

# Maritimes Region Fisheries Atlas: Catch Weight Landings Mapping (2014-2018) on a Hexagon Grid

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## ABSTRACT

K. Rozalska and S. Coffen-Smout, 2020. Maritimes Region Fisheries Atlas: Catch Weight Landings Mapping (2014–2018) on a Hexagon Grid. Can. Tech. Rep. Fish. Aquat. Sci. 3373: vi + 68 p.

This report shows commercial fisheries catch weight landings maps of directed fisheries and bycatch from the Scotian Shelf, the Bay of Fundy, and Georges Bank from NAFO Divisions 4VWX and the Canadian portions of 5Y and 5Z. Atlantic Canadian inter-regional maps of four species (Atlantic Halibut, Bluefin Tuna, Redfish and Scallop) are also included from NAFO Divisions 4RST, 3KLMNOP, and 2GHJ. Five-year composite maps (2014–2018) that aggregate catches for each map series are publicly available and included in this report. The maps aggregate catch weight (kg) per 10 km<sup>2</sup> hexagon grid cell for selected species, species groupings and gear types to identify important fishing areas. These maps may be compared with 2010–2014 landings maps in Butler and Coffen-Smout (2017) and 1999–2003 landings maps in *The Scotian Shelf: An Atlas of Human Activities* (DFO, 2005). These maps may be used for decision making in coastal and oceans management, including marine spatial planning, environmental emergency response operations and protocols, Marine Stewardship Council certification processes, marine protected area networks, and ecological risk assessment.

## RÉSUMÉ

K. Rozalska and S. Coffen-Smout, 2020. Maritimes Region Fisheries Atlas: Catch Weight Landings Mapping (2014–2018) on a Hexagon Grid. Can. Tech. Rep. Fish. Aquat. Sci. 3373: vi + 68 p.

Le présent rapport montre les cartes des débarquements par poids des prises issues de la pêche commerciale en tenant compte des pêches dirigées et des prises accessoires pour la plate-forme Néo-Écossaise, la baie de Fundy et le banc de Georges des divisions 4VWX de l'OPANO et les portions canadiennes des divisions 5Y et 5Z. Les cartes interrégionales de l'Atlantique canadien sont également incluses pour quatre espèces (flétan de l'Atlantique, thon rouge, sébaste et pétoncle) dans les divisions 4RST, 3KLMNOP et 2GHJ de l'OPANO. Les cartes composites sur cinq ans (2014 à 2018) qui regroupent les prises pour chaque série de cartes sont accessibles au public et incluses dans le présent rapport. Les cartes incluent le poids des prises (en kilogrammes) par cellule de carte quadrillée hexagonale de 10 km<sup>2</sup> pour les espèces ou les groupes d'espèces choisis et les types d'engins afin de cibler les zones de pêche importantes. Ces cartes peuvent être comparées avec les cartes des débarquements de 2010 à 2014 dans Butler et Coffen-Smout (2017) et aux cartes des débarquements de 1999 à 2003 dans *La plate-forme Néo-Écossaise : atlas des activités humaines* (MPO 2005). Elles peuvent être utilisées à des fins décisionnelles relativement à la gestion des côtes et des océans, notamment la planification spatiale marine, les opérations et les protocoles d'intervention en cas d'urgence environnementale, les processus de certification du Marine Stewardship Council, les réseaux d'aires marines protégées et l'évaluation de risque écologique.

## INTRODUCTION

The fisheries catch weight landings maps in this report show commercial fisheries landings (directed fisheries and bycatch) for the Scotian Shelf, the Bay of Fundy, and Georges Bank from NAFO Divisions 4VWX and the Canadian portions of 5Y and 5Z. Atlantic Canadian inter-regional maps of four species (Atlantic Halibut, Bluefin Tuna, Redfish and Scallop) are also included from NAFO Divisions 4RST, 3KLMNOP, and 2GHJ. These four species were selected for inter-regional mapping because they feature inter-regional stock assessment and/or management practices. Landings were combined for the years 2014–2018. The commercial fisheries logbook data sources include four regional databases maintained by DFO Policy and Economics Branch: the Maritime Fishery Information System (MARFIS) database in Maritimes Region, as well as data from Gulf Region, Quebec Region, and Newfoundland and Labrador Region. This report includes offshore Lobster and Disputed Zone Area 38B Lobster, but not inshore Lobster. Inshore Lobster fishery landings are recorded using a statistical grid rather than with geographic coordinates. A separate atlas was created for inshore Lobster fished from 2012–2014 (Serdynska and Coffen-Smout, 2017). An updated inshore Lobster atlas is currently in progress to display 2014–2018 data.

Five-year composite maps were created that aggregate landed catch weight (kg) per 10 km<sup>2</sup> hexagon grid cell for selected species, species groupings and gear types to identify important fishing areas. Erroneous data were removed to address missing and incorrect geographic coordinates e.g., data on land, data for bottom fisheries in depths > 1,500 m, and data on the U.S. side of the Gulf of Maine international maritime boundary. Logbook records were also screened for privacy to comply with the Government of Canada’s privacy policy (known as the “Rule of Five”) on vessel-specific fishing locations (Treasury Board Directive, 2010). For each map layer, the logbook records within NAFO unit areas containing data from fewer than five vessel IDs, licence IDs or fisher IDs were excluded. The percentage of total live weight associated with missing or incorrect coordinates and privacy screened data is presented in Table 1. Each map is publicly available and included in this report, and the corresponding digital data containing aggregated catch weight per hexagon grid cell will be published on the Open Data portal.<sup>1</sup>

These maps may be compared with 2010–2014 landings maps in Butler and Coffen-Smout (2017) and 1999–2003 landings maps in *The Scotian Shelf: An Atlas of Human Activities* (DFO, 2005). These spatial depictions of human activity do not represent biological distributions of species as species’ range distributions are broader than fishing intensity footprints. In addition, management measures influence the fishing effort distribution and thus landings. These maps may be used for decision making in coastal and oceans management, including marine spatial planning, informing environmental emergency response operations and protocols, informing Marine Stewardship Council certification processes, planning marine protected area networks, and ecological risk assessment.

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<sup>1</sup> See Open Data portal online: <<https://open.canada.ca/en/open-data>>.

## **METHODS**

### **Data Processing**

The first step in processing logbook data was to standardize the tabular datasets received from four regions. Variables in the datasets included: catch latitude and longitude, species landed, live weight, date caught, date landed, NAFO unit area, gear type, vessel ID, licence type, licence ID (not available for Newfoundland and Labrador Region), and fisher ID. While similar information is reported and stored in these regional databases, the data is organized using different formats that needed to be standardized before merging them into a single dataset.

Individual logbook entries typically include a reported geographic location. The four regional databases store geographic coordinates using various formats that needed to be recalculated into a single, consistent coordinate format. Maritimes and Gulf Region's logbook entry locations were stored in degrees decimal minutes. Newfoundland and Labrador Region locations were stored in degrees minutes seconds. Quebec Region locations were provided as decimal degrees. All coordinates were converted to decimal degrees in preparation for converting the tabular data to spatial data in ArcGIS software.

Non-spatial data fields also required standardization prior to combining the datasets. The data fields in the MARFIS (Maritimes Region) database were used as the template table structure, as it contained the majority of the logbook records used in this analysis. The Newfoundland and Labrador Region stored landed weight values in pounds, which needed to be converted to kilograms to be consistent with the other three regions.

The four regional datasets were then converted to ArcGIS point feature classes using a WGS 1984 coordinate system. The data from all four regions were merged into a single feature class, from which all future data products would be created. Logbook entries were parsed based on species, species groupings and gear type to create individual feature classes. For select fisheries (groundfish and scallop), quarterly datasets were also produced based on the fished date. Two dates (fished date and landed date) were provided by all regions except for Quebec, which provided only the landed date. For Quebec records, and those missing a fished date, the landed date was used instead to derive quarterly maps.

### **Missing and Erroneous Geographic Coordinates**

Logbook entries provided by all four regions contained records with missing or erroneous geographic coordinates. Known errors and records with missing coordinates were excluded, and their corresponding weights are summarized in Table 1. Not all erroneous coordinates could be detected, therefore it is assumed that additional errors exist in the database.

Groundfish, crustacean and mollusc points that were located in depths of greater than 1,500 metres were assumed to be errors, as the gear used to fish those species is not used at those depths. A bathymetry dataset obtained from the General Bathymetric Chart of the Oceans (GEBCO Compilation Group, 2019) was used to overlay landings points to determine which ones were in depths greater than 1,500 m. In addition, some points were located on land. All points located more than one kilometre inland from the coast were excluded. A one kilometre buffer inland of the coastline was created to include points that were on land, but still close to the water. This allowed some additional points to be included in the maps that may have had minor inaccuracies or rounded coordinates. Points located on the U.S. side of the Gulf of Maine

international maritime boundary, in NAFO divisions 5Y and 5Z were also removed. All of the regional logbook datasets listed the NAFO unit area for each record; however, some points were located particularly far from their reported unit area. For example, points listed as being fished in unit areas within the Gulf of Saint Lawrence, but were located on the Scotian Shelf were assumed to have erroneous coordinates and were removed. A review of the maps by the DFO Commercial Data Division staff revealed a small number of additional errors consisting of isolated points and records in areas that are known not to have fishing activity. The percentage of total live weight associated with missing or incorrect coordinates (Table 1) ranged from 0.3 percent (Silver Hake, offshore clam, and shrimp) to 44.1 percent for crab (other than Snow Crab), with an average of 6.6 percent. Presentation of sea urchin landings was considered, however, 84 percent of the logbook records did not have coordinates.

## **Privacy Screening**

To comply with the Government of Canada’s privacy policy on vessel-specific fishing locations (Treasury Board Directive, 2010), privacy assessments were conducted for maps to identify NAFO unit areas containing data from fewer than five vessel IDs, licence IDs or fisher IDs, known as the “Rule of Five.” If this threshold was not met, confidential information such as catch weight has been withheld from these unit areas to protect the identity or activity of individual vessels or companies.

In order to conduct privacy assessments against the Rule of Five, each logbook record was first assigned to a NAFO unit area. NAFO unit areas were derived by DFO for fisheries management and stock assessment purposes, and are subsets of larger NAFO subdivisions (NAFO, 2017). Although each of the regional logbook databases already included the NAFO unit area, there was inconsistency between how the regions assigned unit areas to each record. To maintain consistency, a spatial data layer that is maintained by DFO was used to assign each record to a NAFO unit area. If points landed on a line between two unit areas, the reported unit area was used from the original logbook database. The number of unique occurrences of vessel ID, licence ID and fisher ID per NAFO unit area was tabulated for each species, species grouping and gear type. If all three variables passed the Rule of Five in a given unit area, the data within that unit area were included in the final map. NAFO unit areas failing to meet the privacy screening threshold are symbolized by grey-shaded hatching in catch weight maps and are labelled as privacy screened areas. Digital data published to the Open Maps portal will not include personal information such as fisher ID, vessel ID or licence ID.

Adjustments were made to the privacy assessments of inter-regional maps for Bluefin Tuna, Atlantic Halibut, Scallop, and Redfish to account for the lack of licence IDs in data from Newfoundland and Labrador Region. For these species, logbook entries in NAFO divisions 0, 2, 3 and 4R passed the privacy screening if there were more than five unique fisher IDs and vessel IDs. The total weight of landings for all species, species groupings and gear types that were removed due to privacy screening are listed in Table 1.

For Hagfish, offshore Lobster and offshore clam fisheries with low numbers of licence holders, consent was sought from licence holders to publicly release map products. Consents from Sea Cucumber licence holders were not sufficient to warrant including a regional Sea Cucumber map.

**Table 1.**—Summary of landed weights of logbook records with missing and erroneous coordinates, and data excluded due to privacy screening. Logbook entries per species include all gear types. Weights are provided in metric tonnes (t). Percentages may not total 100 due to rounding. (\* = Inter-regionally mapped fishery)

	Data included in map		Missing or erroneous coordinates		Privacy Screened	
	Live Weight (t)	%	Live Weight (t)	%	Live Weight (t)	%
Groundfish	199,811	98.6	2,860	1.4	5.1	0.003
Groundfish Bottom Trawl	173,222	99.3	1,132	0.6	141	0.08
Groundfish Gillnet	2,635	52.5	501	10.0	1,886	37.6
Groundfish Bottom Longline	16,356	94.5	951	5.5	1.6	0.01
Atlantic Cod†	6,433	-	251	-	-	-
Atlantic Cod, Haddock, Pollock	105,781	98.9	1,137	1.1	0.1	0.0001
Flatfish	5,792	95.7	254	4.2	7.1	0.1
Halibut*	18,423	86.0	2,782	13.0	207	1.0
Greenland Halibut	98	97.8	1.9	1.9	0.2	0.2
Hagfish	5,383	97.9	114	2.1	Permission obtained	
Cusk	783	93.9	50	6.1	0.04	0.004
Dogfish	175	94.4	8.9	4.8	1.5	0.8
Redfish*	45,713	84.1	841	1.5	7,785	14.3
Red Hake	2,221	98.8	11	0.5	16	0.7
Silver Hake	32,771	98.4	106	0.3	434	1.3
White Hake	2,580	95.5	122	4.5	0.5	0.02
Monkfish	430	98.0	8.1	1.9	0.8	0.2
Sculpin	1,275	94.0	74	5.5	6.9	0.5
Skate	206	93.3	2.5	1.1	12	5.6
Wolffish	14	86.0	2.0	12.0	0.3	2.0
Squid	169	96.6	1.1	0.6	4.9	2.8
Herring	271,962	92.0	23,664	8.0	108	0.04
Mackerel	4,324	64.3	2,015	30.0	381	5.7
Large Pelagics	8,513	95.7	379	4.3	2.6	0.03
Bluefin Tuna*	1,942	80.1	451	18.6	31	1.3
Other Tuna	1,492	96.3	56	3.6	1.9	0.1
Swordfish	5,712	97.4	151	2.6	3.7	0.06
Porbeagle, Mako, Blue Shark	327	97.3	6.9	2.1	2.1	0.6
Snow Crab	47,490	97.7	985	2.0	132	0.3
Other Crab	2,043	45.6	1,975	44.1	463	10.3

Scallop*	290,755	98.0	3,791	1.3	2,222	0.7
Offshore Clam	132,042	99.7	440	0.3	Permission obtained	
Shrimp	16,814	99.7	51	0.3	7.4	0.04
Offshore Lobster	3,469	97.2	98	2.8	Permission obtained	
Disputed Zone Lobster Area 38B	2,624	67.9	1,242	32.1	0	0
Whelk	1,737	98.2	31	1.8	Permission not required	

† Only one unit area did not pass the privacy screening criteria for Atlantic Cod. To protect the confidentiality of fishers in this area, the weight fished in this unit area was not included.

## Data Aggregation and Map Production

Data aggregation methods were used to depict fishing intensity and distribution for a public audience. Aggregation methods group the data to illustrate spatial patterns and trends. The simplest and most common method to aggregate fisheries data involves binning spatial data into grid cells. Grids are an array of cells of equal size, with each cell containing a summary of the values of interest (live weight) of the points that land within it.

Hexagon grid cells of 10 km<sup>2</sup> were used for all maps in this report to ensure consistency with DFO's guidance in the Atlantic Canadian Protocol on Mapping Fishing Activity (Koropatnick and Coffen-Smout, 2020). The hexagon grid was created using the Canada Albers Equal Area Conic Projection to minimize grid distortion. Square or fishnet grids are prone to edge effects, require an offset grid to capture data within cells rather than on boundary lines, and create perceived linear patterns. Hexagon grids are preferred for several reasons: (1) they reduce edge effects and sampling bias as a hexagon grid has the lowest perimeter to area ratio of any regular tessellation of the plane; (2) all adjacent cells share the same shared boundary length and the distance between centroids is the same for all neighbouring cells; (3) they are a better fit to curved surfaces and along coastlines; and (4) they are better for connectivity and movement paths.<sup>2</sup> There is potential for points that land on the boundary between two grid cells to be included in both cells. However, this did not occur, therefore none of the logbook entries were duplicated during the aggregation process.

After data aggregation of each map layer, cells with values less than 0.5 kg were excluded from the maps. Blank log records in the Maritimes Region's MARFIS database are assigned a value of 0.001 kg by DFO's Commercial Data Division to avoid calculation errors that would result from zero values. As such, these values do not significantly affect overall calculations or the data aggregation, except where a single hexagon grid cell has a very low binned weight value resulting in spurious map symbolization. Therefore, all hexagon grid cells with a total binned weight of < 0.5 kg were excluded, i.e., the smallest approximate weight of a single fish. The percent of grid cells removed per species, species grouping or gear type data layer ranged from 0 to 20.9 percent, with an average of 1.6 percent. The majority of the map layers (31 of 44) had less than one percent of grid cells removed.

Following data aggregation, a map was created for each species, species grouping or gear type. Hexagon grid cells for each map were divided into five intervals based on their aggregated catch weight using quantile breaks, where each class has an equal number of grid cells. This means that the breaks on each map are different and the coloured cells have different values on

<sup>2</sup> See Fishnets and Honeycomb: Square vs. Hexagonal Spatial Grids: <<https://strimas.com/post/hexagonal-grids/>>.

each map. For seasonal maps (groundfish and scallop), the same break values were selected for each season so that maps can be compared more easily. Therefore, seasonal maps were not divided by quantile breaks. Digital data published on the Open Data portal will only include the aggregated catch weight per hexagon grid cell.

## **FISHERIES DESCRIPTIONS AND CATCH WEIGHT LANDINGS MAPS**

Fisheries are managed using various measures, e.g., quotas, gear restrictions, seasons, area closures, size restrictions, and other characteristics of the targeted species. Management measures outlined in the following brief species, species grouping, or gear type descriptions are incomplete and may change at any time. Information in the descriptions is based on integrated fisheries management plans (IFMPs) and input from DFO Resource Management advisors. Updated descriptions of current fisheries management measures and practices are available in the species-specific IFMPs, conservation harvesting plans (CHPs), fisheries licence conditions, and variation orders available from DFO Resource Management.<sup>3</sup> The following species descriptions include, where applicable, the status of Species at Risk Act (SARA) designations,<sup>4</sup> Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessments,<sup>5</sup> and Marine Stewardship Council (MSC) fishery sustainability certifications.<sup>6</sup> The following maps show catches from directed fisheries and bycatch.

DFO monitors commercial fish stocks on the Scotian Shelf and publishes stock status reports on individual species available from the Canadian Science Advisory Secretariat (CSAS).<sup>7</sup> The State of the Atlantic Ocean Synthesis Report (Bernier et al., 2018) and the State of the Scotian Shelf theme paper, *Fish Stock Status and Commercial Fisheries* (O'Boyle, 2012), provide information on key fish stocks, harvest control rules, and trends in commercial fisheries in Atlantic Canada.

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<sup>3</sup> See IFMPs and Fishery Openings and Closures online: <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/index-eng.html>> and <<http://www.inter.dfo-mpo.gc.ca/Maritimes/Commercial-Fisheries>>.

<sup>4</sup> See SARA Registry: <<http://www.sararegistry.gc.ca>>.

<sup>5</sup> See COSEWIC assessments: <<http://www.cosewic.gc.ca>>.

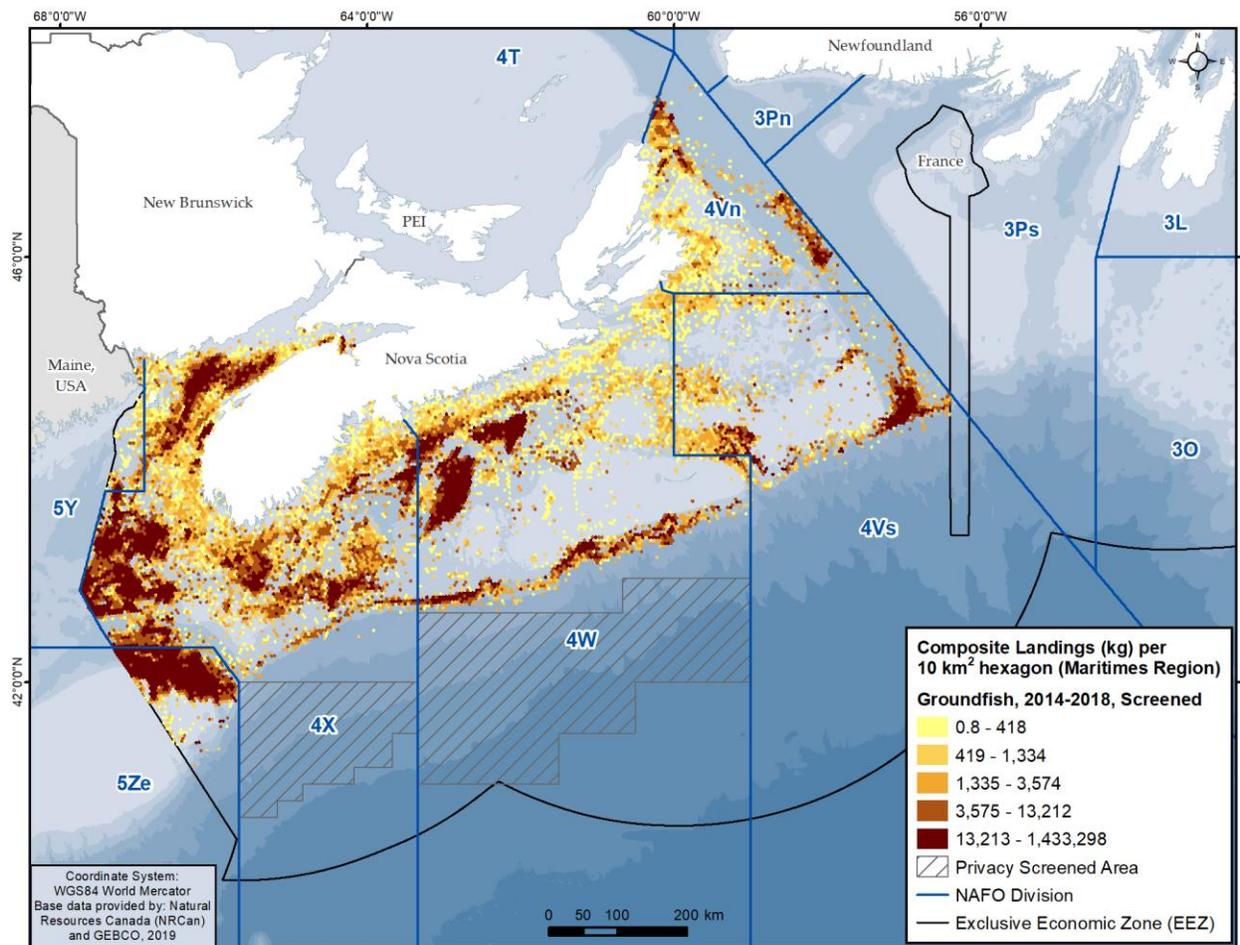
<sup>6</sup> See Marine Stewardship Council: <<http://www.msc.org>>.

<sup>7</sup> See DFO CSAS publications online: <<http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm>>.

## Groundfish (Figure 1)

Figure 1 shows all groundfish species landings (directed fisheries and bycatch), including Atlantic Cod, Atlantic Halibut, Greenland Halibut, Haddock, Pollock, flatfishes (e.g., Yellowtail, Witch and Winter Flounders, and American Plaice), Silver Hake, dogfish, Atlantic Hagfish, wolffish, and redfish. Lesser known species include White Hake, Red Hake, Cusk, skate sp., Arctic Skate, Monkfish, butterfish, tomcod, lumpfish, Roundnose Grenadier, tilefish and sculpin. All groundfish species landed have been mapped regardless of whether they are defined as groundfish under the *Atlantic Fishery Regulations*. The map in Figure 1 shows directed groundfish catch and bycatch in other fisheries. Most groundfish are caught by mobile trawl gear and bottom longline vessels.<sup>8</sup>

Figure 1.—Groundfish Landings (All Species), 2014–2018

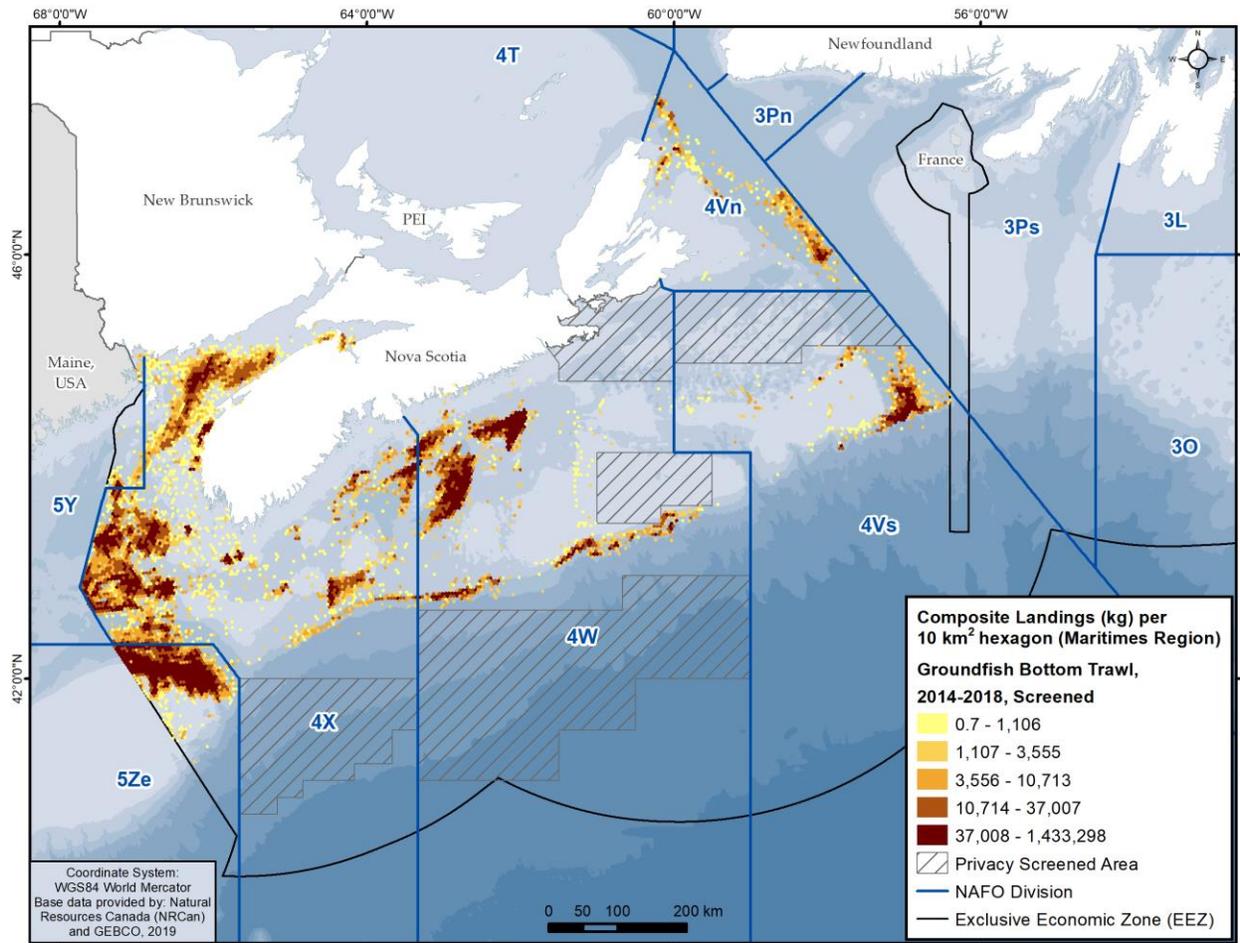


<sup>8</sup> Groundfish 4VWX5 Integrated Fisheries Management Plan, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html>>.

## Groundfish Bottom Trawl (Figure 2)

Figure 2 shows groundfish landings (directed fisheries and bycatch) from otter trawl, stern and side trawl, shrimp trawl, and Danish and Scottish seine. Otter trawls are used across the Scotian Shelf, with the relative lack of fishing activity on the eastern Scotian Shelf due to the 1993 Atlantic Cod and Haddock moratorium. Otter trawlers have higher landings in mid-shelf basins due to the Silver Hake fishery that uses trawl gear in that area. Groundfish trawl landings include Atlantic Cod, Haddock, Pollock, Cusk, flatfish, Halibut, Monkfish, redfish, Red Hake, Silver Hake, White Hake, dogfish, butterfish, Roundnose Grenadier, sculpin, tilefish, skate, and wolffish.

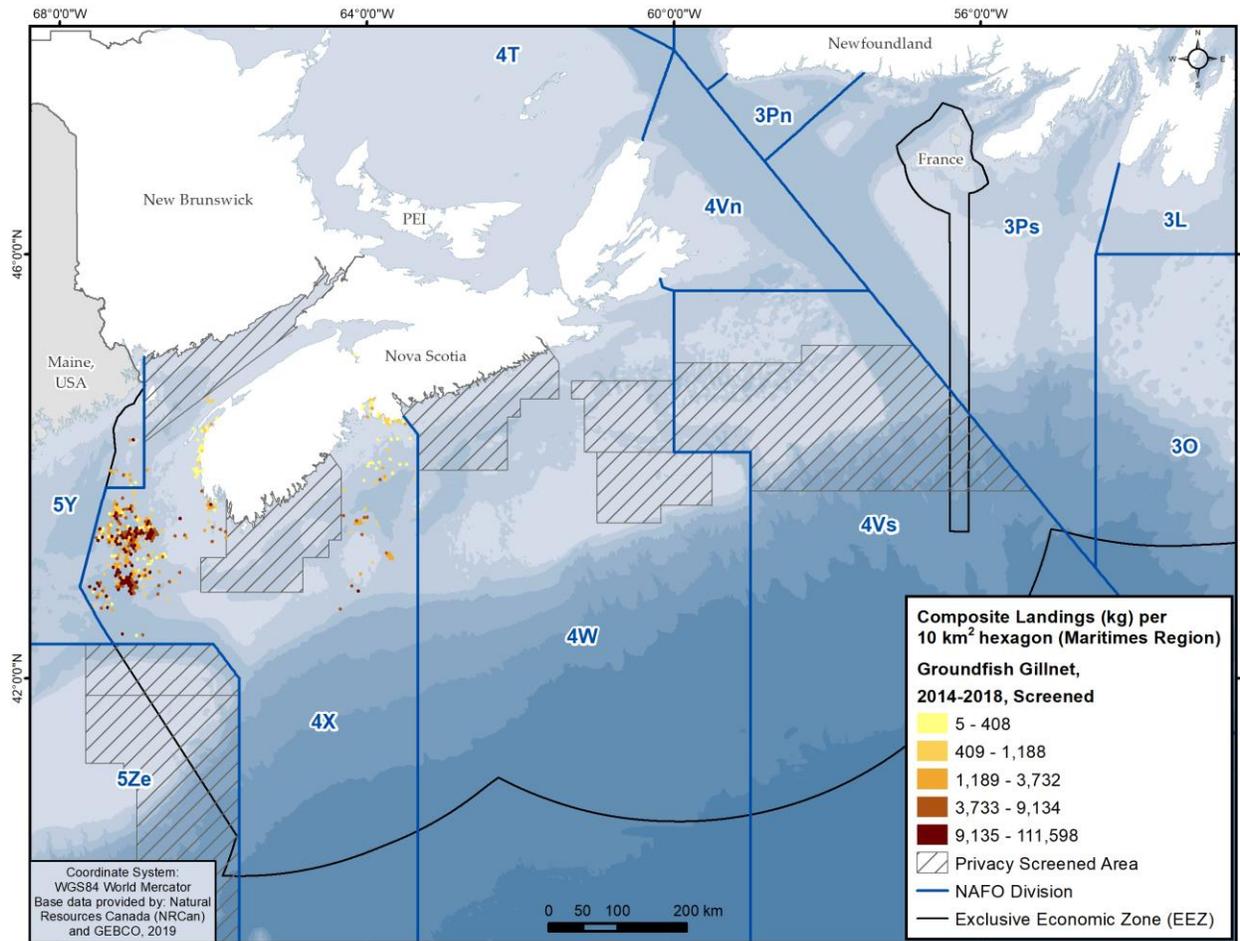
Figure 2.—Groundfish Bottom Trawl Landings, 2014–2018



### Groundfish Gillnet (Figure 3)

Gillnet landings in Figure 3 are from the Scotian Shelf off southwestern Nova Scotia and in the Gulf of Maine. Gillnet landings are scattered, with few areas reporting landings. Many areas do have relatively high landings, suggesting effort is patchily distributed based on important areas. Catch includes Atlantic Cod, Haddock, redfish, Atlantic Halibut, Winter Flounder, skate, Arctic Skate, dogfish, Pollock, White and Silver Hake, Cusk, Monkfish and sculpin.

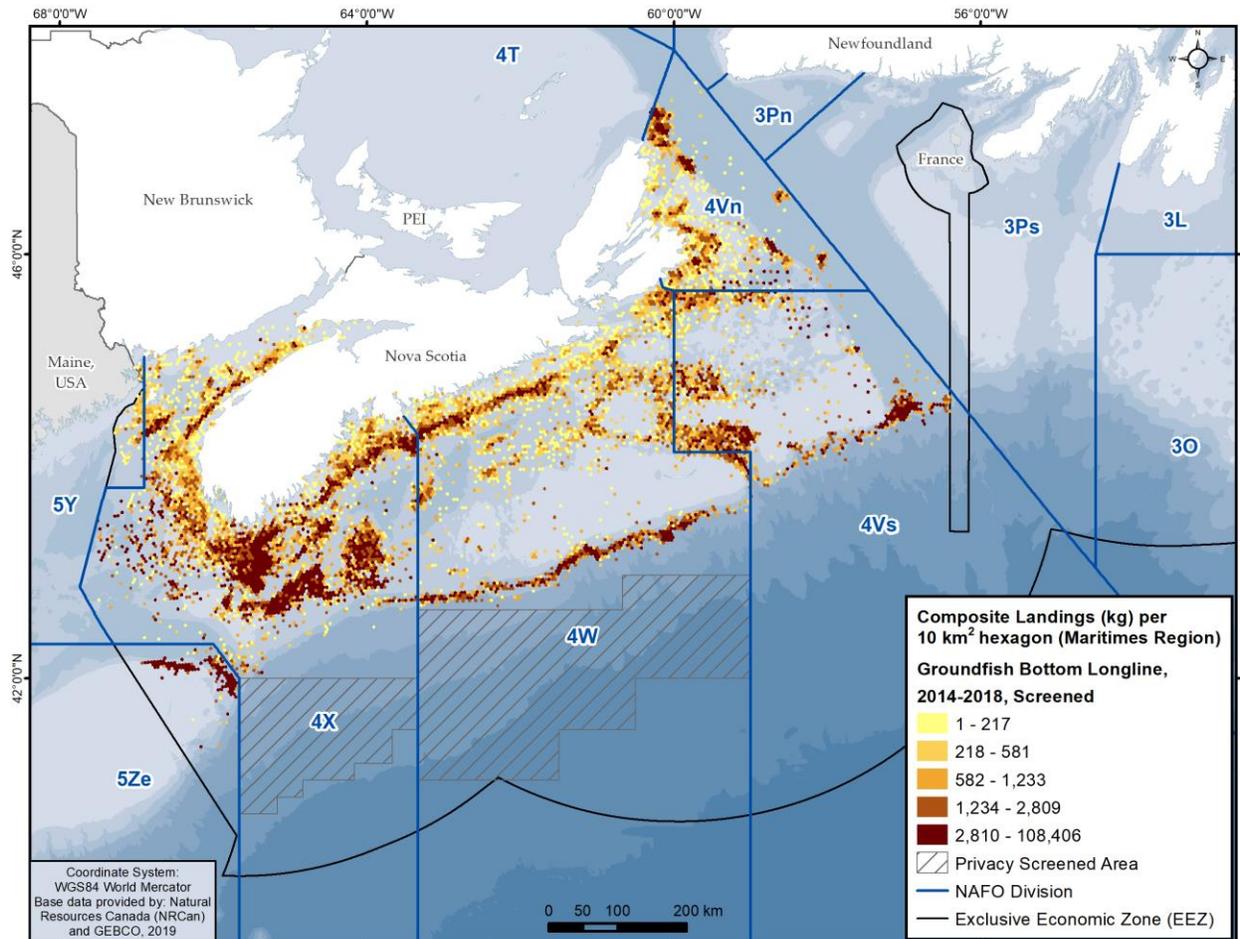
Figure 3.—Groundfish Gillnet Landings, 2014–2018



## Groundfish Bottom Longline (Figure 4)

Figure 4 shows groundfish landings from bottom longline gear. While overlap exists in the areas used by the different groundfish gears, differences are evident. Longline gear is used across the Scotian Shelf, with the relative lack of fishing activity on the eastern Scotian Shelf due to the Atlantic Cod and Haddock moratorium in NAFO areas 4VW. Longliners target Atlantic Halibut along the shelf edge and deeper channels, with fewer landings from the mid-shelf basins.

Figure 4.—Groundfish Bottom Longline Landings, 2014–2018



## Seasonal Groundfish Q1–Q4 (Figures 5 to 8)

Groundfish are caught during all seasons of the year (Figures 5 to 8), with different areas being more or less important depending on the season. Seasonal patterns reflect seasonal fish migrations, management regulations, patterns of activity in other fisheries, and weather and climatic conditions. Some groundfish fisheries run year-round, with higher catches occurring at certain times of the year. From July to September, fishing activity is relatively widespread, particularly on the western Scotian Shelf and in the Bay of Fundy. Georges Bank is closed from the first Sunday in February until June 1 and an active winter fishery occurs in January. A Browns Bank seasonal closure from February 1 to June 15 protects spawning 4X5Y Haddock.

Figure 5.—Seasonal Groundfish Landings, January–March, 2014–2018

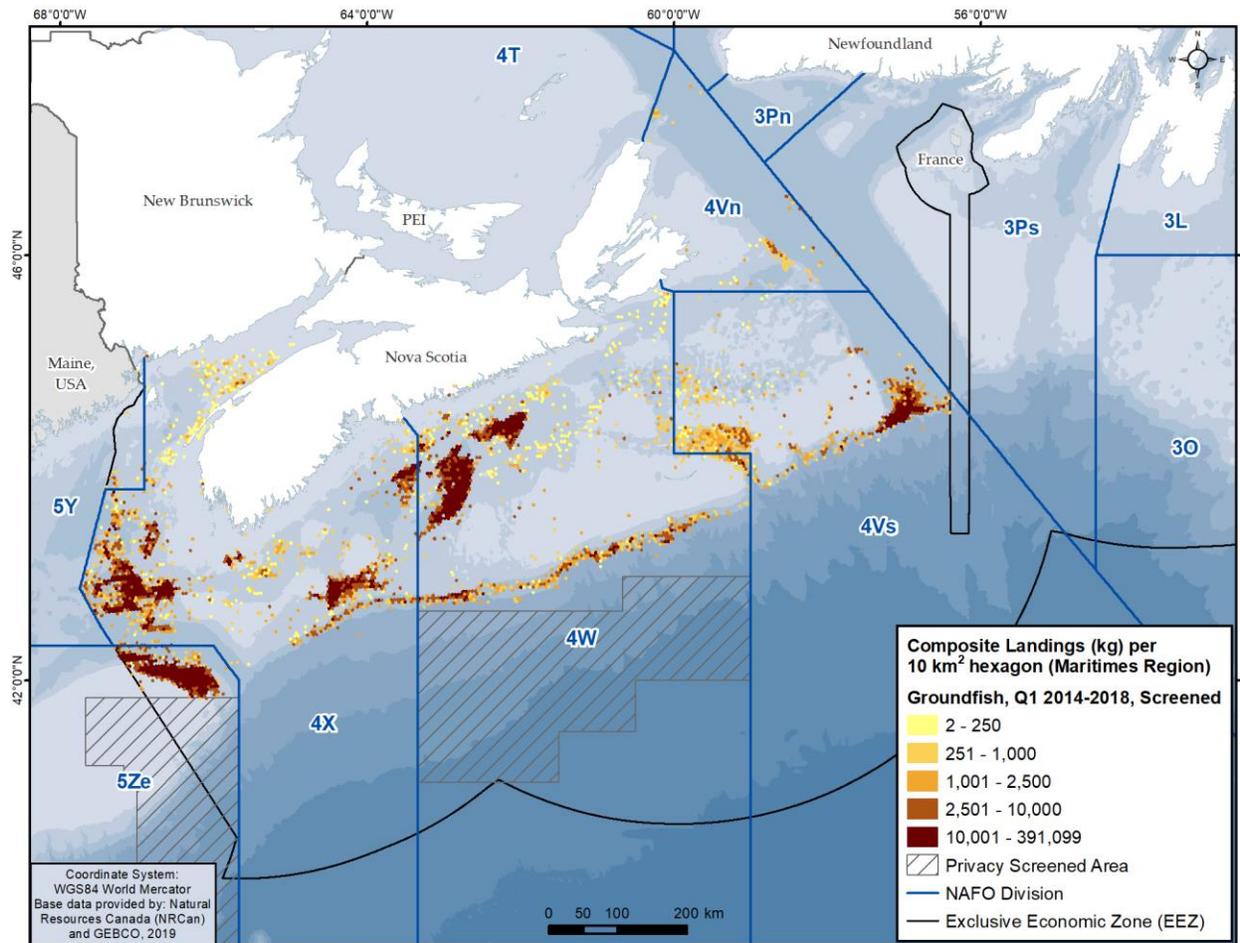


Figure 6.—Seasonal Groundfish Landings, April–June, 2014–2018

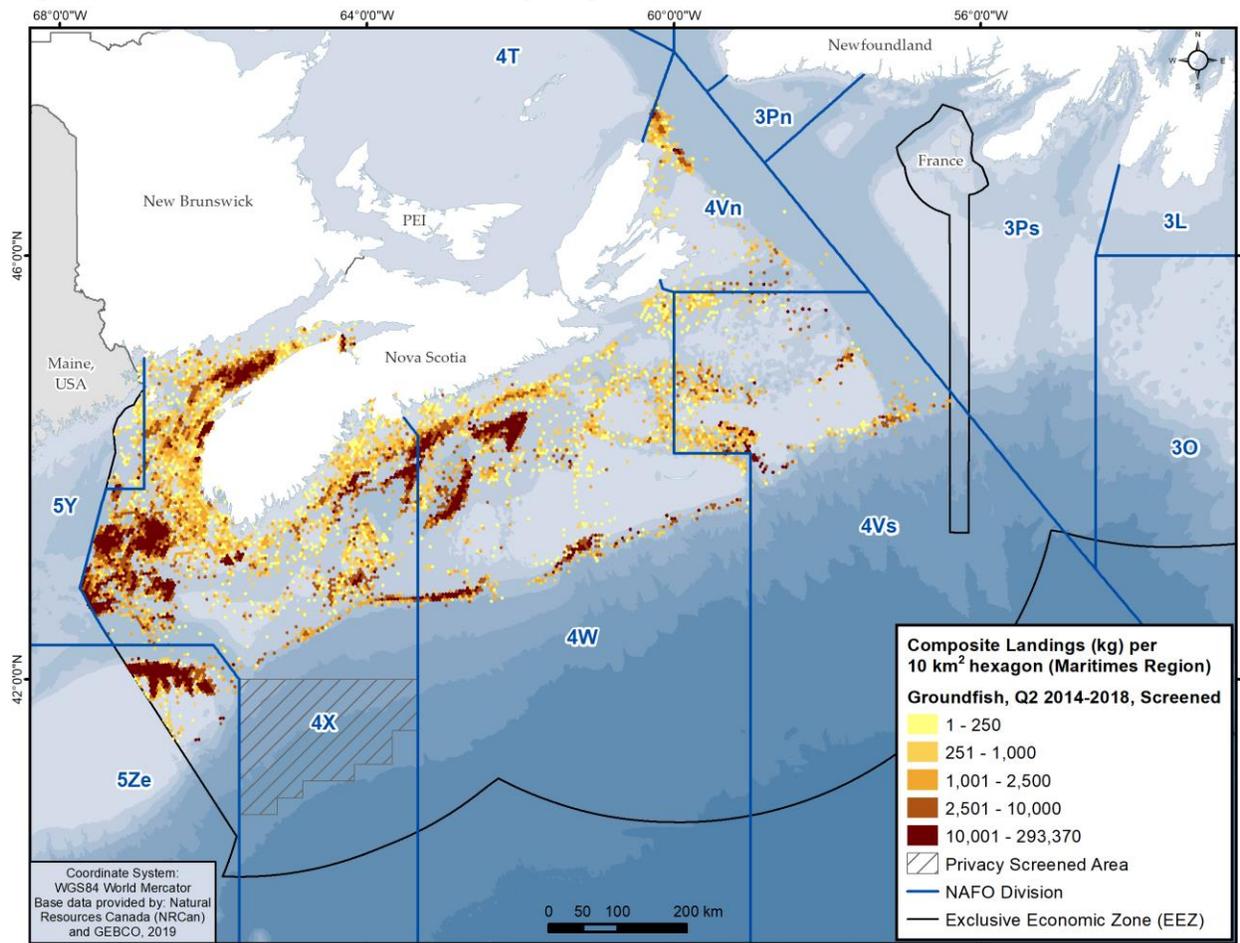


Figure 7.—Seasonal Groundfish Landings, July–September, 2014–2018

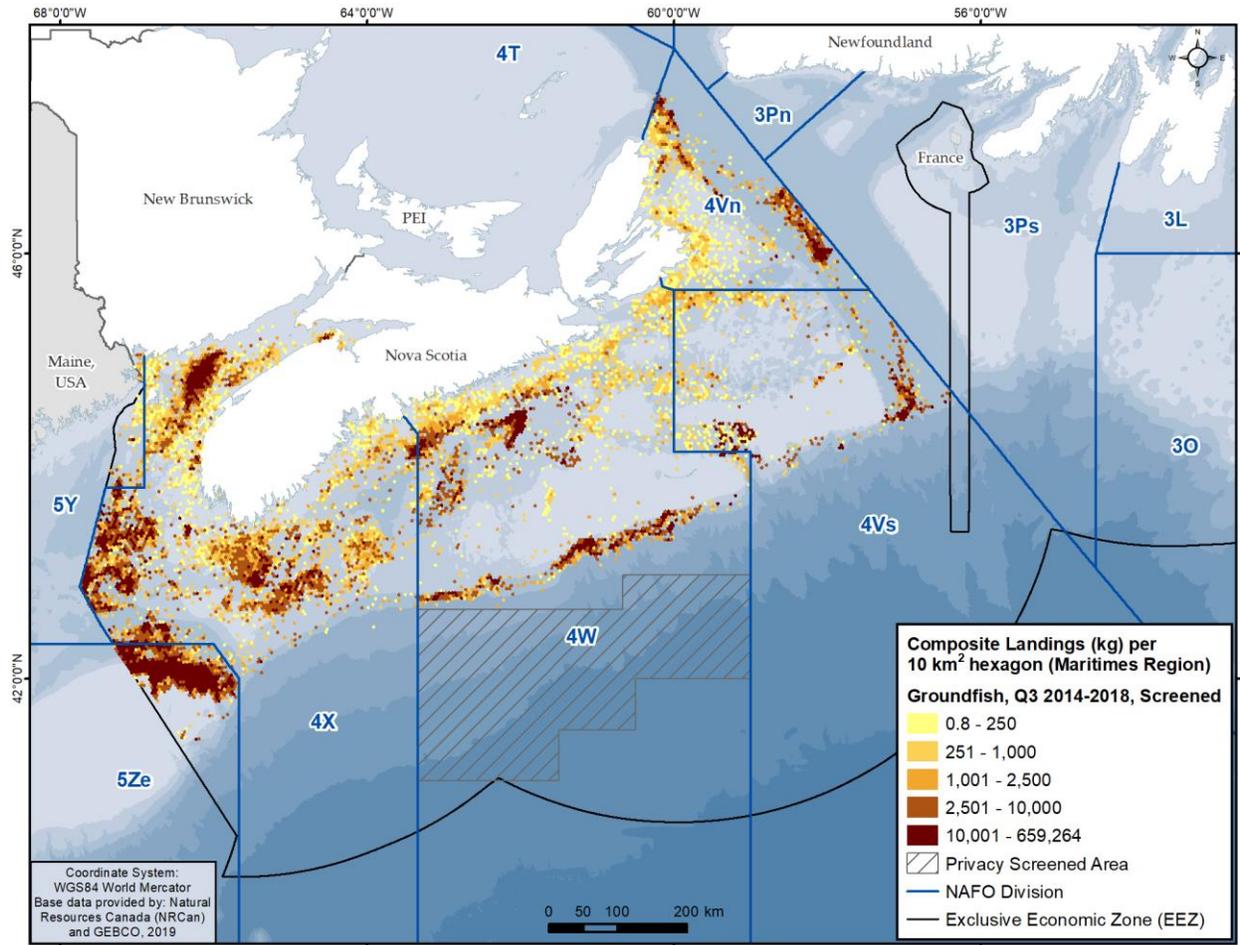
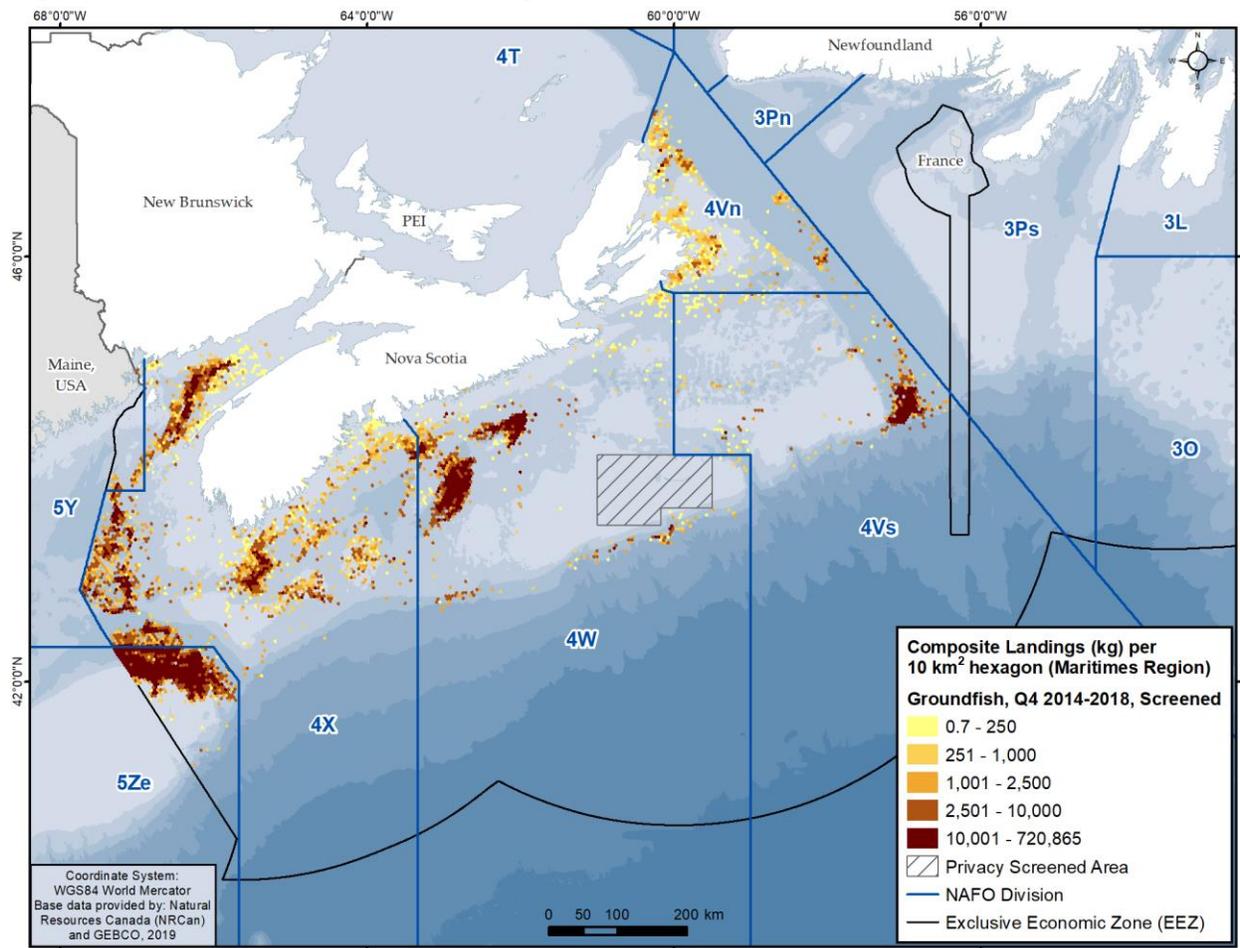


Figure 8.—Seasonal Groundfish Landings, October–December, 2014–2018



### Atlantic Cod (Figure 9)

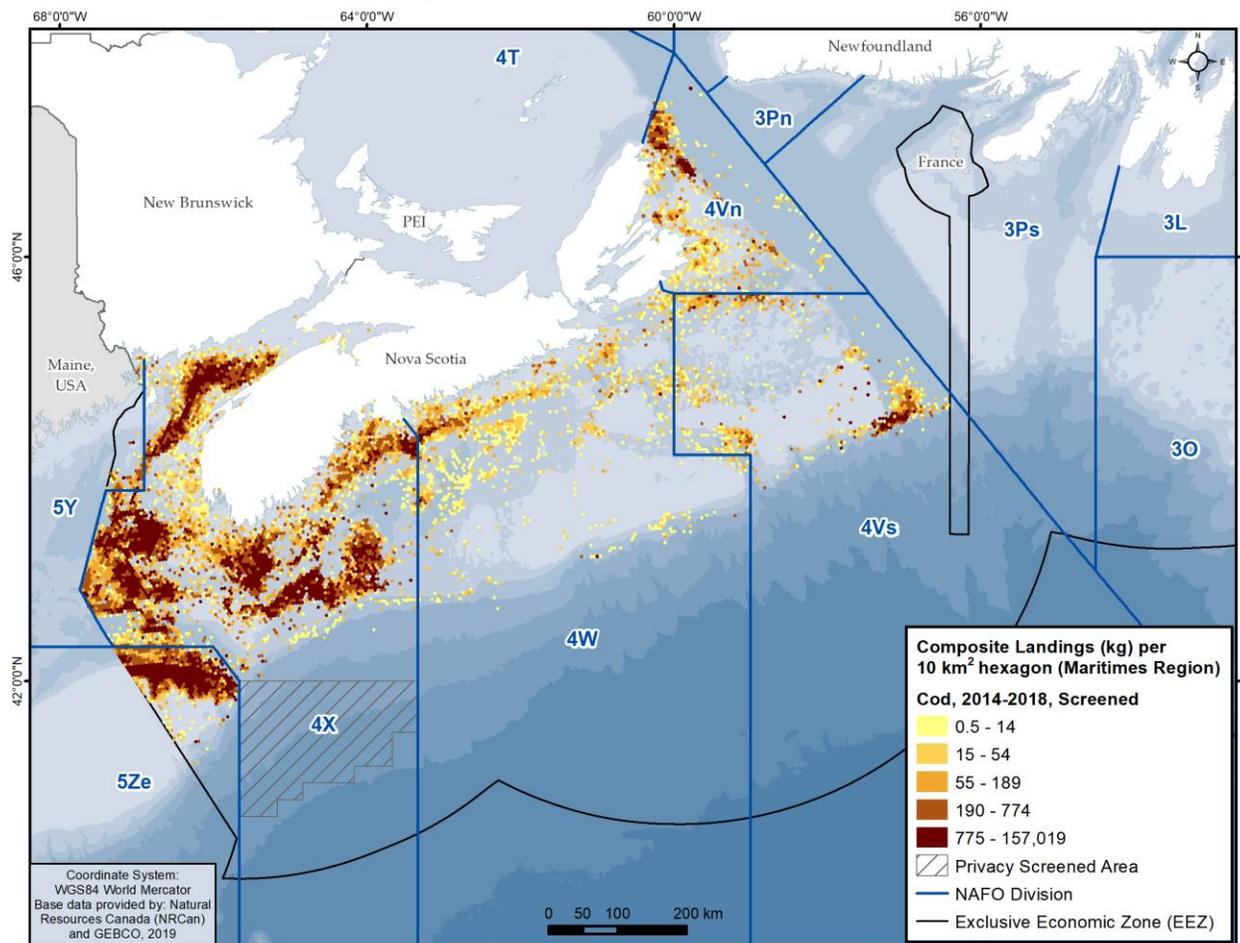
SARA Status: Under consideration for addition to SARA Schedule 1.

COSEWIC Status: Southern and NL Populations, Endangered.

MSC Status: Not in MSC program.

Figure 9 shows Atlantic Cod (*Gadus morhua*) catch as part of a larger multi-species groundfish fishery directing for Atlantic Cod, Haddock, and Pollock using fixed and mobile gear. Landings have declined in the last three decades in areas that have experienced changes in ecosystem trophic structure. With directed fisheries for Atlantic Cod and Haddock closed on the eastern Scotian Shelf (NAFO Divisions 4VW), landings of Atlantic Cod, Haddock and Pollock on the western Scotian Shelf (4X and 5Y) are much higher than on the eastern Scotian Shelf. While there are fishing net mesh size and hook size restrictions in place, there are no minimum size limits for Atlantic Cod in the groundfish fishery.

Figure 9.—Atlantic Cod Landings, 2014–2018



### **Atlantic Cod, Haddock, and Pollock (Figure 10)**

SARA Status: No Status. Atlantic Cod under consideration for addition to SARA Schedule 1.

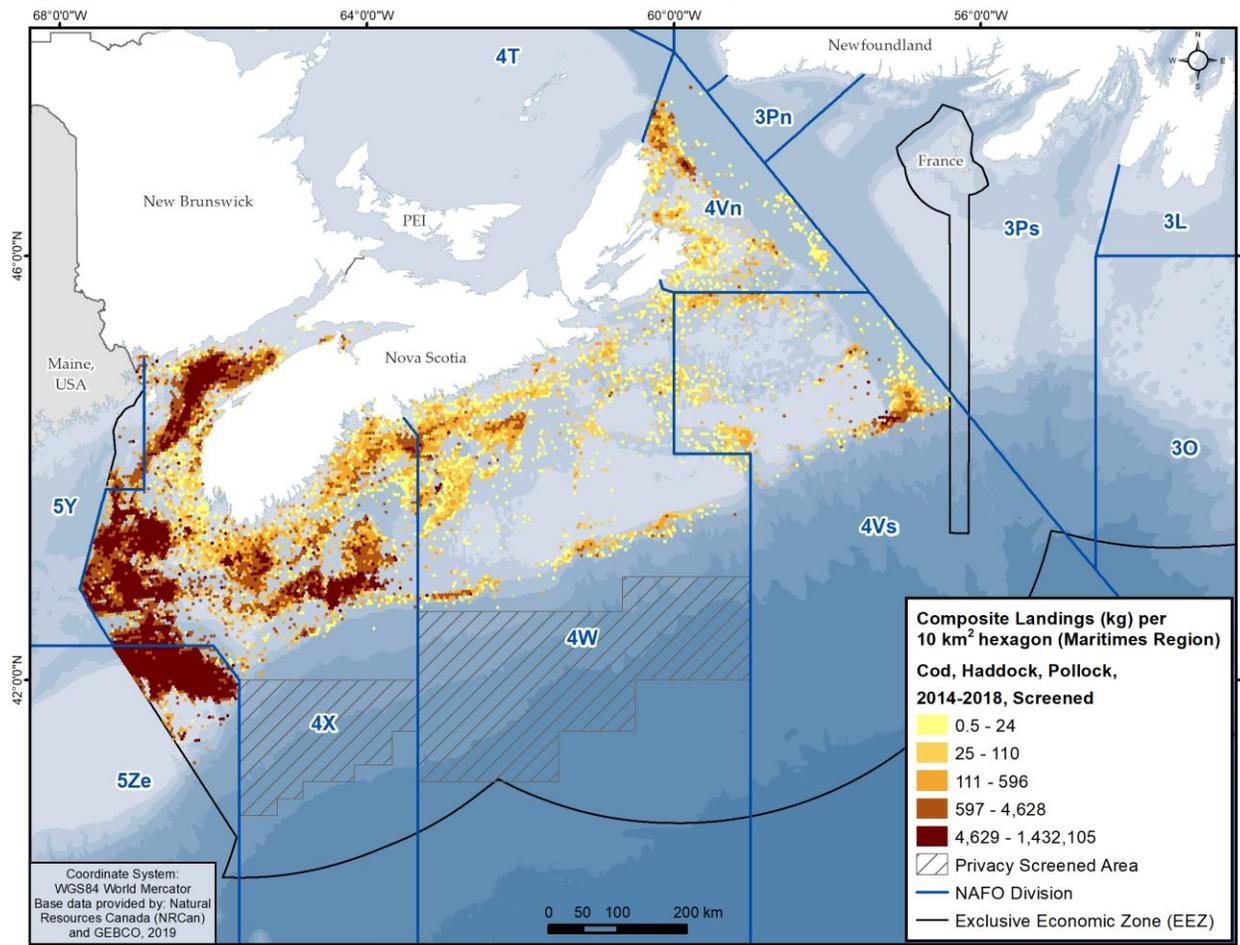
COSEWIC Status: Atlantic Cod Southern and NL populations, Endangered.

MSC Status: Scotia-Fundy Haddock certified as sustainable in October 2010.

Atlantic Cod, Haddock (*Melanogrammus aeglefinus*) and Pollock (*Pollachius pollachius*) have been the dominant groundfish species landed off Nova Scotia. Landings of these species have declined over the last three decades as other species became abundant. With directed fisheries for Atlantic Cod and Haddock closed on the eastern Scotian Shelf (NAFO Divisions 4VW), Atlantic Cod, Haddock, and Pollock landings on the western Scotian Shelf are much higher than on the eastern Scotian Shelf. The Pollock fishery on the eastern Scotian Shelf remains open; however, little effort for Pollock is made in that area due to closures for the other two species. In many parts of the region, fishers catch these three species together.

Atlantic Cod, Haddock, and Pollock fisheries occur mainly on the Scotian Shelf banks and in the Bay of Fundy (Figure 10). The fishery is conducted using otter trawls, bottom longlines, and gillnets. Parts of Browns and Georges Banks are closed seasonally to protect spawning Haddock. In NAFO 4W, the Western/Emerald Banks Conservation Area has been closed to groundfish fishing using mobile gear since 1987 and to all groundfish gear since 1993. The Western/Emerald Banks Conservation Area closure protects a nursery area for spawning and juvenile Haddock and other groundfish and invertebrate species.

Figure 10.—Atlantic Cod, Haddock and Pollock Landings, 2014–2018



### **Flatfish (Figure 11)**

SARA Status: American Plaice, No Status. Under consideration for addition to Schedule 1.

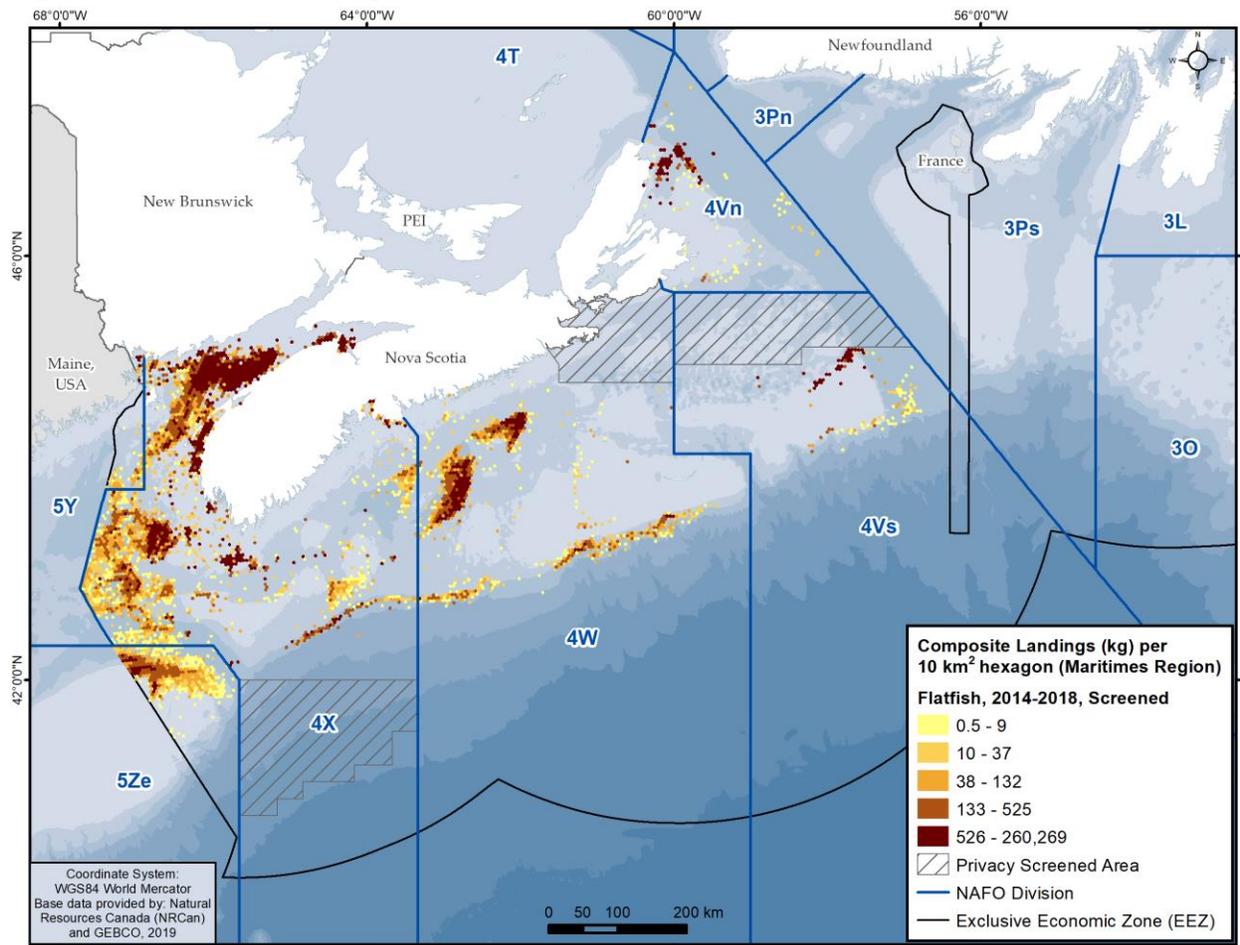
COSEWIC Status: American Plaice, Maritime and NL Populations, Threatened.

MSC Status: Not in MSC program.

Several flatfish species are managed under the 4X5Y total allowable catch (TAC), including Yellowtail Flounder (*Limanda ferruginea*), American Plaice (*Hippoglossoides platessoides*), Winter Flounder (*Pseudopleuronectes americanus*) and Witch Flounder (grey sole) (*Glyptocephalus cynoglossus*). In 4VW, the species are American Plaice, Yellowtail Flounder, and Witch Flounder. On Georges Bank (5Z), Yellowtail Flounder is the primary species caught and this stock is managed separately.

The 4X5Y flatfish TAC was changed to a 4X Winter Flounder TAC in 2015. Figure 11 shows landings from the four species mentioned above, as well as from unspecified flounder. In general, the shelf banks are important for the Yellowtail Flounder and American Plaice fisheries, while deeper areas are more important for Witch Flounder. Winter Flounder is uncommon on the eastern Scotian Shelf, and on the western Scotian Shelf it is concentrated in only a few areas. Historically, the eastern Scotian Shelf (4VW) was more important than the western Scotian Shelf (4X), not including Georges Bank, for Yellowtail Flounder and American Plaice fisheries. However, a general reduction in the groundfish fishery on the eastern Scotian Shelf and a declining abundance of flatfish resulted in low catches in the east (O'Boyle, 2012).

Figure 11.—Flatfish Landings, 2014–2018



## Atlantic Halibut (Figure 12)

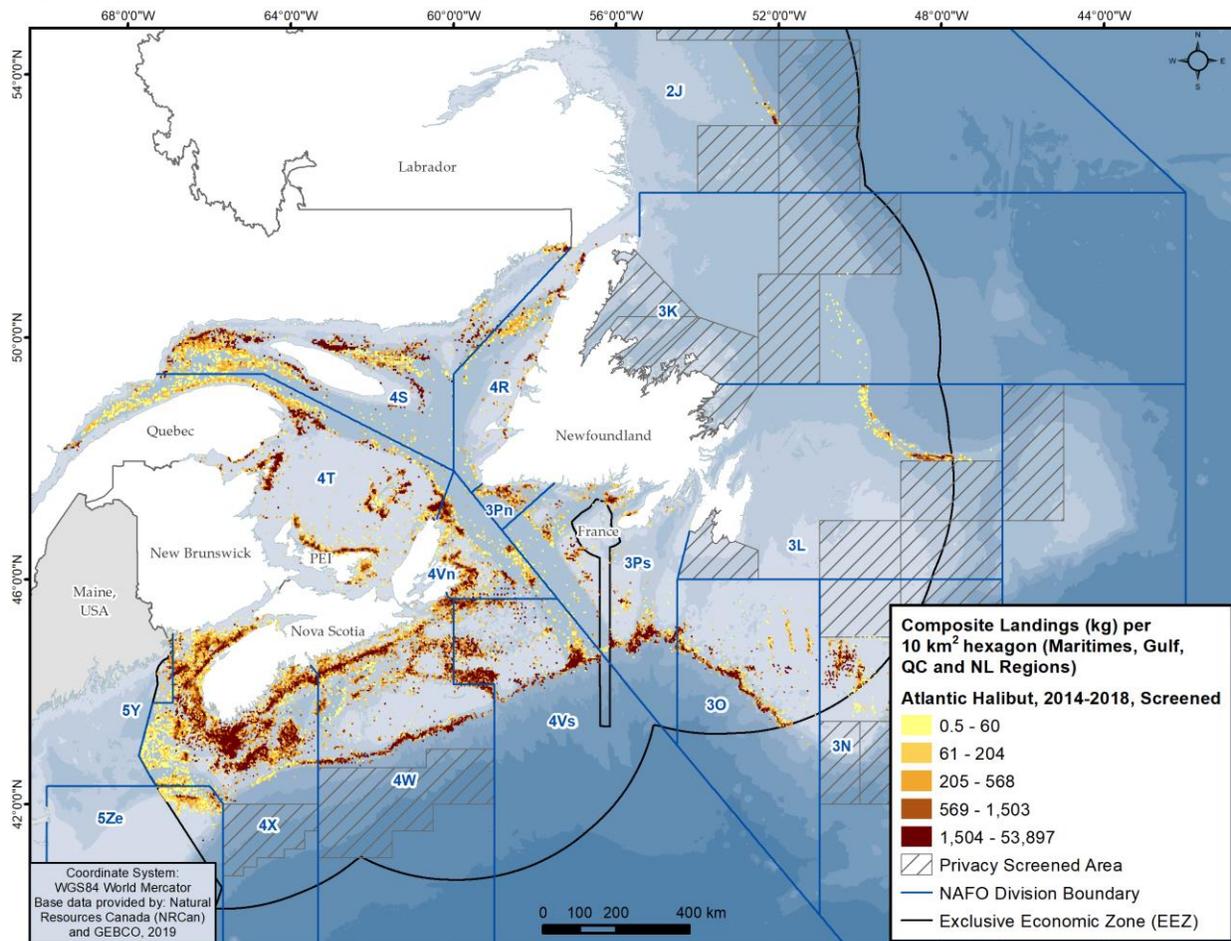
SARA Status: No Status

COSEWIC Status: Not at Risk

MSC Status: Certified as sustainable in May 2013.

Atlantic Halibut (*Hippoglossus hippoglossus*) is the most valuable groundfish species in Atlantic Canada. The Atlantic Halibut fishery was unregulated until 1988, at which time a TAC was implemented for the Scotian Shelf and southern Grand Banks management unit (3NOPs-4VWX5Zc). In 1994, a minimum legal size limit of 81 cm was adopted. On the Scotian Shelf and the southern Grand Banks most landed Halibut is from a directed bottom longline fishery. Halibut is also landed by other bottom longline, trawl, gillnet and handline fisheries. Figure 12 shows inter-regional Halibut catches primarily caught in deep channels and along the shelf edge, but in southwest Nova Scotia (4X) Halibut catch is broadly distributed. There are restrictions on fishing Halibut in the Western/Emerald Banks Conservation Area and in the Gully Marine Protected Area. As well, Halibut fishing is not permitted in the Lophelia Coral Conservation Area and the Northeast Channel Coral Conservation Area. Trip limits and bycatch restrictions are not imposed in the directed Halibut fishery. The Halibut TAC in 2018 was 4,170 tonnes.

Figure 12.—Atlantic Halibut Landings, 2014–2018



### Greenland Halibut (Figure 13)

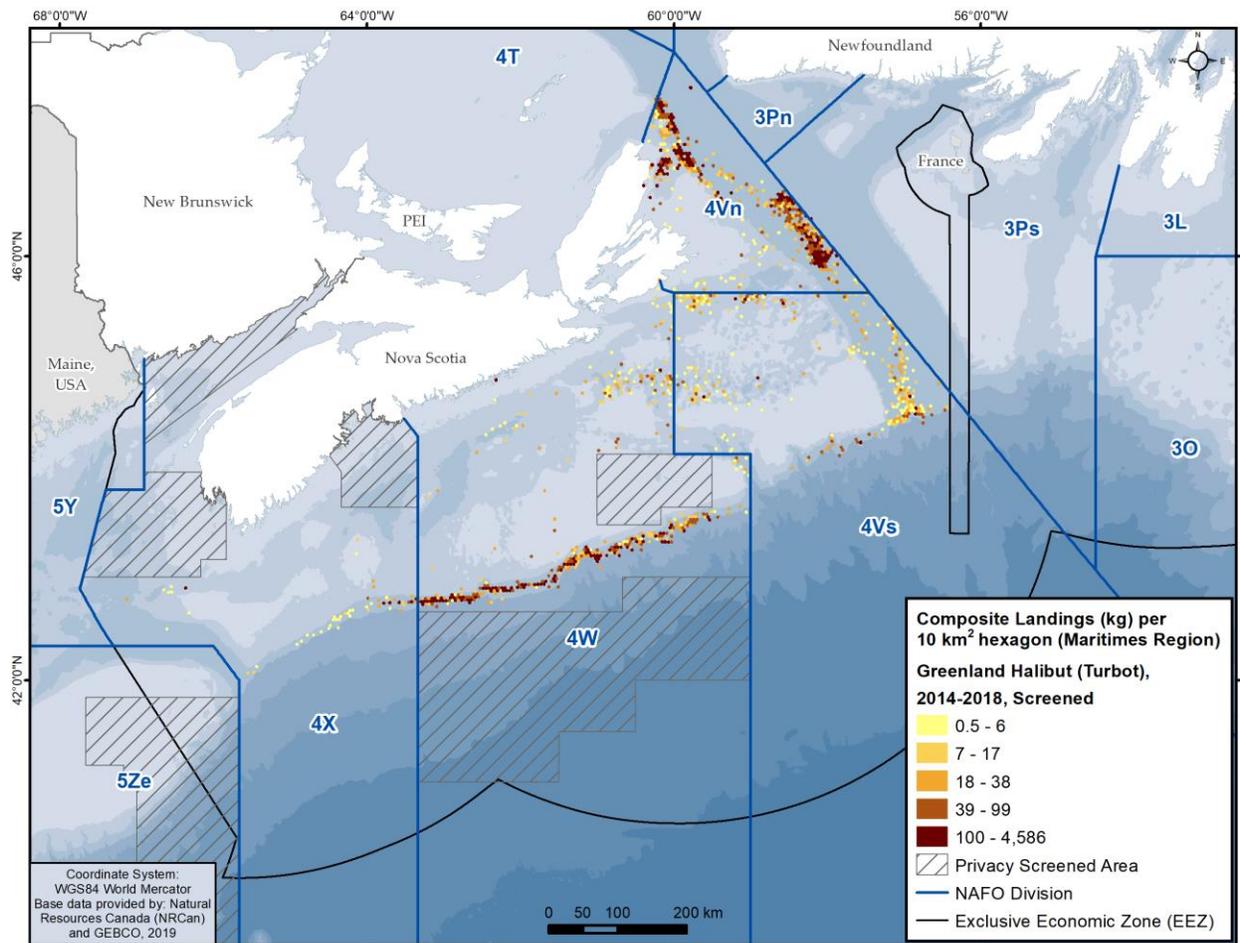
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Greenland Halibut (*Reinhardtius hippoglossoides*) (also called turbot) are highly migratory in the Northwest Atlantic and are generally found north of the Scotian Shelf in the Gulf of St. Lawrence, although they occur as far south as the Gulf of Maine. The occurrence of Greenland Halibut on the eastern Scotian Shelf may be an extension of the stock inhabiting the Gulf of St. Lawrence. Figure 13 shows Greenland Halibut are caught in deeper waters especially near the Stone Fence and along the Laurentian Channel and Scotian Shelf slope. There is no directed fishery for Greenland Halibut in 4VWX and 5YZ as they are only caught as bycatch.

Figure 13.—Greenland Halibut (Turbot) Landings, 2014–2018



### Hagfish (Figure 14)

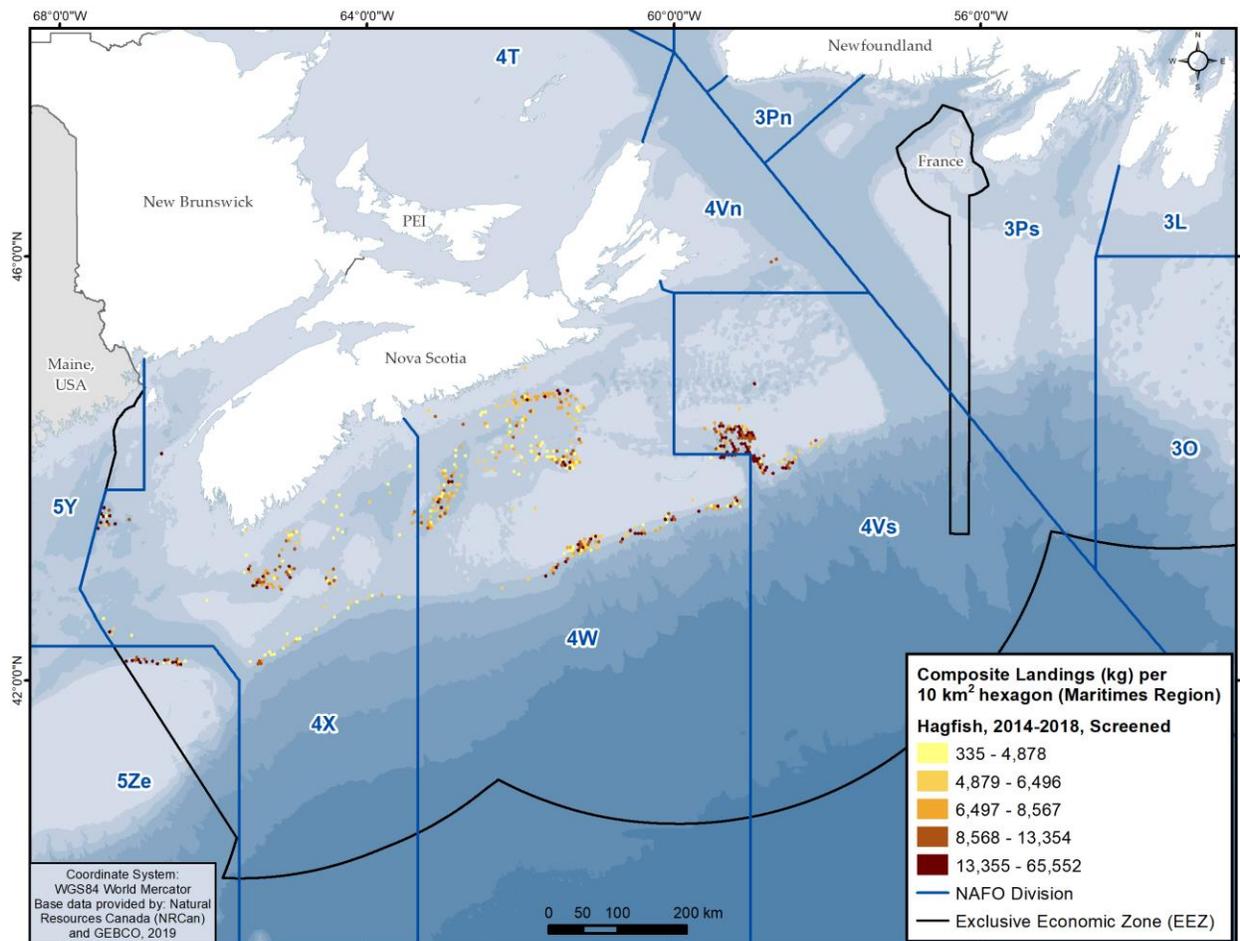
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Atlantic Hagfish (*Myxine glutinosa*) is widely distributed throughout the Northwest Atlantic. There has been a directed fishery for Hagfish off Nova Scotia since the late 1980s. The Hagfish trap fishery consists of modified plastic barrels deployed in strings of 30–35 barrels, with a maximum of 450 traps per licence. The fishing season runs from April 15 to October 15. The fishery is closed in coral and sponge conservation areas, the Gully Marine Protected Area, the Western/Emerald Banks Conservation Area, and is subject to two seasonal groundfish closures on Georges and Browns Banks from March 1 to May 31. Figure 14 shows the landings distribution along the Scotian Shelf edge, in Roseway Basin, and north of Georges Bank. There are few participants ( $n = 6$ ) in the Scotian Shelf fishery, resulting in the majority of unit areas not meeting the criteria for privacy screening. Therefore, participants were contacted and each provided permission to display catch data.

Figure 14.—Hagfish Landings, 2014–2018



### Cusk (Figure 15)

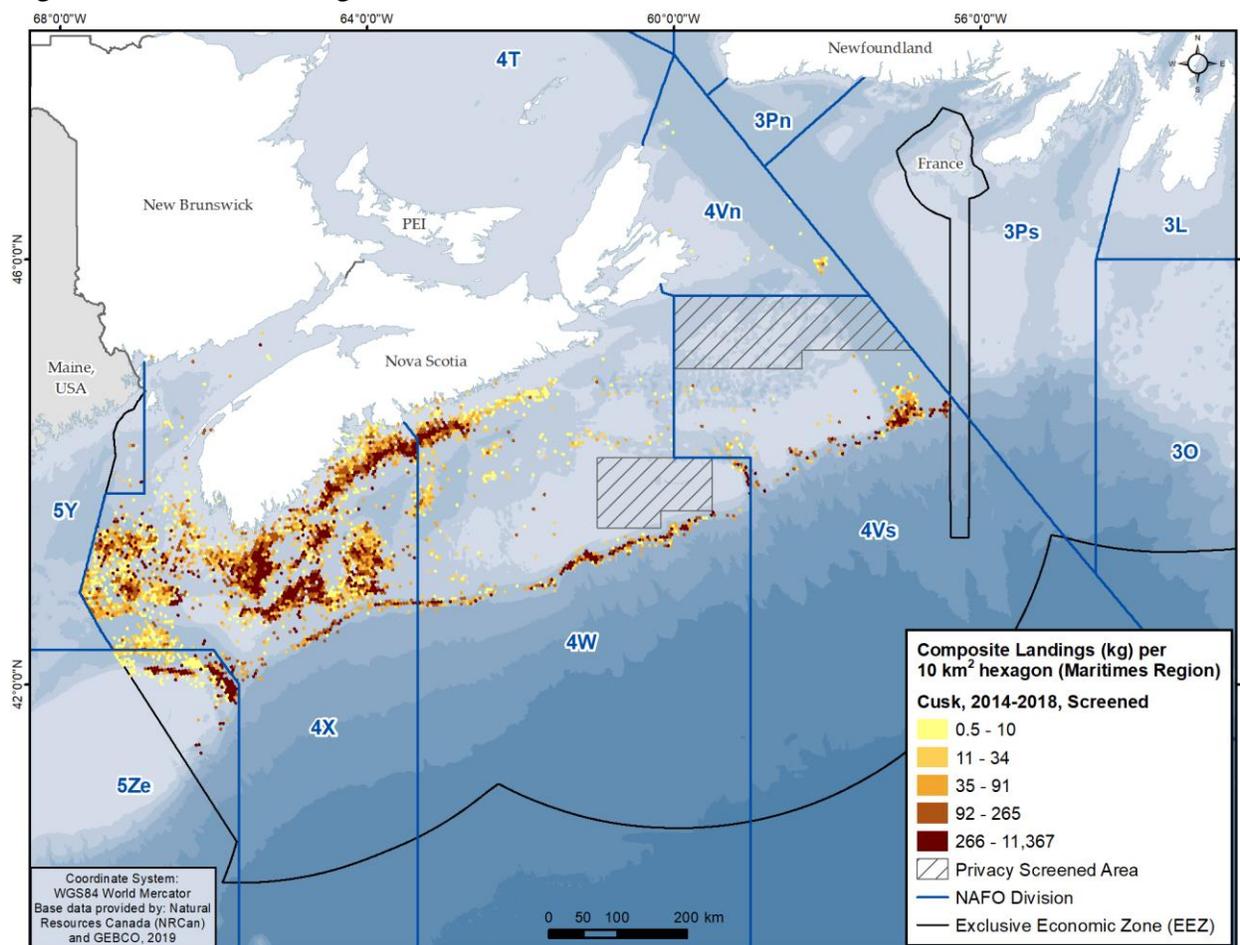
SARA Status: No Status. Under consideration for addition to Schedule 1.

COSEWIC Status: Endangered.

MSC Status: Not in MSC program.

Cusk (*Brosme brosme*) is a non-target bycatch species incidentally harvested in the multi-species groundfish fishery (Figure 15). Cusk are most commonly caught in the Gulf of Maine, western Scotian Shelf, and along the Scotian Shelf edge to Banquereau on bottom longline and in mobile trawl gear. Cusk range from Cape Cod to Labrador, but are rare in the Gulf of St. Lawrence and inner Bay of Fundy. Cusk are also caught in Lobster and crab trap fisheries. Post-capture survival of Cusk is zero percent as they evert their stomach upon surfacing. Bycatch limits are in place so that catch of non-quota species are not to exceed 10 percent of all directed groundfish combined and a cap on the total annual catch of Cusk is also in place. Community and fleet-level caps exist for Cusk, and DFO prohibits Cusk retention once a group reaches their cap.

Figure 15.—Cusk Landings, 2014–2018



### Dogfish (Figure 16)

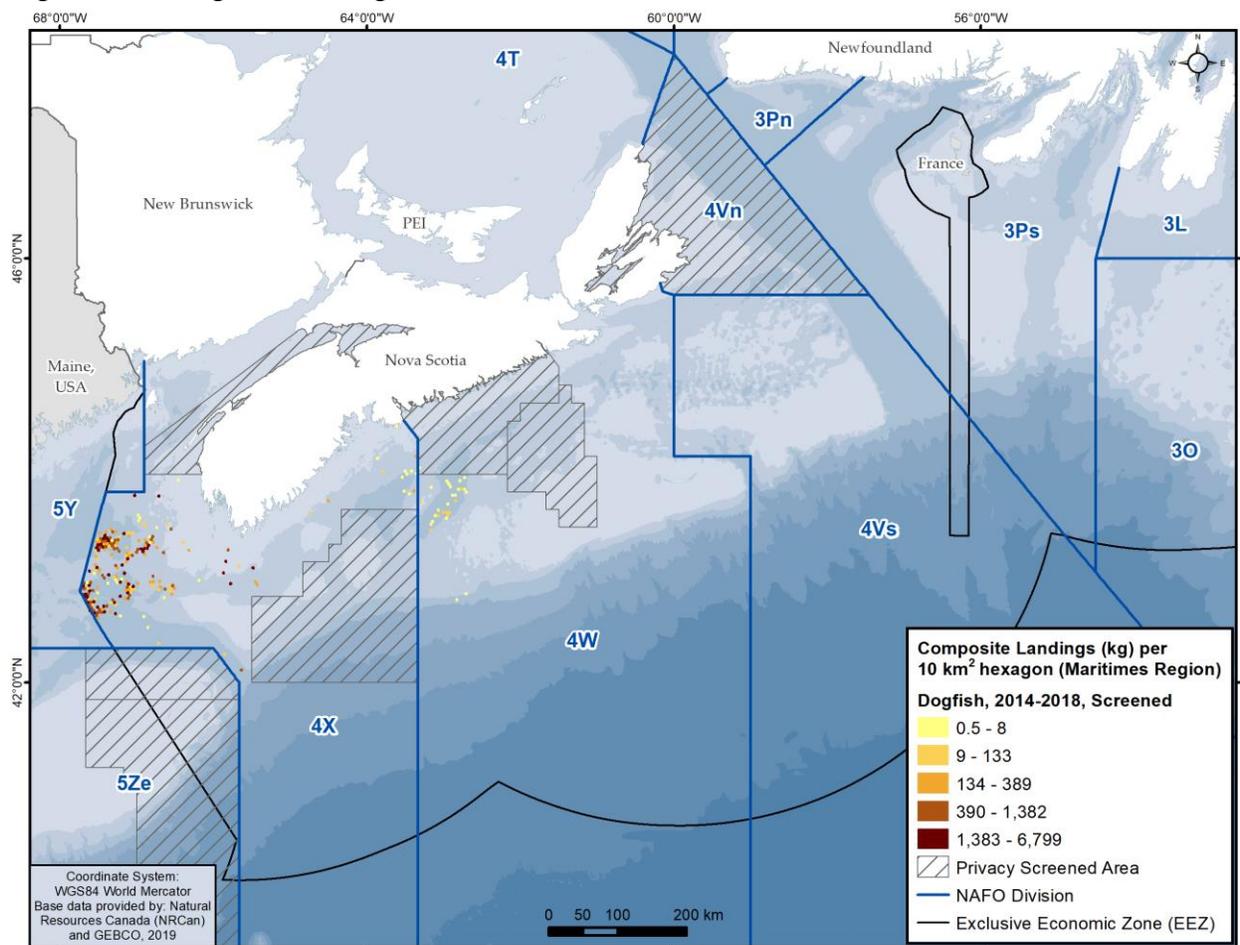
SARA Status: No Status. Under consideration for addition to Schedule 1.

COSEWIC Status: Spiny Dogfish (*Squalus acanthias*), Atlantic population, Special Concern.

MSC Status: Not in MSC program.

Spiny Dogfish (*Squalus acanthias*) and Black Dogfish (*Centroscyllium fabricii*) are landed as bycatch in the multi-species groundfish fishery (Figure 16). Directing for dogfish is only permitted through fixed gear groundfish fisheries. In other groundfish fleets, the bycatch limit is no more than 10 percent. In 2018, a TAC of 4,000 tonnes was in place for the fixed gear <45-foot fleet and another 4,000 tonnes were available to cover landings and discards in other fleets and regions.

Figure 16.—Dogfish Landings, 2014–2018



**Redfish (Figure 17)**

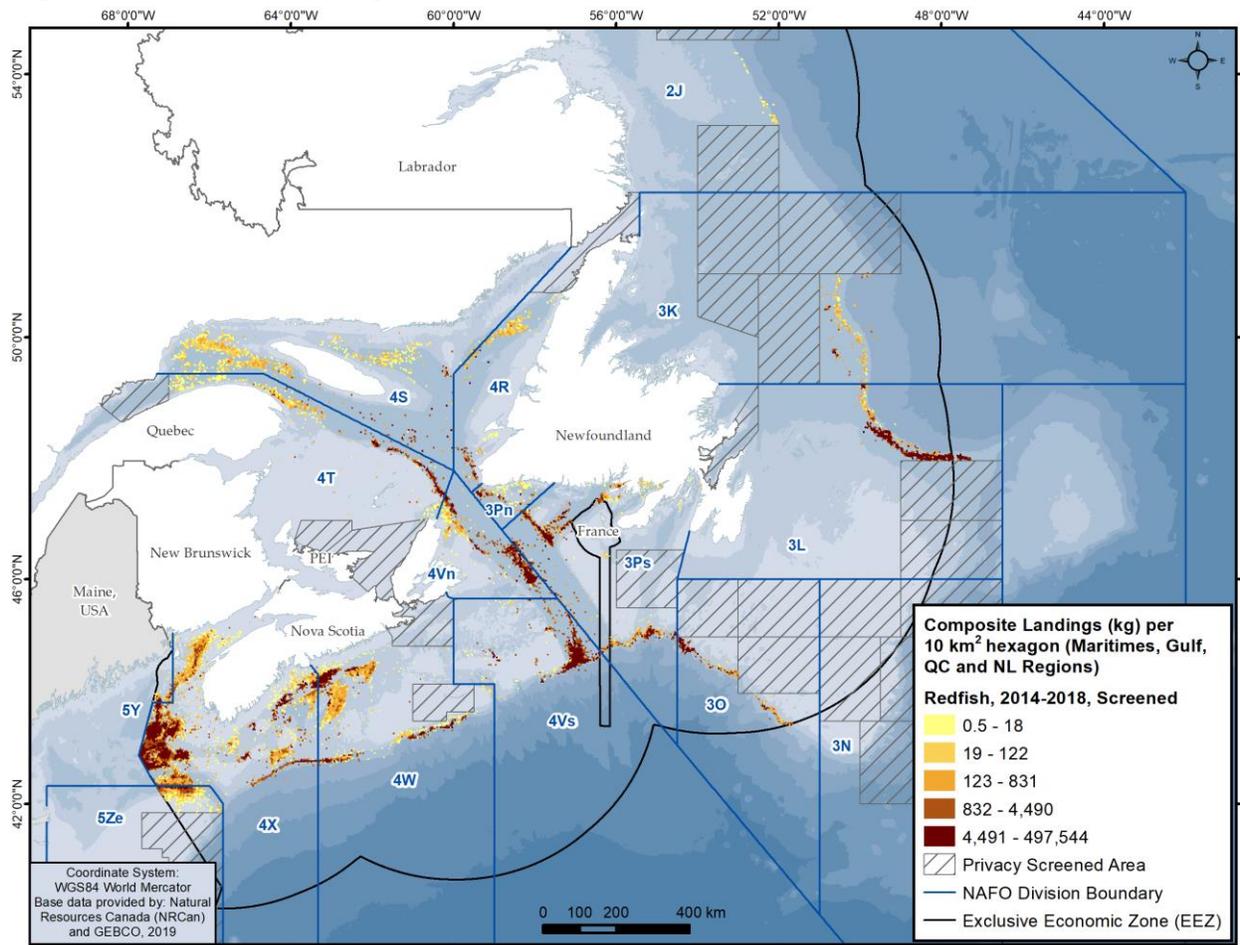
SARA Status: No Status. Under consideration for addition to Schedule 1.

COSEWIC Status: Acadian Redfish (Atlantic population), Threatened. Deepwater Redfish (Gulf of St. Lawrence and Laurentian Channel population), Endangered.

MSC Status: Canada 3LN redfish certified sustainable in May 2017.

Three species of redfish are found in the Northwest Atlantic, namely *Sebastes mentella* and *S. fasciatus* that are dominant in commercial fisheries, and the less abundant *S. marinus*. Redfish (*S. fasciatus* and *S. mentella*) are targeted with otter trawls along the shelf edge, in the Northeast and Laurentian Channels, and in other deep areas of the Scotian Shelf and Bay of Fundy. Figure 17 shows inter-regional landings in the Northwest Atlantic. Since the 2010 stock assessment, redfish managed as Units 1 and 2 (Gulf of St. Lawrence and Laurentian Channel, respectively) are assessed as one stock for each species, i.e., one *S. mentella* stock for Units 1 and 2 combined, and one *S. fasciatus* stock for Units 1 and 2 combined. The Scotian Shelf Unit 3 redfish stock includes portions of 4WX and 5Y. The fishery uses small mesh gear and many management restrictions prevent bycatch of small fish. A special management area in Unit 3 is the Bowtie, which is closed to small mesh gear (110–115 mm diamond mesh) to protect small redfish. The Second Closure in 4Xmn was implemented in 2013 due to catches of undersized redfish. Small mesh gear is also not permitted in waters shallower than 50 fathoms (91 metres), in the Bay of Fundy north of 43°30', and in NAFO Area 5Y and 5Z. The Browns Bank Haddock spawning area has an extended redfish closure from January 1 to June 30.

Figure 17.—Redfish Landings, 2014–2018



### Red Hake (Figure 18)

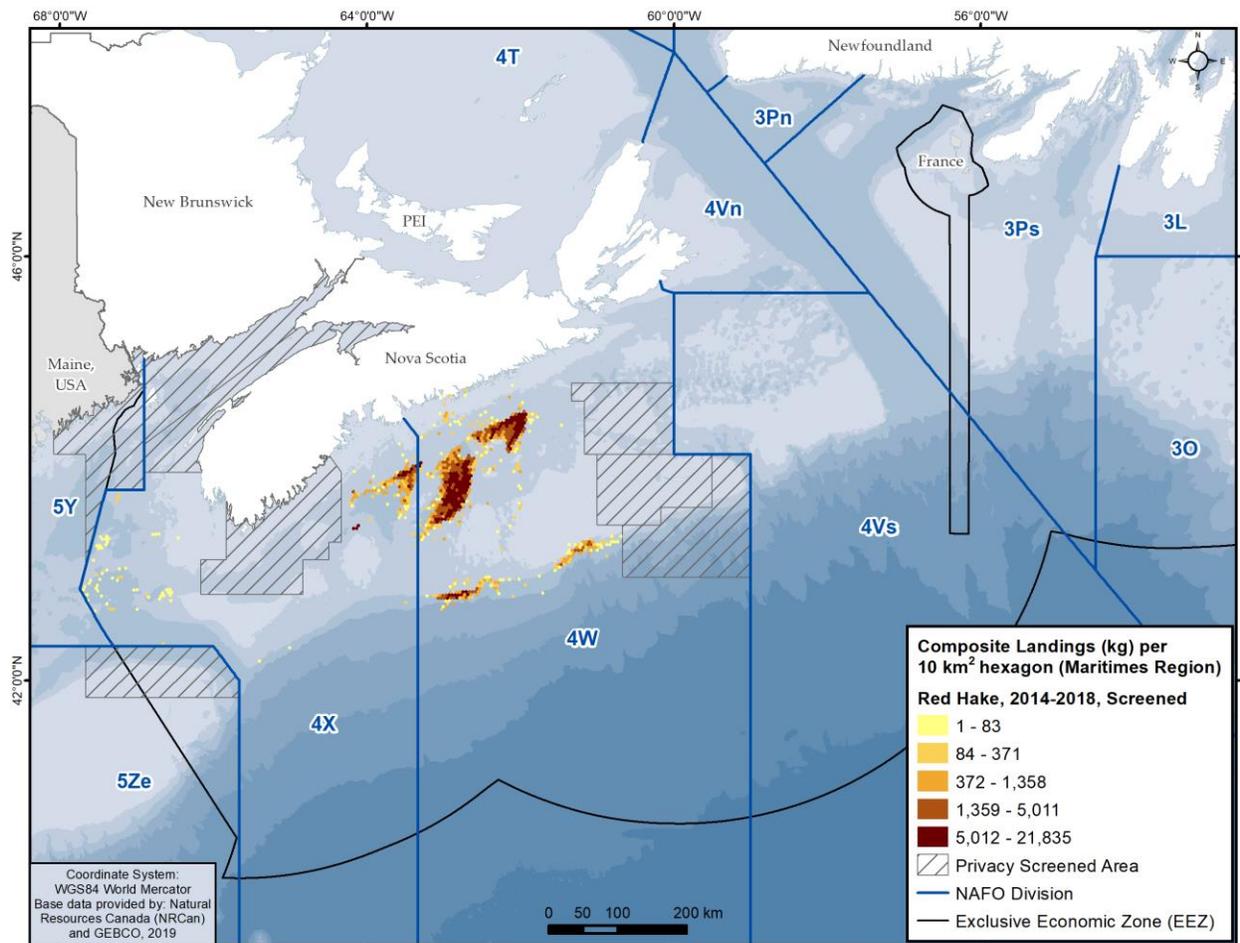
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Red Hake (*Urophycis chuss*) are distributed in the Northwest Atlantic from North Carolina to southern Nova Scotia, straying into the Gulf of St. Lawrence. Throughout the spring and summer, they migrate into more shallow waters to spawn. During winter, they tend to move to deeper waters offshore in the Gulf of Maine and along southern New England and Georges Bank. Red Hake are primarily landed as bycatch in the Silver Hake fishery that occurs on the central Scotian Shelf and in other bottom trawl fisheries (Figure 18).

Figure 18.—Red Hake Landings, 2014–2018



### Silver Hake (Figure 19)

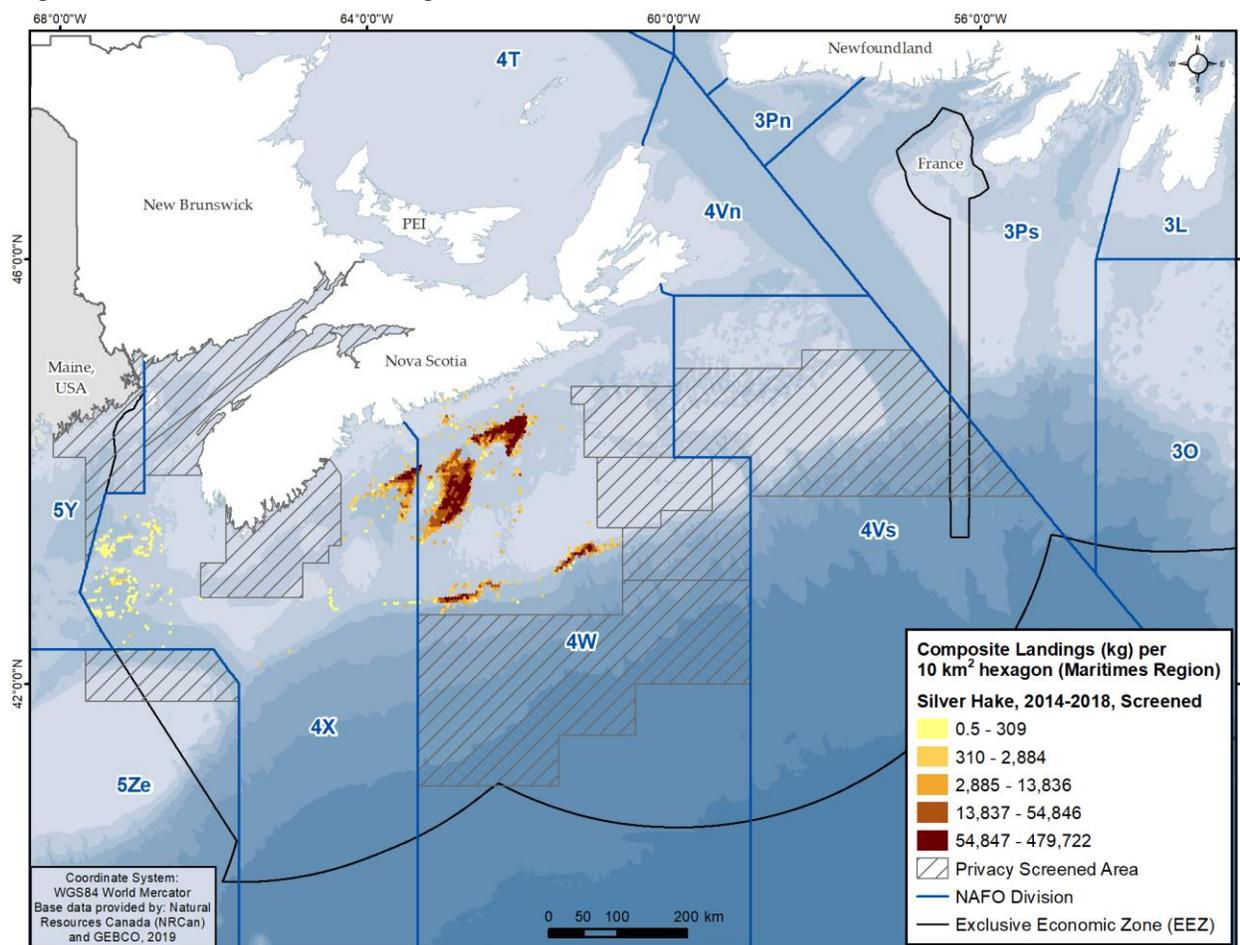
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Silver Hake (*Merluccius bilinearis*) is a demersal-pelagic gadid fish found in shallow waters to 400 m depth from Cape Hatteras to the southern Grand Banks and Gulf of St. Lawrence. The distribution of Silver Hake juveniles and adults is associated with warm bottom temperatures of 5–12° C and 7–10° C, respectively. A population of Silver Hake occurs on the Scotian Shelf in NAFO Divisions 4VWX and is considered to be a self-reproducing stock. This population aggregates in the deep-water depressions of the Scotian Shelf in Emerald and LaHave Basins, and in the warm slope water, except during the spawning period from July to September when large numbers occur on the shelf in shallow waters around Sable Island Bank. From 1995 to present, a commercial fishery has been conducted by mobile gear groundfish fleets in Emerald and LaHave Basins (Figure 19). The fishery is restricted to areas with depths greater than 190 m and uses small-mesh trawl gear that also captures other bycatch species. The fishery uses bottom trawls with 55–60 mm square mesh cods ends and trawls equipped with Nordmore grates to reduce bycatch.

Figure 19.—Silver Hake Landings, 2014–2018



### White Hake (Figure 20)

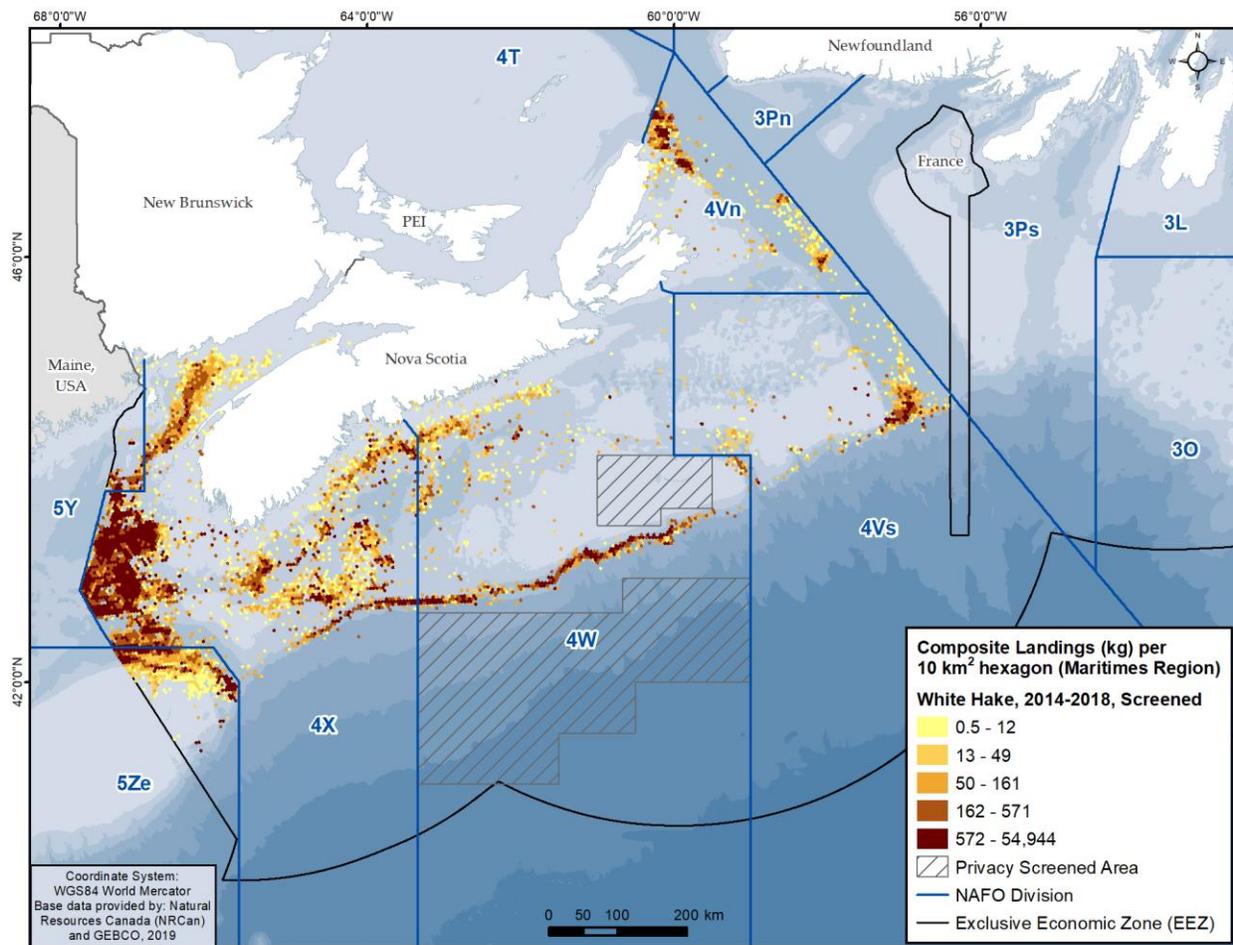
SARA Status: Atlantic and Northern Gulf of St. Lawrence population and Southern Gulf of St. Lawrence population, Under consideration for addition to Schedule 1.

COSEWIC Status: Atlantic and Northern Gulf of St. Lawrence population, Threatened. Southern Gulf of St. Lawrence population, Endangered.

MSC Status: Not in MSC program.

White Hake (*Urophycis tenuis*) is a bycatch species only in DFO Maritimes Region, with fleets operating within bycatch caps. White Hake landings are broadly distributed across the Scotian Shelf and into the Bay of Fundy, with a number of concentrated areas: the Gulf of Maine, Georges Bank, the edge of the Scotian Shelf, and parts of Laurentian Channel (Figure 20).

Figure 20.—White Hake Landings, 2014–2018



### Monkfish (Figure 21)

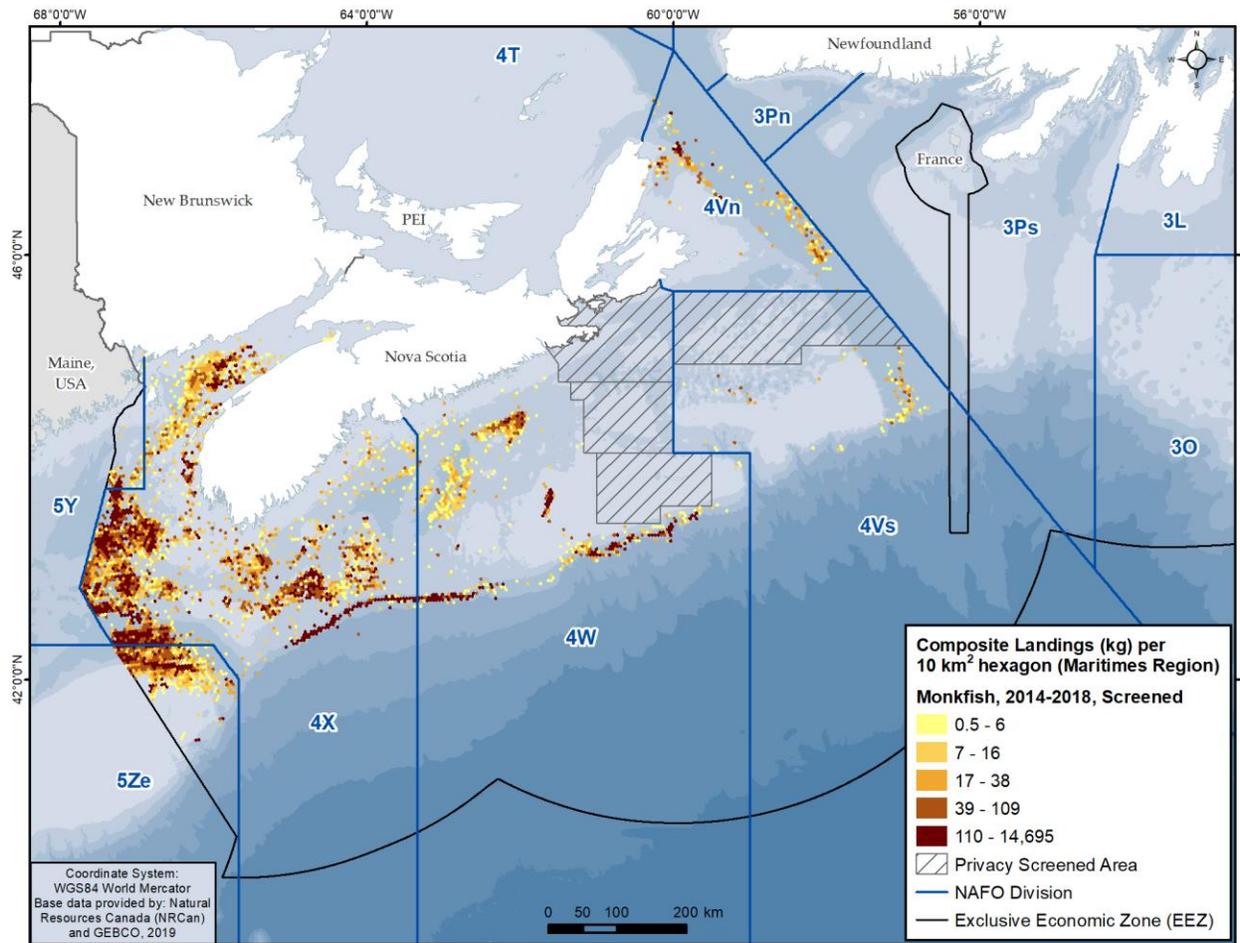
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Monkfish (*Lophius americanus*), also called goosefish or anglerfish, is a benthic fish distributed from the northern Gulf of St. Lawrence to Cape Hatteras. Monkfish are typically a bycatch in groundfish and scallop fisheries on the Scotian Shelf and Georges Bank. Figure 21 shows that Monkfish are mainly caught along the edge of the Laurentian Channel, in the Bay of Fundy and its approaches, and on the Scotian Shelf, particularly along the edges of banks.

Figure 21.—Monkfish Landings, 2014–2018



## Sculpin (Figure 22)

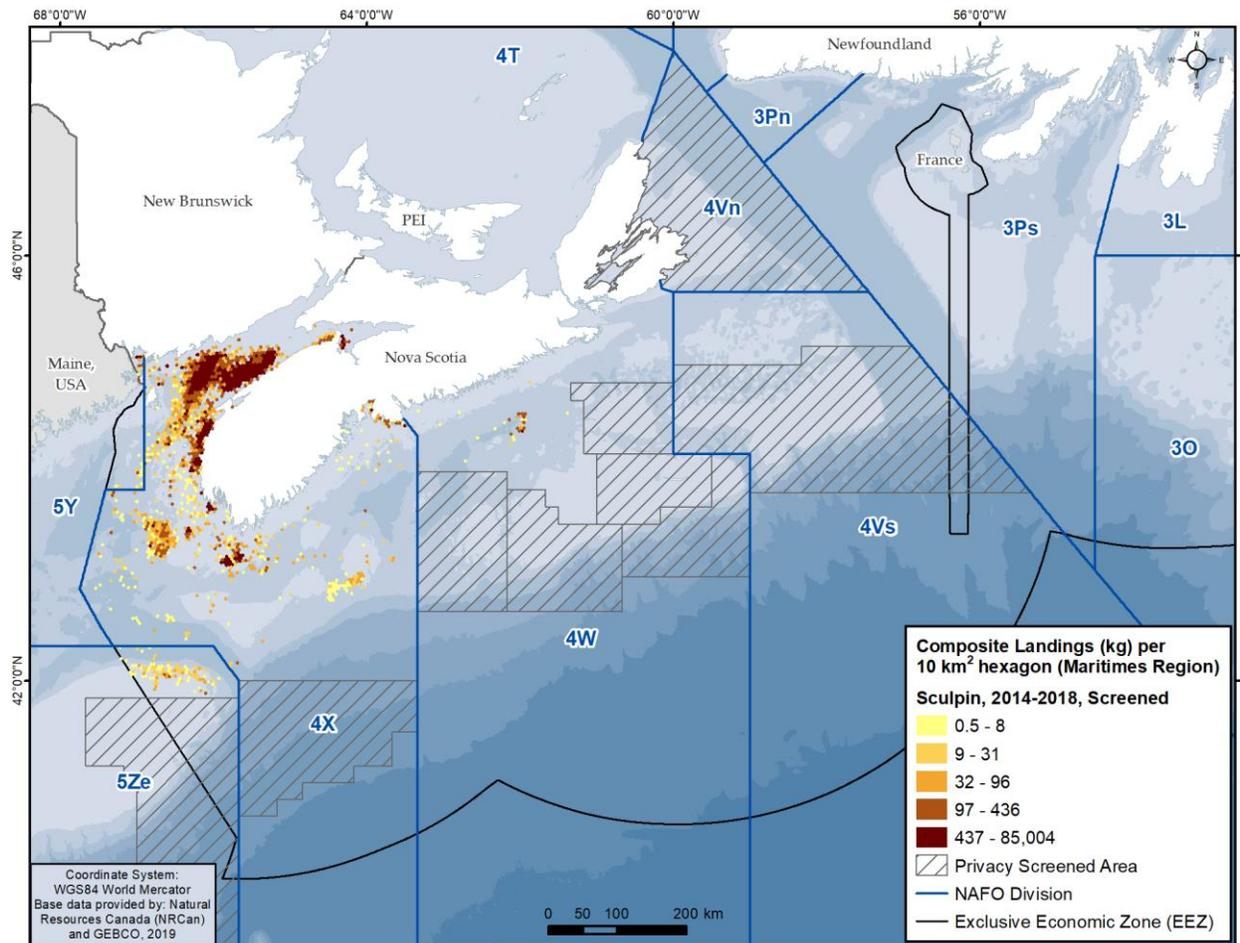
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Sculpins are bottom dwelling, opportunistic feeders distributed throughout coastal shelf seas of the Northwest Atlantic. Common sculpin species in the Maritimes Region include Longhorn Sculpin (*Myoxocephalus octodecemspinus*), Moustache Sculpin (*Triglops murrayi*), and Sea Raven/Sea Sculpin (*Hemitripterus americanus*). A directed fishery for Longhorn Sculpin began in 1999 in St. Mary's Bay in southwest Nova Scotia using otter trawl, bottom longline and handline. All other sculpin landings in Figure 22 are bottom longline and trawl bycatches. Sculpin bycatches in the inshore Lobster fishery are not displayed in the map due to lack of geographic coordinates.

Figure 22.—Sculpin Landings, 2014–2018



### **Skate (Figure 23)**

SARA Status: Smooth Skate, Laurentian-Scotian population, Under consideration for addition to Schedule 1. Thorny Skate, Atlantic Ocean, Under consideration for addition to Schedule 1.

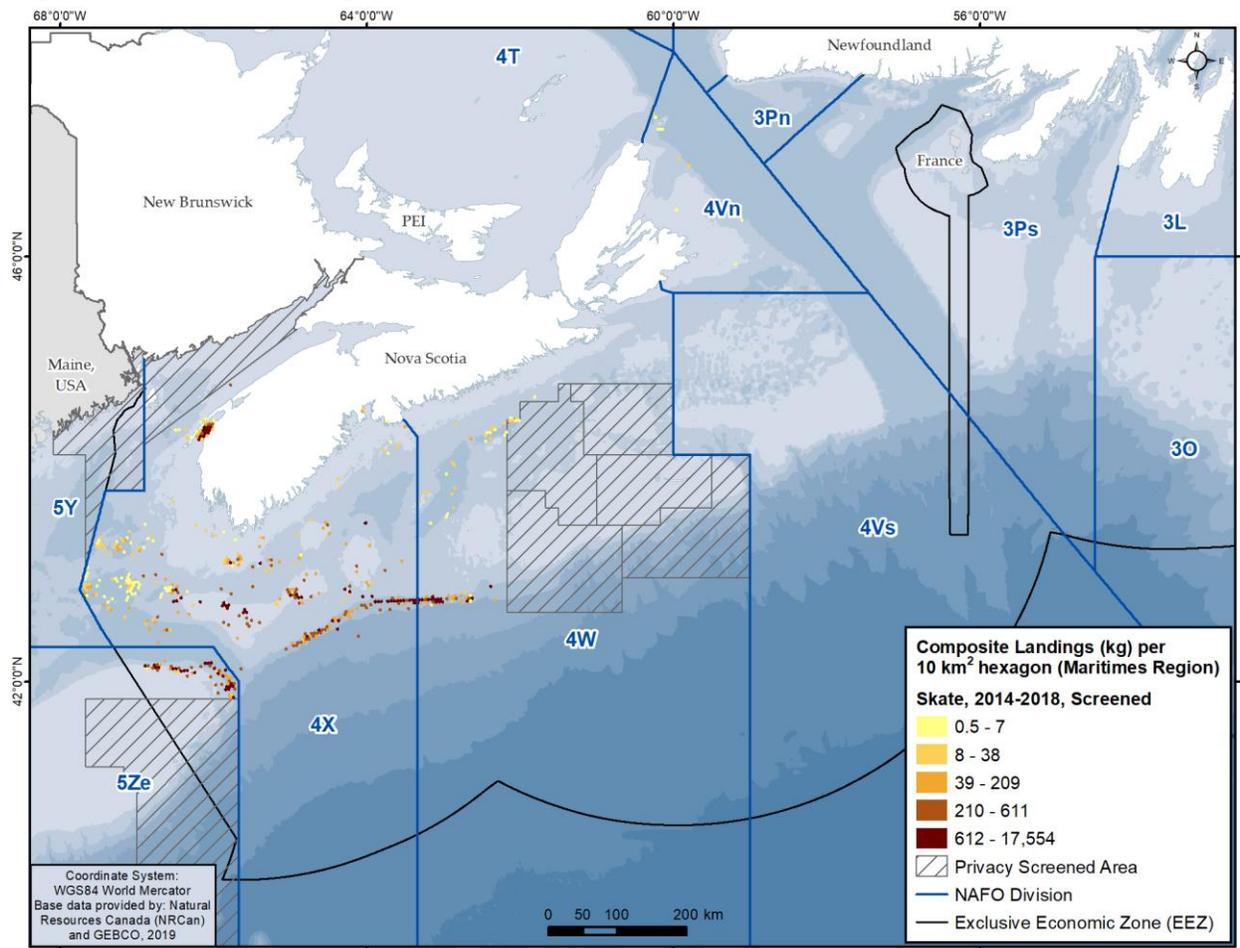
Winter Skate, Eastern Scotian Shelf - Newfoundland population and Gulf of St. Lawrence population, Under consideration for addition to Schedule 1.

COSEWIC Status: Winter Skate (*Leucoraja ocellata*), Georges Bank-Western Scotian Shelf-Bay of Fundy population, Not at Risk; Eastern Scotian Shelf-Newfoundland population, Endangered. Gulf of St. Lawrence population, Endangered. Smooth Skate (*Malacoraja senta*), Laurentian-Scotian population, Special Concern. Thorny Skate (*Amblyraja radiata*), Atlantic Ocean, Special Concern.

MSC Status: Not in MSC program.

There is no directed skate fishery in the Maritimes Region. All 4VW skates, except Barndoor Skates, must be returned to the water. Thorny Skate (*Amblyraja radiata*) must be returned to the water throughout the region. Other skates in 4X5 can be retained or discarded. There are no quotas or bycatch caps on skates, but a general bycatch provision applies for the inshore fleets (fixed gear <45', fixed gear 45–65', and mobile gear <65') in which no more than 10 percent of the catch at the fleet level should comprise skates. If catches exceed 10 percent, fleet closures or other measures to reduce skate capture are considered. This does not apply to the mid-shore and offshore fleets (fixed gear 65–100', mobile gear 65–100', and >100'). A voluntary move-away protocol exists for thorny skates. Figure 23 depicts the distribution of landed skates primarily on the Western Scotian Shelf in 4X and on Georges Bank in 5Ze.

Figure 23.—Skate Landings, 2014–2018

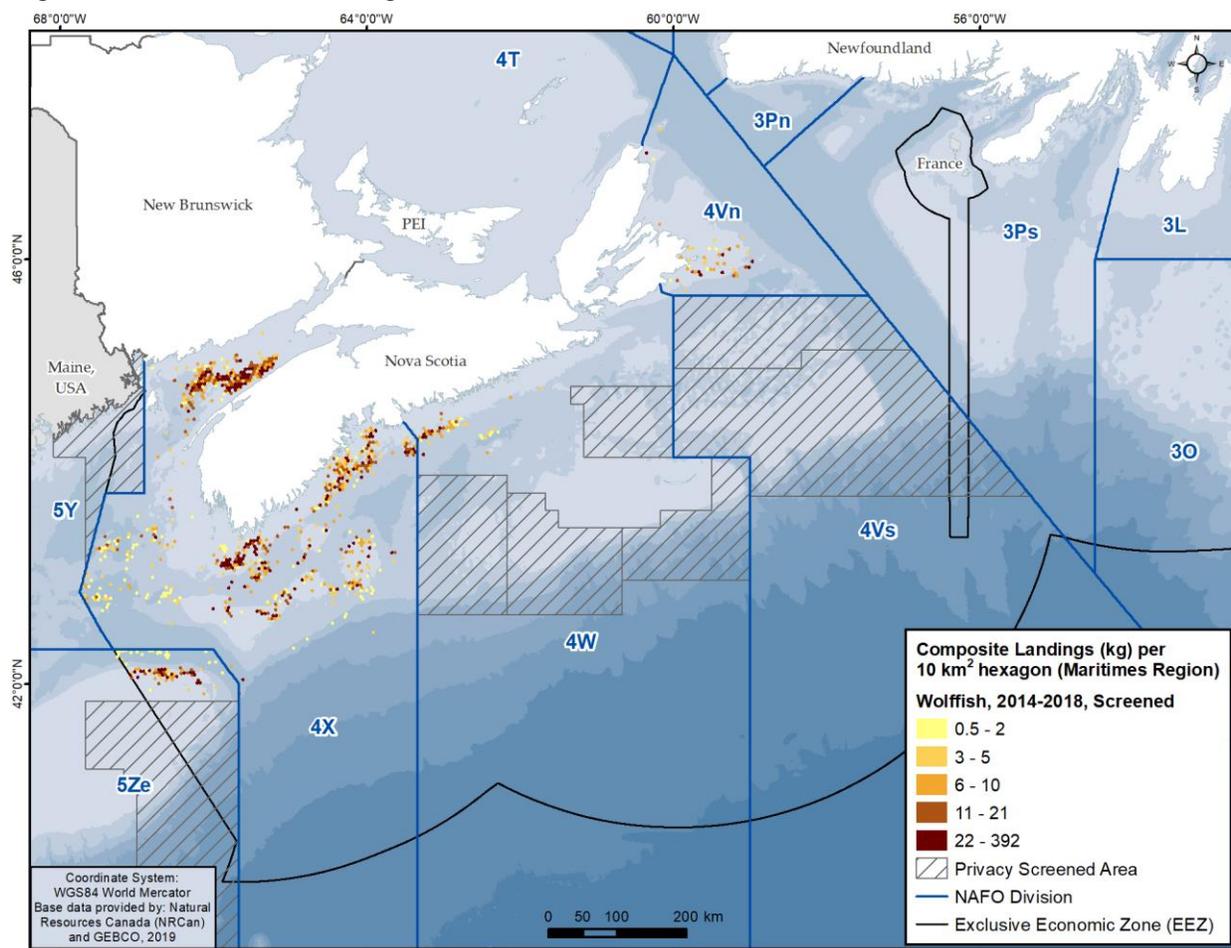


**Wolffish (Figure 24)**

SARA Status: Atlantic Wolffish (*Anarhichas lupus*), Special Concern. Northern Wolffish (*Anarhichas denticulatus*), Threatened. Spotted Wolffish (*Anarhichas minor*), Threatened.  
 COSEWIC Status: Atlantic Wolffish (*Anarhichas lupus*), Special Concern. Northern Wolffish (*Anarhichas denticulatus*), Threatened. Spotted Wolffish (*Anarhichas minor*), Threatened.  
 MSC Status: Not in MSC program.

The Atlantic Wolffish is a large bottom-dwelling predatory marine fish widely distributed across the North Atlantic. It occurs off the west coast of Greenland and southern Labrador, in the Strait of Belle Isle, and the Gulf of St. Lawrence. It is also found off the east and west coasts of Newfoundland, on the Grand Banks, and from the Scotian Shelf to the Gulf of Maine. The Atlantic Wolffish is found in commercial catches, at one time as a target species but now only as bycatch. The Northern Wolffish is found across the North Atlantic from Norway to southern Newfoundland, primarily off northeast Newfoundland. The Spotted Wolffish is found across the North Atlantic from Scotland to Cape Breton and in the Arctic Ocean. In the Northwest Atlantic it occurs primarily off northeast Newfoundland. Wolffish are not targeted by the fishing industry, but are occasionally caught incidentally. Figure 24 shows catch weight landings for Atlantic Wolffish.

Figure 24.—Wolffish Landings, 2014–2018



### **Squid (Figure 25)**

SARA Status: No Status.

COSEWIC Status: No Status.

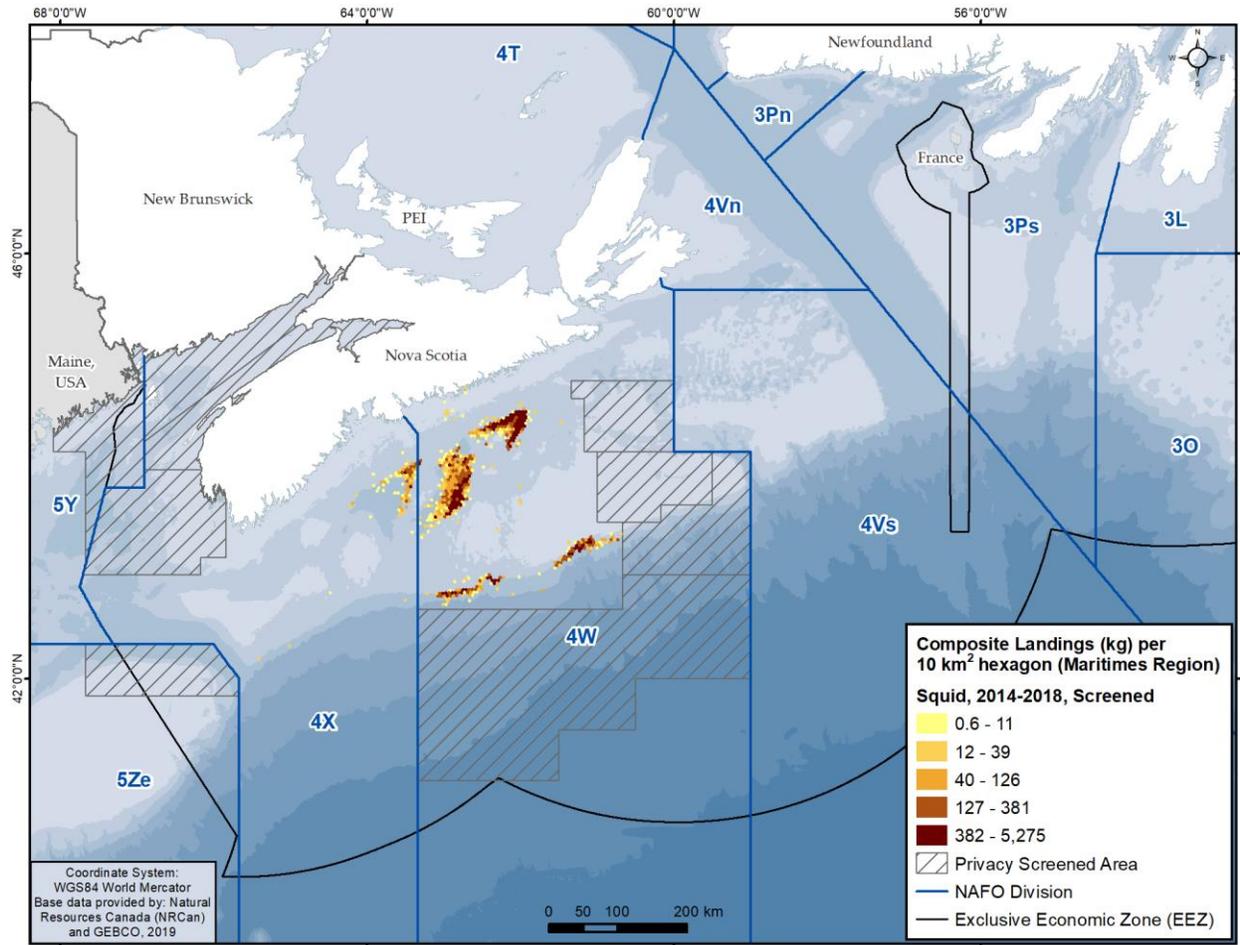
MSC Status: Not in MSC program.

The Short-finned Squid (*Illex illecebrosus*) fishery is conducted from April 1 to December 31 using jiggers and handlines as per squid licence conditions; however, individual licences may also permit the use of otter trawl and purse seine. Gillnets and trap nets may land squid as bycatch. Section 74 of the *Atlantic Fishery Regulations* on squid states that no person shall fish for squid with an otter trawl with a mesh size less than 60 mm and that closure times may be set.<sup>9</sup> Squid fishing is permitted with jiggers and handlines in squid fishing areas 17–21. Fishing for squid with otter trawl may only be carried out in Division 4WX in specific fishing areas outlined in licence conditions (i.e., Silver Hake fishing areas). Prohibited areas include the Gully MPA and the Lophelia and Northeast Channel Coral Conservation Areas. Figure 25 shows the majority of squid landings on the Scotian Shelf includes bycatch in the Silver Hake trawl fishery in Emerald and LaHave Basins. Red Squid, *Loligo*, as well as unspecified squid are also included in the map.

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<sup>9</sup> Atlantic Fishery Regulations, 1985 (SOR/86-21), <<https://laws-lois.justice.gc.ca/PDF/SOR-86-21.pdf>>.

Figure 25.—Squid Landings, 2014–2018



## Herring (Figure 26)

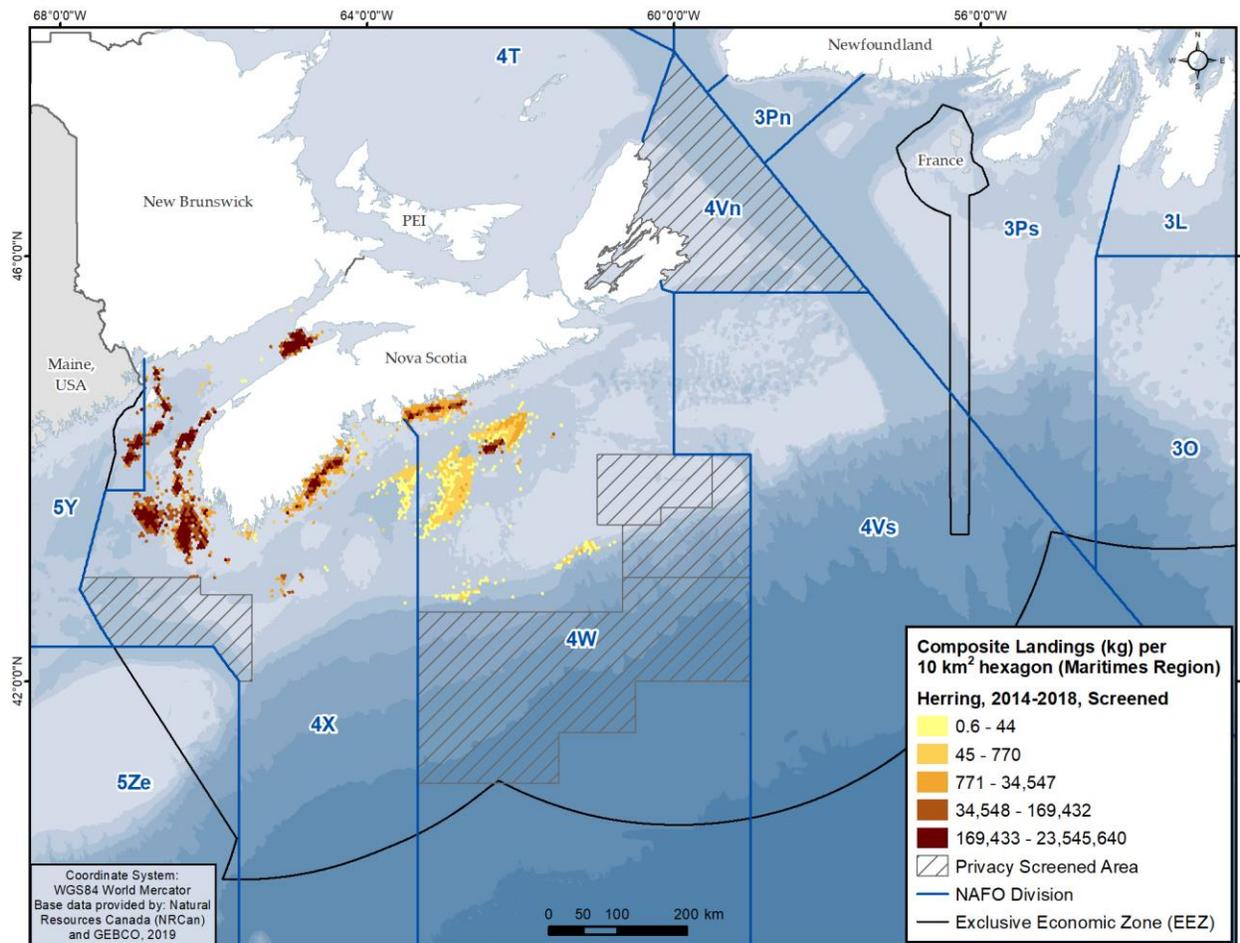
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: The 4VWX purse seine Herring fishery was certified in November 2016 and voluntarily suspended in April 2019.

The 4VWX Atlantic Herring (*Clupea harengus*) fishery is comprised of five spawning components: 1) Southwest Nova Scotia/Bay of Fundy; 2) Offshore Scotian Shelf Banks; 3) Coastal Nova Scotia; 4) Georges Bank; and 5) Southwest New Brunswick migrant juveniles. Each component has several spawning areas and a mixing of fish among the spawning components. The 4VWX Herring fishery is open year-round, with the majority of the landings occurring in the summer purse seine fishery from May to October in the Bay of Fundy area. Figure 26 shows Herring landings off Scots Bay (Upper Bay of Fundy), German Bank, Trinity Ledge, Port Mouton, Eastern Shore, and Herring bycatch in the Silver Hake fishing areas in Emerald and LaHave Basins.<sup>10</sup>

Figure 26.—Herring Landings, 2014–2018



<sup>10</sup> Atlantic Herring Integrated Fisheries Management Plan, 2013, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/herring-hareng/herring-hareng-2013-eng.html>>.

## Mackerel (Figure 27)

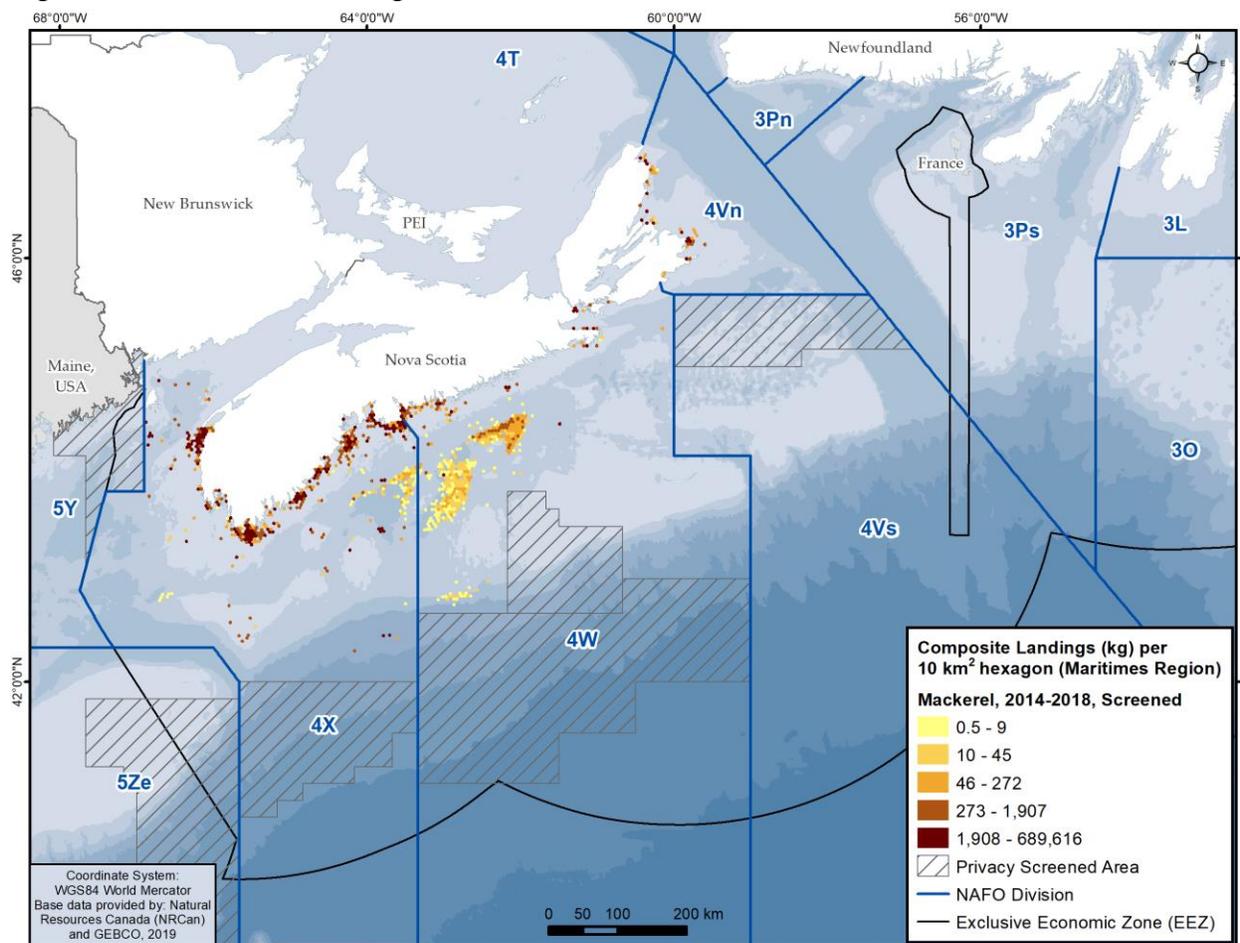
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Inshore gillnet and trap fisheries for Atlantic Mackerel (*Scomber scombrus*) take place primarily in June and July in Nova Scotia, with the main trap net fishery for Mackerel being in St. Margaret's Bay (Figure 27). In late summer and fall, a Mackerel handline fishery operates and a Herring purse seine fishery also lands Mackerel. Mackerel is also a bycatch of the Silver Hake fishery in Emerald and LaHave Basins. Patterns in Figure 27 may not represent the full extent of the coastal Mackerel bait fishery.<sup>11</sup>

Figure 27.—Mackerel Landings, 2014–2018

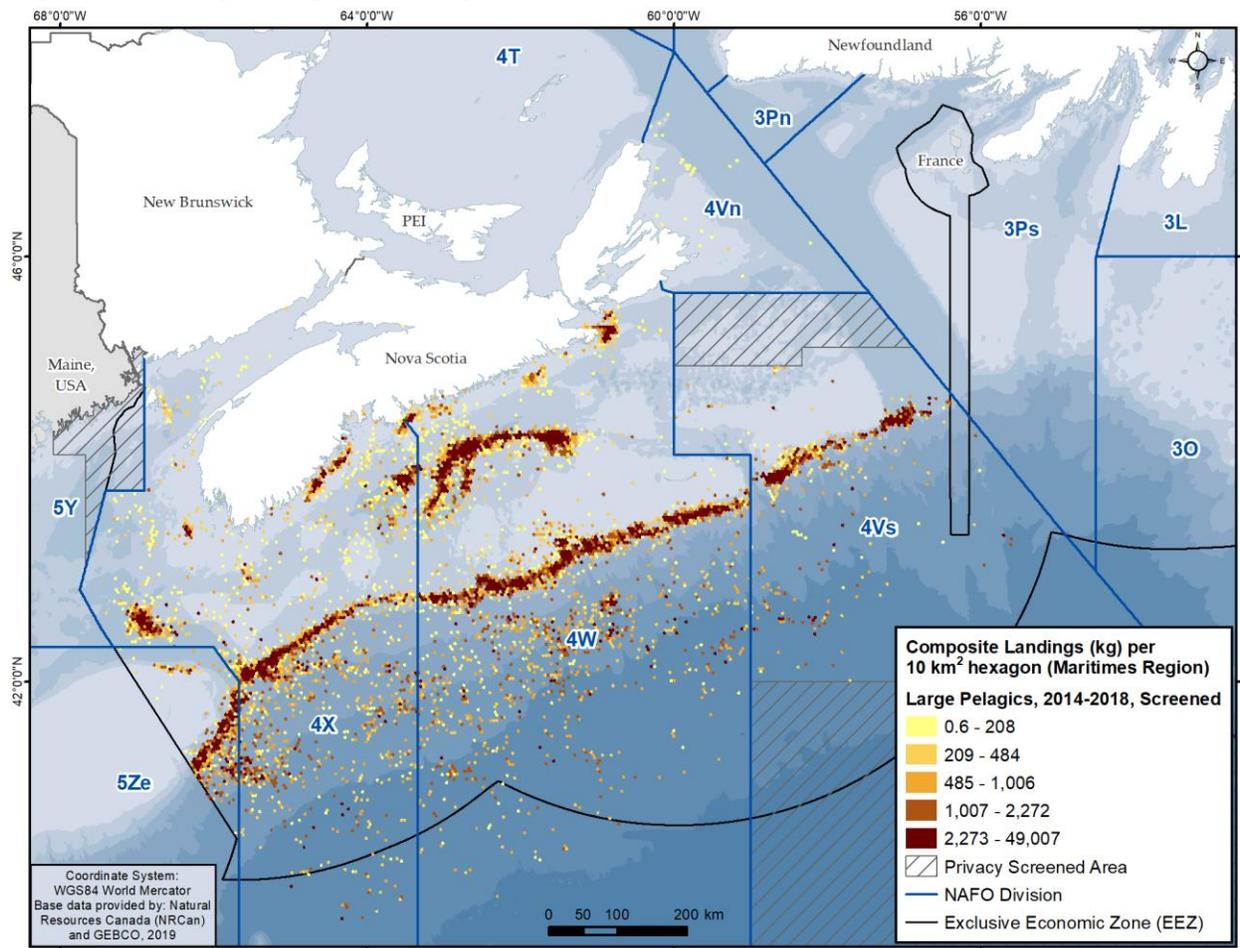


<sup>11</sup> Atlantic Mackerel Integrated Fisheries Management Plan, 2007, <<https://waves-vagues.dfo-mpo.gc.ca/Library/348914.pdf>>.

## Large Pelagics (Figure 28)

The large pelagics species grouping shown in Figure 28 includes Swordfish (*Xiphias gladius*), Albacore Tuna (*Thunnus alalunga*), Bigeye Tuna (*Thunnus obesus*), Bluefin Tuna (*Thunnus thynnus*), Yellowfin Tuna (*Thunnus albacares*), as well as Skipjack Tuna, Mahi-mahi, Blue and White Marlin, and sharks (Blue, Mako, and Porbeagle). Pelagic longlines and harpoon gear are permitted to operate from Georges Bank to Flemish Cap east of Newfoundland when Swordfish migrate inside and beyond Canada's exclusive economic zone (EEZ). The pelagic longline fishery is a multi-species fishery as Swordfish longline licence conditions are used in conjunction with licence conditions for the other tunas (e.g., Albacore, Bigeye, and Yellowfin) and together identify authorized directed species, as well as permitted bycatch species (e.g., shark and marlin). As the fishing season progresses, longline fishing effort generally moves from west to east and back again, and from the offshore to the inshore along the edge of the continental shelf. This pattern occurs as a result of following Swordfish movements associated with seasonal surface water warming trends, and a northward flow of the Gulf Stream. The Canadian large pelagic longline fisheries that direct for, or incidentally catch, Swordfish operate from April to December. Swordfish harpooning occurs from June to late August primarily along the edge of Georges and Browns Banks, targeting large females basking in surface waters during daylight. The Bluefin Tuna fishery directs using the following gear: angling, tended line, electric harpoon and trap net. Only Maritimes Region landings are shown in Figure 28.

Figure 28.—Large Pelagics Landings, 2014–2018



## **Bluefin Tuna (Figure 29)**

SARA Status: No status.

COSEWIC Status: Endangered.

MSC Status: Not in MSC program.

The Atlantic Bluefin Tuna (*Thunnus thynnus*) fishery is conducted inter-regionally (Figure 29) in the following areas: the Hell Hole between Browns and Georges Banks off southwest Nova Scotia; off Grand Manan, NB; St. Margaret's Bay, NS; south of the Canso Causeway, NS; off Cape George in the eastern part of the Northumberland Strait; off North Cape and East Point, PEI; in St. Georges Bay north of the Canso Causeway; and off the southern coast of Newfoundland. Since 1996, Bluefin Tuna have been taken off the coast of Nova Scotia between the Hell Hole and Canso fisheries, particularly off Halifax. Bluefin are also taken along the Scotian Shelf edge as a bycatch of the pelagic longline fleet directing for Swordfish and tuna species other than Bluefin Tuna. NAFO area 4Vn (east of Cape Breton) is closed to Bluefin Tuna harvests, with the exception of two licences.

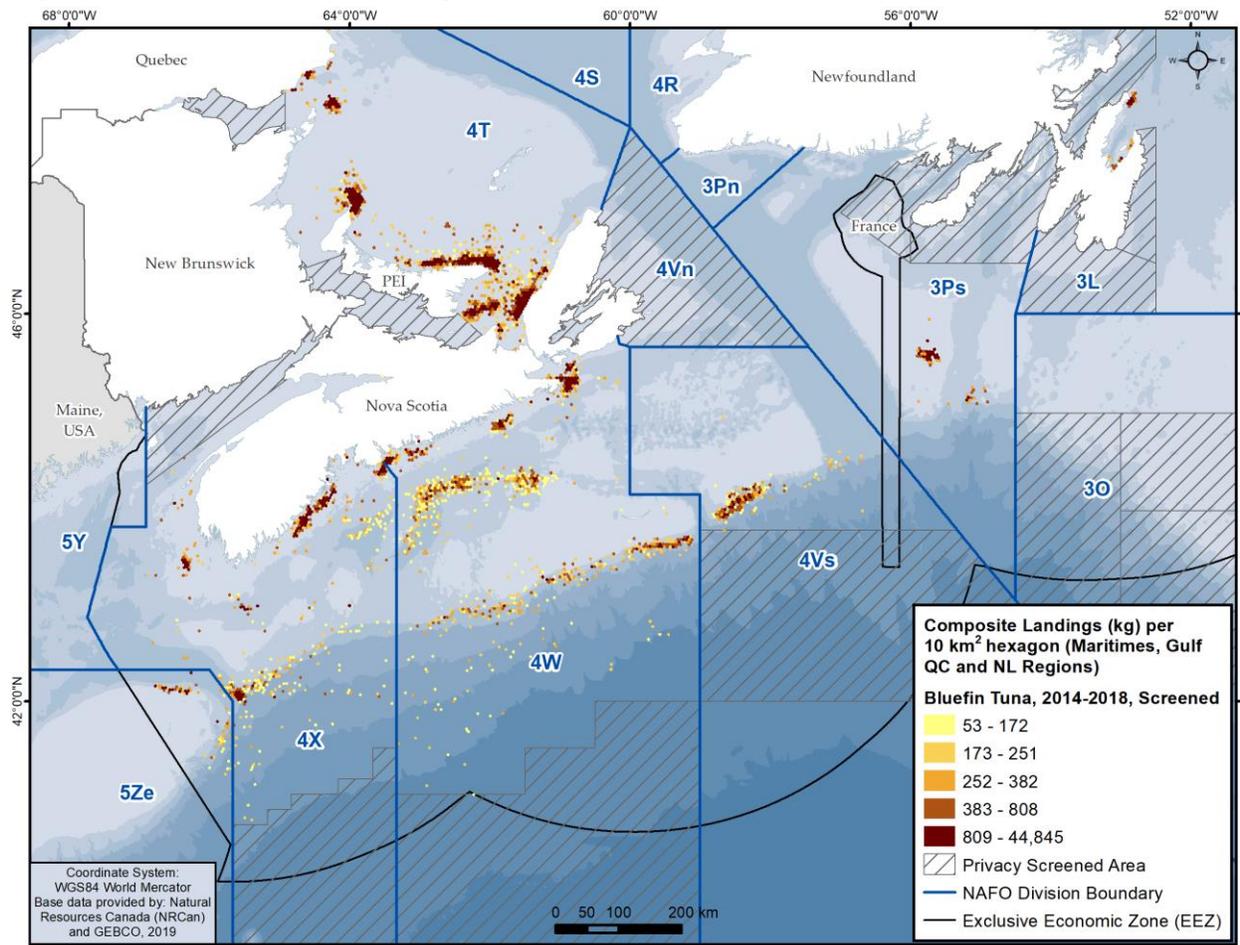
Bluefin Tuna gears include: angling gear (rod and reel with single line and hook); tended line (line with one hook attached at all times to a fishing vessel); trap nets (only used in St. Margaret's Bay, Nova Scotia); electric harpoon (barbed lance or spear connected to an onboard electrical device); and pelagic longline (3.5 mm line suspended by floats, with a series of baited hooks attached at regular intervals fishing the upper water column). Pelagic longlines are 30 to 50 miles long, have 600–1,100 baited hooks per set, and are used by offshore tuna licence and Swordfish and other tuna licence holders. There is no directed Bluefin Tuna fishery using longline, as it is only caught as bycatch; however, bycatch landings exceed tended line landings.

Canadian catch limits for Bluefin Tuna are set by the International Commission for the Conservation of Atlantic Tunas. The Bluefin Tuna fishing season runs from June 24 to June 23 annually, with the main directed fishery running from late July until mid-to-late November. A catch and release charter fishery is also permitted during the commercial catch and retain season for existing Bluefin Tuna licence holders. The charter fishery takes place during September and October off Nova Scotia, July to October in the Gulf of St. Lawrence, and July 15 to December 31 in Newfoundland and Labrador.<sup>12</sup>

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<sup>12</sup> Atlantic Bluefin Tuna Integrated Fisheries Management Plan, 2017, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/bluefin-tuna-thon-rouge/bluefin-tuna-thonrouge2017-eng.html>>.

Figure 29.—Bluefin Tuna Landings, 2014–2018



### **Other Tuna (Figure 30)**

SARA Status: No Status.

COSEWIC Status: No Status.

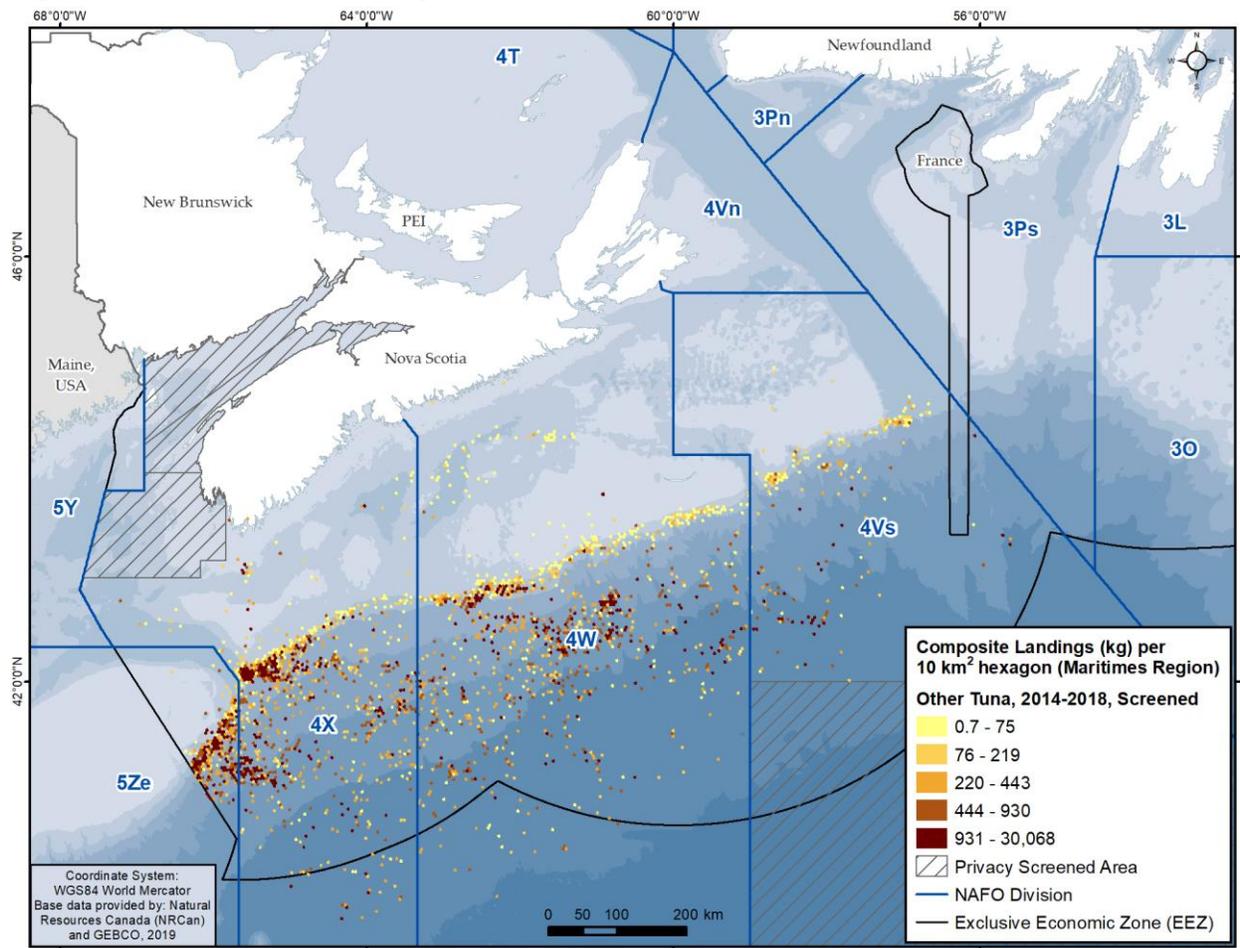
MSC Status: Not in MSC program.

The Albacore, Bigeye, Skipjack and Yellowfin Tuna fishery is known as the “Other Tuna” fishery. The fishery occurs from June to late November. Tunas are highly migratory and catch limits are set by the International Commission for the Conservation of Atlantic Tunas. The directed other tuna fishery began in the mid-1990s, as these species were previously bycatch in the Swordfish fishery. In addition to longline, trolling gear is used where multiple lines with hooks are towed behind a vessel. The fishery occurs along the shelf edge and slope and in the area known as the Hell Hole. The slope of the western Scotian Shelf is more important for this fishery than the eastern Scotian Shelf slope (Figure 30). The same management areas are in place as for the Swordfish longline fishery. Fishing Zone 1 (Gulf of St. Lawrence) and Fishing Zone 2 (Bay of Fundy) are closed to the fishery. Fishing with longline gear is not permitted in the Hell Hole (Northeast Channel) from July to November to reduce Bluefin Tuna bycatch, however, trolling for other tunas is permitted year-round in the Hell Hole. The Bluefin Exclusion Zone along coastal Nova Scotia is closed from August 1 until the end of the season to prevent Bluefin Tuna bycatch.<sup>13</sup>

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<sup>13</sup> Atlantic Swordfish and Other Tunas, Integrated Fisheries Management Plan, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/swordfish-espardon/NEW-swordfish-2013-espado-eng.html>>.

Figure 30.—Other Tuna Landings, 2014–2018



**Swordfish (Figure 31)**

SARA Status: No Status.

COSEWIC Status: No Status.

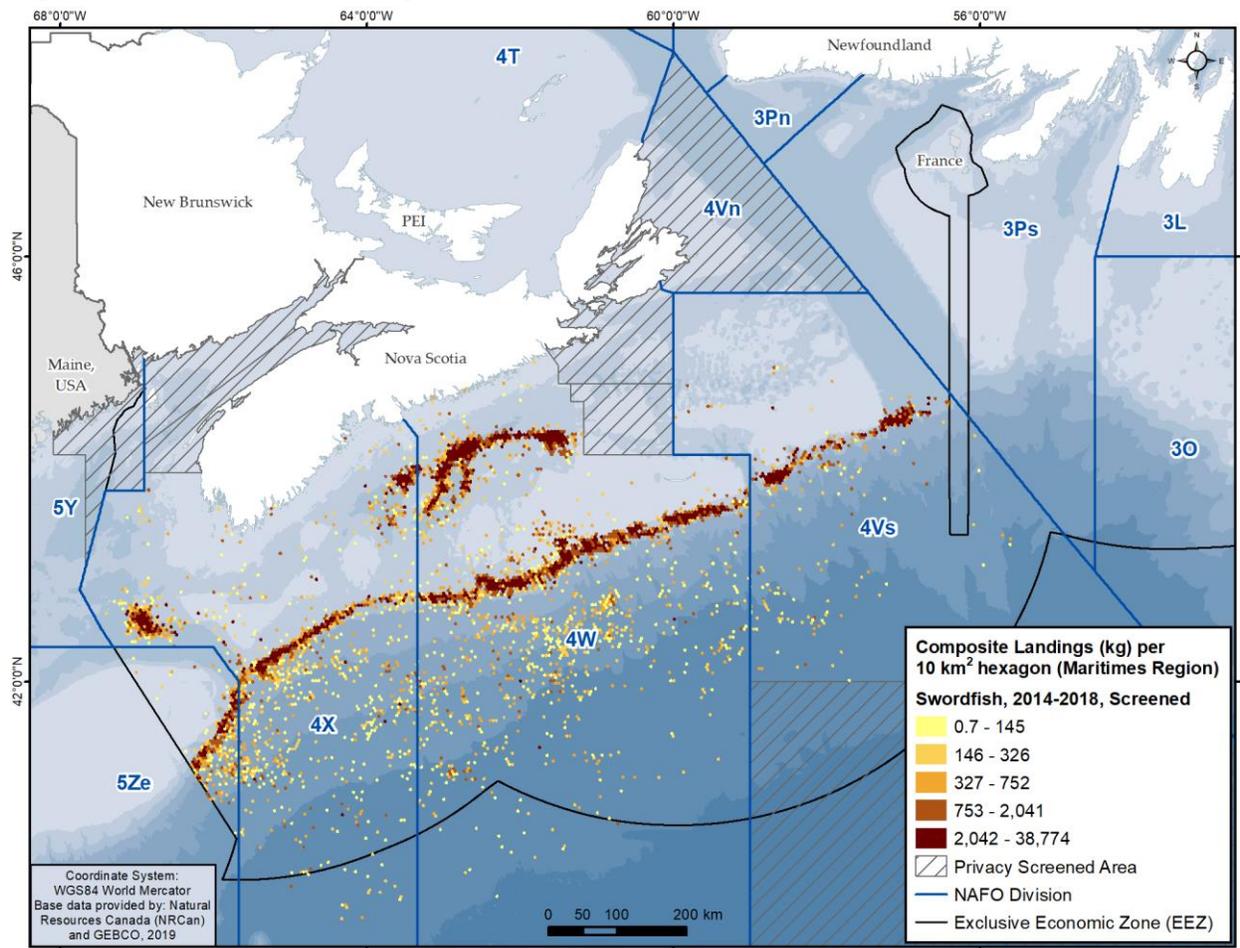
MSC Status: Longline Swordfish certified sustainable in April 2012. Harpoon Swordfish certified sustainable in June 2010.

North Atlantic Swordfish and tuna stocks are under the management of the International Commission for the Conservation of Atlantic Tunas. Pelagic longlines and harpoon gear are permitted in this fishery off Nova Scotia and Newfoundland. Swordfish longline licence conditions are used in conjunction with licence conditions for the other tunas (e.g., Albacore, Bigeye, and Yellowfin) and together identify the authorized directed species as well as permitted by-catch species (e.g., shark and marlin). The longline fishery extends from Georges Bank to the Flemish Cap east of Newfoundland when Swordfish, the main species targeted, migrate inside and beyond Canada's EEZ (Figure 31). As the fishing season progresses, longline fishing effort generally moves from west to east and back again and from offshore to inshore along the edge of the continental shelf. This pattern occurs as a result of following Swordfish migrations associated with seasonal warming trends of surface water temperature, and the northward flow of the edge of the Gulf Stream. Canadian large pelagic longline fisheries that direct for, or incidentally catch, Swordfish operate from April to December. Swordfish longline licences are also able to use harpoon gear. The harpoon fishery occurs from June to late August, along the edges of Georges and Browns Banks, targeting large female Swordfish basking in surface waters during daylight.<sup>14</sup>

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<sup>14</sup> Atlantic Swordfish and Other Tunas, Integrated Fisheries Management Plan, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/swordfish-espardon/NEW-swordfish-2013-espado-eng.html>>.

Figure 31.—Swordfish Landings, 2014–2018



### **Porbeagle, Shortfin Mako and Blue Sharks (Figure 32)**

SARA Status: Porbeagle Shark, Under consideration for addition to Schedule 1; Shortfin Mako Shark, No Status; Blue Shark, No Status.

COSEWIC Status: Porbeagle Shark, Endangered; Shortfin Mako Shark, Endangered; Blue Shark, Not at risk.

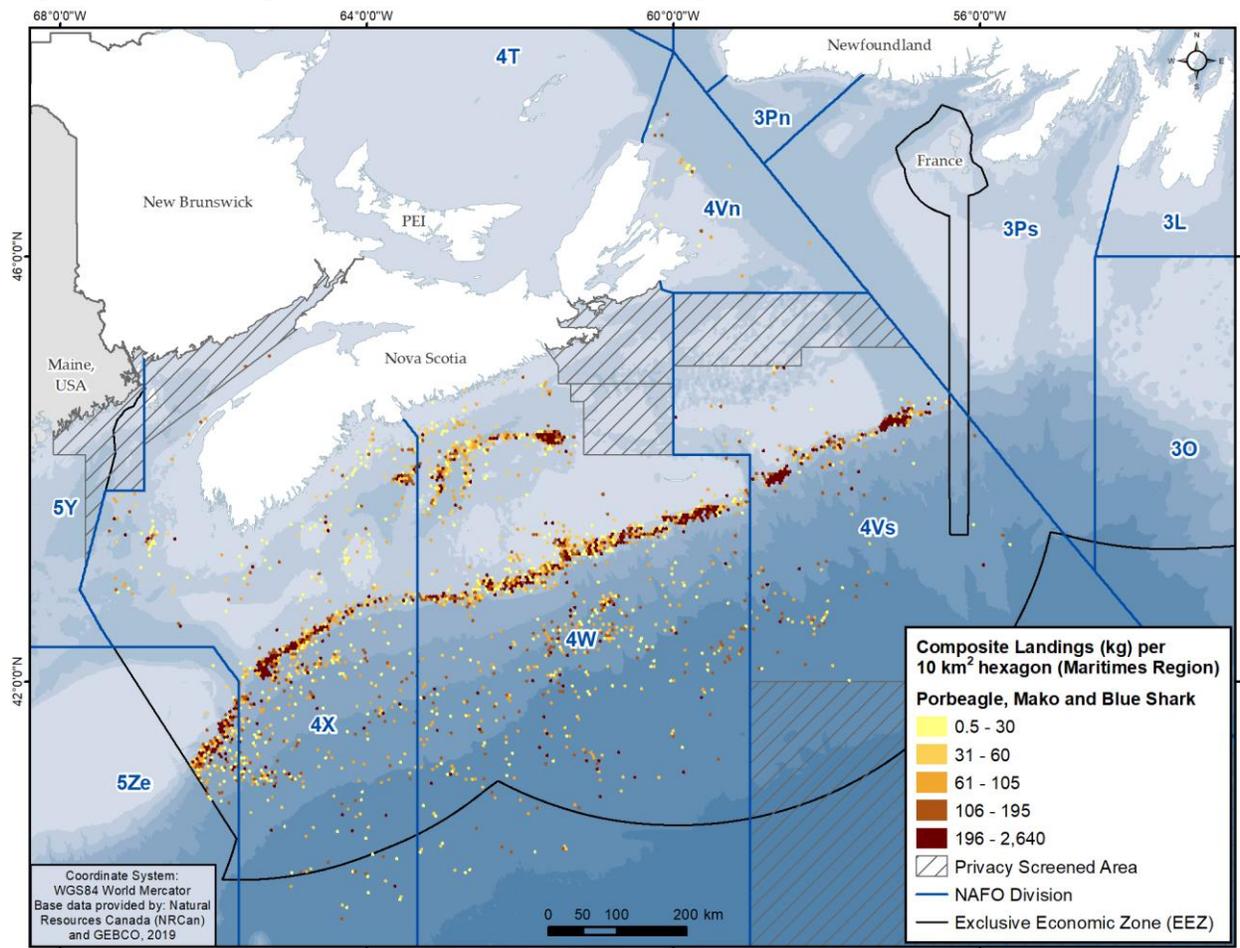
MSC Status: Not in MSC program.

The Porbeagle Shark (*Lamna nasus*) is a cold-temperate species that ranges in the northwestern Atlantic from Newfoundland and Labrador to the Sargasso Sea, inhabiting inshore and offshore waters below 18 °C. Individuals from this population move onto the Scotian Shelf in early spring and into the Gulf of St. Lawrence and onto the Grand Banks during the late spring and summer (Figure 32). They move into deeper water in late fall and in winter are found off the continental shelf and in deep basins such as Emerald Basin and the Gulf of Maine. Although there is no longer a directed Porbeagle Shark fishery, a 185-tonne TAC is applied to all incidental bycatch landings. The licence holder/operator must promptly release all live Porbeagle Sharks in the manner that causes the least harm to the shark and are only authorized to retain dead Porbeagle Sharks.

The Shortfin Mako Shark (*Isurus oxyrinchus*) is a warm-temperate, tropical species that occurs in the Atlantic, Pacific and Indian Oceans. The species' range in the western Atlantic extends from Newfoundland to Argentina in water temperatures from 17 to 22 °C. Shortfin Mako Sharks occur primarily off the continental shelf, but may be found in Canadian Atlantic coastal waters during summer months. In Canadian waters, Shortfin Mako Shark is a valuable bycatch with a higher price per pound than Blue Shark. It is caught incidentally in the same fisheries as Porbeagle and Blue Sharks, though because of a preference for warmer water temperatures, not in the same proportions. Fisheries with a bycatch of Shortfin Mako include Swordfish longline, other tunas longline, groundfish gillnet, and groundfish longline, with bycatch in groundfish occurring mostly in areas south of shelf waters off Nova Scotia near the Gulf Stream. DFO applies a precautionary Shortfin Mako allocation of 100 tonnes annually based on a recovery potential assessment. As of 2020, the Swordfish longline fleet is prohibited from retaining all Shortfin Mako Sharks, whereas during the time series for this analysis the fleet only released live Shortfin Mako Sharks to reduce mortality. In addition, all landings are 100 percent dockside monitored at the time of offloading.

Blue Sharks (*Prionace glauca*) are probably the most widely distributed of all large pelagic shark species and are found globally. The species' range extends from Newfoundland to Argentina in the western Atlantic. They prefer water temperatures in the range of 13–21 °C, but can tolerate from 7–27 °C. They move onto the Scotian Shelf in the late spring and into the Gulf of St. Lawrence and onto the Grand Banks during the summer and early fall. In late fall they move into deeper water, and in winter they are found off the continental shelf. Other than dogfish, Blue Sharks are the most common shark bycatch in Canadian waters with the most significant catches in the large pelagic longline fishery (e.g., the Swordfish fleet where the number of Blue Sharks caught can exceed Swordfish caught). Blue Sharks are currently almost always discarded, but when retained there is a precautionary allocation of 250 tonnes.

Figure 32.—Porbeagle, Mako and Blue Shark Landings, 2014–2018



### **Snow Crab (Figure 33)**

SARA Status: No Status.

COSEWIC Status: No Status.

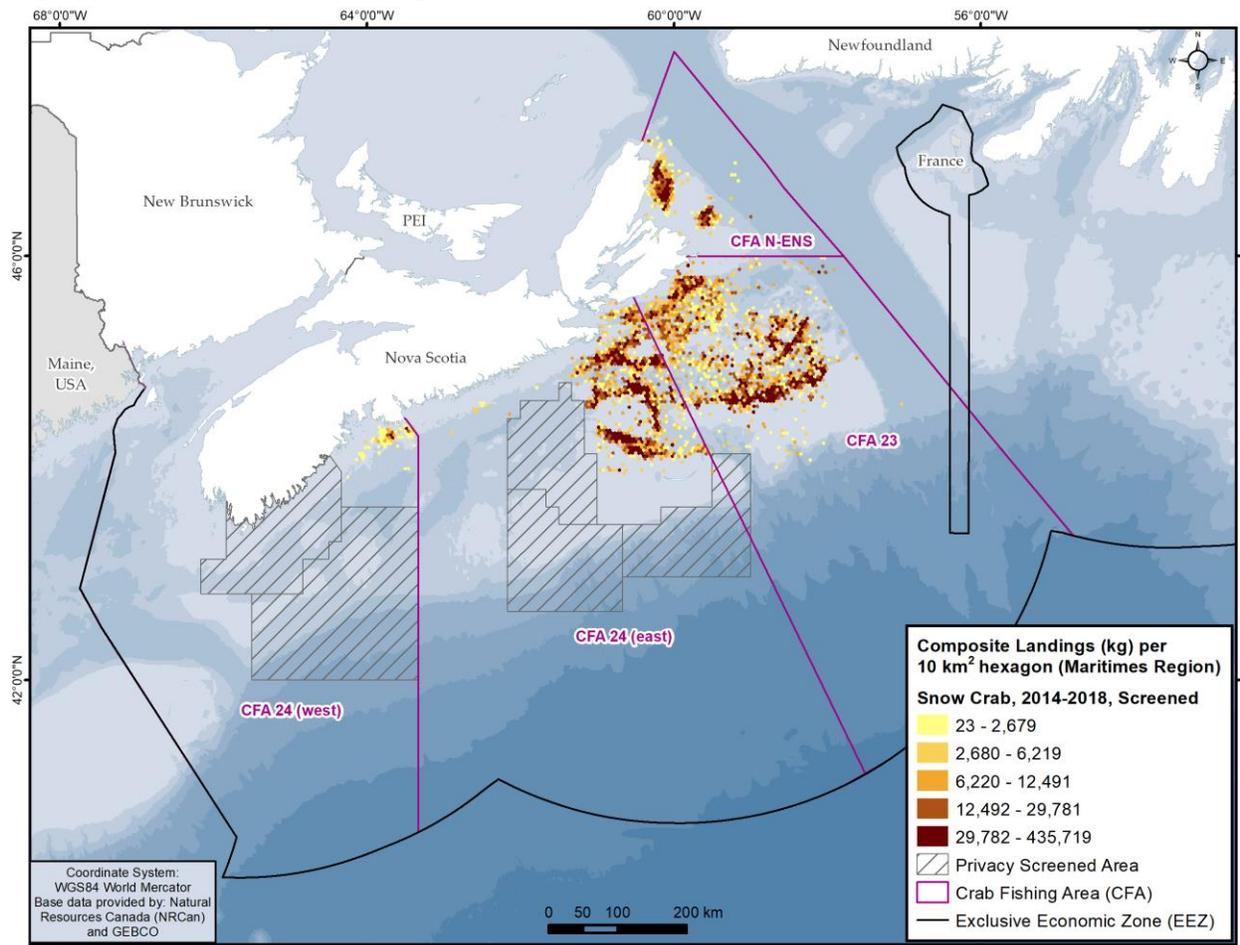
MSC Status: Scotian Shelf snow crab trap fishery certified sustainable in July 2012.

The Snow Crab (*Chionoecetes opillio*) fishery operates in NAFO Divisions 4VW in Crab Fishing Areas (CFAs) known as North-Eastern Nova Scotia (N-ENS), CFA 23, CFA 24 East and CFA 24 West (Figure 33). Snow Crab fishable bottom can be patchy within areas. In the nearshore areas of N-ENS the habitat is continuous from within five miles of shore out to 15–20 miles. In southern areas of CFA N-ENS and CFAs 23-24 the fishable bottom is not evenly distributed and extends further offshore. Snow Crab is found here in gullies 15–20 miles from shore extending to 120 miles offshore. The Snow Crab fishery uses baited conical traps. In N-ENS the fishery historically operated with a spring season from early April to mid-to-late May and a summer season from mid-July to mid-August, but since 2019 has operated with a continuous early April to mid-August season. In CFAs 23–24 the season runs from early April until the end of August. The CFA 24 West season typically opens November 1 and closes March 31.<sup>15</sup>

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<sup>15</sup> Snow Crab Integrated Fisheries Management Plan, 2013, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/snow-crab-neige/snow-crab-neiges2013-eng.html>>.

Figure 33.—Snow Crab Landings, 2014–2018



### Other Crab (Figure 34)

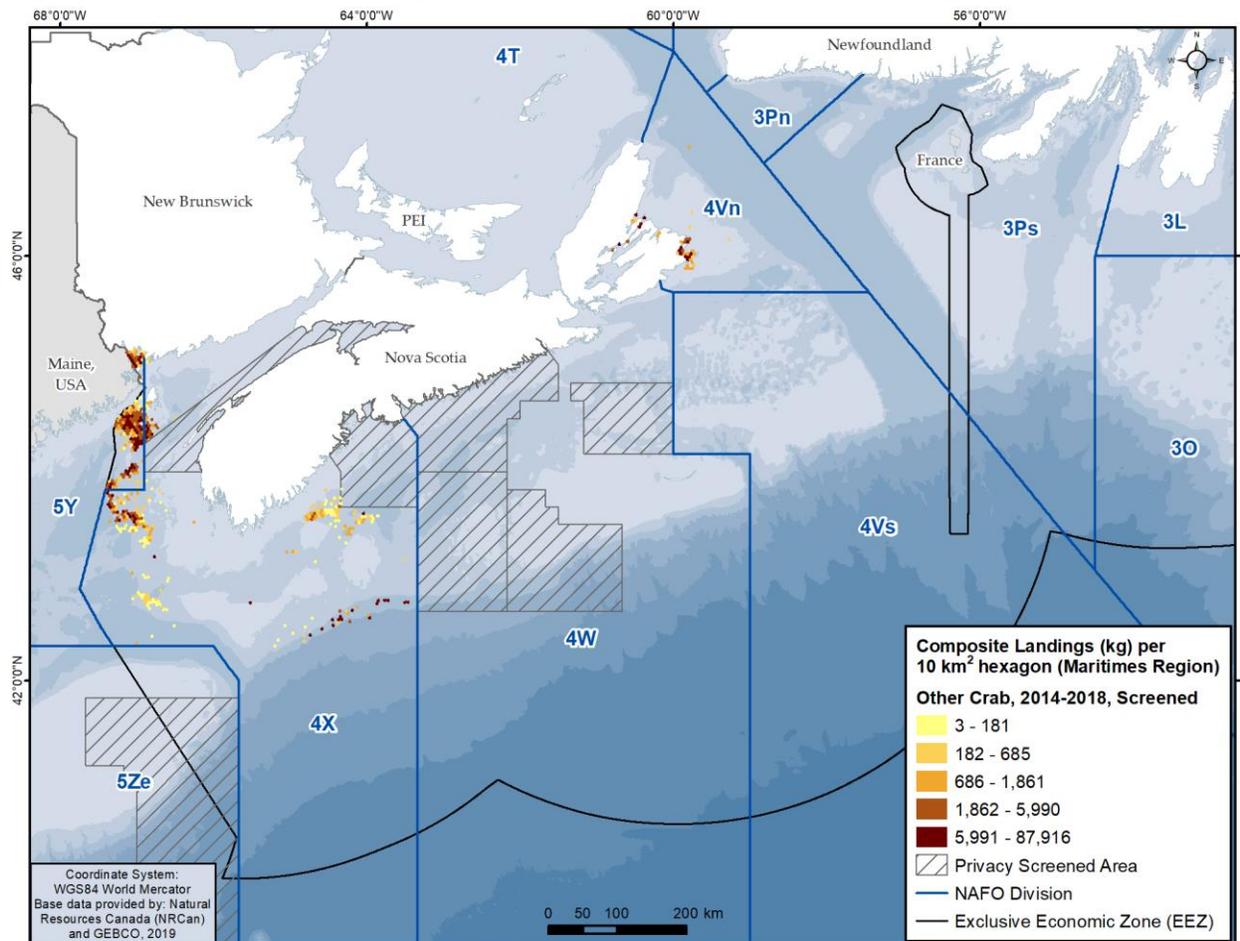
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Fisheries for Red Crab, Jonah Crab, and Rock Crab are smaller in scale than the Snow Crab fishery. There are few licence holders in each fishery and a variety of management units are used, which are different in each crab fishery, including Crab Fishing Areas, Lobster Fishing Areas (LFAs), and NAFO divisions. Offshore Jonah crabs are landed with offshore Lobster in LFA 41 with a TAC of 720 tonnes. Most landings in the Jonah crab fishery are from the Bay of Fundy, Crowell Basin and Browns Bank, with landings also from Georges Basin and Bank (Figure 34). A Red Crab fishery exists in deep waters along the shelf edge, with an annual TAC of 300 tonnes. Exploratory fisheries for Stone Crab and Toad Crab have existed on the eastern Scotian Shelf since the mid-1990s, with few licence holders and low catches. No experimental crab fisheries are currently operating. Figure 34 includes bycatch landings of other crab species.

Figure 34.—Other Crab Landings, 2014–2018



## Scallop (Figure 35)

SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: The Bay of Fundy and Scallop Fishing Area 29 West of 65° 30' W longitude certified as sustainable in July 2013 (Full Bay Fleet only). The Offshore Scallop fishery was certified in March 2010.

All scallop fishing in the Bay of Fundy takes place in Scallop Fishing Areas (SFA) 28A, 28B, 28C, and 28D as described in the *Atlantic Fishery Regulations, 1985*.<sup>16</sup> The various fleet sectors are eligible by licence condition to fish one or more areas as follows: Full Bay: SFA 28A, 28B, 28C and 28D; Mid Bay: SFA 28B and 28C only; and Upper Bay: SFA 28C and 28D only. These areas can be further sub-divided into areas that are closed by either regulation or variation orders that restrict fishing during all or part of the year. In addition, specific management measures are applied to broader Scallop Production Areas (SPA) that are designed to incorporate one or more scallop biological production areas and may fall within the boundaries of one or more of the regulated SFAs. SPA boundaries are described in variation orders and/or licence conditions whereas SFA boundaries are described in the *Atlantic Fishery Regulations, 1985*. Inshore scallop fishing also takes place in SFA 29 as described in the *Atlantic Fishery Regulations, 1985*. SFA 29 is divided into SFA 29 West of 65°30' W longitude west to the 43°40' Line and SFA 29 East of 65°30' W longitude, east to Cape North and within the 12-nautical mile territorial sea. Two of the fleet sectors are eligible by licence condition to fish one or more areas as follows: Full Bay: SFA 29 West; Inshore: SFA 29 East, 64 licences eligible for SFA 29 West.<sup>17</sup>

The offshore scallop fishery in Maritimes Region operates primarily on Georges and Browns Banks, German Bank, Western and Sable Banks, and Banquereau (Figure 35) and includes sea scallop (*Placopecten magellanicus*) and Iceland scallop (*Chlamys islandica*) that are only landed on Banquereau. The quota for Iceland scallop and sea scallop on St. Pierre Bank in NL Region is set by Maritimes Region. The offshore scallop fishery occurs year-round in the Maritimes Region; however, not all areas are open year-round. German Bank is open from June 1 to November 15. The closure during the late fall and spring is to avoid conflicts with the Lobster fishery that takes place in the area from late November until May 31. In addition, there are two specific closures on Georges Bank: one to protect spawning Atlantic Cod (early February to March 31) and one to protect Yellowtail Flounder (June).<sup>18</sup>

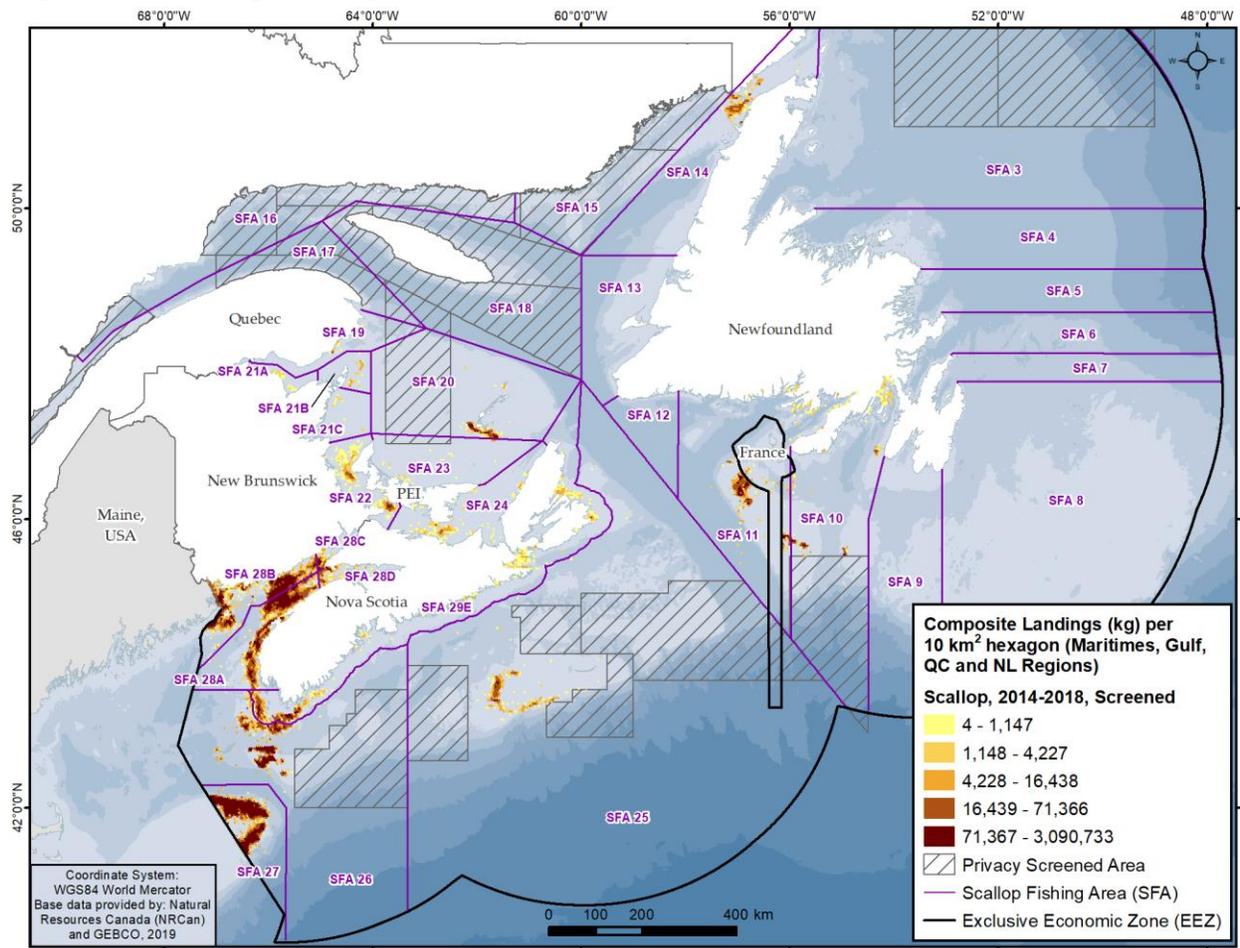
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<sup>16</sup> Atlantic Fishery Regulations, 1985 (SOR/86-21), <<https://laws-lois.justice.gc.ca/PDF/SOR-86-21.pdf>>.

<sup>17</sup> Inshore Scallop Integrated Fisheries Management Plan, 2015, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/scallop-petoncle/scallop-petoncle2015-toc-eng.html>>.

<sup>18</sup> Offshore Scallop Integrated Fisheries Management Plan, 2018, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/scallop-petoncle/2018/index-eng.html>>.

Figure 35.—Scallop Landings, 2014–2018



## Scallop Q1–Q4 (Figures 36 to 39)

Quarterly scallop maps are shown in Figures 36–39. Much of Georges Bank shows high landings year-round, reflecting the area’s importance to the offshore fishery. There is little activity on the eastern Scotian Shelf during the winter. There are high landings in the area off Digby in the Bay of Fundy for much of the year, reflecting the importance of this area to the inshore fishery. A winter scallop fishery exists around Grand Manan and in the Passamaquoddy Bay area off southwest New Brunswick.

Figure 36.—Seasonal Scallop Landings, January–March, 2014–2018

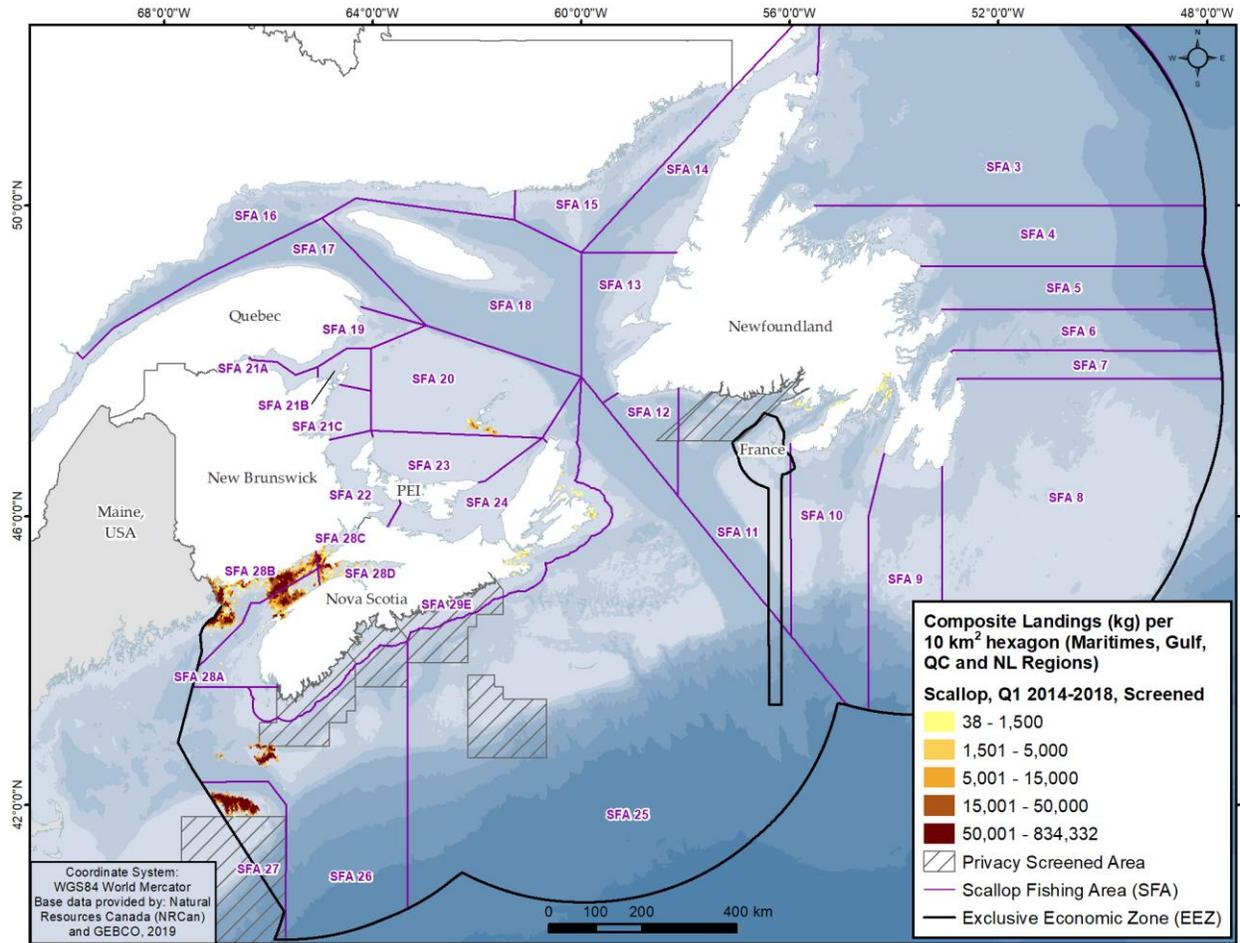


Figure 37.—Seasonal Scallop Landings, April–June, 2014–2018

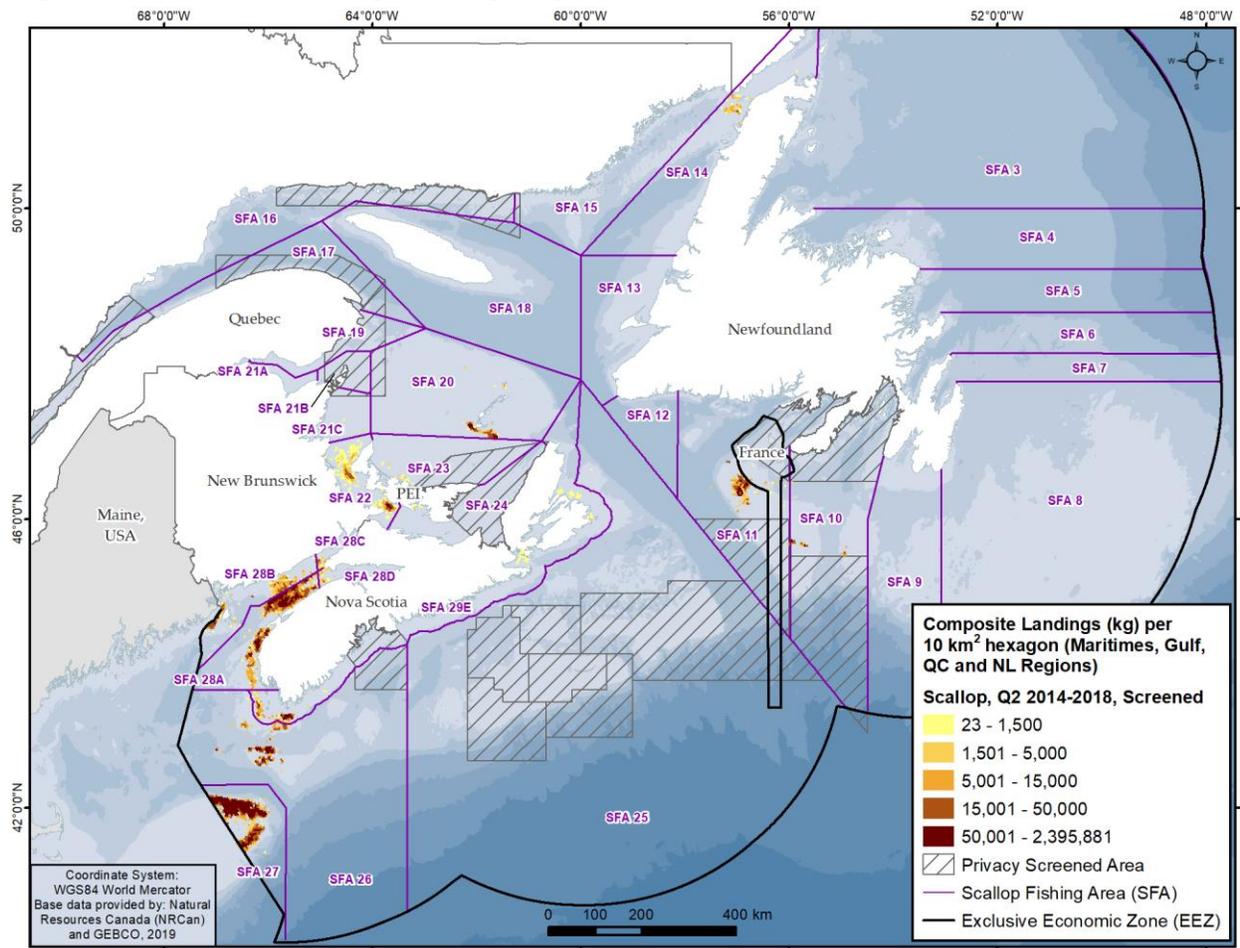


Figure 38.—Seasonal Scallop Landings, July–September, 2014–2018

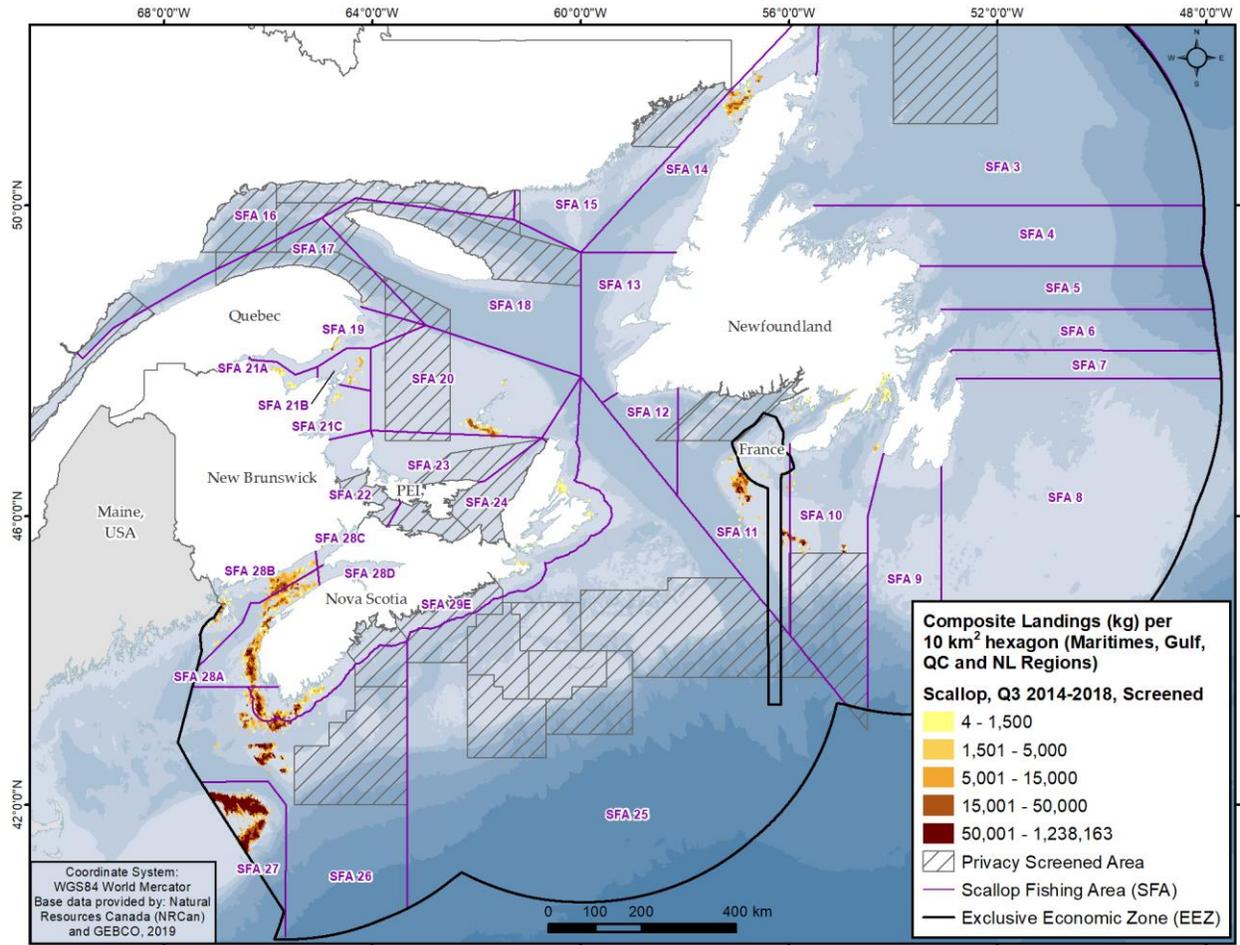
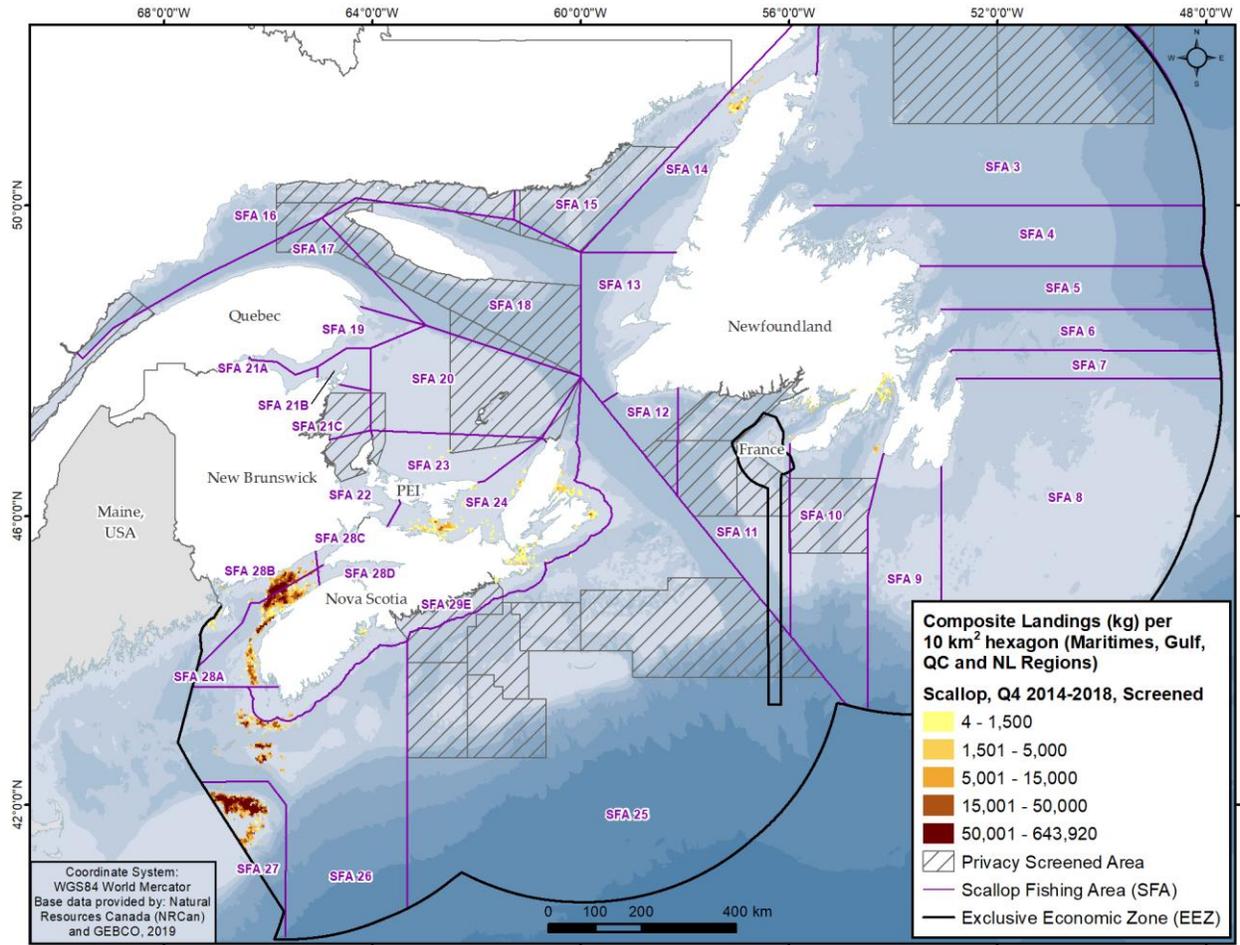


Figure 39.—Seasonal Scallop Landings, October–December, 2014–2018



### **Offshore Clam (Figure 40)**

SARA Status: No Status.

COSEWIC Status: No Status.

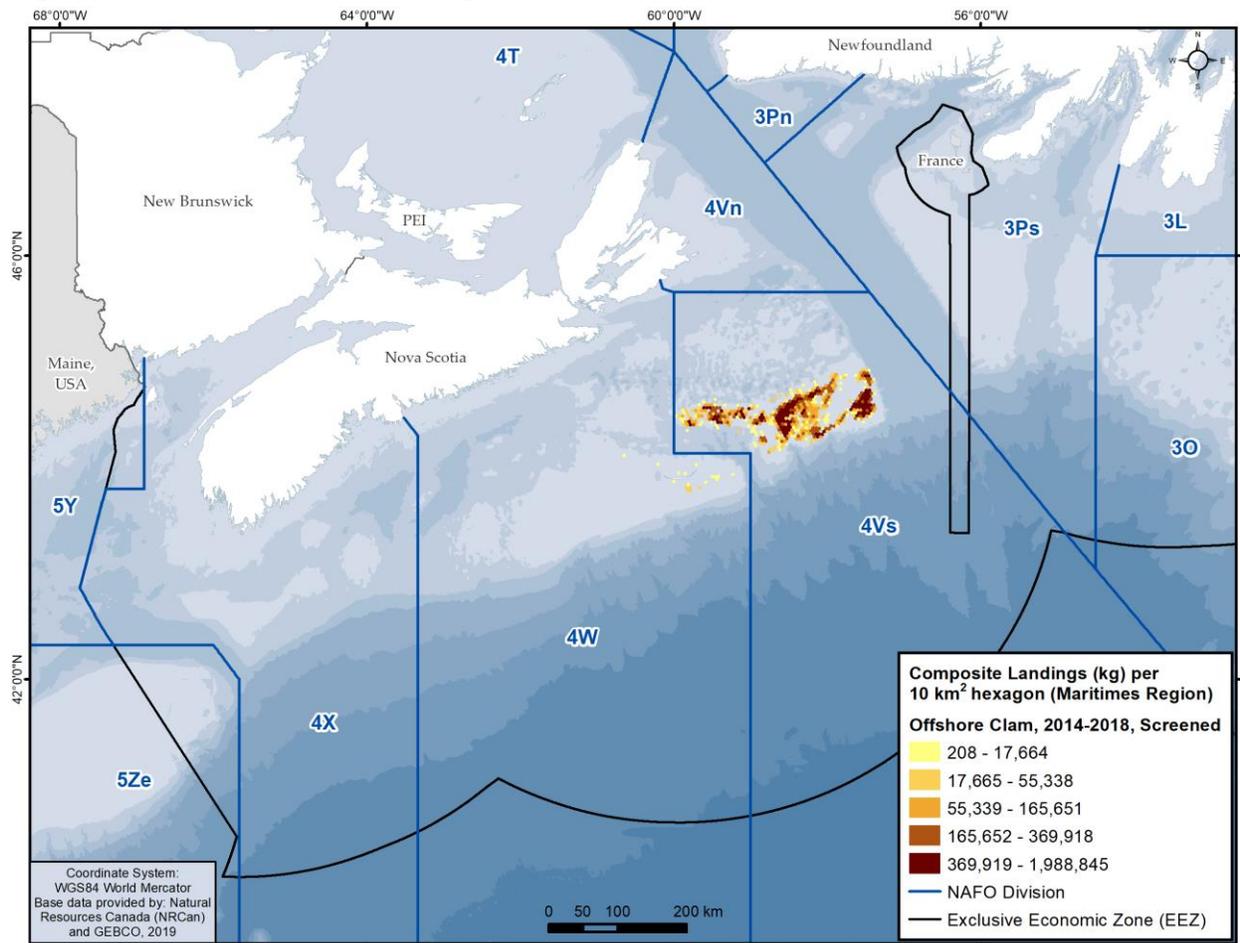
MSC Status: Certified as sustainable in July 2012.

The Arctic Surfclam (*Mactromeris polynyma*) fishery is concentrated on offshore clam beds on the Grand Banks and Banquereau (Figure 40). The Ocean Quahog (*Arctica islandica*) resource is located on Sable Island Bank and the southern Grand Banks; however, licence holders are not permitted to direct for Ocean Quahog on Grand Banks and no quahog harvest has occurred on Sable Island Bank in recent years. The Surfclam fishery is conducted on a year-round basis commencing January 1. There are three licences: Arctic Surf Co. Inc. (NL); Clearwater Seafoods Limited Partnership (NS); and Clearwater Seafoods Limited Partnership (NL). Specialized factory-freezer clam vessels operate year-round and the licences have equal allocations for both commercial fishing areas, Banquereau and Grand Bank. The 2018 TAC was 20,943 tonnes on Banquereau and 14,756 tonnes on Grand Bank, for a total of 35,699 tonnes.<sup>19</sup> Data entry errors in the database were corrected using two polygons provided by the licence holder that approximated the 100-m bathy contour around Sable Island Bank and Banquereau. The offshore clam fishery also retains the following bycatch species: Atlantic Surfclam (Bar Clam), Quahaugs, Propeller Clams and cockles.

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<sup>19</sup> Offshore Clam Integrated Fisheries Management Plan, 2014, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/clams-palourdes/clams-palourdes-2014-eng.html>>.

Figure 40.—Offshore Clam Landings, 2014–2018



### **Shrimp (Figure 41)**

SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Shrimp Fishing Areas 13, 14, and 15 certified as sustainable since June 2011.

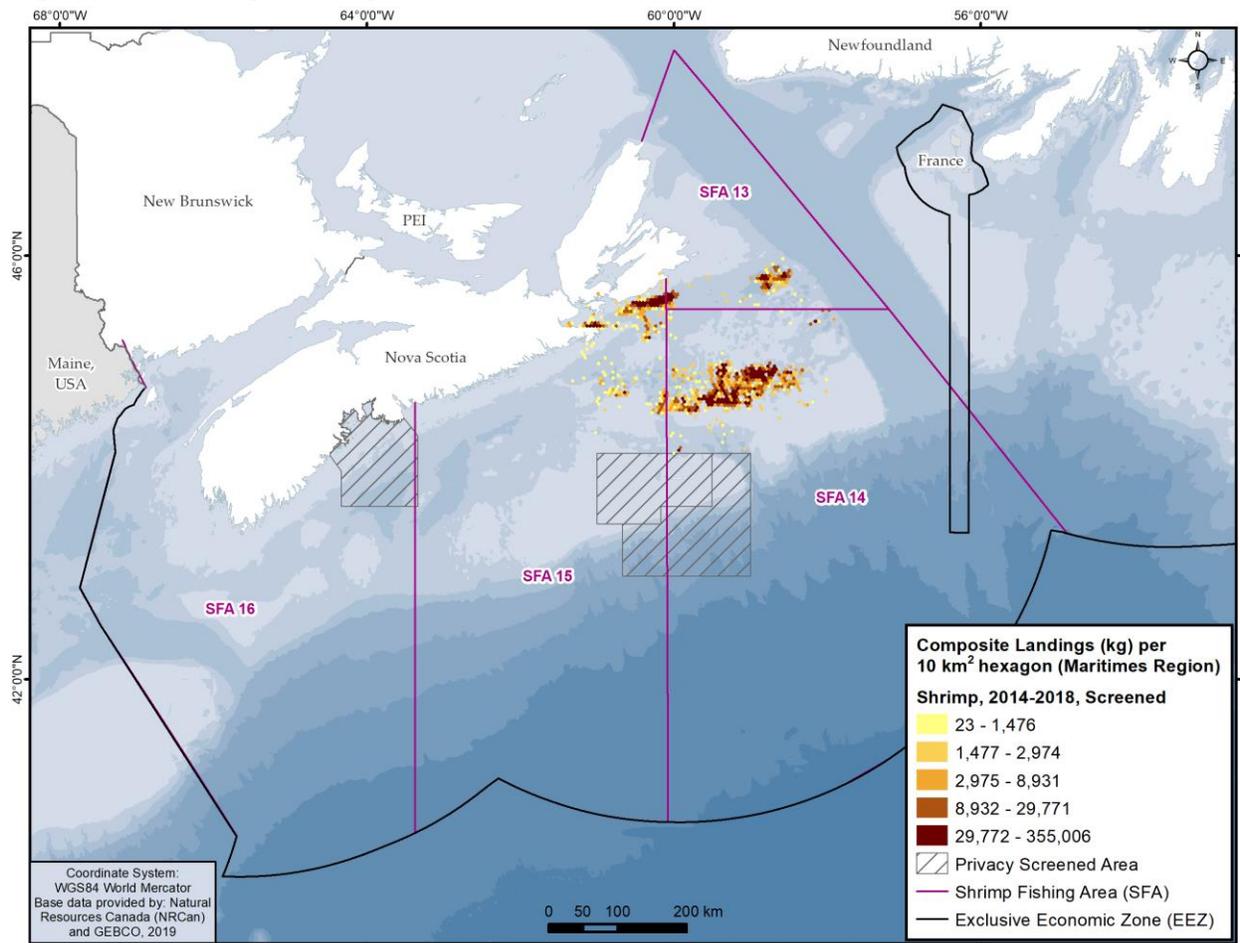
Two species of shrimp are harvested in the Canadian Northwest Atlantic. Northern Shrimp (*Pandalus borealis*) is most abundant and widespread in commercial quantities in ‘holes’ on the Scotian Shelf (Figure 41), and the Striped Shrimp (*Pandalus montagui*) is widely distributed from Davis Strait to the Grand Banks and is more abundant in northerly areas at shallower depths. Northern Shrimp is the only shrimp species of commercial importance in the Maritimes Region. The mobile shrimp fishery uses bottom otter trawls with a minimum mesh size of 40 mm. Shrimp trawl nets are equipped with a mandatory Nordmore separator grate to allow other fish to escape through the upper panel of the trawl. Shrimp in Shrimp Fishing Areas (SFAs) 13-15 are managed as one stock, with a TAC of 2,600 tonnes in 2018. The trawl fishery is open year-round and operates from late winter to early summer. In SFA 13-15, the mobile fleet with 20 active shrimp trawl licences (2014-2018) holds 92 percent of the TAC. Of this, 25 percent is held by Gulf-based vessels and 75 percent by Maritimes-based vessels. The mobile fleet has been operating under a system of individual transferrable quotas since 1998. Shrimp in SFA 16 may be part of the Gulf of Maine stock, which is fished competitively as there is no TAC available in this area. Shrimp harvests in SFA 16 have been very low in recent years.

A small shrimp trap fishery operates in Chedabucto Bay (SFA 15). There are 14 trap licences in total with an allocation of 100 traps each. Five trap licences are located in the north of Chedabucto Bay, eight in the south, and one along the eastern shore just south of the bay. The trap fleet is active primarily from late fall through winter. The trap fleet holds 8 percent of the TAC and trappers fish their share competitively.<sup>20</sup>

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<sup>20</sup> Scotian Shelf Shrimp Integrated Fisheries Management Plan, 2013, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/shrimp-crevette/shrimp-crevette-2013-eng.html>>.

Figure 41.—Shrimp Landings, 2014–2018



## Offshore Lobster (Figure 42)

SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Eastern Canada offshore Lobster trap fishery was certified sustainable in June 2010.

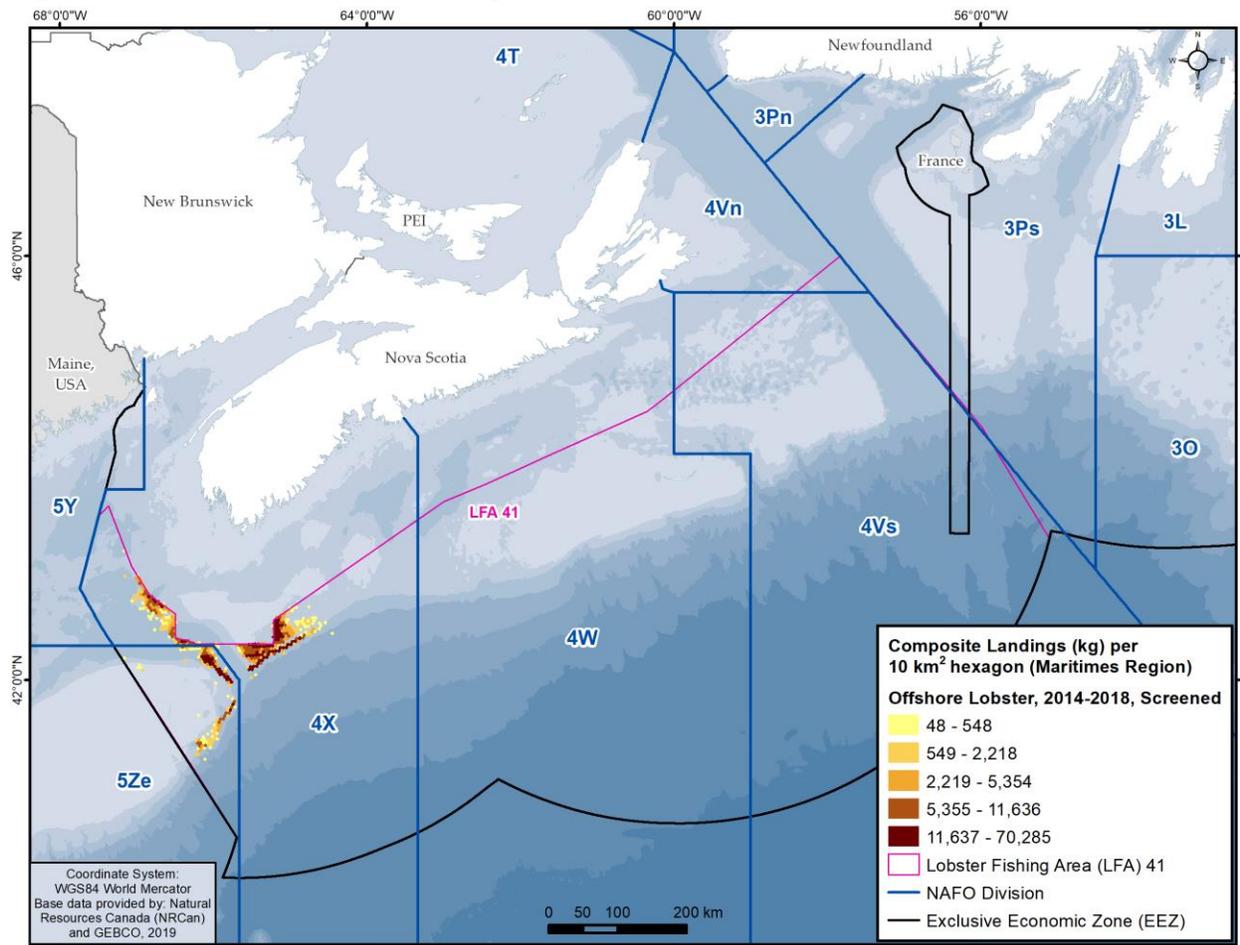
Most Lobster fisheries in the region report landings by inshore Lobster Fishing Area and statistical grid fished, not by latitude and longitude coordinates. However, the offshore Lobster fishery is required to report coordinates. The fishery for offshore American Lobster (*Homarus americanus*) occurs within the boundaries of Lobster Fishing Area (LFA) 41, as described in the *Atlantic Fishery Regulations*.<sup>21</sup> LFA 41 extends from the Hague Line on Georges Bank to the Laurentian Channel off Cape Breton; however, all traditional offshore Lobster and Jonah crab commercial fishing occurs on five major grounds, namely Georges Bank (outer shelf and upper slope), Georges Basin, Crowell Basin, Southeast Browns Bank (outer shelf and upper slope east of Northeast Channel) and west Browns Bank, all within NAFO divisions 4X and 5Ze (Figure 42). The TAC for LFA 41 was established at 720 tonnes in 1985 based on landings history and has remained unchanged.<sup>22</sup> Outlier coordinates north of the LFA 41 line were considered data entry errors and were removed. Data from the statistical grid-based inshore Lobster fishery are not included in this report, but are analyzed and published in a separate atlas (Serdynska and Coffen-Smout, 2017).

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<sup>21</sup> Atlantic Fishery Regulations, 1985 (SOR/86-21), <<https://laws-lois.justice.gc.ca/PDF/SOR-86-21.pdf>>.

<sup>22</sup> Offshore Lobster and Jonah Crab Integrated Fisheries Management Plan, 2019, <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/lobster-crab-homard/2019/index-eng.html>>; <<https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/lobster-crab-homard/index-eng.html>>.

Figure 42.—Offshore Lobster Landings, 2014–2018



### **Disputed Zone Area 38B Lobster (Figure 43)**

SARA Status: No Status.

COSEWIC Status: No Status.

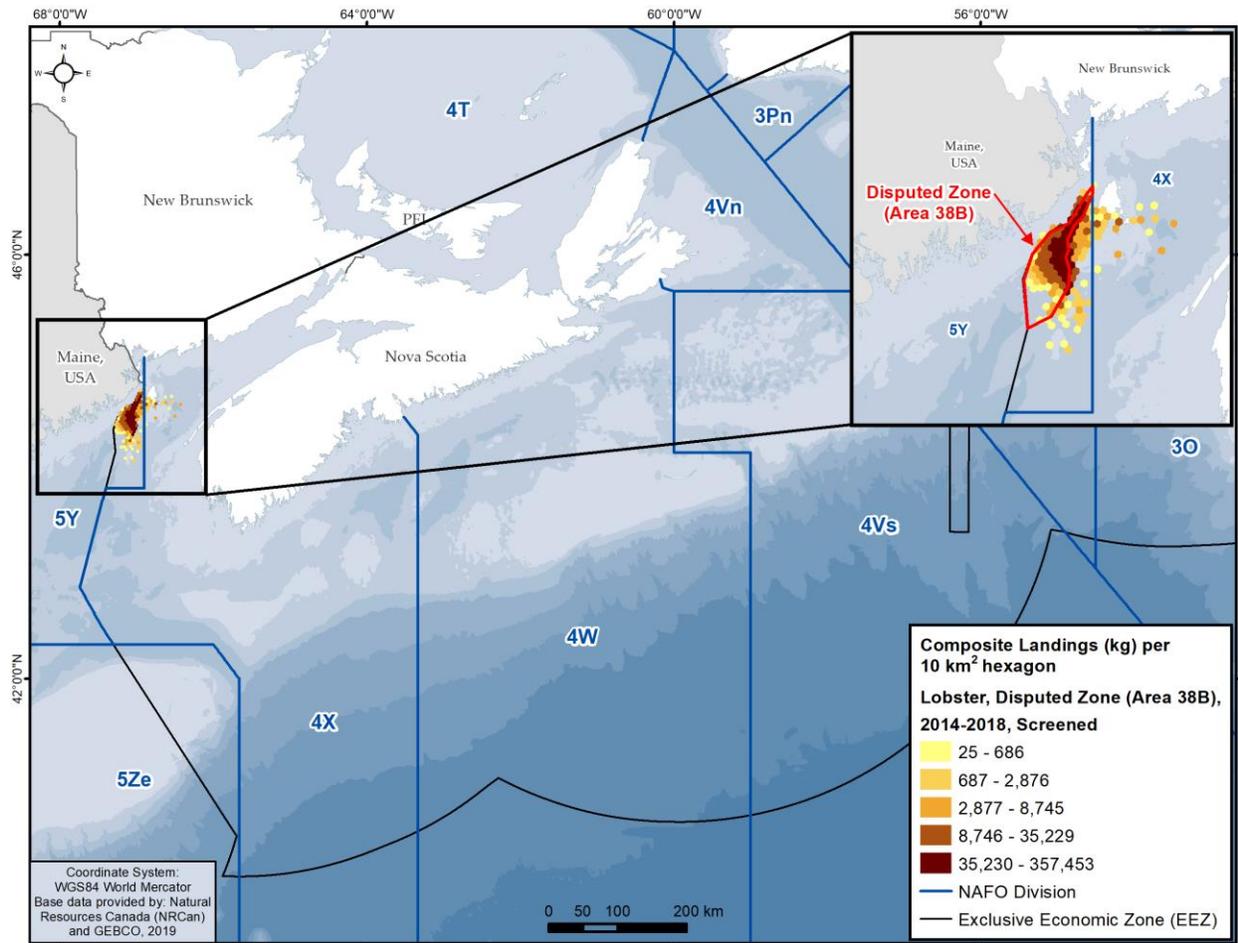
MSC Status: Bay of Fundy, Scotian Shelf and Southern Gulf of St. Lawrence Lobster trap fishery was certified sustainable in May 2015.

Most Lobster fisheries in the region report landings by inshore Lobster Fishing Area and statistical grid, not latitude and longitude coordinates; however, the Disputed Zone Lobster fishery is required to report coordinates. Figure 43 shows Disputed Zone Lobster landings. Landings reported outside the Disputed Zone are considered to have errors in their coordinates, but have not been removed from the map. The Disputed Zone Lobster (*Homarus americanus*) fishery occurs in a disputed zone known as Area 38B (see inset map in Figure 43), an area in Grand Manan Channel disputed between Canada and the U.S.A. The fishing season begins June 30 and ends on the Friday preceding the opening of the regular LFA 38 Lobster season on the second Tuesday in November. Only licence holders with a valid Lobster licence for LFA 38 are permitted to fish in Area 38B. Access to the disputed zone is limited by the number of Lobster licences in LFA 38. Single Lobster licences are limited to 375 traps, while partnership Lobster licences are limited to 563 traps. Licence holders and operators are required to have a DFO-approved Vessel Monitoring System (VMS) on vessels authorized to fish any Disputed Zone fishing licence. U.S.-based fishers from Maine also target Lobster in the Disputed Zone.<sup>23</sup> Data from the statistical grid-based inshore Lobster fishery are not included in this report, but are analyzed and published in a separate atlas (Serdynska and Coffen-Smout, 2017).

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<sup>23</sup> See section 4.6.2, Inshore Lobster Integrated Fisheries Management Plan, 2011, <<http://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/maritimes/2019/inshore-lobster-eng.html>>.

Figure 43.—Disputed Zone Area 38B Lobster Landings, 2014–2018 (Outlier points outside the red polygon are assumed to be data errors.)



### Whelk (Figure 44)

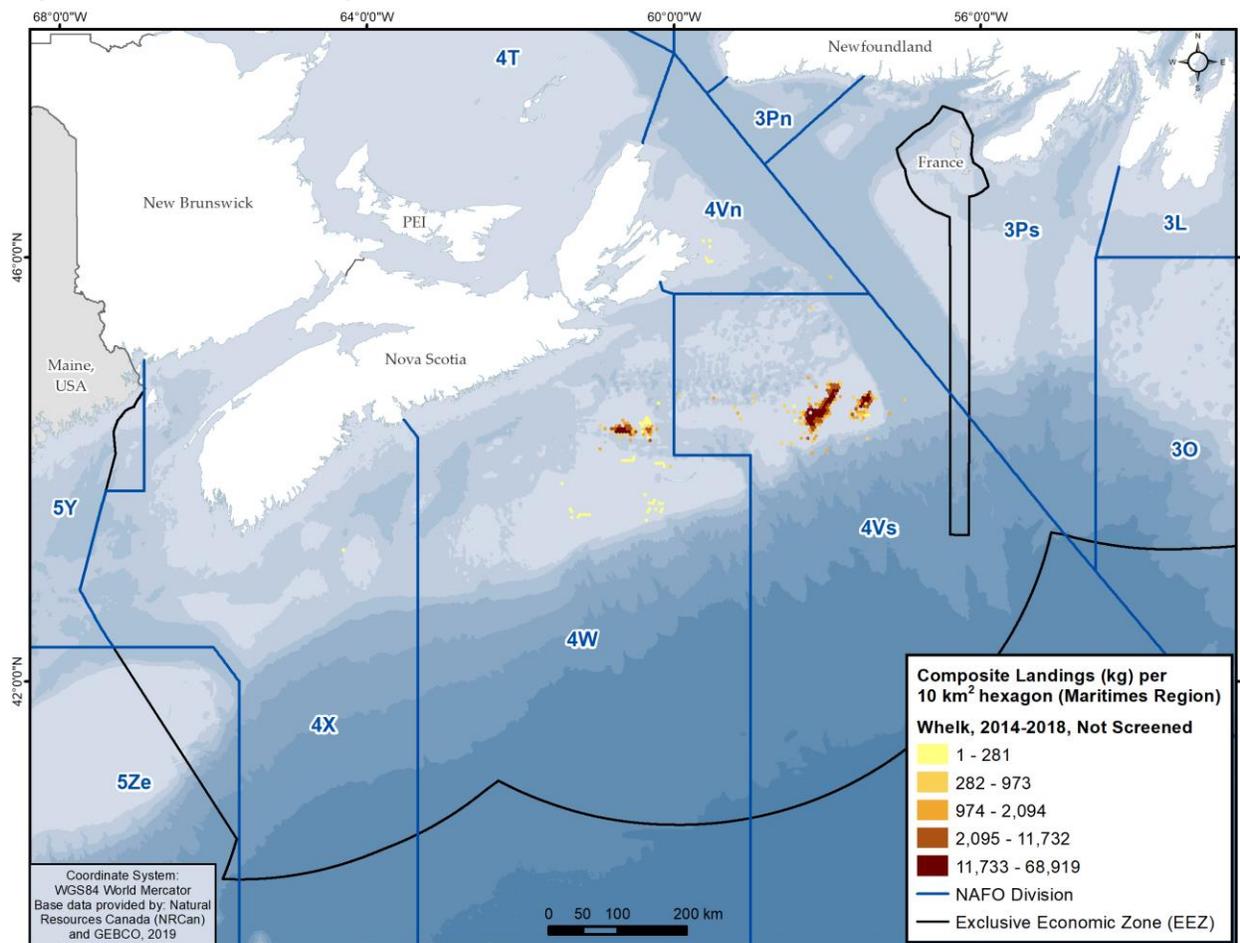
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Waved Whelk (*Buccinum undatum*) is a common marine snail native to the Northwest Atlantic and distributed from Newfoundland and Labrador to New Jersey, USA. A small exploratory fishery for Whelk using conical traps exists off Canada's east coast. Two Whelk licence holders operate inshore exploratory licences restricted to Lobster Fishing Areas 27, 29, 30 and 31A/B off Eastern Nova Scotia. Three offshore exploratory enterprise allocation licences are operated on the Scotian Shelf by two licence holders in NAFO areas 4Vs and 4W. Each offshore licence holder is restricted to a maximum annual catch of 700 tonnes in 4Vs and 250 tonnes in 4W. The licence conditions for Whelk state that "acceptance of these licence conditions acknowledges that the data collected about this fishery from the licence may be made public." Therefore, privacy screening was not required for this fishery. Maritimes Region Whelk landings are shown in Figure 44.

Figure 44.—Whelk Landings, 2014–2018



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