STOCK STATUS REPORT

LAURENTIAN REGION

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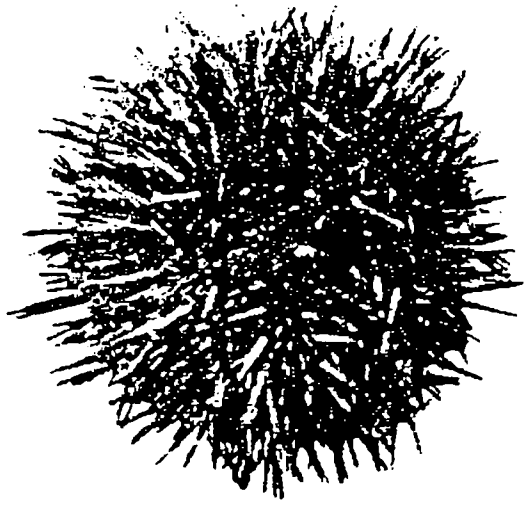
DFO, Atlantic Fisheries, Stock Status Report 96/8 July 1996

QUÉBEC GREEN SEA URCHIN



BACKGROUND

The green sea urchin contains edible gonads, a prized product on the Japanese market. The product quality criteria are fairly rigorous: in general, the test diameter must be greater than 50 mm and the weight of the gonads should be at least 10% of the total weight. In addition, the gonads may range in colour from bright or pinkish yellow to dark yellow-orange. The preferred harvesting technique for the green sea urchin is hand gathering by divers as good quality sea urchins can be selected without disturbing the sea bed. For the moment, the harvesting of green sea urchins in Québec is seen as a complement to traditional harvesting activities (for instance crab or lobster). Although it is fairly difficult to learn how to fish for green sea urchins, the growing demand for licences suggests that Québec fishermen are increasingly interested in harvesting this resource.

OVERVIEW OF THE BIOLOGY

Distribution and habitat

The green sea urchin is an echinoderm encased in a hard shell covered by spines called a test; it contains gonads whose weight may reach 25% of its total weight. The green sea urchin has a circumpolar distribution and is present on both coasts of North America. On the East coast, it is common from New Jersey to Baffin

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Island, wherever salinity is greater than 15 ‰.

The green sea urchin eats preferably macrophytes, especially certain species of meaty macrophytes (*Laminaria spp.* and *Alaria spp.*). In the absence of these algae, the sea urchin also feeds on all kinds of detritus and marine organisms.

Sea urchins live in aggregations on the fringes of kelp forests, beginning at the low tide line, where they grow quickly and acquire a significant gonadic mass. These are moderately dense populations with good commercial potential. Grazing can sometimes be so intense that the kelp forest disappears and sea urchin aggregations are found on barren ground, where their density is often very high (more than $100/m^2$), but they grow more slowly than urchins feeding on kelp and their commercial potential is often negligible. These aggregations can survive for years. The alternating barren patches and kelp forests are related to sea urchin density. A decrease in sea urchin density caused by disease, predation or harvesting would allow the kelp forest to become re-established. Finally, aggregations of sea urchins are often found at depths of up to 50 or 60 m. The diet of these urchins is drift algae and detritus. The commercial value of these aggregations is variable.

Reproduction and life cycle

Sexual maturity begins at 18-25 mm, which corresponds to an age of two to three years, depending on the region. Reproduction follows an annual cycle during which the gonads undergo changes: a rapid increase in weight in the fall, reaching a maximum in early winter when they are also firmer, then maturity and a decrease in firmness as the spawning date approaches, a drop in gonad weight when the eggs are deposited, followed by a slight increase in the summer. The maximum gonad weight increases with size and varies according to the quantity and the nature of the available food, up to 25% of the total weight. Sufficient quantities of meaty macrophytes in the diet usually result in gonads of good quality.

During spawning, which generally occurs in the spring, male and female sea urchins release their gametes in the water column and fertilization takes place externally. Since sperm has a life span of only 20 to 30 minutes, a high fertilization rate depends on the synchronization of emissions by individuals in the same aggregation. The release of sperm is triggered in some males by the appearance of phytoplankton blooms and then synergistically stimulates spawning in other individuals. A high fertilization rate also seems to require favourable thermal conditions, a minimum density of mature individuals and an aggregation with a minimum area.

The fertilized eggs sink to the bottom, but one to three days later, they raise to the surface. The larvae hatch and develop in the water column. They can remain there for two to five months before settling on a suitable substrate and changing into juveniles. Temperature, intolerance to low salinity levels, lack of food, and the availability of shelter are among the factors responsible for the wide variability in larval and juvenile growth and survival. Recruitment can be highly variable: observations over a four- to six-year period indicate only one good year-class. There is little data from nature on the growth of sea urchins bigger than 2 cm

because it is difficult to assess individuals' ages. Laboratory studies on other species of sea urchins show that the growth rate varies with diet and that the absence of food may cause negative growth.

Mortality

Predation and disease are the two main causes of mortality. The green sea urchin's predators include the lobster, rock crab, starfish, Atlantic wolffish and sea birds. On occasion, an epidemic caused by an amoeba causes massive mortalities, such as those in 1980-1983 and, more recently, in 1995 in Nova Scotia and other regions of the Maritimes. Colder waters seem to have spared the sea urchin stocks in Maine.

Surveys of green sea urchins in the estuary and Gulf of St. Lawrence

Surveys were carried out in 1978 and 1979 in two regions along the North Shore (Baie Comeau to Pointe des Monts and Les Escoumins to Tadoussac) and two regions along the south shore (Bic and Ruisseau à la Loutre to Mont St-Pierre). Obviously these surveys represent only a fraction of potential aggregations and may not reflect the current state of the surveyed aggregations. Nevertheless, these data, along with those obtained in the Îles-de-la-Madeleine in 1994 and in the Mingan Archipelago in 1990-91, are used here to provide an initial picture of the distribution of the resource. The density of sea urchins vary according to depth and area. As a general rule, densities decrease with depth, most sea urchins being found at depths of less than 6 or 7 m. The densities reported below are the averages, but the total area covered by these green sea urchins aggregations were not reported.

Densities in the two North Shore regions often exceeded 200/m^2, while densities of 1,200-1,600/m^2 were observed at Pointe de Métis. These sites were on barren ground. Densities in the Bic region varied from 20-74/m^2, while at Cloridorme (the north slope of the Gaspé Peninsula) and Pointe St-Pierre (the end of the Peninsula), densities of 91/m^2 and 41/m^2 respectively were observed. Finally, densities of 10 to 40/m^2 were observed in the Îles-de-la-Madeleine. With some exceptions (areas subject to ice friction, salinities of less than 15‰, and unsuitable for kelp) the green sea urchin was present all sites examined along the coasts of the Estuary and the Gulf.

In the two North Shore regions, kelp was absent or limited to a narrow area (eg, between Les Escoumins and Tadoussac) and the maximum values of the gonado-somatic index are only 11 to 13%. In the Bic region, there was one or two kelp beds and the gonado-somatic index was 19% (Anse à l'Orignal). The highest values for kelp abundance and the gonado-somatic index were observed between Ruisseau à la Loutre and Mont St-Pierre (Petite Tourelle, 24%). Gonado-somatic index values were also high at Pointe St-Pierre (18%), certain sites on the south shore of the Îles-de-la-Madeleine (20-22%), Pointe aux Morts (21% on the North Shore), and in certain sectors of the Mingan Archipelago (18% northeast of Ile du Havre de Mingan and 16% at Ile aux Bouleaux).

The spawning date varies from one region to another, and although this has not yet been clearly established, it appears that spawning takes place earlier in the Gulf (April-May) than in the estuary (mid-May to the end of June). Exceptionally, in certain areas of the estuary, such as Mitis

Bay, spawning occurred later in the summer (August). In the Gulf of St. Lawrence, spawning was finished at Pointe St-Pierre and Newport before the end of May and even earlier at Cloridorme (April). It is possible that the spawning date at any given site varies substantially from one year to the next.

Since the gonado-somatic indices often reach their maximum levels during the winter, the presence of ice could limit the harvesting period for sea urchins.

1995 MANAGEMENT CONTEXT

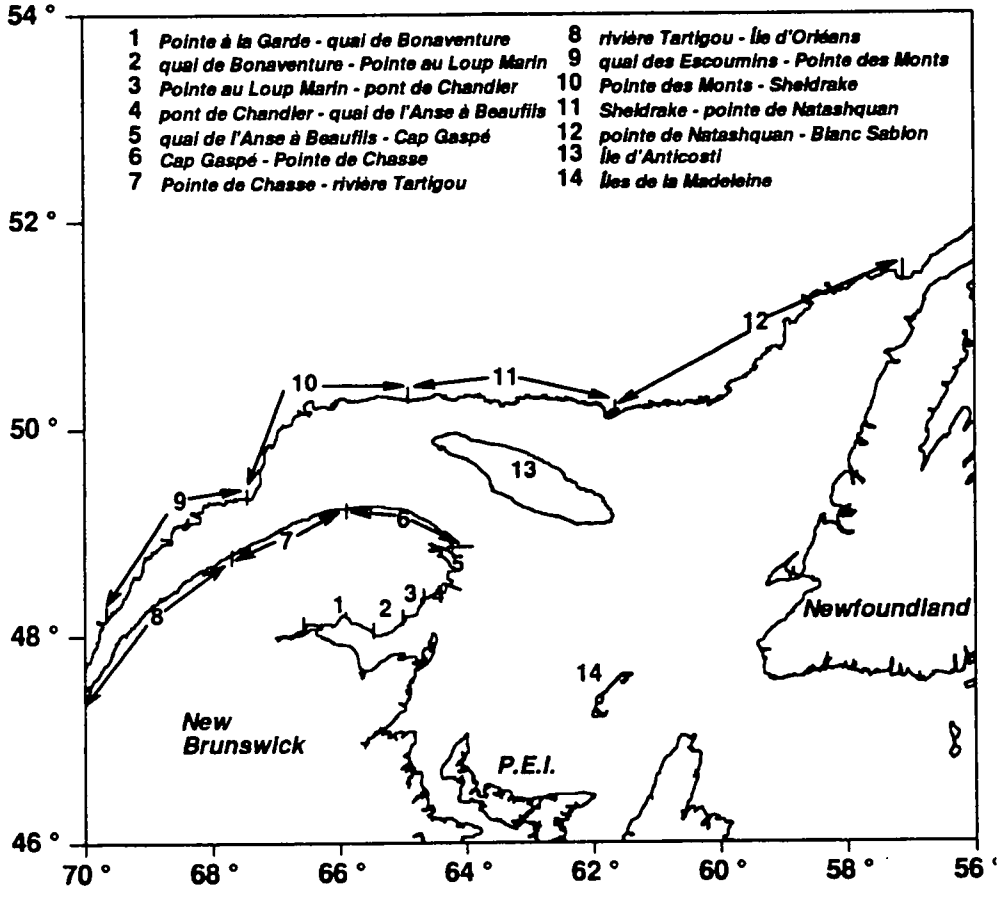

Figure 1. Green sea urchin fishing areas and the number of exploratory (E) and experimental (A) licences issued in 1995. Area S refers to the territory between St Siméon and Baie St Paul. A fishing licence may give access to more than one fishing area.

areas	1	2	3	4	5	6	7	8	9	10	11	12	13	14	S
licence A							1	1	1						1
licence E	10	22	16	4	9	0	2	1	0	3	8	1	0	15	

In the absence of data on the extent and current state of sea urchin aggregations, fishing areas similar to those used for other coastal species were adopted (Figure 1).

In 1995, the territory was divided into 14 areas split into six major regions: Gaspé South (1-5), Upper North Shore (6-9), Middle North Shore (10-11), Lower North Shore (12), Anticosti (13) and the Îles-de-la-Madeleine (14). A total of 93 licences were issued, 91 **exploratory** licences and 2 **experimental** licences. There are no permanent licences at this time.

No restrictions were placed on the size of sea urchins, the number of licences (per area or in total) or the fishing season. The **exploratory fishery** was with some exceptions limited to harvesting by hand with a maximum of four divers and the licence-holders were required to fill out a log book to collect data on the location of fishing sites, catches (weight and total number) and the diving effort. As an exceptional measure, an **exploratory fishing** licence authorized a quota of 250,000 pounds, the use of a 34-foot vessel, a dredge with a 48-inch opening, and harvesting by divers between April 21 and December 31, 1995 in an area extending from Bic to Kamouraska. The only other exception authorized the use of grab dredges at low-tide. Of the 91 **exploratory licences**, 61 were issued in Gaspé South, three in Gaspé North, 12 on the North Shore and 15 in the Îles-de-la-Madeleine.

Finally, two "**experimental fishing**" licences under the Testing and Experimentation Program jointly authorized two licence holders to harvest up to 30,000 pounds per licence without any size restrictions using a dredge with a 48-inch opening and divers. The first licence authorized a harvest from Bic to Kamouraska and Les Escoumins to Pointe des Monts between May 25 and August 30, 1995, while the second authorized a harvest from Bic to Cap Chat and St Siméon to Baie St Paul from October 3 to December 30, 1995. "**Experimental fishing**" licence holders were required to agree to the presence on board of a DFO-designated observer at all times, to complete a log book and to provide data on eight fishing sites (area, density, size distribution and gonado-somatic index) for three periods of the year (spring, summer and fall).

In addition to these licences, lobster fishermen could land sea urchins as by-catches.

Regardless of the type of licence, catches had to be sampled by measuring the size of 250 randomly selected individuals during landings. These measurements were made by a DFO sampler and depended on fishermen's co-operation. Plants also had to provide the DFO with purchase slips.

STATE OF THE HARVEST

No log books were available as of March 7, 1995 to do an analysis of fishermen's yields. As a result, it is impossible to provide a picture of the harvest.

Nevertheless, fishing did take place in the Îles-de-la-Madeleine and Gaspé South according to sampling data and purchase slips. In the Îles-de-la-Madeleine, 34,000 kg of sea urchins were sold to local plants

during the summer, 42% in May, 48% in June and less than 10% in July (Figure 2).

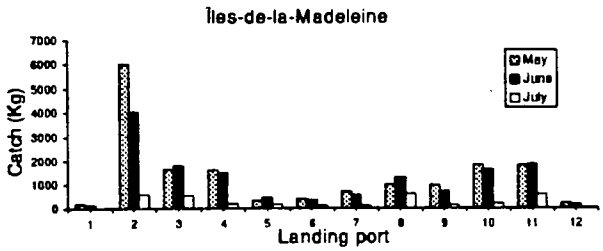

Figure 2. Purchase slips from a Îles-de-la-Madeleine plant. Sea urchin catches (kg) by port of landing in May, June and July. 1: House Harbour; 2: Grande Entrée; 3: Grosse Ile; 4: Pointe Basse; 5: Pointe aux Loups; 6: Old Harry; 7: Amherst Harbour; 8: Millerand, 9: Île d'Entrée, 10: Cap-aux-Meules, 11: Étang du Nord, 12: Cap-Vert.

More than 30% of the catches were landed at Grande Entrée. It is possible that all of these catches are lobster fishermen's by-catches.

Gaspé South data consist of size measurements of sea urchins harvested either by divers (Baie de Gaspé and Shigawake) or in lobster traps (St Godefroi). More than 76% and 88% respectively of the sea urchins gathered by hand were bigger than 50 mm, while the catch per unit of effort varied between 36-40 kg/h (Figure 3a, b). More than 92% of the sea urchins caught in lobster traps were bigger than 50 mm (Figure 3c).

CONSERVATION CONTEXT

When a new harvest begins, the purpose of an "exploratory" fishery is to obtain information on the distribution and extent of the resource while enabling the conservation of stocks and the teaching of new fishing techniques. In the long term,

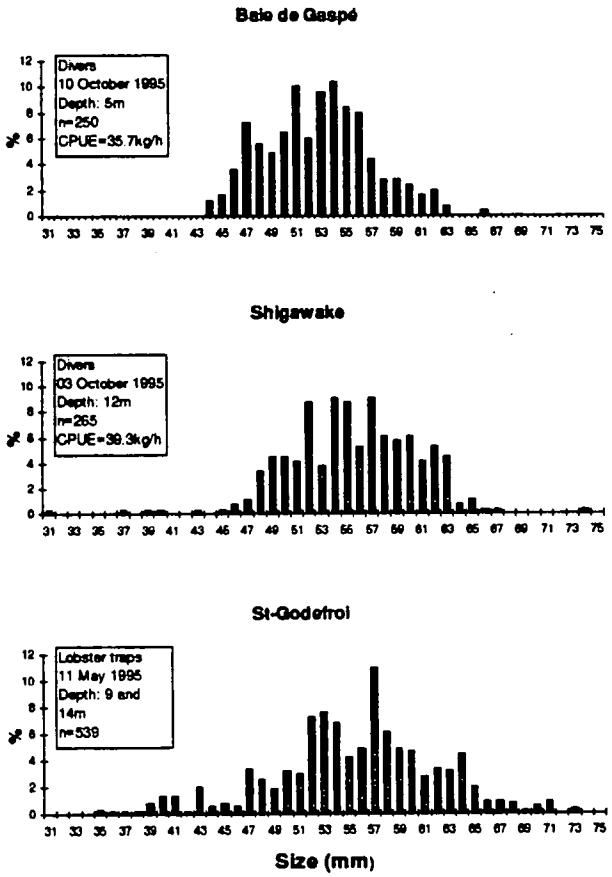

Figure 3. Size distribution of sea urchins collected by hand by divers: a) Baie de Gaspé (October 10, 1995); b) Shigawake (October 3, 1995) and c) in lobster traps at St Godefroi (May 11, 1995).

the data are used to assess changes in the harvest and build models describing the population dynamic required to better manage the resource.

Past experience shows that an effective approach to conservation depends on the introduction of regulations at the very beginning of a new fishery. In the state of Maine, the first regulations were issued in 1994, 50 years after harvesting began and following a rapid expansion of the fishery in 1987. Moreover, in 1996, alarming signs of overfishing led the marine resource regulations committee to

propose emergency legislation in order to avoid a collapse of the stocks.

Conservation measures

Given the green sea urchin's distinctive biology and close association with specific types of habitat, the following conservation measures should be implemented to ensure the fishery's sustainable development.

1. **Harvesting by towed gear should be prohibited.** This type of gear is not very selective and disturbs the sea urchin's habitat, in particular the kelp forest which also serves as a shelter or refuge for several invertebrate species, including the lobster. Only harvesting by hand or with traps should be permitted. With these methods, the best quality individuals can be selected and small individuals can be returned to the water with a good survival rate. These fishing techniques disturb the habitats and biological communities associated with them only slightly or not at all. Harvesting by divers is the most common method used in the Atlantic and on the Pacific coast.

2. **The introduction of a minimum legal size would help protect the sea urchin's reproductive potential by allowing smaller individuals to breed.** A minimum size of 50 mm would definitely be appropriate for the coastal waters of Québec; this minimum size is used everywhere on the Atlantic coast. Sea urchins under the minimum legal size should be returned to the water at the fishing sites, where they will have excellent chances of survival. These small urchins can contribute to the recruitment because size at maturity occurs at sizes smaller than 50 mm.

3. **The fishing effort should be limited and evenly distributed in the regions.** A limit on the number of licences at the beginning of the harvest would be a good way to control the development of this new fishery. Sea urchins are sedentary and move little between regions; they are associated with certain kinds of sea bottoms and their growth may depend on aggregation density and the availability of food. The selective harvest of some individuals may allow other individuals in the population to grow more. It is thus possible that the fishery may to some extent have a beneficial effect on the populations. Learning this type of harvesting may be a relatively long process until fishermen know the aggregations they are harvesting well enough to achieve the beneficial effects of a selective harvest.

At any rate, it is important that information about catches and effort be recorded in a log book so the harvest can be monitored and the state of the populations eventually assessed.

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