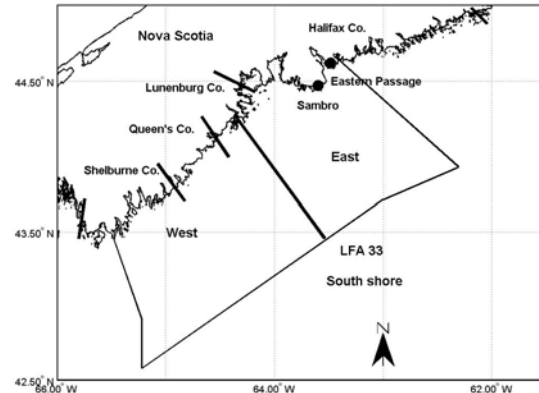


## South Shore Nova Scotia Lobster (LFA 33)



### Background

*In the waters of South Shore Nova Scotia, lobsters take 7 – 9 years to reach the minimum legal size (MLS) of 82.5 mm carapace length (CL). Molting season is mid to late summer. Sexually immature males and females molt annually and sexually mature lobster less often. Molting results in increases in length of about 15% and in weight of about 50%.*

*The size at which 50% of female lobsters are mature is about 95 to 100mm CL. Mating typically occurs soon after the female has molted. The eggs mature within the female ovary until they are extruded to the underside of the tail the following summer. The eggs remain attached until hatching in July - August of the following year. The female then molts and begins the process again. This is the typical 2-year reproductive cycle.*

*The free-floating ("planktonic") larvae spend 4-6 weeks feeding and growing. Currents affect the distance planktonic larvae are transported from their location of hatching. Larval survival is known to be very low.*

*Lobsters settle to the ocean floor and for the first several years, lobsters remain in or near shelters to avoid being eaten. As they grow they move about and spend more time outside the shelter. When they reach the MLS they become new "recruits" to the fishery, and become catchable by lobster traps.*

*Management of the LFA 33 lobster fishery is based on effort, season, and size controls and restrictions on retention of berried females, v-notched lobster, and females with a missing claw (culls).*

### Summary

- Landings since the early 1980's have been higher than the previous 30 years.
- Voluntary v-notching, increasing the minimum legal size (MLS) from 81mm to 82.5mm, and release of lobsters missing claws (culls) were the management measures applied in LFA 33 in response to the Atlantic-wide four year management plan (1999-2003) implemented to double egg production per recruit.
- Legal sized lobster indicators were primarily positive or exhibited no change during the years of the management plan.
- Pre-recruit (sub-legal sized) lobster indicators exhibited no overall change or were negative during the years of the management plan.
- Berried female (larger than 50% size-at-maturity, >100mm) indicators were positive during the years of the management plan.
- Exploitation rate indicators declined during the years of the management plan.

- Positive legal size, berried female, and exploitation rate indicators were consistent with expectations from the management plan. Pre-recruit indicators were not expected to improve as a result of the management plan.
- Fall 2003 initial industry reports were that landings in Sambro and Eastern Passage were very poor. These areas were coincident with the eye of hurricane Juan. Other areas were similar to the fall of 2002 or above.
- The two major data sources that will contribute to improvements in interpreting current indicators are: (1) developing fishermen generated logbooks that include spatial catch and effort data, and (2) increasing the spatial coverage in Fishermen and Scientists Research Society (FSRS) trap programs.

***The Fishery***

LFA 33 extends from Cow Bay, Halifax County to Port La Tour, Shelburne County. Management of the LFA 33 lobster fishery is based on effort, season, and size controls and restrictions on retention of berried females, v-notched lobster, and females with a missing claw (culls). The trap limit has been 250 since 1968. The season has opened the last Monday in November and closed May 31 the following spring with small variations since 1900. There were about 720 licenses issued in the LFA 33 fishery in 2002-2003.

**Distribution of Lobster License Types in LFA 33 During the 2002-2003 Fishery.**

License Category	Number of licenses	Number of traps per license	Total Traps
A	625	250	156,250
B	61	75	4,575
Partnerships	32	375	12,000
Total	718		172,825

The following measures were applied in LFA 33 in response to the Atlantic-wide four-year plan implemented in 1997 and 1998 with the goal to double egg production per recruit:

- 1) A voluntary v-notching program was adopted in 1998.
- 2) Minimum legal size (MLS) increased from 81mm to 82.5mm in the fall of 1999, after the season opened.
  - a) This increase in MLS did not take effect until the spring of 2000 and application was minimal.
  - b) It became fully operational with the opening of the fall of 2000 season.
- 3) A requirement to release female one-clawed or no clawed lobster (culls) was introduced in the fall of 2002.

**Reported Landings (metric tonnes) in LFA 33.**

Season	Fall (Opening to end of Feb.)	Spring (Mar. 1 to May 31)	Total
1989-1990	1236	801	2037
1990-1991	1642	778	2420
1991-1992	1414	435	1849
1992-1993	1219	512	1731
1993-1994	1328	640	1968
1994-1995	949	446	1395
1995-1996	1446	379	1825
1996-1997	1565	302	1867
1997-1998	1472	632	2104
1998-1999	1419	743	2162
1999-2000	1671	626	2297
2000-2001	1657	864	2521
2001-2002	2120	633	2753

Landings for 2002-2003 season are too preliminary to report.

**Resource Status**

The Report of the Lobster Conservation Working Group (2001) recommended the development of indicators to evaluate the status of the stock and fishery. Stock indicators related to legal sizes, pre-recruits (sub-legal sized lobster), berried females, exploitation rate, distribution (prevalence), and temperature are used to evaluate the resource status. Fishermen and Scientists Research Society (FSRS) lobster recruitment traps provided much of

the data for these stock indicators. Size class definition for lobsters caught in these traps are provided below.

**Fishermen and Scientists Research Society (FSRS) Defined Length-Classes.**

Length-class	Size definition (mm)
1	< 51
2	51 - 60
3	61 - 70
4	71 - 75
5	76 - 80
6	81 - 90
7	91 - 100
8	> 100

Landings and production in the western portion of LFA 33 are usually found to be higher than in the eastern portion. The status of the resource was evaluated with respect to this east – west division in LFA 33. The dividing line used in this report is the LaHave River. Statistical districts 18 to 26 (Port Clusters 1 to 6) are in the east and statistical districts 27 to 31 (Port Clusters 7 to 13) are in the west. This division has been examined for the purpose of understanding the lobster population dynamics in LFA 33 and not for providing separate management advice.

Industry comments provided below, acquired during workshops, informal conversations, and LFA 33 Advisory Committee meetings provide an important context for the quantitative indicators.

Industry comments obtained from workshops held between 2000 and 2002 include: Where bathymetry and habitat are suitable, fishing activity further from shore is increasing. This increase is predominately occurring in the western portion of LFA 33. These areas seem to expand the more they are fished. Larger lobsters are generally caught initially and then smaller lobsters. Smaller lobsters are now observed on all types of bottom, inside and outside of the headlands. In recent years there has been increased effort and increased difficulty in maintaining landings. The influence of temperature is important in determining fishing success and whether inside or outside grounds predominate.

Urchins and green crabs appear to be increasing. Some commented on an increase in berried females during the late 1980's.

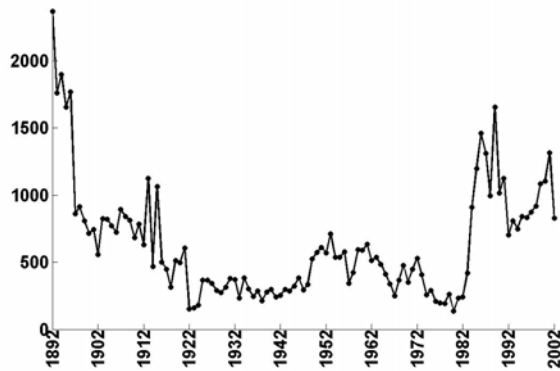
In advisory meetings and elsewhere the following comments were made regarding the two most recent seasons: The fall of 2002 was reported as very poor in all areas, but spring landings were among the best ever in some areas. Initial comments during the first two weeks of the fall of 2003 were that landings were below average in the west and seemed to improve moving east until the Sambro and Eastern Passage area where they were very poor. Sambro and Eastern Passage were coincident with the path of the eye of hurricane Juan on Sept. 29, 2003, which was about 7 weeks prior to the season opening. In the west, there were many comments about the increased numbers of berried females and pre-recruits. This did not seem to apply to the eastern part of the LFA.

**Legal Size**

Indicators for evaluating the status of legal size lobsters in LFA 33 are based on historical landings, reported landings from purchase slips and mandatory logbooks, catch rates (kg/trap-haul) from voluntary logbooks maintained by 49 fishermen, and voluntary logbooks maintained by members of the Fishermen and Scientists Research Society (FSRS). Catch rates (numbers / trap-haul) of legal sized lobster caught in FSRS lobster recruitment project standardized traps were also used.

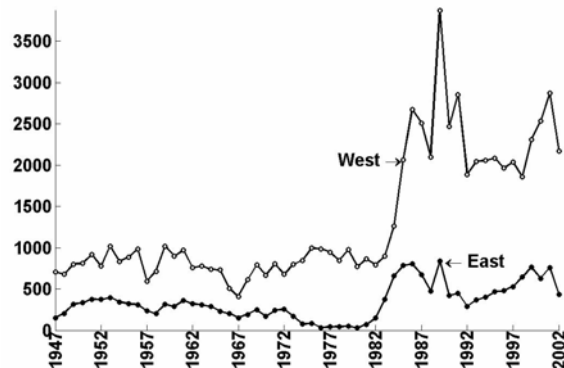
Landings are available by county since 1892. Queen's and Lunenburg counties are the only counties completely within LFA 33 and are the only areas where these long-term comparisons are possible. Landings since the early 1980's are the highest since the 1930's.

Landings (mt) by Calendar Year, Queen's and Lunenburg Counties Combined.



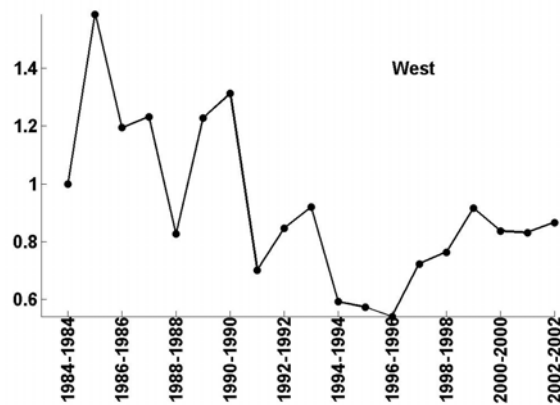
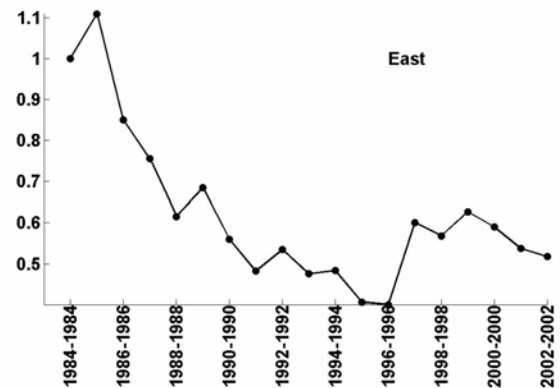
Landings have been available by Statistical District since 1947, these can be used to provide long-term east and west comparisons for LFA 33. Landings since the early 1980's have been higher than those from 1947 to 1980 in the east and west regions of LFA 33.

East and West LFA 33 Landings (mt) by Calendar Year.



Catch rates during the three years of the management plan were higher than the short-term (5 year) mean. This difference is the result of very low catch rates during the mid 1990's in the east and west areas of LFA 33. Catch rates, in the east and west, during the three years of the management plan were not different from the long-term (16 year) means.

Relative Change in East and West Catch Rates Standardized to the 1984-1985 Season.



Most indicators of legal sized lobster were generally positive or exhibited no change during the management plan.

Legal Size Indicator Status 2000-2001 to 2002-2003 Compared to 1999-2000.

Indicator	East	West
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Landings : Calendar year 2000 to 2001		
Compared to 10 yr mean	Positive	Positive
Compared to 50 yr mean	Positive	Positive

Landings: Season 2000-2001 to 2001-2002		
Compared to 10 yr mean	Positive	Positive

Catch rates: Voluntary Log cpue (kg/th)		
Compared to 5 yr mean	Positive	Positive
Compared to 16 yr mean	No change	No change

Catch rates: Voluntary Log combined with FSRS Log		
Compared to 5 yr mean	Positive	Positive
Compared to 16 yr mean	No change	No change

Catch rates: FSRS numbers / trap-haul 2000-2001 to 2002-2003 compared to 1999-2000		
FSRS Size 6	Negative	Positive
FSRS Size 7	No change	Positive
FSRS Size 8	No change	No change

**Pre-recruits**

Most indicators of pre-recruits were negative or exhibited no overall change from the pre-management plan year.

**Pre-recruit Indicator Status, FSRs Numbers/Trap-haul (2000-2001 to 2002-2003 Compared to 1999-2000).**

Indicator	East	West
FSRS Size 1	No change	<i>Negative</i>
FSRS Size 2	No change	<i>Negative</i>
FSRS Size 3	No change	<i>Negative</i>
FSRS Size 4	No change	No change
FSRS Size 5	<i>Negative</i>	No change

**Berried Females**

Berried females, larger than the 50% size-at-maturity (FSRS Size 8), catch rates have increased in the east and west since the management plan was implemented.

**Berried Female Indicator Status, FSRs Numbers / Trap-haul 2000-2001 to 2002-2003 Compared to 1999-2000 and from Voluntary Logbook Compared to 5 yr Mean.**

Indicator	East	West
FSRS Size 4	<i>Negative</i>	<i>Negative</i>
FSRS Size 5	<i>Positive</i>	No change
FSRS Size 6	No change	<i>Positive</i>
FSRS Size 7	<i>Positive</i>	No change
FSRS Size 8	<i>Positive</i>	<i>Positive</i>
Berried females from voluntary logbook	<i>Positive</i>	<i>Positive</i>

**Exploitation**

Two exploitation rates were examined. The first, called the strict exploitation rate is defined as the percentage or proportion of the exploitable population caught during a fishing season.

However, regulations that increase the minimum legal size can result in a smaller exploitable population and therefore increase the exploitation rate, even if catch is constant. As a consequence, a second exploitation rate was examined, called the extended exploitation rate. The extended exploitation rate is defined as the proportion or percentage of the number in

the exploited population plus the number in some non-exploited portion of the population. The extended exploitation rate allows a consistent base population to be compared between years that is independent of size regulation changes.

All estimated exploitation rates declined, a positive response, during the years of the management plan. Effort, as measured by boats reported in logbooks, remained stable during the years of the management plan.

**Exploitation Indicator Status 2000-2001 to 2002-2003 Compared to 1999-2000.**

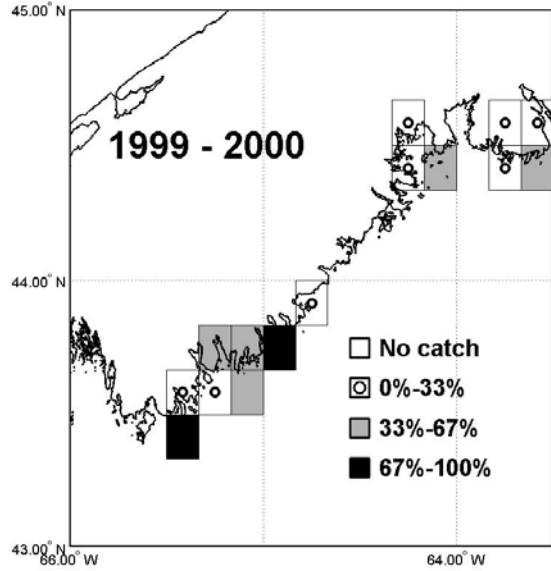
Indicator	East	West
<b>Effort (reported boats)</b>		
Fall	No change	No change
Spring	No change	No change
Fall and Spring	No change	No change
<b>Extended exploitation rate: Change-in-ratio</b>		
Males FSRs Size 6	<i>Positive</i>	<i>Positive</i>
Females FSRs Size 6	<i>Positive</i>	<i>Positive</i>
<b>Strict exploitation rate: Change-in-ratio</b>		
Males FSRs Size 6	<i>Positive</i>	<i>Positive</i>
Females FSRs Size 6	<i>Positive</i>	<i>Positive</i>
Females FSRs Size 7	<i>Positive</i>	<i>Positive</i>

**Distribution (Prevalence)**

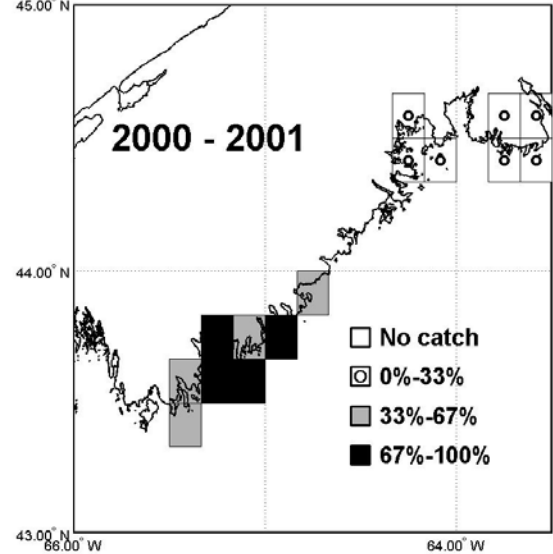
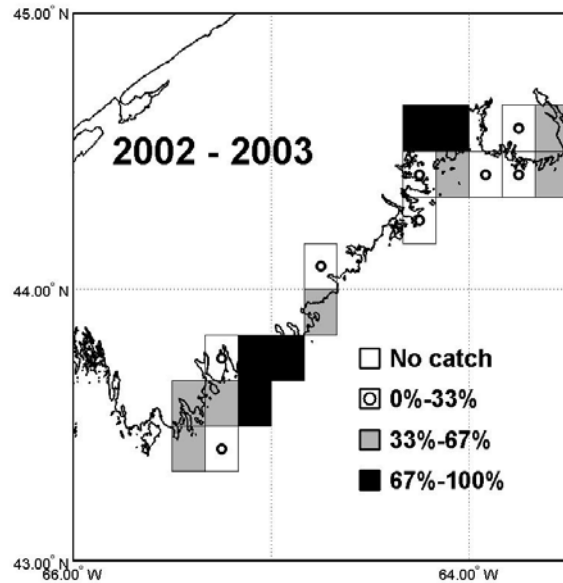
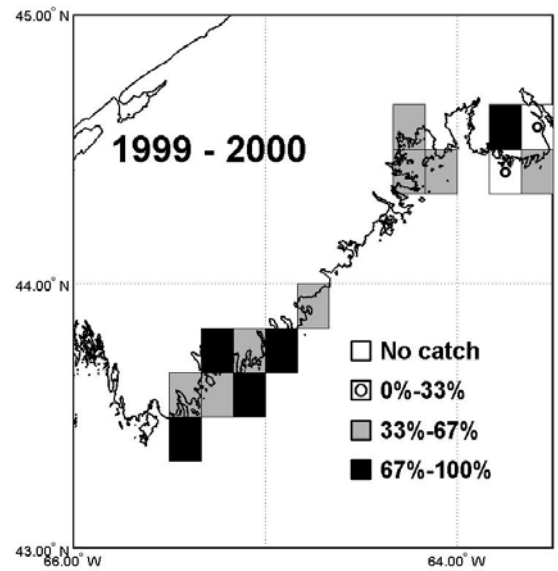
Catch rates (numbers / trap-haul) by FSRs size group were used to derive distribution (prevalence) based indices by 10 minute square and season. Individual square and season catch rates were assigned to percentile categories based on all seasons combined. Indicators were judged to be positive if the number of squares with catch rates in the 67% to 100% percentile category was higher in each of the seasons from 2000 - 2001 to 2002 - 2003 than the 1999 - 2000 season.

Distribution indicators of legal size lobster were positive for FSRs size 7 recruitment trap lobster, but no change was found for FSRs sizes 6 and 8.

FSTRS Size 7 Numbers / Trap-haul



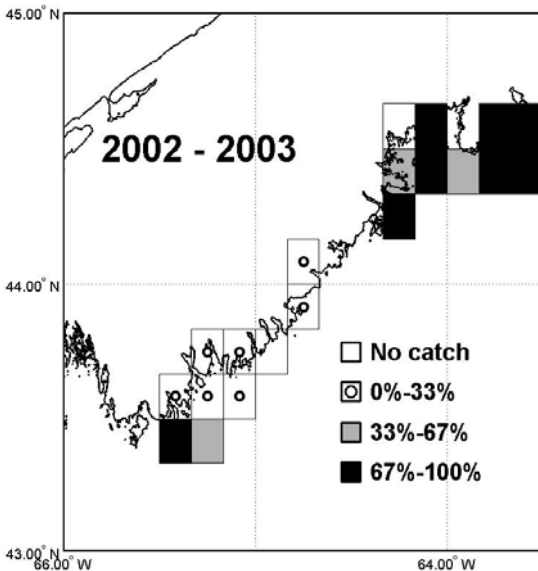
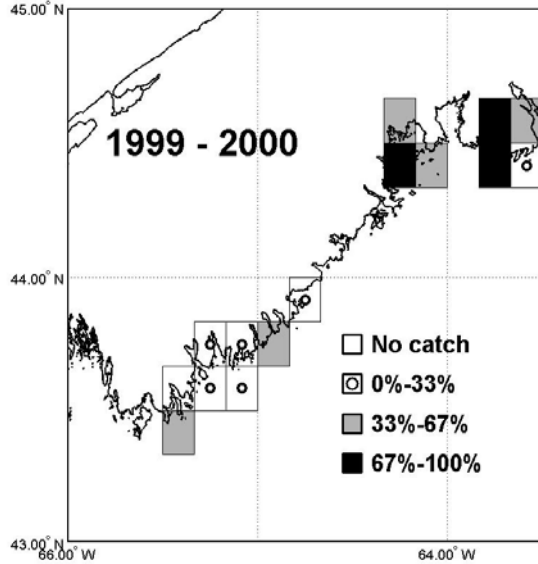
FSTRS Size 5 Numbers / Trap-haul



Pre-recruit distribution indicators were generally negative in the east and exhibited no change in the west.

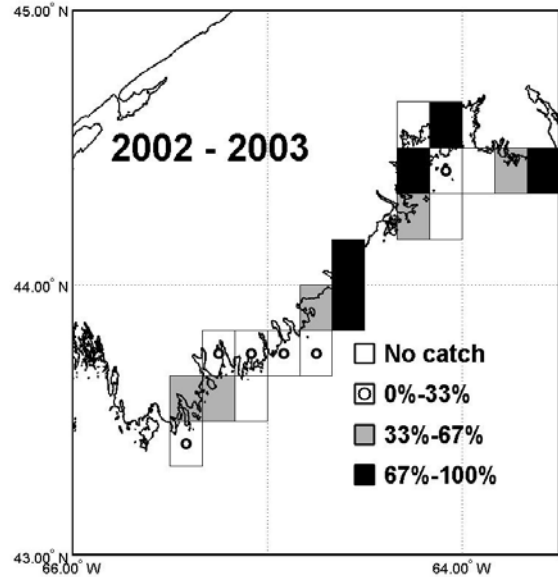
Numbers of berried females were converted to numbers of eggs according to published area-specific fecundity relationships. Spatial distribution indicators of egg distributions are positive. Egg indicators are higher in the east than the west.

FSRs Egg Numbers / Trap-haul



Commercial trap sampling by FSRs members supports the importance of the east as a spawner area and identifies an additional area along the east - west dividing line that is also important.

FSRs Commercial Trap Egg Numbers / Trap-haul



Distribution (Prevalence) Indicator Status, FSRs Numbers / Trap-haul 2000-2001 to 2002-2003 Compared to 1999-2000 by 10 Minute Square.

Indicator	East	West
<b>Legal Sizes</b>		
FSRS Size 6	No change	No change
FSRS Size 7	Positive	Positive
FSRS Size 8	No change	No change
<b>Pre-recruits</b>		
FSRS Size 1	Negative	Negative
FSRS Size 2	Negative	No change
FSRS Size 3	Negative	No change
FSRS Size 4	No change	No change
FSRS Size 5	Negative	No change
<b>Berried females</b>		
Eggs	Positive	Positive

Ecosystem

Temperature from the FSRs recruitment trap project provides seasonal temperature regimes.

Temperatures have been cooler during the spring in the east since the year preceding the management plan. For other seasons in the east, and for all seasons in the west there have been no consistent temperature trends.

**Ecosystem Indicator Status, Temperature 2000-2001 to 2002-2003 Compared to 1999-2000.**

Indicator	East	West
Fall	No difference	No difference
Winter	No difference	No difference
Spring	Cooler	No difference

**Effects of Management Measures**

Initial expected positive effects were an increase in catch rates of lobster between 90 to 100mm (FSRS size 7), berried females, and a decline in extended exploitation rate.

Changes consistent with these expectations are positive changes in overall catch rates compared to previous 5 year means, FSRS size 7 lobster indicators, berried female indicators in east and west, and declines in exploitation rates of the groups affected by the MLS change.

The detection of long-term effects on the fishery, from increased egg production, will have to wait until the progeny of lobster initially affected by the management plan enter the fishery at 7-9 years old. Industry reports that participation in v-notching berried females has ranged from 10% to 50%. The effect of releasing culls may be limited because lobsters with claws exhibiting any growth are considered to be clawed and may be retained. Growth may occur between fall and spring and culls released in the fall may be caught in the spring. V-notching culls would increase the effectiveness of this measure.

The following below from the 1998 SSR (DFO, 1998), describes the relative effect of increasing MLS from 81mm to the indicated size, releasing lobster within a specified size range (Window), releasing lobster above a specified size, and v-notching at the specified rate. The management measures applied to LFA 33 likely produced a 25% to 30% increase in egg production per recruit compared to the 100% goal.

**Relative Effect (0% to 100%) of Various Management Measures in Increasing Egg Production per Recruit.**

Min. Size	Window	Max. Size	% v-notch	Relative Effect
83			0	18
83			15	24
84			0	30
81	110 -120		0	45
84	110 -120		0	95
81	117 -127		0	25
85	117 -127		0	100
81		120	0	40
84		120	0	90
81		127	0	20
86		127	0	90

**Recommended Stock Indicators**

The most accurate conclusions regarding stock status and the effects of management will come from indicators that combine information on relative abundance and distribution.

The two major data sources that will contribute to improvements in interpreting indicators of relative abundance and distribution are:

- 1) Fishermen generated logbooks of catch and effort including improvements by:
  - a) Increasing participation
  - b) Reporting on the spatial distribution of catch and effort
- 2) The FSRS trap programs including improvements by:
  - a) Increasing the area of the population covered by fixed location recruitment traps by adding participants in areas not currently sampled
  - b) Collecting recruitment trap type-data from commercial traps.

The specific indicators that should be continued and further developed are:

- 1) Pre-recruit indicators - catch rates of various sizes based on the FSRS traps.



- 2) Legal indicators – catch rates from index logs, mandatory logs, and FSRS traps.
- 3) Berrried female indicators – catch rates from FSRS traps, at-sea samples, and logbooks.
- 4) Exploitation indicators – change-in-ratio estimates and length-class composition.
- 5) Prevalence or spatial distribution indicators – spatial catch rates from index logs, mandatory logs, and FSRS traps. Participation and spatial coverage in these programs should be expanded where necessary.
- 6) Ecosystem indicators – continue with temperature data in FSRS traps. Investigate collecting data at fixed depths along the coast.

The increased occurrence of soft lobster has been an issue in recent years. There are many hypotheses concerning the cause of increases in soft lobster, including too many lobster, double molt, delayed molt, and poor food supply. In order to distinguish between these hypotheses, data on the occurrence and spatial distribution of lobster condition needs to be collected. This data collection needs to occur routinely and not just in years of concern.

### ***Sources of Uncertainty***

The inability to obtain timely landings data increased the uncertainty in assessing stock status. Data from voluntary logbooks and FSRS project participants were the only sources of information for stock status indicators for the 2002-2003 season. These voluntary programs need to be maintained to compensate for the uncertain delivery timeframe of official statistics.

Lobster abundance is believed to be the main cause of changes in fishery landings from year to year, but annual changes in catchability likely contribute to variability.

Annual temperature variability has likely influenced relative catch rate indicators. A method for including temperature effects in index models needs to be developed in order to provide indicators that more closely reflect changes in abundance.

Ecosystem considerations are not taken explicitly into account when assessing and advising on lobster fisheries. Methods for identifying and incorporating ecosystem effects need to be pursued, and would include the effects of predation, food sources, other fisheries, other species, invasive species, and environmental effects.

In several of the analyses presented, wide confidence limits result from low sample sizes. Increased industry participation in voluntary logbook and trap sampling programs will reduce these uncertainties.

Exploitation rate estimates using the change-in-ratio method are most robust when the unexploited and exploited groups have a similar life-history and are from narrow and adjacent size groups. As these differences increase, it is more likely that some of the key assumptions, for example, that the catchability ratio remains constant over the season, will be violated. Research on relative catchabilities of different sizes and life-history status of lobster is needed to evaluate the degree to which key assumptions are met.

The FSRS data has been extensively used in this assessment. While its original intent was to measure only recruitment, it appears to have many other uses and may provide good indicators of other size groups as well. Comparing FSRS recruitment trap data to indicators obtained by similar methods with commercial traps will help determine the best program for developing trap-based indicators.

Stock structure and linkages within and outside of LFA 33 during the planktonic larval stage are not well understood.

Size-at-maturity estimates are based on studies from the 1980's. There is uncertainty as to whether maturity has changed and up to date estimates are warranted.

Long-term changes in lobster distribution could affect interpretation of abundance trends. Expanding the spatial aspects of all data sets is needed in order to detect changes in lobster distribution.

### ***Outlook***

In the short-term, negative recruitment indicators indicate that catch rates and legal size indicators may not be as positive for the next few years as they were for the most recent years. However, fishermen comments during fall 2003 fishing indicate that berried females and recruits are increasing in the west.

In the long-term, positive indicators for berried females indicate that prospects 7 to 9 years from now, assuming current conditions remain the same, are positive. The total number of legal trips will be reduced during this period as a number of B licenses are expected to retire over the next ten years.

The MLS is one or two molts below the 50% size-at-maturity. The consequences of this are that more than 60% of lobsters are harvested before they reproduce. Ensuring that sufficient numbers of large lobsters are able to reproduce will be the biggest challenge to ensuring that long-term management goals are met.

### ***Management Considerations***

Improving mandatory logbooks by collecting spatial distribution of catch and effort is essential. These landings data need to be available in a more timely and accurate manner, in a structured database.

The FSRS recruitment trap program should be supported and expanded where possible.

The relative indicators discussed in this document are currently the primary tool used to evaluate the lobster fishery and populations. Increasing industry participation in the data collection of indicators and review of their trends will improve lobster science and management in LFA 33.

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

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