

# **Change in fishing capacity in the American lobster (*Homarus americanus*) fishery of the Magdalen Islands (Québec) from 1975 to 1995**

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## ABSTRACT

Gendron, L. and J. Archambault. 1997. Change in fishing capacity in the American lobster (*Homarus americanus*) fishery of the Magdalen Islands (Québec) from 1975 to 1995. Can. Tech. Rep. Fish. Aquat. Sci. 2189: vi + 16p.

Lobster landings rose steadily between the mid-1970s and the early 1990s both in the Magdalen Islands and on the Atlantic coast as a whole. A number of hypotheses have been advanced to explain this increase. Aside from certain environmental factors that may have favoured lobster recruitment, it has also been postulated that the increase in catches may be partly attributable to an increase in the fleet's fishing capacity. To describe the changes made in fishing equipment and practices since the mid-1970s, we interviewed 40 fishers from the 12 fishing wharves in the Magdalen Islands. Since 1975, the 325 Magdalen Islands fishers, each of whom operates 300 lobster traps during the nine-week fishing season, have boosted their harvesting capacity substantially. Changes made to fishing vessels (size, engine power, sturdiness), and the use of electronic navigation systems and colour sounders have made lobster fishers much more mobile than before, leading to a shift in harvesting strategy from interception to pursuit of the resource. Traps have also been modified (size, weight, entrance rings, proportions, design) as have the methods employed in operating these more efficient traps (organization of traps on lines, strategic positioning), thereby contributing to higher catch rates. All of these changes occurred during a period that coincided with rising landings. The expansion in the area harvested and the adoption of a strategy of pursuit have certainly contributed to the upward trend in catches.

## RÉSUMÉ

Gendron, L. and J. Archambault. 1997. Change in fishing capacity in the American lobster (*Homarus americanus*) fishery of the Magdalen Islands (Québec) from 1975-1995. Can. Tech. Rep. Fish. Aquat. Sci. 2189: vi + 16p.

Les débarquements de homard ont augmenté régulièrement entre le milieu des années 70 et le début des années 90 tant aux Îles-de-la-Madeleine que sur l'ensemble de la côte atlantique. Plusieurs hypothèses ont été avancées afin d'expliquer cette augmentation. Mis à part certains facteurs environnementaux qui auraient pu favoriser le recrutement du homard, on a aussi postulé que cette augmentation pouvait être attribuable en partie à une augmentation de la capacité de pêche de la flotille. Afin de décrire les changements apportés à l'équipement et aux pratiques de pêche depuis le milieu des années 70, nous avons interrogé directement 40 pêcheurs provenant des 12 quais de pêche des Îles-de-la-Madeleine. Les 325 pêcheurs des Îles-de-la-Madeleine qui pêchent chacun avec 300 casiers pendant les 9 semaines que dure la saison de pêche, ont depuis 1975, accru leur efficacité de pêche de manière significative. Des changements apportés aux bateaux de pêche (taille, puissance, robustesse), l'utilisation de systèmes de navigation électronique et de sondeuses couleur a rendu le pêcheur de homard beaucoup plus mobile qu'auparavant, ce qui lui a permis d'évoluer d'une stratégie de pêche d'interception à une stratégie de pêche de poursuite. Des modifications ont aussi été apportées aux casiers (taille, poids, anneau d'entrée, proportions, design) ainsi qu'au niveau de la méthode de pêche de ce casier devenu plus performant (organisation des casiers sur les lignes, positionnement stratégique), contribuant à augmenter les taux de capture. Tous ces changements se sont faits à une période qui coïncide avec l'augmentation des débarquements. L'expansion des fonds de pêche ainsi que l'adoption d'une stratégie de poursuite ont certes contribué à cette augmentation.



## INTRODUCTION

Lobster fishing in the Magdalen Islands began in the late 1800s, with landings being recorded since 1875. Over the following century, annual landings generally fluctuated around 1000 t. Between the mid-1970s and the early 1990s, landings nearly tripled, rising from 1000 t to 2800 t between 1976 and 1992 (Figure 1). The same trend was observed for the Canadian Atlantic coast as a whole, with landings increasing from 15 000 t in 1975 to 45 000 t in 1990. A number of hypotheses have been advanced to explain this substantial expansion of catches, observed throughout the distribution range of lobster. It was postulated that changes in environmental factors could have favoured an increase in lobster biomass. More precisely, a reduction in predation by groundfish (Pezzack 1992) and changes in the physical environment, in particular water temperature (Campbell *et al.* 1991), have been suggested as factors that may have favoured the survival and recruitment of lobster.

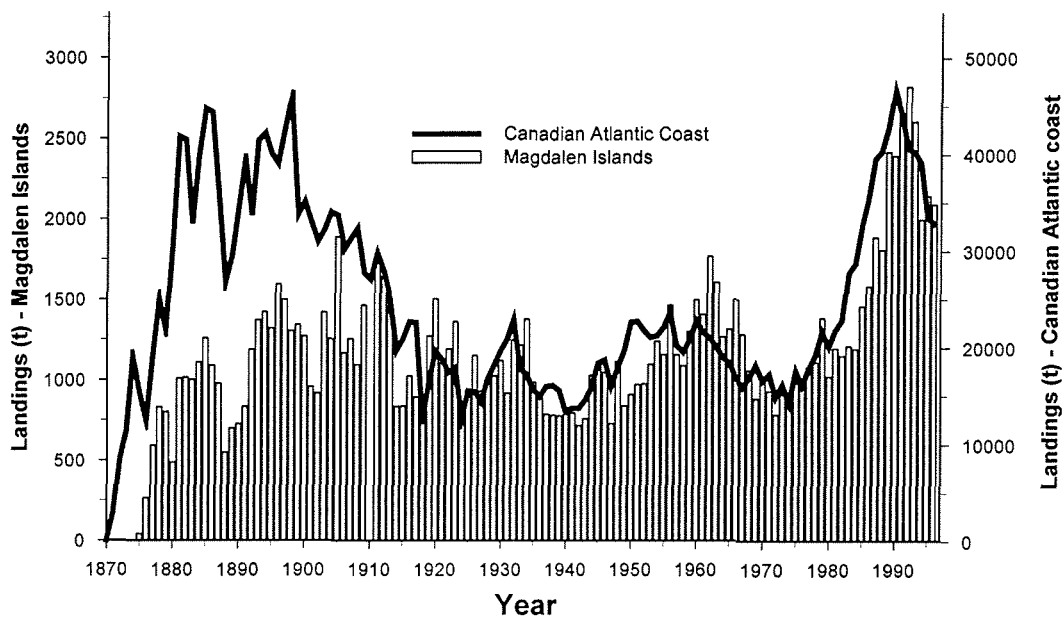


Figure 1. Landings (t) of lobster in the Magdalen Islands (Québec) and along the Canadian Atlantic coast between 1875 and 1996.

So far, however, it has not been possible to confirm the hypothesis that the increase in landings was induced by an increase in water temperature (Drinkwater *et al.* 1996). However, research is still being carried out to determine the effect of other factors such as synchronous and large-scale changes in wind patterns or a reduction in predation by groundfish species (Drinkwater *et al.* 1996).

Aside from the environmental factors that may have favoured lobster recruitment, it is possible that the upturn in landings was partially caused by an increase in the harvesting capacity and efficiency of the lobster fleet (Fogarty 1995, Drinkwater *et al.* 1996). Several improvements in the fishing equipment have led to the discovery of new fishing grounds and favoured their accessibility. Duggan and Pezzack (1995) estimated that the midshore expansion of the lobster fishing grounds off southwest Nova Scotia have contributed for about 15 % to the overall increase of the landings in the area. In Australia, the use of colour sounders and electronic positioning systems, along with adjustments to lobster traps, helped to increase fishing power in the western rock lobster (*Panulirus cygnus*) fishery, despite limits imposed on the number of licenses and the number of traps per license (Brown *et al.* 1995). Brown *et al.* (1994) estimated that over a period of 21 years, nominal effort rose by a rate of 1-3 % per year as a result of technological advances.

In Québec, any recent growth in fishing capacity and efficiency has occurred in a context where fishing effort was controlled by government officials responsible for managing marine resources. For example, in the Magdalen Islands, fishing effort, or more specifically the number of licenses and the number of traps per license along with the length of the fishing season, have not changed since 1973. The region has 325 active licenses, and the number of traps per license is set at 300. This lobster fishery is carried out in the spring and lasts nine weeks.

Although it is implicitly recognized that in recent decades various components of fishing effort in the Magdalen Islands have changed and harvesting efficiency has increased, no attempt has been made as yet to describe the changes. This makes it difficult to establish a link between the increased landings and catch rates and changes in fishing practices. In order to describe these changes, we questioned Magdalen Islands fishers about how their harvesting practices have changed since fishing effort came under government control in 1973. More specifically, our objectives were 1. to describe the types of changes made in their fishing equipment and practices; 2. to determine when the changes occurred relative to the observed increase in landings and catch rates; and 3. to determine the extent of the changes within the lobster fishing community of the Magdalen Islands. This work was carried out as part of a broader study, principally anthropological in nature, aimed at evaluating the traditional knowledge of the lobster fishers of the Magdalen Islands, including not only their fishing practices but also certain aspects of the biology, ecology, and environment of lobster, along with fishers' opinions on conservation and management of the resource (Archambault 1997).

## MATERIAL AND METHODS

The project was carried out in the Magdalen Islands (Québec), a group of islands located in the Gulf of St. Lawrence (Figure 2). The lobster fishery in that region is very important, accounting for between 65 and 75% of Québec's total annual catch of lobster. The sector provides seasonal employment for 325 fishers and some 490 fishers' helpers.

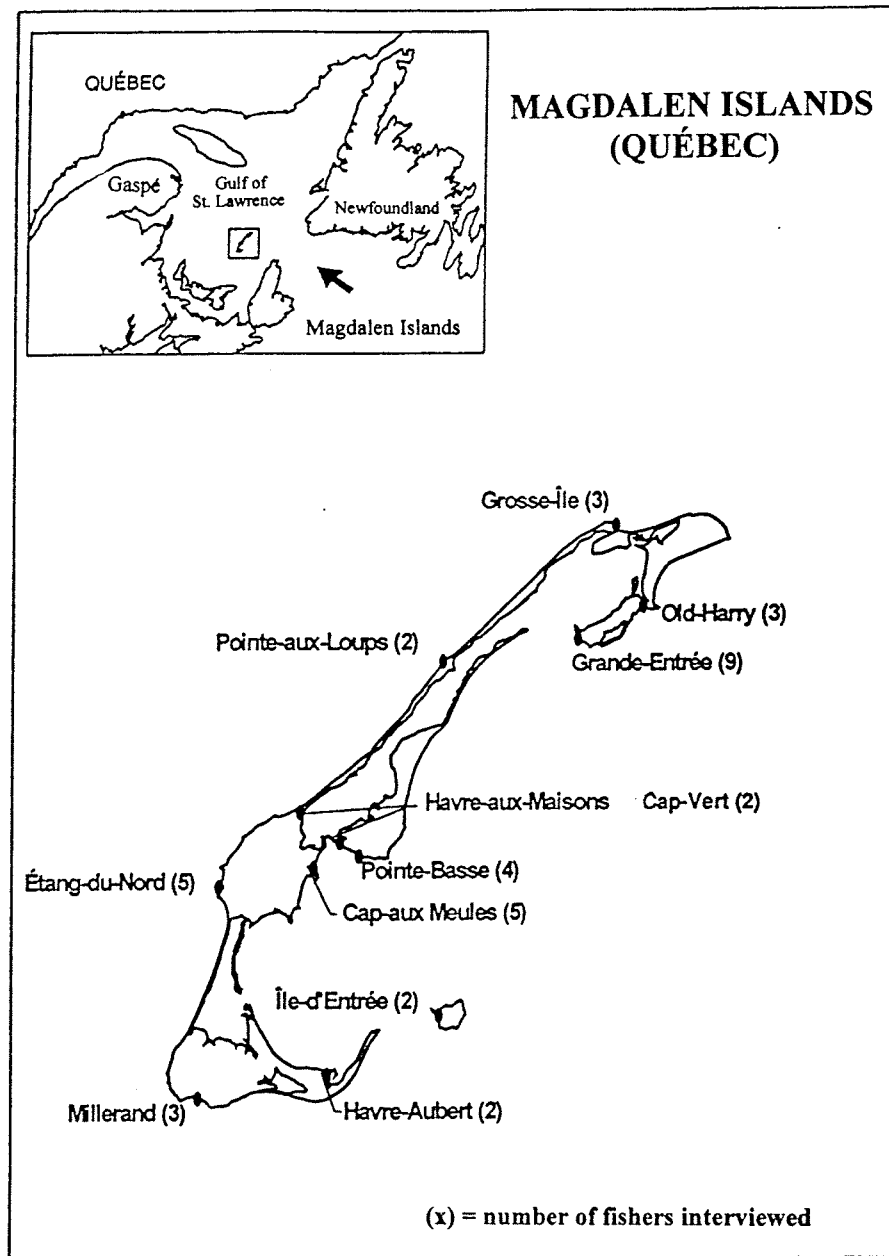


Figure 2. Map of the Magdalen Islands showing the location of the 12 fishing wharves. The numbers in parentheses indicate the number of fishers interviewed.

Information on the changes made in fishing practices over the past two decades (1975-1995) was obtained from fishers through interviews conducted during the winter of 1996. In all, 40 fishermen were selected for the interviews. The selection of the fishers was made in two different ways. Firstly, in order to contrast the different fishing zones around the Magdalen Islands, fishers were selected from the 12 fishing wharves of the Magdalen Islands in proportion to the number of active fishers at each wharf (Figure 2). The fishers were selected by means of a draw and 40 names were retained. Afterward, an additional list was drawn up so as to include fishers from different age groups, along with fishers who had expressed interest in and were open to being interviewed. This second list included the names of 50 fishers and was prepared on the basis of suggestions from a representative of the Magdalen Islands Fishermen's Association (Association des pêcheurs des Îles-de-la-Madeleine) and from the Department of Fisheries and Oceans (DFO) fishery officers. The final selection of participants was made through a draw pooling the two lists of names for each wharf. The final list included 19 fishers from the initial draw and 21 fishers from the second list.

The interviews were semi-structured. The format of the interviews was a mixture of closed questions requiring precise answers and open questions that invited a narration of events as perceived by the fisher. This type of interview gives the opportunity to explore other subjects and expand the discussions. It helps the participant to be more active in the interview process and express himself freely on subjects important to him. Interviews were held in February and March 1996. Each interview, which lasted on average 1½ hour, was recorded and then transcribed. The interviews consisted of questions about the changes that had occurred in equipment characteristics and in fishing practices (Table 1). The interviews were designed to identify differences between present fishing practices and those of the 1970s, shortly after regulations were passed in 1973 to control fishing effort. Questions were also asked about fishing areas in an effort to determine whether they had been modified over the years as a result of observed changes in lobster distribution or abundance or changes in fishing practices.

In general, most of the interviews went well and the participation was considered satisfactory (Archambault 1997). Among the 40 fishers selected, two did not agree to be recorded. Another appeared uninterested and did not speak much. Therefore, no information was available from these three fishers. Also, because of technical problems, the interview of another fisher was poorly recorded, so the information could not be transcribed or analyzed. The analysis was therefore based on 36 interviews. Also, because of the semi-structured approach to the interviews, we realized while listening to the recordings that a number of fishers had not precisely answered certain questions related to when they had made changes in their fishing gear or practices. Therefore, the quantitative results presented below may be based on a sample size smaller than 36 fishers. All the information was processed in an Access (Microsoft) data base.

Table 1. List of elements covered during interviews on changes in lobster fishing practices between 1975 and 1995.

<b>Equipment Characteristics</b>	
Vessels	<ul style="list-style-type: none"> <li>- dimensions</li> <li>- material</li> <li>- engine power</li> </ul>
Navigation equipment	<ul style="list-style-type: none"> <li>- landmarks</li> <li>- Loran C</li> <li>- GPS</li> <li>- others</li> </ul>
Sounder	<ul style="list-style-type: none"> <li>- sounding ball</li> <li>- paper sounder</li> <li>- sounder with screen</li> <li>- colour sounder</li> </ul>
Traps	<ul style="list-style-type: none"> <li>- dimensions</li> <li>- weight</li> <li>- material</li> <li>- rings</li> <li>- design</li> </ul>
<b>Fishing Practices</b>	
Traps and lines	<ul style="list-style-type: none"> <li>- number of traps per line</li> <li>- distance between traps</li> <li>- bait</li> </ul>
Lines	<ul style="list-style-type: none"> <li>- placement</li> <li>- spatial orientation</li> <li>- distance between lines</li> </ul>
Effort	<ul style="list-style-type: none"> <li>- number of days at sea (season)</li> <li>- fishing on Sundays</li> <li>- number of hauls per day</li> </ul>

## RESULTS

### 1.0 Changes in fishing equipment

#### 1.1 Vessels

Among all the fishers interviewed who specified when they bought their most recent boat, the majority of them (31/32) indicated that they had changed their boat between 1984 and 1996. More than half of them (18/32) had made changes in the early 1990s (1991-1993) after experiencing several years of large landings, which may have provided the incentive for the changes. All of these fishers had already changed their vessels 10 to 20 years prior to that, most of them between 1975 and 1985.

The size of lobster vessels increased steadily beginning in the mid-1970s. In the early 1970s, the majority of respondents were using wooden vessels averaging about 28-29 feet in length. The average length of the boats had increased to 30-31 feet by the early 1980s. From the mid 1980s on, the majority of new boats were about 34 feet long and generally wider (13-15 feet wide) than before. In 1995, 46% of the lobster fishers of the Magdalen Islands fished with a boat between 34-35 feet in length. In 1995, only 8% of the fishers had a boat smaller than 34 feet long, while ten years before, in 1985, the percentage was 40% (Source: DFO, Laurentian Region, Statistics Service). Today, very few fishers still use small boats (less than 30 feet long) for the exploitation of shallow grounds. In 1995, we could count only three boats out of 318 that were 30 feet long or less, compared to 40 in 1985 (Source : *ibid.*). Among the respondents, only one owned a 30-foot boat.

During the period when the size of boats increased, diesel motors eventually replaced gasoline-powered ones completely, reducing operating costs. Engine power also increased, allowing the boats to travel faster and farther. The present fishing vessels have an average cruising speed of 10 knots and can reach up to 14 knots at full speed. Fishers said they can travel offshore more easily, up to 15 or 20 miles from the coast, since they are now able to cover such a distance in a single day. During the 1970s, fishing was mainly concentrated within five miles of the coast, and a large proportion of fishermen rarely fished farther than one or two miles offshore. Although the offshore fishing grounds were known, the respondents indicated that relatively few fishers would venture that far and that their excursion offshore was restricted to days when meteorological conditions were favourable.

The increase in vessel length and width, together with improvements in stability and sturdiness, increased their cargo carrying capacity. Fishers stated that until the late 1970s lobster boats could transport only about 50 traps at a time. Most vessels can now carry 150 traps and sometimes even 300. As a result of the improved stability of vessels, fishers can now venture offshore even in

rough seas. The number of fishing days lost due to bad weather has declined markedly; fishers report that they now rarely lose more than 5 days out of a fishing season of 52 days. In the 1970s, they typically lost about 10 days per fishing season.

## 1.2 Navigation and positioning equipment

Throughout the period during which vessel size was increasing, navigation tools (positioning and sounding devices) were being improved as well. Fishers who started to fish lobster before 1980 (92% of the respondents) said that they did not have any electronic equipment when they started. Among the 15 fishers interviewed who started to fish lobster between 1970 and 1980, only one had a Loran-C positioning system. The others said they relied on a compass and coastal landmarks. Also, only 3 of these 15 respondents had a paper sounder. Today, these 15 fishers possess sophisticated electronic navigation and positioning equipment.

Thus, after having navigated until the late 1970s with the aid of a compass or landmarks only, the Loran-C positioning system gradually became part of the standard equipment aboard fishing vessels. In the 1990s, fishers have replaced or complemented the Loran-C with a GPS (Global Positioning System). One of the respondents said he was the first Magdalen Islands fisher to equip his vessel with Loran-C, around 1975. Another fisher indicated that the Loran-C system appeared in the Havre-Aubert sector in 1978. In the early 1980s, they increased in popularity, and it appears that by the end of the decade all Magdalen Islands fishers had equipped their boats with an electronic positioning system. Some of them also invested in a variety of equipment such as radar and track plotters.

For the most part, this electronic equipment enabled fishermen to locate their fishing buoys, regardless of their location and regardless of adverse weather conditions such as wind and fog. By freeing fishermen of the need to use visual reference points, the equipment also enabled them to move farther away off shore, while decreasing the time it took to navigate to fishing sites and retrieve traps. The more recent advent of data recording capacity has enabled many fishers, even less experienced ones, to record the location of fishing grounds exploited by the most productive vessels and to return there the following year, a situation which has accentuated the competitive nature of the lobster fishery. In the late 1980s, all of the fishers added VHF radios to their shipboard equipment, allowing them to access the latest weather forecasts and take appropriate steps such as quickly moving their traps to a safer location when a storm was forecast.

Among the technological innovations, the introduction of the colour sounder has had one of the most significant impact in terms of boosting fishing efficiency. This equipment appeared in the Magdalen Islands around 1983 and gained popularity over the ensuing years, mainly in the early 1990s. Very often, when changing to a new vessel, fishers sought to be at the forefront of technology by purchasing sophisticated equipment of this sort. Today, the vast majority of fishers

use a colour sounder. Of the 31 respondents, 30 mentioned they presently used a colour sounder. This device replaced the paper sounder, which had been in use since the early 1970s. In the 1960s and long before that, the “sounding ball” was used, which is a metal ball that fishermen would coat with grease and lower to the seabed to measure water depth and determine the substrate type. When this instrument touched the bottom, sand or gravel would adhere to the greasy coating.

The colour sounder is a very powerful tool, that provides information on depth as well as on the bottom substrate. An image of the seabed is displayed on the screen, allowing the user to determine what the sea floor is like, whether it is sand, mud, gravel, or rock, and sometimes whether the bottom is covered with algae or marine plants (eelgrass). The high-resolution images allow users to determine reef orientation, examine the fine-scale topography, and more readily locate seabed irregularities that indicate the presence of lobster shelters. Colour sounders have permitted the discovery of new lobster grounds. In fact, the small reefs situated between traditionally harvested areas have been located. Some fishers say that the area exploited has increased by about 50% with the use of this equipment. Although this is only an approximation, all of the fishers interviewed agreed that no stone has been left unturned in the search for new lobster grounds. With this equipment, fishers can now readily find their target species, and some even say that the lobster no longer have any chance of getting away. The combined use of the colour sounder and a positioning system provides improved control over the deployment of traps on reefs, and this strategic placement helps to ensure better catches.

### 1.3 Traps

Since the start of the Magdalen Islands lobster fishery in the 1800s, lobster traps have been continually modified. When a fisherman from one locality found a way to make his traps more efficient and other fishermen noticed the difference between their own catches and his, they would try to discover the reason and copy the improvement. Although trap design has evolved continually over the years, the larger volume traps introduced in the early 1990s marked a major improvement in terms of increased fishing efficiency. This is because adjustments in trap dimensions changed other design features concurrently, while also influencing fishing strategy. Some of these changes ended up being adopted by users of small traps. Even though traps larger than the standard size (24” x 32”) are banned at present in the Magdalen Islands, the experience fishers acquired earlier in using the large traps, whether directly or indirectly, has been harnessed in various ways. The traditional trap in the Magdalen Islands is a hemicylindrical-shaped trap measuring about 22-24 inches by 30- 32 inches at its base, and approximately 13-14 inches high, with a kitchen and a parlour. The lobster enters the trap through two rings of variable diameter that open into the kitchen where the bait is placed. The large traps introduced in the early 1990s were of two types: one had a 26 x 38 inch base fitted with a single parlour, and the other type had a 24 x 48 inch base equipped with two parlours, one on either side of a central kitchen. They were also higher than the traditional ones (16-18 inches high).



Large traps came into use in the Magdalen Islands around 1990. One respondent said he was the first person to use the large traps, in 1987, three years before other fishers discovered them. Between 1990 and 1994, the number of large trap users rose; however, not all Magdalen Islands fishers adopted this type of trap. A little more than half the fishers interviewed (19/36) reported having used the larger traps. The others (17/36) pronounced themselves against their use. Quite soon, a protest movement emerged in the Magdalen Islands, giving rise to petitions and eventually regulations that imposed restrictions on the use of large traps and subsequently banned them. In 1995, the number of large traps permitted was 210 (compared to 300 standard traps). After that regulation was introduced, interest in the large traps waned, and then finally the use of standard traps was made compulsory by DFO in 1997. Although the use of large traps was opposed even within the fishing community, it is conceivable that, had regulations not been passed banning them, they would have come into widespread use, mainly in areas where the fishing is more competitive. Many fishers stated that if their requests to ban the larger traps had not been successful, they would have ended up using the traps despite their reservations because of the competitiveness of the lobster fishery. It is nevertheless interesting to note that in one locality, Étang-du-Nord, the fishers had agreed together, without any formal regulations, to ban the use of the large traps on their fishing grounds.

Over the past two decades, every minute detail of trap design has been examined. The size of the rings, their spacing, the distance between the rings and the bait spike, the angle of the trap entrance, the height of the step at the entrance, the escape mechanisms for small lobsters, the angle of the entrance to the parlour, the closing mechanism for the parlour door, the relative size of the kitchen and the parlour, the height, the luminosity, the ballast, and the soak period (length of time traps are immersed in water before being used for fishing) for new traps. The making of larger traps led to some of these changes.

The size of the entrance rings is presumed to affect trap selectivity by determining what size lobster can enter the trap. Ring diameter was gradually increased to capture larger individuals. According to a number of our respondents, it seems that by the end of the 1970s, the diameter of entrance rings averaged 4  $\frac{3}{4}$  inches and rarely exceeded 5 inches. Most fishers now use rings with a diameter of 5  $\frac{1}{4}$  to 5  $\frac{3}{4}$  inches. Among the 33 fishers who specified the size of rings they now use, none is using rings smaller than 5 inches in diameter and 61% of them (20/33) reported using rings of at least 5  $\frac{1}{2}$  inches. While large traps were being used, some respondents (5/33) said they employed at least 6-inch-diameter rings in order to target bigger lobsters. Some said they are currently considering reducing the size of the rings because there no longer seems to be any big lobsters on the fishing grounds. They claim that all the big lobsters were caught in the large traps with big entrance rings used in the early 1990s.

The traps used at present are very different from those employed in the 1970s. They have become much more effective, and it isn't unusual to hear fishers say they now realize why they didn't catch many lobsters with the traps available 10, 15 or 20 years ago.

## **2.0 Changes in fishing practices**

### **2.1 Organization of traps on lines**

In the Magdalen Islands, fishers string traps together on lines, but the way this is done has changed over the past 20 years. The advent of large traps led fishers to rethink the way they set up fishing lines. Because of the limited working space on vessels, they have reduced the number of traps per line so that they can keep a complete line on board their boats. In the 1990s, after testing various ways of installing the large traps on lines, fishers reproduced these new ways of organizing lines when small traps recently became mandatory. Fishers reported that they used to set 10 to 12 traps on each line in the 1970s and the 1980s compared with an average of 6 now. Among the fishers interviewed, 72% (26/36) set 5 to 7 traps on their lines, 20% (7/36) set 8 or 9 traps, and only 8% (3/36) reported setting 10 traps. The number of lines necessary to set all 300 traps has increased. Each fisher will now set between 45 and 50 lines on average, instead of 25 to 30 lines before, making it possible to cover and lay claim to a larger expanse of lobster grounds. As well, the spacing of traps has increased, reducing competition among individual traps and enhancing their efficiency. In the past, traps were spaced about 8-9 m apart (4 ½ to 5 fathoms), now the distance is 12.5-14.5 m (7 to 8 fathoms).

### **2.2 Deployment of lines on fishing sites**

Despite the increased spacing between traps, lobster lines are today slightly shorter on average, allowing for better deployment on fishing grounds. The imagery provided by colour sounders, gives fishers precise knowledge of the size of the reefs they exploit, and this enables them to adjust the length of their lines so that each trap is suitably positioned. A few fishers said that, in the past, on a line of 10 traps, only 6 traps might have been well located on the reef while 4 would have been on the sand. While this is an approximate figure, the interview data indicate that traps are now positioned with a better control and therefore much more precisely.

### **2.3 Other changes**

Owing to the increased operating speed and efficiency of vessels, the reduction in navigation time and time spent locating traps, and the ability to raise traps faster with hydraulic winches, some fishers have begun to check their traps, or at least a portion of them, more than once a day. This

does not appear to be a widespread practice, however. Fishers who do this say they check only about a third of their traps twice a day, usually only during the first two weeks of fishing.

Technological advances have made fishers a lot more mobile and they can move their traps daily if they wish. Many fishers can transport nearly all their traps on their vessels. This greater mobility allows them to follow lobster as they migrate, explore new sites and quickly move traps to a safe location when a storm is coming.

### **3.0 Scope of the changes**

The technological changes described above have occurred rapidly as a result of the competitive nature of this fishery. The degree of competition varies, however, depending on certain factors such as the way the fishing grounds are shared. A difference has been noted in this partitioning between the north and south shores of the Islands. Although the regulations provide for only one fishing area in the Islands (Area 22), fishers themselves recognize two fishing sectors, the northern one (Grosse Île to Millerand) and the southern one (Old Harry to Havre Aubert) (Figure 2). A third of all Magdalen Islands fishers operate on the north side and two thirds operate on the south side. By local agreement, fishers from the southern sector are not allowed to fish in the northern area, and vice versa; however, occasional departures from this principle are tolerated, as long as the fisherman involved finishes the season in the sector where he started. This rule is justified in that catches on the south side are good in the early part of the season, but decline rapidly after that, whereas catches are more stable throughout the season in the northern sector.

The territoriality of north shore fishers to their lobster grounds is without a doubt stronger than on the south shore of the Islands. Although there are no official boundaries, the fishers from each wharf on the north side set limits that the fishers from other wharves are required to comply with. This territoriality is not as ingrained in the south. In fact, on fishing grounds near the coast, each wharf has a territory that is essentially off-limits to fishers from other wharves. However, during part of the fishing season, most fishers exploit the same grounds located farther offshore. This territoriality diminishes with increased distance from the shore, and vessels from different wharves are present. Lobster grounds off the south shore of the Islands are basically shared by all the fishers. The principle of "first come, first served" governs access to these highly prized fishing sites. It is there that competition for the resource is fiercest and the race to adopt technological and strategic innovations has been most noticeable. Moreover, fishing efficiency increased most rapidly in this sector of the Islands.

It might be thought that there is a link between technological advancement and fishers' age, with the youngest fishers usually being more competitive. In the past, it was mostly the young fishers who had the greatest influence on fishing practices and who, by turning away from traditional practices, discovered new fishing grounds or improved the fishery by developing new approaches

and knowledge. Furthermore, today, the young fishers have for the most part taken navigation courses and familiarized themselves with electronic equipment. The average age of lobster fishermen in the Magdalen Islands is quite low. In 1996, it was 46.5 years, and young fishers under age 35 made up a third of the total. Only 10% of the fishers were over 60 years of age. During the interview process, it was noted that only a few of the oldest fishers, those who had started fishing in the 1940s, appeared to have been a little slower to introduce technological advancements. Hence, the technological changes described above have been embraced by a large majority of fishermen.

## **DISCUSSION**

All the changes made to fishing equipment and practices over the past 20 years are summarized in Table 2. Since 1975, the 325 Magdalen Islands fishers, each of whom operates 300 traps during the 9-week fishing season, have increased their fishing capacity significantly. For example, the modifications made to vessels since the early 1980s have enhanced their power, speed, stability, and trap transportation capacity. In addition, the use of electronic navigation systems has enabled fishers to move farther from the coast and reduce the time it takes to retrieve traps. Fishers have become less dependent on weather conditions and now lose fewer days of fishing. With the advent of colour sounders around the mid-1980s, new fishing grounds were discovered and fishers gained access to fine-scale topographic information, which also revealed the type of seabed. All these changes served to expand the area harvested. According to the fishers, it appears that today, all lobster grounds have been discovered and are now being exploited.

During the 1980s, the lobster fleet became more mobile and more efficient at seeking out and locating lobster. Fishers modified their fishing strategy, shifting from interception to deliberate pursuit of the species. They are now able to go after lobster wherever they are; for example, they exploit offshore lobster grounds early in the season rather than waiting for lobster to reach traps set near the coast, and they follow the lobsters' movements during the season. This pursuit strategy is probably conducive to catching more lobster than simple interception, given that not all lobster would reach the interception site before the end of the season.

Aside from the increased mobility of the lobster fleet, which gradually led to the pursuit strategy, fishers in the 1990s have become much more effective at exploiting the resource. Modifications to traps (size, weight, entrance rings, proportions, escape mechanisms) have made them more efficient at catching lobster, and adjustments in the method of operating traps (organization of traps on lines, deployment of lines) have definitely helped to increase the yield per trap.

Tableau 2. Summary of the main changes made in fishing equipment and practices between 1975 and 1995 by Magdalen Islands lobster fishers.

YEAR	70	75	80	85	90	95
VESSEL size	28'.....	.....	30 - 31'.....	.....	35-40' and wider.....	
engine	gasoline.....	.....	.....	.....	diesel.....	
load capacity	.....50 traps.....	.....	.....	.....	150-300 traps.....	
distance from shore	.....1-2 mi.....	.....	.....	.....	15-20 mi.....	
positioning system	.....compass..... landmarks	.....	.....Loran C..... +Radar	.....	GPS + track plotter.....	
depth sounder	.....sounding ball.....	paper sounder	.....	.....	colour sounder.....	
Grounds exploited					All grounds have apparently been discovered and are now exploited	
TRAPS size	.....22x31".....	.....24x30" 24x31" 24x32".....			.....24x48"..... .....28x36".....	.....24x32".....
entrance rings (diameter)	.....4 ½ - 4 ¾ ".....	.....	.....	.....	.....5 ¼ - 5 ¾ "..... .....6-7 ".....	
number of lines	.....25 to 30.....	Reduction of the number of traps per line Increase in the distance between traps			.....40 to 50.....	
bait	Increase in the quality of bait and frequency of changes					

All of these changes occurred during a period that coincided with increased landings. The expansion in the area harvested and the adoption of a strategy of pursuit have certainly contributed to the upward trend in catches.

Parallel to the increase in landings, we also noticed an increase in catch rates (Figure 3). Theoretically, in a context where fishing effort is constant and where the fishing unit remains constant, the catch rates, or catch per unit of effort (CPUE), will be a good indicator of the abundance of the resource. In such a context, an increase in catch rates will reflect an increase in the abundance of lobster available to the fishery, following for example, the expansion of fishing grounds or an increase in the density of lobster on the grounds.

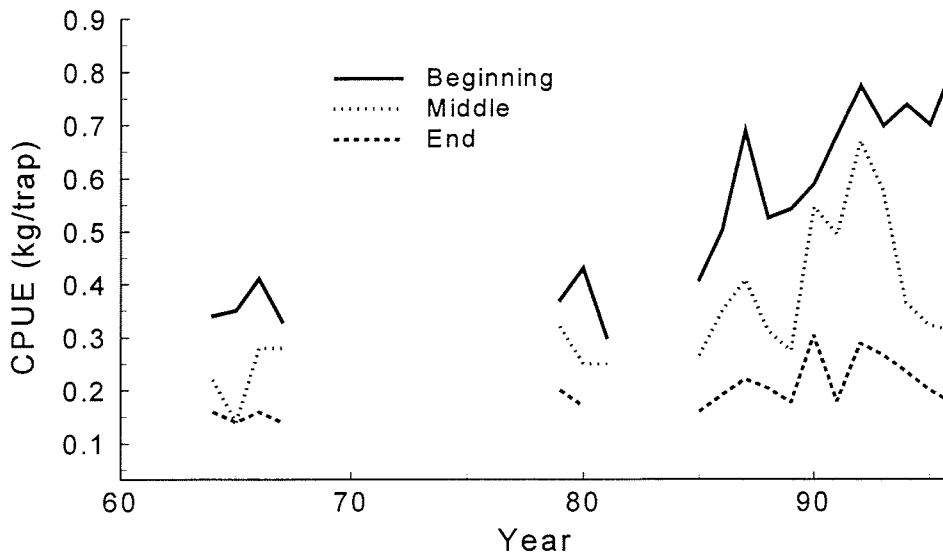


Figure 3. Catch rates (CPUE), expressed in kilograms of commercial size lobster per trap recorded in the Magdalen Islands during at-sea sampling at the beginning, middle, and end of the fishing season. (Source : Gendron 1997).

However, it seems obvious from the information above that the unit of effort has evolved considerably during the last decade. Given that traps can contain more individuals and are less selective in terms of lobster size, and above all considering the strategic way they are positioned on the fishing grounds, suggest that the rise in catch rates observed in recent years is not due solely to an increase in the density of lobster on fishing sites. The observed upward trend may reflect as well an increase in the fishing efficiency. In that sense, the fact that the early-season CPUEs have risen steadily since the late 80s, and despite a decrease in the landings since 1992, suggest that these higher catch rates may partly reflect the effectiveness of the pursuit strategy, i.e. the greater ability of the fishers to locate and harvest concentrations of lobsters at the beginning of the season.

All these changes in technology and strategy have at the very least permitted faster and more efficient harvesting of a resource that was probably also more abundant. In fact, some fishers said that as new fishing grounds were discovered (and the area exploited was expanded using equipment such as colour sounders), some fishers were able to find lobster on bottoms where they did not use to find them, such as substrates other than the preferred type, on sand or gravel for example, as well as in deeper waters than before. This expansion of the area harvested likely reflects an increase in the quantity of lobster on the bottom.

However, it is reasonable to believe that the Magdalen Islands lobster stock has been subject to increased fishing pressure over the past 10 or 15 years. Present harvesting capacity and efficiency allow fishers to remove a much larger proportion of recruits than before. The exploitation of zones that may have been refuges in the past, adjustments made to traps to target the biggest lobsters and the strategy of pursuit rather than interception are all elements that have increased the rate of exploitation of the lobster stock. Biological indices indeed confirm that the exploitation rate of the Magdalen Islands lobster stock has increased in the past ten years (Gendron 1997).

It will never be possible to prevent fishers from becoming more efficient at what they do, even with tight controls. This is why it is important to implement a mechanism that will allow scientists and managers to document and closely monitor innovations related to fishing practices. Such changes can have a strong influence on our idea of the status of a stock. In addition, better knowledge of the evolution of fishing practices will allow to better choose and assess the relevancy and the real efficiency of different protection measures taken to ensure stock conservation. This project, which sought input from 40 fishers, highlights the merits of establishing direct contacts with fishers and building an information exchange network. No form, regardless of how complete, could ever hope to match this kind of exchange.

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