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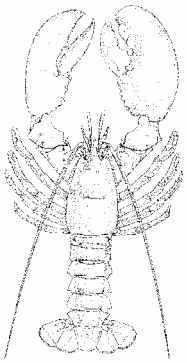

Lobster in the Magdalen Islands (LFA 22) in 2004

Background

American lobster (Homarus americanus) occurs along the west coast of the Atlantic Ocean, from Labrador to Cape Hatteras. Adult lobster prefers rocky substrates where they can take shelter, but can also live on sandy and even muddy bottoms. Commercial-size lobsters are generally found at depths of less than 35 m. Females reach sexual maturity at approximately 79 mm (carapace length) in the southern Magdalen Islands and at 82-84 mm in the northern Magdalen Islands. Males reach sexual maturity at a smaller size. Females generally have a two-year reproductive cycle, spawning one year and moulting the next. Females spawning for the first time can produce nearly 8,000 eggs, while large females measuring 127 mm (jumbo size) can extrude up to 35,000 eggs. Once released, the eggs remain attached to the females' swimmerets for 9 to 12 months, until the planktonic larvae emerge the following summer. The larvae's planktonic phase lasts from 3 to 10 weeks, depending on the temperature of the water. Following metamorphosis, postlarval lobsters (stage IV), which now resemble adult lobsters, drift down from the surface layer to settle on the sea floor. During the first few years of benthic life or until they reach approximately 40 mm, lobsters lead a cryptic existence, meaning that they live hidden in structurally varied habitat providing many shelters. Lobsters are estimated to reach minimum legal size (83 mm) around 8 years of age, after having moulted approximately 15 times since their benthic settlement.

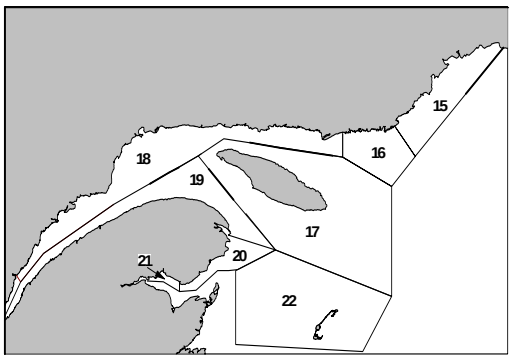

Figure 1. Lobster fishing areas (LFAs) in Quebec. LFA 22 corresponds to the Magdalen Islands.

Summary

- In 2004, lobster landings in the Magdalen Islands accounted for 71% of total landings in Quebec. Lobster landings recorded in the Magdalen Islands totalled 2,371 t in 2004 (preliminary data), up by 13% from 2003 levels (2,087 t), and were 25% higher than the average for the last 25 years (1,894 t).
- In 2004, the mean catch per unit effort (CPUE) was 0.74 lobsters/trap or 0.45 kg/trap, exceeding 2003 levels. Although the CPUE in number was lower than the series average (1985–2003), the CPUE in weight was higher, a consequence of the increase in minimum legal size. The CPUE in number dropped in the northern Magdalen Islands in the mid-1990s, suggesting a drop in recruitment. It has remained relatively steady since 1997 (between 0.6 and 0.7 lobsters/trap).
- The mean size of lobsters caught increased by almost 7 mm, resulting in their mean weight increasing by 25% between 1996 and 2003, following the increase in minimum legal size. Mean sizes and weights observed in 2004 were similar to those recorded in 2003.

The proportion of jumbo lobsters (≥127 mm) remains low (<1%) as a result of high exploitation rates (70%), which have increased in the last decade.

- The results of a simulation model show that, by increasing the minimum legal size from 76 mm to 83 mm, egg production per recruit appears to have doubled. The CPUE of berried females rose significantly following the increase in the minimum legal size between 1996 and 2002. Egg production increased by a factor of two. The number of multiparous females (i.e. females that have already spawned once) has also increased proportionately since 1996. In 2004, estimated egg production was approximately twice as high as in 1996.
- Recruitment indices suggest that landings in 2005 could reach levels similar to those recorded in the two last years. Abundance indices for prerecruits and juveniles have also been rising, suggesting that recruitment levels should be maintained in the medium term. Benthic settlement at the Les Demoiselles site has been good since 2002.

Fishery management

The lobster fishery is managed by controlling fishing effort, regulating minimum legal size and protecting berried females. In 2004, there were 325 active fishers in LFA 22, which corresponds to the Magdalen Islands (Figure 1). The number of traps is limited to 300. Escape vents on traps have been mandatory since 1994. In 2003, the size of the vertical opening of the escape vents was increased from 43 mm to 47 mm. The lobster fishery takes place in spring and lasts 9 weeks. Traps are not hauled on Sundays. From 1997 to 2003, minimum legal size was increased 1 mm a year with a view to doubling egg production per recruit compared to the 1996 level. Since 2003, minimum legal size is set at 83 mm. Between 1957 and 1997, minimum legal size was 76 mm.

Stock status

Stock status assessment is based on abundance indicators: 1. landings taken from processing plant purchase slips, 2. catch rates for commercial-size lobsters obtained from at-sea samplings and logbooks kept on a voluntary basis by index fishers and 3. catch rates of berried females obtained from at-sea sampling. The assessment is also based on the size structures of lobster caught at sea, which are used to estimate exploitation rates, determine the male-to-female ratio per size class and calculate a relative index of egg production. At-sea sampling has been conducted annually since 1985. Indices are compiled separately for the southern (Old Harry to Havre Aubert) and northern (Grosse Île to Millerand) Magdalen Islands (Figure 2). Since 1995, a trawl survey has been carried out in the southern part of the archipelago, after the lobster moulting period, when lobsters are found near the coast. The survey is used to validate indices obtained from the fishery and make short-term predictions about recruitment to the fishery. Benthic settlement in the Les Demoiselles sector (Plaisance Bay) has been monitored annually since 1996 and has helped determine cohort abundance, growth and survival during lobsters' first two or three years of benthic life.

Landings

Landings recorded (preliminary data) in the Magdalen Islands totalled 2,371 t in 2004, up 13% from 2003 levels (2,087 t), and were 25% higher than the average for the last 25 years (1,894 t) (Figure 3). Landings in 2004 were 5% higher than the average for the 1990s, when a record high was set. In 2004, 70% of landings from the Magdalen Islands were made in the southern part of the archipelago, and 30% in the northern part. Compared with 2003 levels, landings increased by 15% in the southern part of the archipelago and 7% in the northern part.

Warmer water temperatures were recorded during the 2004 fishing season than in

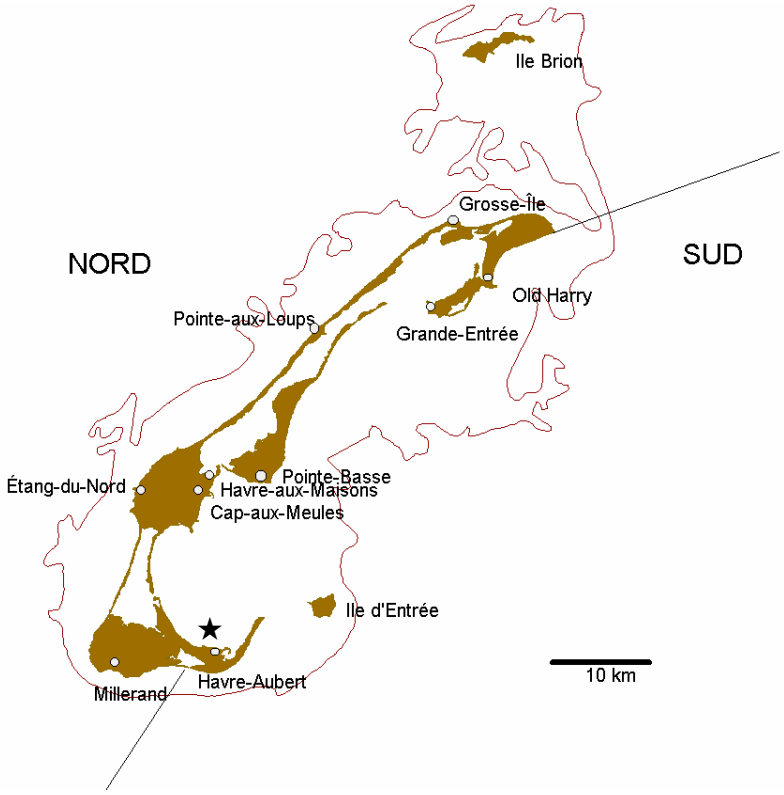

Figure 2. Map of the Magdalen Islands showing the boundaries of southern and northern zones and the Les Demoiselles site (star).

2003, and 50% of the catch made within the first three weeks of the season. In 2004, the number of trips accounted for totalled 16,300, which is slightly above the average for 1990–2003 (15,900 trips). Each trip consists of one daily outing per fisher for which a purchase receipt is produced. The maximum number of trips expected during a fishing season is 17,550 (325 fishers x 9 weeks x 6 days). The number of trips

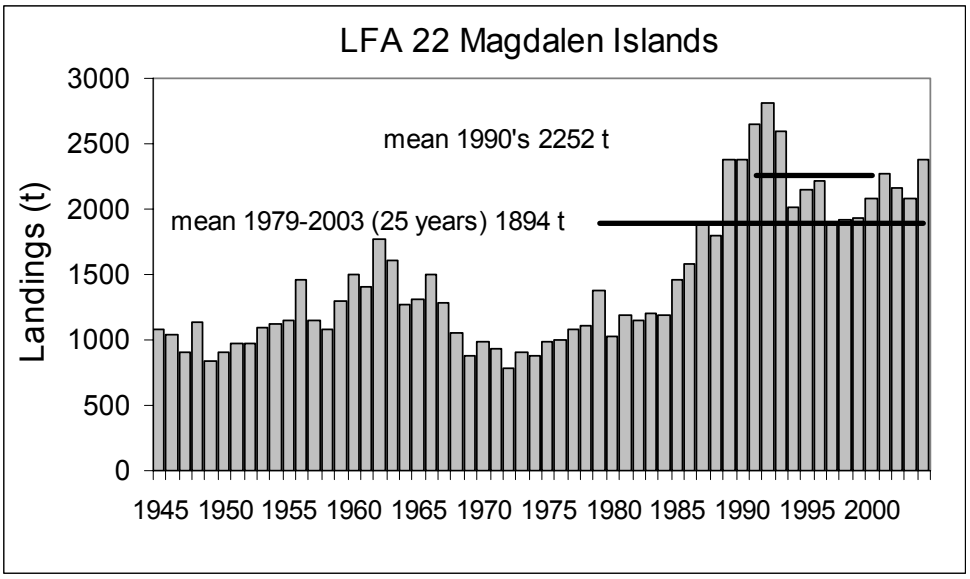

Figure 3. Lobster landings in the Magdalen Islands, 1945–2004.

accounted for gradually increased between the early 1990s and early 2000s. In the early 1990s, some 15,600 trips were made. In 2004, the number of trips made totalled 93% of the maximum allowed.

Catch rates for commercial-size lobsters

Catch rates correspond to the catch per unit effort (CPUE). Since 1985, annual mean CPUEs for commercial size lobster in LFA 22 as a whole have ranged from 0.5 to 1.1 lobsters/trap (Figure 4). In 2004, the mean CPUE was 0.74 l/t, corresponding to an increase of 8.8% from 2003 levels. However, it is 2.6% lower than the series average (1985–2003) of 0.76 l/t. A decrease in the CPUE (10% to 15%) was expected with the increase in minimum legal size, equivalent to annual natural mortality, as the lobsters would remain on the seafloor an extra year before being harvested. The fact that the observed decrease is minimal suggests that the population has remained stable. Larger lobsters partly offset the decrease in the number of lobsters caught. The mean CPUE in weight was 0.45 kg/trap in 2004, which is 15.4% higher than the series average. The overall trend reflects mostly the situation in the southern part of the archipelago. For the northern Magdalen Islands, the CPUE in number increased by only 2% from 2003 levels and is 5.7% lower than the series average. The CPUE in weight is however 9.2% higher than the series average. Index fisher CPUEs correlate strongly with those obtained through at-sea sampling and indicate the same trends.

Catch composition and exploitation rates

Following the increase in minimum legal size (Figure 5), changes have been noted in

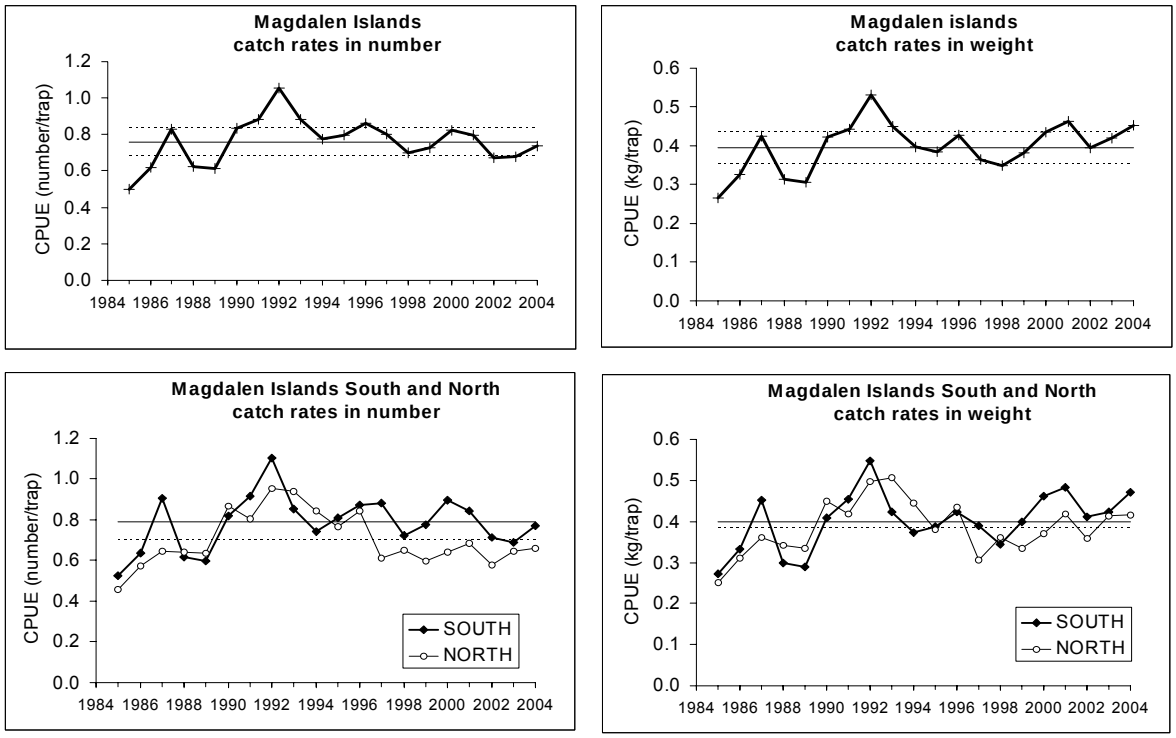

Figure 4. Catch rates (CPUE) in number and weight for commercial-size lobster per trap. Top: CPUE values for 1985–2004 for the Magdalen Islands as a whole. The solid line represents the mean for 1985–2003; the dotted lines represent the ±10% interval around this mean. Bottom: CPUE values for the southern and northern Magdalen Islands. The solid line represents the 1985–2003 mean for the southern part, and the dotted line represents the 1985–2003 mean for the northern part.

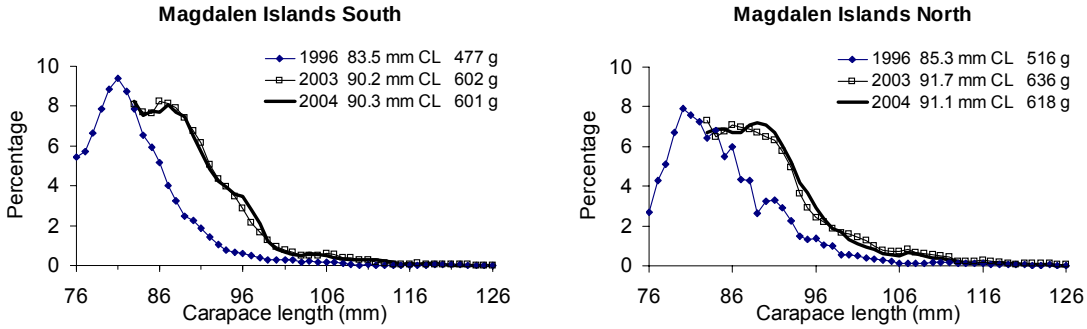

Figure 5. Size frequency distribution for lobster caught (commercial fraction) in 2003 and 2004, compared with 1996, in the southern and northern parts of the Magdalen Islands (LFA 22). The mean length and weight of the lobsters caught is indicated.

size composition for lobster landed in the Magdalen Islands. Between 1996 and 2003, the mean size of lobsters caught increased by almost 7 mm. In the southern part of the archipelago, the mean size increased from 83.5 mm to 90.2 mm, whereas in the northern part, it increased from 85.3 mm to 91.7 mm, remaining steady in 2004. During the same period, the mean weight increased by 26% in the southern part and 23.3% in the northern part, jumping from 477 g to 602 g and 516 g to 636 g, respectively. The trawl survey conducted in the southern Magdalen Islands revealed the same trends.

However, size structures remain just as highly truncated, which is an indication of high exploitation rates. Exploitation rates for commercial-size males remained high in both the northern and southern Magdalen Islands and have been rising since 1985. In 2003, they totalled 70% and 72% for the southern and northern parts, respectively, compared with averages of 66% and 56% for 1985–2002 (Figure 6). Exploitation rates for 1996–2004 were calculated using trawl survey data and were around 65%. Exploitation rates are obtained by measuring the change in abundance between the first moult group recruited to the fishery and the second moult group one year later. However, the exploitation rate for males ≥ 76 mm has decreased since the increase in minimum legal size and is now around 45%. In this case, the exploitation rate is calculated using a method based on changes in the proportions of recruits and pre-recruits over the fishing season. It has been impossible to calculate this index since the size of escape vents was increased in 2002, because small lobsters on which this index is based are no longer caught. The mortality of females is however lower because they are protected when berried.

The proportion of large lobsters observed during at-sea samplings and in the trawl survey was low. In 2004, jumbo lobsters (≥127 mm CL) accounted for only 0.5% of southern Magdalen Island population and 0.8% of northern Magdalen Island population.

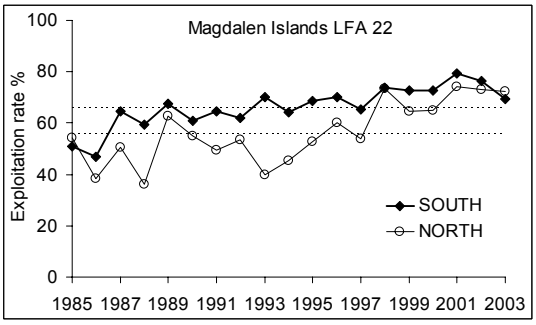

Figure 6. Exploitation rate index for the northern and southern parts of the Magdalen Islands (LFA 22), 1985–2003. The index is calculated based on the population fraction made up of commercial-size males. The dotted lines represent the mean for 1985–2002 for the southern part (upper line) and the northern part (lower line).

Sex ratio and mating success

The overall male-to-female ratio for commercial-size lobster is approximately 1:1 (Figure 7). For sizes greater than 90 mm, males generally outnumber females (M:F = >1:1). Data obtained from at-sea samplings reveal that the male-to-female ratio has been lower in recent years. An unbalanced sex ratio could impact the mating rate and the mating success, which could in turn affect the number of eggs produced.

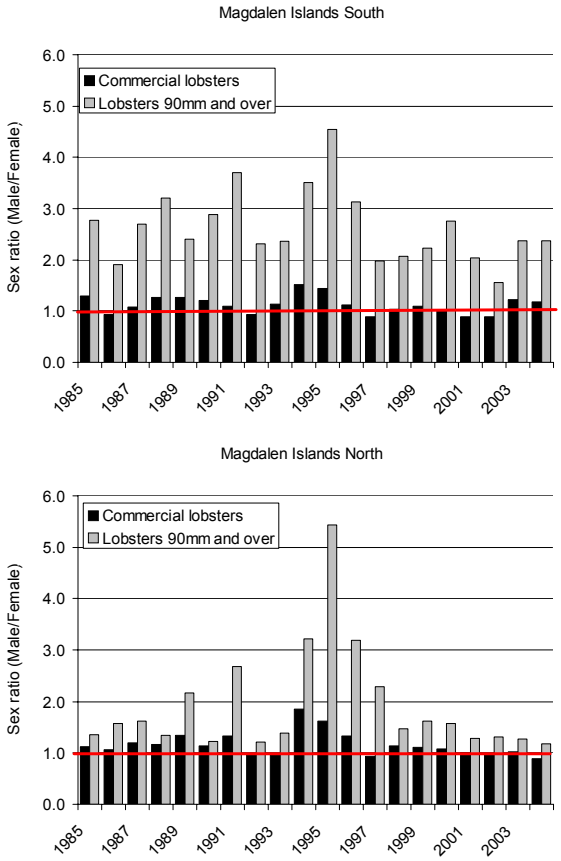

Figure 7. Male-to-female ratio for the commercial fraction and lobsters ≥ 90 mm for the southern and northern parts of the Magdalen Islands (LFA 22), 1985–2004

During the 2004 trawl survey, postmoult females larger than 80 mm were examined to see whether they had a sperm plug at the entrance to their seminal receptacle. Presence of a sperm plug indicates that the female has mated and that her seminal receptacle contains sperm. Of the 985 females examined, 807 (82%) had a sperm plug; 79% of females larger than 90 mm (n=356) had a sperm plug. This indicator will continue to be monitored in the coming years. At the same time, an examination of the content of the seminal receptacle will be carried out to detect any sign of sperm limitation that could result from overly intense fishing pressure on males.

Berried females and egg production

The results of a simulation model show that, with the 7 mm increase in minimum legal size (76 to 83 mm), egg production per recruit would have increased by 100% from 1996 levels, thereby meeting the objective of doubling egg production per recruit. These theoretical results suggest that the other major factors in the dynamics of lobster stocks, such as growth, natural and fishing mortality, fecundity and sexual maturation, have remained unchanged since 1996.

Data obtained through at-sea sampling and the trawl survey show that the abundance of berried females increased significantly between 1996 and 2002 in the southern Magdalen Islands and between 1999 and 2001 in the northern Magdalen Islands, despite the fact that the abundance of commercial-size lobsters remained fairly stable (Figure 8). Abundance dropped in the southern part of the archipelago in 2003, partly due to the increase in the size of escape vents. Examination of the size structure and abundance of berried females suggests that egg production doubled between 1996 and 2004 (Figure 9). The egg production index is obtained by multiplying the abundance index of berried females for each 1-mm size class by the size-specific fecundity. The abundance index of berried females is obtained by weighting size frequency distributions against abundance indices (CPUE, annual mean). The number of multiparous females has also increased proportionately since 1996.

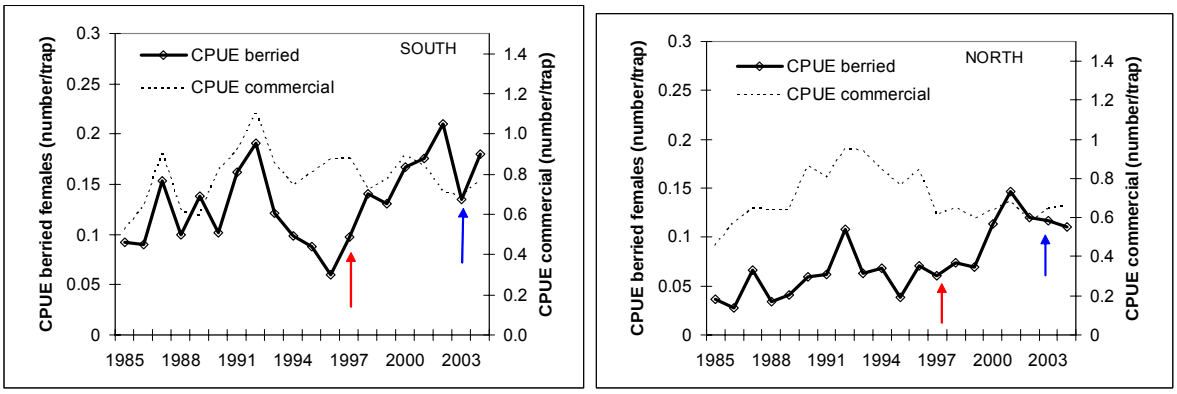

Figure 8. Catch rates (CPUE) of berried females for the southern and northern parts of the Magdalen Islands (LFA 22), 1985– 2004. The first arrow indicates the start of increases in minimum legal size; the second arrow indicates the year when the height of escape vents was increased from 43 mm to 47 mm. The dotted line represents CPUE trends for commercial-size lobster during the same period.

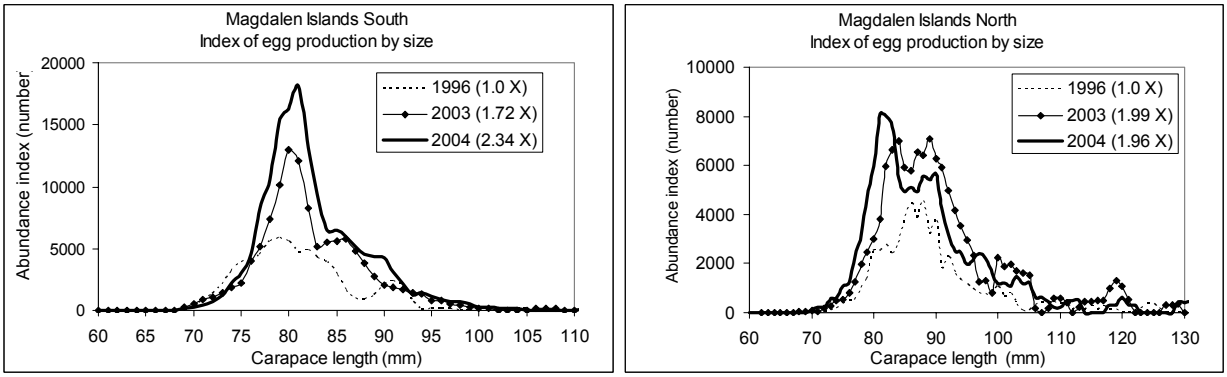

Figure 9. Egg production index calculated for the southern and northern parts of the Magdalen Islands (LFA 22) in 1996, 2003 and 2004. Egg production in 2003 and 2004 relative to that in 1996 is indicated in parentheses.

Recruitment

The recruitment index obtained from the trawl survey indicates that landings in 2005 could be similar to those made in recent years. The correlation between the abundance of commercial-size lobsters in a given year and landings made the following year is positive and significant (Figure 10). Abundance indices for prerecruits and juveniles are up from 2003 levels, suggesting that recruitment should be maintained in the medium term. Benthic settlement in the Les Demoiselles site has been good since 2002. High values recorded in recent years coincide with the increase in egg production. Benthic settlement is also influenced by the strength

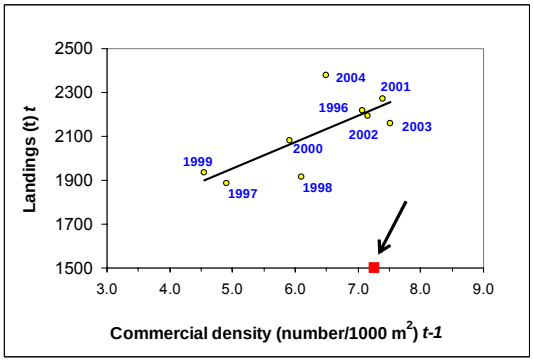

Figure 10. Relationship between the abundance index of market-size lobsters obtained from the trawl survey and landings made one year later. The square on the X axis indicates the density observed during the 2004 survey.

and direction of winds during the larval period.

Conclusion

The increase in minimum legal size contributed to the increase in egg production and helped correct the problem of growth overfishing. The increase in minimum legal size has helped to reduce fishing pressure on immature lobster, promoting the production of eggs by primiparous females (i.e. females that are spawning for the first time). The objective of doubling egg production per recruit was met.

Although it is difficult to establish a direct link between the quantity of eggs produced and recruitment to the fishery, higher egg production should at least ensure that this factor does not become limiting. When environmental conditions are favourable, increased egg production could translate into improved recruitment. In unfavourable environmental conditions, higher egg production could reduce the risk of the stock collapsing.

Recent studies have shown that it would also be advantageous to increase the number of multiparous females (i.e. females that have already spawned once). The larvae of multiparous females are larger and heavier at emergence, which may indicate better survival potential. Additional measures could be implemented to increase multiparous females' contribution to egg production (e.g. V-notching, maximum size).

To date, very few measures have been implemented to reduce fishing effort and exploitation rates. The fishery remains just as dependent as before on annual recruitment. Moreover, the anticipated benefits of increasing the minimum legal size are reduced if the exploitation rate is increased, in terms of increasing egg production per recruit. It would be advantageous to reduce fishing effort, as the greater protection of females tends to create asymmetry between the exploitation rates for males and females. If exploitation rates are too high, the sex ratio could shift in favour of the females. Consequently, the number of large lobsters could drop even further, which would impact females' capacity to reproduce normally.

For more Information

Contact: Louise Gendron
Maurice Lamontagne Institute
850 Route de la Mer
P.O. Box 1000
Mont-Joli, Québec
G5H 3Z4

Tel: (418) 775-0618
Fax: (418) 775-0740
E-Mail: gendronl@dfo-mpo.gc.ca

This report is available from the:

Regional Science Advisory Bureau
Quebec Region
Fisheries and Oceans Canada
Maurice Lamontagne Institute
P.O. Box 1000, Mont-Joli
Quebec, Canada
G5H 3Z4

Phone Number : 418-775-0825
Fax Number : 418-775-0740
E-Mail address : Bras@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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