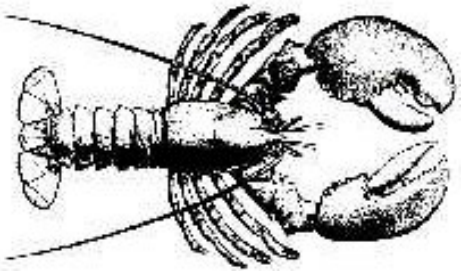
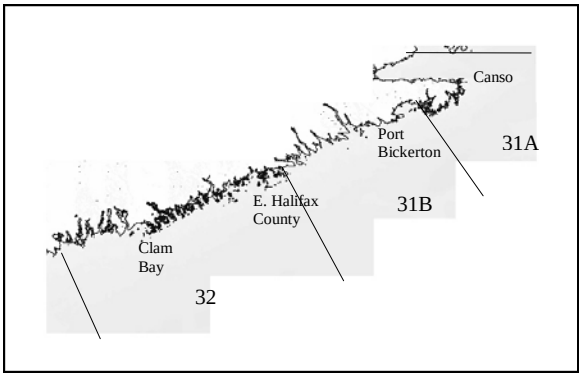


Eastern Shore Lobster (LFAs 31A, 31B, 32)



Background

Lobsters breed in summer to fall. Females use the stored sperm 1-year later to fertilize eggs, then carry the eggs under their abdomen for another year before hatching in July-August.

Larvae swim in the water column for 4-6 weeks before settling to the bottom and seeking shelter. Survival through larval stages is quite low and varies considerably between locations and years.

Six to 9 years are required for lobsters to reach legal size. At legal size males grow (molt) annually for about 3 years, then less often. Females grow annually until sexual maturity, then biennially for about 3 molts, then less often.

Movement of legal sizes is principally shallow to deep in the fall and deep to shallow in late spring. Small juveniles stay within meters of their shelters whereas large sexually mature lobsters may wander a few km in a year.

The fishery is trap-only with no sport fishery. It is regulated by effort controls and limits on the size and sex that can be retained. Management controls the cost of fishing, reduces waste of the harvested resource, and helps realize resource potential in weight and value.

Summary

- Management changes from 1998 through 2001: in LFAs 32 and 31B minimum legal size (MLS) increased 1.5 mm and each license holder returns 50 kg of large non-ovigerous females to the fishing ground annually; in LFA 31A MLS increased 5 mm from 81-86 mm carapace length (CL) and non-ovigerous (window) females 114-124 mm CL are not retained.
- From MLS changes the egg per recruit model predicted increases in eggs/recruit of 12%, 7%, and 34% in LFAs 32, 31B, 31A, respectively.
- In LFA 32 and 31B ovigerous females that were v-notched showed that put-backs benefited total egg production by at least 22% and 14%, respectively. There was no change in ovigerous (berried) females per trap haul.
- In LFA 31A the expected increases in lobster sizes resulted from increase in MLS and protection of windows. However, expected increases in total ovigerous per trap haul were not seen.
- In all LFAs port sampling of catches proved useful to estimate static parameters but was less sensitive for year-to-year changes.
- Catch rates of legals, pre-recruits, ovigerous, and v-notched taken from volunteer fishermen's log records were especially useful indicators.
- Methods for fishermen-directed tag-recapture studies were developed.

These can potentially provide absolute egg production and number of lobsters in any stock component caught and not retained by fishermen.

- Out-of-season larval and pre-recruit surveys may provide early indicators of stock response to changes in fishing effort, environment, or stock management.
- Stock status indicators of catch per trap haul, landings, and pre-recruits were higher in most areas. Exploitation, as measured by percent of catch in the first molt group, was unchanged.
- An observational rather than modeling approach to lobster stock management is recommended. Using this approach, stakeholders would seek to achieve a fishery's yield potential by adjusting regulations on a trial-and-error basis.

The Fishery

Management is based on effort controls (limited licenses, seasons, traps), minimum legal size (MLS), and a variety of means of protecting sexually mature females.

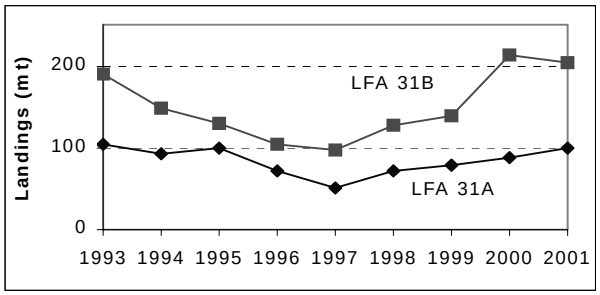
LFA	Season	Trap limit	No. licenses
31A	Apr. 29-June 30	250	75
31B	Apr. 19-June 20	250	72
32	Apr. 18-June 20	250	166

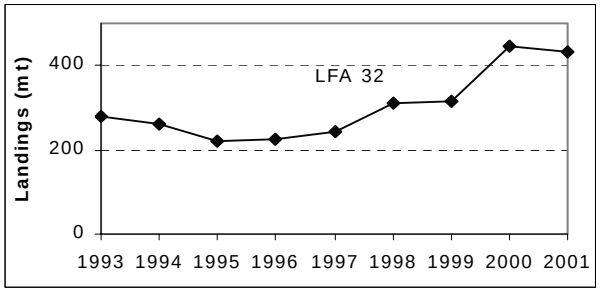
In 1995 the Fisheries Resource Conservation Council (FRCC) recommended that each LFA increase eggs/recruit to 5% of the unfished level. This was not acted upon. In 1997 the DFO minister asked for a new plan. Lobster biologists recommended doubling eggs/recruit as a more attainable target and as a beginning to a more precautionary approach. A 1998 Regional Advisory Process (RAP) presented scenarios developed for achieving the doubling target (DFO 1998). The following table lists the changes that had been adopted by 2001.

LFA	Changes
32	81 to 82.5 MLS and Each licensee v-notches and returns
31B	to the fishing ground annually 50 kg of large, non-ovigerous females. No retention of v-notched females.
31A	81 to 86 mm MLS No retention of non-ovigerous females 114-124 mm CL. No retention of v-notched females.

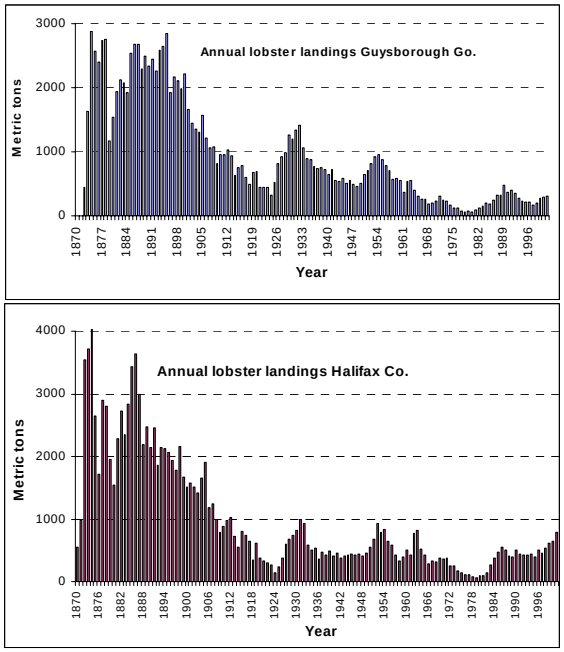
Recent landings in all three LFAs have approximately doubled since 1997, but in Guysborough and Halifax counties remain far below landings occurring just after the fishing-up period which ended in the late 1890s.

Recent landings in LFAs 31 A & B and 32





Long-Term Landings in Two Counties



The accompanying table summarizes increases to egg production from management changes. The only measures of benefits of MLS increases are from the egg/recruit model. Increases of 1.5 mm in LFAs 32 and 31B gave 12% and 7% increases in eggs/recruit. The model predicts an 11% benefit from the put-backs in LFA 32, but the added benefit of their protection by v-notches could not be calculated. Fishermen's records, from several sources, provided catches of ovigerous females with and without v-notches. These showed 22% and 14% contributions from put-backs for LFAs 32 and 31B, respectively. A second method using the same data gave results of 25% and 13%. An expected increase in ovigerous females per trap haul was not seen. It is too soon to see increases in total landings or catch per trap haul from higher recruitment. The lack of expected changes in abundance of ovigerous females can be caused by inadequacy of sampling or increased exploitation of large lobsters.

Effects of Management Measures

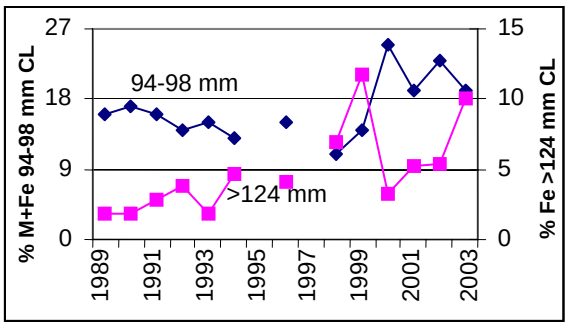
		Results	
Method / Source	Measurement	LFA 32	LFA 31B
E/R model	percentage change in E/R vs. 1997	1.5 mm MLS 12%, put-back 11% + v-notch protection	1.5 mm MLS 7%. put-back <11% + v-notch protection
portion of ovigerous females v-notched, fishermen's records	percentage increase in egg production in current year vs. no protection	22%	14%
2nd method of calculating above ratio	same	25%	13%
median size, port samples	expected increase with MLS	no change	no change
ovigerous females per trap haul, volunteer logs	expected increase with put-backs	no change	no change
landings, legal & pre-recruits catch per trap haul,	higher recruitment from higher E/R	too soon	too soon

Methods / Source	Measurement	Results – LFA 31A
E/R model	percentage change in E/R since 1997	5 mm MLS 34%, window 20%
median size, port samples	expected to increase from MLS and window	equivocal
percent catch 94-98 mm, port samples	expected increase from MLS increase	benefit
percent females >124	expected increase	benefit

mm, port samples	from window protection	
all window and ovigerous window females, at-sea samples	expected increase from window protection	equivocal
total ovigerous per trap haul, at-sea samples	expected increase from MLS and window protection	no change
ovigerous females 81-85 mm, at-sea samples	expected increase from MLS protection	9% more eggs
landings, legal & pre-recruits catch per trap haul	expected increase from greater yield/recruit and recruitment	possible small benefit from yield per recruit

In LFA 31A the egg/recruit model predicted 34% more eggs from the 5 mm MLS increase and 20% more from the window measure. Catch sampling in port showed expected increases from the minimum size and from protection of window females. The large females should first appear in the catch in 2003 when they doubled in percentage of catch compared to 2002. The high value for 1999 is unexplained.

From Port Samples in Canso, Increased Catch in 94-98 mm CL from a Minimum Size Increase, and >124 mm CL from Windows Molting into Legal Size (no data for 1995 and 1997)



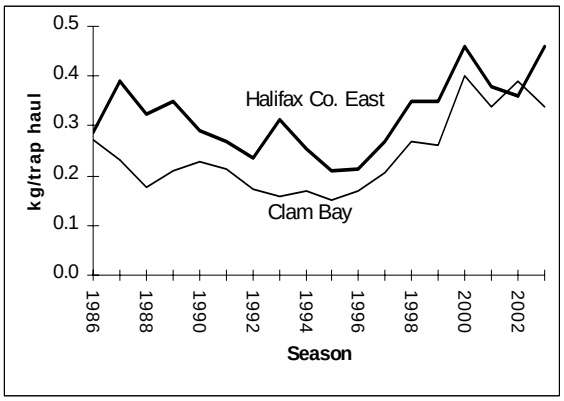
At-sea samples indicated the fraction of window lobsters that are ovigerous is much lower than expected; the number of ovigerous females in the newly protected 81-86 mm size added 9% to egg production; and there was no increase in total ovigerous. Part of the increase in catch per trap haul could be a growth (yield per recruit) benefit of increased MLS. The latest landing record of 2001 is too soon to see benefits of higher recruitment.

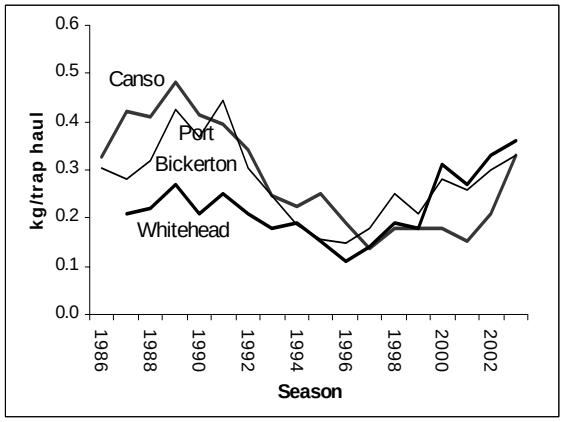
Stock Status

Some of the stock indicators used here were also used in the previous section, but more trends are identified because the years in which changes occurred do not necessarily correspond with changes in regulations.

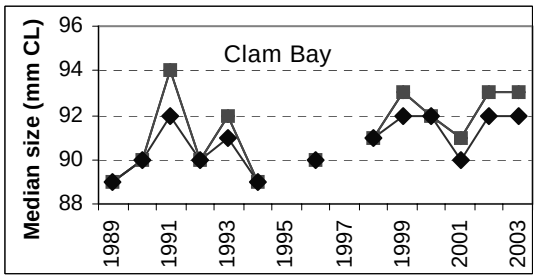
All the trends in stock indicators are positive or neutral. Since 1997 catch per trap haul is up substantially in four of the five sampling ports; in Canso the increase began in 2002. Landings began increasing in 1996 or 1997 in all three LFAs. Although erratic, there are no trends in the percent of catch in first molt over the last several years. Median size in the catch is unchanged in Clam Bay and Port Bickerton, but higher in Canso.

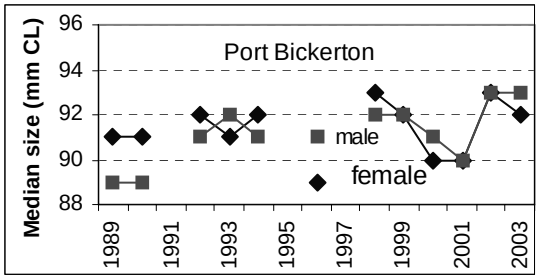
Mean Annual Catch (kg) per Trap Haul

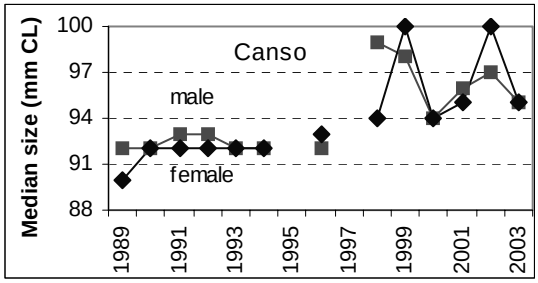




Median Size in Three Sampling Ports (data missing for 1995 and 1997)

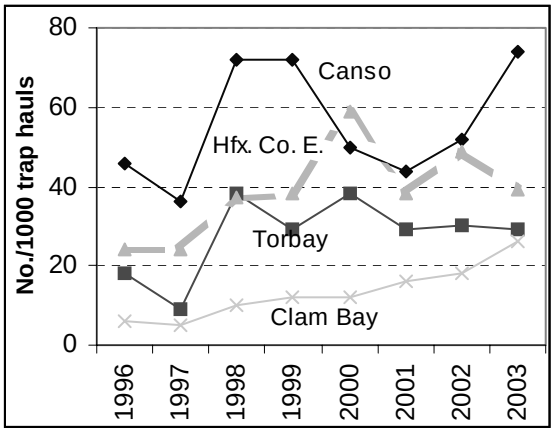




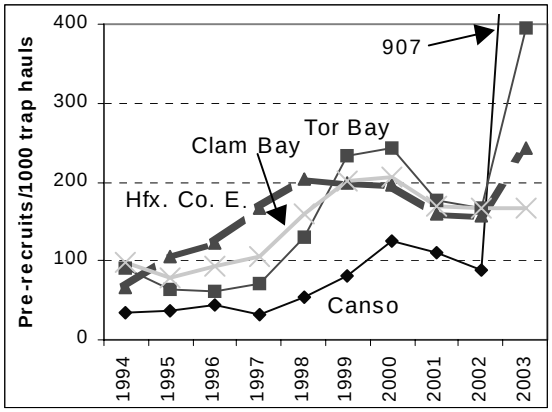


The catch of ovigerous per trap haul is unchanged or higher. In 2003 pre-recruits per trap haul increased in Canso, Torbay, and Halifax County East, but not Clam Bay.

Ovigerous Females per 1000 Trap Hauls



Pre-Recruits per 1000 Trap Hauls



Recommended Stock Indicators

We have traditionally sampled lobster catches three ways: size frequency and sex of catches landed in port, sex and size frequency of catches on-board fishing vessels, and volunteer fishermen's records of total catch per trap haul, shorts and ovigerous per trap haul. Port samples appear to be of limited use for following annual trends. They are more useful for location-specific static measures such as the fraction of the catch affected by a change in legal size or a port-to-port comparison of exploitation. We propose to reduce the frequency of these samples. The 3-year time series of at-sea samples was too short to assess their usefulness for annual trends.

Volunteer fishermen's records of catch per trap haul track landings and provide inexpensive feedback on catch of undersized and ovigerous.

The percentage ovigerous that are v-notched is a convenient measure of the benefit of the put-back program.

Lobster landing statistics are a useful report card of management success, but are inaccurate and late in becoming available.

Tag-recapture studies were carried out in 2002 and 2003 to measure abundance of ovigerous and window females. Using a size-fecundity relationship lobster abundance was converted to egg production. For example, on the fishing grounds of the port of Whitehead annual egg production was 91 million, and 22 million of this was contributed by 114-124 mm window females. The tag-recapture method can be used for any population component caught by fishermen but not retained, including undersized, v-notched, or culls.

Larvae were sampled from lobster boats in the summers of 2002 and 2003 and pre-recruits were sampled in trapping surveys from four ports in the fall of 2003. Stage IV abundance was higher in 2002 and may be related to surface circulation. If continued, larval and pre-recruit surveys may measure changes in stock production and survival resulting from changes in fishing effort, environment, or stock management.

Sources of Uncertainty

Nearly all our measurements have sources of uncertainty. For the egg/recruit model measurements of fishing and natural mortality, growth of large lobsters, and annual changes in mortality are uncertain.

Because of spatial and temporal changes in stock distribution and within-season changes in catchability, port and at-sea samples represent the stock size distribution imperfectly. Recent landings have been underreported. Changes in the management regime and data collection methods probably affect the accuracy of long-term landing statistics.

Counts of ovigerous females, notched and unnotched, may be incomplete. Some window and v-notched lobsters may be landed by fishermen. Some assumptions of mark-recapture studies may not be met when estimating window and ovigerous stock components.

Outlook

Recent trends in stock indicators are positive or neutral. We have not made a prediction of future landings.

Management Considerations

Levels of stock indicators can either be set as management targets (e.g. egg/recruit at 5% of the unfished value) or measures of a stock's response to management (e.g. female put-backs added 20% to egg production). Here it is advocated that stakeholders use landings as their management target and assume landings much higher than present levels are possible, given the high levels supported by the fishing grounds a century ago. To achieve higher landings stakeholders could periodically adjust, on a trial and error basis, the management regime. The impacts of these adjustments on the stock should be measured as early as practical as changes in ovigerous females, egg production, larval or juvenile abundance. Fishermen participation can greatly reduce the costs of these surveys. This observational approach is an alternative to modeling predictions of change.

An expectation among some stakeholders that increased egg production will result in increased recruitment to the fishery in one lobster generation is unreasonably optimistic. Lobster stock-recruit relationships are not that predictable.

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