



ASSESSMENT OF LOBSTER (*HOMARUS AMERICANUS*) IN THE MAGDALEN ISLANDS (LFA 22), QUEBEC, IN 2018

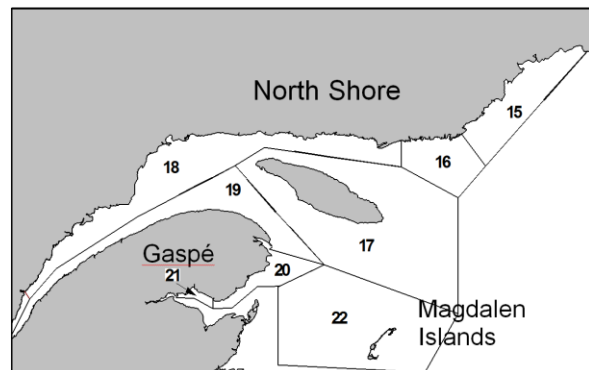
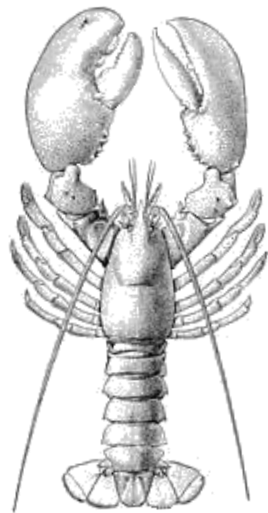


Figure 1. Map showing lobster fishing areas (LFAs) in Quebec (LFAs 15 to 18: North Shore and Anticosti, LFAs 19 to 21: Gaspé and LFA 22: Magdalen Islands).

Context:

Lobster fishing in the Magdalen Islands (LFA 22, Figure 1) is practiced by 325 enterprises (a skipper-owner and one or more fishers' helpers). About two-thirds of the fleet is on the south side (Old Harry to Havre-Aubert) and one-third is on the north side (Grosse-Île to Millerand) (Figure 2). The fishery is managed by controlling the fishing effort (number of licences, number and size of traps, fishing season and daily fishing schedule, organization of trap lines) and by escapement measures (escape vents, release of berried females and minimum legal size [MLS]). Management and conservation measures introduced over the past 24 years follow the recommendations of the Fisheries Resource Conservation Council (FRCC). In 2012, a precautionary approach was suggested for LFA 22. The status of the resource is assessed every three years. This report describes the situation in 2018 and changes observed since the last stock status assessment in 2015.

SUMMARY

- **Landings** reached a historic peak of 4,757 t in 2018, which was 91% higher than the 25-year average for a similar or lesser fishing effort. The increase in landings between 2015 and 2018 was greater in the south (40%) than in the north (31%).
- In 2018, for the Islands as a whole, the **catch per unit effort (CPUE)** in weight for commercial sampling was higher (69%) than in 2015 and 111% higher than the average of the historical series (1985–2017). The CPUE in number and the logbook CPUE showed a similar trend. The density of commercial lobsters in the trawl survey showed a strong increase in 2015 followed by a downward trend since then. In 2018, it was 22% lower than in 2015, but 58% higher than the historical average (1995–2017).

- The **demographic indicators** show that the average size of commercial lobsters sampled during the fishery has increased slightly, but in a sustained manner since the end of the legal size increase in 2003. In contrast, in the trawl survey, the average size has been decreasing for males since 2013 and relatively stable for females since 2003.
- The **fishing pressure indicators** show a slight decrease in exploitation rates since 2010.
- The **productivity indicators** remained high. For the Islands as a whole, theoretical egg production compared to the 1994-1996 period was 3.9 times higher in 2018 compared to 2.6 times higher in 2015. However, since 2015, there has been a downward trend in the proportion of post-molt females who have been inseminated.
- Fishing **recruitment indicators** suggest that landings will remain high for the next 2-3 years. The benthic recruitment index decreased between 2010 and 2016, which could suggest a decrease in fishing recruitment in the medium term.
- High abundance and productivity indicate that the Magdalen Islands lobster stock is in good condition and that current exploitation levels are adequate. According to the **precautionary approach**, the Magdalen Islands lobster stock is currently in the healthy zone.

INTRODUCTION

Biology

American Lobster (*Homarus americanus*) is found along the Atlantic coast, from Labrador to Cape Hatteras. Adult lobsters prefer rocky bottoms 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 (carapace length, CL) on the south side and around 84 mm CL on the north side. In general, 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 (primiparous) can produce nearly 8,000 eggs while large females (≥ 127 mm CL or jumbo) 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 hatch the following summer. Differences exist between primiparous and multiparous females. In addition to being more fertile, some jumbo females could spawn two years in a row before moulting. It has also been observed that spawning and hatching can occur earlier in the season and that larvae can be larger upon emergence for multiparous females (having already spawned) than for primiparous females. After hatching, the larvae's planktonic phase lasts from 3 to 10 weeks, depending on the temperature of the water, and goes through three stages of development before undergoing metamorphosis. Following metamorphosis, postlarval lobsters (stage IV), which now resemble adult lobsters, leave the surface waters to settle on the sea floor, initiating the benthic phase. The survival of lobsters from their larval stage to their initial benthic stages is impacted by predation as well as hydrodynamic factors that determine the advection or retention of the larvae near areas that are favourable for benthic settlement. During the first few years of their benthic life, until they reach a size of approximately 40 mm, lobsters are cryptic; i.e. they live hidden in habitats that provide many sheltered spaces. Lobsters are estimated to reach the minimum legal size (MLS) (83 mm CL) at around 7-8 years of age after having moulted approximately 16 times since their benthic settlement and recruit to the fishery the following year.



Figure 2. Map of the Magdalen Islands showing the boundaries of the southern and northern areas and the Les Demoiselles site (indicated by a star).

Description of the fishery

The lobster fishery is managed by controlling fishing effort that restricts the number of licences, the number and size of traps, and the duration of the fishing season. Traps cannot be hauled on Sundays. Since 2015, the authorized number of traps per licence is 273 (Table 1); traps are normally hauled once a day from Monday to Saturday and the immersion time is at most 72 hours.

Table 1. Fishing rules in 2016-2018

LFA	Duration (week)	MLS (mm)	No. traps	Trap size (cm) (Length x Width x Height)	Escape vents	No. licences
22	9	83	273	82 x 61 x 50 (round traps) 82 x 61 x 42 (square traps)	2 circulars (65 mm) or 1 rectangle (127 x 47 mm)	325

The minimum number of traps per line was set at seven, with a maximum distance of eight fathoms between traps. The length of the trap lines from the first to the last trap was limited to 56 fathoms. In addition, fishing hours (5:00 a.m. to 9:30 p.m.) were implemented in 2007, in keeping with the ban on making more than one trap haul per day. These measures will allow the effective effort to be controlled or even reduced. The presence of escape vents for juvenile lobsters has been mandatory since 1994. From 2011 to 2015, the number of active fishers in the southern area of the Magdalen Islands has decreased (222 to 205 fishers) in favour of the northern area (103 to 120 fishers). In 2018, the number of active fishers in the south and north was 209 and 116 respectively.

The MLS was increased from 76 mm in 1996 to 83 mm in 2003. The objective of the increase in MLS was to double egg production per recruit from the 1994-1996 level. At the same time as

the MLS was increased, the size of the vertical opening in trap escape vents was increased from 43 mm in 1996 to 47 mm in 2003. Berried females must be released regardless of their size.

STOCK STATUS ASSESSMENT

Source of data

The stock status assessment is based on indicators of abundance, demographics, fishing pressure and stock productivity. Abundance indicators include landings recorded on processing plant purchase slips and catch rates of commercial-size lobsters obtained from samplings. The demographic indicators are taken from the lobster size structures and include mean size and weight, jumbo (≥ 127 mm) abundance, and sex ratios based on the abundance of commercial lobsters (male/non-berried females). The fishing pressure index (exploitation rate) is derived from a measurement of the ratio between the number of individuals (males) from the first moult class recruited to the fishery in a given year and that of the second moult class recruited to the fishery one year later (tracking cohort strength). Productivity indicators are based on abundance of berried females and on egg production (reproduction), abundance of pre-recruits (one year before entering the fishery), and cohort strength at the time of benthic settlement (recruitment).

The indicators are compiled mainly from two sources of data: at-sea sampling (0.14% of fishing activities), which has been conducted on board fishing vessels since 1985 and covers the south and north sides of the Islands; and a trawl survey, which has been conducted on the south side of the Islands since 1995. The latter is a source of fishery-independent data. Trawl survey data were standardized using a correction factor by size class to account for the impact of the change of research vessel in 2013 (*CCGS Calanus II* to *CCGS Leim*). In addition, divers have studied the benthic settlement of lobster in the Les Demoiselles area (Baie de Plaisance) since 1995.

For each indicator, data from the three previous years are examined and the 2018 data are compared to the averages from the existing data series (from before 2018). When the data are more variable, the average for the current assessment period (2016-2018) is compared to the average for the previous period (2012-2015).

Abundance indicators

Landings

Lobster landings recorded for the Magdalen Islands reached a historic record of 4,757 t in 2018 (preliminary data) (Figure 3), 91.3% higher than the past 25years average (2,487 t). Landings increased by 36.5% compared to 2015 (3,486 t) and the increase was noticeable on both the south and north sides. The south side accounted for 66.1% (3,144 t) of the total landings on the Islands and the north side accounted for the other 33.9% (1,613 t). In 2018, lobster landings from the Magdalen Islands accounted for 58% of the total landings in Quebec (8,127 t).

Commercial lobster catch rate (≥ 83 mm CL)

Catch rates correspond to catches per unit effort (CPUE) expressed in number or weight of commercial lobster (≥ 83 mm) per trap. In 2018, for the Islands as a whole, the CPUE was 1.48 lobsters per trap (lobster/trap), which corresponds to 0.98 kg of lobster per trap (kg/trap) (Figures 4A and 4B). The CPUE in number for 2018 was 67.6% higher than in 2015 and 81.7% higher than the series average (1985 to 2017), which stood at 0.82 lobster/trap. The CPUE in

weight was 69% higher than in 2015 and 110.8% higher than the historical series' average, which was 0.46 kg/trap. Logbook data follow a similar trend to that of commercial sampling.

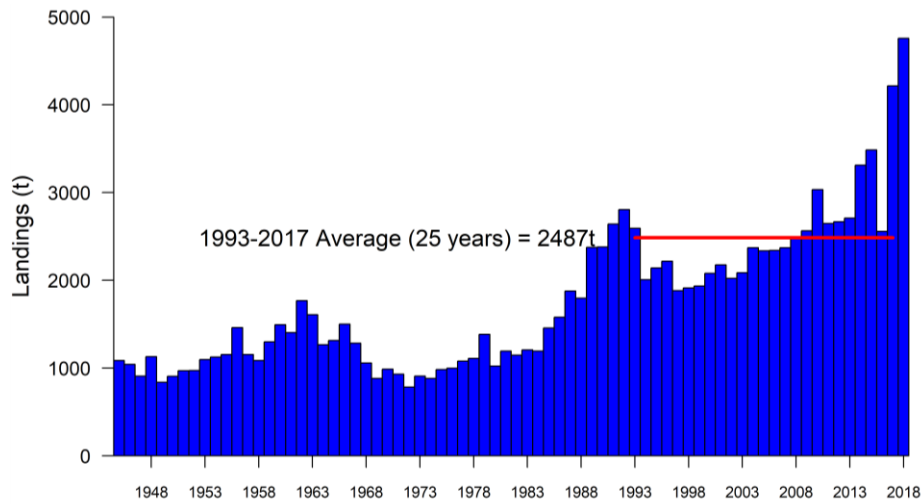


Figure 3. Lobster landings in the Magdalen Islands from 1945 to 2018.

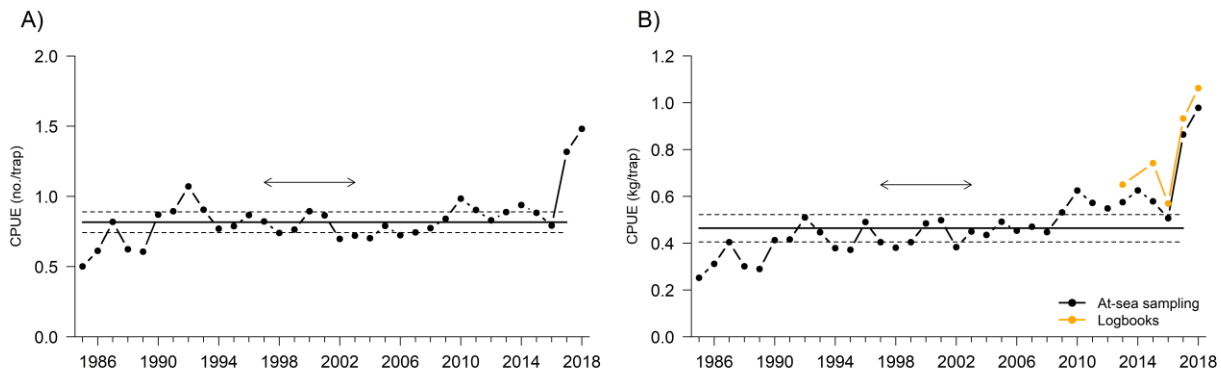


Figure 4. Catch rates (CPUE) of commercial-size lobsters for the Magdalen Islands from 1985 to 2018 in A) number and B) in kg per trap. 1985–2017 mean (solid line) \pm 0.5 standard deviation (dotted lines). The horizontal arrow indicates the period (1997 to 2003) when the MLS was increased from 76 to 83 mm.

Number and biomass of commercial lobsters (trawl)

The lobster population sampled in the fall of one year during the trawl survey represents the population to be available to the fishery in the spring of the following year. The commercial lobster density observed in the 2017 trawl survey (available in spring 2018) was 12.4 lobsters per 1,000 m² (no./1,000 m²) (Figure 5A). The corresponding biomass was 8.3 kg of lobster per 1,000 m² (kg/1,000 m²) (Figure 5B). The density and biomass values observed in 2017 were respectively 107.5% and 98.9% higher than those observed in the 2014 survey and respectively 88.7% and 97.3% higher than the series average (1995 to 2016). Both density and biomass have shown a downward trend since the sharp increase in 2015. During the 2018 survey, the density (10.6 lobsters per 1,000 m²) and biomass (7.0 kg per 1,000 m²) values were lower than those observed from 2015 to 2017, but remained high compared to the historical series.

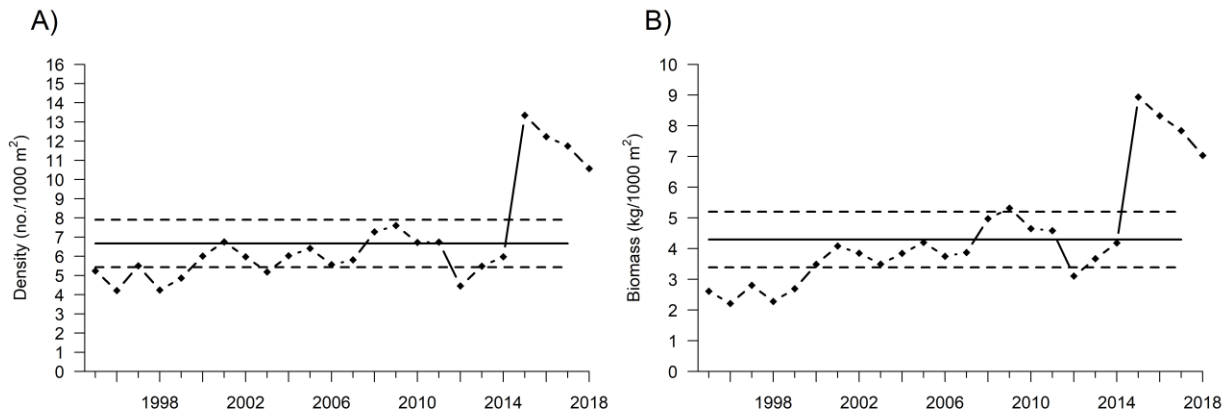


Figure 5. Commercial-size lobster density A) in number and biomass B) in kg per 1,000 m² of commercial sized lobster observed during the September trawl survey conducted on the south side of the Magdalen Islands between 1995 and 2018. 1995–2017 mean (solid line) \pm 0.5 standard deviation (dotted lines).

Demographic indicators and fishing pressure

There has been no notable change in the general form of commercial-size lobster size structures since 2014 (Figures 6A and 6B) or since the end of the MLS increase in 2003. Size structures appear truncated and are dominated by a moult class (83–95 mm for males and 83–93 mm for females) reflecting the year’s recruits. Female size distributions are more truncated toward small sizes than male size distributions, reflecting slowed growth among females upon sexual maturity.

The average size and weight of landed lobsters have slightly increased in the south between 2012-2015 and 2016-2018, from 91.7 mm to 92.0 mm and from 633 g to 640 g in the south. In the north, for the same periods, the average size and weight of lobsters landed decreased slightly from 92.9 to 92.2 mm and from 658 to 644 g. There is a slight decrease in the average size and weight of commercial-size lobsters in the trawl survey for the corresponding years, from 93.4 to 92.9 mm and from 670 to 659 g.

The proportion of jumbo lobsters (≥ 127 mm) observed during at-sea sampling is generally less than 1%. Within the fishery, it was 0.52% in 2018 for the south side of the islands, compared to 0.56% in 2015, and for the north side of the islands, it was 0.35% in 2018, compared to 0.85% in 2015. In the trawl survey conducted on the south side, the proportion of jumbos was 0.32% in the fall of 2017, compared to 0.66% in the fall of 2014. These downward trends are related to a strong recruitment to the fishery observed over the past 3-4 years.

Truncated size structures are indicative of high exploitation rates. The exploitation rate calculated for commercial-size males has been declining since 2010. Between the 2011-2014 and 2015-2017 periods, the exploitation rate decreased from 66.5 to 61.1% in the south and from 62.7 to 62.4% in the north. In the south, the exploitation rate in 2017 is lower than the 1985-2016 series average (67.5%) while it is higher in the northern part (61.0%). The greater decrease in the exploitation rate in the south would be partly due to the decrease in the number of active licences on the south side in favour of the north side.

Overall, female mortality due to fishing is not as high because they are protected when berried. As a result, the sex ratio for lobsters left on the sea floor could shift towards females, which is more likely when exploitation rates are high. For now, the sex ratio (number of males/number of

non-berried females; at-sea sampling and trawl survey) seems theoretically appropriate for ensuring mating (≥ 1).

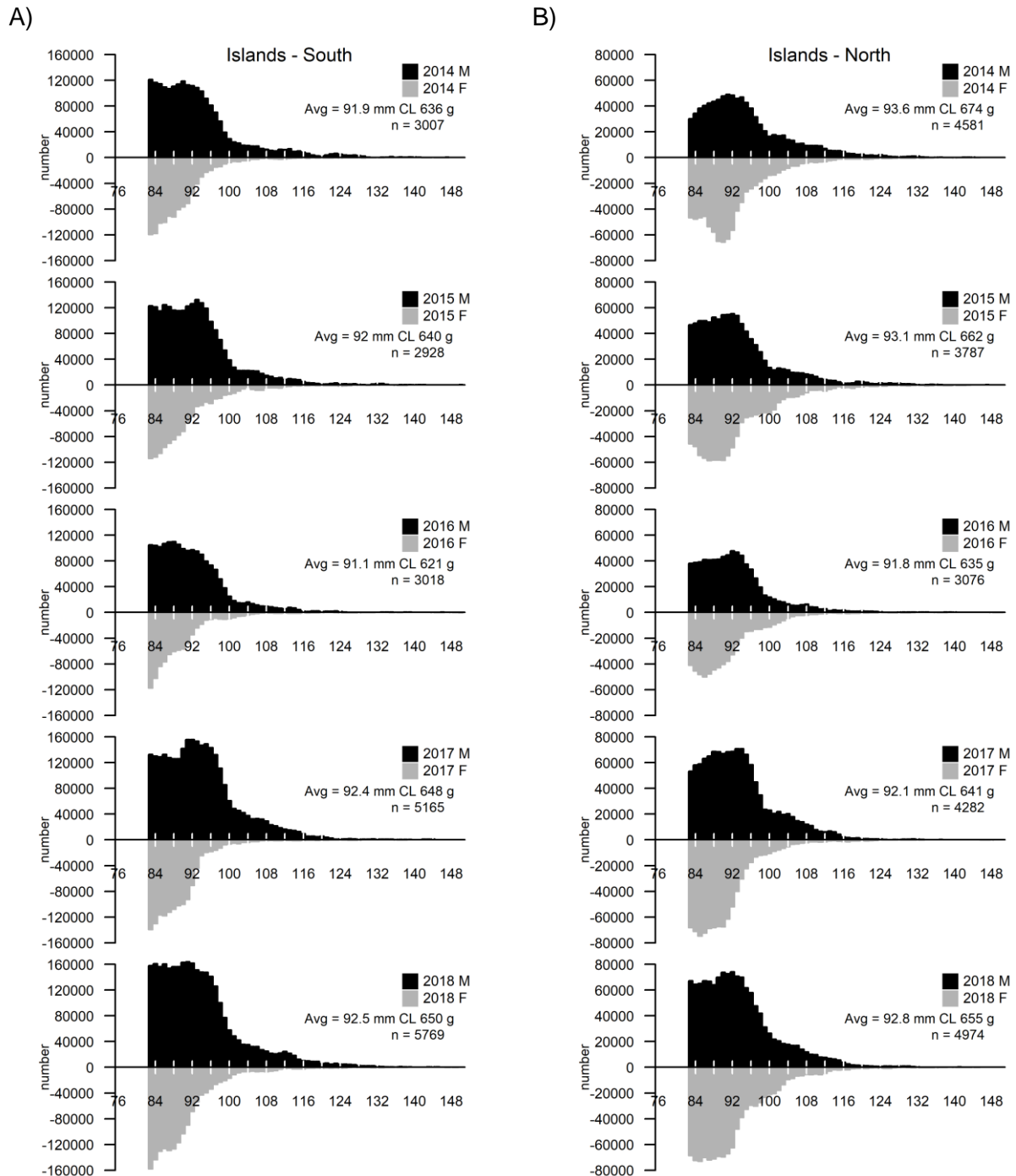


Figure 6. Size frequency distribution of commercial male (black) and female lobsters (grey) within the fishery (at-sea sampling) from 2014 to 2018 for A) the south side and B) the north side of the Magdalen Islands. Frequencies are in numbers weighted by landings. The average size and weight (Avg) and the number of lobsters measured (n) are indicated.

Productivity indicators

Berried females and egg production

In 2018, for the Islands as a whole, the CPUE for berried females was 0.26 lobster/trap. The average CPUE since the end of the increase period (2003–2010) of the MLS to 83 mm, was 0.18 lobster/trap compared to 0.09 lobster/trap for 1985 to 1996 when the MLS was 76 mm (Figure 7). The 2018 CPUE was higher than its 2015 counterpart (0.16 lobster/trap). An abundance index for females ≥ 79 mm CL (assumed to be mature) calculated from trawl survey data also shows that the density of mature females was less than 3.0 per 1,000 m² before 1997, had reached an average of 3.5 per 1,000 m² from 2012 to 2014 and reached an average of 7.4 per 1,000 m² from 2015 to 2018.

The examination of the size structure of berried females shows a strong mode under the MLS on the south and north sides (Figures 8A and 8B). On the south side, 57% of berried females are under the MLS whereas on the north side, 39% are below it. Before the MLS was increased, most of these females between 76 and 83 mm CL did not contribute to egg production. In 2018, the average size of berried females was 83.1 mm in the south and 85.1 mm in the north. The larger size of berried females on the north side is mainly explained by a larger size at sexual maturity. Berried female size structures from the trawl survey are similar to those from at-sea sampling on the south side of the Islands. In 2018, multiparous females represented 22% and 14% of berried females in the south and the north, respectively, compared to 22% and 21% in 2015. This gap between 2015 and 2018 in the north is partly due to the increased presence of small primiparous females.

An egg production index was calculated by multiplying the abundance index of berried females for each 1-mm size class by the size-specific fecundity. In 2018, the egg production index for the Magdalen Islands was 3.9 times higher than that calculated for 1994 to 1996, before the MLS began to be increased. In 2018, multiparous females contributed to 26% of total egg production.

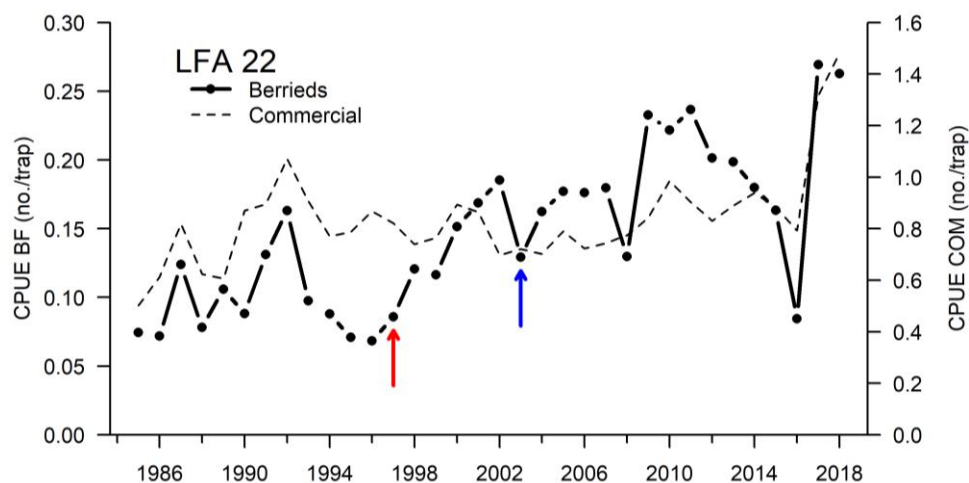


Figure 7. Catch rates (CPUE) of berried females (BF) for the Magdalen Islands from 1985 to 2018. The first red arrow indicates the start of the increases in MLS and the second blue arrow indicates the year when the height of the escape vents was increased from 43 mm to 47 mm. The dotted line indicates CPUEs of commercial-size lobsters (COM) during the same period.

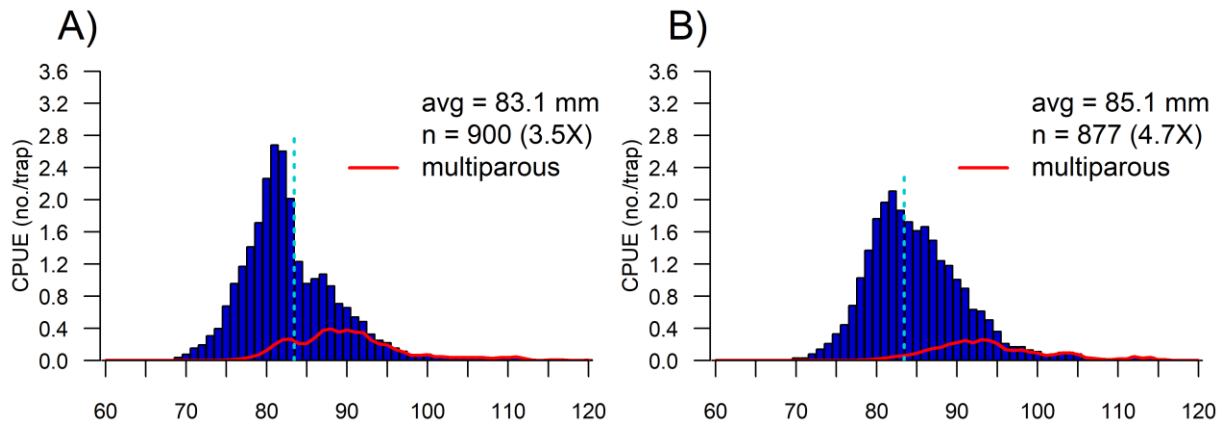


Figure 8. Size distribution frequencies of berried females on A) the south side and B) the north side of the Magdalen Islands in 2018. The red line represents multiparous females. Distributions are weighted by abundance indices (annual CPUE). The average size, the total number of berried females and the rate of increase in egg production compared to the 1994–1996 average (in parentheses) are indicated.

Since 2004, at the time of the trawl survey, females ≥ 80 mm in recent postmoult have been examined to see if they have a sperm plug in the entrance of the seminal receptacle. The presence of a sperm plug indicates that the female has mated and that there is sperm in the seminal receptacle. The purpose of this type of observation is to detect any anomalies in mating success that could be a result of, for example, excessive fishing pressure on males and a sex ratio imbalance. From 2016 to 2018, an average of 66% of females wore a sperm plug. This is lower than the average of 71% in 2012-2014 and the historical high of 82% reached in 2015.

Recruitment

Commercial-size lobster biomass estimated during the trawl survey in a given year gives a fairly good prediction of total landings in the Islands for the following year (Figure 9). This suggests, for the 2019 season, landings greater (3,861 t) than the historic series (1995–2014), but lower than those in 2017 and 2018, if catchability remains similar.

The benthic settlement at the Les Demoiselles site (Figure 2) has been higher on average since 2002 compared to the 1996 to 2001 period (Figure 10). The generally high values since 2002 coincide with the increase in egg production. From 2010 to 2016, the density of young aged 1+ has decreased from 2.62 to 0.31 lobster/m². In 2017 and 2018, the density of young increased (average 0+ : 2.1 lobster/m² ; 1+ : 1.05 lobster/m²), with the young aged 1+ being higher than the average for the 2002-2009 period (0.61 lobster/m²) which was considered excellent. However, the decline from 2010 to 2016 suggests a decrease in the biomass available to the fishery that is already reflected in the trawl survey from 2015 to 2018. Benthic settlement may also be influenced by wind strength and direction and by the growth and survival rate during the larval period. The survival rate of young lobsters to commercial size remains uncertain.

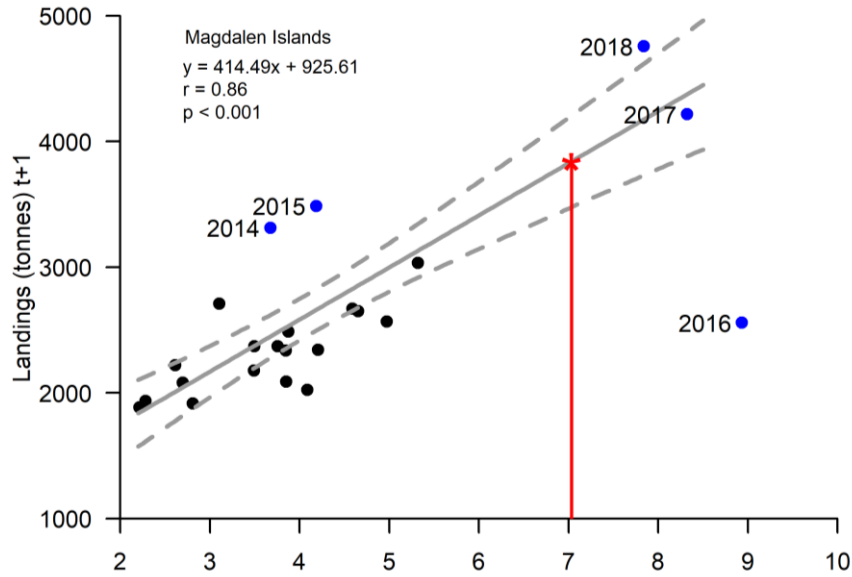


Figure 9. Relationship between the commercial-size lobster biomass index from the trawl survey in a given year (t) and the total lobster landings in the Magdalen Islands one year later ($t+1$). The dotted lines show a confidence interval of 95% around the regression line (2016 excluded). The blue points show recent biomass values observed in the survey in 2013-2017 (at time t) and landings for 2014-2018 (at time $t+1$). The years shown in the figure correspond to the years at time $t+1$. The red line indicates the 2018 biomass value and the red asterisk indicates the prediction of 2019 landings.

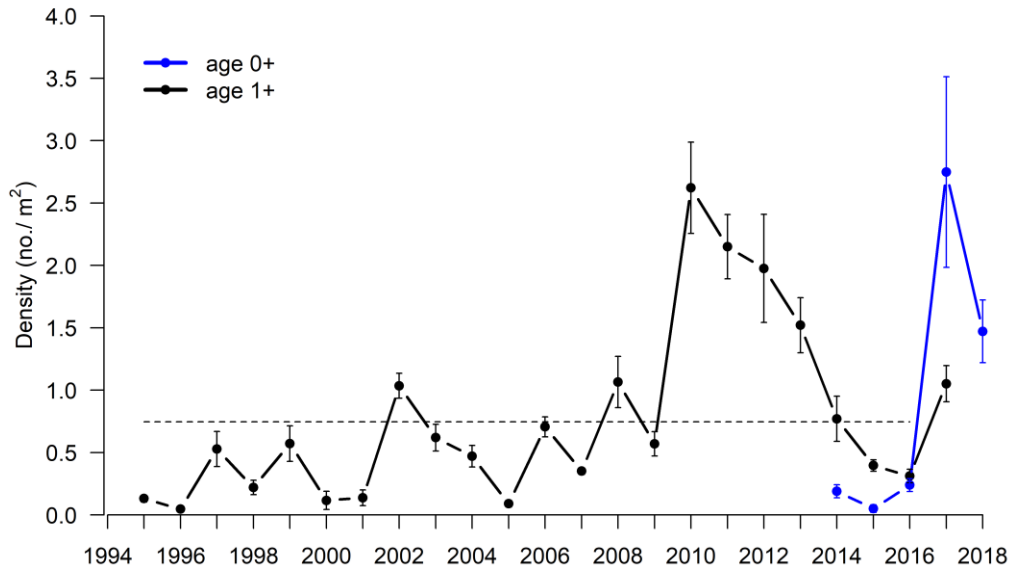


Figure 10. Density of young lobsters from 1995 to 2018. The densities of lobsters aged 1+ are presented for year $t-1$. The 1995-2016 series average for lobsters aged 1+ is shown with a black dotted line. Preliminary data for 2017 and 2018.

Precautionary approach

A precautionary approach (PA) based on an empirical method was suggested and adopted for the lobster fishery in the Magdalen Islands. The Limit Reference Point (LRP) and the Upper Reference Point (URP), as well as the stock status zones (healthy, cautious and critical) were defined using a stock biomass indicator (landings), in accordance with the DFO operational policy framework. According to the definition in framework, reference points are defined in relation to the maximum sustainable yield (B_{MSY}). The mean value of landings from 1985 to 2009 was used as an approximation of B_{MSY} . These 25 years correspond to a productive period for lobsters and during which at least two large cohorts of lobster were produced. Average landings from 1985 to 2009 were 2,188 t. The LRP (40% x average) was 875 t and the URP (80% x average) was 1,750 t. (Figure 11). Based on 4,757 t of landings in 2018, the stock is considered to be in the healthy zone (Figure 11).

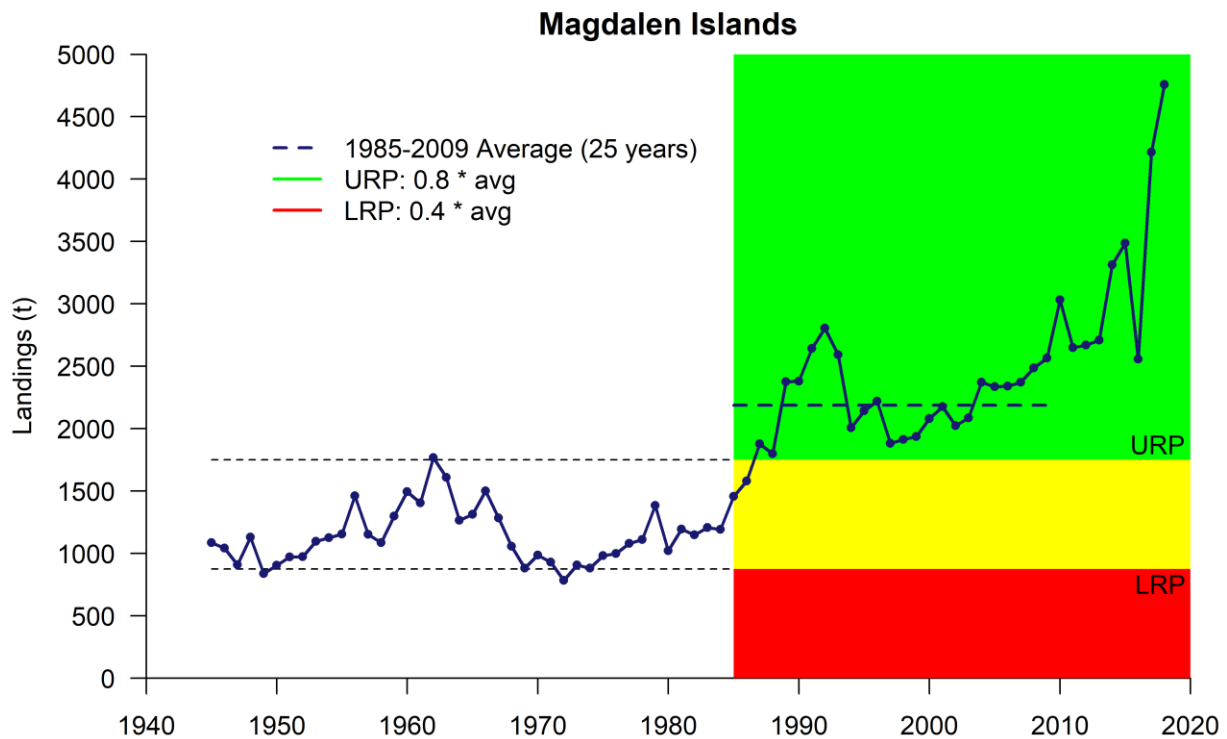


Figure 11. Lobster landings in the Magdalen Islands from 1945 to 2015. Healthy zone is green. Cautious zone is yellow, and the Critical zone is red. The dotted line from 1985 to 2009 corresponds to the average value that approximates the B_{MSY} .

Sources of uncertainty

The climate (long term) and weather conditions (short term) have significant impacts on all stages of lobster development. The climate determines periods of migration, moulting, reproduction, larval release and benthic settlement. It also conditions feeding and growth rates and periods. Weather conditions (temperature and wind) can affect lobster catchability. For example, when the water temperature is slow to increase in the spring or if it falls rapidly due to cold water upwelling, lobster catchability will be lower. Interannual or seasonal variability in climate and weather conditions can therefore have impacts on several demographic

Quebec Region

assessment indicators, including trawl and commercial fishery catch rates, which are considered to be abundance indicators and which are used in calculating indexes of exploitation rates.

At-sea sampling coverage is low (0.14% of fishing trips), which may bring about uncertainties in the representativeness of the CPUE estimates. Spatial fishing patterns can affect the abundance index of berried females if, for example, fishers avoid areas where these females can gather. Work is underway to attempt to predict the biomass available to the fishery based on benthic settlement data and the abundance of pre-recruit in the trawl survey. There is also uncertainty as to the representativeness of small-scale observations for the entire population.

CONCLUSION

High abundance and productivity indicate that the Magdalen Islands lobster stock is in good condition and that current exploitation levels are generally adequate. According to the precautionary approach, the Magdalen Islands lobster stock is in the healthy zone.

LIST OF MEETING PARTICIPANTS

Name	Affiliation	March 12	March 13	March 14
Arseneau, Cédric	DFO – Fisheries management	x	x	-
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Belley, Rénaud	DFO – Science	x	x	x
Bernier, Denis	DFO – Science	x	x	x
Bouchard, Danielle	MAPAQ	x	-	-
Bruneau, Benoit	DFO – Science	x	x	x
Coté, Jean	RPPNG	x	x	x
Couillard, Catherine	DFO – Science	-	x	x
Cyr, Charley	DFO – Science	x	x	x
Deraspe, Norman (tel)	Fisher from Iles-de-la-Madeleine	-	x	-
Gauthier, Pierre	DFO – Science	x	-	-
Gilbert, Michel	DFO – Science	x	-	x
Gillis, Carole Anne	Listuguj Fisheries	-	-	x
Hurtubise, Sylvain	DFO – Science	x	x	x
Jérôme, Adam	AGHAMM	x	-	x
Juillet, Cédric	DFO – Science	x	x	x
Larochelle, Mia (tel)	DFO – Fisheries management	-	-	x
Lévesque, Isabelle	DFO – Science	x	-	-
Maltais, Domyrick	DFO – Science	x	-	x
Monseau, Alexandre	Fisher from Anticosti	-	x	-
Paille, Nathalie	DFO – Science	x	x	x
Parent, Shanie	DFO – Fisheries management	x	x	x
Plourde, Stéphane	DFO – Science	x	x	-
Roy, Virginie	DFO – Science	x	-	-
Sainte-Marie, Bernard	DFO – Science	x	x	x
Sean, Anne-Sara	DFO – Science	x	-	-
Smith, Andrew	DFO – Science	x	x	-
St-Cyr Leroux, Thomas	Merinov	-	x	-
Tamdrari, Hacène	DFO – Science	x	x	-
Tremblay, Claude	DFO – Science	x	-	-
Turbide, Carole	DFO – Science	x	x	x
Two-Axe, Tara	Gesgapegiag	x	-	x

SOURCES OF INFORMATION

This Science Advisory Report is from the March 12-14, 2019 regional peer review meeting on the Assessment of the lobster in Quebec's inshore waters. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

DFO. 2009. [A fishery decision-making framework incorporating the precautionary approach](#). (assessed on February 20, 2016)

DFO. 2016. [2015 Lobster stock assessment in the Magdalen Islands \(LFA 22\), Quebec area](#). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/045.

Gendron, L. and Savard, G. 2012. [Lobster stock status in the coastal waters of Quebec \(LFAs 15 to 22\) in 2011 and determination of reference points for the implementation of a precautionary approach in the Magdalen Islands \(LFA 22\)](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/010. xvii+ 143 p.

THIS REPORT IS AVAILABLE FROM THE:

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ISSN 1919-5087

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Correct citation for this publication:

DFO. 2019. Assessment of lobster (*Homarus americanus*) in the Magdalen Islands (LFA 22), Quebec, in 2018. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/061.

Aussi disponible en français :

MPO. 2019. *Évaluation de l'état du stock de homard (Homarus americanus) des Îles-de-la-Madeleine (ZPH 22), Québec, en 2018. Secr. can. de consult. sci. du MPO, Avis sci. 2019/061.*