STOCK STATUS REPORT

LAURENTIAN REGION

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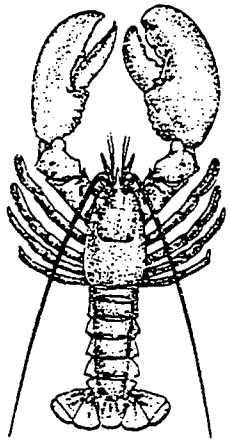
DFO, Atlantic Fisheries, Stock Status Report 96/3 March 1996

QUÉBEC LOBSTER



BIOLOGY

The American lobster (*Homarus americanus*) is one of the most important species found in North American coastal waters from an economic and ecological standpoint. The lobster lives along the west coast of the Atlantic, from Labrador to Cape Hatteras. Adults prefer rocky bottoms where they can find shelter, but are also found on sand or even mud. Concentrations of commercial-sized lobsters occur at depths of less than 35 m. However, they are also found along the Scotian Shelf at depths of up to 450 m, where they are harvested by an offshore fleet.

Females reach sexual maturity at a cephalothorax length (CTL) of about 79 mm in the southern part of the Magdalen Islands and around 84 mm in the northern part of the Islands and the Gaspé. In general, females have a two-year reproductive cycle, spawning one year and moulting the next.

A female spawning for the first time can produce nearly 8,000 eggs, while one with a CTL of 125 mm (5 in.) can lay up to 35,000 eggs. After the eggs are released, they remain attached to the female's swimmerets for 9 to 12 months, until they hatch the following summer. The newly-released pelagic larvae remain in the plankton for 3 to 10 weeks, depending on the water temperature. Once they reach Stage 4, following metamorphosis, the postlarvae leave the surface and settle on the bottom.

During the first few years of their benthic life, or until they reach a CTL of about 40 mm, lobsters lead a cryptic existence,

living in structurally varied habitats that offer numerous hiding places. They reach minimum legal size (76 mm CTL) between 6 and 8 years of age, after moulting 15 to 20 times.

Lobster landings have been very high in Québec and on Canada's entire Atlantic coast over the past 20 years. In some locations, they have reached the levels recorded during the early days of the fishery in the late 19th century. Catches in the Magdalen Islands over the past seven years have exceeded the peak recorded in 1905, while landings in the Gaspé in 1995 equalled the record posted in 1880. This general increase in landings is surprising given that the biological data on lobster populations suggest that stocks are overfished. Over the next few years, a more determined effort will be made in Québec and on the Atlantic coast to better understand and forecast fluctuations in the abundance of lobster.

MANAGEMENT SITUATION

Lobster is fished along the entire coast of Québec. In 1995, there were 658 actively exploited lobster fishing licences divided among eight fishing areas (Figure 1).

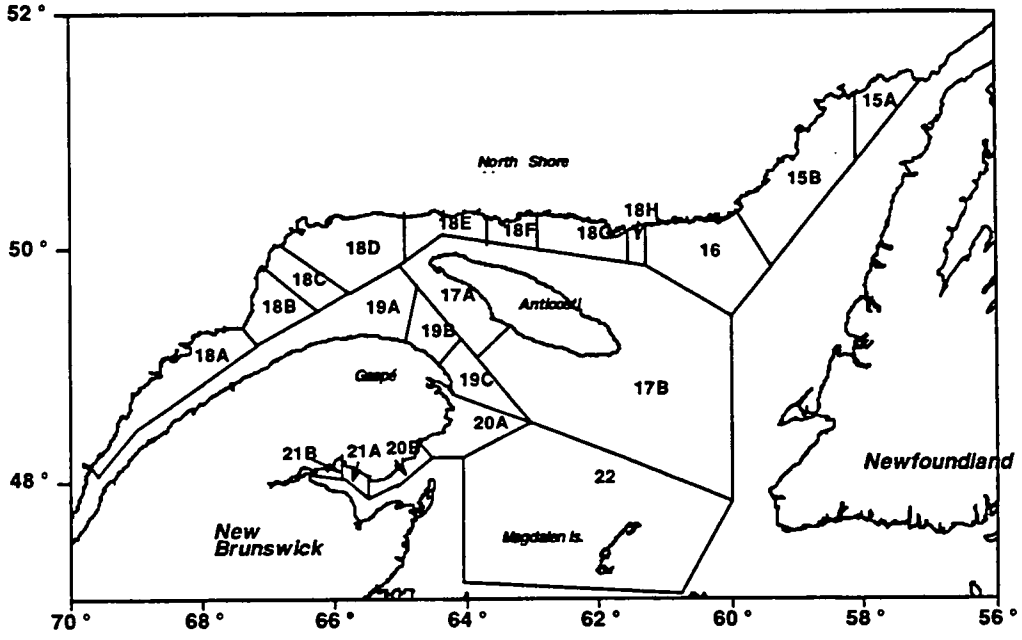


Figure 1. Lobster fishing areas in Québec

The number of standard traps authorized per licence is 250 to 300 depending on the area. The use of larger traps is controlled by limiting their number according to their efficiency. For example, the number of traps larger than standard traps (whose size varies depending on the fishing area) is limited to 175 or 210 in areas where a maximum of 250 to 300 standard traps is authorized. The fishing season lasts 9 to 12 weeks, and the fishery normally begins early in spring, after the ice breakup. The fishery is subject to regulations on minimum legal size and returning berried females to the sea, which are aimed at conserving the resource by maintaining a certain level of egg production. The minimum legal size in all Québec fishing areas is 76 mm (3 in.) CTL.

To limit the harvesting of noncommercial-sized lobsters, the use of traps with escape vents became compulsory in 1994. All traps must now have a 43 mm x 127 mm rectangular opening or two circular openings with a diameter of 56 mm in each parlour. Fishermen in southern Gaspé (areas 20A (part), 20B and 21) have been marking berried females since 1993. They mark a notch on the telson (V-notch) of a certain number of egg-bearing individuals and throw them back into the water. The mark is still visible the following year, making it possible to recognize females that are potential spawners even when they are not bearing eggs. Protecting these females enables them to produce eggs a second and perhaps even a third time. Since 1994, fishermen have been required to return females with a V-notch on the telson to the sea. In November 1995, the Fisheries Resource Conservation Council (FRCC) tabled a report on lobster conservation establishing guidelines for future initiatives in this regard. The conservation principles, strategy and measures proposed are described and analyzed below.

STATUS OF STOCKS IN 1995

Landings

Lobster landings in Québec in 1995 were up by 6.5% compared with the previous year, increasing from 2,982 t in 1994 to 3,177 t in 1995 (Figure 2, Table 1). This situation contrasts with that of 1994, when landings dropped by 18% compared with the year before. In 1995, 66% of the total Québec catch came from the Magdalen Islands (Area 22), 30% from the Gaspé (areas 19, 20 and 21) and 4% from the North Shore (areas 15, 16 and 18) and Anticosti Island (Area 17).

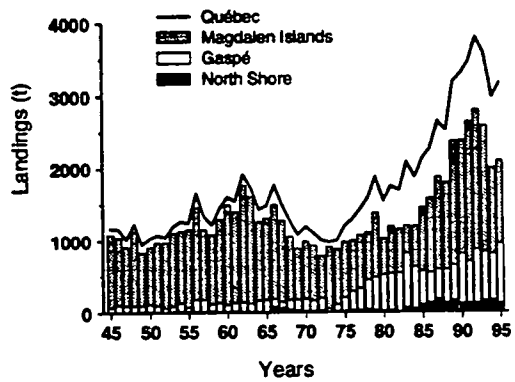


Figure 2. Lobster landings in Québec

In the Magdalen Islands, the catch increased by 4.6%, from 2,007 t in 1994 to 2,099 t in 1995. Landings in the Gaspé rose substantially, i.e. by 18%, from 806 t in 1994 to 951 t in 1995. Landings were

much smaller on the North Shore in 1995, particularly in Area 16, dropping from 10 t in 1994 to only 2 t in 1995. Landings for Area 15 were the same as in 1994, i.e. 8 t, but lower than between 1984 and 1993, when they averaged 34 t.

Table 1. Lobster landings (t) in Québec by fishing area

	1991	1992	1993	1994	1995*
Area 15	32	37	26	8	8
Area 16	12	16	14	10	2
Area 17	76	98	108	143	113
Area 18	12	5	12	8	4
Area 19	17	18	25	25	37
Area 20	621	797	751	730	864
Area 21	64	58	59	51	50
Area 22	2642	2806	2593	2007	2099
Total	3476	3835	3588	2982	3177

* preliminary data

The fishing season began slightly later (up to one week later in some spots) in 1995 than in 1994. Weather conditions were more favourable, however, than the previous year. The fishing effort at the beginning of the season (first three weeks) was more intensive and landings were made more rapidly in 1995 than in 1994. In the Magdalen Islands, for example, 53% of landings were made during first three weeks of the fishing season, compared with 41% in 1994. As a rule, fishing effort in the Gaspé and the Magdalen Islands is very high, making it possible to harvest the available biomass rapidly, especially when weather conditions permit, as in 1995.

In general, landings along the entire Québec coast were very high compared with the past 25 years, when they averaged 2,150 t. The increase has been especially spectacular in the Magdalen Islands, where landings almost tripled between 1976 and 1992. They also rose steadily from the mid-1970s to the early 1990s along almost all of Canada's Atlantic coast, probably in response to common variables favouring large-scale lobster recruitment. For the moment, however, the factors responsible for this phenomenon are not clearly understood.

Abundance indices

Abundance indices for commercial-sized lobster (with a CTL of over 76 mm) are derived from catch per unit of effort (CPUE) (number of lobsters/trap/day) data obtained by sampling commercial catches at sea. In the Magdalen Islands, CPUE values were fairly high (1.44 lobsters/trap/day) at the beginning of the 1995 season. Moreover, as in previous years, they declined as the fishing season progressed (Figure 3). The mid-season CPUE was 0.67 lobsters/trap/day, while that recorded two weeks before the end of the season was 3.5 times lower (0.42 lobsters/trap/day) than early in the season, indicating a decline in the number of lobsters available to the fishery. CPUE values recorded at the beginning, middle and end of the season were similar in all respects to those observed in 1994. The drop in CPUE values in mid-season contrasts with the situation in earlier years (1990-1993), when high CPUE values were maintained for longer periods, probably because of the larger biomass available on the fishing grounds. As in 1994, this mid-season drop suggests that lobsters were not sufficiently

abundant to maintain high catch rates for an extended period of time.

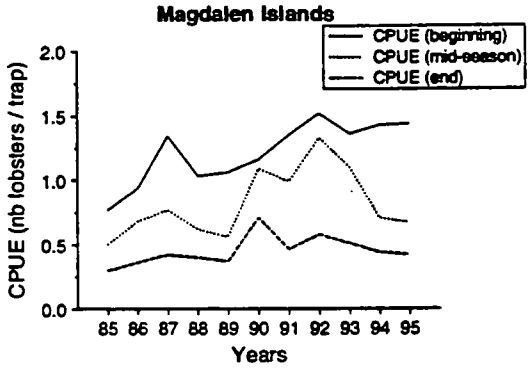


Figure 3. Catch per unit of effort (CPUE) - Magdalen Islands

In the Gaspé, CPUE values at the beginning of the 1995 fishing season (1.13 lobsters/trap/day) were twice as high as the previous year (0.55 lobsters/trap/day). Moreover, they were much higher than the levels observed since 1988. This situation is very different from last year, when very low CPUE values were recorded early in the season, perhaps because of low sea temperatures (less than 2°C) on the fishing grounds, which probably affected catchability. Temperatures at the beginning of the 1995 season were slightly warmer than the year before (around 3°C), which might partly explain the higher catch rates. CPUE values were just as high in mid-season (1.10 lobsters/trap/day), which suggests that the lobster biomass was much larger than in previous years. As a rule, the high yields observed early in the season in the Gaspé are not maintained for very long. However, an analysis of weekly changes in CPUE values derived from the Index Fishermen Program shows that catch rates fell after the first sampling period and then rose again during the second. The decline in catch rates might be linked to colder sea temperatures during the short time between the two sampling periods. In fact, cold temperatures (0°C) were recorded on the fishing grounds at that time. At the end of the fishing season, CPUE values were much lower than earlier on, and slightly lower than those observed the previous year, i.e. 0.23 lobsters/trap/day in 1995 compared with 0.37 lobsters/trap/day in 1994.

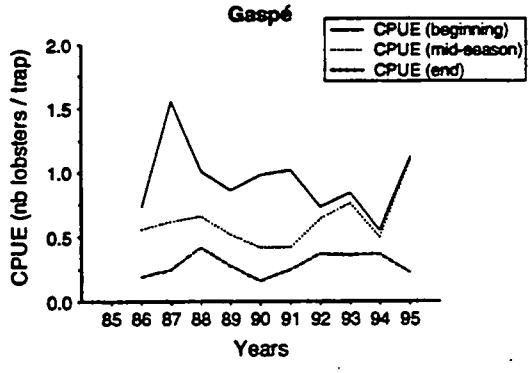


Figure 4. Catch per unit of effort (CPUE) - Gaspé

In general, catch rates decrease toward the northern boundary of the species' distribution. During the 1995 fishing season on the Lower North Shore, CPUE values for commercial-sized lobsters at the beginning, middle and end of the season were 0.53, 0.21 and 0.18 lobsters/trap/day respectively, and except for early in the season, were generally lower than in 1994, when they stood at 0.50, 0.57 and 0.40 lobsters/trap/day respectively. The catch rates on the North

Shore were much lower than in other regions and comparable to those recorded late in the season in the Gaspé and the Magdalen Islands.

Information on catch rates was also obtained from the Index Fishermen Program, which began in 1991. In 1995, 27 fishermen from the Magdalen Islands, the Gaspé and the North Shore took part in the program. CPUE values expressed as weights (kg lobster/trap/day) were compiled from daily catch and fishing effort data provided by the participating fishermen, making it possible to arrive at a global estimate of catch rates for the season as a whole. Since 1991, catch rates have followed the same trend as landings. From 1994 to 1995, overall CPUE values rose from 0.46 to 0.48 kg/trap/day in the Magdalen Islands and from 0.27 to 0.30 kg/trap/day in the Gaspé, while on the North Shore, they decreased from 0.14 to 0.12 kg/trap/day. These values confirm observations on landings and commercial sampling. Although it may be assumed that CPUE values provide a fairly good indication of the abundance of lobster on the fishing grounds, it should also be noted that the high values observed in the Magdalen Islands and the Gaspé may partly reflect recent changes to the unit of effort (larger traps, escape vents) or the fishing strategy, which have boosted the yield of the lobster fishery.

Demographic structure and mortality

Catches generally consist of equal proportions of males and females. The proportion of berried females varies from year to year and depending on the point in the fishing season. They are usually better represented in traps late in the season when commercial-sized lobsters are much less abundant and fishing is carried out in shallower water much nearer to the coast. Size frequency distributions show that the proportion of individuals of commercial size (CTL of over 76 mm) is high at the beginning and middle of the fishing season and declines toward the end of the season, reflecting the decrease in the number of commercial-sized lobsters available to the fishery as the season progresses. As commercial-sized individuals are removed from the fishing grounds, the proportion of sublegal lobsters and berried females in catches increases.

An analysis of the size composition of catches enables us to estimate the intensity of harvesting. In 1994, the exploitation rate in the southern Magdalen Islands was 69% compared with 52% in the northern section. Between 1985 and 1994, average exploitation rates in these two sectors were 64% and 53% respectively. As a rule, exploitations rates are higher in the Gaspé, where they averaged 73% between 1986 and 1994.

The exploitation rate observed in the Gaspé in 1994, i.e. 67%, was the lowest recorded since 1986. Poor weather conditions in 1994 led to low catch rates and a reduction in fishing effort, factors that may have contributed to the lower exploitation rate. Annual natural mortality in lobster populations is approximately 10%. In general, the annual mortality of lobsters in Québec and Atlantic Canada as a whole is considered high. Fishing success depends, therefore, on the number of lobsters that reach commercial size in a given year. Only a few moult classes are harvested, and landings fluctuate with the size of moult classes entering the fishery. At current exploitation rates, good recruitment years cannot sustain the fishery for very long.

OUTLOOK FOR 1996

The abundance of pre-recruits, or individuals under the prescribed commercial size, may provide an indication of the number of lobsters that will enter the fishery in the coming years. Generally, pre-recruits between 67 and 76 mm in the Magdalen Islands and between 64 and 76 mm in the Gaspé moult during the summer or fall after the fishing season, and thus make up the following year's catch. Abundance indices for pre-recruits are derived from catch rates recorded during sampling of commercial catches at sea. A retrospective analysis of the relationship between pre-recruit abundance indices for a given year and landings for the following year shows that this type of index provides a fairly accurate forecast of landing trends for the next year (Figures 5 and 6). The downward trend in landings that began in the Magdalen Islands in 1993 was in fact reflected in the abundance of pre-recruits observed the year before. The same is true for the decrease in landings observed in 1994.

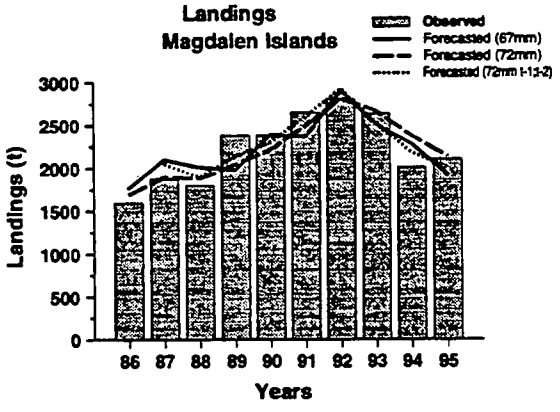


Figure 5. Observed and forecasted landings in the Magdalen Islands between 1986 and 1995

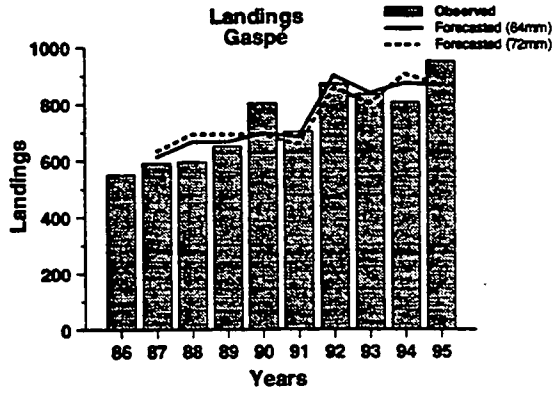


Figure 6. Observed and forecasted landings in the Gaspé between 1987 and 1995

After regulations on escape vents came into effect in 1994, there was a substantial reduction in the number of pre-recruits found in traps. The introduction of the vents caused a gap in the time series of data gathered on pre-recruits up to 1993, and another method had to be devised to estimate pre-recruit abundance. Additional sampling of commercial catches has since been undertaken in the Magdalen Islands and the Gaspé using traps with blocked escape vents. We have thus been able to estimate the number of pre-recruits lost because of the vents and to correct the pre-recruit values obtained during regular sampling. In 1995, the number of pre-recruits in traps with blocked vents was higher in the Magdalen Islands and roughly the same in the Gaspé compared with the previous year. Based on these observations, it might be expected that, in 1996, landings will increase in the Magdalen Islands and be approximately the same in the Gaspé compared with 1995. At present, however, the observations used to calculate abundance indices vary widely,

and there is some uncertainty as to the projections that can be made for next year. We will have to wait until the time series of data cover a few more years before we can accurately interpret the abundance indices obtained with this new calculation method.

A tool for predicting landings independent of the commercial fishery is also being developed in the Magdalen Islands. Sampling with a *Nephrops* bottom trawl provides a picture of the population segment made up of the smallest individuals, namely, moult classes that will enter the fishery in one to three years. An effort is being made to estimate the abundance and growth of pre-recruits in the various moult classes to predict when they will enter the commercial fishery. However, we will have to wait a few years before we can use these abundance indices to predict the number of lobster likely to be recruited to the fishery.

CONSERVATION MEASURES

In 1994, the Department of Fisheries and Oceans asked the Fisheries Resource Conservation Council (FRCC) to examine current conservation measures for the Atlantic lobster and to make recommendations on management strategies for conserving the resource. The report tabled by the FRCC in November 1995 included a definition of conservation and a statement of objectives. It also announced a conservation strategy and principles as well as measures for achieving specific objectives. The FRCC proposed a new geographical basis for formulating conservation strategies, which groups together fishing areas with similar biological and environmental characteristics. No decision has yet been made as to how the report's recommendations will be implemented, a choice that depends on the Minister's endorsement of the document. We presume, however, that the recommendations will be carried out gradually and that fishermen will be required to decide, in conjunction with the DFO, which management measures they will apply in their respective fishing areas.

One of the general conservation objectives set by the FRCC is to maintain stocks at optimum levels under all environmental conditions by sustaining a spawning biomass capable of producing a strong, steady supply of juveniles. More specifically, the conservation measures proposed by the FRCC are aimed at increasing egg production, reducing exploitation rates and actual fishing effort, and improving stock structure. At present, egg production is low compared with what it would be if stocks were not harvested. Egg production per recruit in most lobster stocks along the Atlantic coast of Canada is about 1% of that of unharvested stocks. The FRCC considers this level unacceptable and recommends that appropriate measures be implemented to increase egg production per recruit in all lobster stocks along the coast to 5% of that of unexploited stocks. Although this level is lower than that adopted by other countries, the FRCC considers it reasonable and achievable over the medium term. Several countries have adopted management systems based on biological reference points. Australia and the United States define overfishing by using the concept of egg production per recruit. In the United States, for example,

a lobster stock is considered to be overfished if the number of eggs produced per recruit is below 10% of what it would be if the stock were not harvested. The FRCC has proposed several measures for achieving the target egg production level of 5%, including increasing the minimum legal size, marking berried females (V-notch), setting a maximum legal size, reducing exploitation rates, closing fishing areas and using more selective traps.

Egg production per recruit has been calculated for lobster stocks in the Gaspé and the northern and southern parts of the Magdalen Islands using a model developed and currently used in the United States. So far, we have made a series of preliminary estimates, which will be reassessed during the year after adapting the model to certain Canadian realities and more accurately estimating the model's parameters. At current exploitation rates, egg production per recruit in the various Québec lobster stocks is estimated at 1% to 4% of what it would be if the stocks were not harvested.

The calculations made with the model indicate the relative effectiveness of the various management strategies for increasing egg production. Increasing the minimum legal size appears to be one of the most effective approaches. It would also have a beneficial effect on recruit weight, given that the weight of lobsters returned to the sea, 90% of which survive, increases by 45%. For example, raising the minimum legal size from 3 to 3 1/4". would, in theory, increase the yield of a cohort by 18%. Any such change could be introduced over a period of a few years to minimize the short-term impact. Measures targeting large females (maximum legal size, marking of berried females with a V-notch) are somewhat less effective given the high exploitation rates, which result in the presence of a limited number of large females in the population. However, larger females presumably produce eggs of better quality, thus improving larval survival, an aspect that cannot be ignored in choosing conservation measures. A substantial decrease in exploitation rates could bring egg production per recruit up to the target level. However, this would require a very significant reduction in fishing effort. According to calculations based on the relationship between catches and fishing effort, it is estimated that the number of traps would have to be reduced by around 30% to obtain a 10% decrease in the exploitation rate and a similar reduction in catches.

In its lobster conservation strategy, the FRCC stipulated that the choice of conservation measures must be left to the industry. In due course, DFO scientists will be able to carry out more detailed impact studies on the management scenarios that are proposed and thus help the industry to make appropriate choices for achieving conservation objectives.

For more information:

FRCC. 1995. A Conservation Framework for Atlantic Lobster. 49 pp. & Appendices.

Gendron, L., J.P. Dallaire and G. Savard. 1995. Lobster on the Québec coast (fishing areas 15 to 22). *In* Status Report on Invertebrates in 1994: Crustaceans and Molluscs on the Québec Coast, Northern Shrimp and Zooplankton in the Estuary and Gulf of St. Lawrence, edited by L. Savard. Can. Man. Rep. Fish. and Aquat. Sci. 2323: 27-54.

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