

Green sea urchin of the inshore waters of Quebec

Background

The green sea urchin (*Strongylocentrotus droebachiensis*), which belongs to the branch of Echinoderms that also includes sea stars and sea cucumbers, has a circumpolar distribution. On the east coast of North America, this species ranges from the southern Arctic to New Jersey. In surveys in the Estuary and Gulf of St Lawrence, green sea urchins have been found at all depths down to more than 200 metres. Sea urchins are particularly abundant between 0 and 10 metres and generally occupy hard or rocky substrates where the salinity is greater than 15‰. Although their preferred food resource is algae, sea urchins can be omnivorous. They are especially fond of kelp and may sometimes wipe out an entire kelp forest through their intensive grazing.

Green sea urchins are harvested for their gonads, which are considered a delicacy. The fishing season is tied to the species' annual reproductive cycle, during which the commercial quality of the gonads varies considerably. In Quebec, the fishery takes place mainly in the early spring and during the fall.

The green sea urchin fishery began in 1994 and developed slowly with modest but irregular landings. Management measures, instituted in 1996, consist mainly of imposing a minimum legal size of 50 mm, prohibiting the use of towed gear types and limiting the number of licences per fishing area. The authorized fishing methods are hand-gathering by divers and the use of traps.

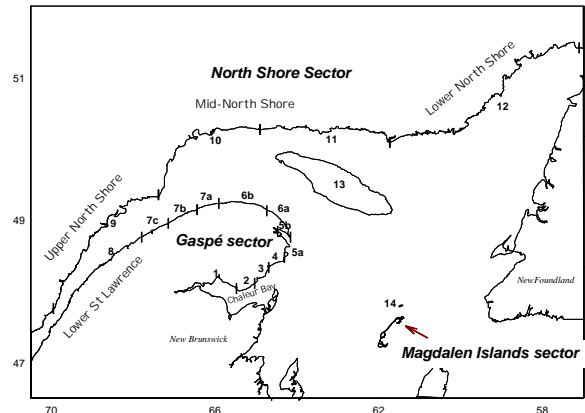


Figure 1. Green sea urchin management areas in the Estuary and Gulf of St Lawrence

Overview

- In Quebec, the green sea urchin fishery is recent. This is considered to be an « emerging species », meaning that it is currently not harvested very much but has considerable commercial potential. In 1999, the fishery was still exploratory and no permanent licences existed.
- Harvesting of this species in Quebec is getting off to a slow start. Since 1994, landings have been modest but irregular. The largest landing was recorded in 1997 at 159 tonnes.
- In 1998 and 1999, the landings totalled 10 and 18.6 tonnes. There has been a drop in landings, which is believed to be associated with a decrease in fishing effort, not a decline in the resource. The lack of market outlets and the difficult fishing conditions for divers have been put forward as an explanation for the reduced level of effort.
- At present, the lack of specific biological information on sea urchins, i.e., the abundance and resilience of their populations, is an impediment to the issuance of scientific advice on the stock

status and on the harvesting potential of this species.

- The conservation principles recommended for the green sea urchin in Quebec were the same in 1999 as in 1996, that is, minimum legal size of 50 mm, spatial distribution of fishing effort and prohibition on the use of towed gear types.

Biology

The sexes are separate in sea urchins and cannot be distinguished on the basis of external characteristics. Males and females are caught indiscriminately in this fishery. The species has five gonads, ranging in colour from yellow to dark orange-brown, which are located on the upper part of the internal cavity in the hard shell, or test. During the annual reproductive cycle, the gonads undergo major changes in volume and firmness. In the winter, under optimal conditions gonad weight may account for as much as 25% of the animal's total weight. The gonads become less firm prior to spawning in the spring. Gonad weight may drop below 10% of total weight during spawning and remain at that weight through the summer. The commercial value of sea urchins decreases during this time period. However, with the arrival of fall, gonad weight increases once again, restoring the species' appeal for commercial harvesting.

Spawning generally occurs in the spring and appears to coincide with the first spring blooms of phytoplankton (microscopic algae that drift with the currents). Male and female sea urchins release their spermatozooids and ova into the water column and fertilization takes place externally. In the Gulf of St Lawrence, spawning takes place around April and May, whereas in the Estuary the timing is later, between May and June. After the fertilized eggs hatch, the pelagic larvae drift for two to five months in the surface water and then settle to the bottom. At the

time of settlement, the juvenile sea urchins measure barely 0.5 mm.

Studies on the Atlantic Coast show that sexual maturity begins when the sea urchin reaches a diameter of about 18 to 25 mm, which may correspond to an age of 2 or 3 years. In the Estuary and Gulf of St Lawrence, the species reaches sexual maturity at a body weight of 10 g, which corresponds to a size of about 30 mm.

It is not known at present how many years it takes urchins to reach the minimum size limit of 50 mm in Quebec coastal waters. Growth rates in this species may vary depending on the quality and quantity of food available and environmental conditions. Sea urchins present on barren grounds or at great depths where food resources are limited appear to grow more slowly than those living on the edge of kelp forests (large brown algae) and those living in places where the currents bring a regular supply of drifting algae. Consequently, it would be erroneous to estimate a sea urchin's age on the basis of size alone. For example, the preliminary results from an examination of growth rings in urchins harvested in Chaleur Bay in 1999 indicate that sea urchins measuring between 47 and 73 mm in diameter were 4 to 23 years old.

Predation and disease are the other causes of death besides fishing mortality. Along the Quebec coastline, potential predators include lobster, rock crab, sea stars, wolffish, northern red anemone and seabirds. In Nova Scotia and New Brunswick, mass mortalities of green sea urchins extending over several kilometres of coastline have been reported occasionally over the past 20 years. These mortalities are believed to have been caused by a pathogen (an amoeba), which spreads in warmer water masses. Mass mortalities of this sort have never been reported in the cold waters of the Estuary and Gulf of St Lawrence.

Management

In 1999, there were 14 main fishing areas in the inshore waters of Quebec (Figure 1). The number of fishing licences is limited by fishing area. Most of the active licences in 1999 were of the exploratory type, and there were three experimental licences as well.

Two fishing methods are currently authorized in the Laurentian Region, hand-gathering by divers and the use of whelk traps. Harvesting by divers is generally allowed in all areas, except five exclusion sites in Area 9. Depending on the sector, the maximum number of divers allowed per boat is four to five. Traps are used primarily in Area 9; they are not very popular although their use is authorized east of Escoumins on the North Shore (areas 9 to 13) and on the south shore, from the Lower St Lawrence region to Cape Gaspé (areas 8 to 6a). The use of towed gear is prohibited in this fishery. However, the Quebec Department of Agriculture, Fisheries and Food (MAPAQ) has authorized the use of a small drag for harvesting urchins within the aquaculture sites scattered along the Lower St Lawrence coast between Trois-Pistoles and Rimouski.

The minimum size limit imposed on the fishery is 50 mm, which means that individuals smaller than this have to be thrown back. The legal size of 50 mm is applied all along the Atlantic Coast. This measure is designed to protect the species' reproductive potential, by allowing urchins that reach sexual maturity around 25-30 mm to participate in spawning before they are taken by the fishery.

No by-catches are allowed in the green sea urchin fishery.

Logbooks are compulsory in the North Shore and Magdalen Islands areas and must be turned in after every fishing trip. In the Gaspé area, logbooks have not been required

since 1997, despite the fact that landings have been concentrated there.

Description of the fishery

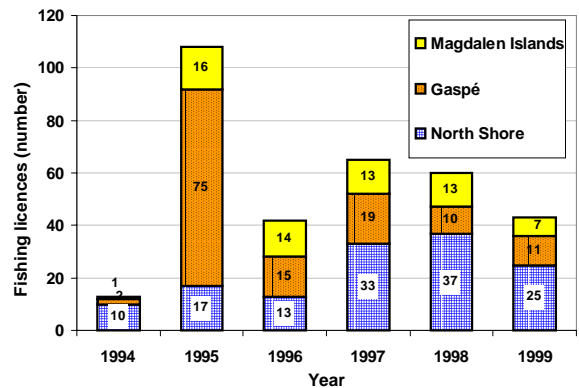


Figure 2. Change in the number of sea urchin fishing licences since 1994

In Quebec, applications for green sea urchin fishing rose considerably in 1995 from the 1994 level, indicating an interest in the development of this new fishery (Figure 2). However, only a small proportion of the licences in circulation has been used, and the fishery has not grown much. Since 1995, landings have been modest and their size has fluctuated. The largest catch, 159 t, was recorded in 1997. The subsequent landings, for 1998 and 1999, amounted to only 10 and 18.6 t (Figure 3). The recent declines in landings can be attributed to reduced fishing effort during both of these years, with the number of fishing days totalling only 22 and 20 in 1998 and 1999 (Figure 4). According to a survey of the industry, the factors inhibiting development of the fishery in Quebec at present are the absence of regular buyers, the difficult fishing conditions for divers and lack of knowledge of the resource.

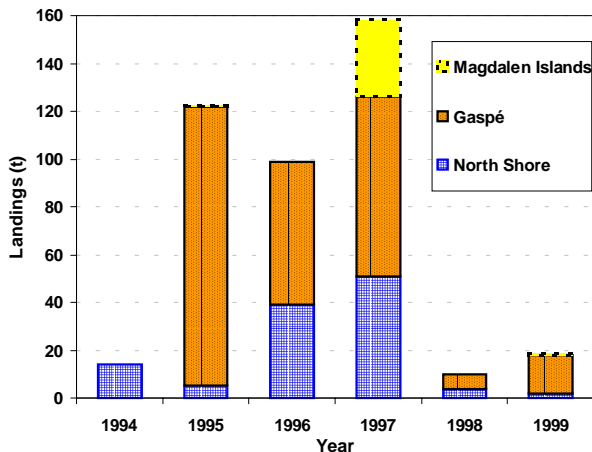


Figure 3. Quebec landings of green sea urchins since 1994

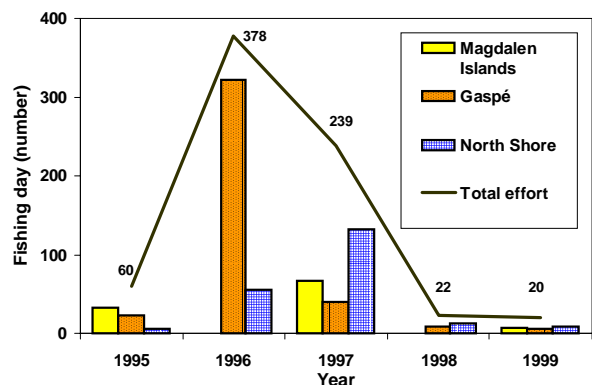


Figure 4. Change in nominal fishing effort in the three Quebec fishing areas since 1995.

The sea urchin fishing season is limited by biological and environmental factors. First, the season is closely tied to the annual reproductive cycle, during which commercial quality of the gonads (roe) varies greatly. The fishery begins in early spring, i.e. March or April, and generally stops when spawning begins in May, because roe quality no longer meets market requirements then. Fishing may resume again in the fall when the gonads undergo further development. During the winter, the harsh climatic conditions in Quebec and the ice cover that is present in coastal zones makes harvesting difficult, although this is a

time when the gonads are mature and of superior quality, market demand is greater and the prices are higher.

Resource status and outlook

Gaspé

The Gaspé fishers have participated in the fishery yearly and their reported landings have represented between 47 and 96% of annual Quebec landings (Figure 3). Since 1995, several methods or gear types have been used for exploratory and harvesting activities in this sector, including diving, traps and a small drag that the local people call a sea urchin sled.

The fishery is concentrated above all in the Lower St Lawrence region (Area 8). A few exploratory fishing activities were carried out around Chaleur Bay in 1995 (Figure 5) but the low and not very promising landings did not lead to sustained fishing. At a meeting of the advisory committee in 1998, the lobster fishers from Chaleur Bay voiced strong opposition to the development of a sea urchin fishery because they feared that increased activities in local waters would promote lobster poaching.

It is particularly difficult to monitor the sea urchin fishery in the Gaspé sector. It is practically impossible to provide advice on the resource that is underpinned by biological information. With the exception of the data obtained from commercial catch sampling, the conventional tools for deriving abundance indices, such as landings, logbooks and scientific surveys, are either incomplete or absent. According to the various information sources in the region, not all landings are reported and hence the total catch is underestimated. The catch may also be exported without being landed. If so, there would be no purchase slips from sales to processing plants and therefore no way of tallying these landings. Fishing effort in this

sector may thus be greatly underestimated. Furthermore, logbooks have not been filled out since 1997; hence no information is available on the location of fishing sites (Figure 5) or on the catch per unit effort. No scientific abundance survey is carried out either. In addition to this lack of information on harvesting and resource status,

aquaculture grow-out sites have been established for sea urchins but there is no mechanism for keeping track of transfers of sea urchins from fishing sites to these grow-out sites. The lack of information on such an active sector is worrisome because the monitoring is insufficient to prevent overharvesting.

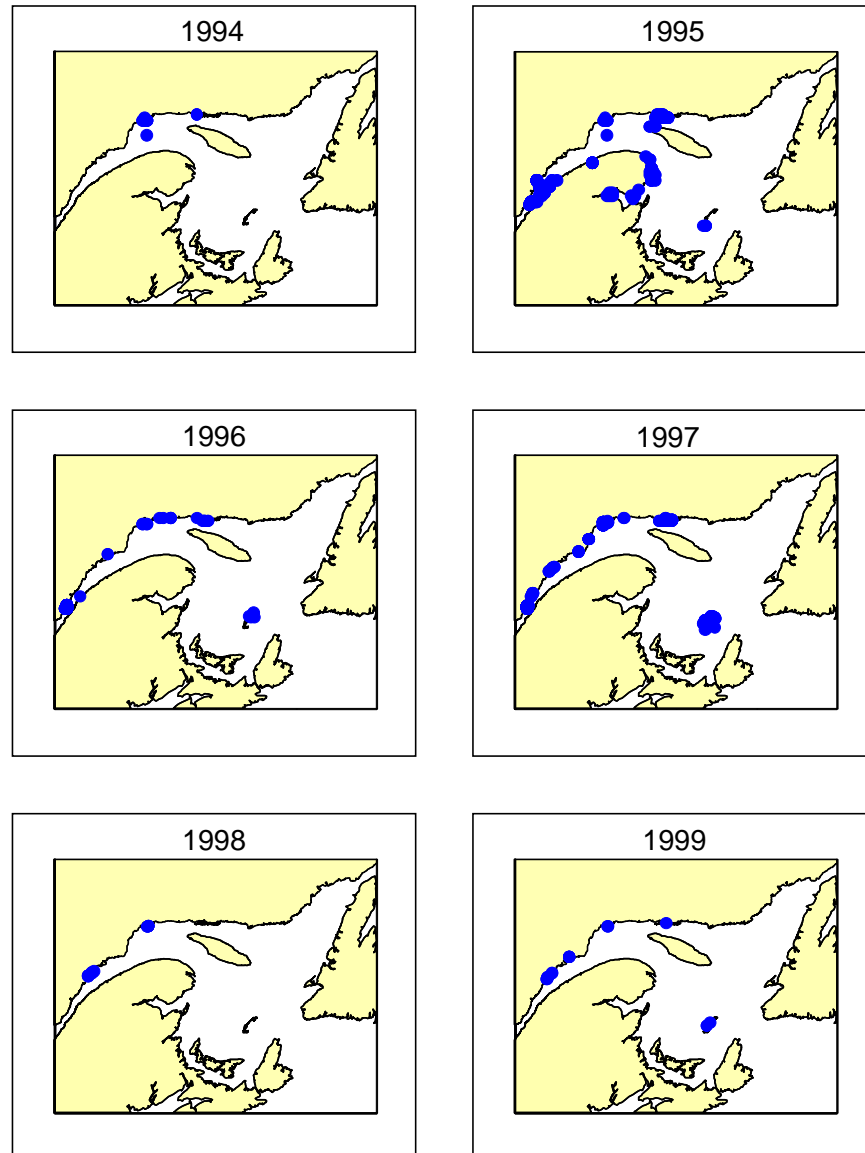


Figure 5. Location of exploratory sea urchin fishing sites from 1994 to 1999 based on available logbooks. The fishing sites on the Gaspé Peninsula and in the Lower North Shore region are not shown for the years 1997, 1998 and 1999 in areas where logbooks were not required.

In 1999, sampling was done in four different management units. Although the sampling methods used cannot be compared, the results shed light on the maximum size of the sea urchins found in each of those areas (Figure 6). The maximum size of commercially harvested sea urchins in Area 8 was greater than that of individuals caught elsewhere in Quebec in 1999; these urchins included some large individuals of up to 98 mm in diameter (Figure 6b). The sea urchins from Area 8 may have enjoyed environmental conditions in the Estuary that were favourable for their growth or they may have benefited from the absence of major predators such as lobster. Another possibility is that the fishery targeted previously unharvested (virgin) aggregations composed of older, larger individuals.

North Shore

From 1994 to 1999, the North Shore fishers participated in the green sea urchin fishery every year albeit sporadically (Figure 3). The tools necessary for monitoring fishing activities are adequate in this sector. Peak landings of 52 t were recorded in 1997, but the catch has been small since then. In 1999, only 1.7 t was landed in spite of the 25 licences in circulation. No fishing was carried out on the Lower North Shore (Area 12) owing to a lack of buyers. In the Mid-North Shore region (Area 11), a few dives were made in the spring, mainly in an effort to see what the market would be like. Thanks to the co-operation of a fisher from Havre-Saint-Pierre, a sample of sea urchins was taken and diameter measurements were made (Figure 6c). Laboratory analysis of a subsample of commercial-size sea urchins showed that, as at May 10, 12 females out of 14 had already begun spawning and had gonad indices (i.e. gonad weight as a percentage of total weight) of under 5%, compared with 21% in the other two females. The gonad indices for males were

more variable, ranging from 3 to 12% with an average of 7%. This indicates that, at the time of sampling, spawning had already occurred. In the Upper North Shore region (Area 9), a small trap fishery was conducted near Forestville as in past years. The yields from this fishery were down slightly from the previous year, with 2.5 kg of commercial-size urchins per trap versus 3.6 kg.

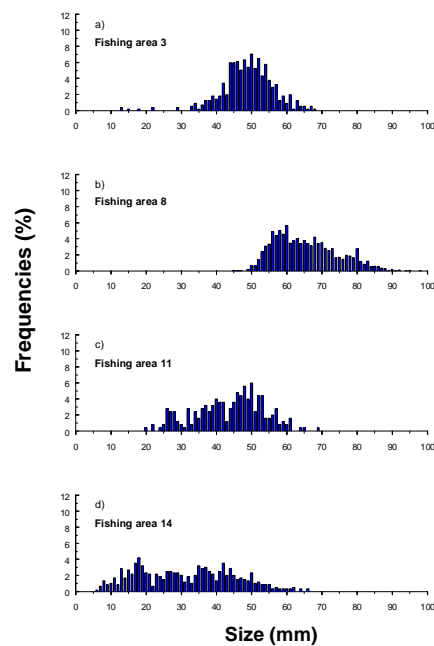


Figure 6. Size frequencies of sea urchins taken in 1999 in four management units a) sea urchins harvested in lobster traps, b) urchins > 50 mm based on commercial catch sampling, c) urchins taken by a diver, d) urchins from a diving survey.

In the Upper North Shore region, an experimental fishing licence was issued to permit testing of a new gear type—a turbine pump designed to facilitate sea urchin harvesting by divers. According to the project leaders, the use of this new gear can help to increase divers' yields as much as threefold. In the event of rapid development of a fishery tied to the success of this gear

type, the conservation measures that should be given precedence are clearly the establishment of a spatial strategy for fishing, that is, the division of the coastal zone among fishers along with the establishment of marine reserves, rather than the arbitrary implementation of a total allowable catch.

Magdalen Islands

In 1997, Magdalen Islands fishers participated actively in the fishery, attaining landings of 30 t (Figure 3). The main sites fished were Ile Shag, Gros-Cap and Grande-Entrée at a depth range of 0 to 10 metres. At these sites, an individual diver's average yield can vary between 47 and 107 kg per hour. Landings have declined since the record catch year of 1997. In 1998, the absence of local buyers was a hindrance to the fishery and no landings were reported. A small fishery was conducted in 1999 to supply sea urchins for an experimental aquaculture project involving sea urchin grow-out in lagoons. An initial scientific survey using divers was carried out in fall 1999, providing the opportunity to estimate the sea urchin densities present on sites with a hard or rocky substrate between the sectors called Demoiselles (Ile du Havre-Aubert) and Dune du Sud (Ile du Havre-aux-Maisons). The sites surveyed had densities ranging from 0 to 83 sea urchins per square metre. The maximum size of the individuals sampled was 66 mm. (Figure 6d). Commercial-size individuals of 50 mm and over were few in number and represented only 9% of the total population. Recruitment was present (Figure 6d) with small sea urchins being dominant on the sea bottom. The age determination results obtained for the sea urchins collected in this survey will be analysed and should provide indications on growth rates. The preliminary results show that the individuals 50 mm in diameter from the sites studied are 4 to 13 years old,

with a mean age of nearly eight years. This new information should be supplemented with data from future fishing seasons in order to assess the carrying capacity of the Magdalen Islands region for sea urchin populations and hence to determine the level of fishing effort that will ensure sustainability.

Management issues

Compared with the large landings made in the Maritimes, the small quantities of sea urchins harvested in Quebec in recent years may appear to suggest that Quebec stocks have not been exploited to a great extent and that they are probably in good condition. However, Quebec catches have been mainly concentrated in certain regions, such as the Lower St Lawrence and the Magdalen Islands, where the abundance of this resource and the environment's carrying capacity in terms of fishing remain unknown.

Given the uncertainties related to the resource, the conservation measures recommended in 1996 should be maintained in order to avert overharvesting: 1) minimum legal size of 50 mm in order to protect reproductive potential; 2) spatial distribution of fishing effort; and 3) prohibition on using towed gear types with the aim of preserving the habitat.

The tools required for monitoring this new harvesting should be improved. In order to permit the acquisition of fishing statistics, **logbooks should be made compulsory in all regions** and they should be filled out appropriately with information on every fishing trip. Additionally, transfers of sea urchins from fishing sites to aquaculture sites should be documented in logbooks. To permit more effective estimation of landings, it is also essential that fishers report the quantities of sea urchins sold

directly to foreign buyers that do not generate a processing plant purchase slip.

References

Godbout, L. 1996. Quebec Green Sea Urchin. DFO, Atlantic Fisheries, Stock Status Report 96/8.

Correct citation for this publication:

DFO, 2000. Green sea urchin of the inshore waters of Quebec. DFO – Science, Stock Status Report C4-13 (2000).

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ISSN 1480-4913

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