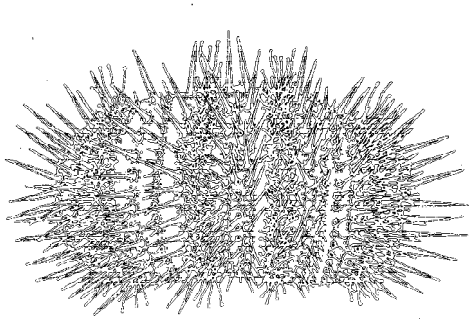

Nova Scotian Sea Urchin

Background

The green sea urchin (Strongylocentrotus droebachiensis) is common to shallow rocky bottoms throughout Atlantic Canada. It matures at about 7 g and 25 mm shell diameter. Spawning occurs in spring and the larvae are planktonic for about 8 weeks before taking up a benthic existence. Its principal food is seaweed, but attached bottom animals and decaying organic mater are also eaten. It can reach commercial size in as little as 4 years if well fed but may never reach this size on a low ration.

The fishing area considered in this report is from the northern tip of Cape Breton to the Nova Scotia-New Brunswick border in the Bay of Fundy. Currently about three-quarters of the landings come from east of Halifax and most of that from the Eastern Shore.

The fishery began slowly in 1989, but increased several fold in 1994 in response to a marked increase in price. Fishing is by diving, although one Bay of Fundy license acquired the option to try dragging in 1996-97. Diving limits the depth of harvest to 20 m, and mostly to less than 13 m.

The fishery is regulated by minimum size, season, restricting licenses to zones, a requirement to sort the catch on the fishing grounds, diver only, and a participation clause.

The Fishery

Most **regulations** came into effect at the beginning of the 1995-96 season (Anon 1995). Seasons start on 1 October and end between April 30 and May 31, reflecting the times when the roe reaches acceptable size and quality. A minimum size of 50 mm test diameter is about the minimum acceptable to the market. Undersized urchins must be discarded on the fishing ground. A participation clause requires landings of 2000 kg the first year in the fishery and 4000 kg in subsequent years. Sea cucumbers are the only bycatch permitted. Diving is the only fishing method permitted and no more than four divers may work from a boat in any day. The diver-only restriction results in a high value catch with no degradation of the physical habitat.

An important regulation change was to smaller harvesting zones. These represent a philosophy of **"habitat-based" rather than "stock-based" management**. To apply this method, a regulator, in consultation with harvesters, determines the potential yield of a unit area of habitat then assigns a reasonable number of fishers to that unit to develop the potential. It is the obligation of fishers to develop the stock's yield potential, i.e. to increase the natural sustainable yield. In 1995 all licenses were assigned to a county based on residence or fishing history. This assignment distributed effort geographically, encouraged fishers to become familiar with their fishing ground, encouraged them to fish near home, and, by limiting the number of fishers sharing the same grounds, increased the possibility for them to negotiate individual harvesting

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zones among themselves. Those who chose could negotiate with DFO for legal individual harvesting zones; 15 harvesters were successful in these negotiations in 1995, as were a further 12 in 1996. Although variable in size, they average 4.5 and 5.7 nautical miles (straight line distance) on the Eastern and South Shores respectively.

These individual zones enhance the potential of habitat based management. They eliminate competition for the resource and free the fisher to harvest the resource at optimum times dictated by roe development, price, and weather. It also rewards the fisher personally for any work done to enhance the productivity of the zone. Because fishers are not competing for the same resource they are willing to share information on harvest and enhancement methods, and have done so. Because they are all supplying the Japanese market is to their advantage to jointly build a reputation for quality.

In 1996, all holders of individual zones were required to produce maps of the kelp and sea urchins in their zones. This knowledge will permit them to plan harvests and enhancement for optimum yields. They were also required to submit plans for at least two enhancement projects and to have their enhancement areas inspected by an independent diver. These requirements were prerequisites to receiving their license conditions to fish in the autumn of 1996. Holders of individual zones are also required to provide detailed log book records, including fishing locations and effort, to Science Branch.

In the autumn of 1995 disease eliminated sea urchins from harvestable depths along 120 km (straight line distance) of coast; in 1996 another 25 km or more was eliminated. This required further negotiations to accommodate some the affected fishers to unaffected zones. Others of the affected fishers chose not to relocate in exchange for an individual zone that could be fished when the urchin stock recovered. The pathogen's identity was confirmed as the one responsible for mass mortalities of 270,000 t within harvestable depths in the early 1980s.

Ten new licenses were issued in 1995; a few more may be issued in 1997.

The concept, distribution and sizes of the individual zones will be reviewed after 4 years.

Landings are underreported. Landings were <100 t until 1994 when prices and landings greatly increased. Landings temporarily decreased in the fall of 1995 because of loss of resource to disease and the constraint that individual zones imposed on the fleet's high-liners. Landings for the 1995-96 season were approximately 1000t, and may be the first record within 30% of true values. Over 90% were taken in Guysborough, Halifax, and Shelburne counties. The new licenses added in 1996 were late in the season and make only a token contribution to landings.

Licenses and landings by county 1995-96

County	Licenses		Reported
	start	end	Landings (mt)
Victoria	3	5	0
Cape Breton	7	7	30
Richmond	4	4	16
Guysborough	10	15	433
Halifax East	8	9	226
Halifax West	3	3	5
Lunenburg	2	2	0
Queens	2	2	30
Shelburne	7	7	260
Yarmouth	0	0	0
Digby-Annapolis	5	5	0
Hants-Cumberland	0	2	0
Colchester	0	0	0
Total	51	61	1000

Age distribution of the fishable stock is unknown, but can span a range of 4-15 or more years depending on the nutritional history of the individual sea urchins. Age range decreases rapidly as old, slow-growing animals are fished up and more food is available per animal.

To determine the feasibility of **transferring sea urchins** from one location to another for cage culture, or to more favorable areas in the natural habitat, sea urchins were exposed to rough handling and to air for variable periods. Experiments were carried out at optimum temperatures of $\pm 2^{o}$ C. Air exposures of 20 min. to 20 hours and rough handling (dropping boxes full of sea urchins, stacking 80 kg of full boxes on top of overfull boxes) all produced negligible mortality even after 2 weeks in cages in the sea. Urchins were also exposed to freezing air temperatures for variable times. At -4°C all urchins survived 2, 4, and 6 h exposures, but one-third died after 8 h. At -9°C, the shortest exposure time of 2 h resulted in 25% mortality; at 4 h exposure 93% died.

Because sea urchins are diver collected, **discards** are low, typically 10-15% by weight. Grading by size occurs on deck. Some catches with unacceptable roe quality are also discarded. Each diver's take is checked a few times each day by the licensee. On some boats each divers catch is kept separate and the pay is based

on the quality and quantity of the individual's harvest.

Resource Status

Implementing the habitat based management approach required knowledge of the **distribution of sea urchins and kelp**. These were obtained from extensive diving surveys conducted during the early 1980s, a survey of much of Guysborough County and parts of Shelburne, Queens, Lunenburg, and Halifax Counties in 1995, and further surveys in Shelburne, Halifax, and Guysborough counties in 1996. The 1995 and 1996 surveys included diving, but relied heavily on three other methods: towing a diver on the surface, looking over the side of a skiff through a glass-bottomed-bucket, and locating the edge of kelp beds using a colour depth sounder. Information on Queens and Lunenburg Counties were obtained from reliable fishers. Surveys were confined to depths that could be commercially harvested, about 15 m, or less where the sea urchin-kelp front was shallower. About 1000 sites were visited in 1995-96.

Survey of sea urchin and kelp distribution, proceeding from west to east.

Location	**Observations**
Lobster Bay	abundant kelp, no commercial urchin concentrations
W. Cape Island	abundant kelp and urchins
E. Cape Island to Sable R.	abundant urchins kelp scarce, urchin disease widely scattered in autumn 1996
to Port Mouton	disease eliminated nearly all urchins within diving depth in autumn 1996
to Halifax Hbr.	disease eliminated nearly all urchins within diving depth in autumn 1995
to Jeddore Hbr.	kelp abundant, urchins scarce disease scattered
to Guysborough County line	kelp abundant, many beds of good quality urchins on exposed shores
to Little Dover	mix of large kelp beds, overgrazed urchin barrens, and a good balance of urchins and kelp
to Guysborough Hrb	mostly overgrazed urchin barrens

In areas of urchin dieoff, kelp beds are rapidly recovering, repeating the pattern observed in the early 1980s.

Urchin harvesters have improved the balance of sea urchins and kelp in Lockeport Harbour and west of Cape Sable Island, but most of Shelburne County still needs development to bring it to full production. Jeddore Harbour to the Guysborough Co. line has been much improved over the past two years, and there have been more modest improvements from the county line to Canso Harbour (pers. comm. harvesters and buyers, pers. obs.). There has been no improvement in Chedabucto Bay.

Lobster fishers are opposed to sea urchin fishers' moving underfed urchins to kelp beds. They equate sea urchins to kelp destruction and to poor lobster catches. However, their concern is misdirected; kelp is more important to urchin fishers than to lobster fishers. Sea urchin fishers decrease (not increase) urchin density and their fishery promotes kelp growth by controlling the density of the grazers. Although lobsters aggregate along the edge of kelp beds there is as yet no evidence that the presence of kelp increases overall lobster density.

Because the quality and quantity of sea urchins are heterogeneous and because the survey methods are not quantitative, estimating the total size of the fishable stock would be prohibitively expensive. By thinning overstocked areas and applying enhancement techniques fishers are changing the size of the fishable stock by bringing more beds into production.

Outlook

The sharing of information among license holders is having a positive influence on the efficiency and safety of fishing, and on the quality of the stock. The individual fishing zones have given harvesters the incentive to invest in the urchin stocks through selective harvesting and expanding the distribution of kelp. These measures increase harvestable biomass and price per pound. However, sea urchin disease remains a threat that could eliminate a large portion of the stock. Its scattered occurrence from Barrington Bay to Sable River in the autumn 1996 may forcast the complete destruction of this portion of the stock in 1997. In the early 1980s expansion continued for 4 years killing 270,000 t within harvestable depths.

Sea urchin cage culture began in several locations in 1996. Twenty permits are pending or have been approved by the Nova Scotia Dept. Fisheries. These operators buy legal sized but poorly fed sea urchins from commercial harvesters and feed them for long enough to increase their gonad content. This industry is useful to harvesters by providing them a market for otherwise unmarketable urchins.

For More Information

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