in 2000, when the 1995 cohort enters the fishery.

One of the major concerns in recent years has been the stock's ability to renew itself. It is even reasonable to suppose that if the gradual decrease in the abundance of spawners continues, it will have an impact on reproductive success. In 1998, intensive fishing of large spawners on the Banc de l'Est and low collection rates for spats raised a great deal of concern. However, in 1999, the number of spats determined from collector samples was 10% greater than the average for the past ten years, despite the

very low abundance of spawners on the sea bed.

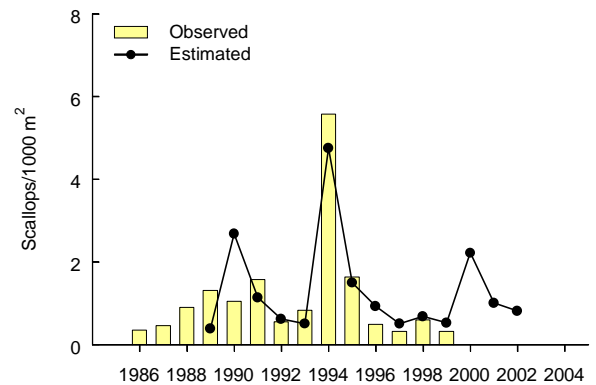


Figure 7. Density of 5-year-old recruits, values measured in research surveys and values projected from numbers of 2 year-old prerecruits observed in research surveys 3 years earlier.

## Outlook

Abundance of the scallop stocks in the traditional Îles-de-la-Madeleine fishing beds was again very low in 1999. Our research surveys showed that the harvestable biomass was at its lowest since 1987 and only 8% of its peak, which occurred in 1969. Fishing effort was 29% lower in 1999 than in 1998, but still 5% higher than the average for the past ten years. Commercial yields have been declining since 1995, and they reached their lowest levels in history in 1998 and 1999. Since 1990, the exploitation rate index has ranged from 13 to 29%, and the decline in the stock has continued. The fleet's fishing effort is far too high for the productivity of the beds. In order to apply the same management strategy as in the Middle North Shore, fishing effort would have to be reduced to 1/5 its current level.

Recruitment is still low. The presence of two cohorts of prerecruits in 1999 (born in 1995 and 1996) makes it possible to consider some recruitment to the fishery in 2000 and 2001, respectively. But a minimum catch size should be imposed and/or a part of the



Étang-du-Nord bed should be closed for two to three years to increase the yield from these cohorts.

Under current circumstances, harvesting of the sea scallop in the Îles-de-la-Madeleine sector threatens the conservation of this resource. Any commercial fishing will only worsen the decline of the spawning biomass to new historic lows.

### ***Gaspé (areas 17A, 18B, and 19A)***

The Gaspé sector contains three management units, areas 17A, 18B and 19A. For the past two years, scallop fishers from area 18B have had access to area 18C. In 1999, there was a single fishing licence in area 17A, two in area 18B, and six in area 19A. There was a fishing season in each of these areas, and for area 18B, an overall quota was imposed.

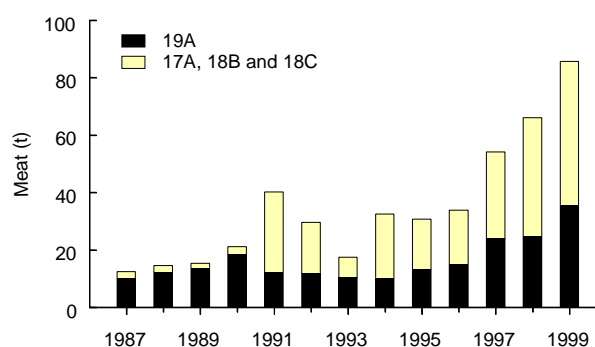
Landings from the Gaspé sector come chiefly from the waters of Chaleur Bay (area 19A) and Anticosti Island (areas 18B and 18C) (Figure 8). Until very recently, the Chaleur Bay scallop fishery targeted mainly sea scallops, but in 1999, over 80% of the landings consisted of Iceland scallops. Around Anticosti Island and along the north shore of the Gaspé, the Iceland scallop is harvested. Landings from the Gaspé sector have been growing steadily, by over 400% from 1993 to 1999.

In 1999, a new bed, the Rouge Island, was harvested. This bed is located at the western boundary of area 17A and extends into area 16A. The 500% increase in scallop landings in area 17A is due to the exploitation of this bed. Catch per unit effort is very high here indeed, the highest anywhere in Quebec, at 7.63 kg/h m. However, the scallops taken are small, with a modal size of about 80 mm. In the eastern part of this area, fishing effort was 38% lower in 1999 than in

1998, and yields were relatively stable (Table 1).

*Table 1. Catch per unit effort (kg of meat per fishing hour and metre of drag width) estimated from logbooks.*

Année	17A		18B	18C	19A	
	East	West			Sea	Iceland
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	1.27		1.19		0.71	
1997	1.03		1.32		1.00	
1998	0.95		2.79	3.35	0.72	8.88
1999	1.44	7.63	4.12	4.03	0.71	3.35



*Figure 8. Scallop landings for the Gaspé sector.*

For some years now, the areas south of Anticosti Island (areas 18B and 18C) have contributed substantially to the Gaspé catch. Harvesting has begun only recently in these areas, and the fishery is still being developed. From 1995 to 1998, landings and yields from area 18B increased gradually (Figure 8 and Table 1). In 1999, landings and fishing effort were down 18% and 41%, respectively, from 1998. However, yields were 37% higher than in 1998. The size structure and mortality index (% of clackers) have remained relatively stable since 1996.

Landings from area 19A have been increasing steadily since 1994 (Figure 8). In 1999, they totalled close to 36 t. The growth in landings since 1998 is due to redirection



of the fishing effort toward the Iceland scallop. Overall, however, fishing effort has remained stable since 1995. Since 1994, with the exception of 1997, sea scallop yields in area 19A have been stable but low,

at about 0.7 kg/h m (Table 1). In 1999, the Iceland scallop catch per unit effort was higher 3.4 kg/h m but down 62% from 1998.

The average size of sea scallops taken has been increasing since 1996. The

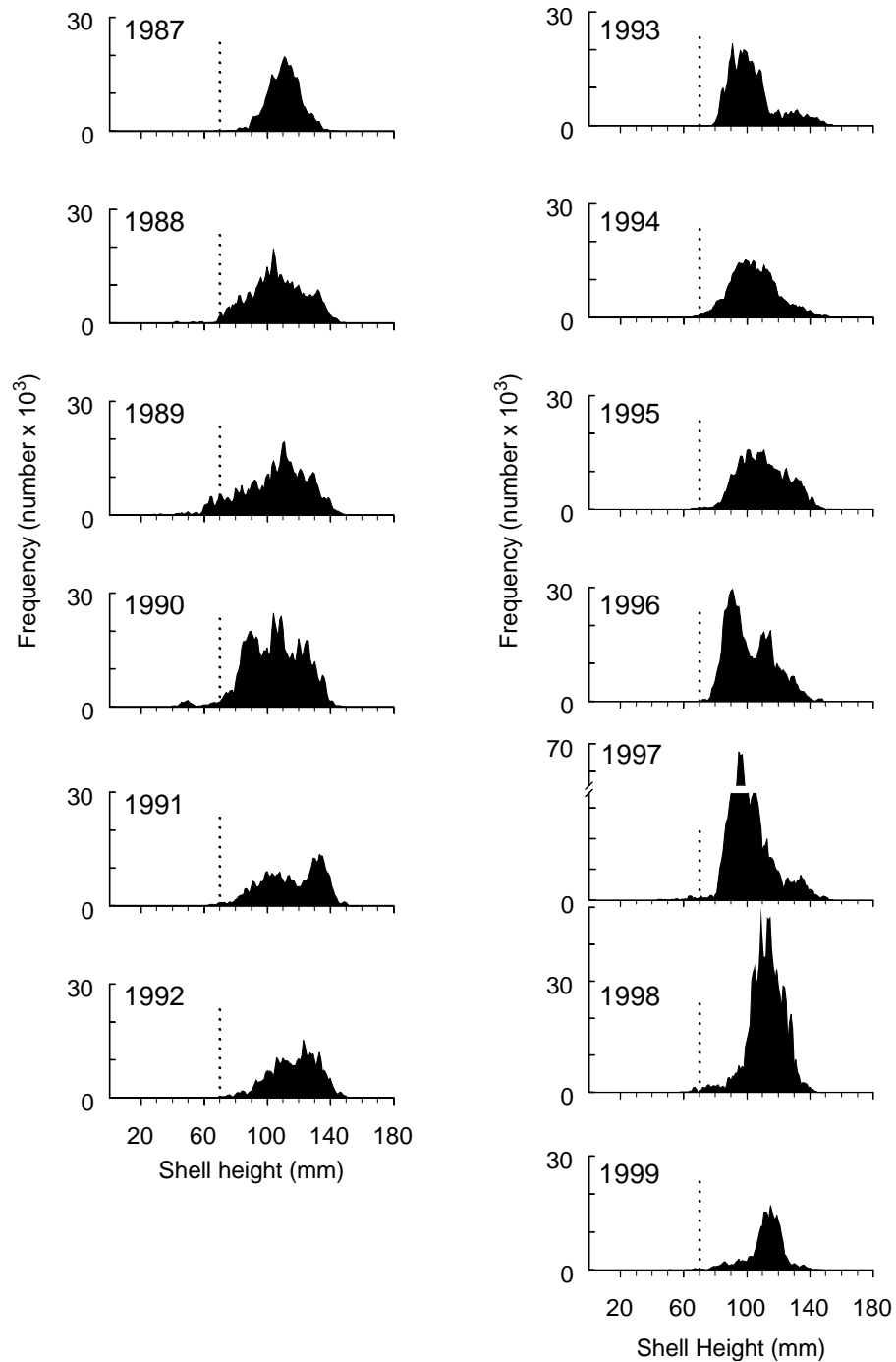


Figure 9. Size structure of sea scallops from area 19A, based on commercial sampling. The dotted line separates the prerecruits (< 70 mm) from the recruits (≥ 70 mm).

prerecruitment index, measured from commercial samples (scallops < 70 mm) is low, and the mortality index is stable (Figure 9).

### Outlook

The reason that total scallop landings have grown so steadily in the Gaspé sector since 1993 is the development of an Iceland scallop fishery along the south coast of Anticosti Island and, more recently, in Chaleur Bay and the Rouge Island bed in the St. Lawrence estuary.

The sharp increase in landings in area 17A in 1999 suggests that it may have good potential. But the 15% exploitation rate index for the Rouge Island bed (in the western part of area 17A) is too high for the Iceland scallop. The same index calculated for certain beds along the Middle North Shore suggests that a harvesting rate of about 5% could prevent this resource from being overfished.

Overall, landings and yields in areas 18B and 18C, a region now being developed, have been on the rise since 1995. The status of the resource in these areas is not a concern, given the low fishing effort.

Landings in area 19A have been increasing since 1994, with the variations being attributable largely to changes in fishing patterns. In 1998 and 1999, fishers in Chaleur Bay focussed their efforts on the Iceland scallop, because of the scarcity of sea scallops in their traditional fishing grounds. Little information exists about the number and size of the Iceland scallop beds in this area, but it seems unlikely that they could support current harvesting levels for very long.

### North Shore

The North Shore sector is divided into 11 different fishing areas, located between

the mouth of the Saguenay River and Blanc-Sablon. Landings for the North Shore sector totalled about 214 t of meat in 1999, 66% of which came from the Middle North Shore.

### Areas 16A, 16B and 16C

Landings in these areas, which roughly constitute the Upper North Shore, totalled about 54.9 t in 1999 and consisted entirely of Iceland scallops (Figure 10). These areas are harvested by only five fishers. Fishing effort is low and is controlled by the number of licences issued. Also, since 1997, a competitive quota has been in place for area 16C.

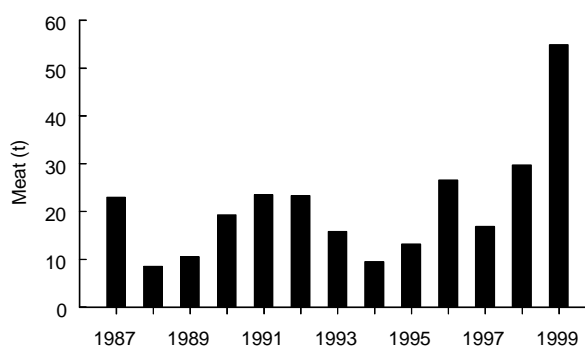


Figure 10. Scallop landings from areas 16A, 16B and 16C.

Landings in area 16A have increased steadily since 1997, due to harvesting activity in the Rouge Island bed. This bed is located at the southwestern boundary of this fishing area and also extends into area 17A West. As Table 2 shows, the catch per unit effort is very high in this area too, similar to that in area 17A.

Since 1995, there have been few official landings in area 16B. Yields in 1999 fell by 23% compared with 1998 (Table 2).

In area 16C, the growth in landings between 1995 and 1997 is attributable to the harvesting of new beds and the sale of whole scallops in the shell (Figure 10). The reason that landings levelled off in 1997 and 1998 was that an overall quota was put in place.

In 1999, landings and effort dropped by 70% and 43%, respectively, compared with 1998. Yields also fell in 1999, to 4.6 kg/h m (Table 2), which was 49% lower than the 1998 figure and 9% lower than the average for the past ten years. The size structures of commercial samples show a predominance of small scallops, most measuring less than 80 mm.

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

Year	16A	16B	16C
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		1.00	7.86
1997	3.11		5.28
1998	5.92	1.84	8.99
1999	7.01	1.41	4.58

### **Outlook**

The very large increase in landings and the very high exploitation rate index (15%) in the Rouge Island bed and in area 16A in 1999 raise concerns for the conservation of this resource. The same index estimated for certain beds in the Middle North Shore suggests that a harvesting rate of about 5% could prevent overfishing of the Iceland scallop. The status of the resource in areas 16B and 16C seems stable, but we have little information to confirm this trend.

### **Areas 16D, 16E, 16F, 16G and 18A**

Seven scallop fishers have access to area 16E, nine to areas 16F and 18A, and four to area 16G, while all of the Middle North Shore's scallop fishers have access to area 16D. Each of these areas is subject to a quota, and fishing effort in these areas is controlled on both a daily and a seasonal

basis. Landings of Iceland scallops in the fishing areas along the Middle North Shore have increased sharply since the early 1980s. This is the most productive scallop region in Quebec, at the same time as being the most strictly managed.

Fishing effort has declined substantially in these areas since 1990. The reasons include the imposition of individual quotas in 1991, the shortening of the fishing season in all these areas, and the subdivision of these areas. The adjustment of quotas, upward or downward depending on the area, has also affected the degree of effort.

The meat weight of scallops landed in these areas reached an all-time high of nearly 300 t in 1990 (Figure 11). In 1991, landings fell off sharply, especially in areas 16E and 16F. Since then, landings have followed the upward and downward fluctuations in quotas, except in area 16G, where landings have been more variable. In 1999, landings in this sector totalled nearly 142 t of meat, with the largest landings coming from areas 16E and 18A.

Since 1996, landings and yields in area 16D have been low, because of the weak, sporadic fishing effort in this area (Figure 11). In area 16E, the quota of 57.2 t of meat was met in 1998 and 1999. This quota was lower than the 1997 quota, however, having been reduced in response to the sharp drop in yields between 1993 and 1998. In 1999, the catch per unit effort stabilized at about 8.7 kg/h m (Table 3). The average size of the scallops landed in 1999 was slightly smaller than in preceding years, probably because of the recruitment of a new cohort into the fishery.

In area 16F, landings (and quotas) have been stable since 1996; they totalled 30.5 t of meat in 1999 (Figure 11). However, fishing effort was 36.5% greater in 1999 than 1998. Catch per unit effort has been declining since 1997 (Table 3). The average size of

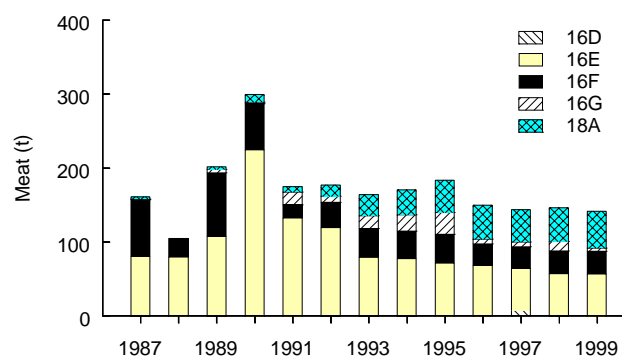
scallops landed also fell between 1995 and 1998. However, not enough information is available for 1999 to confirm whether these trends have continued.

*Table 3. Catch per unit effort (kg of meat per fishing hour and metre of drag width) estimated from commercial samples.*

Year	16E	16F	16G	18A
1991	15.18	16.94	8.21	14.23
1992	21.92	14.97	6.33	
1993	17.81	14.78	8.55	10.09
1994	16.49	9.62	9.48	9.81
1995	13.26	9.11	5.95	10.37
1996	13.34	8.55	4.41	8.39
1997	12.51	9.96	2.52	7.08
1998	8.52	7.43	5.53	7.76
1999	8.72		1.70	8.11

In area 16G, landings, effort, and yield have been somewhat variable (Figure 11 and Table 3). In 1999, landings totalled 4.1 t of meat, and yields averaged 1.7 kg/h m. The average size of the Iceland scallops in this area is very small (75 mm), which explains the lack of interest in harvesting them.

In area 18A, landings have been on the rise since 1997. They reached 50.1 t of meat in 1999 an increase of nearly 10% over 1998. This increase was due to an increase in quotas. The yield figures for 1998 and 1999 were similar, approximately 8.1 kg/h m. But this figure is 14% lower than the average for the past ten years. The size structure of scallop landings in this area has remained stable since 1996. In 1999, an exploratory survey was conducted in co-operation with the fishers. The results of this survey were used to determine the boundaries of the beds, to estimate the abundance of the scallops, and to calculate an exploitation rate index, on the order of 3%.



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

### Outlook

Currently, it is impossible to determine the exact status of the fishery in each of the management units, especially since areas 16D and 16G are still relatively unexplored. The reduced fishing effort since the adoption of individual quotas in 1991, and the establishment of a greater number of fishing areas, have made it possible to spread the harvesting effort out over a larger territory.

Since the early 1990s, the abundance of the Iceland scallop in area 16E has diminished, and quotas have been revised downward. The status of the resource stabilized in 1998 and 1999, but the situation still requires close monitoring.

In area 16F, yields have decreased by about 21% since 1994. The average size of the scallops taken has also decreased since 1995. There is not enough information for 1999 to confirm these trends. But as a precaution, it is recommended that the size of the catch be reduced substantially for the 2000 season.

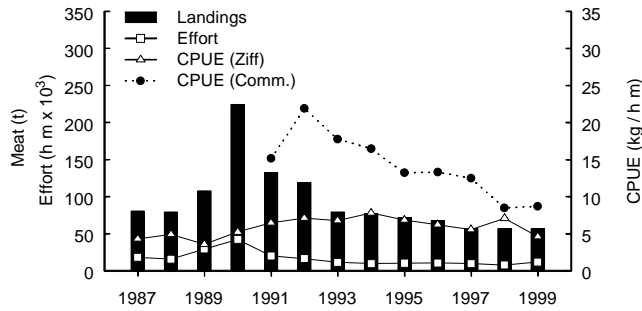


Figure 12. Scallop landings, fishing effort (by fishing hour and metre of drag width), and catch per unit effort calculated from logbooks (Ziff) and commercial samples (Comm.) in area 16E.

The average size of the Iceland scallops in area 16G is small, which is why the fishers have little interest in harvesting them. This explains why the fishing effort in this area has been declining for some years, despite the high densities of scallops in these beds.

In area 18A, quotas and landings increased by 10% in 1999. Yields and size structure have remained relatively stable since 1996. The exploitation rate index is 3%, and this low level of harvesting does not seem to be having a negative impact on the resource.

**Areas 16H, 16I and 15**

In 1999, there were three licences to take scallops in area 16H, and 34 licences that allowed access to area 15. Area 16I was included in area 15 in 1999. Prior to 1992, most of the scallops landed on the Lower North Shore were sea scallops (Figure 13). Over the years 1992 to 1998, landings of Iceland scallops from area 16H and the western and eastern ends of area 15 took on growing importance.

In 1999, no scallops were landed in area 16H. The reason for the sharp drop in landings in this area since 1993 (Table 4) is not that the yields were static, but rather that the fishers were less interested, because of the small size of these scallops. In area 15, landings rose from 8.7 t in 1995 to 36.9 t in 1998. The preliminary figure for 1999

landings is 17.4 t of meat, a 53% decrease from 1998. This decline in landings is due to decreased effort, because the yields have been fairly stable.

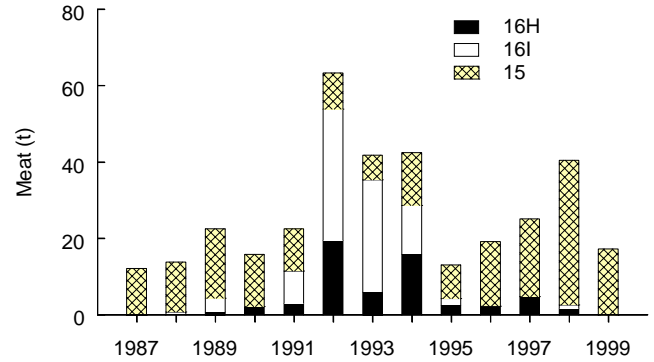


Figure 13. Scallop landings in areas 16H, 16I and 15.

Table 4. Catch per unit effort (kg of meat per fishing hour and metre of drag width) estimated from logbooks.

Year	16H	16I	15
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	2.27		1.09
1997	2.64		1.42
1998	2.66	1.94	2.15
1999			2.28*

\* area 16I was included in area 15 in 1999

**Outlook**

In area 16H, landings of Iceland scallops and fishing effort have been negligible since 1995 and fell to zero in 1999. Landings of Iceland scallops in area 15 also declined in 1999. However, yields remained stable in both of these areas. The situation in areas 16H and 15 is hard to interpret, because of the scant information available.

The state of our knowledge of the sea scallop of the Lower North Shore precludes

any assessment of the status of this resource. The biological characteristics of this species, its contiguous distribution, and the mass mortalities seen at some fishing locations in the past make it highly vulnerable to overfishing. For the time being, it would be inappropriate to step up the fishing effort directed at sea scallops in area 15.

### ***Conservation measures***

The conservation measures recommended for scallop are intended to protect the sustainability of each bed. Any approach designed to boost spawning potential, whether by leaving more adults on the bottom or by creating refuges, would have a positive impact on conservation of the resource. Moreover, because the number of eggs that a female scallop produces is proportionate to its size, allowing the population to age would result in a net gain in productivity, with the side benefit of increasing the yield per recruit, and hence commercial profitability.

Scallops spawn in late summer, and the juveniles settle to the bottom in the fall. Dragging the beds with fishing gear at this time of year reduces spawning potential and stirs up sediment, which disrupts the settlement of the juveniles. A halt in fishing during the spawning and settling seasons (August through November) would limit dragging damage to the substrate and favour survival of the young scallops.

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