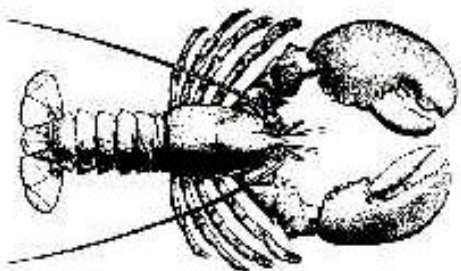




Maritimes Region

Stock Status Report 2004/032



Eastern Cape Breton Lobster (LFAs 27-30)

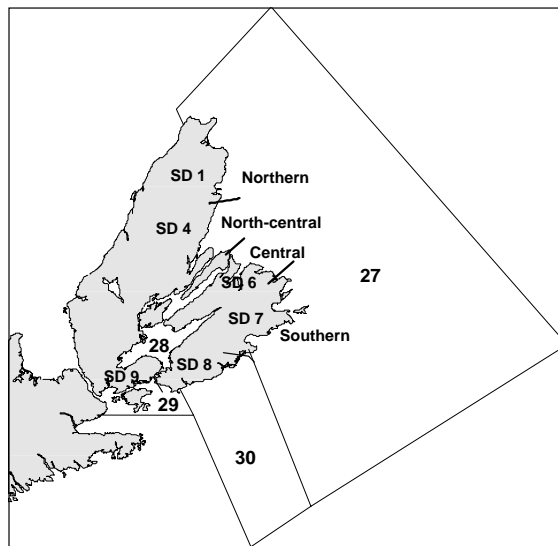
Background

In the waters off eastern Cape Breton lobsters take 5-8 years to reach the minimum legal size (MLS). Molting season is mid to late summer and 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 estimated to be 73 mm CL off northern Cape Breton, 78 mm CL off the southern end of LFA 27 and in LFA 30, and 84 mm CL off southeast Cape Breton in the Iles Madame area (LFA 29). 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. The distance planktonic larvae are transported from their location of hatching depends upon currents. Larval survival is known to be low.

After settling to the bottom 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.



Summary

- A series of management measures were introduced in LFAs 27-30 from 1998-2002. The largest change was a stepped increase from 70 to 76 mm in the minimum legal size (MLS) in LFA 27.
- With the adopted management measures, Egg/Recruit (E/R) doubled in LFA 27 and increased by a lesser amount in LFAs 28-30 based on earlier runs of the E/R model.
- Landings in LFAs 27, 29 and 30 were higher in 2001 than in 1997 (the year before management changes were introduced).
- 2001 is the last year for which reliable total landings data are available, but catch rates from index logs indicate total landings in LFAs 27-30 were higher in 2003 than 2001.
- Coincident with the increase in MLS in LFA 27, there are improvements in indicators for egg-bearing females and market lobsters in the north of LFA 27.
- Estimates of "extended exploitation" that account for the increase in the size of the unexploitable population from a

MLS increase indicate a decline in LFA 27.

- Proportions of the catch in the first molt group of the exploitable population have not declined and are indicative of continued high exploitation rates in much of LFA 27.
- Stock improvements in LFAs 29 and 30 resulting from the management measures were not detectable by the indicators.
- In LFA 29 catch rates of several size groups increased substantially in 2003. The source of the increase is unclear with the data currently available.
- In LFA 30 there are signs of increased exploitation, but removals are still low relative to LFA 27.
- The lack of reliable indicators for LFA 28 clouds the picture of stock status. Ongoing studies in LFA 28 will address questions related to lobster habitat in Bras d'Or Lake.

The Fishery

Management of the lobster fishery is based on effort controls, size controls, and a restriction on retention of egg-bearing females. For management purposes, eastern Cape Breton is divided into Lobster Fishing Areas (LFAs).

Lobster Management Regime. MLS = minimum legal size

LFA	Season	Trap limit	MLS (mm)	No. licenses
27	May 15-Jul 15	275	76	543
28	May 9-Jul 9	250	84	17
29	May 9-Jul 9	250	84	71
30	May 20-Jul 20	250	82.5	20

A set of conservation measures for the spring lobster fisheries in the Maritimes Region was announced in April 1998, following the call by the Minister of Fisheries and Oceans for industry to adopt measures that would double eggs per recruit (E/R, the average eggs produced by a single female lobster over her lifetime). Management measures that were eventually adopted

between 1998 and 2002 include increases to minimum legal size (MLS), restrictions on large females (LFA 30), changes to trap design and trap limit reductions (LFA 29). The MLS increase was phased in over several years in LFAs 27-29 (1998-99 in LFAs 28-29, 1998, 1999, 2001, 2002 in LFA 27).

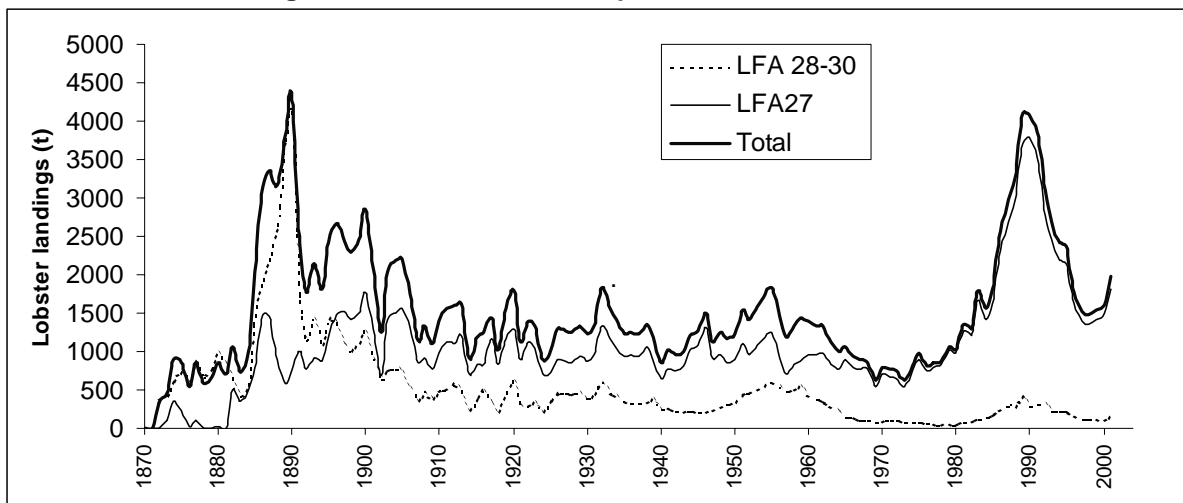
Management changes 1998-2002

LFA 27	MLS increased from 70-76 mm CL
LFAs 28 & 29	MLS increased from 81-84 mm CL Maximum hoop size of 153 mm Trap limit reduced to 250 Return of notched females
LFA 30	MLS increased from 81-82.5 mm CL Female maximum CL of 135 mm CL Return of notched females

Landings

Lobster landings for LFAs 27-30 are available back to the 1870s. While these earlier data must be used cautiously, they indicate a peak in the late 1880's attributed to what is now LFAs 28-30, and a more recent peak in the late 1980s comprised of landings in LFA 27. Since 1990 landings declined until 1997 and then increased until 2001 (the most recent year for which landings data are fully compiled).

Historical lobster landings for LFAs off eastern Cape Breton*.



* Caution should be used when using earlier landings data given the very different fishery and statistical system at that time.

Lobster Landings (t) by LFA

Year	27	28	29	30	Total
1991	3526	9	159	151	3845
1992	2778	9	141	167	3095
1993	2458	12	92	132	2694
1994	2190	13	91	130	2424
1995	2142	15	90	126	2373
1996	1615	14	61	90	1780
1997	1397	12	39	80	1528
1998	1346	12	52	70	1480
1999	1419	5	50	70	1544
2000	1499	5	54	54	1612
2001	1818	5	66	98	1987
Averages					
1991-00*	2037	11	83	107	2238
1981-90	2267	-----	210	-----	2746
1971-80	787	-----	70	-----	857
1961-70	802	-----	191	-----	993
1951-60	985	-----	505	-----	1489
50 yr (1951-00)	1376	-----	235	-----	1611

*First full decade for which landings for each of LFAs 28, 29 and 30 compiled separately.

Reported total landings for LFAs 27-30 in 2001 were below the means for the periods 1981-90 and 1990-2000, but were well above the means for the 1960s and 1970s and the 50 yr mean. LFAs 28-30 (total) remain below most decadal averages, as well as the long-term mean.

Although total landings data for 2002 and 2003 are unavailable, catch rates from

index logs indicate landings in 2003 and 2002 were likely higher than 2001.

Resource Status

The management measures adopted in LFA 27 resulted in an increase in E/R of more than 100% based on previous estimates using the E/R model. In LFAs 28-30, E/R increased by 20-30% with the measures adopted.

While the E/R model provided a direction for management of lobster fisheries, the Report of the Lobster Conservation Working Group (Anon, 2001) recommended the development of data-intensive indicators.

Here resource status is evaluated from indicators derived from volunteer index fishermen logs, from sampling the commercial fishery and from Fishermen and Scientists Research Society (FSRS) recruitment traps.

Indicators used to evaluate LFAs 27-30.

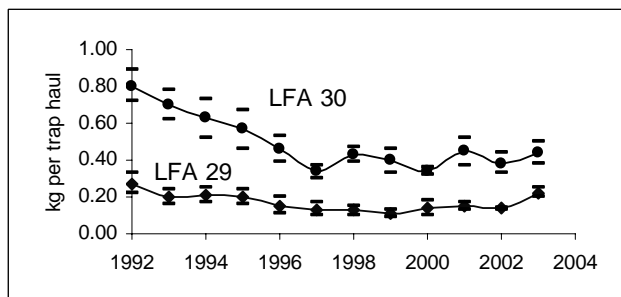
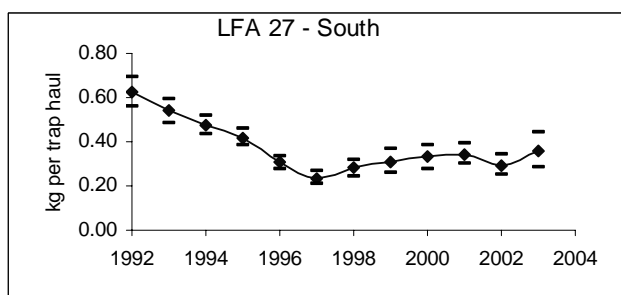
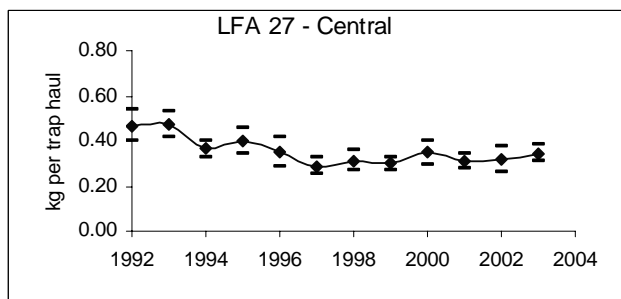
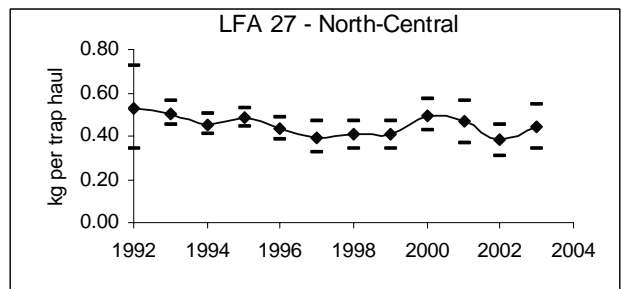
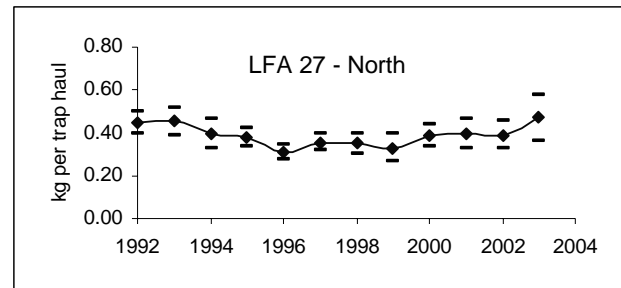
Kgth = kg per trap haul; **npth** = number per trap haul. **ER** = Exploitation rate

Category	Indicator
Legal sizes	- Landings - kgth in index logs - npth in FSRs traps and at-sea samples
Pre-recruits	- npth of sublegal size groups in FSRs traps and at-sea samples
Spawners	- npth of egg-bearing females in FSRs traps and at-sea samples)
Exploitation	- No. of trap hauls - Mean size - Percentage of catch in 1 st molt group - ER from Length Composition Analysis (LCA) - ER from Change-in-ratio

Overall stock status in LFAs 27-30 has improved since 1997.

Legal sizes – In all LFAs catch rates of legal sizes in 2003 were higher than 2002, and 1997 (last assessed year). From 1999-2003 the catch rate of market sized lobsters (81 mm CL and greater) in FSRs traps increased in 3 of 4 subareas of LFA 27. In the one subarea where this did not increase (North-central), at-sea samples from 1997-2003 did indicate an increase in market catch rate.

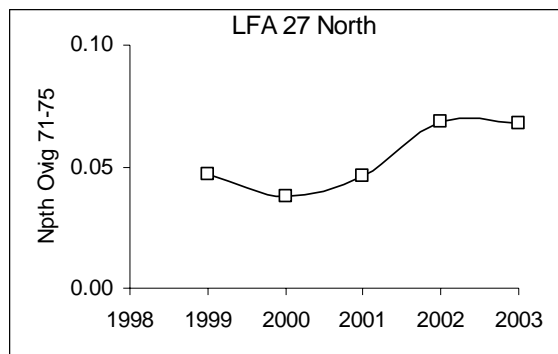
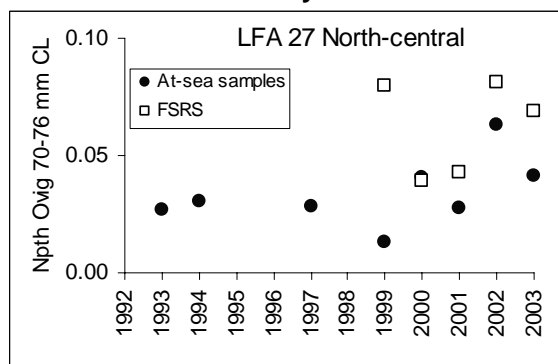
Mean catch rates (kg per trap haul) from index fishermen logs 1992-2003. Bars are 95% confidence limits.



Prerecruits - Catch rates in FSRS traps of prerecruits (51-60 mm CL, 61-70 mm CL and 71-MLS) showed mixed trends in LFA 27. In LFA 29 (all prerecruit sizes), and LFA 30 (51-60 mm CL) prerecruit catch rates increased in 2002 and 2003.

Spawners – Indicators of egg-bearing females 71-75 mm CL (size range of MLS increase) in the northern portions of LFA 27 trended upwards after 1998. The catch rate of spawners declined in LFA 30.

Catch rates (Number per trap haul or Npth) in North-central and North subareas of LFA 27 in at-sea samples and in FSRS traps. FSRS data available only from 1999-2003.



Exploitation – Indicators for exploitation show that spatial differences in exploitation evident in 1998 remain with higher levels in LFA 27 North compared to LFA 27 South and the other LFAs. This is evidenced by the percentage of the catch in the first molt group (highest in LFA 27 North) and by LCA estimates of exploitation (highest in LFA 27 North).

Estimates of exploitation that account for the increase in the size of the unexploitable population (the sublegal sizes) from an MLS increase have been termed “extended exploitation”. Such estimates were available from a change-in-ratio method and from the LCA method and both indicate a decline in extended exploitation in LFA 27. More traditional estimates of exploitation are based only on the exploitable population. Proportions of the catch in the first molt group of the exploitable population have not declined and are indicative of continued high exploitation rates in much of LFA 27.

In LFA 30 exploitation estimates using LCA increased after 1997, while those in LFA 29 were variable. Estimated exploitation rates in both areas are still low relative to other LFAs.

Summary of stock status – In LFA 27, the increases in catch rates of legal sizes and the evidence for increased reproduction are positive. So also are the signs of reduced exploitation (increased mean size, lower estimates of extended exploitation). The exploitation rates are still high in much of LFA 27 however. Prerecruit indicators are mixed, but the time series is not very long (5 years).

In LFA 29 catch rates of several size groups increased substantially in 2003. The source of the increase is unclear with the data currently available. The positive signs of increased recruitment need to be verified with further monitoring. There are some negative signs for LFA 30 (apparent decrease in egg-bearing females, possible increased exploitation), but these are not a major concern. Regarding the status of LFA 28 (Bras d'Or Lake) there are few longer-term data available. Ongoing studies of lobster distribution and habitat in LFA 28 will improve our understanding of this LFA.

Summary of trends for different indicators by LFA and subarea. Years considered follow indicator. ↑ = clear increase; ↓ = clear decrease; ↗ = variable but increased from start year to end year; ↘ = variable but decreased from start year to end year; → no clear trend. Mark = Market size class. MLS = minimum legal size. na = not applicable; nd = no (or insufficient) data.

Indicator	27 All	27-N	27 NC	27 C	27 S	28	29	30
Landings								
1997-2001	↑	↑	↑	↑	↑	↑	↑	↑
Compared to 10 yr mean	↘	↗	↘	↓	↓	↓	↓	↓
Compared to 50 yr mean	↑	↑	↑	↑	↑	↓		
Percent of Market sizes	↑	↑	↑	↑	↑	na	na	na
Legal Sizes								
Log cpue (kg/th) 97-03	↑	↑	→	↗	↑	-	↑	↗
FSRS Legal npth 99-03	→	↑	↓	↘	→	↑	↑	→
FSRS Mark npth 99-03	↑	↑	→	↑	↗	na	na	na
At-sea Legal npth 97-03		nd	↗	nd	nd	nd	nd	↓
At-sea Mark npth 97-03		nd	↑	nd	nd	nd	nd	na
Prerecruits								
FSRS 51-60 npth 99-03	→	→	→	↗	→	↓	↑	↑
FSRS 61-70 npth 99-03	↘	↓	↓	→	→	→	↑	→
FSRS 71-MLS npth 99-03	↑	↑	↑	↑	↑	→	↑	→
At-sea 51-60 npth 97-03		nd	↘	nd	nd	nd	nd	
At-sea 61-70 npth 97-03		nd	↓	nd	nd	nd	nd	↑
At-sea 71-MLS npth 97-03		nd	↑	nd	nd	nd	nd	→
Spawners								
FSRS Ov 71-75 npth 99-03	↗	↑	→	↘	↗	↗	↗	→
FSRS Ov 81-90 npth 99-03		↑	↘	↘	↑	→	↘	↓
FSRS Ov (all) npth 99-03	→	↑	↘	↓	→	↘	→	↓
At-sea Ov 71-75 npth 97-03		nd	↗	nd	nd	nd	nd	-
At-sea Ov 81-90 npth 97-03		nd	↗	nd	nd	nd	nd	↓
At-sea Ov (all) npth 97-03		nd	↑	nd	nd	nd	nd	↓
Exploitation								
Effort (n trap hauls) 97-03	→	→	→	↗	→	nd	↗	↗
% in 1 st molt group 97-03	↗	↗	→	→	↗	nd	↗	↑
Mean size 97-03	↑	↑	↑	↑	↑	nd	↓	↓
F – LCA 97-03	↓	↓	↓	↓	↘	nd	→	↑
F- Change-in-ratio 99-03			↘		↘	nd	nd	nd

Effects of Management Measures

The effects of the size increase in LFA 27 are most evident in the North subarea. This was expected because LFA 27 North had the highest proportion of lobsters between 70 and 76 mm CL prior to the MLS increase. Therefore when the size

was increased this was the subarea where the highest proportion of lobsters was left in the water to grow and reproduce. Below are positive effects consistent with the MLS increase:

- Increase in the catch rate of legal lobster in LFA 27 North and most of the remainder of LFA 27 (index fishermen logs).

- Increase in the catch rate of market sized lobsters in most of LFA 27 (FSRS traps).
- Increase in the catch rate of egg-bearing female lobsters between 71 and 75.9 mm CL in LFA 27 North from 1999-2003 (FSRS traps) and in LFA 27 North-central (2000-2003 compared to 1993-1997).
- Increase in mean size of the catch throughout LFA 27 (samples of commercial catch).
- Decrease in estimates of extended exploitation rate throughout LFA 27.

In LFAs 28-30 the effects of the management measures were not detected in the indicators available. We should have detected effects similar to those in LFA 27 but of a smaller magnitude given the less significant management changes in LFAs 28-30. We might also have expected to see an increase in the catch rate of females greater than 135 mm CL in LFA 30 given the maximum size put in place there.

Possible reasons for the lack of detection of effects include the following:

- Changes were not as substantial as in LFA 27 (3 mm and 1.5 mm increases in CL compared to a 6 mm increase in LFA 27).
- The percentage of animals in the first molt group prior to the MLS increase were not as high as in LFA 27.
- Sampling of these areas has been less effective because catch rates are generally lower.
- Catch rates of female lobsters >135 mm CL is very low.

The maximum ring size in LFA 29 (153 mm) is providing some protection for large lobsters. A study conducted with fishermen volunteers in LFA 30 found that lobsters greater than 150 mm CL (5-6 lb in weight) were more likely to be captured in traps with entrance rings larger than 153 mm.

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 indicators of relative abundance and distribution are:

- 1) Fishermen generated logbooks of catch and effort including improvements by:
 - a) Increasing participation; and
 - 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; and
 - b) collecting recruitment trap type-data from commercial traps.

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

- 1) Prerecruit indicators - catch rate of various sizes based on the FSRS traps.
- 2) Legal size indicators - catch rate from index logs and mandatory logs.
- 3) Berrried female indicators – catch rate from FSRS traps and at-sea samples.
- 4) Exploitation indicators – Change-in-Ratio estimates and length information from index ports.
- 5) Prevalence or spatial distribution indicators – develop from index logs, mandatory logs, and FSRS traps and expand participation and spatial coverage where necessary.
- 6) Ecosystem indicators – Continue with temperature data in FSRS traps. Investigate collection of data is obtained at fixed depths along the coast.

Sources of Uncertainty

Caution should be used when using earlier landings data given the very different fishery and statistical system at that time.

The inability to obtain timely landings data increased the difficulty 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 data sources still represent a small fraction of the fishery.

Lobster abundance is believed to be the main cause of changes in fishery landings from year to year, but annual changes in effort and catchability likely contribute to variability. Cooler temperatures in recent years compared to the pre-management year have likely influenced relative levels of FSRs indicators. A method for including temperature effects in indicator models is essential.

In several of the analyses presented, wide confidence limits result from low sample sizes. Increased industry participation in voluntary logbook and trap sampling programs such as those conducted by FSRs are essential.

Exploitation rate estimates using length-based composition analysis (LCA) provide estimates that are somewhat lower than other methods, perhaps related to model assumptions regarding the growth and reproduction of larger animals.

Exploitation rate estimates using the change-in-ratio method are most robust when the reference 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 required.

For larger lobster sizes there is uncertainty regarding the relative merits of indicators based on FSRs recruitment traps compared to indicators based on commercial traps. The FSRs data have 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 both within and outside of eastern Cape Breton during the planktonic larval stage are not well understood.

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

Long-term changes in lobster distribution could affect interpretation of abundance trends. There are currently no indicators of spatial distribution in LFAs 27-30.

Outlook

In the short-term (1-2 years) prerecruit indicators from FSRs recruitment traps are mixed for LFA 27, but do not indicate major decreases. Prerecruit indicators are more positive for LFA 29 but additional years are needed to determine whether increased prerecruit catch rates in the FSRs traps translate into increases in legal sizes. In LFA 30 prerecruit indicators are positive for the smallest sizes (51-60 mm CL) and mixed for the larger prerecruits. In LFA 28 prerecruit indicators show no consistent trend.

In the long-term the lobsters comprising LFA 27-30 have a better chance of replenishing themselves with the increased MLS and other management measures in place. Indicators of egg production have

increased, but it is not known as yet whether this will result in a measurable increase in recruitment to the fishery.

Concerns remain about high fishing mortality in much of LFA 27, and the lack of protection for large female lobsters in LFA 27.

Management Considerations

Information on catch, effort and fishing location is needed from fishermen to assess lobsters in LFAs 27-30 and to evaluate interactions with industrial development and species at risk. 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 size of escape vents should be increased to match the increased MLS of lobsters.

Additional measures to protect large females should be considered in LFA 27 in particular.

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