

END-OF-LIFE FISHING GEAR MANAGEMENT IN EASTERN QUÉBEC



Grande Entrée, Les Îles-de-la-Madeleine © Rachel A. Kendall

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EXECUTIVE SUMMARY

This report summarizes the results of a comprehensive study to gain an understanding of the life cycle of fishing gear in Québec – from its manufacturing and use to its end-of-life management. In particular, the study focused on end-of-life fishing gear generated by the commercial lobster fishery, as this is the most prominent target species in Québec fisheries and the most important species fished from the Atlantic Ocean, and thus produces the greatest amount of gear.

Data were gathered using online research methods and collaborating with members of the Fishing Gear Coalition of Atlantic Canada to gain insights into the Québec fishing industry. The data collected were summarized by fishing gear type and use, gear suppliers and retailers, size and location of commercial fishing harbours, waste resource management facilities, and the end-of-life management of gear from the commercial fishery. Maps were created to illustrate the spatial relationships within and between these research focus areas.

In 2020 the Department of Fisheries and Oceans issued 582 lobster licences in Québec. About 7 600 lobster traps are replaced annually in Québec. About 20-33 tonnes of lobster fishing rope and about 15 tonnes of crab fishing rope are replaced in Québec each year. Fish harvesters in Québec are responsible for managing their end-of-life fishing gear and transporting it to the nearest waste resource management facility. The linear distance to these facilities varies throughout the province in which 73% of commercial fishing harbours are located within 50 km of a waste resource management facility, 40% within 25 km, and 38% within 10 km. Some fish harvesters continue to illegally dump their gear, notably due to a lack of waste resource management facilities in or near their communities.

This research identified a large metal recycler with potential capacity to recycle all wire lobster traps generated in Québec. However, solutions to responsibly manage wood traps at end-of-life are less consistent, with all solutions at a small-scale or landfilled. Currently rope is primarily sent to landfill, but there is a pilot project being conducted in Québec for recycling fishing rope generated in the province as well as rope recycling initiatives in Atlantic Canada that could support Québec recycling. These solutions show promise for the future if their capacity can be scaled up.

Recommendations, for the near and longer term are as follows:

1. Use the results of this research as well as the lessons learned and success of developing and piloting a management program for end-of-life fishing gear in Nova Scotia to expand it to eastern Québec.
2. Work with the 17 coastal Municipalité Régionale de Comtés (MRCs) in Québec to ensure facilities accept wire lobster traps "as-is" for recycling.
3. Evaluate the feasibility of issuing a province wide tender for the collection and recycling of wire lobster traps to help ensure all wire lobster traps are recycled.

4. Further investigate solutions to increase diversion of wood traps from landfills that minimize non-wood contaminants and the need for fish harvesters to dismantle them.
5. Collaborate with fishing industry stakeholders to promote the use of traps with a longer life that are fully recyclable.
6. Determine reliable solutions with the necessary capacity to manage end-of-life fishing rope and build upon recent recycling developments that are beginning to show promise in Québec and Atlantic Canada.

This report fills existing knowledge gaps for the current state of end-of-life fishing gear management in the province. The baseline data gathered for this report provides the necessary foundation for implementing better management practices, as well as supporting potential development of product stewardship programs for end-of-life fishing gear in eastern Québec.

INTRODUCTION

BACKGROUND

The Fishing Gear Coalition of Atlantic Canada (FGCAC) has been working collaboratively on developing sustainable solutions for end-of-life fishing gear and associated materials since forming in December 2018. The FGCAC is composed of over 30 members from a variety of backgrounds including industry, government, Indigenous communities, academia, non-governmental organizations, and the public. It is actively pursuing three pillars of focus:

1. Resource management,
2. Retrieval and innovation, and
3. Research and communications.

Building upon the FGCAC's previous research published, such as the *End-of-life Fishing Gear Management in Nova Scotia* report (2020), that found a lack of a unified program for recycling or reuse of end-of-life fishing gear in Atlantic Canada. Understanding the current management of end-of-life fishing gear in Québec is necessary to support developing sustainable and long-term solution for end-of-life fishing gear across Atlantic Canada and eastern Québec.

This Québec study is part of a larger project funded by the Department of Fisheries and Oceans Canada (DFO) Sustainable Fisheries Solutions & Retrieval Support Contribution Program (SFSRSCP). SFSRSCP projects fall under four themes: ghost gear retrieval, responsible disposal, acquisition and piloting of available technology, and international leadership. This project fits within the responsible disposal theme, and as such must “work with relevant partners (ports, industry, etc.) to identify and facilitate measures or activities related to the responsible disposal and recycling of ghost gear and end-of-life fishing gear”. For this to be feasible, a solid understanding of the current situation at core commercial fishing harbours and waste resource collection sites across Québec is necessary. The data gathered in this report compliments work initiated in Nova Scotia, and information presented in the other provincial end-of-life fishing gear management reports for this project, for determining efficient and effective infrastructure for end-of-life fishing gear collection and management throughout the province.

This study documents the current state of fishing and waste resource management infrastructure and management practices in eastern Québec to gain a better understanding of potential gaps and challenges surrounding the management of end-of-life fishing gear in the province. Information gathered will provide valuable insight into where the larger project should focus its efforts to support the long-term goal of implementing a management program for end-of-life fishing gear across Atlantic Canada and eastern Québec.

RESEARCH GOALS

The overall research goal of this report was to develop a comprehensive repository of data on the fishing industry and its practices to better manage end-of-life fishing gear in eastern Québec. Specifically, the main outcome of this research was to develop a spreadsheet of the compiled information on the types and quantity of gear used and/or replaced, suppliers and retailers of this gear, number of fish harvesters, size and location of fishing harbours, and waste resource management costs and infrastructure available to accept end-of-life gear. As well, maps were developed to visualize the data gathered of largest concentration areas of harbours for end-of-life gear and their proximity to waste resource management facilities. The findings of this report will be used as the foundation for assessing infrastructure needs and costs for collecting and managing end-of-life fishing gear throughout eastern Québec.

RESEARCH FOCUS AREA

Research for this report focused primarily on lobster and crab, as they are the main fisheries in Québec, contributing 13% (\$0.3 billion) of all Atlantic coast commercial lobster and crab fishery landed values in 2019 (DFO 2021a). Throughout Atlantic Canada and Québec, DFO manages 45 lobster fisheries, including one for the offshore fishery and one that is closed for conservation. Québec falls within the DFO inshore lobster fisheries management region of Québec, which comprises ten main Lobster Fishing Areas (LFAs) (15-22; Figure 1). This same region is also overlapped by the snow crab fishing areas (CFAs) 12-17 (pers. comm. March 29, 2021), with many lobster fish harvesters also harvesting crab.

Indigenous peoples fished lobster with a variety of fishing gear long before European colonialists began harvesting the resource. Lobster is one of the longest regulated fisheries in Canada. Before the late 1800s, the lobster fishery had no restrictions on who could fish and how much could be caught (DFO 2020a). Following the change from manual harvesting and harpooning to baited lobster traps in the late 1800s, practices have changed only in efficiency of gear (faster, larger vessels and larger, more efficient traps), which increased fishing pressure significantly (DFO 2020a). Limited entry licensing and three licence classes were introduced in the 1960-70s (DFO 2020a). These classes are: Category A for licences authorized to those fully dependent on lobster fishing, Category B for licences authorized to those not fully dependent but with a historical attachment to the fishery (since 1968), and Communal Commercial. A report produced by the Fisheries Resource Conservation Council in 1995 led to a series of multi-year lobster management plans throughout Atlantic Canada aimed at increasing egg production (DFO 2020a).

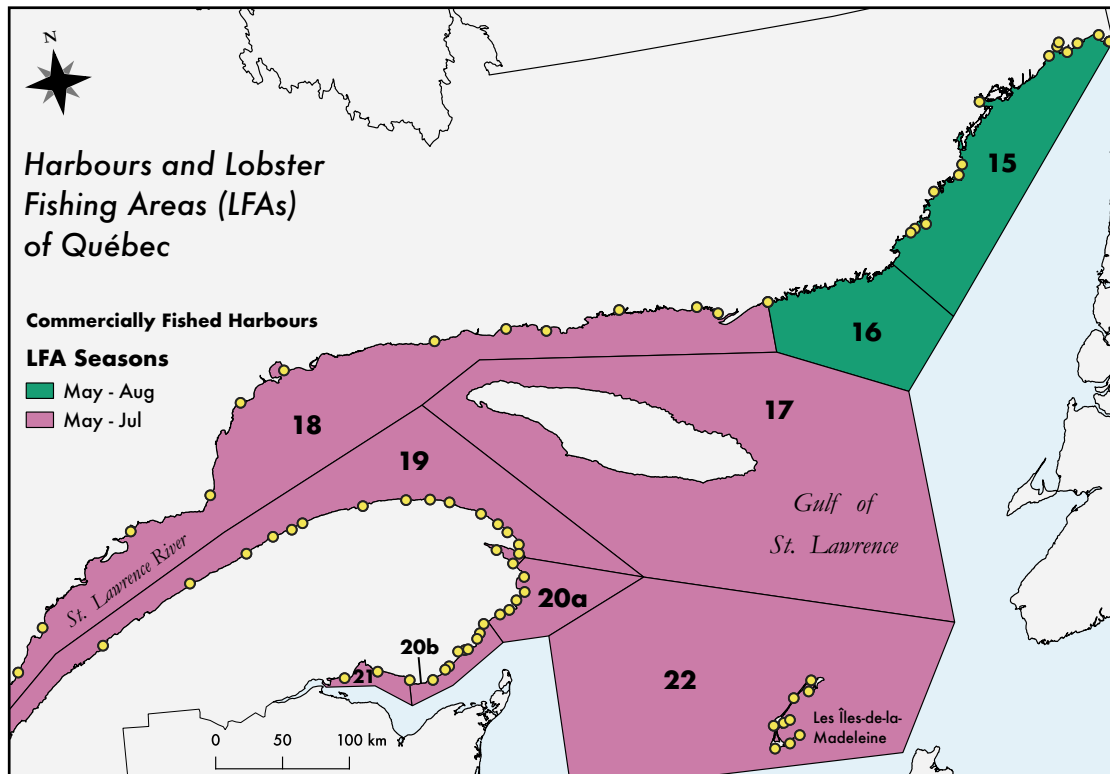


Figure 1. Harbours and lobster fishing areas (LFAs) in Québec. Map projection: NAD 83 CSRS UTM Zone 20N, Transverse Mercator. Sources: LFA delimiting lines and provincial boundaries modified based on Coffen-Smout (2020), DFO. Number of commercial fishing boats provided by Clark et al. (2021). Map created using QGIS 3.10 by Rachel A. Kendall.

LFA seasons are staggered, with LFAs 17 to 22 lobster fishing seasons lasting from May to July and LFAs 15 and 16 lasting longer into August (Figure 1). In 2020, 582 lobster licences were issued to participants in the lobster fishery of LFAs fished in Québec (DFO pers. comm. March 29, 2021), representing approximately 6% of the 10 000 licensed fish harvesters in Canada (DFO 2015). Additionally, 302 snow crab licenses were issued to participants in the snow crab fishery from Québec (DFO pers. comm. March 29, 2021). Lobsters and snow crab are caught using baited traps that are placed on the seafloor, as either single or multiple traps attached to synthetic rope lines. This gear, when abandoned, lost, or discarded, makes up a large portion of marine debris and is harmful to the fishery, causing habitat degradation and indiscriminate fishing (Goodman 2020).

METHODS

BASELINE DATA COLLECTION

Data was collected on various aspects of the commercial fishery in Québec from December of 2020 to March of 2021. This research focused on the commercial lobster and snow crab

fisheries and their end-of-life fishing gear management. Prior to contacting industry representatives, readily available information was gathered online. To gain an understanding of the current management of end-of-life fishing gear throughout the province, waste coordinators, waste resource management facilities (transfer stations, construction and demolition (C & D) sites, and landfills), and recyclers were contacted for interviews in March of 2021 by FGAC member support (Master's student, Boniface Roth, L'Université du Québec à Rimouski). These interviews provided information on tipping fees applicable to end-of-life fishing gear, acceptable products, and required product preparation (Appendix A).

Phone conversations and online surveys were conducted with 95 fish harvesters by FGAC member Merinov (Clark et al. 2021) for their project titled *Engins de Pêche Abandonnés ou Perdus: Introduction à la Recirculation (EPAPIR)*; 53 from Gaspésie, 31 from Les Îles-de-la-Madeleine, and 11 from Côte-Nord. These interviews were used to gain an understanding of the types of fishing gear that are used in the commercial fisheries throughout Québec, the types of materials these products are made from, quantities replaced, and current barriers or opportunities to end-of-life fishing gear management.

Information relating to the active Québec core commercial fishing harbours was provided by the Small Craft Harbours program of DFO. Small Craft Harbours provided information pertaining to lobster licensing and LFA seasons. Based on information collected from the fishing industry, each LFA and harbour was classified by the type of lobster trap used, whether primarily wood, wire, or a combination of both. Clark et al. (2021) provided information on commercial fishing harbour location and the approximate number of commercial fishing boats at each harbour.

BASELINE DATA ANALYSIS

Four maps were created using QGIS Version 3.10. Provincial boundaries were derived from a LFA shapefile (Coffen-Smout 2020) and reprojected to World Geodetic System 1984 Universal Transverse Mercator (UTM) Zone 20N. Some topological errors needed to be adjusted and re-digitized to reflect official LFA and provincial boundaries. Addresses of core commercial fishing harbours and waste resource management facilities were geocoded and presented in the maps using the MMQGIS plugin with ESRI Geocoding URL. If addresses could not be geocoded, they were corrected using coordinates gathered from Google Maps. A total of 73 commercial fishing harbours (56 active core harbours managed by a harbour authority and 17 private fishing harbours) were categorized by the number of commercial fishing boats to approximate harbour size and presented on three maps. Since some harbours were situated close together, they were amalgamated for presentation purposes in the harbour size categories (Appendix B), therefore resulting in 63 amalgamated harbours being mapped.

Buffers of 10, 25, and 50 km were drawn around each waste resource management facility on one map using the vector buffer processing tool. The buffers were drawn to illustrate how far fish harvesters currently must transport their end-of-life gear from core commercial

fishing harbours. For another map illustrating the primary lobster trap type used (wire or wood), LFAs were categorized by whether more harbours per LFA use wire, wood, or a combination of both wire and wood.

Quantity of lobster traps and rope replaced annually were estimated using Québec licence numbers provided by DFO (pers. comm. March 29, 2021) and rope weights provided by S. Burke (pers. Comm. December 4, 2020). The maximum number of traps issued reflects the trap limit per licence for each LFA (e.g., LFA 15 has a limit of 250 traps per licence) unless in a partnership, which permits two licences on one boat. For a partnership, the maximum number of traps allowed is 1.5 times the number of traps of the licence (e.g., a partnership in LFA 15 could have a maximum total of 375 traps).

RESULTS AND DISCUSSION

MAJOR COMMERCIAL FISHERIES IN QUÉBEC

Lobster is the most commercially valuable species in Québec (Table 1) although the snow crab fishery produced greater landing in quantity (DFO pers. comm. March 29, 2021). Other important commercial species harvested in the province include shrimp, Greenland halibut, and herring (Table 1). The type of gear used varies among these fisheries. While both lobster and snow crab use traps, those used for crab have a conical steel frame covered with netting. Lobster traps are traditionally made of wood or vinyl coated steel wire. Shrimp are only harvested with trawls with nets by Québec fish harvesters. Halibut and herring are harvested using seines, gillnets, midwater trawls, and weirs, but halibut may be fished with fixed or mobile gear (Table 1) (DFO 2020b).

To support the FGCAC's End-of-Life Fishing Gear Management Project for Atlantic Canada and eastern Québec, the research of this report focused primarily on lobster traps and fishing rope. Lobster traps are composed of a variety of parts and materials, but the main materials can include wood, vinyl coated steel wire, rubber, netting, and ballasts made of concrete or steel. Fishing rope made from polyethylene, polypropylene, and/or a blend of polyethylene and polypropylene are used in lobster and crab fishing in Québec. Additionally, buoys constructed from various rigid plastic resins and expanded polystyrene are also used.

Lobster is a more important fishery for Les Îles-de-la-Madeleine and Gaspésie compared to the Côte-Nord region where snow crab is more important for the economy (Clark et al. 2021). Though lobster and crab are the primary species harvested by fish harvesters in Québec, many will harvest other species, particularly during the off-season for lobster and crab. Halibut, mackerel, and herring were noted to be fished more in the Côte-Nord and Gaspésie regions and scallop fished more from Les Îles-de-la-Madeleine (Clark et al. 2021).

Table 1. Primary commercial fisheries in Québec and the types of gear used.

Species	2020 Landings (\$ Thousands) ^a	Gear Used
Lobster	113 856	Wire or wood traps; some wood-wire combinations; polypropylene/polyethylene rope; buoys; concrete or steel ballasts; rubber.
Snow Crab	103 895	6-7 ft conical steel traps: welded steel ring frame, netting, twine, rope, and plastic cone.
Shrimp	25 753	Trawls with nets.
Greenland Halibut	4 927	Fixed gear: longline and gillnets (bottom hook-and-line with gangions, hooks, buoys, and rope). Mobile gear: otter trawl, midwater trawls, or seines.
Herring	1 517	Purse seines, tuck-ring seines, fixed gear, midwater trawls, weirs and gillnets.

^aDFO (pers. comm. March 29, 2021).

HARBOURS AND FISHING AREAS IN QUÉBEC

There are 73 fishing harbours used commercially in Québec (63 when amalgamating them; Appendix B), with 56 managed by DFO Small Craft Harbours and 17 private harbours noted to be fished commercially, ranging in size from 1 up to 152 boats per harbour. Most fishing harbours will have either 1-10 boats (57%) or 11-25 boats (30%). Two harbours (Middle Bay and Sainte-Anne-des-Monts) did not have information on the number of boats. Only one harbour, Grand Entrée, has more than 75 boats (Figure 2). The remaining harbours have 26-75 boats (11%). Along the Côte-Nord, there are only small harbours, having either 1-10 or 11-25 boats. The largest fishing areas of Québec are Les Îles-de-la-Madeleine and the most eastern part of the Gaspésie, with Rivière-au-Renard being the most important commercial harbour in Gaspésie (Figure 2).

Fishing seasons in Québec are limited to the spring and summer months, with LFAs 15 and 16 lasting four months, and the others limited to three months (Table 2). In 2020, LFA 22 had the most licences issued (58% of all licences) (Table 2), which would be largely fished from Les Îles-de-la-Madeleine (Figure 2), therefore representing the largest lobster fishing area in Québec. LFAs (and their subareas) have trap limits ranging from 50 to 425 per licence holder (Table 2). Snow Crab Fishing Areas (CFAs) overlap the LFAs in the Gulf of St. Lawrence, with most licences issued CFA 12 (Table 3). In total, there were 580 lobster fishing boats and 275 crab fishing boats registered in Québec in 2020 (DFO pers. comm. March 29, 2021).

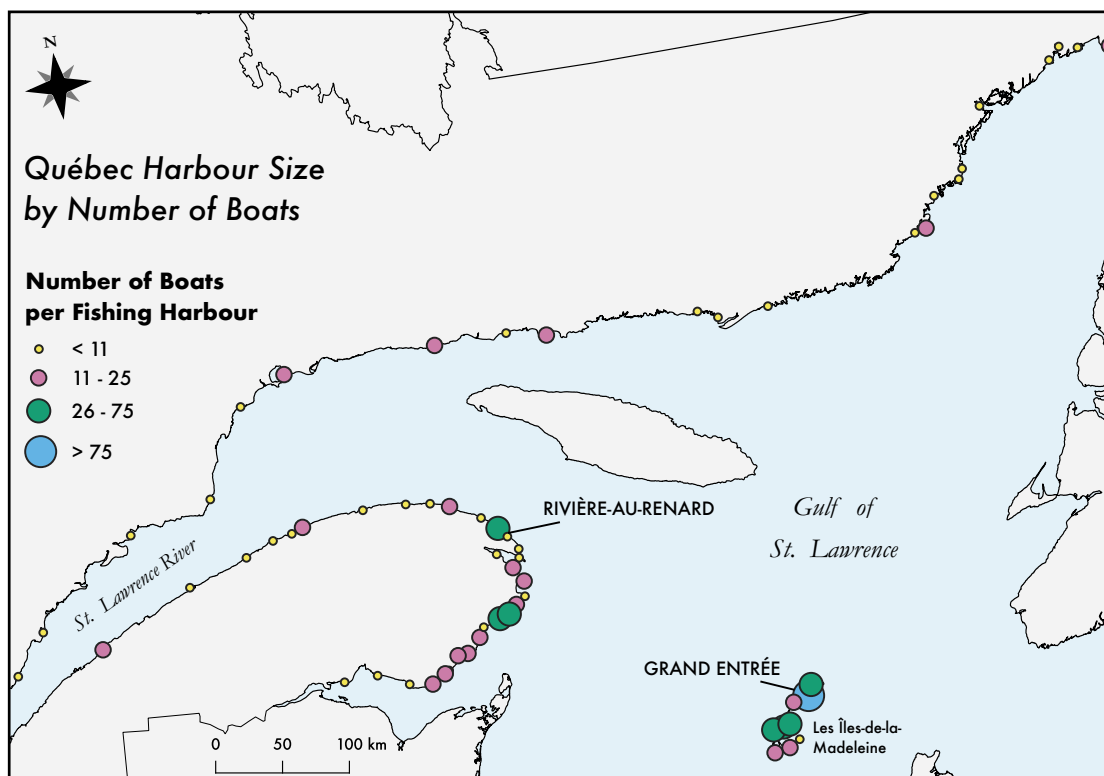


Figure 2. Size of Québec commercial fishing harbours by number of boats. Refer to Figure 1 for map sources.

Table 2. Lobster Fishing Area (LFA) licences and traps, 2020.

LFA	Fishing Season	Total Licences	Trap Limit per Licence ^b	Traps Licensed
15	May 16 – Aug 7	66	250	16 500
16	May 16 – Aug 7	9	250	2 250
17a	May 6– Jul 15	1	50	50
17b	May 7 – Jul 21	15	300	4 500
18	May 13 – Jul 28 ^a	8	250	2 000
19	May 9 – Jul 18	8	250	2 000
20a	May 9 – Jul 2	74	310 ^c	19 623

20b	May 9 – Jul 2	63	262 ^c	15 430
21	May 9 – Jul 16	13	235	3 055
22	May 9 – Jul 11	325	273	88 723
Total	—	582	—	154 131

Season, licence, and tag information from DFO (pers. comm. March 29, 2021). ^aLFA 18A season is different than LFA 18b-h: May 16 – Aug 7. ^bTrap limit is for “Category A” or full-time licence holders. Part-time or “Category B” licences are allowed 30% and Partnerships 150% the limit of a single full-time licence. ^cAverage value for multiple subareas with a range from 235-435 trap limits.

Table 3. Gulf of St. Lawrence Crab Fishing Area (CFA) licences and traps, 2020.

CFA	Total Licences	Pot Limit per Licence	Pots Licensed
12	88	300	10 304
12a	10	150	825
12b	6	225	1 050
12c	5	100	500
12e	1	100	100
12f	10	120	795
13	36	75	2 700
14	19	142	1 784
15	8	170	765
16	51	200	4 600
16a	36	106	3 186
17	39	191	2 977
Total	309	—	29 616

Season, licence, and tag information from DFO (pers. comm. March 29, 2021).

FISHING GEAR TYPE BY FISHING AREA

The information presented in this section is derived from conversations with fish harvesters and fishing gear retailers conducted mainly by Clark et al. (2021). Wire lobster traps are primarily used by lobster fish harvesters in Côte-Nord (LFAs 15-16, 18), but there is also far less lobster fishing here than in other regions of the province. Shrimp fishing requires the use of trawls in Québec, which is an important fishery for Côte-Nord and Gaspésie. In Les Îles-de-la-Madeleine (LFA 22). Wood lobster traps are primarily used and in Gaspésie (LFAs 21-19), a mixture of wood and wire lobster traps are used (Figure 3), but more survey respondents noted wire than wood traps. According to the Regroupement des pêcheurs professionnels du sud de la Gaspésie, some lobster fish harvesters continue to use wood traps, but many are making the transition to wire traps (M. Cousineau pers. comm. March 30, 2021). In LFA 17, a mix of wire and wood traps are likely used, depending on individual preferences.

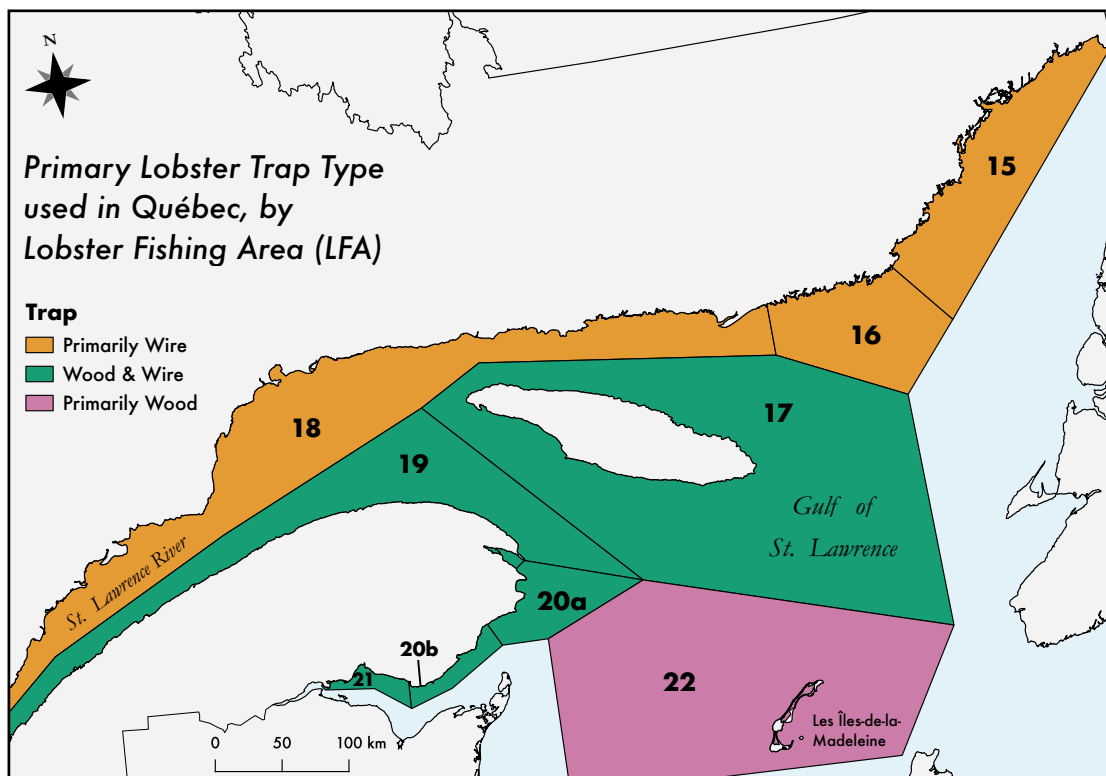


Figure 3. Primary lobster trap type (wire, wood, or both) by LFA. Refer to Figure 1 for map sources. Information on trap types used from fish harvester surveys by Clark et al. (2021).

The primary fishing rope used by fish harvesters is made of polypropylene, polyethylene, or a blend of polyethylene and polypropylene. Rope diameter size, and therefore rope weight, used by fish harvesters varies by region and by type of fishery. Fishing rope is commonly sold as 366 m (1200 ft) coils. Lobster fishing rope with 3/8-inch diameter is most used in the Gulf of St. Lawrence, according to fish harvester and retailer interviews conducted for the New Brunswick and Prince Edward Island end-of-life fishing gear management reports (2021) and the Regroupement des pêcheurs professionnels du sud de la Gaspésie (M. Cousineau pers. comm. March 30, 2021). A coil of 3/8-inch fishing rope weighs about (36 lb or 16 kg) (S. Burke pers. comm. December 4, 2020). The type of traps and fishing rope used vary throughout the regions due to factors such as ocean floor topography, currents and tides, and as a personal preference based on perceived fishing ability and efficiency.

QUANTITY OF FISHING GEAR USED

In 2020, there were 154 131 lobster trap tags issued in LFAs fished from Québec (DFO pers. comm. March 29, 2021). Information on lobster trap and fishing rope replacement was derived from interviews and surveys conducted with 95 fish harvesters across eastern Québec by Clark et al. (2021). Each year, most fish harvesters noted that they change on average 1 coil of rope for crab fishing and 2 coils of rope for lobster fishing. Wood lobster traps were found to last longer than wire lobster traps, for 7-15 years compared to 4-5 years, respectively. Fishing rope used for both lobster and crab fishing were indicated to last 3-5 years. According to the Regroupement des pêcheurs professionnels du sud de la Gaspésie (M. Cousineau, pers. comm. March 30, 2021), a fish harvester may replace 15% of the traps each year, and after 5-6 years make a complete renewal. Using the number of lobster traps used per fish harvester (150) provided by Clark et al. (2021), if this quantity is replaced every 5 years for wire traps and every 15 years for wood traps, this represents 30 wire traps per year and 10 wood traps per year per fish harvester.

Multiplying the total number of lobster licences issued per LFA in 2020 (licences represent the number of lobster fish harvesters) by the approximate number of traps replaced per fish harvester (Table 2), about 7 595 traps would have been replaced annually by fish harvesters. This estimate assumes that fish harvesters in LFA 22 use primarily wood, in LFAs 17, 19-21 use 50% wire, and in LFAs 15-16, 18 use primarily wire (Figure 2). Assuming that on average 2 coils of lobster fishing rope are replaced per fish harvester annually, approximately 1 164 coils of lobster rope may be replaced in LFAs 15-22 each year. By multiplying the number of coils replaced by the length of rope in a coil (366 m or 1 200 ft), this represents 426 km (1 396 800 ft) of lobster rope replaced each year. In weight, this represents about 20 tonnes annually. Additionally, Clark et al. (2021) estimated that an additional 15 tonnes of crab fishing rope and 33 tonnes of lobster fishing rope are replaced annually by Québec fish harvesters.

The replacement lobster trap and rope numbers are estimates based on approximated values derived from Québec fish harvester surveys conducted by Clark et al. (2021). These

values will vary from year to year depending on how many traps are lost by fish harvesters due to storms and other environmental conditions that damage fishing gear.

FISHING GEAR RETAILERS

The main fishing gear retailers identified in Québec are Les Agrès de pêche ACPG, Les Agrès de Pêches Commerciales Le Marin, and Les Industries FIPEC. Of these retailers, all sell fishing rope, lobster trap material, and crab trap material. Les Agrès de Pêches Commerciales Le Marin does not assemble traps. Lobster fish harvesters often construct their own traps using material purchased from fishing gear retailers. Entreprises Shippagan, based in New Brunswick, was identified as the main supplier of fishing gear to retailers in Québec (Clark et al. 2021). Rainbow Net and Rigging does not have a physical location in Québec but supplies traps and other material from Nova Scotia.

LOBSTER TRAPS

Traditionally, lobster traps were made of wood. This changed over time as lobster traps constructed of vinyl coated wire entered the market. The main wire mesh brands noted during phone conversations with retailers were Aquamesh and Cavatorta. However, wood traps are still commonly used in Québec and are returning in popularity in the Gulf of St. Lawrence. Wire and wood traps also include twine netting, rope, and ballasts (Figure 4). The ballast or weight is used to ensure the lobster traps sink to the sea floor and is typically made of either concrete or steel. Lobster traps can be sold with the concrete ballasts already poured in the vinyl mesh, or ballasts can be added in after purchase.

Retailers of lobster traps may sell either concrete or steel ballasts in their traps. Additionally, most retailers provide custom-built lobster traps that are tailored to individual fish harvester needs and preferences. Many retailers indicated that traps 3-4 ft in length were among the most common sizes sold to fish harvesters in the Gulf of St. Lawrence. However, the size of the traps purchased vary by harbour and will often correspond to the size of the fishing vessel, as fish harvesters with larger vessels tend to purchase larger traps and vice versa. The number of traps sold annually by retailers varied from 5 000 to 9 000 traps.

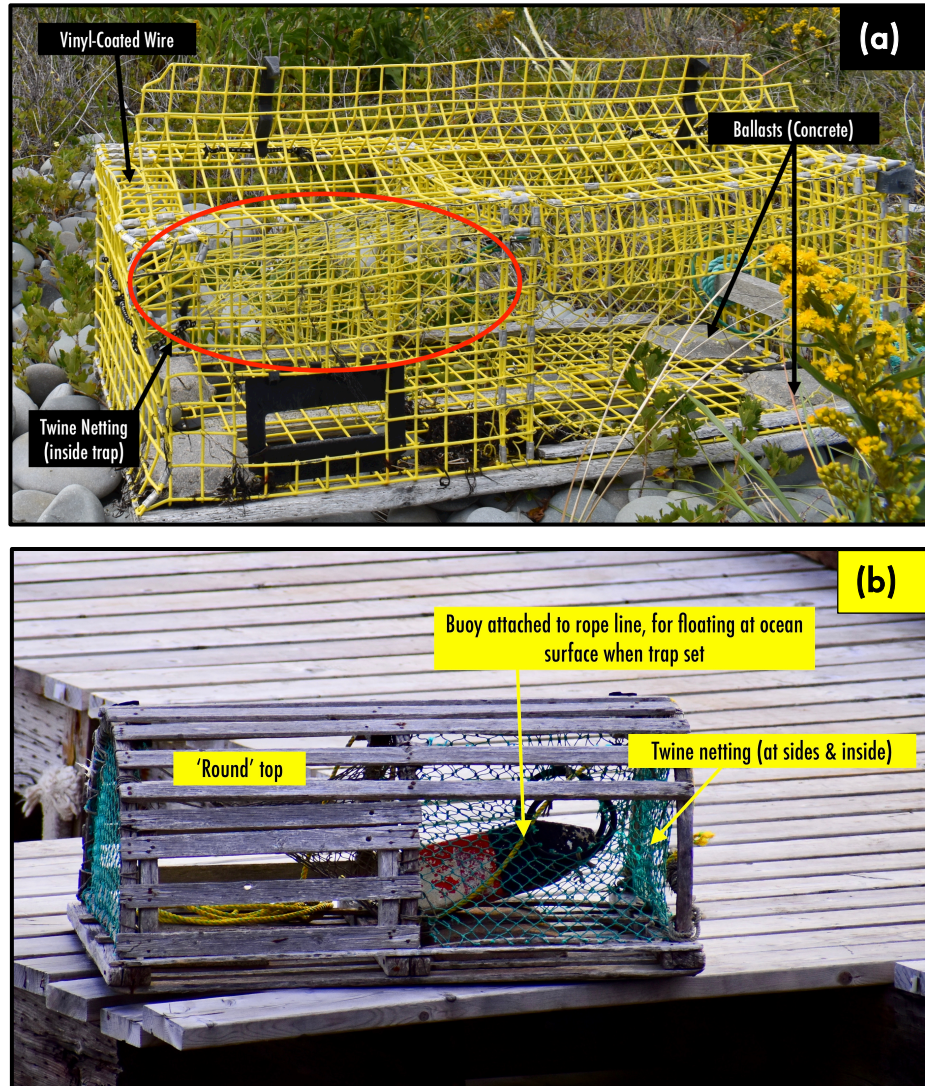


Figure 4. Diagram showing the parts of (a) a wire lobster trap and (b) a 'round' wood lobster trap. Photos copyrights Rachel A. Kendall.

ROPE

Fishing rope used in the lobster and crab fishery are made of polyethylene and polypropylene material. There are many other ropes used for specific purposes, such as the polyester or polypropylene with a latex core Trapcord, manufactured by Novabraid, in Nova Scotia, for lobster trap doors. Other ropes are made of nylon, but these are not commonly used for lobster fishing in Québec. Major retailers and distributors of lobster fishing rope in Québec are Les Agrès de pêche ACPG, Les Agrès de Pêches Commerciales Le Marin, Les Industries FIPEC, and Entreprises Shippagan. Rainbow Net and Rigging also supplies some fishing rope to Québec from Nova Scotia. Polysteel Atlantic rope was indicated by fish harvesters as a commonly used fishing rope brand, which is the only manufacturer of lobster fishing rope in Eastern Canada and is the largest supplier of rope to retailers and distributors. The

approximate quantity of fishing rope sold annually by suppliers in Québec ranged up to 600 000 ft (Clark et al. 2021).

MANAGEMENT PRACTICES FOR END-OF-LIFE FISHING GEAR

WASTE RESOURCE MANAGEMENT FACILITIES

Waste resources are managed within each Municipalité Régionale de Comté (MRC) of Québec, with 17 in the coastal Gaspésie, Les Îles-de-la-Madeleine, Côte-Nord, and Bas-Saint-Laurent regions. Fish harvesters in Québec are responsible for managing their end-of-life fishing gear. Ideally, fish harvesters will transport their gear to the nearest Écocentre (transfer/sorting station) or directly to a landfill within their MRC. If harbour authorities provide collection bins, they are to be used only for “black bin” garbage that would be generated by the fish harvesters on their boats, but not for rope or lobster traps. Most collection bins for recyclables are restricted to “blue/green bin” recyclables of paper and beverage containers generated on the boats and not end-of-life fishing gear.

Most fishing harbours across the province do not have collection programs in place for end-of-life fishing gear. Some harbour authorities will organize as-needed removal of end-of-life fishing gear by renting large dumpsters or organizing harbour clean-ups when gear is taking up too much space at the harbour. Rather than taking their end-of-life fishing gear to waste resource management facilities, many harbour users will stockpile rope and lobster traps at their homes or other personal properties.

To help visually approximate the distance that fish harvesters need to transport their end-of-life gear, 10, 25, and 50 km buffers were drawn around each of the waste resource management facilities in the province (Figure 5). These buffers represent the current situation, and no determination has yet been made as to what is considered a reasonable distance for a fish harvester to have to transport their gear. This mapping shows that 39 of the 63 amalgamated harbours are located greater than 10 km from a waste resource management facility (Figure 5). The largest fishing harbour (Grand Entrée) is located within 10 km of waste resource management facility. Although 25 harbours are located within 25 km of a waste resource management facility, 17 harbours are located greater than 50 km from a waste resource management facility. These harbours are mainly in the Côte-Nord region, where there is only one Écocentre past Sept-Îles (Figure 5).

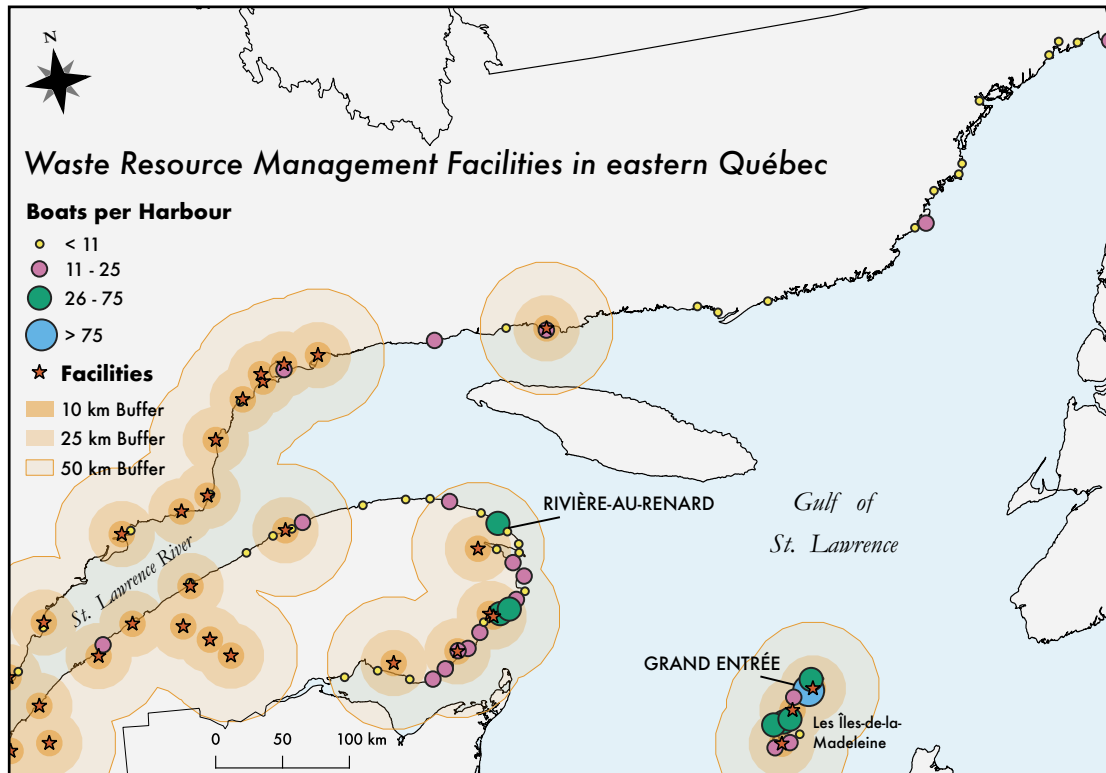


Figure 5. Québec commercial fishing harbours and eastern waste resource management facilities with 10, 25, and 50 km buffers. Refer to Figure 1 for map sources. Not all facilities accept or receive fishing gear.

Tipping fees for end-of-life wire traps, wood traps, and fishing rope vary by Québec MRC and facility. Each facility charges tipping fees ranging from \$0 in the case of metal crab pots up to \$175 per tonne. Some facilities may charge a few dollars per trap: \$2-7 per trap was noted for these facilities. Often end-of-life fishing gear is charged the Industrial, Commercial, and Institutional (ICI) waste tipping fee (i.e., not residential waste tipping fee). Of the 20 facilities that accept wire traps, 11 recycle the metal and 4 of these will only recycle them if other material such as rope is removed prior (Table 4). The Écocentres in MRC Haute-Côte-Nord accept crab pots and fishing rope for recycling but because there is no lobster fishing in this area, the facilities do not receive any lobster traps. There are 17 facilities that receive and accept wood lobster traps. Of these facilities, 8 noted that they will recycle the wood (Table 3). Additionally, some facilities have C & D landfills on site in which wood from the traps may be buried. Traps not recycled are landfilled.

Currently most of the rope received at these facilities is landfilled. Exceptions are the facilities in MRCs of Haute-Côte-Nord, Sept-Rivières, and Rimouski-Neigette that noted accepting end-of-life fishing rope for recycling. The rope received at the Sept-Rivières Écocentres are accepted for a pilot project for recycling rope by the Centre de recherche sur les milieux insulaires et maritimes (CERMIM), which is a research centre affiliated with L'Université du Québec à Rimouski.

Table 4. Management of end-of-life lobster traps at Québec waste resource management facilities.

Coastal MRC	Facility Name	Wire Traps	Wood Traps
Basques	Écocentre Trois-Pistoles	<i>No data</i>	<i>No data</i>
Bonaventure/ Avignon	Écocentre de Saint-Alphonse/ Exploitation Jaffa	✗	✗
Côte-de-Gaspé	Écocentre Grande Rivière	✗	✗
Grande-Entrée	Centre de transbordement de Grande-Entrée	<i>No data</i>	<i>No data</i>
Haute-Côte-Nord	Écocentre des Bergeronnes**	✓	---
Haute-Côte-Nord	Écocentre de Sacré-Coeur**	✓	---
Haute-Côte-Nord	Écocentre de Portneuf-sur-Mer**	✓	---
Haute-Gaspésie	Écocentre Percé	✓	✓
Haute-Gaspésie	Lieu d'enfouissement technique de Gaspé	✓	✓
Havre-aux-Maisons	Centre de gestion des matières résiduelles de Havre-aux-Maisons	<i>No data</i>	<i>No data</i>
L'Île-du-Havre-Aubert	Centre de transbordement de L'Île-du-Havre-Aubert	<i>No data</i>	<i>No data</i>
Manicouagan	Écocentre de Baie-Comeau	<i>No data</i>	<i>No data</i>
Manicouagan	Southern Valley Transfer Station	<i>No data</i>	<i>No data</i>
Manicouagan	Écocentre de Baie-Trinité	<i>No data</i>	<i>No data</i>
Manicouagan	Écocentre de Godbout	<i>No data</i>	<i>No data</i>
Matanie	Matane Lieu d'enfouissement technique et Écocentre*	✓	✓
Matapédia	Écosite Amqui*	✓	✓
Matapédia	Écosite Causapsal*	✓	✓

Matapédia	Écosite Sayabec*	✓	✓
Mitis	Écocentre de la Mitis	✓	✓
Rimouski-Neigette	Écocentre Rimouski	✓	✓
Rivière-du-Loup	Écocentre Rivière-du-Loup	No data	No data
Rivière-du-Loup	Écocentre Saint-Hubert	No data	No data
Rocher-Percé	Écocentre Gascons	×	×
Sept-Rivières	Écocentre Sept-Îles	×	×
Sept-Rivières	Écocentre Port-Cartier	×	×
Sept-Rivières	Secteur Rivière-Pentecôte	×	×
Sept-Rivières	Secteur Gallix	×	×
Sept-Rivières	Secteur Clarke	×	×
Sept-Rivières	Secteur Moisie	×	×

'✓' indicates facilities that receive lobster traps for recycling or allow collection by third parties for reusing or repurposing to divert the traps from landfill. 'x' indicates that the traps are landfilled. '—' indicates that a facility either does not accept or receive fishing gear. *Facilities accept wire traps only if concrete ballasts and other material is removed prior. **Only wire from crab pots received for recycling. MRC = Municipalité Régionale de Comté.

A common barrier to disposal is distance to waste resource management facilities and the cost to transport end-of-life fishing gear to the facilities. Some areas in Québec lack greater waste management resources than others. Notably, many of the commercial fishing harbours in Côte-Nord are have no access to waste resource management facilities (Figure 5). Although there are waste resource management facilities in Les Îles-de-la-Madeleine, these facilities are sorting and transfer stations in which the waste (other than some C & D waste) must be exported from the archipelago to the mainland for final disposal. In 2006, a project to construct a landfill facility failed due to economic constraints and coastal erosion risks, and although there was an incinerator for waste, this broke down in 2008 and has not been remediated (Municipalité des Îles-de-la-Madeleine 2016).

The fishing industry can be a significant source of waste in various parts of the province, as not all rope and traps are currently diverted from the landfill and in more extreme cases may be illegally dumped at sea or on land as well as burned or buried. Although some facilities indicated that they recycle wire traps, not all gear received is reused or recycled due to an

item's condition, recycling cost, or the capability of the facility to hold and separate the materials. For example, traps that arrive at a facility tangled with other waste may not be easily separated and will end up in the landfill. Rope was raised as an issue, as it is difficult to manage by facilities and there are limited options to divert it from landfill.

SMALL-SCALE SOLUTIONS

Some fish harvesters have their own small-scale solutions for diverting their end-of-life fishing gear from landfills. Although these small-scale solutions are effective for some individual fish harvesters or communities, they are not adequate to sustainably divert all end-of-life fishing gear across the province. Examples of small-scale solutions identified are:

1. Repairing or reusing old lobster trap and crab pot parts on newer gear,
2. Using fishing rope for making mats, baskets, and other craft products, and
3. Burning clean wood from wood lobster traps for fuel.

LARGE-SCALE SOLUTIONS

Currently limited options exist for recycling fishing rope in Québec. As a result, most facilities in the province must landfill rope and even lobster traps at their end-of-life. While recycling markets exist for pure polyethylene or polypropylene rope, having fish harvesters keep these rope types separated or having to separate them out after they are intermixed, poses both logistical and technical challenges. However, in Québec there is a pilot project by CERMIM that is funded by Recyc-Québec until March 31, 2022 for recycling fishing rope and other materials made of polyesters. The project aims to find local outlets for these materials and conduct testing to develop petroleum absorbents from these materials, which could be used to replace absorbents currently imported from the continent, therefore allowing local reuse of these materials, and promoting a circular economy in Québec (J. Marcotte 16 août 2018).

Additionally, some recent developments are beginning to show promise for rope recycling in Atlantic Canada, such as Goodwood Plastic Products and Drastic Plastics using fishing rope in their plastic products and Sustane Technologies that have a process currently undergoing regulatory approvals to convert various plastic resins into diesel fuel. These new developments are summarized in the FGAC's report on *End-of-life Fishing Gear Management in Nova Scotia* (2020).

American Iron and Metals (AIM) Recycling was identified as the main metal recycler with a large shredder for processing wire lobster traps with the ballasts attached. AIM Recycling was also identified as one of the main recyclers of wire lobster traps in the Atlantic Canadian provinces of New Brunswick and Nova Scotia. Prices paid for the metal fishing gear (wire lobster traps, crab pots, and leaded rope) from both waste resource facilities and individuals are tied to the global metal market and while they will vary from year to year, they are generally around \$5-10 per tonne. The price paid will also depend on what percentage of the traps contain concrete ballasts as concrete can add significantly to the weight and subtract from the value. Some fish harvesters may take their traps and pots directly to a metal

collector or processor rather than to a waste resource management facility. Many smaller local metal collectors throughout the province receive wire lobster traps, leaded rope, and crab pots and supply AIM Recycling. These collectors include Métal du Golfe Rimouski, Conteneurs KRT, Récupération Brisson, Baie-Comeau Métal, and various AIM Éco-Centres. The dismantling of the lobster traps and crab pots are required by the fish harvester prior to buying the metal for recycling. Typically, waste resource management facilities in the province issue tenders or Requests for Quote to sell their metal stockpiles. These metal stockpiles often consist of a separate stockpile of wire lobster traps.

Waste resource management facilities in Sept-Rivières noted that they accept and separate clean wood for turning into wood chips for using in biomass furnaces. As more fish harvesters in the Gaspésie region are making the switch from wood to wire lobster traps, the Regroupement des pêcheurs professionnels du sud de la Gaspésie are working on a SFSRSCP funded project to set up a program for the collection and disposal of end-of-life wire lobster traps in the Gaspésie region. Such a program will allow fish harvesters to dispose of the traps in their region in a simple and eco-responsible manner to be recycled (DFO 2021b). Merinov's multi-partner project is aimed at mapping existing end-of-life fishing gear in eastern Québec, developing a method for transporting them to sorting facilities and maximize processing stages for removing materials that can be integrated into existing recycling channels by characterizing gear components and materials (Clark et al. 2021). One waste facility in the Gaspésie region and one waste facility in the Côte-Nord region are part of this pilot project with Merinov to dismantle traps, nets, and trawls, but now do not recycle these materials.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Lobster and snow crab are the primary commercial fisheries in Québec, contributing commercial landings of \$0.3 billion in 2019. Although lobster and crab are important both economically and culturally to coastal communities of Québec, the scale of the fisheries produce large volumes of end-of-life fishing gear to manage. Wire and wood lobster traps, wire crab pots, and plastic rope are the main gear used. Nearly all rope, and many traps, are not diverted from landfills and in some extreme cases, may be illegally dumped at sea or on land, or even burned.

The type of fishing gear used varies throughout the province as do the materials that the gear is made of. In the Côte-Nord region, there is very little lobster fishing because snow crab is the dominant fishery, resulting in mainly crab pots arriving at waste resource management facilities. In the Gaspésie region, both lobster and snow crab are important fisheries, with a mixture of wood and wire lobster traps used. In contrast, the most important fishery in Les Îles-de-la-Madeleine is lobster where wood traps are primarily used. Polyethylene and polypropylene rope, or blends of the two, are used in the lobster and crab fishery, with some

leaded rope used. With increasing use of wire lobster traps in the Gaspésie, there will be increased volumes needing to be managed at end-of-life.

The variety of traps and rope used results in differing amounts and types of end-of-life gear received by waste resource management facilities throughout the province as well as end-of-life management challenges. In total, about 7 600 lobster traps are replaced annually by fish harvesters in Québec. More end-of-life wire traps are generated each year than wood traps because wood traps last longer. Furthermore, approximately 20-33 tonnes of lobster fishing rope and 15 tonnes of crab fishing rope, are replaced each year in Québec.

Fish harvesters in Québec are responsible for managing their end-of-life fishing gear by taking it to the nearest waste resource management facility or a metal recycler in the case of wire traps and pots. The linear distance to these facilities varies notably throughout the province. Of the 63 amalgamated commercial fishing harbours mapped, 38% of harbours are located within 10 km of a waste resource management facility, 40% within 25 km, and 73% within 50 km. However, some fish harvesters continue to illegally dump their gear, notably due to lack of waste resource management infrastructure in their communities.

This research identified a primary metal recycler with the capacity to recycle all wire lobster traps generated in Québec on an annual basis: AIM Recycling, which was also identified as a primarily recycler of wire lobster traps in New Brunswick and Nova Scotia. As well, the Regroupement des pêcheurs professionnels du sud de la Gaspésie is working on a project in the Gaspésie region to support their members in responsibly managing their end-of-life wire lobster traps. Although wire lobster traps can be recycled, many waste resource facilities do not recycle them.

In contrast to traps, rope is primarily sent to landfill because the multi-material composition of most rope used in the lobster fishery prevents it from being recycled by traditional plastic recyclers. The technology and infrastructure required to separate the single resin rope from the blends once collected does not currently exist in Québec. While there are some potentially promising solutions in Québec and Atlantic Canada, such as converting the rope to petroleum absorbents or using the rope in plastic lumber, these do not currently have the capacity to manage all end-of-life rope generated by Atlantic fisheries on an annual basis.

RECOMMENDATIONS

Based on the research findings, the following recommendations for the near and longer term can be made:

1. Use the results of this research as well as the lessons learned and success of developing and piloting a management program for end-of-life fishing gear in Nova Scotia that is accessible, cost-effective, and environmentally responsible solution and expanding it to Québec.

2. Support the active projects for end-of-life fishing gear management and recycling in Québec identified in this report by Merinov, Regroupement des pêcheurs professionnels du sud de la Gaspésie, and CERMIM.
3. Work with the 17 coastal MRCs in Québec to ensure facilities accept wire lobster traps “as-is” for recycling.
4. Evaluate the feasibility of issuing a province wide tender for the collection and recycling of wire lobster traps to help ensure all wire lobster traps are recycled.
5. Further investigate solutions to increase diversion of wood traps from landfill that minimize non-wood contaminants and the need for fish harvesters to dismantle their traps.
6. Collaborate with fishing industry stakeholders in Québec, to promote the use of wire and wood lobster traps with removable/reusable ballasts, traps that are durable and repairable to extend their useful life, and new innovative traps that are fully recyclable.
7. Determine reliable solutions across Atlantic fisheries with the necessary capacity to manage end-of-life fishing rope and build upon recent recycling progress being made in Atlantic Canada and eastern Québec by companies such as CERMIM, AIM Recycling, Goodwood Plastic Products, Drastic Plastics, and Sustane Technologies.

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APPENDICES

APPENDIX A – QUESTIONS FOR WASTE RESOURCE MANAGEMENT FACILITIES IN EASTERN QUÉBEC

- 1) Acceptez-vous les engins de pêche en fin de vie (casiers à homard en bois, casiers à homard, corde de pêche)?
 - a. Si non, pourquoi pas?
- 2) Si oui:
 - a. Quels sont les frais de pourboire pour ces matériaux?
 - b. Y a-t-il une préparation requise avant qu'un pêcheur dépose le matériel? (comme enlever les ballasts/ciment)
 - c. Qu'advient-il du matériel? (Mis en décharge, recyclé?)
 - d. Si quelque chose est recyclé, y a-t-il une entreprise de recyclage qui fait cela? Qui sont-ils?

APPENDIX B – AMALGAMATED HARBOURS FOR HARBOUR SIZE CATEGORIES BY NUMBER OF BOATS

Table 5. Amalgamated Harbours for Categorized Harbour Size by Number of Boats

Location	Harbours
Blanc Sablon	Blanc Sablon – Cale de Halage, Blanc Sablon – Grand Quai des Pecheurs, Blanc Sablon – Petit Quai des Pecheurs, Baie de Brador
Gascons	Gascons (Anse à la Barbe), Gascons (Ruisseau Chapados)
Kegaska	Kegaska – Cale de Halage Est, Kegaska – Quai Débarcadère
Newport	Newport (Îlots), Newport (Pointe)
Rivière Cross	Chevery (Rivière Cross) - Quai, Chevery (Rivière Cross) – Rampe de Lancement
Rivière St-Paul	Rivière St-Paul (Baie Chevalier), Rivière St-Paul (Village), Salmon Bay