

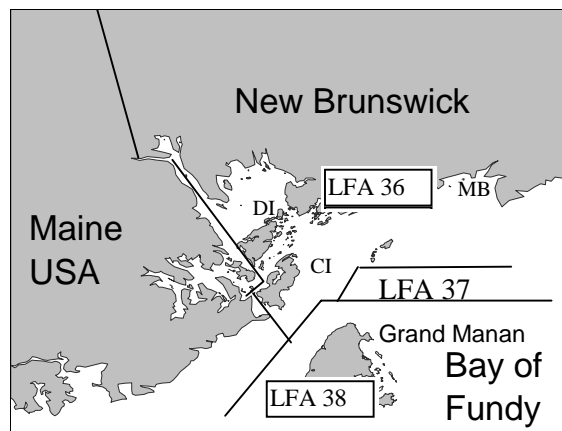
Southwestern New Brunswick (LFA 36-38) Green Sea Urchins

Background

The green sea urchin, *Strongylocentrotus droebachiensis*, is a panboreal echinoderm that ranges in the Atlantic Ocean from New Jersey to the Arctic, extending south to Britain. It is also distributed in the Pacific Ocean from Washington to Alaska. The animals are omnivorous in nature although they feed primarily on seaweed. Sea urchins are most plentiful in shallow waters less than 10 m deep, although they may be found down to 1,200 m. Urchins can be found on virtually any type of substrate, but they generally prefer harder surfaces. The animals have separate sexes and spawn in late winter/early spring. The resulting planktonic larvae settle in 8 to 12 weeks. Growth can be variable and is dependent on temperature, food supply (seaweed, small animals, other urchins), and the time required to reach commercial size (50 mm) may take from 5 to 15 years). There has been no evidence of the urchin die-off caused by the microorganism, *Paramoeba invadens*, to date in the Bay of Fundy.

There are two main fishing zones, based on Lobster Fishing Areas: LFA 38 (Grand Manan) and LFA 36 (encompassing the remaining area on the mainland including coastal islands). Fisheries based in both LFA's are also eligible to fish in a small adjoining area, LFA 37. The majority of the catch is taken from shallow water coastal areas less than 10 m.

The sea urchin fishery, in LFA 36-38, initially developed as an additional source of product for the industry based in the United States. On Campobello Island, small landings (1-2 tonnes) occurred in the 1950's and 1960's just before the Christmas season, but the industry did not really develop until 1987.



DI= Deer Island, CI=Campobello Island,
MB=Maces Bay

Summary

- This fishery is data poor in both biological and fishery information. This lack of information impacts on the interpretation of much of the data and has implications for the development of future management options.
- The landings from the LFA 36-38 sea urchin fishery peaked in 1996 at 1,900 t and have dropped slightly since then, partly due to introduction of quotas. The value of the fishery is about \$4 million annually.
- Catch rate (CPUE) analyses do not indicate any stock related problems in LFA 36 (Mainland) for either the dive or drag fishery.
- There appears to have been a drop in the CPUE during 1998-1999 in LFA 38 (Grand Manan) suggesting a drop in the standing stock, although at-sea discards could bias the interpretation of these results. However, the implied drop in CPUE agrees with current industry observations.

- The last surveys of the stocks were done in 1992-1994. They showed substantial differences in the size distributions and biomass of the sea urchin populations between LFA 36 and 38. The current TAC's are based on these surveys (approximately 5% annual harvest rate).
- In general, the harvested populations are old, slow growing and appear to have a low recruitment rate.
- Consideration should be given to lowering the TAC for LFA 38. More up-to-date biological information from surveys on the stocks would help this decision process.
- Projections of production are not possible due to the lack of understanding of the productivity of the populations within the ecosystem. More research should be done on this aspect.

The Fishery

The fishery is currently managed by the Department of Fisheries and Oceans (DFO). A Conservation Harvesting Plan (CHP) specifically for LFA 36-38 was developed in consultation with all license holders in the fishery. At the present time, there are two versions of the CHP, one for LFA 38 (Grand Manan) and one for LFA 36 (the rest of the Quoddy Region).

All participants must have a personal fisher's registration and the license holder must be the operator of the vessel. The common elements of both plans are: a minimum size limit (test diameter) of 50 mm (2.0 in.), sea urchins to be sorted and culled at sea, harvesting between sunrise and sunset, mandatory submission of logbooks, and the establishment of protected areas for scientific research. The fisheries based in both LFA's are also eligible to fish in a small intermediate area, LFA 37.

For LFA 38 (Grand Manan), the season extends from November 1 to April 15, and fishing gear is limited exclusively to either "Green" drags with a maximum width of 1.83 m (6 ft) or diver-based techniques (i.e. suction harvester). A program for individual non-transferable quotas with dockside monitoring is in place.

For LFA 36, the season extends from October 1 to May 15, fishing gear is limited to "Green" drags with a maximum width of 3.05 m (10 ft) or diver-based techniques (i.e. suction harvester). A maximum of four divers in the water and two skiffs may be used within 457 m (1,500 ft) of the mother boat to tend the divers. There is an overall quota for the fishery with maximal catch limits imposed for an individual license.

Dragging operations are subject to scallop regulations in the inshore areas (i.e. no dragging within near-shore scallop conservation zones), which limits the season in some locations to the second Tuesday in January to the end of March. These regulations are reviewed on an annual basis with members of the sea urchin industry.

The **total allowable catch (TAC)** for each LFA management area was calculated in 1996 from the biomass estimates of the dive survey in 1992-1994 and has been applied annually at that level since. For LFA 36, an annual quota (established in 1996) of 900 t was set on an estimated biomass of legal animals of 13,245 t (6.8%). Recruitment was apparent in this population (as evidenced by small animals in the size-frequency distribution). For LFA 38, the TAC of 979 t was set on an estimated biomass of legal (commercial sized) animals of 29,879 t (3.3%). There did not appear to be as much annual recruitment to this population.

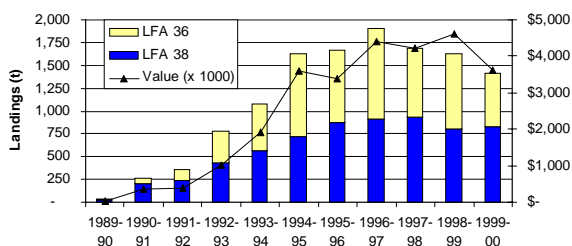
Landings in LFA 36-38 have increased by almost two orders of magnitude since 1989 from 29 t to over 1,700 t in 1999. For the first 6 years landings increased dramatically, peaked in 1996, but have dropped in each of the following three years. The value of the product has increased from \$16,000 in 1987 to over \$4 million in 1998-1999.

Bay of Fundy landings (SWNB) (tonnes), value (\$'000s) by fishing season

Year	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99*	1999-00*
LFA 36 Wt.	510	912	786	991	757	826	593
LFA 36 Value	890	2,098	1,612	2,302	1,907	1,914	1,471
LFA 38 Wt.	563	721	875	912	928	807	821
LFA 38 Value	957	1,173	1,664	1,944	1,995	1,870	2,037

* 1999 data are still preliminary

Sea urchin landings by fishing region and season



Resource Status

The fishery is primarily monitored through logbooks submitted regularly by the 31 fishers to the dockside monitoring service. Recent compliance for logbook submission is very high, as it is part of their license conditions. These data are used to calculate CPUE indices for individuals, groups and locations although they may not be directly related to population size due to onboard

culling. When a fisher makes a tow, he will only take the legal sized animals that come aboard and he then dumps the sub-legal sea urchins back overboard. He may dump the entire catch overboard if it is not of sufficient quality.

The mean CPUE (catch-per-unit-effort) in LFA 36-38 for draggers was approximately 1,000 kg/day. The largest difference between draggers and divers is the number of days they can fish during the season due to seasonal restrictions on dragging. Divers are limited to calmer periods of weather and locations.

The mean CPUE per dive license in LFA 36 from 1991-1992 to 1999-2000 was approximately 750 kg/day. Over this period, CPUE increased from 500 kg/day in 1991-1992 to 1,000 kg/day in 1995-1996, dropped back to 550 kg/day in 1997-1998 and increased again to almost 900 kg/day in 2000. The CPUE for draggers decreased slightly from about 750 kg/day in 1991-1992 to 500 kg/day in 1995 and then increased to about 900 kg/day in 1999-2000. Analysis of the CPUE on the fishing grounds indicated the areas yielding the highest CPUE have been stable for the last three years in LFA 36.

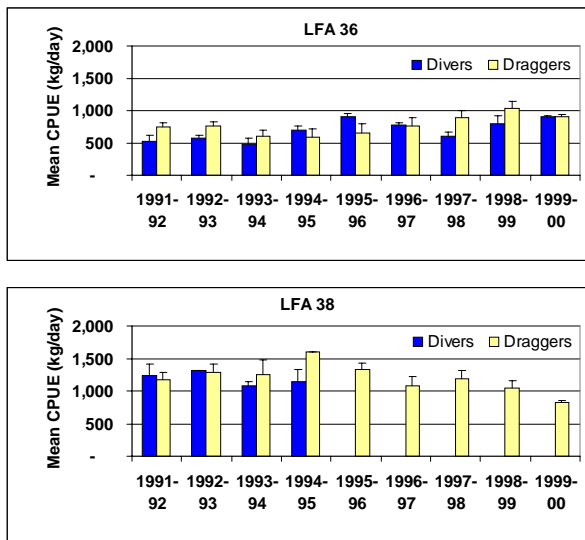
The mean CPUE for divers in LFA 38 between 1991-1995 was approximately 1,100 kg/day. Diving operations ceased in the spring of 1995 as the only diver there was permitted to convert his license to dragging. For draggers in LFA 38, the CPUE per license holder increased from about 1,100 kg/day in 1991-1992 to over 1,500 kg/day in 1994-1995 and then slowly dropped to about 900 kg/day in 1999-2000.

Analysis of the CPUE on the fishing grounds in LFA 38 has shown there has been a southward shift in the areas yielding the

highest CPUE suggesting a drop in the population abundance. This observation has also been confirmed anecdotally by the fishers from the area.

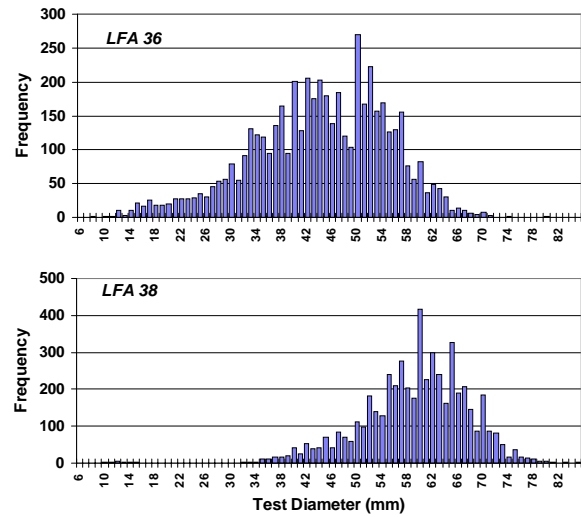
In 1999 onboard sampling of the catch from a single long-term monitoring site in LFA 38 indicated a shift in the mode of the size frequency to smaller animals.

Catch rates for dive and drag licenses (kg/day) in SWNB (LFA 36 & 38) by fishing season from 1991 to 2000.



From 1992-1994, a large-scale diver-based survey was done for much of the commercially fished areas. Subsequent to those surveys, reference transects were surveyed annually to monitor changes in density and size distribution. The dive survey, which assessed animals larger than 10 mm, indicated there was a sharp change in population size distributions from predominantly small sea urchins in LFA 36 to predominantly large sea urchins in LFA 38. The mode for animals in LFA 36 was approximately 45 mm while the mode from LFA 38 was 60 mm. There was very little recruitment to the population observed in LFA 38.

Sea urchin size distribution from LFA 36 and LFA 38 from 1992-94 (n=45,368 for LFA 36 and 14,603 for LFA 38)



Biomass in LFA 36 was considered for three areas: Campobello Island and Deer Island which were surveyed in 1992-1993, and the mainland from Letete to Maces Bay which was surveyed in 1993-1994.

Total biomass (>=10 mm) and fishable (urchins => 50 mm) biomass (t) of sea urchins by LFA based on dive surveys.

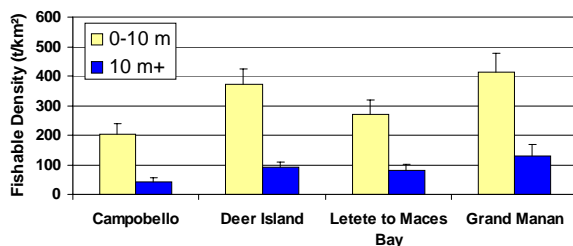
LFA	Area	0-10 m depth		10+ m depth	
		Total	Fishable	Total	Fishable
36	Campobello	4,110	1,736	1,070	197
	Deer Island	12,660	4,265	4,574	991
	Letete - Maces Bay	10,189	5,237	1,897	819
	Subtotal	26,959	11,238	7,540	2,007
38	Grand Manan	26,815	23,350	10,433	6,529
36+38	Total	53,774	34,588	17,974	8,536

In LFA 36, the biomass of sea urchins for the three areas surveyed (all depths) was 34,500 tonnes of which a total of 13,245 was fishable (38%). Most of this was in the

shallow areas (<10 m). LFA 38 showed similar patterns in distribution with depth although a higher percentage of animals were in the fishable category.

The fishable densities of sea urchins (tonnes/km²) in the different geographic areas ranged from 200 to over 400 in the shallow waters.

Density of sea urchin biomass from the dive surveys in LFA 36 and LFA 38 for shallow and deep water



The **re-surveying** of reference transects in 1993-1995 was moderately helpful in trying to understand how the fishery was affecting the local sea urchin stocks. It was hard to interpret some of the changes occurring as the sampling dates were relatively close together. The comparative value of these distributions will be more helpful if and as the time series develops. There were many areas where the size distribution of the population changed from the 1992 sampling period as the proportion of larger individuals were reduced in the population. This is not surprising, as the commercial fishery would be targeting those larger animals.

The same trends from the dive survey were found in the 1995 reference transect survey, as the average size of sea urchins in the mainland sites was generally much smaller than that found on Grand Manan. The size distributions of the sea urchins were very much site dependent.

There was also no clear pattern of changes in the density of sea urchins between sites. In

some areas, the densities increased while in others, it either stayed the same or decreased. Patterns of distribution also varied similarly. Some of this variation might be explained by the time of year when the animals were sampled (e.g. if the distribution of the animals differed between the spring and the fall). However, no information is available on seasonal movement patterns of animals in this area.

Overall, no clear changes in population size, density or distribution were detectable from the surveys.

Growth studies on sea urchins (1993-1995) in LFA 36-38 have revealed that the sea urchins are slower growing and much older than originally expected. The average age for a legal size (50 mm) sea urchin in most locations sampled was 12 to 15 years. This is two to three times older than those found on the east coast of Nova Scotia (1995). This slow growth is thought to be due to competition among animals and over-grazing of the food supplies.

Recruitment to the population at all sites tested so far has been low. Recruitment rates of juveniles to standardized settlement surfaces were found to be approximately 20 to 60 juveniles/m² of experimental settlement substrate (1994-1996). These results are consistent with those found in the Eastport area of Maine, but are three order of magnitude lower than those found on collectors in similarly populated urchin beds in New Hampshire (40,000/m²). How this affects the recruitment rate of animals into the fished population is unknown at the present time.

Sources of Uncertainty

This fishery is data poor in both biological and fishery information. There is a lack of recent surveys for any of the harvested populations within either LFA, which significantly complicates the interpretation of the analyses from logbook data.

It is very difficult to give an accurate picture of the state of the urchin populations, as we do not have a good understanding of the new animals entering the fished populations.

Based on scientific observations, there is an interaction between the fishing operation and the benthic ecosystem. The removal of larger sea urchins from the population will likely result in the successful competition for food items within the smaller size groups. The removal of urchins may also affect the growth of macrophyte algae by lowering the grazing pressure. However, the largest benthic impact at the present time is the effects of the drags on the benthic community. As the fishery generally operates on hard bottom, the action of the chain sweeps on the bottom of the drag act in a shearing fashion and scrape a lot of epibenthic organisms off the rocks as well as the targeted sea urchins. The levels of this impact or the long-term effects are unknown. Another interaction between the fished population and the gear is the incidental mortality rate and the harvesting operation from either divers or draggers. Experiments have demonstrated the sensitivity of the animals to stress from harvesting and handling. There is also the issue of the discarding of sub-legal and sub-quality legal-sized animals during the fishing operation.

It may be possible that the growth rates observed are the result of density dependent growth factors. The sea urchin populations

in southwestern New Brunswick are generally old and slow growing in comparison to animals from eastern Nova Scotia. In most locations examined so far, a 50 mm animal (minimum legal size) is between 10 and 15 years old. In Nova Scotia, a 50 mm animal is between 4 and 6 years old in most cases. The only exceptions to this slow growth were found in two locations, Lubec Narrows, near Campobello Island and Nantucket Island off Grand Manan where a 50 mm animal may be 4 to 5 years old. Both of these locations have been fished heavily for years. More work is needed in the future to determine the carrying capacity of a particular type of substrate for sea urchin production.

Outlook

Landings of sea urchins from LFA 36-38 peaked in 1996 and have declined slightly since then. This peak may be partly due to the institution of TACs in recent years.

Based on the existing information from the 1992-1993 dive survey and the logbook records for CPUE data, there are no signs of resource decline within LFA 36.

There are signs in LFA 38 that population densities are diminishing, as evidenced by changes in the distribution of the mean landings per day from 1997-1999. This is supported by anecdotal observations by the fishers. In LFA 38, the existing data from surveys, the logbook records and the observations of the local fishers do not support the status quo. This suggests a decrease in TAC should be considered and firmer management controls should be applied.

Projections of production at the present time are not possible due to the lack of

understanding of the productivity of populations within the ecosystem. Harvesting will affect the densities, which will subsequently affect the production rates due to intraspecific competition. What that new production level will be is not known at the present time.

Management Considerations

Before any new entrants or increased quotas are allowed in this data poor fishery, more information should be gathered. Steps should be taken to do this as soon as possible.

There are not enough resources in the present system (either people or fiscal) to carry out the level of additional data collection required to support the continued development of this fishery. Because of the value of this fishery, this should become a management priority.

The concept of joint project agreements (JPA's) should be investigated in order to facilitate the collection of data for this fishery.

The current logbook program has some problems associated with it in regard to quality control, precision and the availability of the data. Steps should be taken to rectify this problem.

One of the new issues facing the management of the industry is the concept of harvesting poor quality sea urchins, holding them in captivity and fattening them with supplemental food and then selling them at a much higher price. Another approach may be to seed previously harvested beds with juveniles that will be harvested later in a rotational type of system. These types of ventures may require changes to the current regulation structure.

Recommendations

DFO needs to initiate a process with industry to develop methods for a plan to reduce the total allowable catch in LFA 38.

Update the current biological information on the stocks currently being harvested as soon as possible, through surveys, an on-board observer program and experimentation.

Action a strategy to develop the resource base required to manage this fishery. This may involve direct contributions from both DFO and local fishers through a JPA.

The knowledge of the current stock status is partly limited by the present logbook program. Changes should be made to increase the accuracy and precision of this tool.

More research should be done on: the relationship between catch composition relative to the CPUE; the possibility of recruitment over fishing; growth and recruitment of local populations; utility of local ocean data; and the existing biological conservation areas.

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