

END-OF-LIFE FISHING GEAR MANAGEMENT IN NOVA SCOTIA



Baxters Harbour © Alexa Goodman

June 25, 2021
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This report serves as a living document subject to revisions upon new and additional information that is uncovered.

Information presented in this report was funded by Government of Canada - Fisheries and Oceans Canada and Divert NS.



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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 Nova Scotia – 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 prominent target species in Nova Scotia fisheries, and thus produces the greatest amount of gear.

Data were gathered using online research methods and through conversations with industry representatives. 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 2019 the Department of Fisheries and Oceans issued 3 434 lobster licences in Nova Scotia. Of these licences, 1 660 were issued in lobster fishing areas (LFAs) 33 and 34, the largest in the province. These two LFAs also have the longest lobster fishing season (about seven months) and as a result, generate the largest amount of end-of-life fishing gear. About 244 400 traps are replaced annually in Nova Scotia, with about two-thirds of these traps replaced in LFAs 33 and 34 alone. About 17 890 km or 1 130 tonnes of rope are replaced in Nova Scotia each year. More than 80% of that by weight (950 tonnes) is generated just at the harbours in LFAs 33 and 34.

Fish harvesters in Nova Scotia 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, with 12% of core commercial fishing harbours within a 10 km range of a waste resource management facility, 73% within 25 km, and 100% within 50 km. However, some fish harvesters continue to illegally dump their gear, even if harbours are near waste resource management facilities that do not charge tipping fees.

This research identified two metal recyclers with capacity to recycle all wire lobster traps generated in Nova Scotia. However, solutions to responsibly manage wood traps at end-of-life are less consistent, with some used as a fuel source at a biomass energy facility or composted, but most are landfilled. Currently rope is primarily sent to landfill, but local recycling solutions are under development. 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 to inform a consultation process with fishing industry stakeholders on the potential development and implementation of a management program for end-of-life fishing gear in the province that is accessible, cost-effective, and easily understandable.

2. Work with the ten waste resource management facilities identified as not recycling wire lobster traps with concrete ballasts and other material attached, to accept these 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 rope and build upon recent recycling developments that are beginning to show promise.

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 and in particular the development of product stewardship programs for end-of-life fishing gear in Nova Scotia.

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.

Past studies, such as Emory Ackman's 2016 report *Feasibility of Repurposing 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 Nova Scotia. The FGCAC identified the management of end-of-life fishing gear as a knowledge gap, which is necessary to understand for developing sustainable solutions for end-of-life fishing gear. This 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 Nova Scotia is necessary. The data gathered for this report also addresses information gaps identified by Ackman (2016) and will aid in 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 Nova Scotia 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 in 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 Nova Scotia. 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 Nova Scotia.

RESEARCH FOCUS AREA

Research for this report focused primarily on lobster, as it is the main fishery in Nova Scotia, contributing nearly half (\$0.77 billion) of all Atlantic Canadian commercial lobster fishery landed values in 2018 (DFO 2020a). Throughout Atlantic Canada and eastern Québec, DFO manages 45 lobster fisheries, including one for the offshore fishery and one that is closed for conservation. Nova Scotia falls within two DFO inshore lobster fisheries management regions: Gulf and Maritimes. The Maritimes Region inshore lobster fishery comprises twelve Lobster Fishing Areas (LFAs) (27-38; Figure 1), stretching from the northern tip of Cape Breton into the Bay of Fundy to the border with the United States. The Gulf Region comprises five LFAs, with two fished from Nova Scotia (26a and 26b; Figure 1).

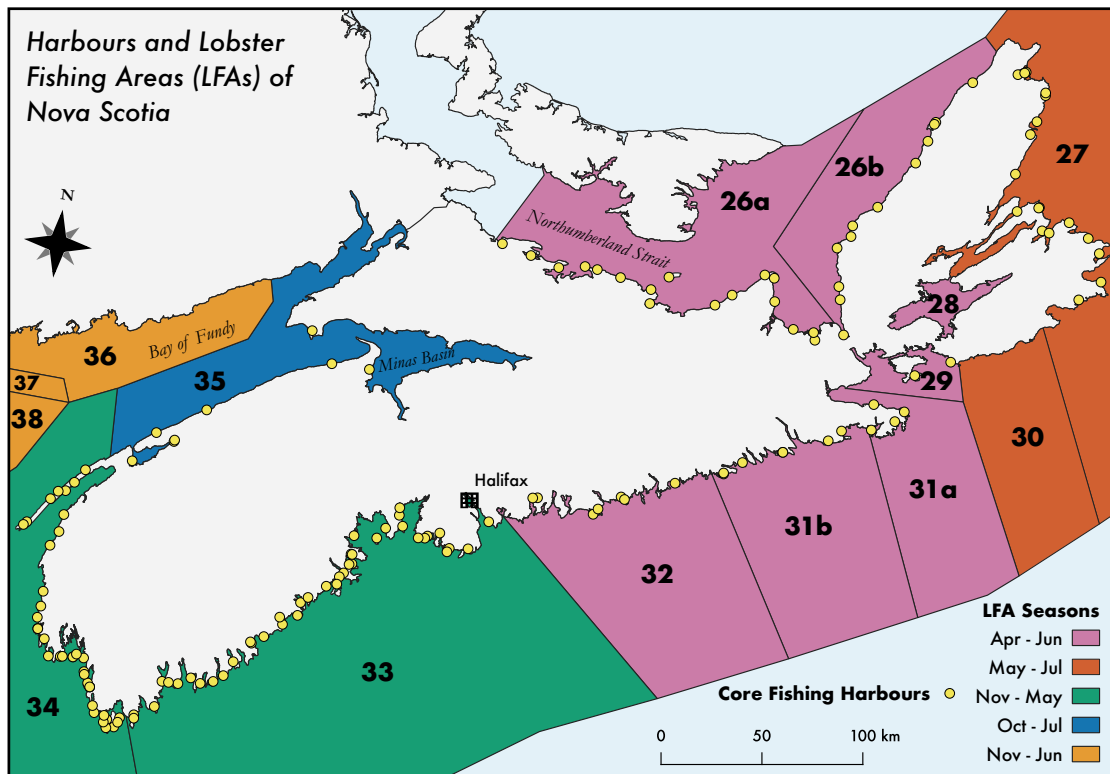


Figure 1. Harbours and lobster fishing areas (LFAs) in Nova Scotia. Map projection: NAD 83 CSRS UTM Zone 20N, Transverse Mercator. Sources: LFA delimiter lines and provincial boundaries modified based on Coffen-Smout (2020), DFO. Map created using QGIS 3.10 by Rachel A. Kendall.

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 2020b). 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 2020b). Limited entry licensing and three licence classes were introduced in the 1960-70s (DFO 2020b). 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 2020b).

LFA seasons are staggered, with LFAs 26-32 in the northeast portion of the province having short lobster fishing seasons lasting three months in the spring and early summer, while LFAs 33-38 in the southwest portion of the province have longer fishing seasons running from fall to spring (Figure 1). In 2019, 3 434 lobster licences were issued to participants in the lobster fishery of LFAs 26-38 (DFO pers. comm. October 1 and 9, 2020), representing approximately 34% of the 10 000 licensed fish harvesters in Canada (DFO 2015). Lobsters are caught using baited wire or wood 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 Nova Scotia from September to November of 2020. This research focused on the commercial lobster fishery and 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. 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 156 active core Nova Scotia 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 to fish at each harbour. DFO Maritimes and Gulf offices provided information pertaining to lobster licensing and LFA seasons. Other information regarding

commercial fishing per harbour and LFA (other species fished, other fishing seasons, type of gear used for fisheries, 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 managers, fish harvesters, fishing association members, and seafood plant employees). 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.

Phone and email conversations and interviews were conducted with 24 lobster trap and rope retailers from across the province in October 2020 (Appendix A). These interviews were used to gain an understanding of the types of lobster traps and fishing ropes that are used in the commercial lobster fishery throughout Nova Scotia 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 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 (156 commercially active Small Craft Harbours and the Digby private harbour) 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 and rope replaced annually were estimated using Nova Scotia licence numbers provided by DFO (pers. comm. October 1 and 9, 2020) 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 26a(1) has a limit of 280 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 26b could have a maximum total of 375 traps). The weight in rope varies by LFA due to different rope diameters and material used by fish harvesters.

RESULTS AND DISCUSSION

MAJOR COMMERCIAL FISHERIES IN NOVA SCOTIA

Lobster is the most commercially valuable species in Nova Scotia (Table 1). Other important commercial species harvested in the province include sea scallop, snow crab, Atlantic halibut, and other groundfish species (Table 1). 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. Sea scallops are fished using steel drags; Atlantic halibut and other groundfish are harvested using longline, gillnets, otter trawls, midwater trawls, and seines (Table 1) (DFO 2020c).

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

Species	2018 Landings (\$ Thousands) ^a	Gear Used
Lobster	771 107	Wire or wood traps; some wood-wire combinations; polypropylene/polyethylene rope; buoys; concrete or steel ballasts; rubber.
Sea Scallop	153 696	Steel scallop drags/dredges 12-17 ft wide; 'miracle gear' or Digby drags; 2-3 in rubber washers.
Snow Crab	149 872	6-7 ft conical steel traps: welded steel ring frame, netting, twine, rope, and plastic cone.
Atlantic 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 Groundfish ^b	38 599	Fixed gear: longline and gillnets (bottom hook-and-line with gangions, hooks, buoys, and rope). Mobile gear: otter trawl, midwater trawls, or seines.

^aDFO (2020a). ^bOther Groundfish include cod, haddock, pollock, flounder, dogfish, and hake.

Ackman (2016) identified wire lobster traps and fishing rope as the most disposed types of fishing gear in Nova Scotia. As such, the research of this report focused primarily on lobster traps and 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. Rope made from polyethylene, polypropylene, and/or a blend of polyethylene and polypropylene are used in lobster fishing in Nova Scotia. Additionally, buoys constructed from various rigid plastic resins and expanded polystyrene are also used.

Many fish harvesters harvest other species in addition to lobster, particularly during the off-season for lobster. For example, the crab fishery is significant in Cape Breton and in LFAs 31 and 32. Although lobster is fished in these areas, crab is more valuable to many fish harvesters due to the short lobster fishing seasons and limited tags, when compared to the LFAs of southwest Nova Scotia and the Bay of Fundy. In LFAs 33-35, lobster is the primary species fished, and groundfish and scallops are common secondary species.

HARBOURS AND LOBSTER FISHING AREAS IN NOVA SCOTIA

There are 157 core commercial fishing harbours in Nova Scotia (156 active Small Craft Harbours and the privately-owned Digby harbour) ranging in size from 1 to 200 boats. Most core fishing harbours will have either 1-10 boats (31%) or 11-25 boats (40%). Only seven harbours have more than 75 boats (4.5%), with Louisbourg being the largest harbour in the province with up to 200 boats (Figure 2). The remaining harbours have 26-75 boats (25%). The largest harbours are in southwest Nova Scotia and Cape Breton. Most harbours between Halifax and Canso are within the 1-10 and 11-25 boat range only (Figure 2). Along the Minas Basin, there are only three smaller core fishing harbours (two in the 1-10 boat category and one in the 11-25 boat category; Figure 2).

Fishing seasons in LFAs 26-32 are limited to three months, while LFAs 33-38 have longer fishing seasons (Table 2). In 2019, LFA 34 had the most licences issued (28% of all licences), followed by LFA 33 and LFA 27 (Table 2). Most LFAs have a trap limit of 250-300 per licence holder, except for LFAs 38 and 34, having limits of 375 and 400 traps, respectively (Table 2). As LFA 33 and 34 had the most traps licensed in 2019, these are considered the largest lobster fishing areas in Nova Scotia.

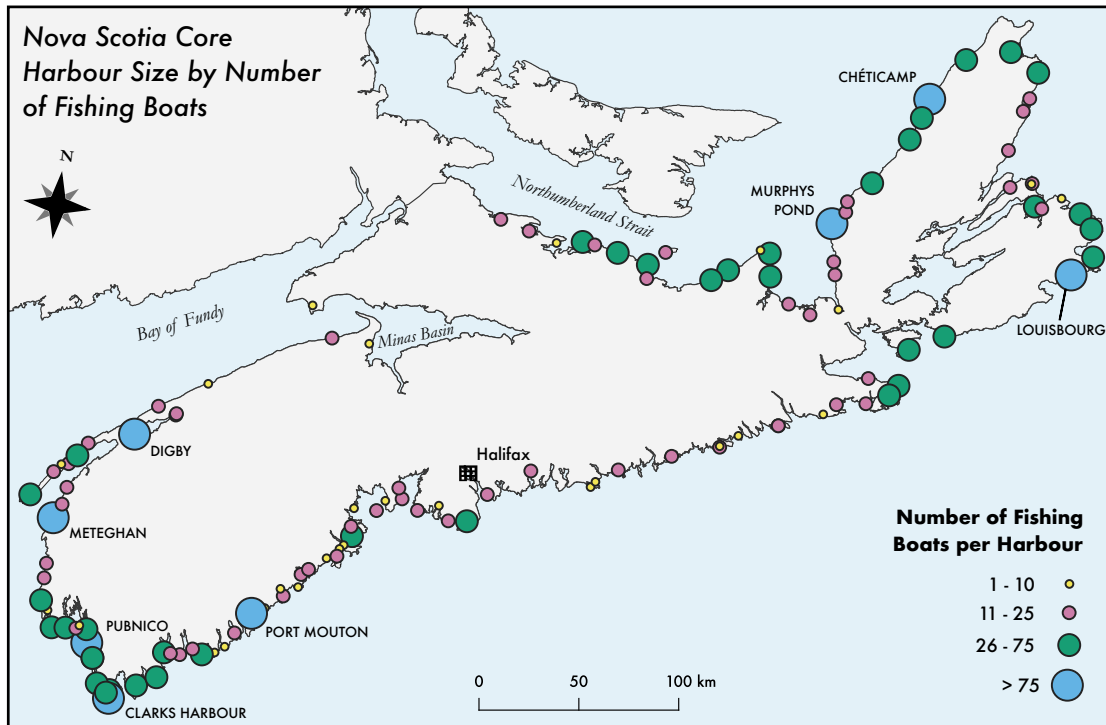


Figure 2. Size of core Nova Scotia commercial fishing harbours by number of boats. Refer to Figure 1 for map sources.

LOBSTER FISHING GEAR TYPE BY LFA

The information presented in this section is derived from conversations with members of the fishing industry and retailers and manufacturers of fishing gear. Wire lobster traps are used predominantly by fish harvesters in LFA 26a and 32-38, while a mixture of wire and wood lobster traps are used in LFA 27 and 31 (Figure 3). There are exceptions, with some fish harvesters at harbours in Cape Breton and in LFA 31a and 31b fishing predominantly with wood traps. In LFA 26b and 28-30, wood is primarily used by fish harvesters. The primary fishing rope used by fish harvesters is made of polyethylene, polypropylene, or a blend of polyethylene and polypropylene. The type of lobster traps and fishing rope used can vary throughout the province due to factors such as ocean floor topography, currents and tides, and as a personal preference based on perceived fishing ability and efficiency.

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

LFA	Fishing Season ^b	Total Licences	Trap Limit per Licence ^c	Maximum Traps Licensed
26a(1)	Apr 30 - Jun 30	133	280	37 240
26a(2)	Apr 30 - Jun 30	145	255	39 531
26b	Apr 30 - Jun 30	226	250	55 270
27	May 15 - Jul 15	481	275	129 971
28	Apr 30 - Jun 30	14	250	3 500
29	Apr 30 - Jun 30	63	250	14 875
30	May 20 - Jul 20	20	250	5 000
31a	Apr 29 - Jun 30	71	250	17 225
31b	Apr 19 - Jun 20	70	250	17 500
32	Apr 19 - Jun 20	157	250	38 550
33	Last Mon Nov - May 31	682	250	165 775
34	Last Mon Nov - May 31	978	400	391 200
35	Oct 15 - Dec 31; Mar 1 - July 31	94	300	37 780
36 ^a	2nd Tues Nov - Jan 14; Mar 31 - Jun 30	177	300	52 890
38 ^a	2nd Tues Nov - Jun 30	136	375	37 208
Total	—	3 434	3 885	1 055 629

Licence and tag information from DFO pers. comm. October 1 and 9, 2020. ^aLFA 37 is shared among LFA 36 and 38. ^bDFO 2020b. ^cTrap 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.

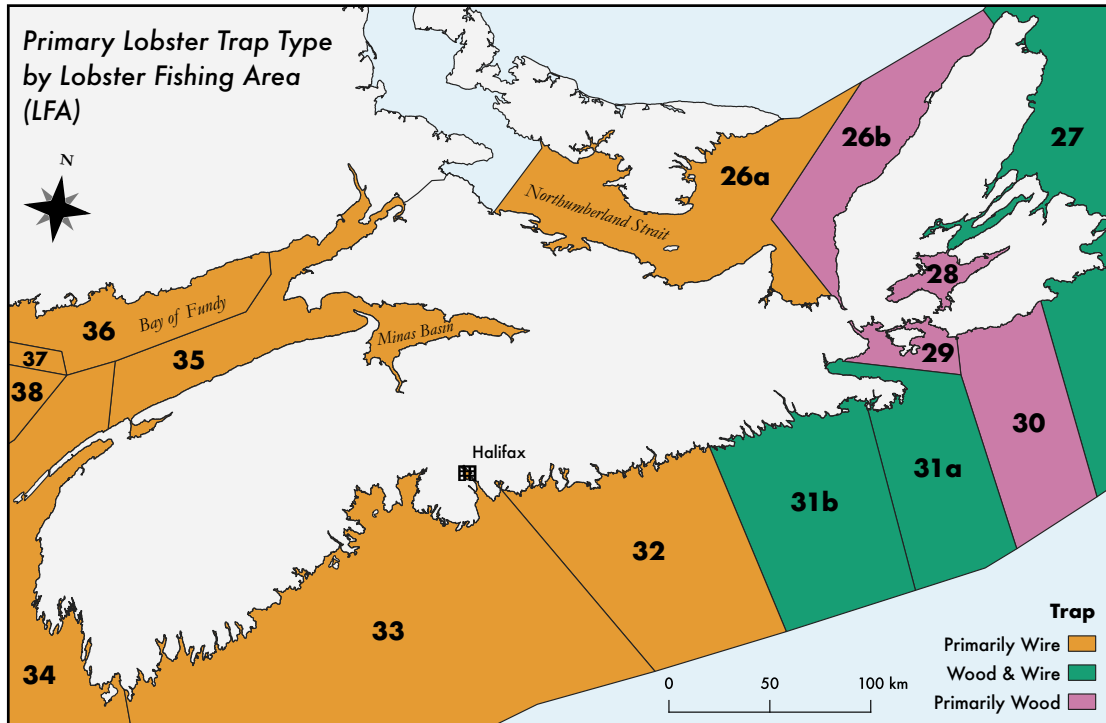


Figure 3. Primary lobster trap type (wire, wood, or both) by LFA. Refer to Figure 1 for map sources.

Lobster is primarily fished near shore with single pots from LFA 26a to the northern part of LFA 33 (Figure 3). Some fish harvesters using this single pot fishing method favour smaller diameter high-density polyethylene rope, as it does not abrade as quickly from the harsh conditions of the rocky ocean floor. Rope diameter size, and therefore rope weight, used by lobster fish harvesters varies by LFA. Lobster fishing rope is commonly sold as 366 m (1200 ft) coils. Weight of coils commonly sold to lobster fish harvesters will vary from about 13 to 15 kg (28 to 77 lb) because the diameter primarily used increases from LFA 26 to 35 (S. Burke, pers. Comm. December 4, 2020). In the southern part of LFA 33 and in LFAs 34-38, traps are set farther offshore as a trawl line with stronger rope that is a larger diameter and contains more polypropylene. This type of fishing also requires the use of wire traps as they are sturdier, maintain a consistent weight, and can be built larger than wood traps. Many fish harvesters in LFAs 29-32 set wire traps early in the season when the water is warmer and then set wood traps later in the season. Reasons given for this change were that wire traps are tougher when used on the rough ocean floor during storms and, when the water is colder, wood acts as an insulator and stays warmer while wire can be colder, thus not attracting lobster.

QUANTITY OF LOBSTER GEAR USED IN THE FISHERY

In 2019, there were 953 417 lobster trap tags issued in LFAs 26-35 (DFO pers. comm. October 1 and 9, 2020). Of these, 556 975 (58%) of lobster traps were licensed in southwest Nova Scotia (LFAs 33 and 34). Information on trap replacement was derived from

conversations with members of the Nova Scotia fishing industry. About 50 traps per fish harvester are replaced annually in areas with shorter, three-month fishing seasons (LFAs 26-32). Conversely, about 100 traps per fish harvester are replaced annually in areas with longer fishing seasons (LFAs 33-35). Southwest Nova Scotia (LFAs 33-35) has 87 active fishing harbours and received 1 754 licences and 594 755 lobster tags in 2019. 1 660 of these licences were issued for the two largest fishing areas, LFAs 33 and 34.

Multiplying the total number of licences issued per LFA in 2019 (licences represent the number of lobster fish harvesters) by the approximate number of traps replaced per fish harvester (Table 2), about 244 400 traps would have been replaced annually by fish harvesters in LFAs 26-35. Of this total, 166 000 traps (68%) would have been replaced by fish harvesters in LFAs 33 and 34. Breaking down the total number of traps replaced annually (244 400) to wire versus wood traps (Figure 3), about 31 700 wood traps would be replaced annually. In comparison, about 212 700 wire traps would be replaced annually. These estimates assume that fish harvesters in LFAs 26b and 28-30 fish entirely with wood traps and that fish harvesters in LFAs 27 and 31 fish with 50% wood traps. This also assumes that fish harvesters in LFAs 26a and 32-35 use wire traps and those in LFAs 27 and 31 fish with 50% wire traps.

In LFAs that have trap limits up to 300 and shorter fishing seasons, about 10 coils of rope are replaced each year. In LFAs that have trap limits greater than 300 and longer fishing seasons, an average of 20 coils of rope may be replaced annually. This means that approximately 48 880 coils of rope would be replaced in LFAs 26-35 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 17 890 km (58 656 000 ft) of rope replaced each year. In weight, this represents 1 130 tonnes annually. In LFAs 33 and 34, 33 200 coils or 68% of the total annual coil replacement would occur. Considering the length of rope in a coil, this represents 12 150 km (39 840 000 ft) of rope replaced in LFAs 33 and 34 alone. By weight this results in 950 tonnes annually.

The replacement lobster trap and rope numbers are estimates based on average values provided by members of the fishing industry and by retailers of fishing gear in Nova Scotia. 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.

LOBSTER FISHING GEAR RETAILERS

Of the 19 fishing gear retailers in Nova Scotia, five sell fishing rope, eight sell lobster traps, and six sell both fishing rope and lobster traps (Table 3). Of these retailers, 12 sell wire traps, and one sells both wire and wood traps. Additionally, retailers often sell supplies for constructing and repairing wire and wood traps. The remaining two retailers sell traps made of plastic (The Lobster Trap Company) and stainless steel (Ashored Innovations) that are designed to be longer lasting and more easily recycled. The major trap retailers identified are V & R Traps, Wades Wire Traps, Spartan Marine Industrial, and Rainbow Net and Rigging.

Additionally, North Shore Ballast & Concrete Works produces concrete ballasts for lobster traps in Nova Scotia. Retailers and distributors of lobster fishing rope in Nova Scotia are Digby Marine Supply, Cape Breton Fish and Marine Supplies, Coastline Group, Hampidjan Canada, Pictou Fishing Supplies, Rainbow Net and Rigging, Rossway Trap and Marine Supplies, Sable River Fishing Supplies, Spartan Industrial Marine, Vernon d'Eon Fishing Supplies, and Waterview Marine Supplies.

Table 3. Types of lobster traps sold by retailers.

Company	Wire Traps	Wood Traps	Other Materials
A & D Adams Wire Traps	✓	×	×
Ashored Innovations	×	×	✓
Basinview Traps & Wire/Digby Marine Supply	✓	×	×
Cape Breton Fish and Marine Supplies	✓	✓	×
Island Traps	✓	×	×
Louisbourg Ship Supply and Service	✓	×	×
Rainbow Net and Rigging	✓	×	×
Rossway Trap and Marine Supplies	✓	×	×
S & E Traps	✓	×	×
Sable River Fishing Supplies	✓	×	×
Spartan Industrial Marine	✓	×	×
The Lobster Trap Company	×	×	✓
V & R Traps	✓	×	×
Wades Wire Traps	✓	×	×

Sale of lobster traps made of various materials (wood, wire, or other materials) indicated by an '✓'. The Lobster Trap Company and Ashored Innovations retail traps that are made from plastic and stainless steel, respectively. An 'x' indicates that the material is not sold.

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. Recently, some traps are being made of alternative materials, such as plastic and stainless steel. However, wire and wood traps are still dominantly used in Nova Scotia. 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 bottom 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. Most retailers in the province sell concrete ballasts (43%) or both concrete and steel ballasts (43%), while 14% sell only steel ballasts (Figure 5). Additionally, most retailers provide custom-built lobster traps that are tailored to individual fish harvester needs and preferences. Many retailers indicated that traps 4 ft in length were among the most common sizes sold in Nova Scotia. However, the size of the traps purchased 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 greatly from 200 up to 50 000 traps.



Figure 4. Diagram showing the parts of a wire lobster trap. Photo copyright Rachel A. Kendall.

Two local Nova Scotia companies, The Lobster Trap Company and Ashored Innovations, have developed innovative new lobster traps that are built using plastic and stainless steel, respectively. Their goal is to manufacture traps that have a longer useful life and fully recyclable at the end of their life. While these traps cost more up front, early results indicate that their total cost of ownership should be comparable or less than vinyl coated wire or wood traps.

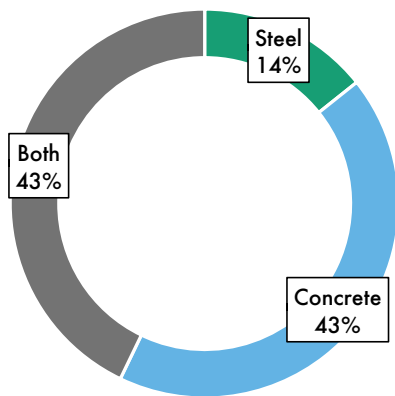


Figure 5. Percentage of retailers and distributors that sell steel or concrete ballasts (sold both separately and as part of pre-assembled traps). Fourteen retailers and distributors listed in Table 3 with the addition of North Shore Ballast & Concrete Works.

ROPE

Of the 14 brands of lobster fishing rope identified as being sold by retailers and distributors in Nova Scotia, 43% are polyethylene material, 21% are polypropylene material, and 36% are a blend of polyethylene and polypropylene (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. Other ropes are made of nylon, but these are not commonly used for lobster fishing in Nova Scotia. Major retailers and distributors of lobster fishing rope in Nova Scotia are Vernon d'Eon, Spartan Industrial Marine, and Rainbow Net and Rigging. Polysteel Atlantic is the only manufacturer of lobster fishing rope in Nova Scotia and is the largest supplier of rope to retailers and distributors.

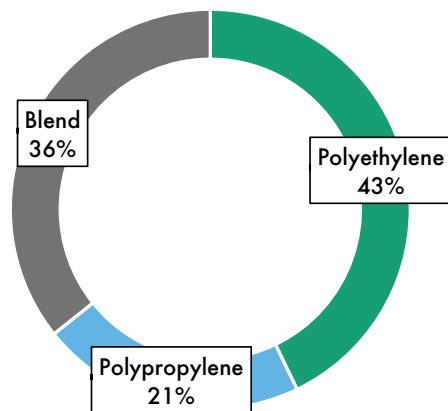


Figure 6. Percentage of lobster fishing rope made using polyethylene, polypropylene, or a blend of both.

MANAGEMENT PRACTICES FOR END-OF-LIFE FISHING GEAR

WASTE RESOURCE MANAGEMENT FACILITIES

Fish harvesters in Nova Scotia are 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. If harbour authorities provide collection bins, they are to be used only for “black bag” garbage that would be generated by the fish harvesters on their boats, but not for rope or lobster traps. Some harbours have collection bins for recyclables, but these would be restricted to “blue bag” recyclables such as 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 and 25 km buffers were drawn around each of the waste resource management facilities in the province (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. This mapping shows that 138 of 157 core commercial fishing harbours are located further than 10 km from either a municipal or private waste resource management facility (Figure 7). Of the larger fishing harbours (> 75 boats), only Meteghan and Digby are located within 10 km of a waste resource management facility. However, 115 of the 157 core fishing harbours are located within 25 km of a waste resource management facility. The larger fishing harbours (> 75 boats) of Chéticamp, Louisbourg, and Port Mouton fall outside the 25 km buffer, with Murphys Pond at the 25 km buffer edge. Other harbours with 26-75 boats in Cape Breton and along the Northumberland Strait also fall outside the 25 km buffer and are approximately 30-45 km from the nearest waste resource management facility. While all core commercial fishing harbours are within a 50 km linear distance from a waste resource management facility, a few harbours are more than 50 km by road. For example, the harbour of Westport on Brier Island is farther based on its island location.

While end-of-life fishing gear is accepted at nearly all private and municipally owned waste resource management facilities in the province, a majority is taken to municipal facilities. However, the proximity of municipal facilities to the harbours appears to be a factor in this, rather than only a result of the tip fees that are charged. For example, in locations where the private facilities are near a harbour, fish harvesters transport their end-of-life fishing gear to these facilities such as Digby Salvage and Disposal, near the large Digby private harbour, and Marinus Verhagen C & D, near harbours along the Northumberland Strait (Figure 7).

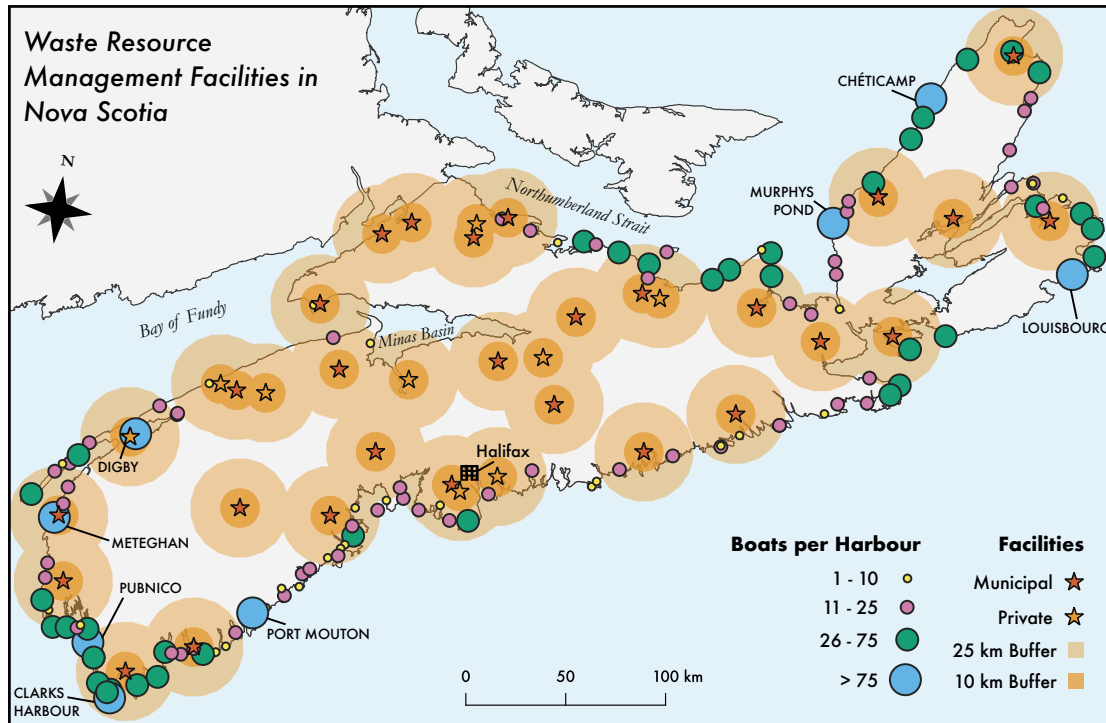


Figure 7. Nova Scotia core commercial fishing harbours and waste resource management facilities with 10 and 25 km buffers. Refer to Figure 1 for map sources. Not all facilities accept or receive fishing gear.

Although many waste resource management facilities accept end-of-life fishing gear with little or no tipping fee, some fish harvesters continue to illegally dump their gear in the ocean or on land. This activity occurs throughout the province. For harbours that highlighted issues with fish harvesters not taking their gear to a waste resource management facility, even when the facility charged no tipping fees, one was located more than 25 km from a facility; however, the others were less than 25 km from a facility.

Tipping fees for end-of-life wire traps, wood traps, and fishing rope vary greatly by waste resource management facility throughout the province (Figure 8). Some municipal facilities do not charge any tipping fees, while others charge up to \$215 per tonne. The Dingwall Transfer Station, St. Mary's Transfer Station, Baddeck Waste Management Facility, HRM Sheet Harbour Transfer Station, and HRM Middle Musquodoboit Transfer Station do not charge tipping fees for end-of-life fishing gear or for any types of waste. However, the Dingwall Transfer Station and Baddeck Waste Management Facility will be implementing tipping fees in 2021, while the HRM Sheet Harbour and Middle Musquodoboit transfer stations only accept limited quantities of fishing gear. The Barrington C & D Landfill and the Shelburne Regional Material Recovery Facility do not charge tipping fees for lobster traps and rope. However, the Shelburne facility does charge tipping fees for other types of sorted materials, even if recycled, such as wood, shingles, and drywall, as well as all unsorted material, whereas the Barrington C & D facility only charges for unsorted material received.

The lowest tipping fees are typically for wire traps at the facilities that accept them. Wire traps can be recycled and sold as scrap metal. Most waste resource management facilities stockpile wire lobster traps separately from other metals for processing by a metal recycler. However, the conditions under which traps are collected for recycling are not consistent across the province. While many waste resource management facilities will accept traps with non-metal material still attached, such as concrete ballasts and plastic netting, other waste resource management facilities will only set traps aside for recycling if the ballasts and other materials are removed. Traps not recycled are landfilled. Of the 28 facilities that accept wire traps, 18 recycle them even with ballasts and netting attached. Facilities requiring wire lobster traps to be stripped of other material prior to recycling are Colchester Balefill Facility, HRM Sheet Harbour Transfer Station, HRM Middle Musquodoboit Transfer Station, Queens Municipal Landfill, Valley Waste Eastern Management Centre and Western Management Centre, West Hants Landfill, Lunenburg Community Recycling Centre, Kaizer Meadow Landfill, and Clare Transfer Station. Also, of the 28 facilities that accept wire traps, 13 do not charge tipping fees. The remaining charge tipping fees ranging from \$30 to \$150 per tonne as follows: six charge \$1-50, seven charge \$51-100, and two charge \$101-150 (Figure 8).

There are 25 facilities that receive wood traps on a regular basis. 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 4). Eleven waste resource management facilities were identified to have a separate wood pile for wood from traps to be chipped. Of those 11, six require that all non-wood materials be removed. For wood traps, eight charge no fees, five facilities charge tipping fees of \$1-50 per tonne, and nine facilities charge \$51-100.

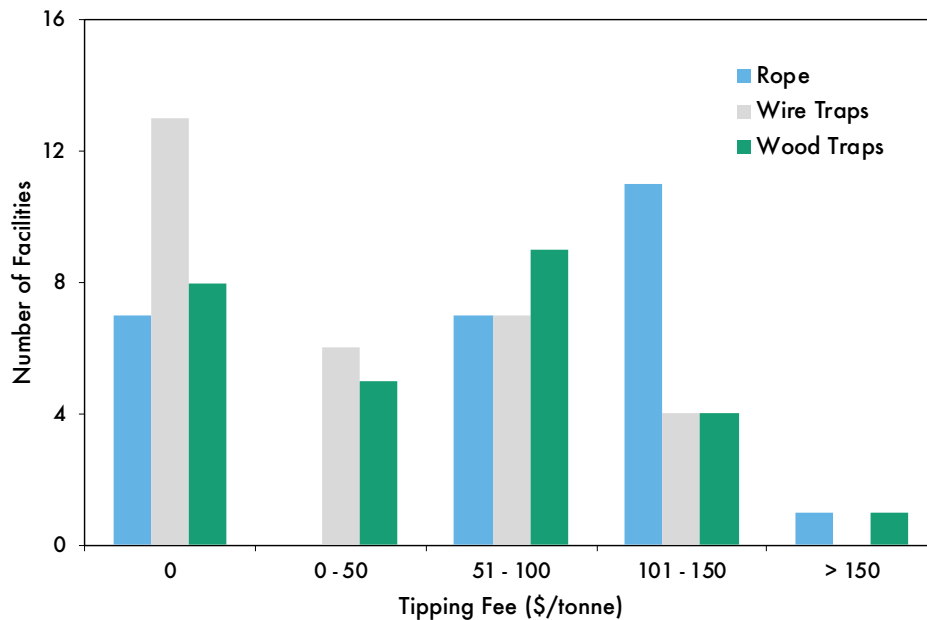


Figure 8. Tipping fees charged for end-of-life fishing gear by waste resource management facilities in Nova Scotia.

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

Region	Facility Name	Wire Traps	Wood Traps
1	Baddeck Waste Management Facility	✓	✓
1	Cape Breton Regional Municipality (CBRM) Transfer Station	✓	✓
1	Dingwall Transfer Station	✓	✓
1	Inverness C & D Landfill	✓	✗
1	Richmond Waste Management Facility	✓	✗
2	Beech Hill Waste Management Facility	✓	✗
2	Guysborough County Recycling Transfer Station	✓	✓
2	Marinus Verhagen C & D Disposal Site	✓	✗
2	Pictou County Transfer Station	✓	✗
2	St. Mary's Transfer Facility	✓	✓
3	Advocate	✓	---
3	Colchester Balefill Facility*	✓	✓
3	Colchester Containers	---	---
3	Cumberland Central Landfill CD Site	✓	✓
3	East Hants Waste Management Centre	✓	✓
3	Mount Pleasant C & D	---	---
3	Oxford	---	---
3	Pugwash	✓	---
3	River Hebert	---	---
4	Halifax C & D Recycling	---	---

4	HRM Middle Musquodoboit Transfer Station*	✓	×
4	HRM Sheet Harbour Transfer Station*	✓	×
4	Otter Lake Waste Processing and Disposal Facility	---	---
5	Arlington Heights C & D Landfill	---	---
5	Eastern Management Centre (Valley Waste)*	✓	✓
5	Western Management Centre (Valley Waste)*	✓	✓
5	Torbrook C & D Disposal and Recovery	---	---
6	Barrington C & D Landfill	✓	✓
6	Kaizer Meadow Landfill*	✓	×
6	Lunenburg Community Recycling Centre*	✓	✓
6	Queens Municipal Landfill	✓	×
6	Shelburne Regional Material Recovery Facility	✓	×
6	West Hants Landfill*	✓	✓
7	Clare Transfer Station*	✓	✓
7	Digby Salvage and Disposal, Digby Transfer Station	✓	×
7	Yarmouth County Solid Waste Park	✓	---

‘✓’ 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.

Of the waste resource management facilities identified in Nova Scotia, 26 accept fishing rope. Currently most of the rope received at these facilities is landfilled. Other facilities, however, stockpile, reuse, or recycle rope in some form when possible. For example, at the Guysborough County Landfill, rope that arrives in good condition is set aside for the public to use. Due to the limited solutions for end-of-life rope, the tipping fees charged to dispose of rope is generally higher than the tipping fees charged for wire and wood traps. For example, 10 of the 26 waste resource management facilities in the province charge between \$101-150 per tonne for rope.

The fishing industry can be a significant source of waste in various parts of the province, as rope, wood traps, and some wire traps are not 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 many facilities indicated that they recycle these items, not all gear received is reused or recycled due to an item's condition, recycling cost, or the capability of the facility to separate the materials. For example, rope or 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 and there are limited options to divert it from landfill. While the Municipality of Barrington is looking for a solution to divert fishing rope from the landfill, they currently must landfill it as they do not have enough space to stockpile the quantities of rope they receive at their municipal C & D facility.

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 (Guysborough County Landfill, Shelburne Regional Material Recovery Facility, and St. Mary's Transfer Station) and some harbour authorities will set aside end-of-life fishing gear for similar solutions in which local community members use the gear for projects. 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, especially in the busier fishing areas such as southwest Nova Scotia. Examples include:

1. Repairing or reusing old lobster trap parts on newer traps,
2. Using lobster rope for making mats, baskets, and other craft products,
3. Selling old lobster traps as décor,
4. Burning clean wood from wood lobster traps for fuel,
5. Using wire lobster traps for retaining walls, and
6. Using netting like a tarp for covering loads, for growing hops, or for in gardens and on farms.

LARGE-SCALE SOLUTIONS

Currently limited options exist for recycling fishing rope in Nova Scotia. As a result, most facilities in the province must landfill rope at end-of-life. Various solutions have been investigated such as sending stockpiled rope to Aquafil; however, they only accept nylon 6, and most of the fishing rope in Nova Scotia is made from polyethylene, polypropylene, or a blend of these two resins. Also, rope made with a blend of resins results in several additional challenges. Recyclers that sort and pelletize plastic resins for resale to downstream markets cannot separate and process blended rope into pure streams of polyethylene and polypropylene. 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. A small local company, Pubnico Plastics, operated for a few years and processed rope for recycling. However, this

rope was shipped to China for recycling and Pubnico Plastics could not meet the new contamination restrictions put in place by China in January 2018.

Some recent developments are beginning to show promise for rope recycling in Nova Scotia. Goodwood Plastic Products (GPP), based in Stewiacke, has shown that fishing rope from Nova Scotian sources can be used in their plastic lumber products. They purchased more than 40 tonnes of rope from Pubnico Plastics including their remaining inventory of shredded rope and other end-of-life fishing plastics such as insulated fish tubs and buoys. GPP also accepted a trial load of stockpiled rope of just over 10 tonnes from the Inverness C & D facility. GPP recently installed a high-capacity shredder that can more easily process rope. However, they currently have an excess supply of plastic and will need to increase their sales capacity before accepting the volume of rope generated in Nova Scotia on an annual basis. Also, GPP will likely require a tipping fee because of the significant handling and processing requirements for rope. Another recycling company with potential to recycle end-of-life fishing gear is Drastic Plastic, based in Nova Scotia.

Another potential longer-term solution is under development by Sustane Technologies, based in Chester. They have a process currently undergoing regulatory approvals to convert various plastic resins into diesel fuel. They plan to receive approximately four tonnes of fishing rope as part of Coastal Action's SFSRSCP funded project to test the ability of their system to convert rope into diesel and identify any risks/challenges. If the pilot project to convert end-of-life fishing rope (currently destined for landfill) is successful, Sustane remains open to the idea of an expanded program going forward. This would be contingent on a couple of factors including a viable business case and the necessary regulatory approvals from the Nova Scotia Department of Environment.

The Lafarge cement plant in Brookfield is also a potential outlet for end-of-life fishing rope. They currently are permitted by the Nova Scotia Department of Environment to use shredded plastic as an alternative fuel source in their kiln to replace coal. However, rope is very pliable and resilient, making it a challenge to shred into a consistent particle size needed before the rope can be used as a fuel source. While companies such as Halifax C & D and GPP shred plastics for use by Lafarge, they both have adequate supplies of easier to process plastics to meet Lafarge's current needs for alternative fuel.

The main recyclers of wire lobster traps collected in Nova Scotia are AIM Recycling (Saint John, NB), Dartmouth Metals (Dartmouth), and John Ross & Sons (Goodwood). Each of these companies has a large shredder for processing a variety of metals including wire lobster traps. AIM Recycling and John Ross & Sons will accept traps with concrete ballasts, while Dartmouth Metals requires traps to be stripped of ballasts. Limar Enterprises, a trucking company based in New Brunswick, also plays a significant role collecting lobster traps from Nova Scotia and transporting them to AIM Recycling in New Brunswick for processing and recycling. Prices paid for the wire lobster traps 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 stockpiled traps contain concrete ballasts as concrete can add significantly to the weight and subtract from the value.

Some fish harvesters may take their traps 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 and supply AIM Recycling, Dartmouth Metals, and John Ross & Sons. These collectors include BMI, Harbour Metals Recycling, McNutt's Scrap Metal, Paul Hashem Scrapyard, Bill Stewart's Scrap Metal, ScrapCo Atlantic, and Terramac Contracting. 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. Aim Recycling, Dartmouth Metals, John Ross & Sons, and Limar Enterprises are the four main companies that bid on these tenders.

Many waste resource management facilities in the province accept and separate clean wood for various applications. The Cape Breton Regional Municipality (CBRM) transfer station noted that wood from lobster traps is used as fill on site and sometimes in compost. In other cases, particularly in southwest Nova Scotia and the Annapolis Valley, wood from traps is chipped and sent to Brooklyn Energy, which is owned by Emera, for use as a biomass fuel to generate electricity for Nova Scotia Power.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Lobster is the primary commercial fishery in Nova Scotia, contributing commercial landings of \$0.77 billion in 2018. Although lobster is important both economically and culturally to Nova Scotia, the scale of the fishery produces large volumes of end-of-life fishing gear to manage. Wire and wood lobster traps and plastic rope are the main gear used. Nearly all rope, and some traps, are not diverted from landfills and in some extreme cases, may be illegally dumped at sea or on land, or even burned.

The largest LFAs in Nova Scotia are 33 and 34 with the most lobster licences issued (1 660) and the longest lobster fishing season (about seven months), and as a result, produce the largest amount of end-of-life fishing gear. The size of traps and diameter of rope used varies throughout the province as do the materials that the traps and rope are made of. Larger primarily wire traps are used in the southwest part of the province and smaller and primarily wood traps are used in the northeast part. Wire, however, is more dominantly used overall. Polyethylene and polypropylene rope, or blends of the two, are used in the lobster fishery, with larger diameter rope needed in southwest Nova Scotia for use in trap trawl lines whereas smaller diameter rope is used for single trap fishing.

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 244 400 lobster traps are replaced annually by fish harvesters in Nova Scotia, with approximately two-thirds of these traps replaced in LFAs

33 and 34 alone. More end-of-life wire traps are generated each year than wood traps, with about 212 700 wire traps replaced annually compared to 31 700 wood traps. This is reflected in products sold by retailers in the province, with most selling only wire traps. Furthermore, a total of approximately 48 880 coils of rope, measuring 17 890 km or weighing 1 130 tonnes, are replaced each year in Nova Scotia. Two-thirds of these coils are replaced in LFAs 33 and 34 alone, representing 12 150 km or 950 tonnes (84% by weight) of rope that is primarily landfilled.

Fish harvesters in Nova Scotia 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 lobster traps. The linear distance to these facilities varies notably throughout the province. Of the 157 core commercial fishing harbours, 19 (12%) are within a 10 km range of a waste resource management facility, 115 (73%) are within 25 km, and all are within 50 km. Some fish harvesters continue to illegally dump their gear, even with some waste resource management facilities charging no tipping fees.

For those facilities that charge tipping fees, the fees are typically less for wire traps than for wood traps and rope because of the well-established infrastructure in the province for recycling metal. This research identified two metal recyclers with the capacity to recycle all wire lobster traps generated in Nova Scotia on an annual basis with no requirement for fish harvesters to remove concrete ballasts and other material. Those facilities that have tipping fees, the lowest are typically for wire traps because of the current infrastructure in place in the province for recycling metal. However, nearly one-third of the waste resource management facilities continue to landfill traps if fish harvesters do not remove these materials. Also, 11 facilities charge tipping fees greater than \$50 per tonne for wire lobster traps even 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. While some fish harvesters deconstruct their traps and use the wood for fuel, most wood traps are transported to waste resource management facilities with the mesh netting still attached. In the case of some facilities in southwest Nova Scotia and the Annapolis Valley, the wood from wood lobster traps is intermittently chipped for use as a local fuel source at a biomass boiler.

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. In addition, the technology and infrastructure required to separate the single resin rope from the blends once collected does not currently exist. While there are some potentially promising local solutions, 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 in the province 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 to inform a consultation process with fishing industry stakeholders on the potential development and implementation of a management program for end-of-life fishing gear in the province that is accessible, cost-effective, and easily understandable. Consultations should focus on infrastructure needs, collection, and transportation to waste resource management or other designated sites, program funding, and other related issues.
2. Work with the ten waste resource management facilities identified as not recycling wire lobster traps with concrete ballasts and other material attached, to accept these 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 landfill that minimize non-wood contaminants and the need for fish harvesters to dismantle their traps.
5. Collaborate with fishing industry stakeholders 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.
6. Determine reliable solutions with the necessary capacity to manage end-of-life rope and build upon recent recycling progress being made in the province by companies such as Goodwood Plastic Products, Sustane Technologies, and Drastic Plastic.

ACKNOWLEDGEMENTS

The baseline data collection for this report was made possible with the funding provided by the Department of Fisheries and Oceans Solutions & Retrieval Support Contribution Program (SFSRSCP), as well as the Divert NS Research & Development Grant. Thank you to all the members of the fishing industry, retailers and distributors, municipal waste coordinators, and waste resource management facility supervisors, and other participants who dedicated time to answer our questionnaires, and those of you who shared our questionnaires with others. This work would not have been possible without the support of all the members of the Fishing Gear Coalition of Atlantic Canada.

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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)
 - a. 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 OTHER FISHING INDUSTRY MEMBERS

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.

Location	Harbours
Argyle	Camp Cove, Surettes Island, Morris Island
Bay St. Lawrence	Bay St. Lawrence, Dingwall, White Point
Bayport	Bayport, Feltzen South
Brier Island	Freeport, Westport
Cape Sable Island	Clark's Harbour, Cripple Creek, Stoney Island, South Side Harbour, Swims Point, West Head Harbour, Newellton
Chéticamp	Chéticamp Town Wharf, Chéticamp La Dingue
Chezzetcook	East Chezzetcook, Three Fathom Harbour
Havre Boucher	Havre Boucher, Barrios Beach
Hubbards	Fox Point, Mill Cove
Lunenburg	Lunenburg Fishermen's Wharf, Lunenburg Railway Wharf
Neil's Harbour	Neil's Harbour, White Point
Peggy's Cove	Peggy's Cove, East Dover, West Dover
Port La Tour	Port La Tour, Upper Port La Tour
Port Mouton	Port Mouton, Central Port Mouton
Pubnico	Dennis Point, Ledge Harbour, Abbotts Harbour
Shag Harbour	Shag Harbour, Bear Point, Lower Woods Harbour
Tangier	Cooper's Point, Carter's Point
Terence Bay	Terence Bay, Lower Prospect
Victoria Beach	Parkers Cove, Battery Point
Bay St. Lawrence	Bay St. Lawrence, Dingwall, White Point