

END-OF-LIFE FISHING GEAR MANAGEMENT IN NEWFOUNDLAND AND LABRADOR



Fox Cove, Newfoundland and Labrador © Marquita Davis

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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 Newfoundland and Labrador – 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 and crab fisheries, as these are among the most commercially valuable species in Newfoundland and Labrador, and solutions for the sustainable management of the gear used are under development in other Atlantic Canadian provinces.

Data was gathered using online research methods and through conversations with industry representatives. The data collected was 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 2019, the Department of Fisheries and Oceans issued 2 326 lobster licences and 2 324 crab licences in Newfoundland and Labrador. The commercial lobster fishery takes place around the island of Newfoundland, while commercial snow crab fisheries occur in both Newfoundland and Labrador. It is estimated that 52 046 lobster traps, 65 319 crab pots, and 2 974 km (202 tonnes) of rope are purchased, replaced, or built annually by fish harvesters in Newfoundland and Labrador.

Fish harvesters in Newfoundland and Labrador are often 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, with 29% of core commercial fishing harbours within a 10 km range of a waste resource management facility, 71% within 25 km, and 97% within 50 km. However, some fish harvesters continue to burn their gear due to perceptions around the low environmental impact of this practice or limited disposal options for end-of-life fishing gear at nearby facilities.

This research identified a metal recycler with capacity to recycle all wire lobster traps and crab pots generated in Newfoundland and Labrador. However, solutions to responsibly manage wood traps at end-of-life are less consistent, with most being landfilled. Currently, rope is primarily sent to landfill, but recycling solutions for Atlantic Canada are under development. These solutions show future promise 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 that is an accessible, cost-effective, and environmentally responsible solution, and expand it to Newfoundland and Labrador.

2. Work with the seven waste resource management facilities identified as not recycling wire lobster traps and crab pots with concrete ballasts or other non-metal material attached to accept these traps “as-is” for recycling.
3. Work with the waste resource management facilities that do not accept commercial fishing gear to accept this gear in a way that is easy for the facilities to manage and provides opportunities for fisheries to sustainably manage their end-of-life fishing gear.
4. 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.
5. Further investigate the volume of gillnets that are disposed of annually in Newfoundland and Labrador and potential future solutions to recycling the end-of-life rope and monofilament netting used in gillnet fisheries.
6. Determine reliable solutions with the necessary capacity to manage end-of-life rope and build upon recent recycling progress being made in Atlantic Canada by companies such as Goodwood Plastic Products, Drastic Plastics, and Sustane Technologies.

This report starts to fill the 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 part of the foundation for implementing better management practices, as well as supporting potential development of product stewardship programs for end-of-life fishing gear in Newfoundland and Labrador.

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.

The FGCAC identified the management of end-of-life fishing gear as a knowledge gap that is necessary to understand to develop sustainable solutions for end-of-life fishing gear. Past studies, such as Emory Ackman's 2016 report *Feasibility of Repurposing Fishing Gear in Nova Scotia*, and the FGCAC's report *Management of End-of-Life Fishing Gear in Nova Scotia* found that there is a lack of a unified program for recycling or reuse of end-of-life fishing gear in Atlantic Canada (2020). This study, along with concurrent studies in Prince Edward Island, Québec, and New Brunswick, were undertaken to gain a broader understanding of the management of end-of-life fishing gear in the Atlantic region.

This study is part of a larger project funded by the Fisheries and Oceans Canada (DFO) Sustainable Fisheries Solutions & Retrieval Support Contribution Program (SFSRSCP). SFSRSCP projects fall under themes: ghost gear retrieval, responsible disposal, acquisition, and piloting of available technology, and international leadership. This project is part of 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 fishing harbours and waste resource collection sites across Newfoundland and Labrador is necessary. The data gathered for this report is part of a larger study to determine efficient and effective infrastructure for end-of-life fishing gear collection and management throughout Atlantic Canada and eastern Québec.

This study documents the current state of fishing and waste resource management infrastructure and management practices in Newfoundland and Labrador 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 product stewardship 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 Newfoundland and Labrador. 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 fishing gear. Maps were also developed to visualize the data gathered of the largest concentration areas of harbours for end-of-life fishing 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 Newfoundland and Labrador.

RESEARCH FOCUS AREA

The research presented in this report focuses on the commercial lobster and crab fisheries around the island of Newfoundland and southern Labrador. Lobster and crab are among the most valuable fisheries in Newfoundland and Labrador, having a combined landings value of \$373 277 438 in 2019 (DFO 2019). Newfoundland and Labrador has diverse multispecies fisheries, with the majority of industry members fishing multiple species throughout the fishing season. Newfoundland and Labrador is located in Northwest Atlantic Fisheries Organization (NAFO) Divisions 2GHJ, 3KLMNOPs, 3Pn, and 4R (Figure 1). This study is primarily focused on Divisions 2J, 3KLMNOPs, 3Pn, and 4R, as most of the province's commercial lobster and/or snow crab fisheries are focused in these areas.

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).

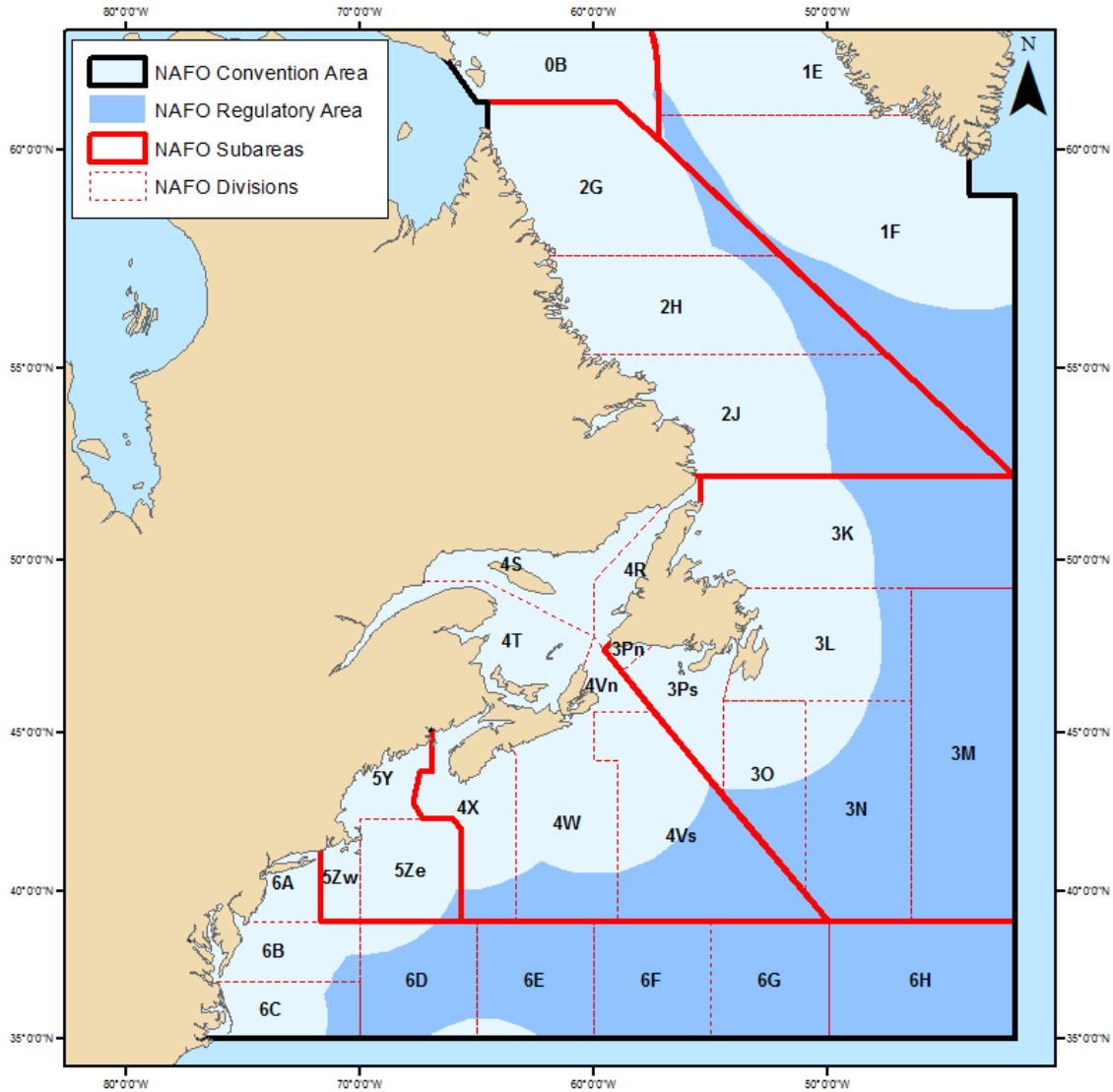


Figure 1. Northwest Atlantic Fisheries Organization (NAFO) Divisions in Newfoundland and Labrador. Image ©NAFO

The commercial lobster fishery began in Newfoundland and Labrador in the 1870s, with landings peaking at 8 000 tonnes in 1889. The lobster stock collapsed in the 1920s, resulting in a fishery closure and the introduction of regulations to protect undersize and egg-bearing lobsters. The number of lobster licences declined by 47% from 1990-2017, resulting from limited entry licences and licence retirement programs implemented by DFO (DFO 2021).

The lobster fishery in Newfoundland and Labrador occurs in designated Lobster Fishing Areas (LFAs) around the island of Newfoundland, in NAFO Divisions 3KLPs and 4R3Pn (Lobster Fishing Areas 3-14C, Figures 1 and 2). Lobster is fished by vessels under 40 ft long, the majority of which are less than 30 ft. Lobster is fished close to shore, in waters 1-30 m

deep where temperatures are favourable for lobster. The fishing season for lobster is eight to ten weeks long, and typically runs from mid-April or May to mid-July (Figure 2). There were 2 311 commercial lobster fishing licences issued in 2019 (Figure 2). The largest Newfoundland and Labrador lobster fisheries take place in LFAs 11-14C, stretching from the south coast of Newfoundland to the Strait of Belle Isle. Lobster is fished using baited wood or wire traps that are placed on the seafloor as either single or multiple traps attached to synthetic rope lines (DFO 2020b).

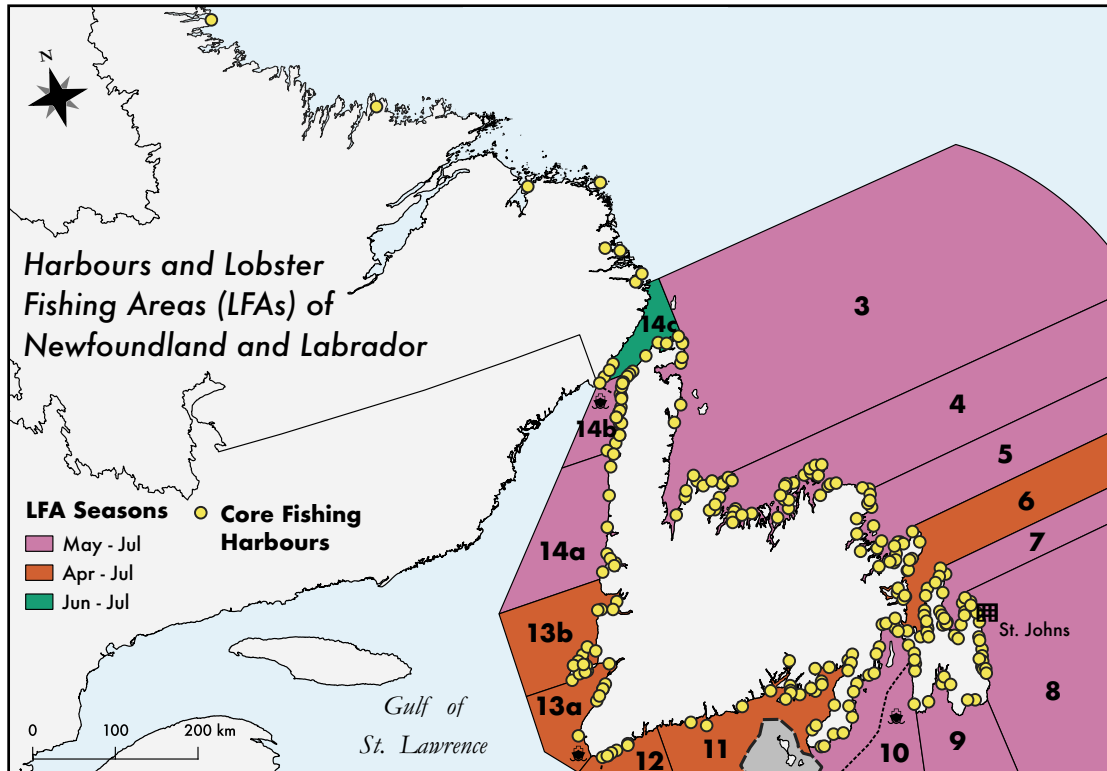


Figure 2. Harbours and lobster fishing areas (LFAs) in Newfoundland and Labrador. Map projection: NAD 83 CSRS UTM Zone 20N, Transverse Mercator. Sources: LFA delimiter lines and provincial boundaries modified based on Coffen-Smout (2020), DFO. Map created using QGIS 3.10 by Rachel A. Kendall.

The first directed commercial fishery for snow crab in Newfoundland and Labrador began in the 1970s along the northeast coast of Newfoundland (NAFO Div. 3L). This fishery later expanded into 3K, 3Ps, 2J, and 4R. Snow crab fisheries were developed in 2J, 3K, 3Ps, and 3K in the mid- to late-1990s to supplement the incomes of fish harvesters, which were negatively impacted by declines in groundfish stocks (supplementary fisheries). The fishery is divided into different fleets based on NAFO area, vessel size, and enterprise type. The snow crab fishery is both an inshore and offshore fishery, with the offshore fleet typically operating larger vessels and fishing with a greater number of crab pots per licence. Snow crab fisheries typically open in April or May and close mid- to late July, except for north of 2J, which is open from July to late August (DFO 2021).

There are various fleet sectors in the commercial snow crab fishery, with some vessel fishing crab as far as the 200 nautical mile limit and beyond (Exclusive Economic Zone). “Full-time” licence holders operate vessels that are 15-20 m in length (50’ to 89’11”). Snow crab is an important fishery for most of the under 89’11” sector. In 2017, Divisions 2J, 3K, and 3L had the highest dependence on snow crab, with the species making up an average of 63-93% of a vessel landings value (DFO 2019). Conversely, in Divisions 4R3Pn, where lobster is the main fishery, snow crab comprised only 22% of the <89’11” fleet’s total landed value. Snow crab is fished using baited conical iron or steel traps that are placed on the seafloor as multiple traps attached to synthetic rope lines (DFO 2021).

METHODS

BASELINE DATA COLLECTION

Data was collected on various aspects of the commercial fishery in Newfoundland and Labrador from January to March 2021. This research focused on the commercial lobster and 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, regional waste service boards, waste management facilities (transfer stations, construction and demotion (C&D) sites, and landfills), and recyclers were contacted for interviews. These interviews provided information on tipping fees applicable to end-of-life fishing gear, acceptable products, and required product preparation (Appendix A).

Information relating to 255 active core Newfoundland and Labrador commercial fishing harbours was provided by the Small Craft Harbours program of DFO. Small Craft Harbours’ Harbour Authorities provided information on each harbour’s location and the number of commercial fishing boats registered at each harbour. DFO Newfoundland and Labrador offices provided information pertaining to lobster licensing, crab licensing, and their associated fishing seasons. Other information on commercial fisheries, including species fished, fishing gear used, seasons, and current management of end-of-life fishing gear, was gathered from phone and email conversations and interviews with members of the fishing industry (harbour authority committees, fish harvesters, and the Fish, Food, & Allied Workers Union). Information was also gathered from an online survey that DFO distributed to Harbour Authorities on behalf of the FGCAC. Phone conversations and online surveys were conducted with 87 fish harvesters and harbour authorities from across the province (Appendix A). Based on information collected from the fishing industry, each LFA was classified by the type of lobster trap used, whether primarily wire, wood, or a combination of both.

Online research, phone, and email conversations with fishing gear retailers and members of the fishing industry were used to gain an understanding of the types of lobster traps, crab pots, and fishing ropes that are used in the commercial lobster fishery throughout Newfoundland and Labrador and the types of materials these products are made from.

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 the 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. Core commercial fishing harbours were categorized by the number of fishing boats (not necessarily lobster fishing) to approximate the size of harbour 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).

Buffers of 10 and 25 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.

Amounts of lobster traps, crab pots, and rope replaced annually were estimated using Newfoundland and Labrador licence numbers provided by DFO (pers. comm. February 2021) and rope weights provided by S. Burke (pers. Comm. December 4, 2020). The maximum number of traps and pots issued reflects the trap limit per licence for each LFA or fleet (e.g., Crab fishing fleet 3K inshore 3A has a limit of 150 traps per licence) unless in a partnership (“buddy-up arrangement”), which permits two licences on one boat. For a partnership, the maximum number of traps allowed is 1.5-2 times the number of traps of the licence (e.g., a partnership in 3K inshore 3A could have a maximum total of 300 traps).

RESULTS AND DISCUSSION

MAJOR COMMERCIAL FISHERIES IN NEWFOUNDLAND AND LABRADOR

Shellfish species make up most of Newfoundland and Labrador’s most valuable fisheries (snow crab, northern shrimp, lobster, mollusks, Table 1). Greenland halibut (turbot) is also among the province’s most valuable species. Aquaculture is also an important industry in the province. The primary aquaculture species include Atlantic salmon and blue mussel (DFO 2021).

Table 1. Most valuable commercial fisheries in Newfoundland and Labrador and the types of gear used for each.

Species	2019 Landings (\$ Thousands) ^a	Gear Used
Snow Crab	308 683	Conical steel traps: iron or steel ring frame, netting, twine, rope, and plastic cone.
Northern Shrimp	171 178	Otter trawls, sorting grid (Nordmore grid), trawl doors, bobbins, rockhopper disks, bridles, floats, net, fishing line, toggle and chain
Lobster	64 610	Wire or wood traps; polypropylene/polyethylene rope; buoys; concrete or brick ballasts; rubber.
Greenland Halibut	40 152	Fixed gear: longline and gillnets (bottom hook-and-line with gangions, hooks, buoys, and rope). Mobile gear: otter trawl, midwater trawls, or seines.
Other Molluscs ^b	38 599	Steel drag/dredges; hydraulic clam dredge; plastic or aluminum rollers, fishing line, aluminum crimps.

^aDFO (2021). ^bOther Molluscs include oysters, surf clam, and squid.

The type of gear used varies among these fisheries. While both lobster and snow crab fisheries use traps, those used for crab have a conical steel frame covered with netting, while lobster traps are traditionally made of wood or vinyl coated steel wire. Other molluscs are fished using steel drags, and squid rollers; turbot are harvested using longline, gillnets, otter trawls, midwater trawls, and seines (Table 1) (DFO 2021).

Commercial fisheries in Newfoundland and Labrador are diverse, and the most prominent fisheries vary around the province. Most fishing enterprises fish multiple species over the course of the fishing season. The most important fisheries in NAFO Div. 3L are snow crab and cod. Div. 3K is dominated by snow crab, cod, turbot, and shrimp, while the fisheries from harbours in Div. 3Ps are dominantly lobster, sea cucumber, scallop, and cod. The main fisheries from Div. 3Pn are lobster, cod, and halibut. 4R is like 3Pn, but with the addition of shrimp. 2J is dominantly snow crab, cod, and turbot, while 2H and 2G are primarily turbot and northern shrimp.

HARBOURS AND FISHING AREAS IN NEWFOUNDLAND AND LABRADOR

There are 255 core fishing harbours in Newfoundland and Labrador that range in size from 1-120 fishing vessels (Figure 3). The majority of these have between 1-10 or 11-25 fishing vessels that fish out of their harbours (~42% and ~37%, respectively). Only six of the core

fishing harbours (Port aux Choix, Bay de Verde, Old Perlican, Twillingate, St. Anthony, and La Scie) had more than 75 fishing vessels that fish from their harbour. Port aux Choix and St. Anthony are located on the northern peninsula (4R), Twillingate and La Scie are in NAFO Division 3K, and Bay de Verde and Old Perlican are located on the east coast of Newfoundland (3L).

Lobster fishing seasons throughout the province are seven weeks long, typically running from April or early May into July (56-72 fishing days, Table 2). The largest lobster fishing areas in Newfoundland and Labrador are on LFAs 11-14, which encompass Fortune Bay and the south coast, the southwest and west coasts, and the Strait of Belle Isle (NAFO Div. 3Ps, 3Pn, and 4R). Lobster trap limits across LFAs vary from 135-300 traps per licence.

Commercial fisheries for snow crab take place in most of the fishing areas in the province (NAFO Div. 2, 3, and 4R). Crab fishing seasons around the island are approximately two and half to three months long, while in Labrador the season is approximately 2-2.5 months long (Table 3). Trap limits typically range from 100-300 pots per licence for the inshore crab fishery and from 800-1200 pots per licence for the offshore crab fishery (Table 4). The NAFO Div. 3L fish harvesters hold the highest number of crab licences, followed by NAFO Div. 3K. Start dates for both crab and lobster fisheries will vary depending on environmental conditions, particularly the presence of sea ice.

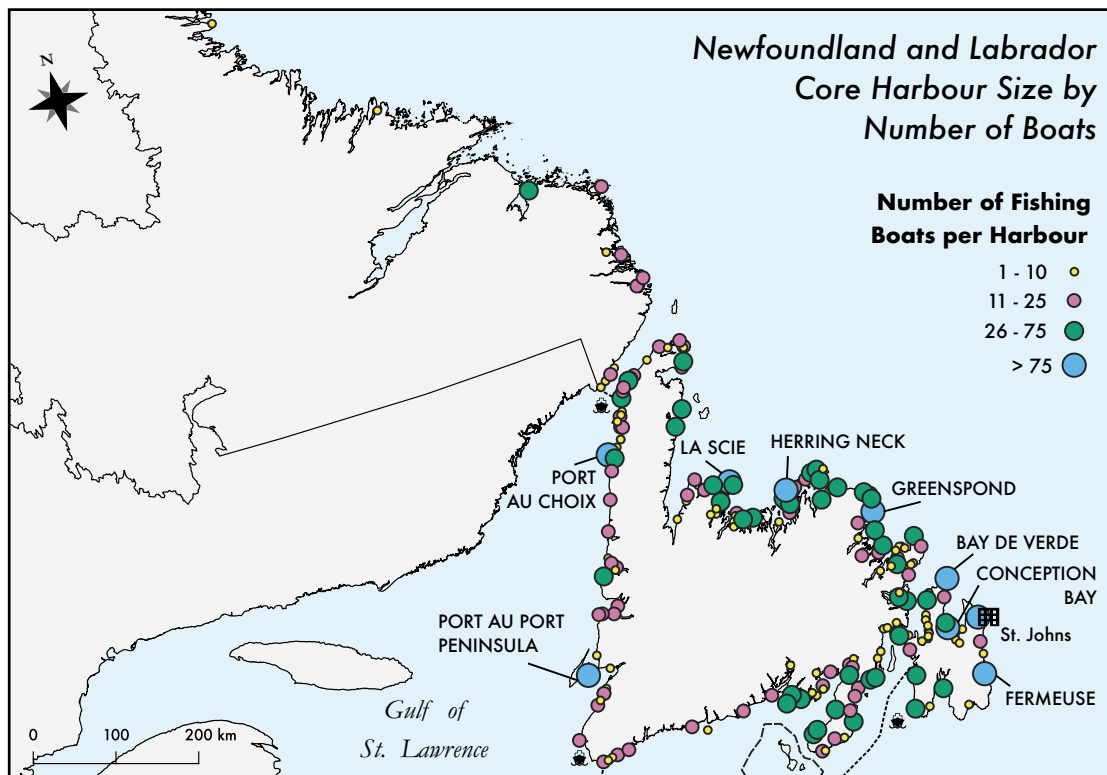


Figure 3. Size of core Newfoundland and Labrador commercial fishing harbours by number of boats. Refer to Figure 1 for map sources.

Table 2. Lobster Fishing Area (LFA) licences and traps^a, 2019.

LFA	2019 Fishing Season	Total Licences	Trap Limit per Licence	Traps Licensed
3	May 18 – Jul 15	56	200	11 200
4a	May 25 – Jul 15	159	200	31 800
4b	May 11– Jul 5	307	200	61 400
5	May 8 – Jul 11	219	150	32 850
6	Apr 27 – Jul 7	193	100	19 300
7	May 2 – Jul 5	137	150	20 550
8	May 9 – Jul 11	76	100	7 600
9a	May 9 – Jul 4	30	200	6 000
9b	May 3 – Jul 4	2	100	200
10	May 1 – Jul 9	288	200	57 600
11E 11W	Apr 20 – Jun 21 May 4 – Jul 5	262	185	48 470
12	Apr 23 – Jul 2	109	135	14 715
13a	Apr 23 – Jul 3	154	220	33 880
13b	Apr 23 – Jul 4	166	250	41 500
14a	May 11 – Jul 8	5	250	1 250
14c	Jun 1 – Jul 15	38	300	11 400
Total	—	2 326	—	422 215

^aLicence and trap information from DFO pers. comm. February 2021.

Table 3. Snow crab seasons, 2019^a.

NAFO	Area	2019 Fishing Season
2HJ	2GHJ North	Jul 4 – Aug 31
2HJ	2J South	May 26 – Jul 31
3K	4	Apr 11 – Jun 30
3K	3A	Apr 14 – Jul 15
3K	3BC	Apr 14 – Jun 30
3K	3B	Apr 24 – Jun 30
3K	3C	Apr 29 – Jun 30
3K	3D	Apr 14 – Jul 30
3LNO	NS, MS, Msex, 3Lex, 3N200, 3L200	Apr 5 – Jul 31
3LNO	8Bx South	Apr 5 – Jul 15
3LNO	5A, 6A, 6B, 6C, 8A, 9A	Apr 8 – Jul 31
3Ps	10A	Apr 8 – Jun 30
3Ps	10B, 11S	Apr 5 – Jun 30
3Ps	11E	Apr 8 – Jun 30
3Ps	11W	Apr 8 – Jun 30
4R3PN	08	Apr 5 – Jun 15
4R3PN	12CF, BOI	Apr 8 – Jun 15
4R3PN	12ABDEGH, BSG	Apr 8 – Jun 15

^aDFO (2021).

Table 4. Snow Crab fishing licences, fleets, and trap limits, 2019^a.

NAFO	Fleet	Total Licences ^b	Single Enterprise Trap Limit	Combined Enterprise Trap Limit
2J	Fulltime	4	1 200	1 200
2J	Supplementary	23	1 200	1 200
2J	Inshore	48	200	400
3K	Fulltime	22	800	800
3K	Supplementary	93	800	800
3K	Inshore 3A	56	150	300
3K	Inshore 3B	64	150	300
3K	Inshore 3C	102	200	200
3K	Inshore 3BC	21	300	300
3K	Inshore 3D	196	200	200
3K	Area 4 Inshore Fleet (> 10 GRT)	6	200	400
3L	Fulltime	32	1 200	1 200
3L	Large Supplementary	35	1 200	1 200
3L	Small Supplementary	158	400	600
3L	Inshore 5A	166	150	200
3L	Inshore 6A	158	150	250
3L	Inshore 6B	116	150	250
3L	Inshore 6C	91	200	300

3L	Inshore 8A	51	300	300
3L	Inshore 9A	22	300	300
3Ps	Supplementary	62	400	600
3Ps	11S/11Sx	13	300	450
3Ps	Inshore 10A	235	200	N/A
3Ps	Inshore 11E	220	100	N/A
3Ps	Inshore 11W	8	150	N/A
4R3PN	Outside 8	58	250	N/A
4R3PN	Inshore 12A – 12 H	264	100	N/A
Total	—	2 324	11 650	6 950

^aDFO (2021). ^bSingle and Combined Enterprise licences.

FISHING GEAR TYPE BY FISHING AREA

Information on lobster fishing gear type was obtained from conversations with the fishing industry. Both wood and wire lobster traps are used in the Newfoundland and Labrador lobster fishery. Wire lobster traps are the dominant trap type used in LFAs 7 and 11-13 (Figure 4). LFA 3 and 14 are transitioning from wood traps to wire traps and it is estimated that roughly 50% of the traps used in these areas are still made from wood. Wood is primarily used in LFAs 4, 5, and 9. LFAs 6, 8 and 10 also use a mixture of both wood and wire traps. In these areas it was noted that the type of traps used may vary by community, but the use of wood or wire traps is largely determined by personal preference. On the west coast of Newfoundland, lobster is fished using fleets of five to six traps, but elsewhere they are fished only as single traps.

Wire traps are sturdier, require fewer repairs, less weight in the ballasts, and have a longer lifespan. Many fish harvesters build their traps (wire or wood) or purchase the wire cages with no ballasts and will add weights. Ballasts for wood traps are made from concrete or stone, while concrete or bricks are used in wire traps. Bricks absorb water, which increases their weight on the seafloor. When dry however, these traps are lighter and easier to handle than those with concrete ballasts. Wire traps are usually 34"-36" long and are purchased new or used. Fish harvesters will purchase new traps from retailers within the province, fishing companies, other fish harvesters that build them, or from retailers in Nova Scotia.

Used traps are purchased from other fish harvesters in Newfoundland or Nova Scotia. Traps purchased from Nova Scotia have typically only been used for one to two fishing seasons and are still in good condition.

Crab is harvested using fleets of conical baited traps. These traps are allowed a minimum mesh size of 65 mm. Trap limits vary with the NAFO Division, fleet category, and type of enterprise, ranging from 100-1 200 traps. The fishing season for crab typically opens in April in Newfoundland and late-May for southern Labrador and closes sometime between late-June and mid-to-late July (Table 2). The snow crab fishery north of 2J opens in July and ends in late August. Start dates will vary depending on environmental conditions, particularly the presence of sea ice. Traps are made with iron or steel frames, twine, netting, and a plastic bait pot.

The prominent fishing ropes used by fish harvesters in the lobster and crab fisheries are made from polyethylene, polypropylene, or a blend of polyethylene and polypropylene. Ropes used in the lobster fishery and are typically smaller than those used in the crab fishery. In particular, the offshore crab fishery uses larger ropes as they deal with deeper water, stronger currents, and rougher ocean conditions. Larger ropes are stronger and will not abrade as quickly as smaller fishing ropes. Lobster fishing rope is commonly sold as 366 m (1 200 ft) coils that weigh approximately 13 to 15 kg (28 to 77 lbs).

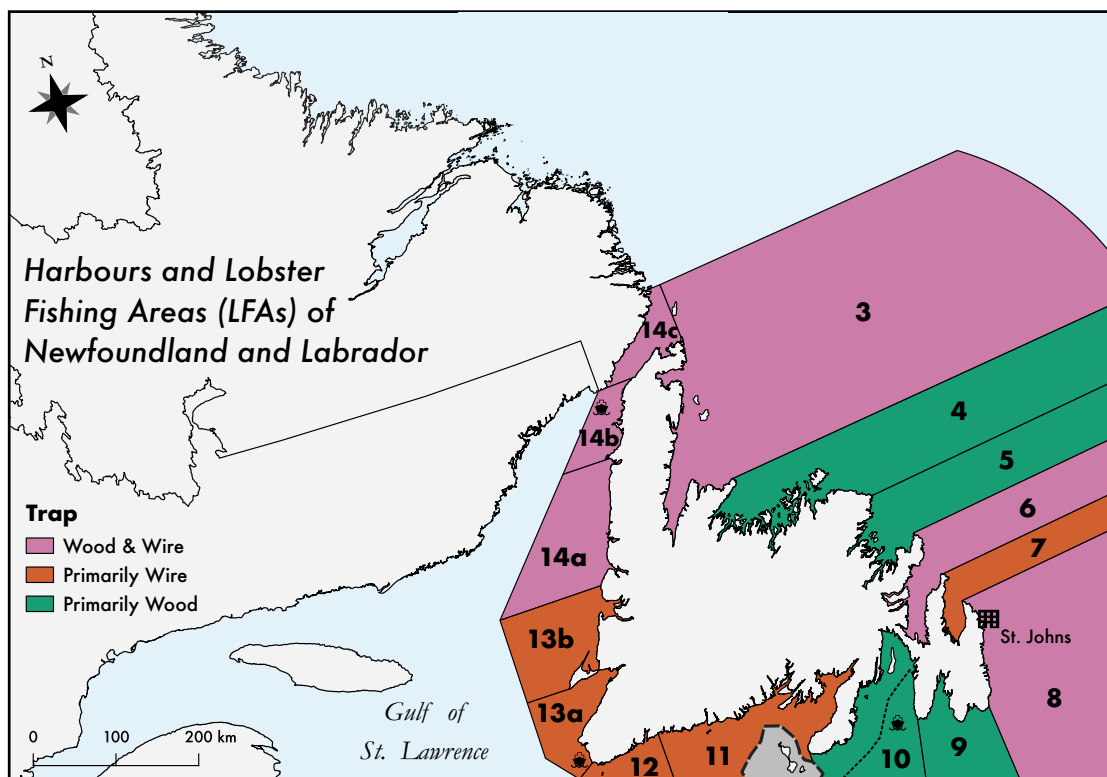


Figure 4. Primary lobster trap type (wire, wood, or both) by LFA. Refer to Figure 2 for map sources.

QUANTITY OF FISHING GEAR USED

Information on lobster trap and crab pot replacement was gathered from conversations with members of the fishing industry. The term “replacement” indicates that fish harvesters received, built, or purchased traps or pots. In 2019, there were 3 296 replacement lobster trap tags issued in LFAs 3-14C (DFO pers. comm. February 2021). Wood lobster traps are damaged more easily and more frequently need to be repaired or replaced than their wire counterparts. An average of approximately 31 wood traps are replaced annually for lobster fish harvesters in Newfoundland. For wire traps, fish harvesters replace an average of approximately 17 lobster traps each year.

Inshore crab fish harvesters replace an average of 15 crab pots a year, while offshore crab fish harvesters replace an average of 86 pots a year. Inshore fish harvesters replace an average of 2 coils of rope each year, and those fishing crab replace approximately 9 coils of rope a year. The number of traps or pots replaced each year will vary based on several factors such as environmental conditions, fishing area, and age of the gear. Both lobster traps (wood and wire) and crab pots can be damaged beyond repair by sea ice.

Fish harvesters frequently spoke to both the longevity and cost of fishing gear. Short fishing seasons mean that fishing gear is not in the ocean for extended periods of time, resulting in less wear and tear. Many inshore fish harvesters indicated that 1 coil of rope will last them anywhere from 10-20 years, wire lobster traps from 7-10 years, and crab pots from 15-20+ years before it must be disposed of. Proper care of fishing gear (rinsing it with fresh water, allowing it to dry, and then storing it out of the sun after the fishery has ended) aids in increasing its lifespan. Fishing gear is expensive to replace so many fish harvesters will also buy used gear and repair damaged gear (e.g., replace parts of wire, cut out worn pieces of rope from a coil). Offshore crab fish harvesters replace more rope and crab pots than the inshore fish harvesters, as they fish with more gear in harsher ocean conditions causing faster deterioration. As such, offshore crab fish harvesters replace an average of almost 9 coils of rope a year and 86 crab pots a year. It is also important to note that although this replaced gear is no longer suitable for offshore fishing, much of it is still usable in inshore fishing conditions. As such, offshore crab fishing gear is frequently sold or given to inshore crab fish harvesters. Additionally, fish harvesters typically build or purchase extra traps and crab pots to have in case of damage or lost during the fishing season. An inshore fish harvester may have between 20-100 extra traps/pots stockpiled.

Multiplying the total number of licences issued per LFA in 2019 by the approximate number of traps and pots replaced per fish harvester (Table 2), about 22 438 wood traps and 29 609 wire traps are replaced annually by fish harvesters in LFAs 3-14. These estimates assume that fish harvesters in LFAs 7 and 11-13 fish only wire traps, and that fish harvesters in LFAs 1, 5, and 9 fish only wood traps. It also assumes that 50% of fish harvesters in LFAs 3-5, 8, 10, and 14 fish with wire, and that 50% of fish harvesters in these areas fish with wood traps.

Multiplying the total number of inshore crab licences issued per NAFO Division in 2019 by the average number of crab pots replaced each year, 28 425 pots are replaced by inshore crab fish harvesters. Following the same process for offshore crab fish harvesters, an estimated 36 894 pots are replaced each year by offshore fish harvesters, for a total of 65 319 crab pots replaced annually.

Many fish harvesters participate in both the lobster and crab fisheries. To avoid an overestimation of rope replacement, only crab licences were used for 2J3KLPs, and only lobster licences were used for 4R3Pn, where lobster is the prominent fishery. For inshore fisheries, about 2 coils of rope are replaced each year. The offshore crab fishery replaces approximately 9 rope coils each year. This means that 4 372 coils of rope would be replaced in the inshore crab and lobster fishery and approximately 3 754 coils of rope are replaced in the offshore crab fishery, giving a total of 8 126 coils of rope replaced annually. This represents a total of 202 tonnes each year. Considering the length of rope in a coil, this represents 2 974 km (9 750 900 ft) of rope is replaced in the province each year.

FISHING GEAR RETAILERS

Of the seven major fishing gear retailers and manufacturers in Newfoundland and Labrador, 5 sell fishing rope, 4 sell completed wire lobster traps, and 5 sell crab pots (Table 5). Additionally, retailers often sell supplies for constructing and repairing wire and wood lobster traps. The major trap retailers (completed traps) identified are ESL Marine Supplies, Spartan Industrial Marine, Land and Sea, and Marine Services and Consulting. New lobster traps are also purchased from Nova Scotia and some Prince Edward Island retailers, as well as local fish harvesters that build the traps themselves. Used lobster traps are purchased from Nova Scotia lobster fish harvesters or other local fish harvesters. The retailers of fishing rope in Newfoundland and Labrador include ESL Marine Supplies, Hampidjan Canada, Spartan Industrial Marine, and Vonin Canada. These retailers also sell crab pots.

LOBSTER TRAPS

Traditionally, lobster traps were made with wood. This changed over time as lobster traps constructed of vinyl coated wire entered the market. Recently, some traps are being made with innovative materials, such as plastic and stainless steel, however wood and wire traps are still dominantly used. Wood and wire traps also include twine netting, rope, and ballasts (Figure 5). The main wire mesh brands noted during phone conversations with retailers were Aquamesh and Cavatorta. Many fish harvesters purchase just the wire frames for lobster traps and add their own ballasts (concrete or bricks) for weight in lobster traps. Concrete or stone are added to wood lobster traps as ballasts. Runners are not necessary in single trap fisheries. Most retailers provide custom-built lobster traps that are tailored to individual fish harvester needs and preferences. Fish harvesters commonly use wire traps that are 34” to 36” in length.

Table 5. Major fishing gear retailers and distributors identified in Newfoundland and Labrador and types of gear sold.

Company	Wire Traps	Wood Traps	Crab Pots
ESL Marine Supplies	✓	×	✓
Hampidjan Canada	×	×	✓
Mercer's Marine	×	×	✓
Spartan Industrial Marine	✓	×	✓
Vonin Canada	×	×	✓
Land and Sea	✓	×	×
Marine Services and Consulting	✓	×	×

Sale of complete wire lobster traps, wood traps, and crab pots indicated by a '✓'. An 'x' indicates that the material is not sold.

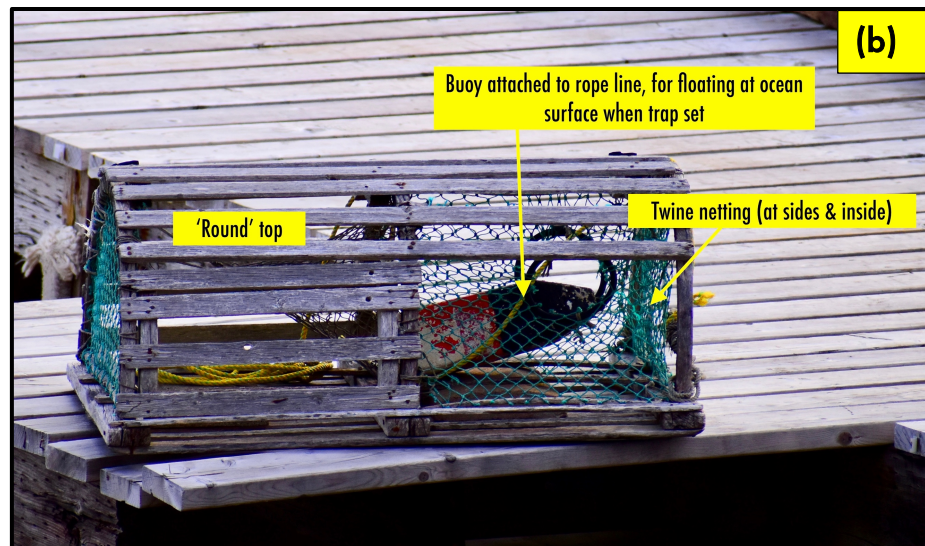


Figure 5. Diagram showing the parts of (a) a wire lobster trap and (b) a 'round' wood lobster trap. Photos copyrights Rachel A. Kendall.

ROPE

Of the 14 brands of crab and lobster fishing rope identified as being sold by retailers in Newfoundland and Labrador, 28% are polyethylene material, 29% are made of polypropylene material, and 43% are a blend of polypropylene and polyethylene (Figure 6). There are many other ropes used for specific purposes, such as the polyester or polypropylene with a latex core Trapcord, manufactured by NovaBraid for lobster trap doors.

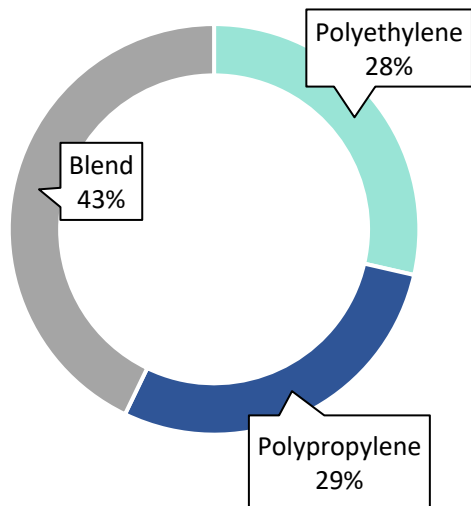


Figure 6. Percentage of lobster fishing rope made using polyethylene, polypropylene, or a blend of both.

MANAGEMENT PRACTICES FOR END-OF-LIFE FISHING GEAR

WASTE RESOURCE MANAGEMENT FACILITIES

Newfoundland and Labrador is divided into 11 waste regions. The province’s 2019 provincial waste strategy report indicated a plan to regionalize waste streams in the province and close many of the small waste sites that exist around the province, replacing them with waste transfer stations. The strategy has been implemented in the Northern Peninsula, Western, Central, and Eastern waste management regions. All the waste from the Northern, Western, and Central waste regions is sent to the Norris Arm Regional Waste Facility, and all the waste collected at the transfer stations in the Eastern Region are brought to the Robin Hood Bay Regional Waste Facility. Labrador Straights Waste Disposal Inc. operates a regional landfill in the Labrador Straits area. Only one landfill remains in the Burin Peninsula Waste Region, near Marystown. Several waste disposal sites still exist in the Coast of Bays, Discovery, and Baie-Verte Green Bay subregions, and in Labrador. In total, there are 56 waste resource management facilities on the island of Newfoundland, and 21 waste resource management facilities in Labrador. Information was successfully gathered from 42 of these waste resource management facilities. Of these, 28 accept or receive fishing gear. Waste resource management facilities located inland or not surrounded by fishing communities did not receive any significant amount of fishing gear.

Fish harvesters are generally responsible for managing their end-of-life fishing gear. Ideally, fish harvesters will transport their gear to the nearest transfer station, C&D facility, or directly to a landfill. However, in some areas fish harvesters can place their old gear curbside for collection on bulk garbage pickup days. Harbour authorities that provide collection bins, typically only allow them to be used only for “black bag” garbage that would be generated by the fish harvesters on their boats, but not for large amounts of fishing gear. Some harbours

allow fish harvesters to dispose of fishing rope in the garbage bins, however, this is usually only for small amounts of rope.

None of the 82 fishing harbours have collection programs in place for end-of-life fishing gear. Harbours do not allow for the storage of gear on the wharf for extended periods of time. However, in many areas fish harvesters have their own fishing sheds and wharves nearby where they store their old gear or gear that is not in use. Some communities and harbours indicated that there are deteriorating fishing sheds with unusable fishing gear in them.

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 and DFO compounds in the province as shown in Figure 7. 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. The results show that most harbours (70%) are located further than 10 km from a waste resource management facility (Figure 8). However, 71% of harbours are located within 25 km of a waste resource management facility, and 97% are located within 50 km of a facility.

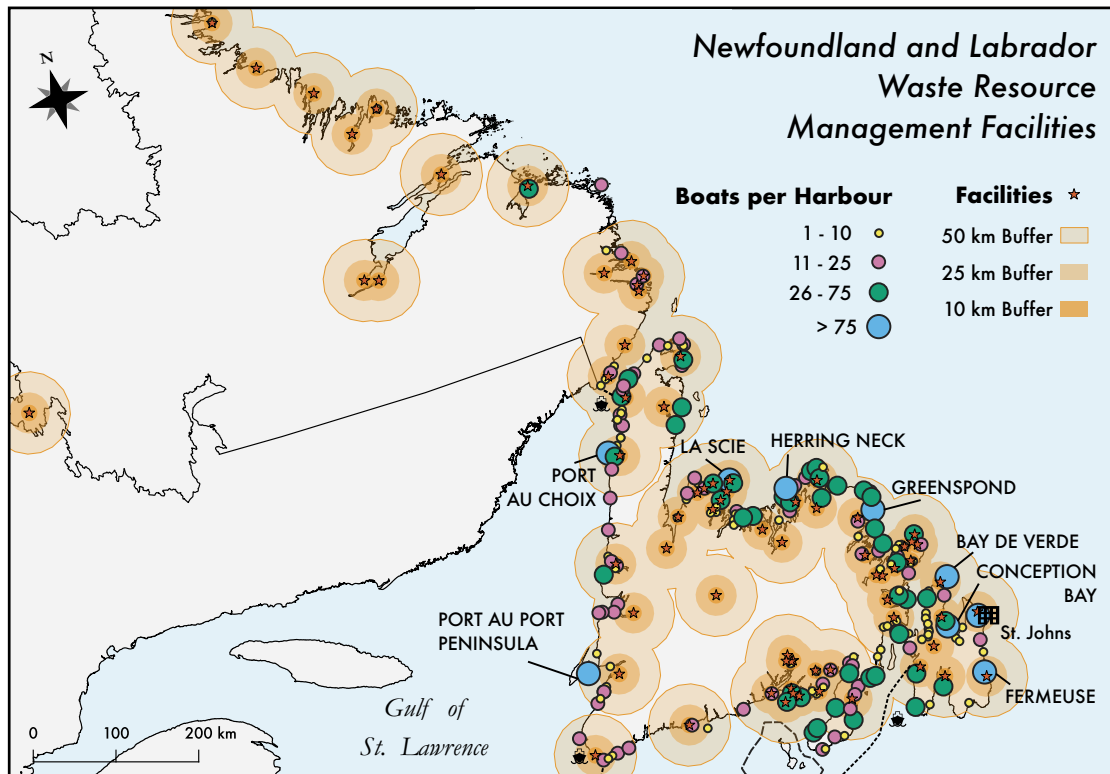


Figure 7. Newfoundland and Labrador harbours and waste management facilities with 10, 25, and 50 km buffers. Refer to Figure 2 for map sources. Not all facilities accept or receive fishing gear.

Many waste sites indicated that they do not receive many lobster traps. The most problematic waste for many facilities is fishing rope and nets. Nets were typically the monofilament nets used in the inshore cod, flounder, turbot, and lumpfish fisheries. Nets consist of a head-rope, footrope, and monofilament netting. The monofilament netting used in gillnets is cut out approximately every two years and is replaced.

The ropes received by waste resource management facilities in Newfoundland and Labrador come from commercial fisheries, aquaculture, and in some cases the offshore oil and gas industry. Rope and nets can cause issues for waste resource management facilities as it becomes tangled in the facility's equipment. This can be very costly and time consuming to fix. As a result, most facilities ask that rope and netting be kept separate from other waste so that it can be buried without the risk of entanglement. Some waste resource management facilities allow for reuse of rope or wood lobster traps by community members. While rope may be used for various purposes, wood lobster traps would only be retrieved for decoration.

All but one of the waste resource management facilities indicated that Newco Metal and Auto Recycling currently recycle their metal. Despite this, seven indicated that they require all materials to be removed from crab pots and wire lobster traps to be recycled, while 15 said that they do not require these materials to be removed. Wire lobster traps are recycled at 15 of the 28 waste resource management facilities. The Robin Hood Bay regional waste facility directs users to the neighbouring AIM Recycling to recycle their metals.

Though many waste resource management facilities in the province accept fishing gear, fish harvesters often deal with it in other ways. There are some cases of illegal disposal on land and at sea, but the most common ways that end-of-life fishing gear is managed by fish harvesters is through burning. Old fishing rope, wood lobster traps, and monofilament netting is often burned by fish harvesters. Additionally, there are also stockpiles of fishing gear in many fishing communities. This is gear that is no longer used is due to changes in the fishery or the type of gear that is used (e.g., areas that have transitioned from wood to wire lobster traps, old cod pots in areas where there is no longer a cod fishery, etc.).

Tipping fees for end-of-life wire lobster traps, wood lobster traps, crab pots, and fishing rope vary at waste resource management facilities throughout the province (Figure 8). Some municipal waste resource management facilities do not charge any tipping fees, while others charge up to \$164 per tonne. The La Scie, Harbour Breton, Hermitage-Sandyville, Bonavista, and Trinity Bay North do not charge tipping fees for end-of-life fishing gear or for any types of waste. Additionally, the Port Rexton and Red Bay waste resource management facilities are not included in Figure 8 as they charge tipping fees by the pickup load (volume) rather than by weight. These facilities charge between \$10-\$20 per pickup load of waste.

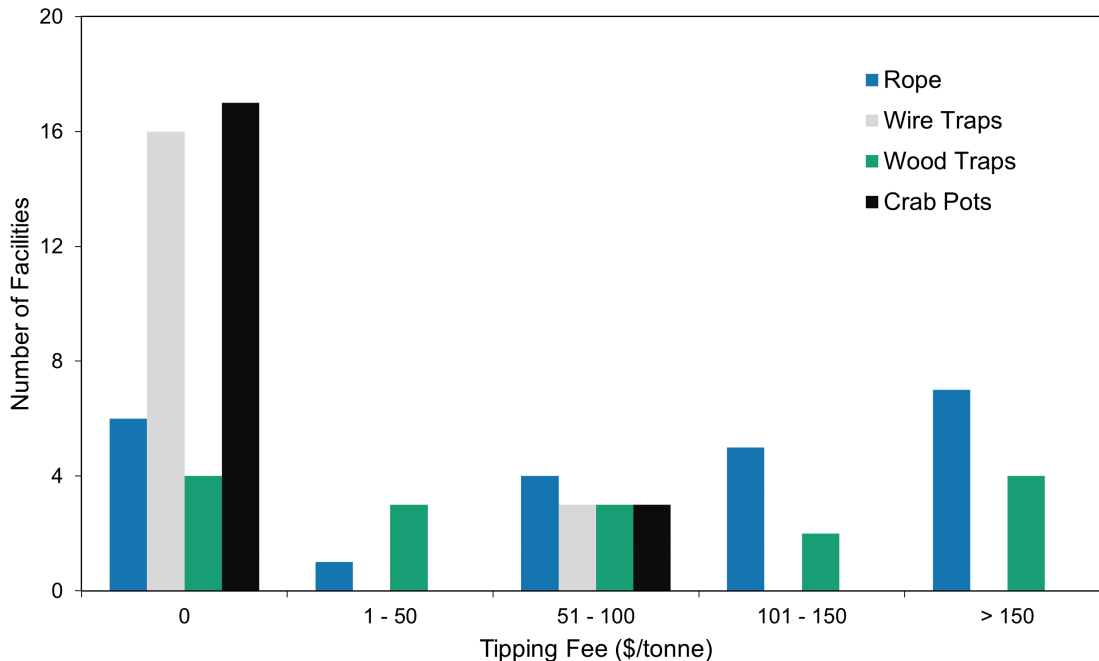


Figure 8. Fees charged by waste resource management facilities in Newfoundland and Labrador for end-of-life fishing gear.

The lowest tipping fees are typically for crab pots and wire lobster traps at the waste resource management facilities that accept them. Crab pots and wire lobster traps can be recycled and sold as scrap metal. However, the conditions under which crab pots and lobster traps are collected for recycling are not consistent. While many waste resource management facilities will accept crab pots and lobster traps with non-metal material still attached, such as concrete ballasts and netting, other waste resource management facilities will only set them aside for recycling if these materials are removed. Generally, traps and pots that are not recycled are landfilled. Of the 22 facilities that accept wire traps and or crab pots, 15 recycle them even if they have non-metal materials attached (Table 6). These facilities are the Central Waste Management transfer stations and the Baie Verte Landfill. Of the 19 facilities that receive wire traps, 16 charge no tipping fees. Similarly, of the 20 facilities that receive crab pots, 17 charge no tipping fees. The remaining three facilities for each charge between \$51-100 per tonne (Figure 8).

There are ten waste resource management facilities that regularly or occasionally receive wood traps. The wood from these traps is recycled in some cases, but because the traps typically still contain concrete ballasts and plastic netting when they arrive at the facility, they often end up in the landfill (Table 6). Four facilities charge between \$0-50, three charge between \$51-100, one charges between \$101-150, and one charges more than \$150 per tonne for wood traps. The Port Rexton waste disposal site charges \$20 a pickup load. An additional six facilities will accept wood traps, but they do not see them often. The tipping fees for these facilities are also included in Figure 8. 24 of the 28 facilities that accept fishing gear accept fishing rope. 21 disposed of the rope in the landfill, while four allowed for

reuse of the material by community members for various purposes. Rope has some of the highest tipping fees, with five facilities charging between \$101-150 and seven facilities having tipping fees greater than \$150 per tonne.

The fishing industry can be a major source of waste in some areas, as many materials are not currently diverted from the landfill. Although Table 6 indicates recycling at various facilities, not all gear received can be reused or recycled due to an item's condition, recycling cost, or the capacity of the facility. For example, rope or traps that arrive at a facility entangled with other waste may not be separated and will end up in the landfill. Many waste resource management facilities expressed interest in a product stewardship program for end-of-life fishing gear.

Table 6. Management of end-of-life fishing rope and lobster traps at Newfoundland and Labrador waste resource management facilities.

Facility Name	Rope	Crab Pots	Wire Traps	Wood Traps
Bay Bulls Waste Recovery Facility	---	---	---	---
Bell Island Waste Recovery Facility	---	---	---	---
Cavendish Waste Recovery Facility	---	---	---	---
Clarenville Transfer Station	---	---	---	---
Harbour Grace Waste Recovery Facility	---	---	---	---
Old Perlican Waste Recovery Facility	✗	✓	✓	---
Placentia Waste Recovery Facility	---	---	---	---
Robin Hood Bay	✗	---	---	---
Renews-Cappahayden Waste Recovery Facility	---	---	---	---
St. Joseph's Waste Recovery Facility	---	---	---	---
Sunnyside Waste Recovery Facility	---	---	---	---

Whitbourne Waste Recovery Facility	---	---	---	---
Central Newfoundland Regional Landfill	×	✓	✓	---
Buchan's Junction Transfer Station	---	---	---	---
Fogo Island Transfer Station*	×	✓	---	×
Gander Bay Transfer Station*	×	✓	---	---
Indian Bay Transfer Station*	✓	✓	✓	---
New World Island/Twillingate Transfer Station*	✓	✓	✓	---
Point Leamington Transfer Station*	×	---	---	---
Terra Nova Transfer Station*	✓	✓	✓	---
Bay St. George Waste Transfer Station	×	✓	✓	---
Burgeo Waste Transfer Station	×	✓	✓	×
Long Range Waste Transfer Station	×	✓	✓	---
Southwest Coast Waste Transfer Station	×	---	---	---
Wild Cove Waste Transfer Station	×	---	✓	×
White Bay South Waste Transfer Station	×	✓	✓	×
Eddie's Cove East-Castor River North	×	✓	✓	✓
Eddie's Cove West-River of Ponds	---	---	---	---
Goose Cove-Boat Harbour	×	×	---	---
Main Brook-Englee	---	---	---	---

Burin Landfill	×	✓	✓	---
Baie Verte Landfill*	---	✓	---	---
La Scie Landfill	×	✓	---	---
South Brook Landfill	---	✓	---	---
Trinity Bay North	✓	✓	✓	×
Bonavista	×	✓	✓	×
Port Blandford	---	---	---	---
Port Rexton Waste Disposal Site	×	✓	---	×
Milltown-Head of Bay D'Espoire Landfill	---	---	---	---
Hermitage-Sandyville Landfill	×	✓	✓	---
St. Alban's Landfill	×	---	---	---
Harbour Breton	×	✓	✓	---
Labrador Straits Waste Disposal	---	---	---	---
Labrador City-Wabush	---	---	---	---

'✓' indicates facilities that recycle, stockpile for future recycling or repurposing, reuse fishing materials, or otherwise divert waste from the landfill. 'x' indicates that these materials are landfilled. This table shows facilities that recycle, reuse, or repurpose the above fishing gear materials, but does not necessarily indicate that gear is diverted from the landfill in absolute.

SMALL-SCALE SOLUTIONS

Some fish harvesters have their own small-scale solutions for diverting their end-of-life fishing gear from landfills. Likewise, some waste resource management facilities (New World Island/Twillingate Transfer Station, Bonavista Waste Disposal Site, Trinity Bay North Landfill, Indian Bay Transfer Station, Terra Nova Transfer Station) will set aside end-of-life fishing gear for similar solutions by local community members. 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 in the province. Examples include:

1. Repairing or reusing old lobster trap or crab pot parts on other traps or pots,

2. Using fishing rope for making mats, baskets, and other craft products,
3. Giving away old wood lobster traps as décor,
4. Burning clean wood from wood lobster traps for fuel,
5. Using netting like a tarp for covering or helping secure materials, and
6. Rope used by aquaculture farms for mussel lines and seed collection.

LARGE-SCALE SOLUTIONS

There are currently no options for recycling fishing rope in Newfoundland and Labrador. As a result, waste resource management facilities in the province landfill or burn most rope they receive at end-of-life. Various facilities are investigating potential solutions for end-of-life rope and nets, but none have been implemented. On the northeast coast of the island (NAFO Div. 3K), many fish harvesters sell their end-of-life rope to local mussel aquaculture farmers that grow mussels on the frayed rope farms (Badger Bay Mussel Farms and Thimble Bay Blues).

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

The main buyers of wire lobster traps and crab pots in Newfoundland and Labrador are Newco Metal and Auto Recycling, AIM Recycling, and Manuel's Recycling. Each of these companies has a large shredder for processing a variety of metals. Newco Metal and Auto Recycling collects metals from facilities around the island and in Labrador. Newco Metal does not require that netting be removed from crab pots or ballasts removed from lobster traps. Prices paid for the wire lobster traps and crab pots are tied to the global metal market. 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 stockpiled traps contain concrete ballasts as concrete can add significantly to the weight and subtract from the value.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Lobster and crab are some of the most commercially valuable fisheries in Newfoundland and Labrador, having combined landings of over \$373 million in 2019. The scale of the fishery produces large volumes of end-of-life fishing gear to manage. For these fisheries, metal crab pots, wire and wood lobster traps, and plastic fishing rope are the main gear used. Nearly all rope, nets, and some lobster traps, are not diverted from landfills and in many cases are burned.

The diameter of rope and the materials that the traps and rope are made of vary with location and fishery. Wire lobster traps are used primarily in LFAs 5 and 11-13, while other fishing areas use a combination of wood and wire traps or primarily wood traps. The variety of fishing gear used results in differing amounts and types of end-of-life gear received by waste resource management facilities throughout the province as well as the management challenges they present.

In total, about 52 046 lobster traps, 65 319 crab pots, and 2 974 km (202 tonnes) of rope are purchased, replaced, or built annually by fish harvesters in Newfoundland and Labrador. Crab pots and wire lobster traps can usually be recycled by waste resource management facilities; however, some will not recycle them if they have non-metal materials attached. Rope and monofilament nets were most often identified as problematic at waste resource management facilities due to the volumes received and because they can become entangled in equipment.

Fish harvesters are responsible for managing their end-of-life fishing gear, often by taking it to the nearest waste resource management facility or a metal recycler. The linear distance to these facilities varies notably throughout the province. Of the 255 core commercial fishing harbours, 29% are within a 10 km range of a waste resource management facility, 71% are within 25 km, and 97% are within 50 km. However, not all facilities accept commercial fishing gear.

For those facilities that charge tipping fees, the fees are typically less for wire traps and crab pots than for wood traps and rope because of the province's infrastructure for recycling metal. Newco Metal and Auto Recycling collects and recycles the metals from almost all the waste resource management facilities reviewed in this study. Though many facilities do not require non-metal materials to be removed for recycling, seven of the waste resource management facilities continue to landfill traps if fish harvesters do not remove these materials. Additionally, three facilities charge tipping fees greater than \$50 per tonne for wire lobster traps and/or crab pots though the traps are typically sold to metal recyclers.

Solutions to responsibly manage wood traps at end-of-life are less consistent across the province. End-of-life wood traps are often disposed of by fish harvesters through burning or disposal at sea with the non-wood material removed. Useable parts are typically salvaged by fish harvesters from both wood and wire traps for reuse or repair. Most of the wood traps that are sent to waste resource management facilities are landfilled, though at some facilities they are given away as decorations.

Most rope that goes to waste resource management facilities is landfilled, but it is burned at some facilities. Fish harvesters will also burn their end-of-life fishing rope. Rope is sent to landfill because the multi-material composition of most rope used in the lobster and crab fisheries prevents it from being recycled by traditional plastic recyclers. Furthermore, the technology and infrastructure required to separate the single resin rope from the blended rope after they have been collected does not currently exist. While there are some potentially promising solutions in Atlantic Canada, such as using the rope in plastic lumber or converting

it to diesel fuel, these do not currently have the capacity to manage all end-of-life rope generated across Atlantic Canada 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 an accessible, cost-effective, and environmentally responsible solution, and expanding it to Newfoundland and Labrador.
2. Work with the seven waste resource management facilities identified as not recycling wire lobster traps and crab pots with concrete ballasts and other material attached, to accept these traps “as-is” for recycling.
3. Work with the waste resource management facilities that do not accept commercial fishing gear to accept this gear in a way that is easy for the facilities to manage and provides opportunities for fisheries to sustainably manage their end-of-life fishing gear.
4. 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.
5. Further investigate the volume of gillnets that are disposed of annually in Newfoundland and Labrador and potential future solutions to recycling the end-of-life rope and monofilament netting used in gillnet fisheries.
6. Determine reliable solutions with the necessary capacity to manage end-of-life rope and build upon recent recycling progress being made in Atlantic Canada by companies such as Goodwood Plastic Products and Drastic Plastics.

ACKNOWLEDGEMENTS

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APPENDICES

APPENDIX A – QUESTIONNAIRES

QUESTIONS FOR WASTE RESOURCE MANAGEMENT FACILITIES

- 1) What type of products do you accept?
- 2) Do you see much fishing gear come to your site? What do you see most of?
- 3) What are the tipping fees for fishing gear? (Wire traps, wood traps, rope, netting)
- 4) Do lobster traps need to be separated/stripped before bringing to the facility?
- 5) What happens to traps that are not stripped before arriving?
- 6) Do you recycle metal lobster traps?
- 7) Does the metal need to be kept separate from other metals?
- 8) Who buys/collects the metal for recycling?
 - a. How often do they come and how much do they take?
 - b. Is there any required preparation, such as removing concrete weights?
- 9) Is wood from wood traps recycled?
- 10) If fishing gear is not accepted, is there adequate space available to accept fishing gear products?

QUESTIONS FOR FISHING GEAR RETAILERS

- 1) What brands of rope do you sell?
- 2) What is your best-selling rope for commercial fishing?
- 3) What are the main ropes you sell for lobster trap lines?
 - a. What material is it made from?
 - b. What sizes do you sell?
- 4) How much do you sell each year (in terms of weight of number of coils)?
- 5) What materials do you use to build lobster traps?
- 6) What size lobster traps do fish harvesters often purchase? What other sizes do you sell?
- 7) What style of traps do you sell?
- 8) How many lobster traps do you sell each year? How much wood and how much wire?
- 9) Do you sell crab pots? How many do you sell each year?

QUESTIONS FOR HARBOUR AUTHORITIES

1. Approximately how many lobster traps fish out of this harbour?
2. What types of lobster traps are used? (e.g. wire or wood traps)
3. Is there a garbage bin on site?
4. Do you permit all waste in the dumpster? (e.g. fishing rope, bait boxes, netting)
 1. If no, what is not permitted? Why?
5. Do you have a recycling bin on site?
6. Are there any other storage type bins on site for fishing gear waste?
7. Who is your waste hauler?
8. Do you rent your dumpster?

9. How often does the hauler come during lobster season?
10. How often does the hauler come during off season?
11. Do the users store old gear at the harbour?
12. Do you have stockpiles of rope or lobster traps to be recycled? How much?
13. Do the users take end-of-life fishing rope and lobster traps to another site? (e.g. home, C&D facility, or landfill)
14. What is the distance/travel time?
15. What other commercial fishing happens at your harbour?
16. When are those fished?
17. What type of gear is used for those fisheries?

QUESTIONS FOR HARBOUR AUTHORITIES

Note: These questions were modified to ask about fish harvesters when speaking with fishing associations or seafood plant employees.

- 1) What do you fish?
 - a. Lobster? Crab? Herring? Groundfish? Mackerel? Tuna? Swordfish? Shrimp? Halibut? Other?
- 2) How much fishing rope do you buy each year? (e.g., How many coils?)
- 3) How long does your fishing rope usually last (e.g., How long can you fish with it)?
- 4) What type of rope do you mainly use for lobster fishing?
- 5) What type of lobster trap do you use? (wood or wire, size)
 - a. If both wood and wire, approximately how much of each? (e.g., 50/50 wood and wire)
- 6) How many traps do you replace each year?
- 7) How long do your lobster traps usually last (e.g., How long can you fish with them)?
 - a. Do you repair them yourself?
- 8) What kind of gear do you use to fish other species?
- 9) Is there a bin/dumpster at the harbour/wharf to dispose of your end-of-life fishing gear?
 - a. If yes, what gear can go in?
- 10) Do you take your unusable fishing gear to another site (away from the harbour)?
 - a. How often do you take it there?
 - b. What is the distance/travel time?
- 11) How do you dispose of your unusable fishing rope? Reused/recycled? How reused/recycled? Landfill? C&D Facility? Harbour Dumpster? Home? Other?
 - a. If stored at home how many are in your stockpile?
- 12) How do you dispose of your lobster traps when no longer usable? Reused/recycled? How reused/recycled? Landfill? C&D Facility? Harbour Dumpster? Home? Other?
 - a. If stored at home how many are in your stockpile?
- 13) How do you dispose of your crab pots when no longer usable? Reused/recycled? How reused/recycled? Landfill? C&D Facility? Harbour Dumpster? Home? Other?
 - a. If stored at home how many are in your stockpile?

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

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

Relative Location	Harbours
Admirals Beach	Admirals Beach, O'Donnells, Riverhead
Anchor Point	Anchor Point, Black Duck Cove, Forresters Point
Bay Bulls	Bay Bulls, Witless Bay
Bay de Verde	Bay de Verde, Grates Cove, Sibleys Cove, Old Perlican
Bonaventure	New Bonaventure, Old Bonaventure
Bridgeport	Bridgeport, Moreton's Harbour, Valley Pond
Conception Bay	Bay Roberts, Hibbs Cove, Port de Grave, Ship Cove (Conception Bay)
Fermeuse	Aquaforte, Brigus South, Calvert, Cape Broyle, Fermeuse, Port Kirwan, Renewes
Gooseberry Cove	Gooseberry Cove, Little Heart's Ease, Southport
Greenspond	Greenspond, Valleyfield, Wesleyville
Hermitage	Hermitage, Sandyville (Dawson's Cove)
Placentia	Fox Harbour, Jersey'side, Placentia,
Port-au-Port Peninsula	Abrahams Cove, Black Duck Brook, Blue Beach, Cape St. George, Lourdes, Mainland, Piccadilly, Sheaves Cove, Ship Cove (Cape St. George), Three Rock Cove, West Bay Centre
St. Johns	Bauline, Flatrock, Petty Harbour, Pouch Cove, St. Philip's, St. John's (Prosser Rock), Portugal Cove, Torbay
Summerville	Princeton, Summerville
Twillingate	Jenkins Cove, Twillingate

Upper Island Cove

Carbonear, Harbour Grace, Upper Island Cove
