

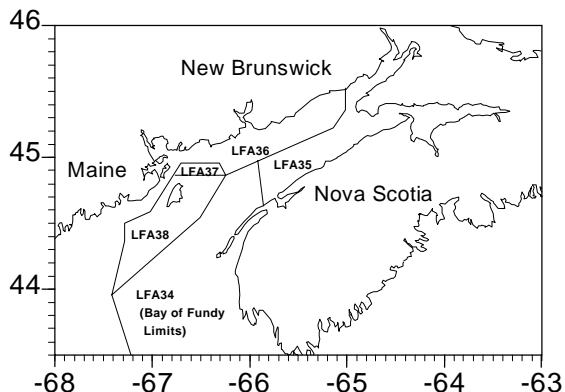
## Bay of Fundy Lobster (LFAs 35, 36, and 38)

### Background

The lobster, a crustacean, has its skeleton on the outside of its body and to grow must shed the shell, a process called molting. Very young lobsters molt 3-4 times a year, increasing 50 % in weight and 15 % in length with each molt. In the waters of the Bay of Fundy, lobsters take 8 or more years to reach legal size at 81 mm carapace length (CL). At that size, they weigh 0.45 kg (1 lb.) and molt once a year. Larger lobsters molt less often, with a 1.4 kg (3 lb) lobster molting every 3-4 years. The largest lobster ever reported was 20 kg (44 lb), estimated to be 40-65 years old.

At an estimated 104 mm CL, Bay of Fundy lobsters have the largest average size at maturity across the range of the lobster, due to the colder waters they experience. Mature females mate after molting in midsummer and the following summer produce eggs that they attach to the underside of their tails. The eggs are carried for 10-12 months and hatch in either July or August. The larvae spend 30-60 days in the plankton, before settling to the bottom and seeking shelter. For the first 2-3 years of benthic life, lobsters remain in or near their shelter to avoid the small fish that feed on them. As they grow, and have less chance of being eaten, they move about and become catchable by lobster traps.

Lobsters are found in coastal waters from southern Labrador to Maryland, with the major fisheries in the Gulf of St. Lawrence and the Gulf of Maine. Though lobsters are most common in coastal waters, they are also found in warm deep water areas of the Gulf of Maine and along the outer edge of the continental shelf from near Sable Island to off North Carolina. Lobsters make seasonal migrations, moving to shallower waters in summer and deeper waters in winter. Over most of the lobster's range, these movements amount to a few kilometers. However in the Bay of Fundy, Gulf of Maine, offshore regions of the Scotian Shelf, and off New England, lobsters can undertake long distance migrations of 10s to 100s of km. Tagging studies have also shown that at least some of these lobster return to the same area each year.



### Summary

- Landings have increased dramatically over the past two years and are well above average levels.
- Mean size of the catch in the upper bay has declined by about 10 mm (due to increased recruitment), but there has been no change in mean size in other areas where catches have been sampled.
- Because of the large number of pre-recruit lobsters appearing in at-sea samples, landings over 1000 tonnes are expected to continue for several years.
- A new analytical approach has generated lower estimates of exploitation rates in LFAs 35 to 38. Previous published estimates ranged from 60-85%; current estimates range from 39-70%.
- A Bay of Fundy-wide exploitation rate was calculated for input into egg production per recruit analysis. For 1988-93 (stable landings period prior to recent increase) average exploitation rate was 53% (range 49 - 55%).
- Several options for doubling egg production per recruit in the Bay of Fundy are presented, using an exploitation rate of 53%, and a more conservative estimate of 70%.

### *The Fishery*

The present **management** regime is based on limited entry and effort controls which vary between LFAs:

LFA	License details	A licenses (full time)	Partnership (full time)	B licenses (part-time)
35	Number	93	-	4
	Trap limit	300	-	90
36	Number	149	9	2
	Trap limit	300	450	90
38	Number	77	30	1
	Trap limit	375	563	113

Lobsters are vulnerable to trap fisheries from October 15 to July 31 of the next year:

LFA	Fall season open	Fall closure	Spring season open	Spring closure
35	Oct. 15	Dec. 31	April 1	July 31
36	2nd Tues. in Nov.	Jan 14	March 31	June 30
38	2nd Tues. in Nov.	Open through winter	Open through winter	June 30

There is a common minimum size of 81mm carapace length (CL), and a prohibition on landing egg-bearing females. Boundary lines between LFAs, and the international border (including a disputed zone off Machais Seal Island), cover considerable distances leading to contention over proposed changes in management of component LFAs, as well as concern over the lobster management regime in US state and federal waters.

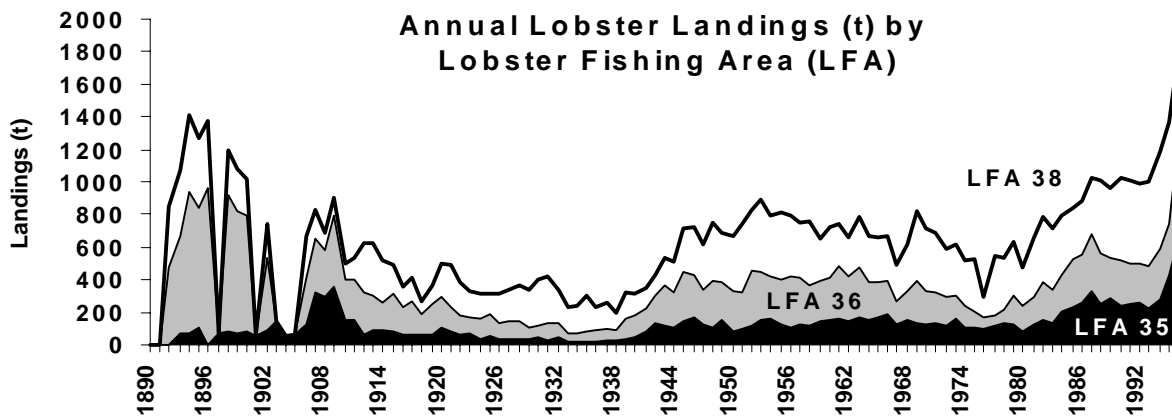
**Fishing grounds** have expanded over the last two decades in the upper bay, along the New Brunswick shore, and in LFA 38. Since

the late 1970's, a small group of LFA 38 fishers have fished deep waters (to 205 m depth) at the entrance to the bay, targeting seasonal lobster migrations.

In November 1995, the Fisheries Resource Conservation Council (FRCC) presented a review of the **conservation** status of the Atlantic lobster fishery (FRCC, 1995). It concluded that the present fisheries were operating at high exploitation rates, harvesting primarily immature animals, which did not allow for adequate egg production. A new framework of seven large conservation units (Lobster Production Areas, LPAs) was proposed, within which measures should be taken to increase egg production. LFAs 35-38 fell within LPA 7 (Gulf of Maine), which the FRCC took to include LFA 34, and portions of LFA 41. A target of egg production per recruit (E/R) equivalent to 5% of that of an unfished population was recommended.

Despite general agreement by industry on the need to change, there was no agreement on the FRCC target and as a result, doubling of E/R was selected. In December 1997, the Minister of Fisheries and Oceans issued a directive to Atlantic lobster fishers to implement new conservation measures, over 4 years, which would achieve a doubling of egg production from current E/R levels.

Lobster **landings** in the Bay of Fundy were first reported on an annual basis in 1892. Landings peaked in 1895 at 1415 t, then subsequently declined, over a 40-year period, to a low of 179 t in 1938. From 1939 onwards, landings increased to a second peak of 897 t in 1953.



Recent landings are compared on a seasonal basis, as lobsters growing into the first molt-group of the fishable stock over summer form most of the landed catch in the following fall and spring fisheries.

Seasonal<sup>†</sup> Landings (t)

LFA	Mean 70-79	Mean 80-89	Mean 90-92	93-94	94-95	95-96	96-97
35	114	216	240	241	311	546	726
36	130	258	259	274	317	421	651
38	295	382	493	523	648	600	516
Total	538	856	992	1038	1276	1567	1893

<sup>†</sup>Fall to subsequent spring fishery; for season dates see table above

On a seasonal basis, total landings were relatively stable (between 491-897 t) from 1946/47 to 1974/75. A low of 296 t was reported in 1975/76; however landings rebounded to 545 t the following year.

From 1988-89 to 1993-94, total landings appeared to have stabilized at approximately 1000 t (range 942-1046 t). Landings then increased by approximately 300 t each fishing season to reach 1893 t in 1996-97.

On a percentage basis, LFA 38 has represented approximately 50% of the total landings during most of the last 50 years, but currently ranks below LFAs 35 and 36.

### Stock Structure

While a portion of the Bay of Fundy fishery depends on lobsters migrating into fishing areas at different times of the year, there are areas of local lobster production, as evidenced by the presence of juvenile lobsters in commercial traps, and in benthic biological censuses. Examples are southern Grand Manan, and the Fundy Isles/S.W. New Brunswick coastal area. Historically, the fishery in the upper bay was thought to rely mainly on seasonal immigration of lobsters. Fisheries monitoring during the 1990's, principally in the Alma area, has documented a dramatic change in lobster size distribution, which suggests that local benthic production in the upper bay has increased.

Recent results on **lobster movement** (Robichaud and Lawton, 1997) are consistent with studies conducted in the late 1970's which demonstrate substantial mixing

throughout the Bay of Fundy, and along the Maine coast. The total percentages of tag returns in these tagging studies varied between 13% and 20%.

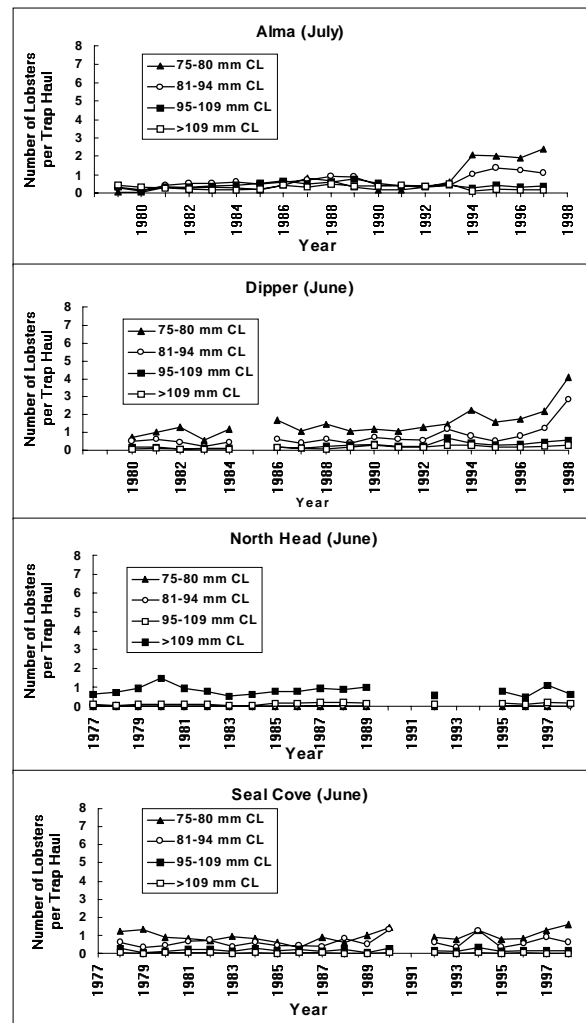
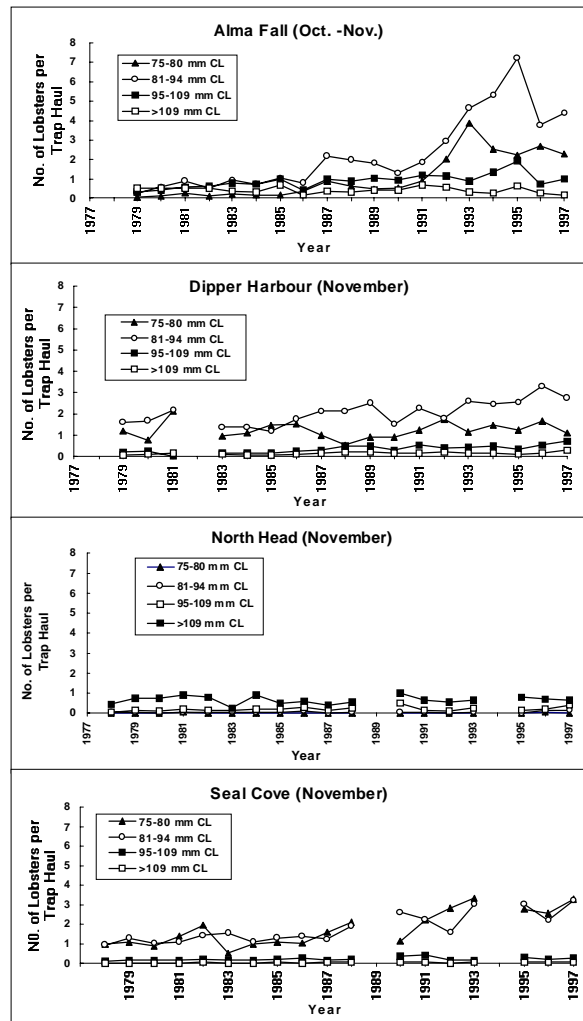
**Resource Status**

**At-sea sampling** has been conducted over a 20-year period at four major ports in the Bay of Fundy. Samples are generally available from the first two weeks of the fall season, and from the last two weeks of the spring season, which represent the bulk of the catch (e.g. approx. 60% on Grand Manan).

For Seal Cove (LFA 36), annual sampling has indicated a stable size frequency, with average sizes ranging from 77 - 85 mm CL.

Despite the introduction of escape panels in lobster gear, pre-recruit lobsters are still retained and recent observations (June 1998) show a continued strong representation.

Fishery samples from Dipper Harbour (LFA 36) show a broader range of size classes of lobster, both in pre-recruit sizes (<81mm CL), and larger lobsters beyond the first molt group in the legal size range (81-94mm CL). A progressive increase in pre-recruit presence is indicated for samples taken in June, such that the latest sample contains the highest number per trap haul in the series.



The mean size of lobsters sampled in Alma in the 1990/91 season was 93 and 100 mm CL

in fall and spring samples. There has been a downward shift in mean size of lobster (84 and 88 mm CL in July and October 1997 respectively), and an increase in catch rate, both of pre-recruits, and the first molt group.

The North Head (LFA 38) fishery is similar to the midshore and offshore fisheries in LFAs 34 and 41 (in terms of fishing strategies, soak days, winter fishing period, and lobster size distribution). The average size of lobsters has ranged from 115 to 123 mm CL in fall sampling, and 127 to 130 mm CL in spring sampling over the period 1990 to 1998.

Length-based cohort analysis (LCA: Cadrin and Estrella, 1996) was used to estimate **exploitation rates**. These were generally lower than were provided in earlier assessments (FRCC, 1995: range 60-85%). The current estimates range between 39 - 70% for LFA 35, 48-56% for LFA 36, and 54-66% for LFA 38. Using the available size frequency data for the three LFAs, and reported landings, a combined Bay of Fundy LCA yielded exploitation rate estimates of 49-63% .

As with all length composition analyses, LCA is sensitive to changes in size structure, due to changes in recruitment level. Thus an apparent increase in exploitation rate in LFA 35 in 1994 and 1995 may be an artifact. Average exploitation rates generated by LCA analyses between 1988 to 1993, when landings were more stable for the Bay of Fundy, were used in calculations of egg production per recruit and the impacts of proposed management changes.

### *Sources of Uncertainty*

Regarding **landings**, major gaps are the number of trap hauls which contribute to reported landings, and fishing location. The

landings reporting system changed in 1995 (from collection of sales slip information to self reporting logbooks), and so the recent landings increases may be confounded by reporting differences. Bay of Fundy fishers have noted that some of the shifts in effort applied to lobster are related to the relative performance of other fisheries.

Regarding **stock structure**, the degree to which the Bay of Fundy is reliant upon adjacent areas for larval production remains unclear. A number of historical studies did not consider the area to be very favorable for local larval production due to relatively cold summer water temperatures, though benthic surveys and other fisheries monitoring from 1989 onwards indicate significant current levels of benthic settlement. The general conclusion from the available scientific studies on the Bay of Fundy lobster fishery is that it should be considered to be a component of a Gulf of Maine lobster metapopulation.

Regarding the **exploitation rate** analysis, the existing sampling of length composition in the Bay of Fundy lobster fishery is limited. It was not possible to break the landings data down much beyond the LFA level, and single at-sea samples were used to model fall and spring landings data.

The new, lower exploitation rate estimates for the Bay of Fundy are consistent with general results from application of the LCA approach in other lobster fishing areas.

The **E/R analysis** and the projected benefits of various management scenarios are based on recent formulations of the Idoine-Rago E/R model (Anonymous, 1996). An earlier version of this model was used to develop E/R scenarios in the FRCC review (FRCC, 1995). Remaining uncertainties in applying the model include:

1. Lower exploitation rates from LCA. There is uncertainty in these new estimates, and risk associated with the fact that they may lead to greater projected benefits from some stock conservation measures. For this reason, additional runs of the model were completed using a higher exploitation rate.

2. Appropriate time scales and magnitude of benefit for specific stock conservation measures (e.g. minimum size, maximum size, and v-notching).

**Outlook**

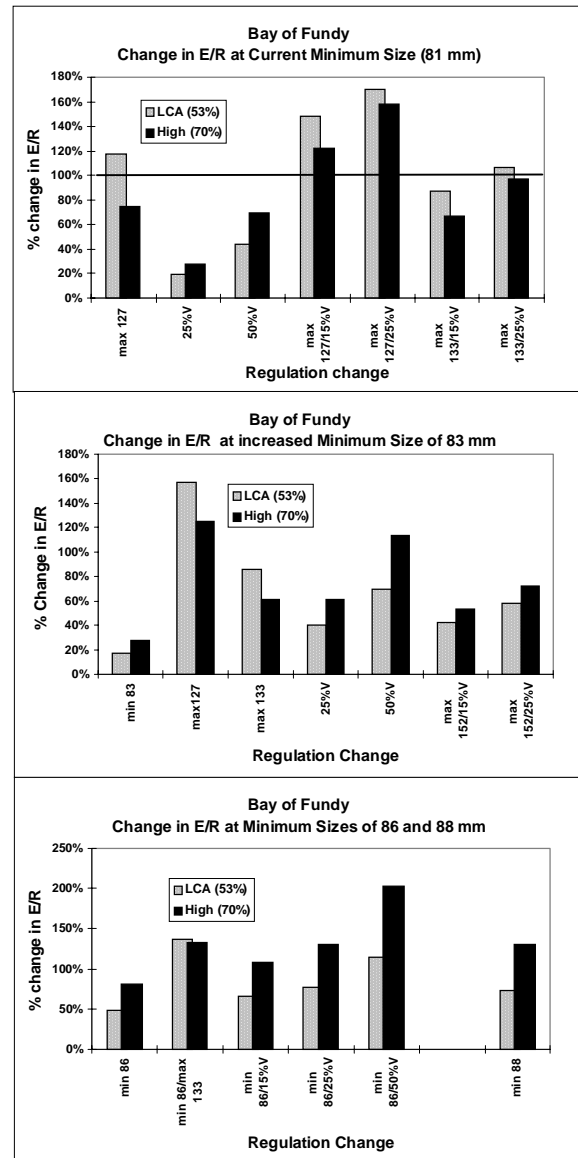
The short-term outlook for Bay of Fundy lobster is for continued landings well above 1000 metric tonnes, based on recent landed catch trends and evidence of continued high levels of pre-recruit abundance in commercial trap samples. The recent increase in landings, and recruitment pulse in the upper bay need to be better understood in the context of Gulf of Maine lobster production before long-term projections on landings may be made.

**Management Considerations**

Consultations have been ongoing with Bay of Fundy lobster fishermen since the release of the FRCC report in October 1995 through direct mail-out of interpretive documents, community-level meetings, discussions at regular Lobster Advisory Committee meetings, and cross-LFA working group meetings. Fishers are currently preparing their response to the Minister’s December 1997 directive to introduce new stock conservation measures in fall 1998 which will lead to a doubling of E/R.

At 81 mm minimum size and at exploitation rates of 53% (LCA analysis) and 70% (high,

based on previous studies), current levels of E/R in the Bay of Fundy are estimated to be 1.3% and 0.36% of virgin population E/R, respectively. In terms of egg numbers, the two scenarios yield 990 and 276 eggs per recruit, respectively.



To achieve a doubling of E/R, significant increases in minimum size to 88 mm CL (adopting this as the sole approach) would be required. Similarly, if only a maximum size were to be considered, then a 127 mm CL (5”) maximum size would be required to

approach the target under both exploitation rate scenarios.

Adopting v-notching as a single conservation measure would require bay-wide target v-notching rates above 50%, which would be difficult to attain, based on current assumptions on berried female presence during fishing seasons, and participation rates by fishers. Due to fishing season structure and lobster movement, berried females are intercepted more frequently in some areas than others. For example, annual fall fishery sampling off Alma (October) yielded  $21 \pm 3$  berried lobsters per 100 trap hauls (19 yr series). Catch rates off North Head (November) were similar, at  $26 \pm 4$  berried lobsters per 100 trap hauls (17 yr series). In contrast, sampling off Dipper Harbour, and Seal Cove (November) yielded only  $3 \pm 0.5$ , and  $1 \pm 0.3$  berried lobsters per 100 trap hauls (17 yr series).

Regulation changes undertaken at 81 mm minimum size, or those including a move to the current US minimum size, 83 mm CL, require a combination of measures to achieve the target doubling under both exploitation rate scenarios. Each combination of measures will lead to a loss of catch by certain sectors of the Bay of Fundy fleet, at least on an interim basis. Minimum and maximum size regulations have varied through the history of the fishery, particularly in the 1930's and 40's. The current minimum size has not changed since 1951.

### ***For more Information:***

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## ***Erratum***

*Please note the following corrections in regards to certain references in the Stock Status Report:*

### Documents Referenced:

Lawton, P., D.A. Robichaud, D.S. Pezzack, M.B. Strong, and D.R. Duggan. 1998. The American Lobster, *Homarus americanus*, fishery in the Bay of Fundy (Lobster Fishing Areas 35, 36, and 38) DFO Can. Stock Assess. Sec. Res Doc. **98/73**.

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### Corrections:

Document numbers should be **99/31** and **99/32**, respectively.