



## ASSESSMENT OF THE LOBSTER STOCKS OF THE MAGDALEN ISLANDS (LFA 22) IN 2005

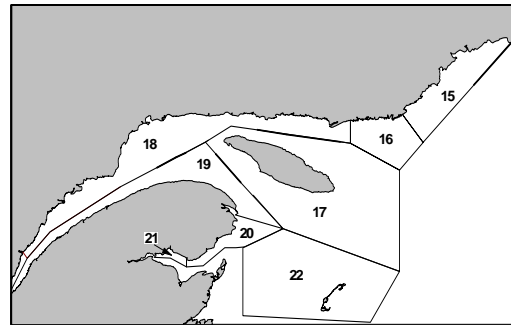
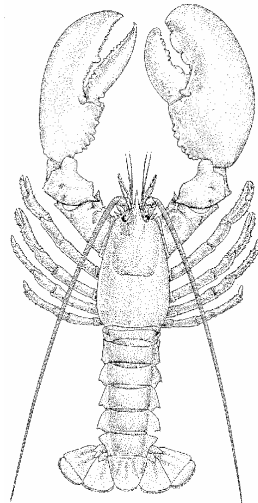


Figure 1: Map showing the lobster fishing areas (LFAs) in Quebec (LFAs 15 to 18: North Shore and Anticosti; LFAs 19 to 21: Gaspé Peninsula; and LFA 22: Magdalen Islands).

### Context

Lobster fishing is practiced in the Magdalen Islands by 325 fishing enterprises distributed around the archipelago. The two thirds of the fleet is active along the southern side of the Islands (Old Harry to Havre-Aubert) and one third along the northern side (Grosse Isle to Millerand) (Figure 2). The lobster fishery is managed by controlling the fishing effort and is also subjected to a regulation prescribing a minimum legal size and the protection of berried females in order to maintain the reproductive potential. The minimum legal size was increased at a rate of 1 mm every year between 1997 and 2003. The minimum legal size, which was established to 76 mm between 1957 and 1996, reached 83 mm (carapace length) in 2003. This increase made it possible to achieve the goal of doubling the egg production per recruit compared to the levels of 1996.

The resource status assessment is done on an annual basis in order to closely monitor the impacts of the changes made to the management measures on the lobster population and to focus on the elements for which additional conservation efforts would be desirable.

### SUMMARY

- In 2005, landings and CPUEs in the Magdalen Islands remained high.
- The average sizes and weights have stabilized since the end of the increase in minimum legal size, up to 83 mm in 2003. The size is now 7% larger and the weight 22% higher than before 1997, when the minimum legal size was 76 mm.

- Marked differences were observed between the size structures of males and females due, among other things, to a decrease in female growth when they reach their sexual maturity and to the fact that females that spawn enter the fishery a year later than males.
- The 2004 exploitation rates calculated for males in the commercial portion reached 74% in the southern and northern parts of the Magdalen Islands. A lower fishing mortality level is desirable.
- The abundance of berried females is significantly higher than it was before the increase of the minimum legal size; during the same period, the egg production index doubled. The number of multiparous females also increased, but their proportion compared to primiparous females did not change significantly between 1996 and 2005.
- Abundance indices of prerecruits and juvenile calculated from the trawl survey suggest that recruitment levels could be maintained in the medium term.
- In order to decrease exploitation rates, measures to reduce fishing effort by 12.5% have been proposed to the industry. This would therefore make it possible to reduce the fishery's dependence on annual recruitment, to increase the levels of egg production per recruit, to increase the proportion of multiparous females in the population, and to ensure their reproductive success by keeping balanced sex ratios.

## INTRODUCTION

### Biology

American lobster (*Homarus americanus*) occurs along the west coast of the Atlantic Ocean, from Labrador to Cape Hatteras. Adult lobsters prefer rocky substrates where they can find shelter, but can also live on sandy and even muddy bottoms. Commercial concentrations are generally found at depths of less than 35 m. In the Magdalen Islands, females reach sexual maturity at around 79 mm of carapace length in the southern part and 84 mm in the northern part. 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 lay 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, i.e. they live hidden in habitat providing many shelters. Lobsters are estimated to reach the minimum legal size (83 mm) around 8 years of age, after having moulted approximately 16 times since their benthic settlement.

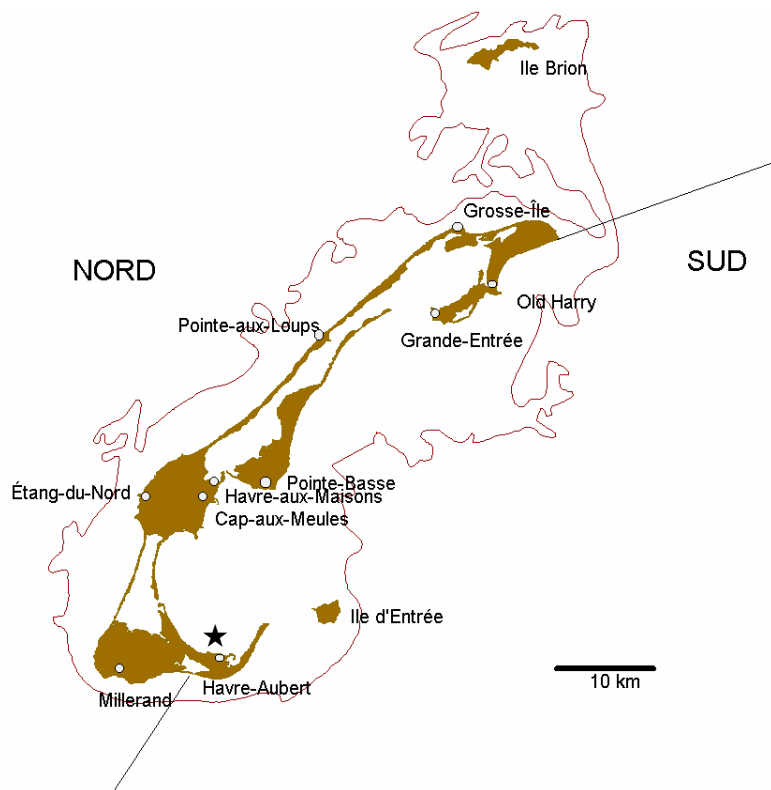


Figure 2. Map of the Magdalen Islands showing the boundaries of the southern (SUD) and northern (NORD) part and the Les Demoiselles site (star).

## **Fishery management**

The lobster fishery is managed by controlling fishing effort by restricting the number of licences, the number and size of traps, and the duration of the fishing season. The lobster fishery is a spring activity that lasts 9 weeks in the Magdalen Islands. In 2005, 325 commercial licences were issued with a limitation of 300 traps each. In addition to the size of the traps, which is currently limited to 81 cm in length, 61 cm in width and 50 cm in height, the presence of escape vents on traps has been mandatory since 1994, and the size of their vertical opening went from 43 mm to 47 mm in 2003. In 2005, the minimum legal size was 83 mm, and the release of berried females was mandatory.

## **ASSESSMENT**

### **Source of data**

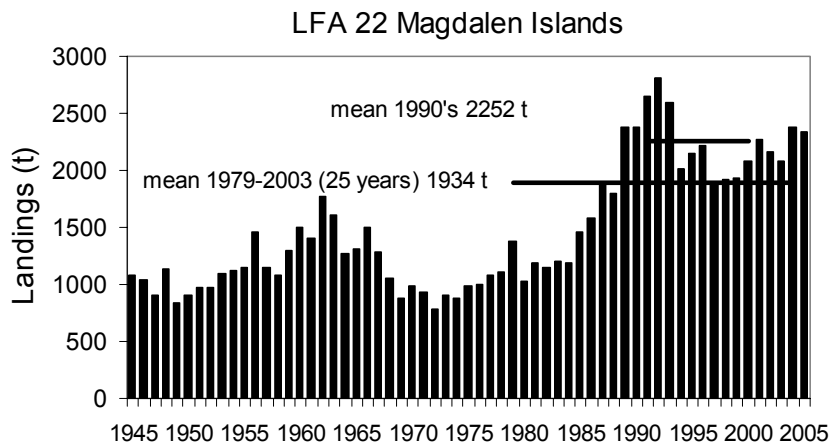
The stock status assessment is based on abundance indicators derived from landings recorded on processing plant purchase slips, catch rates of commercial-size lobsters obtained from commercial capture at-sea samplings, and logbooks kept on a voluntary basis since 1992 by a variable number of index fishermen (from 6 to 8). The assessment is also based on the analysis of the size structures of lobsters captured at sea, which are used to follow the evolution of the average and maximum sizes, to estimate the exploitation rates, to assess the abundance of berried females, and to calculate a relative index of egg production. At-sea sampling has been conducted annually since 1985 on the fishing grounds of the southern and northern parts of the

archipelago. A trawl survey is also carried out on the southern part of the archipelago since 1995. 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.

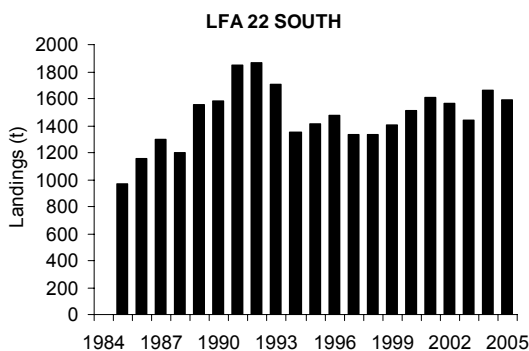
**Landings**

Landings recorded in the Magdalen Islands (preliminary data) reached 2,336 tons in 2005 (preliminary data), which represents a reduction of 1.5% compared to 2004 (2,371 tons) (Figure 3A). These are 21% higher than the average of the last 25 years (1,934 tons). This is also higher than the average for the 1990s (2,252 tons), when a record high was set. Compared with 2004 levels, landings decreased by 4% on the southern part of the archipelago and increased by the same percentage on the northern part (Figures 3 BC). They reached 1,595 tons and 741 tons on in the southern and northern parts of the Islands, respectively. In 2005, 68.3% of the landings were made in the southern part and 31.7% in the northern part of the archipelago. In 2005, lobster landings in the Magdalen Islands accounted for 73.6% of total landings in Quebec.

A)



B)



C)

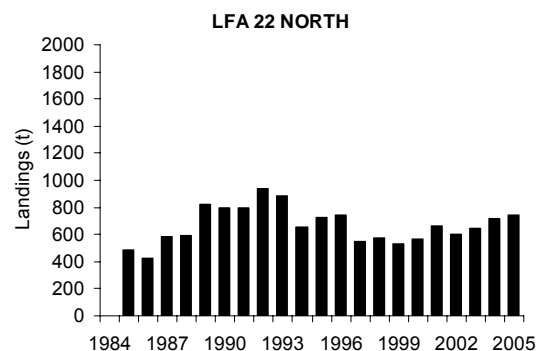


Figure 3. Lobster landings A) in the Magdalen Islands, 1945-2005, B) in the southern part and C) in the northern part, 1985-2005.

Climatic conditions prevailing in 2005 during the fishing season were favourable. At the opening of the fishing season, temperatures recorded on the bottom were relatively warmer than usual, both in the southern and northern parts of the Magdalen Islands, which favoured lobster catchability. The number of trips accounted for totalled 15,859, which is 2.7% less than in 2004, but comparable to the 1990-2004 average. 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). In 2005, the number of trips made totalled 91% of the maximum allowed.

### Catch rates for commercial-size lobsters

Catch rates correspond to the catches per unit of effort (CPUEs) expressed in number or weight of lobster per trap. Since 1985, in LFA 22, average annual CPUEs of commercial-size lobsters derived from at-sea sampling of commercial captures ranged from 0.5 to 1.1 lobsters per trap (l/t) (Figure 4A). In 2005, the average CPUE was 0.74 l/t, which corresponds to that recorded in 2004. It was slightly (2.6%) below the series average (1985-2004) of 0.76 l/t. Average CPUE weight value was 0.45 kg/trap in 2005, which is equal to that observed in 2004 (Figure 4B). The 2005 average weight CPUE was 14.5% above the series average. Logbook data indicate approximately the same trends.

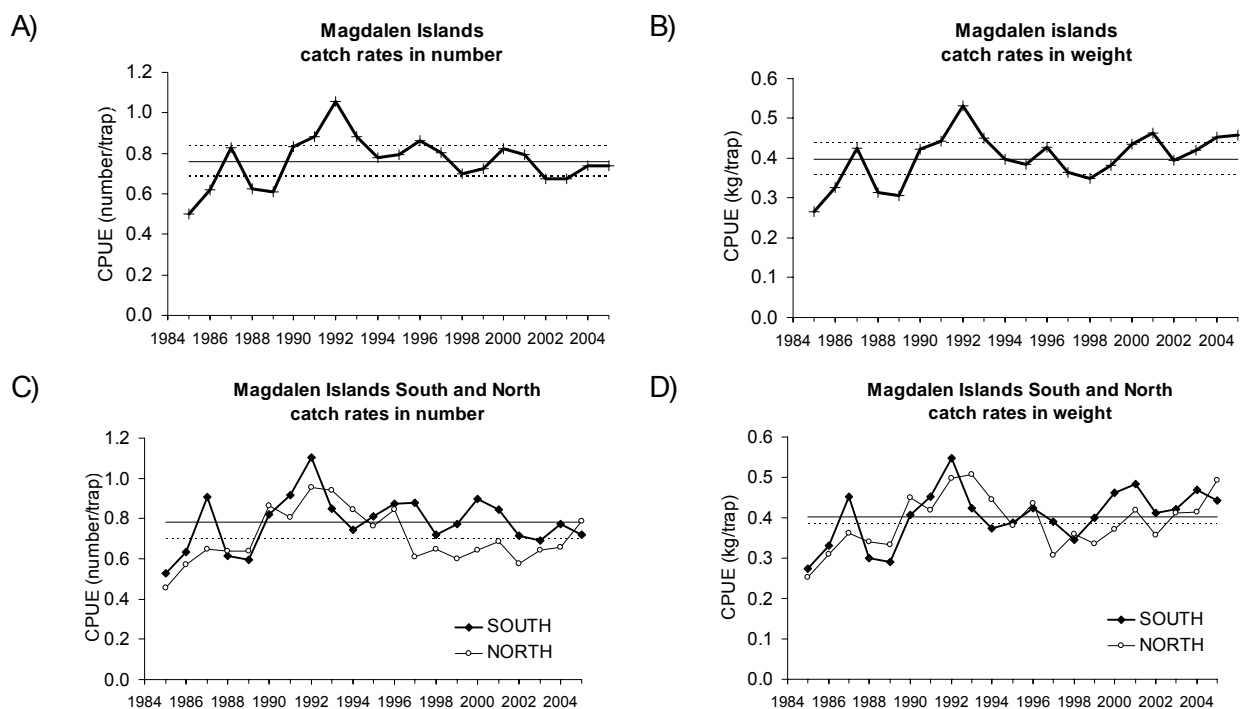


Figure 4. Catch rates (CPUEs) in the Magdalen Islands from 1985 to 2005 A) in number and B) in weight per trap of commercial-size lobsters. The solid line represents the 1985-2004 mean; the dotted lines represent the  $\pm 10\%$  interval around this mean. CPUE values for the southern and northern Magdalen Islands C) in number and D) in weight. The solid line represents the 1985-2004 mean for the southern part and the dotted line represents the mean for the northern part for the same period.

In the southern part, CPUE in number decreased since 2000 (Figure 4C). This trend is however not significant. The drop in the CPUEs in number could be associated to the increase in the minimum catch size as lobsters remain on the bottom an extra year before being fished and as they are subjected to an estimated natural mortality of approximately 10-15%. The larger size of lobsters landed can compensate for the reduction in numbers. The 2005 CPUE mean number was 0.72 l/t, which is 8% below the series average (1985-2004). However, the average weight CPUE (0.44 kg/t), although slightly lower (6%) than that of 2004, was 11% above the series average (Figure 4D).

In the northern part, CPUE in number dropped in 1997 and up until 2004 remained at levels lower than what had been recorded in the beginning of the 1990s, ranging between 0.60 and 0.68 l/t (Figure 4C). In 2005, mean CPUE in number reached 0.79 l/t, representing a 19.1% increase from 2004. Between 1997 and 2004, mean CPUE in weight increased from 0.31 to 0.42 kg/t, reflecting the increase in the mean size of lobsters in the catch (Figure 4D). In 2005, CPUE in weight reached 0.49 kg/t, which is 18.5% higher than the 2004 level and 26.1% above the series average (1985-2004).

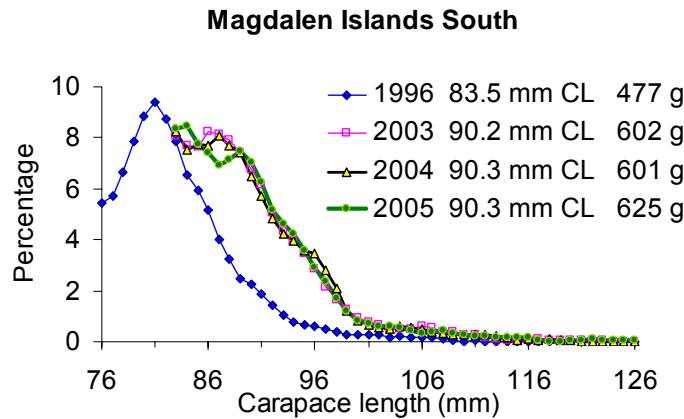
### **Catch composition**

In LFA 22, the size composition of landed lobsters stabilized since the end of the increase in minimum legal size in 2003. The 2003-2005 size structures are similar but different from what they were in 1996, before the increase in minimum legal size (Figure 5). In 2005, in the southern part, the average size of landed lobsters was 90.3 mm for an average weight of 625 g, which is similar to values estimated for 2003 and 2004 (Figure 5A). This represents a size increase of 7.5% and a weight increase of 22% compared to 1996. Values obtained from the trawl survey indicate the same trends. In the northern part, the mean size of landed lobsters is around 91-92 mm since 2003, compared to 85.3 mm in 1996 (Figure 5B). This represents an increase of 7%. During the same period, average weight increased by 22%, jumping from 516 g to 630 g.

Marked differences can also be observed between male and female size structures. Female size distributions are more truncated toward smaller sizes than those of males, which reflect a decrease in female growth as they reach sexual maturity.

The proportion of large-size lobsters observed during at-sea samplings remains low and, in 2005, for the whole of LFA 22, jumbo lobsters (CL  $\geq$ 127 mm) represented only 0.3% of the catches, in both sides of the Magdalen Islands. Values were lower compared to 2004 (0.5% and 0.8% in the southern and northern parts respectively).

A)



B)

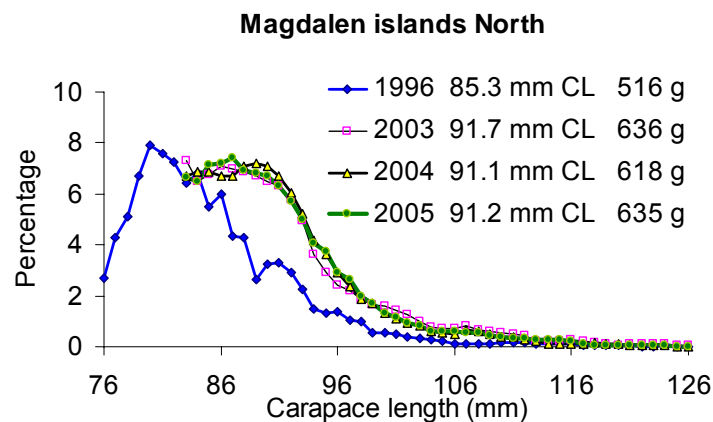


Figure 5. Size frequency distributions of commercial-size lobster in 2003, 2004 and 2005, compared to 1996 for A) the southern part and B) the northern part of the Magdalen Islands. The mean length and weight of the lobsters caught are indicated.

## **Exploitation rates**

Truncated size structures are indicative of high exploitation rates. Exploitation rates calculated for the commercial-size males in LFA 22 remained high in 2004, reaching 74% in both parts of the Magdalen Islands (Figures 6AB). Exploitation rates reached 70% and 72% in 2003, in the southern and northern parts respectively. Mean values for the 1985-2003 period were 66% and 57% for the southern and northern parts respectively. Exploitation rates derived from the trawl survey data were around 66% for the 1996-2005 period. For 2005, the estimated rate was 73% (Figure 6A). This exploitation rate is derived from a measurement of the change in abundance between the first moult class recruited to the fishery and that of the second moult class one year later. The exploitation rate for males  $\geq 76$  mm has decreased since the minimal size was increased and is around 50% (Figures 6CD). 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. Generally, the fishing mortality is lower for females because they are protected when bearing eggs. Consequently, the sex ratio for lobsters remaining on the bottom tends to favour females, and this trend is further visible at higher exploitation rates.

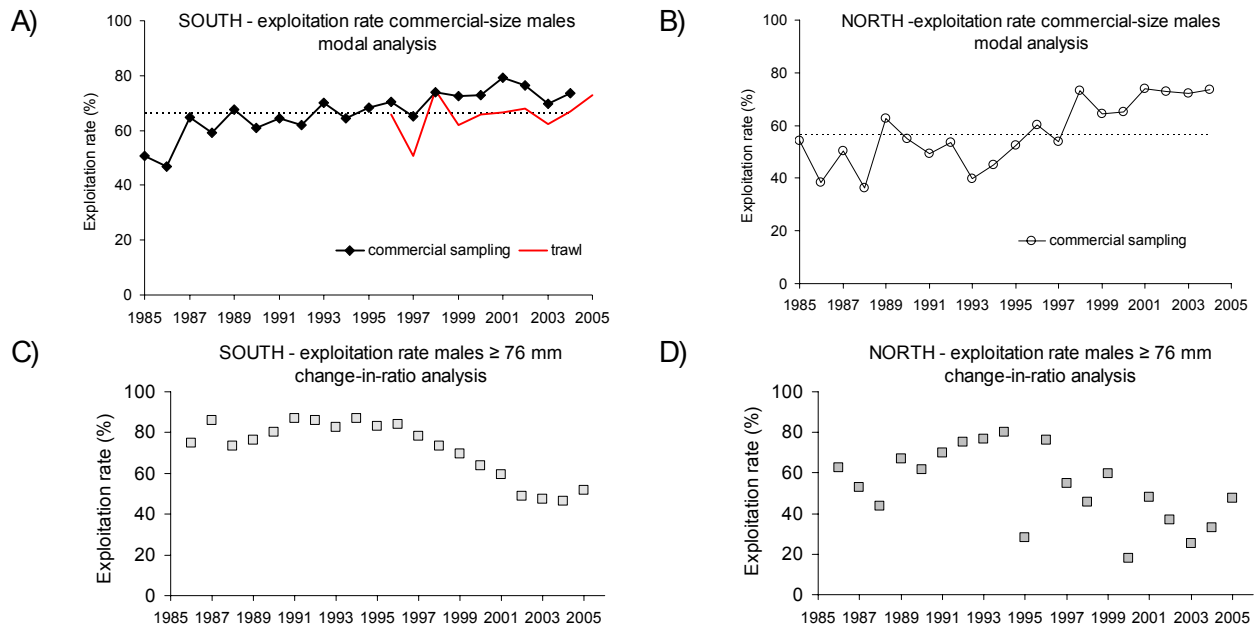


Figure 6. Exploitation rate indices estimated by modal analysis based on data from commercial sampling and from the trawl survey for A) the southern part and B) the northern part of the Magdalen Islands from 1985 to 2004 and 2005 (trawl). Dotted lines represent the mean for the 1985-2003 period (commercial sampling). Exploitation rate indices for male  $\geq 76$  mm derived from the change-in-ratio analysis for C) the southern and D) the northern parts of the Magdalen Islands for 1986-2005.

### Berried females and egg production index

Data from at-sea sampling and from the trawl survey indicate that the abundance of berried females increased significantly between 1997 and 2002 in the southern part of the Islands and between 1999 and 2001 in the northern part, despite the fact that the abundance of commercial-size lobsters remained stable (Figures 7AB). The reduction in the abundance of berried females observed in 2003 was partly associated to the increase in the size of escape vents. In 2005, the abundance of berried females was relatively high.

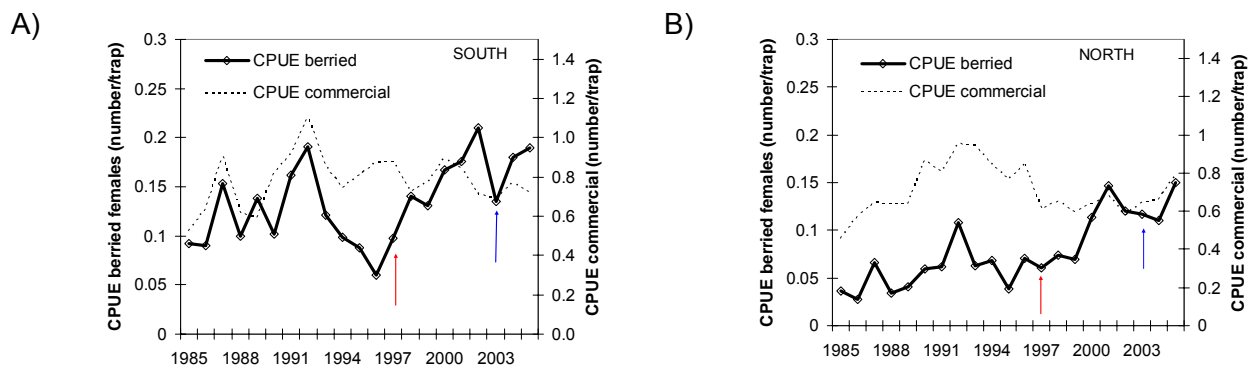


Figure 7. Catch rates (CPUEs) of berried females for A) the southern part and B) the northern part of the Magdalen Islands from 1986 to 2005. The first arrow indicates the start of the increases in minimum legal size and the second arrow indicates the year when the height of the escape vent was increased from 43 mm to 47 mm. The dotted line represents CPUE trends for commercial-size lobster during the same period.



The examination of the size structures and abundance of berried females suggests that egg production doubled between 1996 and 2005 (Figures 8AB). 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 by abundance indices (average annual CPUEs). The number of multiparous females could have also increased proportionately since 1996. In 2005, the mean size of berried females was 80.9 mm and 85.9 mm in the southern and northern parts of the Magdalen Islands respectively. The larger size of the berried females in the northern part is partly explained by the larger size at sexual maturity.

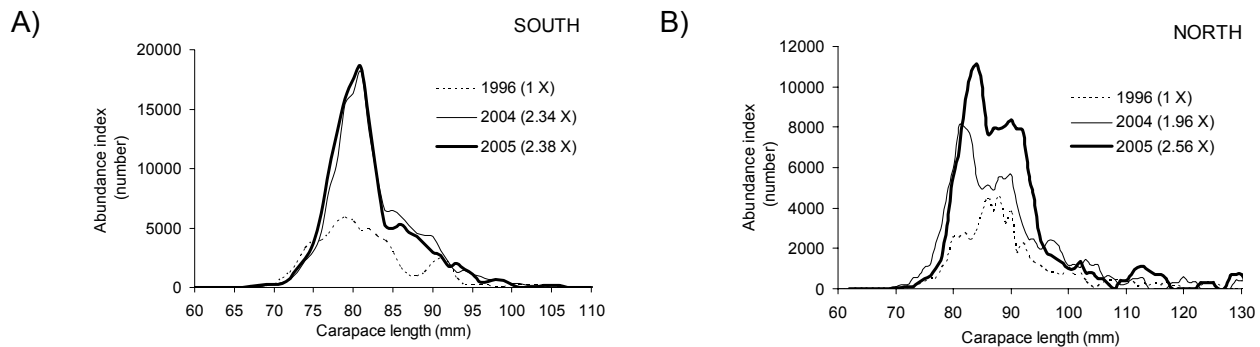


Figure 8. Egg production index calculated for A) the southern part and B) the northern part of the Magdalen Islands in 1996, 2004 and 2005. Egg production in 2004 and 2005 relative to that in 1996 is indicated in parenthesis.

## Mating success

During the 2004 and 2005 trawl surveys, 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 in 2004, 807 (82%) had a sperm plug; 79% of females larger than 90 mm ( $n=356$ ) had a sperm plug. In 2005, 1,293 females were examined and 75.9% and 79.7% of the females larger than 80 and 90 mm respectively had a sperm plug. This indicator will continue to be monitored in the coming years to detect any problem in mating success that could result from overly intense fishing pressure on males creating an unbalanced sex-ratio in favour of females.

## Recruitment

The recruitment index obtained from the trawl survey suggests that landings in 2006 could remain high, although somewhat lower than those of 2005. The correlation between the abundance of commercial-size lobsters in a given year estimated from the trawl survey and landings made the following year is positive and significant (Figure 9). Abundance indices for prerecruits and juveniles remain high, suggesting that recruitment could be maintained in the medium term. Benthic settlement in the Les Demoiselles site (see map, Figure 2) has been higher between 2002 and 2004 compared to the average observed between 1996 and 2001. High values recorded in recent years coincide with the increase in egg production. Benthic settlement is also influenced by the strength and direction of winds during the larval period. In 2005, no benthic settlement (2005 cohort) was recorded. Benthic settlement will continue to be monitored in 2006 to determine the success of the 2005 benthic settlement. It has already

occurred in the past that a cohort became visible only in its second year on the bottom. Moreover, recreative divers reported seeing young-of-the-year lobsters in other sites of baie de Plaisance.

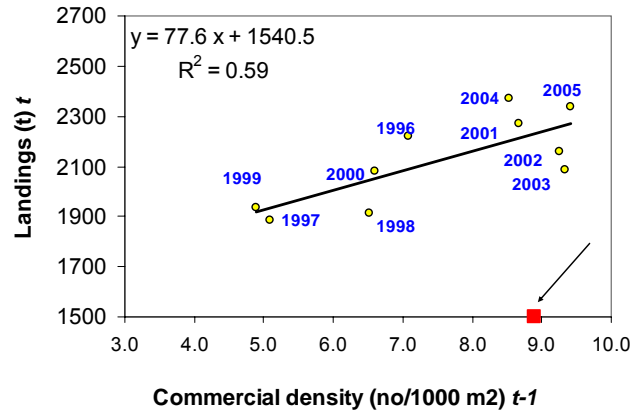


Figure 9. Relationship between the abundance index of commercial-size lobsters obtained from the trawl survey and landings recorded one year later. Abundance estimates were adjusted by the mean weight of lobsters. The square on the X-axis (arrow) indicates the density observed during the 2005 survey.

## **Sources of uncertainty**

The data on landings presented correspond to the landings recorded on processing plant purchase slips. There are uncertainties as for the non-recorded lobster captures, which correspond among other things to the quantities set aside for personal consumption and to the quantities poached. A bipartite group composed of industry and DFO representatives is currently working on developing and validating a model to assess non-recorded lobster landings.

The lack of logbooks does not allow for the estimation of precise abundance indices for each fishing sectors of the archipelago. Abundance indices are derived from at-sea sampling of commercial catches that covers 0.14% of all fishing activities and from data gathered by index-fishermen, which represent between 2-3% of all fishermen. The low sampling effort creates uncertainty on the representativity of the estimates.

Although it is considered that catch rates reflect the abundance of lobster on the seafloor, they can also be affected by both intra and inter-annual variations in lobster catchability. Cold temperatures, winds and currents are factors that have a negative impact on catchability. These effects are difficult to quantify and introduce uncertainty into the interpretation of catch rates. Changes in catchability can also create uncertainty in the calculation of exploitation rate indices.

There is ongoing work to develop tools to forecast lobster landings. Short-term forecast appears possible based on the results obtained from the trawl survey since 1995. Longer term forecasting is however more difficult given the difficulty in sampling early benthic stages, the uncertainty and variability of the age at recruitment and the absence of knowledge on the factors influencing lobster survival between settlement and their entry in the fishery (8-10 years later). There is also uncertainty in the representativity of observations made on a small spatial scale for a whole population.

## CONCLUSION AND ADVICE

Globally, in 2005, abundance indices of commercial-size lobster remained high in the Magdalen Islands. The abundance of berried females and the level of egg production were high as well, compared to levels before the increase in the minimum legal size. However, exploitation rates are high. Up until now, very few measures have been implemented to decrease fishing effort and exploitation rates. Although fishing mortality for the whole of the population decreased with the increase in the minimum legal size, it is also true that the exploitation rates measured on the commercial portion are constantly increasing. Moreover, the greatest protection granted to females compared to males tends to create an asymmetry in exploitation rates between both sexes. With high exploitation rates, the sex ratio tends to advantage females. If the exploitation rates are too high, the number of large male lobsters could be reduced to a point where it could have an impact on the capacity of females to reproduce normally. An unbalanced sex ratio could affect the mating ratio and the success of female insemination. And this could ultimately affect the quantity of eggs produced.

In order to reduce exploitation rates, measures to decrease fishing effort by 12.5% were proposed to the industry. If the effort reduction is not counterbalanced by changes in gear (size of traps) and in fishing practices (increase in the number of hauls per day), this reduction could help reduce fishing mortality. In turn, this could reduce the fishery dependence on annual recruitment, increase the level of egg production per recruit, increase the proportion of multiparous females in the population, and ensure spawning success by keeping sex ratios balanced.

## 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) 775-0617

Fax : (418) 775-0740

E-mail : [gendronl@dfo-mpo.gc.ca](mailto:gendronl@dfo-mpo.gc.ca)

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Regional Advisory Process (RAP) Office  
Quebec Region  
Fisheries and Oceans Canada  
Maurice Lamontagne Institute  
P.O. Box 1000  
Mont-Joli  
Quebec, Canada  
G5H 3Z4

Telephone: (418) 775-0825

Fax: (418) 775-0740

E-Mail: [Bras@dfo-mpo.gc.ca](mailto:Bras@dfo-mpo.gc.ca)

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ISSN 1480-4913 (Printed)

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## CORRECT CITATION FOR THIS PUBLICATION:

DFO, 2006. Assessment of the Lobster Stocks of the Magdalen Islands (LFA 22) in 2005. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/012.