



ASSESSMENT OF THE BAY OF FUNDY SEA URCHIN FISHERY, LOBSTER FISHING AREA 36

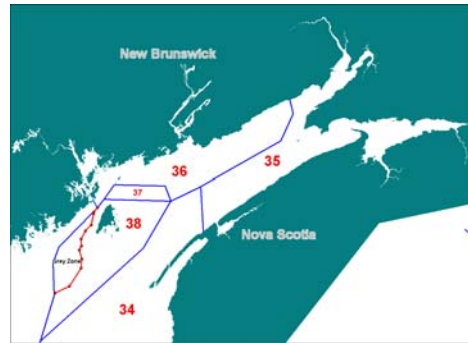
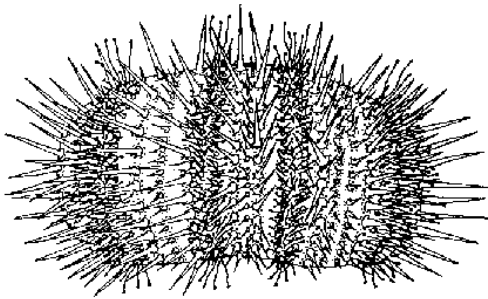


Figure 1: Bay of Fundy Lobster Fishing Areas.

Context:

The green sea urchin (*Strongylocentrotus droebachiensis*) fishery along the coast of southwestern New Brunswick, in the Bay of Fundy, operated at a small scale in the 1950s, 1960s, and the early 1980s. The commercial industry did not actually develop until 1989. The sea urchin fishery in southwestern New Brunswick was separated into two management areas. These two areas were assigned the same boundaries as Lobster Fishing Areas (LFA) 36 and 38 (Figure 1). In LFA 36 the existing sea urchin fishery is based on a Total Allowable Catch (TAC) system. The urchins are harvested mainly by diving and to a lesser extent by dragging. It is currently managed using a minimum legal size limit of 51 mm test diameter (TD), and by a fishing season. The majority of the catch is taken from shallow water coastal areas less than 10 m.

Management and urchin fishers were concerned about the lack of up to date information on the status of the sea urchin stock in this fishery. In order to address this lack of information, diver-based sea urchin surveys were initiated during the summer of 2002 and 2003. The objective was to survey the expansion area from Maces Bay to Chance Harbour, where no previous surveys had been done, and to resurvey the traditional fishing grounds around Campobello Island, Deer Island, and the area along the coast between Letete and Pocologan.

The LFA 36 sea urchin fishery is currently managed by Fisheries and Oceans Canada (DFO). A Conservation and Harvesting Plan (CHP) was developed in consultation with all the license holders in the fishery. These management measures are reviewed on an annual basis with members of the sea urchin industry. The last peer-reviewed stock assessment of this resource was completed in 2000 using data from the 1992-94 surveys.

SUMMARY

- There has been an increasing trend in the catch per unit of effort (CPUE) for both the dive and drag fisheries since 1991-92. This could be due to improved fishing practices and experience, changing market conditions, or changes in abundance.

- CPUE has elements of population abundance but is influenced by discarding due to product quality and market prices. Therefore, the CPUE series must be interpreted with caution and cannot be used exclusively as an indicator of population abundance.
- For the dive fishery, the number of fishing trips showed an increasing trend from 1999 to 2005 but has been variable in recent years.
- For drag licenses, the number of trips have declined from the 1996-97 fishing year to 2003-04 and has been increasing since.
- With the exception of Deer Island, where legal size sea urchin densities have decreased, all other areas show no statistically significant differences in densities for each size grouping between the 1992-94 and 2002-03 survey periods.
- With the exception of immature urchins (< 25 mm test diameter), the density of urchins was significantly higher in the shallow depth strata (0-10 m).
- Total biomass has changed little between the 1992-94 and 2002-03 survey periods. Estimated fishable biomass appears to have declined, but is not significantly different between the two surveys due to a high degree of variability.
- Based on the established Total Allowable Catch (TAC) of 900 t, the harvesting rate is estimated to be 7.9% -- 1.1% higher than the harvesting rate of 6.8% that was approved in 1996. However, Passamaquoddy Bay area is also fished but has never been surveyed; thus, no biomass estimate for this area is available. For that reason, the 7.9% harvesting rate is an overestimate.
- Implementation of the new logbook format will facilitate collection and analysis of effort and harvesting rate data by fishing area in more detail and on a timelier basis.
- Fishery impacts on the ecosystem with respect to by-catch of non-urchin species and potential impact of urchin fishing on the habitat requires collection and processing of new information.
- The recommended assessment schedule is every 5 years. However, annual monitoring of the landings, fishing effort, and catch rate from the fishing logs would be useful to determine if an earlier than scheduled assessment is required.

BACKGROUND

Species Biology

The green sea urchin, *Strongylocentrotus droebachiensis*, is an echinoderm that is distributed 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 seaweeds. 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, mature at approximately 25 mm test diameter (TD) and spawn in late winter/early spring. The resulting planktonic larvae settle in 8 to 12 weeks. Growth can be quite variable, and is dependent on food supply and environmental conditions. The time estimated to reach commercial size (51 mm TD) may take from 3 to 15 years. Currently there are no estimates of natural mortality available. There is no evidence of mortality due to the infectious disease caused by *Paramoeba invadens* in the Bay of Fundy, as has been experienced in the past along the Atlantic coast of Nova Scotia.

Rationale for Assessment

The sea urchin fishery exploitation rate is currently based on a percentage of fishable biomass (6.8%, implemented in 1996) that was estimated using survey data from 1992-94. The last peer-reviewed advice on biomass for LFA 36 was completed in 2000. Updated peer-reviewed advice on the fishable biomass is required, including results of resource surveys from 2002 and 2003.

The Fishery

The LFA 36 sea urchin fishery is currently managed by Fisheries and Oceans Canada (DFO). A Conservation and Harvesting Plan (CHP) was developed in consultation with all the license holders in the fishery. At the present time, all participants must have a personal fisher's registration and the fishery is subject to owner operator policies. The CHP includes; a minimum size limit (TD of 51 mm (2.0 in.); sea urchins to be sorted and culled on the fishing grounds as soon as possible, with the culled animals returned to the sea immediately upon being culled and in a manner that causes the least harm; harvesting between sunrise and sunset; mandatory submission of logbooks; and dockside monitoring of 50% of all landings (trips). The season extends from October 1st to May 15th. At the inception of the commercial LFA 36 sea urchin fishery in the early 1990s, this fishery was limited entry and the number of licenses by gear type was split evenly. The conversion of a drag license to a dive license is permanent, which is a management measure to gradually move the fishery toward an all-dive fishery. As of 2008/09, there were 14 diver based license operator and only 4 licensed dragging operators. The conversion of a drag license to a dive license is permanent.

The diver-based fishing consists of a maximum of four divers in the water and two skiffs with a maximum length of 7.3 meters (24 feet) each. The skiffs must be used within 457 m (1,500 ft) of the mother boat to tend the divers.

Dragging operations are required to use urchin drags with a maximum opening width of 3 m (10 feet). In addition, dragging operations are subject to mobile gear restrictions that limit access to inshore areas off LFA 36 until the second Tuesday in January and again starting April 1 until the end of the season to avoid gear conflicts with other fleets and specially designated non-fishing areas.

The fleet operates competitively under a total allowable catch (TAC) of 900 t. These management measures are reviewed on an annual basis with members of the sea urchin industry.

Figure 2 shows the commercial landings for this fishery since 1989-90. A TAC of 900 t was established in 1996, and it has been in place for the subsequent 12 years. Landings exceeded the TAC in 1996-97, 2004-05 and 2007-08. During the years when the fleet TAC was exceeded, final landing statistics were summarized only after the end of the season.

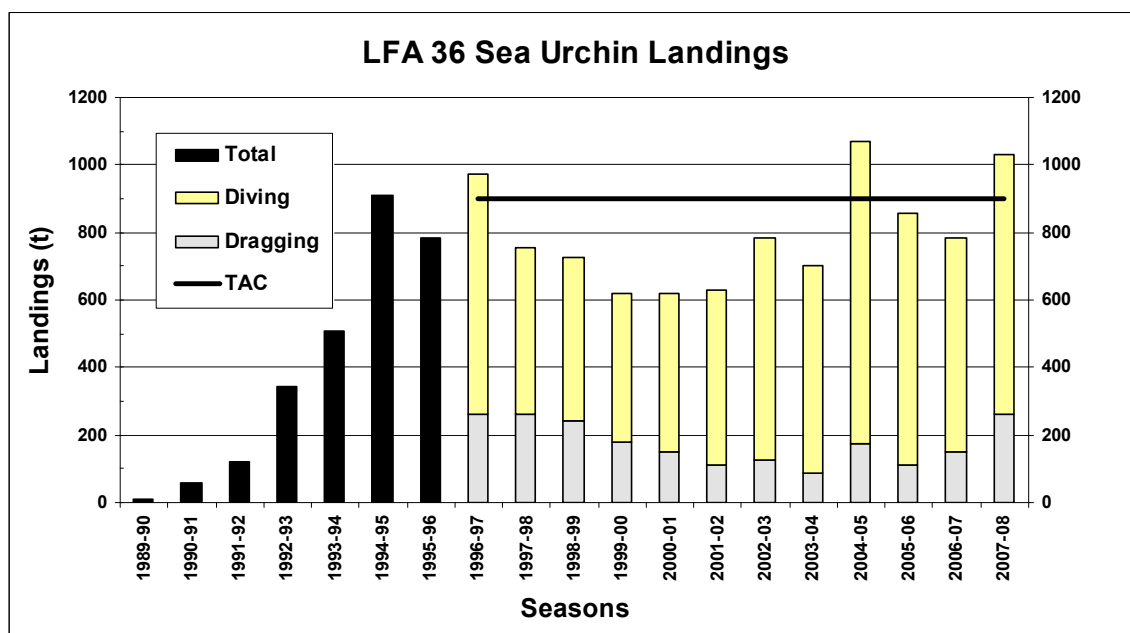


Figure 2: Historical sea urchin landings in metric tonnes (t) for LFA 36.

The proportion of the catch in LFA 36 harvested by divers has fluctuated between 65% (1997-98) to 88% (2003-04) and is currently at the long term average of approximately 77%.

Landings trends in LFA 36 are analyzed using logbook information. During fall 2008, a new type of logbook was introduced that reported the location of fishing by previously defined fishing areas. However, data from the new logbook used in 2008/09 were not yet available in time to be analyzed for this report. Logbook data are used to calculate effort trends and catch per unit of effort (CPUE) indices for individuals, groups, and locations. Catch rate and effort trends based on the analysis of logbook information prior to 2008/09 is presented as the weight of urchin landed per fishing trip (Kg/Trip), and the total number of fishing trips during each fishing season (Table 1).

Table 1. Landings in metric tonnes (t), catch rates in kilograms per trip (Kg/Trip), and effort in number of trips per season for dive and drag licenses in LFA 36 by fishing season from 1996-97 to 2007-08.

Seasons	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
TAC	900	900	900	900	900	900	900	900	900	900	900	900
Dragging(t)	262	261	242	180	148	114	127	85	174	109	150	263
Kg/Trips	772	884	890	765	714	821	903	967	1016	910	992	983
# of Trips	325	293	270	234	207	138	139	88	171	120	151	267
Diving (t)	710	495	484	437	470	517	656	618	893	749	635	766
Kg/Trips	807	595	683	652	598	683	719	739	911	873	827	841
# of Trips	873	817	700	661	779	749	908	835	979	856	765	909
Total landings (t)	972	756	726	617	619	630	783	703	1068	858	785	1028

CPUE has elements of population abundance but is influenced by discarding due to product quality and market prices. Therefore, the CPUE series must be interpreted with caution and cannot be used exclusively as an indicator of population abundance.

There has been an increasing trend in CPUE for both the dive and drag fisheries since 1991-92 (Figure 3). This could be due to improved fishing practices and experience, changing market conditions, or changes in abundance.

For the dive fishery, the number of fishing trips showed an increasing trend from 1999 to 2005 but has been variable in recent years.

For drag licenses, the number of trips have declined from 1996-97 fishing year to 2003-04 and has been increasing since.

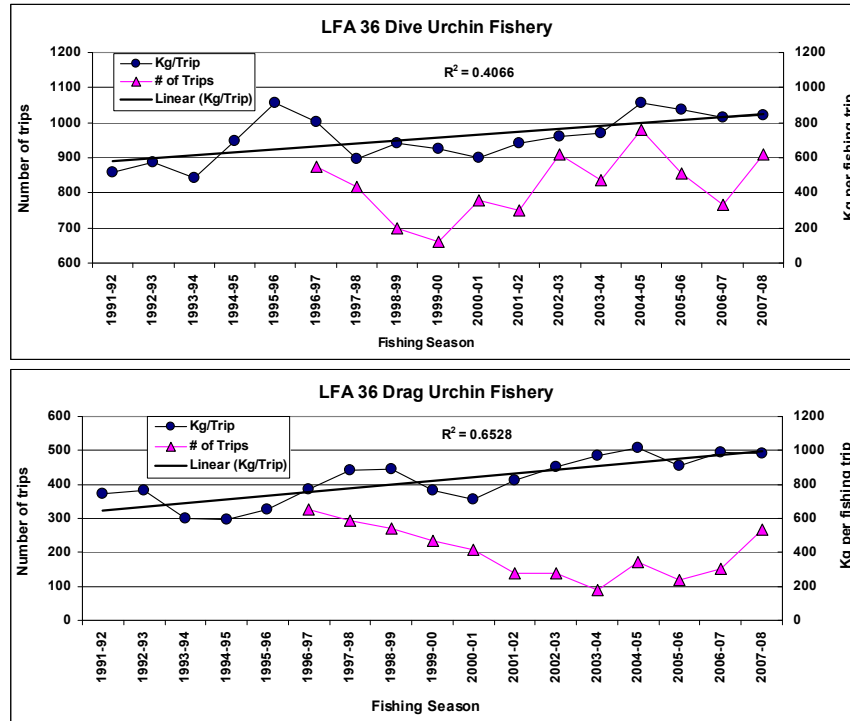


Figure 3: Number of trips per season and average catch in kilograms per fishing trip for the LFA 36 diving fishery (top) and drag fishery (bottom) from the 1991-92 to 2007-08 fishing seasons.

RESOURCE ASSESSMENT

In LFA 36 a seasonal TAC of 900 t was established in 1996 based on biomass estimates from diver based surveys that were done between 1992, 1993 and 1994 in Campobello Island, Deer Island and Letete to Pocologan fishing areas. The TAC was set on an estimated total biomass of legal size urchins of 13,245 t (6.8%). An additional area, Maces Bay, was added for the 2002-03 survey.

Urchin surveys were initiated during the summer of 2002 and were continued during the summer of 2003. These initiatives were made possible through Joint Project Agreements (JPA) between the license holder groups, Sea Urchins of New Brunswick Inc., the St. Mary’s First Nation, and Fisheries and Oceans Canada (DFO).

The 2002-03 survey methods were based on similar diver transect methods used during the 1992-94 surveys (Robinson and MacIntyre 1993, 1995). Although fewer transects were sampled overall, they were located in the exact same positions as in the 1992-94 survey. Only data from locations resurveyed in 2002-03 were compared with the corresponding locations surveyed in 1992-94.

In summary, 98 dive transects were completed during July, August and September of 2002-03 in the three fishing areas that were surveyed in 1992-94 and an additional 50 transects were completed in Maces Bay.

Diver Based Surveys (1992-94 Versus 2002-03)

Density

Based on statistical analyses of mean urchin densities (Table 2), the following conclusions were reached.

Within all the fishing areas combined, in both depth strata, the overall density of urchins of all sizes was not significantly different between the 1992-94 and 2002-2003 survey periods or between fishing areas. The density of legal size urchins was not significantly different between fishing areas and between survey periods, with the exception of Deer Island where the density of legal size urchins were significantly lower in 2002-03 than in 1992-94. The density of legal size urchins (≥ 51 mm TD) was significantly higher in the shallow strata (< 10 m) during both survey periods and within each fishing area compared to the deeper strata (10 – 20 m).

The density of sub-legal size urchins (25 to 50 mm TD) was not significantly different between survey periods and between fishing areas. The density of sub-legal size urchins was significantly higher in the shallow depth strata than in the deep stratum (10-20m) during both survey periods. The density of immature urchins (< 25 mm TD) was not significantly different between survey periods for each fishing areas and depth strata.

Table 2. Mean densities (urchins/m²) of legal size urchins (≥ 51 mm test diameter (TD)), sub-legal (25 to 50 mm TD) and immature (< 25 mm TD) size urchins for each fishing area during the 1992-94 and 2002-03 surveys.

Locations	1992-94 (Urchins/m ²)											
	All sizes			Legals			Sub-legals			Immature		
	≤ 10 m	> 10 m	Total	≤ 10 m	> 10 m	Total	≤ 10 m	> 10 m	Total	≤ 10 m	> 10 m	Total
Campobello	14.7	15.6	15.1	2.5	0.3	1.6	9.5	8.8	9.2	2.6	6.6	4.3
Deer Is.	42.0	22.5	34.7	5.5	1.5	4.0	26.2	10.2	20.3	10.2	10.8	10.4
Letete	26.5	16.6	23.2	4.0	1.4	3.1	14.5	9.3	12.8	8.0	5.9	7.3
Grand Total	28.2	18.0	24.4	4.1	1.1	3.0	16.7	9.4	14.0	7.4	7.5	7.4
Maces Bay												
Locations	2002-03 (Urchins/m ²)											
	All sizes			Legals			Sub-legals			Immature		
	≤ 10 m	> 10 m	Total	≤ 10 m	> 10 m	Total	≤ 10 m	> 10 m	Total	≤ 10 m	> 10 m	Total
Campobello	26.0	10.2	19.4	3.2	0.7	2.1	19.9	5.3	13.7	3.0	4.2	3.5
Deer Is.	32.2	12.6	24.9	2.4	0.7	1.8	23.8	7.0	17.5	6.0	4.5	5.5
Letete	27.8	8.5	21.3	3.3	0.5	2.3	17.9	3.0	12.9	6.6	5.0	6.1
Grand Total	28.7	10.2	21.9	3.0	0.6	2.1	20.1	4.8	14.4	5.6	4.6	5.2
Maces Bay	12.1	2.8	10.3	2.7	0.8	2.3	7.0	1.4	5.9	2.4	0.6	2.1

Biomass

The fishable biomass estimate for the survey areas (Table 3), based on the same areas as the 1992-94 surveys (i.e., not including Maces Bay) was estimated at 5,071 t during 2002-03 in comparison to 7,700 t during 1992-94, a decrease of 34%. Total biomass has changed little between the two survey periods.

A fishable biomass for the Campobello Island survey area was estimated at 1,240 t during 2002 in comparison to 1,014 t during 1992, an increase of approximately 22% since 1992. Most of the legal biomass increase occurred off the northern and southern end of Campobello Island. A fishable biomass for the Deer Island survey area was estimated at 1,200 t during 2002-03 in comparison to 2,965 t for 1992-93, a decrease of approximately 60% since 1992-93. A fishable biomass for the Letete to Pocologan survey area was estimated at 2,631 t during 2003 in comparison to 3,721 t during 1993-94, a decline of approximately 29% since 1993-94. A fishable biomass for the Maces Bay survey area was estimated at 2,706 t during 2002. The fishable biomass from the Maces Bay area was not included in the 1996 estimates when the original TAC of 900 t was established. By adding the fishable biomass from Maces Bay, the total survey fishable biomass based on the 2002-03 survey was estimated at 7,777 t.

With extrapolation of the biomass estimates to the total LFA, assuming a decline of 34% of the overall legal biomass of 13,245 t (estimated for all the fishing areas surveyed during 1992-94), a fishable biomass of 8,742 t is estimated. By adding the 2,706 t of fishable biomass from the Maces Bay area, an LFA total fishable biomass of 11,448 t is estimated. Based on the established TAC of 900 t, the harvesting rate is estimated to be 7.9% – 1.1% higher than the harvesting rate of 6.8% that was approved in 1996.

However, the Passamaquoddy Bay area is also fished but has never been surveyed; thus, no biomass estimates for this area are available. Therefore, the 7.9% harvesting rate is an overestimate.

Table 3. Total (all urchin sizes) and fishable biomass estimates in metric tonnes (t) for each depth strata, fishing area and survey period.

1992-94	0 to 10 m		11 to 20 m		Combined	
Area	Total (t)	Fishable (t)	Total (t)	Fishable(t)	Total (t)	Fishable(t)
Campobello	2279	938	821	76	3100	1014
Deer Is.	7269	2538	1412	427	8681	2965
Letete to Pocologan	7438	3128	1703	593	9141	3721
Total	16986	6604	3936	1097	20922	7700

2002-03	0 to 10 m		11 to 20 m		Combined	
Area	Total (t)	Fishable(t)	Total (t)	Fishable(t)	Total (t)	Fishable(t)
Campobello	4124	1063	742	177	4866	1240
Deer Is.	5268	1020	894	179	6162	1200
Letete to Pocologan	7980	2412	632	218	8612	2631
Total	17372	4496	2268	575	19640	5071

2002-03	0 to 10 m		11 to 20 m		Combined	
Area	Total (t)	Fishable(t)	Total (t)	Fishable(t)	Total (t)	Fishable(t)
Maces Bay	5232	2510	311	196	5543	2706

Roe Quality

Sea urchin roe quality expressed as proportion of marketable roe prior to the opening of the fishery provides an indication of quality later in the year and may be important in the management of the fishery. At this time, data on roe quality from the July to September period is only available from surveys.

In order to be able to compare this data with roe quality data previously collected during the 1992-93 surveys, only data that came from the same locations and season were used in the analysis. Data from July, August and September 1992-93 and 2002-03 were compared.

Based on survey data, roe quality had improved during 2002-03 in comparison to 1992-93, which is consistent with anecdotal information from the fishery. However, no data are available for the intervening years.

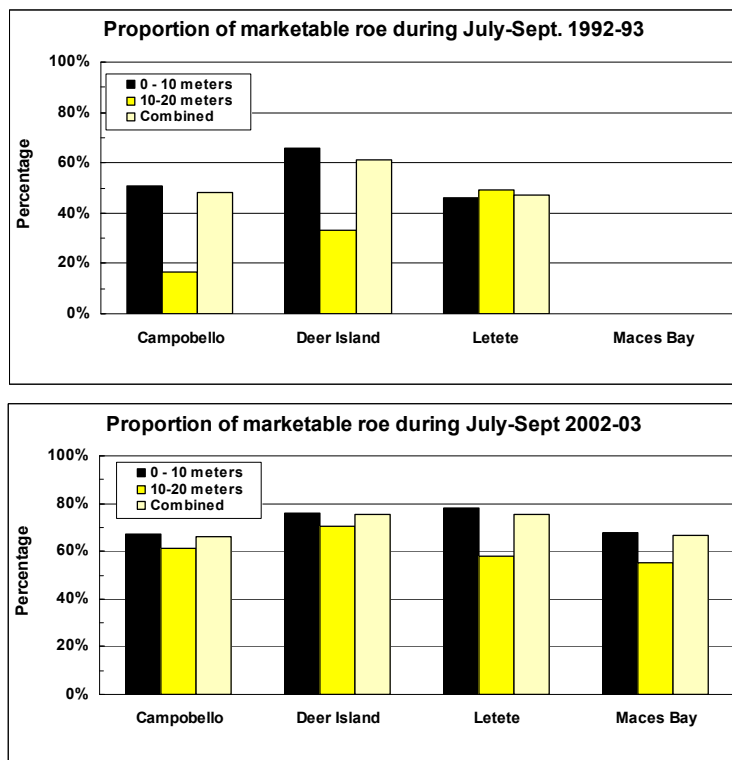


Figure 4. Proportion of marketable roe for each survey periods (1993-94 and 2002-03) and for each depth stratum and all depth combined within each survey period.

Age Structure

Robinson and MacIntyre (1997) have demonstrated that populations of sea urchins throughout the southwestern New Brunswick area differ in their size and age distributions and, in some areas, could be up to 25 years old (Figure 5). Their results showed a great deal of variation in the age at a particular size, suggesting the animals were limited in their growth potential, probably through lack of food. For example, a 20 mm sea urchin could be between 2 and 10 years old while a 50 mm sea urchin could range from 4 to almost 25 years.

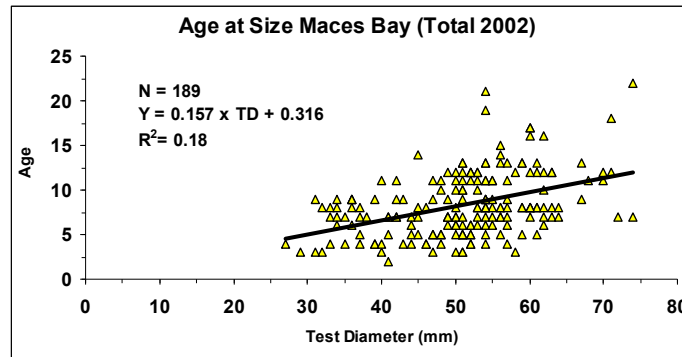


Figure 5. Test diameter (mm) versus age for the Maces Bay area during 2002.

Size and age data collected during 2002 in Maces Bay, which has been heavily fished for at least a decade, shows similar variability in size at age as the previous study (Robinson and MacIntyre 1997).

Sources of Uncertainty

Only two surveys are available, are 10 years apart, and do not provide a time series to interpret biological characteristics.

No survey has been conducted since 2002-03, so recent information is not available.

Biases in survey design may have been introduced because survey transect locations were not re-randomized for the most recent survey. A review of survey design should be considered.

CPUE has elements of population abundance but is influenced by discarding due to product quality and market prices.

There is a lack of information on mortality of sea urchin due to interaction with drags and divers.

Survival of discards by drag and divers is unknown.

Natural mortality is unknown.

Recruitment is difficult to predict due to variability in size at age.

Roe is not sampled for quality and yield during the fishery, although the fishery is highly influenced by this factor.

Drag and diver impacts on the benthos have not been evaluated.

CONCLUSIONS AND ADVICE

With the exception of Deer Island, where legal size sea urchin densities have decreased, all other areas show no statistically significant differences in densities for each size grouping between the 1992-94 and 2002-03 survey periods. Total biomass has changed little between the two survey periods. Estimated fishable biomass appears to have declined but is not significantly different between the two surveys due to a high degree of variability. Based on the established TAC of 900 t, the harvesting rate is estimated to be 7.9% -- 1.1% higher than the harvesting rate of 6.8% that was approved in 1996. However, Passamaquody Bay area is also

fished but has never been surveyed; thus, no biomass estimates for this area are available. Therefore, the 7.9% harvesting rate is an overestimate.

Catch rates based on both urchin dragger and diver logbooks have been the highest during the last four fishing seasons since 1996. However, CPUE is influenced by discarding due to product quality and market prices.

Implementation of the new logbook format will facilitate collection and analysis of effort and harvesting rate data by fishing area in more detail and on a timelier basis.

The recommended assessment schedule is every 5 years. However, annual monitoring of the landings, fishing effort and catch rate from the fishing logs would be useful to determine if an earlier than scheduled assessment is required.

The diver based surveys are critical to the assessment of this resource and another survey including all fishing areas in LFA 36 is recommended in the next 2 to 3 years.

At the present time there is no at-sea observer coverage, which limits quantification of by-catch amounts by the dragger fleet and the ability to evaluate ecosystem impacts of the fishery by both divers and draggers.

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