Eastern Canadian Commercial Fishing Data

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TABLE OF CONTENTS

MAPPING BY SPECIES FIGURES iv
ABSTRACT vi
RÉSUMÉ vi
INTRODUCTION 1
METHODS 3
Data Processing 3
Privacy Screening & Quality Assurance/Quality Control (QA/QC) 4
Data Aggregation and Mapping 9
CONCLUSION 9
SPECIES AND GEAR TYPE MAPPING 10
Commercial Maps by Species 11
Commercial Maps by Gear Type 43
APPENDIX A 63
ACKNOWLEDGEMENTS 65
REFERENCES 65

MAPPING BY SPECIES FIGURES

Figure 1 - All Species 11
Figure 2 - All Offshore Clam 12
Figure 3 - Atlantic Cod (Gadus morhua) 13
Figure 4 - Atlantic Halibut (Hippoglossus hippoglossus) 14
Figure 5 - Atlantic Herring (Clupea harengus) 15
Figure 6 - Bluefin Tuna (Thunnus thynnus) 16
Figure 7 - Capelin (Mallotus villosus) 17
Figure 8 - Crab (other) 18
Figure 9 - Cusk (Brosme brosme) 19
Figure 10 - Dogfish (Squalus acanthias) 20
Figure 11 - Flounder (other) 21
Figure 12 - Greysole/Witch Flounder (Glyptocephalus cynoglossus) 22
Figure 13 - Groundfish (other) 23
Figure 14 - Haddock (Melanogrammus aeglefinus) 24
Figure 15 - Hagfish/Slime Eel (Myxini) 25
Figure 16 - Hake 26
Figure 17 - Lobster (Homarus americanus) 27
Figure 18 - Mackerel (Scomber scombrus) 28
Figure 19 - Pollock (Pollachius virens) 29
Figure 20 - Queen/Snow Crab (Chionoecetes opilio) 30
Figure 21 - Redfish (Sebastes fasciatus/Sebastes mentella) 31
Figure 22 - Scallop (Placopecten magellanicus) 32
Figure 23 - Sea Urchin (Stronglyocentrotus droebachiensis) 33
Figure 24 - Sculpin (Myoxocephalus Scorpius/Myoxocephalus octodecimspinosus) 34
Figure 25 - Shark 35
Figure 26 - Shrimp 36
Figure 27 - Swordfish (Xiphias gladius) 37
Figure 28 - Turbot/Greenland Halibut (Reinhardtius hippoglossoides) 38
Figure 29 - Tuna (other) 39
Figure 30 - Whelk (Buccinum undatum) 40
Figure 31 - Winter Flounder (Pseudopleuronectes americanus) 41
Figure 32 - Yellowtail Flounder (Limanda ferruginea) 42
Figure 33 - All Fixed Gear 43
Figure 34 - All Mobile Gear 44
Figure 35 - Angling/Rod and Reel 45
Figure 36 - Beach and Bar Seine 46
Figure 37 - Bottom Otter Trawl 47
Figure 38 - Danish and Scottish Seine 48
Figure 39 - Diving with Hand Tool 49
Figure 40 - Dredge (Boat) 50
Figure 41 - Gillnet 51
Figure 42 - Hand Line (Baited) 52
Figure 43 - Harpoon and Spear 53

Figure 44 - Longline (Groundfish) 54
Figure 45 - Longline (Pelagics) 55
Figure 46 - Mechanical Device (Mackerel) 56
Figure 47 - Pot 57
Figure 48 - Purse and Tuck Seine 58
Figure 49 - Shrimp Trawl 59
Figure 50 - Trap Gear (All Types) 60
Figure 51 - Trap Net 61
Figure 52 - Troller Lines 62
Figure 53 - Northwest Atlantic Fisheries Organization Divisions 63
Figure 54 - Fisheries and Oceans Canada – Unit Areas 64

ABSTRACT

Parmenter, C. and Gullage, M. 2024. Eastern Canadian Commercial Fishing Data. Can. Tech. Rep. Fish. Aquat. Sci. 3627: vi + 65 p.

The following report contains commercial fishing data maps for all Fisheries and Oceans Canada (DFO) regions of Eastern Canada, including Newfoundland and Labrador, Maritimes, Gulf, Quebec and Eastern Arctic. These maps include records within Northwest Atlantic Fisheries Organization (NAFO) Divisions 0, 2, 3, 4 and 5 during a ten-year period from 2012 to 2021. Data is aggregated by 10 km^2 hexagon grids that display total catch weight (kg). The data is displayed by individual species (species sought), gear type groupings, all species, fixed gear types and mobile gear types. Species and gear type are mapped separately as the two are not mutually exclusive, and multiple species can be seen within the same gear type and vice versa. The species and gear type data are publicly available on the Open Data portal (Government of Canada, 2024) and has undergone privacy screening as per the Government of Canada's privacy policy. (Eastern Canada Commercial Fishing - Open Government Portal).

RÉSUMÉ

Parmenter, C. and Gullage, M. 2024. Eastern Canadian Commercial Fishing Data. Can. Tech. Rep. Fish. Aquat. Sci. 3627: vi + 65 p.

Le rapport suivant contient des cartes de données sur la pêche commerciale pour toutes les régions de Pêches et Océans Canada (MPO) de l'Est du Canada, y compris Terre-Neuve-et-Labrador, les Maritimes, le Golfe, le Québec et l'Est de l'Arctique. Ces cartes comprennent des données provenant des divisions 0, 2, 3, 4 et 5 de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO), recueillies au cours d'une période de dix ans allant de 2012 à 2021. Les données sont regroupées dans des grilles hexagonales de 10 km^2 qui affichent le poids total des prises (kg). Elles sont présentées pour une espèce donnée (espèce recherchée), pour un type d'engin donné, pour toutes les espèces, pour les engins fixes et pour les engins mobiles. Les espèces et les types d'engins sont cartographiés séparément, car ils ne sont pas mutuellement exclusifs. En effet, plusieurs espèces peuvent être capturées par le même type d'engin et plusieurs engins permettent la capture d'une espèce donnée. Les données sur les espèces et les types d'engins sont accessibles au public par l'entremise du Portail du gouvernement ouvert (Gouvernement du Canada, 2024) et ont fait l'objet d'une vérification de la confidentialité conformément à la politique relative à la protection des renseignements personnels du gouvernement du Canada. (Pêche Commerciale dans l'Est du Canada - Portail du gouvernement ouvert).

INTRODUCTION

The information in this report is for directed fisheries and displays commercial catch weight (kg) landings over a ten-year period from 2012 to 2021. Catch weight (kg) is used as the representative variable because it is a standard measure. Landed value is not used to represent the fishery because it is a variable that changes with the market, meaning the value at the time of catch may not be the same as the value at the time this data is processed/observed. Commercial landings data was obtained from Statistics Branch in DFO for NAFO Subareas 0AB, 2GHJ, 3KLMNOP, 4RSTVWX and 5YZ (see Appendix A, (NAFO, 2024)) between 2012 and 2021, which corresponds with Fisheries and Oceans Canada (DFO) regions in Newfoundland and Labrador, Maritimes, Gulf, Quebec and the Eastern Arctic. Previous datasets have been created regionally, where the data is uniquely formatted to those regions' specifications. Therefore this creates one consistent dataset for all regions with standardized formats and attributes referred to as a Zonal Interchange Formatted File (ZIFF).

The data is represented in two categories: species sought and gear type, as the species and the gear types represented are not mutually exclusive. By using species sought, targeted locations are identified for each species, and does not include bycatch species. The layers were created by overlaying a 10 km^2 hexagonal grid on commercial fisheries point data and summing the total landings by weight reported for each cell over the ten-year period. Therefore, the value of each grid cell is equal to the total landings in kg from 2012 to 2021 for the area, and may represent many fishing events from several vessels over the ten-year period. All landings are from Canadian vessels greater than 35 ft, and do not include information pertaining to international fishing vessels (i.e., St. Pierre and Miquelon, France). Individuals should exercise caution when interpreting this data as it may contain errors such as inaccurate or non-viable coordinates, landed weights and/or species and gear type identification. For example, fishing events may be reported in a DFO unit area (i.e., subzones of NAFO Divisions created by DFO) with corresponding coordinates falling outside that particular DFO unit area, data may be on land or there may be other erroneous or missing geographic coordinates. Such cases were excluded from the dataset. A ratio table (Table 1) is provided to show what portion of the data for each year has been excluded. This table indicates that overall, ~41% of the data is displayed. Only one location is provided for each fishing event; therefore, a fishing activity that would normally occur over a large area (i.e., trawling) is only shown in a single location. Hence, areas shown should only be used as an estimation of fishing intensity and a general idea of where fishing actually occurs.

This dataset has been privacy screened to comply with the Government of Canada's privacy policy (Treasury Board, 2020). Privacy assessments were conducted to identify DFO unit areas containing data with less than five vessel IDs, license IDs or fisher IDs. If this threshold was not met, catch weight locations have been withheld from these statistical areas

to protect the identity or activity of individual vessels or companies. The withheld areas are indicated by the unit area that has been removed and given a weight of -9999.

Table 1 - Erroneous Point Removal Statistics by Year. The following table displays the number of starting records, the number of records deemed erroneous and removed during the clean-up process, as well as the number and percentage of retained records when starting the processing and privacy screening.

Table 1 - Erroneous Point Removal Statistics by Year

Year	Number of Total Records	Number of Removed Records	Number of Retained Records	Percentage of Points Retained
2012	874,306	503,054	371,252	42.46
2013	828,876	459,019	369,857	44.62
2014	805,694	474,364	331,330	41.12
2015	779,581	462,117	317,464	40.72
2016	827,989	497,440	330,549	39.92
2017	838,837	517,780	321,057	38.27
2018	842,904	532,025	310,879	36.88
2019	814,643	508,674	305,969	37.56
2020	722,804	422,763	300,041	41.51
2021	772,288	479,618	292,670	37.90
Total	8,107,922	4,856,854	3,251,068	40.10

METHODS

Data Processing

The logbook data was initially obtained from DFO Statistical Services as layers using NAFO Divisions for their dividing attribute (e.g., all years 2009 - 2018 of NAFO Division 0A). Since the initial data collection, logbook data is now retrieved on an annual basis, not per NAFO Division (e.g., all regions, all data of 2009). The clean-up for datasets is performed by year, which allows for any range of years to be used for future analysis.

Data is acquired in tabular datasets (.csv format), which include commercial logbook entries for all Eastern DFO regions (Newfoundland and Labrador, Maritimes, Gulf, Quebec and Eastern Arctic) for each year of data. Each dataset is acquired with the understanding that all the attributes are standardized for that year.

Data acquired from Statistical Services have standardized attributes for each dataset as they are attained by year. However, attributes from one year to the next may vary and any required attributes need to be standardized across datasets. The same standardization must take place for attribute inputs, not just the fields themselves (e.g., the Region attribute from 2009 contains entries 'Gulf, Maritimes, Quebec, Newfoundland,' whereas other years have 'G, S, Q, N' (S = Maritimes Region)). Once it is confirmed that all datasets have a common latitude and longitude field (in decimal degrees), they are converted to spatial point data using a WGS84 coordinate system. Where it is not mandatory to provide coordinate data for every record, some data may be excluded/removed during the clean-up process and cannot be displayed. (See Table 1: Erroneous Point Removal Statistics).

Prior to processing commercial data, it must be prepared for use. Cleaning the dataset required removing records with missing or erroneous coordinates. Records that appear on land were removed if they were outside a 1 km buffer of the coastline. This was done to account for rounding of the decimal degrees, which may cause some points to appear just within the coastline. Records that occurred outside their respective DFO unit area (with a 50-km buffer to account for start or end coordinates of a fishing event) were removed. Fishing records which occurred outside of areas where there are gear or species limitations/prohibitions were also removed. It is important to reiterate that it is likely that not all erroneous records have been identified. All datasets were checked for additional erroneous records, such as extreme depths, extreme distances, and outside of fishing zones, etc.

All standardized datasets were combined into a single feature to represent the range of years for all regions of Eastern Canada (2012 – 2021 in this report). Attributes were reduced to only necessary variables/attributes for privacy needs, which also allows for reduced processing time. New attributes are created for any code field that requires a descriptor (i.e., Species code field requires a Species Description field which will detail the species that is represented e.g., 001 = Cod). The full dataset is then exported/divided into separate datasets by individual species and gear types.

Certain species and gear types that lack significant information were removed from the datasets or similar species and similar gear types were combined. This pertains to any species or gear type where there were so few records over the ten-year period that they are likely errors, failed the privacy screening, permissions were not granted to display data in areas where privacy screening did not pass, was protected data or the data could not be grouped with similar data. Thresholds for data that cannot be grouped include:

1. Less than 500 records for a dataset are excluded.
2. Datasets with 500 – 1500 records are reviewed to determine whether they should be retained or excluded based on the species/gear type significance. For example, there were 843 Beach and Bar Seine records, but this fishery is deemed significant in NL region, so it is retained.
3. Greater than 1500 records are retained.

It is important to note that this threshold is used to determine which data to exclude before the privacy screening process. The number of records for these datasets may further decrease during the privacy screening process, at which time a secondary analysis should be performed to retain or exclude datasets.

Certain gear types may be divided to distinguish between catch events that will have different variables for the clean-up process and privacy screening process. For example Longline is divided into "Longline – Groundfish" and "Longline – Pelagic" as they represent two different directed fishery types.

Privacy Screening & Quality Assurance/Quality Control (QA/QC)

The Government of Canada's privacy policy on commercial fishing data (Treasury Board, 2017) known as the "Rule of Five", indicates that DFO unit areas cannot depict commercial fishing locations where the total records for the area are less than five, or there are fewer than five unique vessel IDs, fisher IDs or licence IDs (Koropatnick and Coffen-Smout, 2020). If any unit area fails to meet these requirements, the information within (including catch weight) must be excluded from the datasets/maps, unless permission is granted by the licence holders. These areas are uniquely represented as Privacy Screened Areas within the maps below and identified within the accessible datasets as having -9999 catch weight.

A tool was created in ArcGIS Pro which takes each dataset (species and gear types) and checks it against each DFO unit area to determine whether it passes the privacy screening. If the total records in a single DFO unit area is less than five, the records are removed/exported and retained. If there are five or more total records, the tool then checks the number of unique vessel IDs (cfv), and if there are five or more, it checks fisher IDs (fin) and then licences in the same manner. The privacy screening tool maintains all data removed during the screening process and labels the data with the reason and location in which it was removed. As an example, if yellowtail flounder data is removed in 3Nc because the data did

not have five or more unique vessel IDs, the data removed would be labelled "Yellowtail_3Nc_cfv." The data points that have been removed are then retained for statistical analysis, potential reintroduction and documentation.

Once the data has gone through the privacy screening process, steps need to be taken to ensure the quality of both the retained data and the removed data. It is during this process that further erroneous data or data with permissions are extracted and/or reintroduced.

During this QA/QC process, the primary reason for further data points being removed is that they appear on a unit area boundary line. Data points that appear on the boundary line are not considered by the tool/workflow to be 'within' the boundary area and are incorrectly retained. These points must be investigated and removed if they are associated with a unit area that has failed the privacy screening process.

There are two primary reasons that data would be reintroduced back into the datasets.

1.) Data points that are reintroduced for having NULL variables: In some cases, the variables used in privacy screening (vessel ID, fisher ID and licence ID) are NULL. These NULL values are assumed to be unique values and are reintroduced assuming the unit area would then pass the privacy screening process. These NULL values are only reintroduced if they appear within the variable that failed the privacy screening, and if the remaining variables continue to pass screening.
2.) Data points where permission is granted: In the case of fisheries with limited licenses, vessels or fisher IDs, privacy screening will always fail (e.g., Offshore Clam). In these cases, permission is sought to map these fisheries from the fishers or companies who conduct them.

The percentage of records removed during privacy screening and reintroduction should be maintained and ranged for analysis. The ranges for these percentages are 1-10, 10-25, 25-50, 50-75, and 75-100. The goal is to have less than 10% of any dataset removed during the privacy screening process, in which case permissions are not sought. Data with 10% - 50% removal are to be reviewed to determine if permission should be sought. Datasets with 50% removal or greater are determined to be significant, permissions should be sought for these datasets. Any data in which permission is given to be reintroduced into their respective datasets need to follow the stipulations of the permissions given.

All reintroduced points, whether for permissions or NULL values, follow a set of rules:

1. Points in areas that have less than five records overall can only be reintroduced if permission is granted, not for NULL values.
2. If points are reintroduced, that area will no longer be displayed as hatched (Privacy Screened), even if other data remains removed from that area.
3. Thresholds for NULL values that are removed during the privacy screening process:
    a. In datasets where the total removed points are less than 1% of the overall dataset, NULL values are not reintroduced.
    b. In datasets where the total removed points are 1% - 5% of the overall dataset, NULL values are to be evaluated for reintroduction.
    c. In datasets where the total removed points are greater than 5% of the overall dataset, NULL values are to be reintroduced.
4. Points with NULL values are only reintroduced in areas that failed privacy screening, where the failing variable (vessel IDs (cfv)/fisher IDs (fin)/licence) is NULL. For example, if the Shrimp fishery failed privacy screening in Unit Area 3PSB because there were less than five fisher IDs (FIN), only records with a NULL FIN field within that area can be reintroduced.
5. If NULL values are reintroduced to a failed variable, the remaining variables must continue to pass privacy screening, unless those variables also contain NULL values, in which case the previous rules must still apply.

It is important to note that a privacy screened area is not indicative of a lack of activity. Areas with significant activity can still fail the privacy screening if less than five unique values within the variables comprise that activity.

Table 2 - Privacy Screening Summary Table by Species. The following table displays the number of records, by species grouping, at the beginning of the privacy screening process, as well as the number and percentage of retained records represented in the final figures and datasets.

Table 2 - Privacy Screening Summary Table by Species

Species	Starting Records	Records Represented in Dataset	Percent of Data Represented in Dataset
All Offshore Clam	114,285	113,072	98.94
Atlantic Cod	115,587	115,153	99.62
Atlantic Halibut	192,387	190,899	99.23
Atlantic Herring	58,720	58,448	99.54
Bluefin Tuna	19,065	19,002	99.67
Capelin	11,341	11,257	99.26
Crab, Other	34,389	34,045	99.00
Cusk	4,691	4,605	98.17
Dogfish	945	873	92.38
Flounder, Other	1,865	1,470	78.82
Greysole/Witch Flounder	31,914	21,680	67.93
Groundfish, Other	8,881	8,090	91.09
Haddock	450,900	450,336	99.87
Hagfish/Slime Eel	1,625	1,549	95.32
Hake	170,881	169,665	99.29
Lobster	72,036	68,870	95.60
Mackerel	23,256	23,004	98.92
Pollock	84,401	84,217	99.78
Queen/Snow Crab	421,871	421,721	99.96
Redfish	278,988	273,043	97.87
Scallop	332,960	330,615	99.30
Sculpin	19,495	19,412	99.57
Sea Urchins	16,776	15,294	91.17
Shark	1,165	1,083	92.96
Shrimp	396,452	319,807	80.67
Swordfish	38,083	37,955	99.66
Tuna, Other	18,040	17,944	99.47
Turbot/Greenland Halibut	113,104	111,850	98.89
Whelk	28,181	22,401	79.49
Winter Flounder	65,682	65,354	99.50
Yellowtail Flounder	106,606	105,740	99.19

Table 3 - Privacy Screening Summary Table by Gear Type. The following table displays the number of records, by gear type grouping, at the beginning of the privacy screening process, as well as the number and percentage of retained records represented in the final figures and datasets.

Table 3 - Privacy Screening Summary Table by Gear Type

Gear Type	Starting Records	Records Represented in Dataset	Percent of Data Represented in Dataset
Angling/Rod and Reel	12,463	12,341	99.02
Beach and Bar Seine	927	843	90.94
Bottom Otter Trawl	1,196,869	1,190,312	99.45
Danish and Scottish Seine	24,438	14,798	60.55
Diving with Hand Tool	15,666	14,356	91.64
Dredge (Boat)	458,535	457,198	99.71
Gillnet	205,453	200,131	97.41
Hand Line (Baited)	16,979	16,846	99.22
Harpoon and Spear	7,814	7,635	97.71
Longline - Groundfish	263,083	262,674	99.84
Longline - Pelagic	54,843	54,662	99.67
Mechanical Device (Mackerel)	2,009	1,958	97.46
Pot	473,153	469,895	99.31
Purse and Tuck Seine	24,522	23,960	97.71
Shrimp Trawl	390,516	314,264	80.47
Trap Gear (All Types)	87,799	87,514	99.68
Trap Net	4,307	4,223	98.05
Troller Lines	1,525	1,457	95.54

Data Aggregation and Mapping

To further maintain the privacy of each fishing record, the data must be aggregated. This aggregation into a hexagon grid allows the data to be represented and interpreted in a way that displays directed fishing trends based on species and gear types. All privacy screened data is joined with a 10 km^2 hexagon grid, during which time the relevant attributes are reduced to just total aggregated weight. The 10 km^2 hexagon grid cells are used in accordance with the Atlantic Canadian Protocol on Mapping Fishing Activity (Koropatnick and Coffen-Smout, 2020). The weight from all records that appear in a hexagon are summed to show the total weight in kg for that hexagon. Any unit areas that have failed privacy screening are then merged with the hexagon dataset and the weight value is assigned as "-9999." It is important to reiterate that although many projects and programs desire the discerning variable to be landed value, it is not an accurate representation of the data at the time it is analyzed. Landed value is recorded at the time in which the record is created, and though the market value may change over time, the variable within the data does not. Each year and species have widely varied average values and to generalize them over such a large area would be misrepresenting the data. After each gear type and species layer are aggregated with the hexagon grid and the privacy screened polygons, any hexagons with a 0 kg total weight are removed from the dataset.

Once the data has been fully aggregated, each species and each gear type are mapped with a specific set of symbologies that display their total weight in quantiles, excluding the privacy screened polygons, which are represented by their own hatched symbology. Quantiles are used as they give a better visual representation of hotspots and trends for directed fisheries. Three extra datasets and maps, displaying all of the species, all of the fixed gear and all of the mobile gear were produced throughout the processing. Privacy screened areas for these three layers are not displayed.

CONCLUSION

These datasets were created as a representation of the footprint for fisheries based on individual or similar species and gear types, as well as providing a general overview of the fishing intensities for Eastern Canada. The logbook data was plotted and assessed for data quality assurance and erroneous records were removed. To facilitate Government of Canada Treasury Board standards, the data underwent a thorough privacy screening process so as to not display records that do not meet the set standard known as the "Rule of Five." After privacy screening, the data was reviewed and where possible, records were reintroduced to ensure the best possible representation of the fisheries. Records were aggregated into a 10 km^2 hexagon grid, where all remaining attributes were removed, leaving the summed weight of all records as a representation for fishing intensity.

SPECIES AND GEAR TYPE MAPPING

The following figures are maps that depict the directed fishing efforts of commercial fishing data for 2012 – 2021. Each figure displays a specific species, gear type or grouping of similar species/gear types as explained in their respective descriptions. Three separate maps have been created to display 1) all species, 2) fixed gear only and 3) mobile gear only within the dataset and have undergone separate privacy screenings. The legend in each map displays the overall weight (kg) per 10 km^2 hexagon grid, displayed as quantiles to properly represent the directed fishing efforts using main species sought. Total weight within each hexagon grid is the summed value of all records that appear within that grid cell. Areas with hatched polygons represent full DFO unit areas that have failed privacy screening, meaning all data has been removed, but the symbology still indicates records were present. All variables of these records, including the location and number of records, are protected and cannot be displayed. Each figure represents all respective, available, georeferenced data for all of Eastern Canada. They are not displayed regionally, and the extents of each map are determined by the extents of the data itself.

Commercial Maps by Species

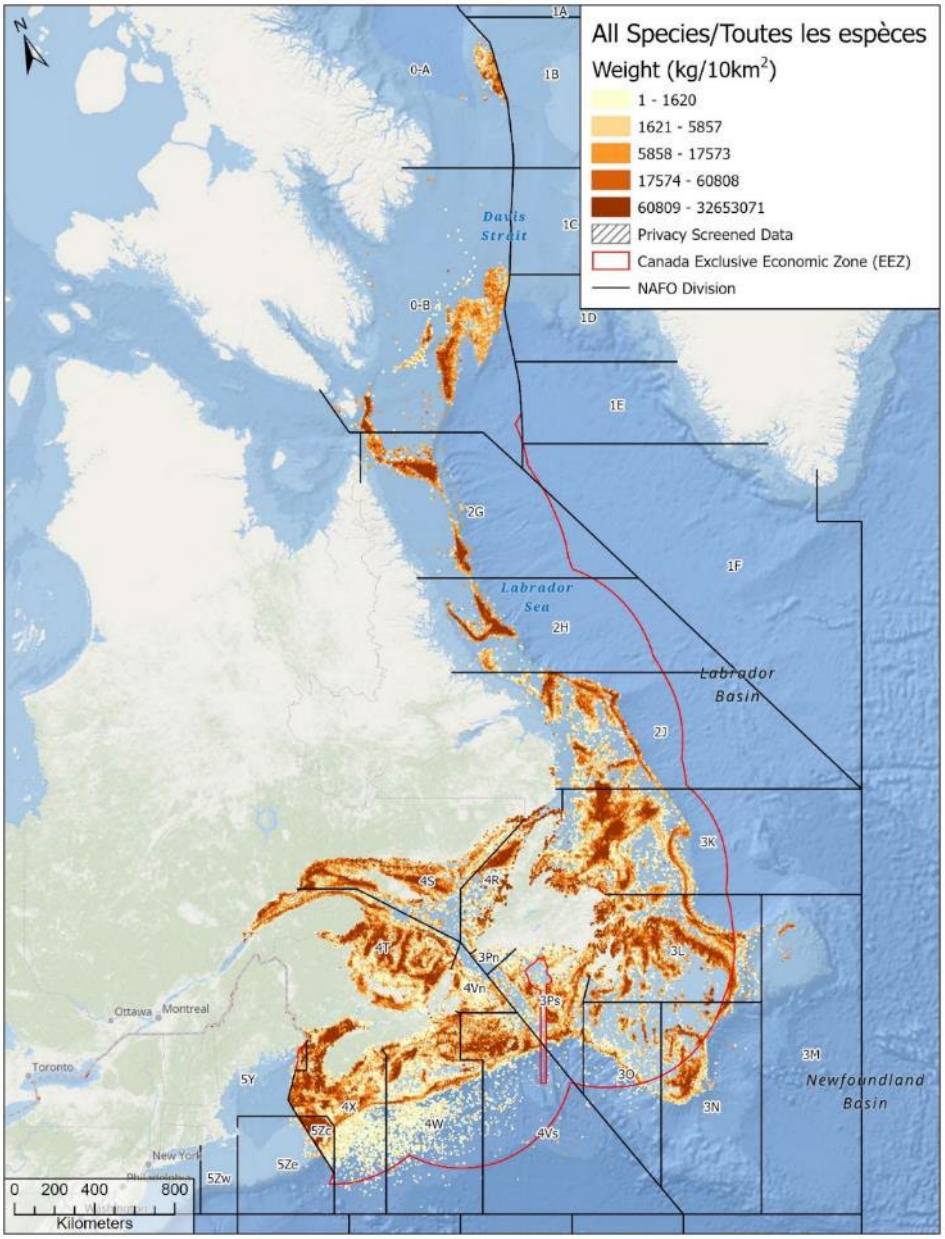

Figure 1 - All Species

Figure 1 - All fishing records of all species sought between 2012 and 2021. This includes all Clam species, Atlantic Cod, Atlantic Halibut, Atlantic Herring, Bluefin Tuna, Capelin, Cusk, Dogfish, Greysole/Witch Flounder, Groundfish (Other), Haddock, Hagfish, Hake, Lobster, Mackerel, Crab (Other), Flounder (Other), Tuna (Other), Pollock, Queen/Snow Crab, Redfish, Scallop, Sculpin, Sea Urchins, Shark, Shrimp, Swordfish, Turbot/Greenland Halibut, Whelk, Winter Flounder and Yellowtail Flounder. Some species where there were similarities or there were too few records to display were amalgamated with other species, the distinctions of each can be found in their figure descriptions below.

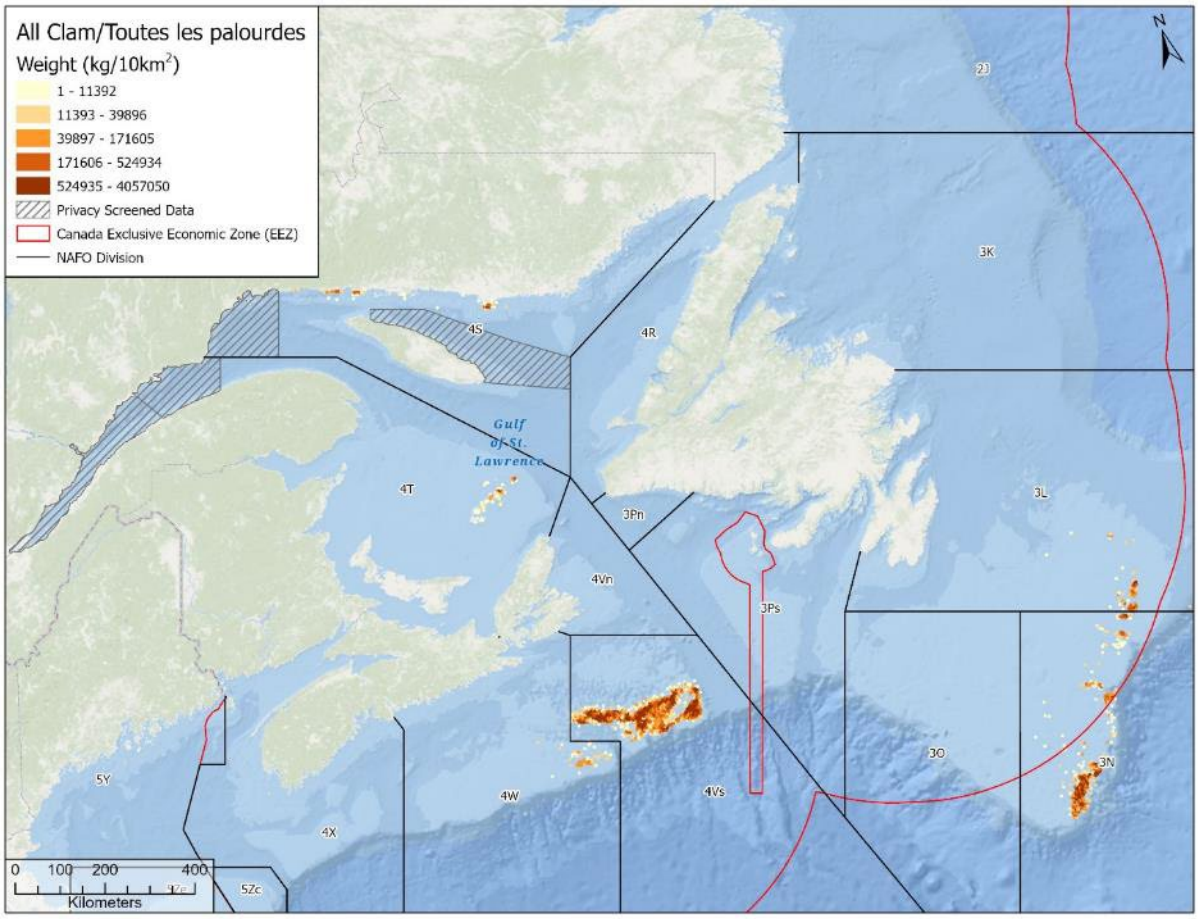

Figure 2 - All Offshore Clam

Figure 2 - All Offshore Clam. This fishery is an amalgamation of species based on their similarities and/or lack of data on an individual scale. This fishery includes Stimpson's Surf Clam (*Mactromeris polynyma*), Bar Clam (*Spisula solidissima*), Propeller Clam (*Cyrtodaria siliqua*), Quahaug Clam (*Mercenaria mercenaria*), Razor Clam (*Siliqua patula*), Ocean Quahaug (*Arctica islandica*) and Cockle (*Cerastoderma edule*). The majority (almost 100%) of this fishery was performed using dredge (boat). The small remainder was performed using other gear types which include mechanical diggers, hydraulic rakes and other hydraulic devices.

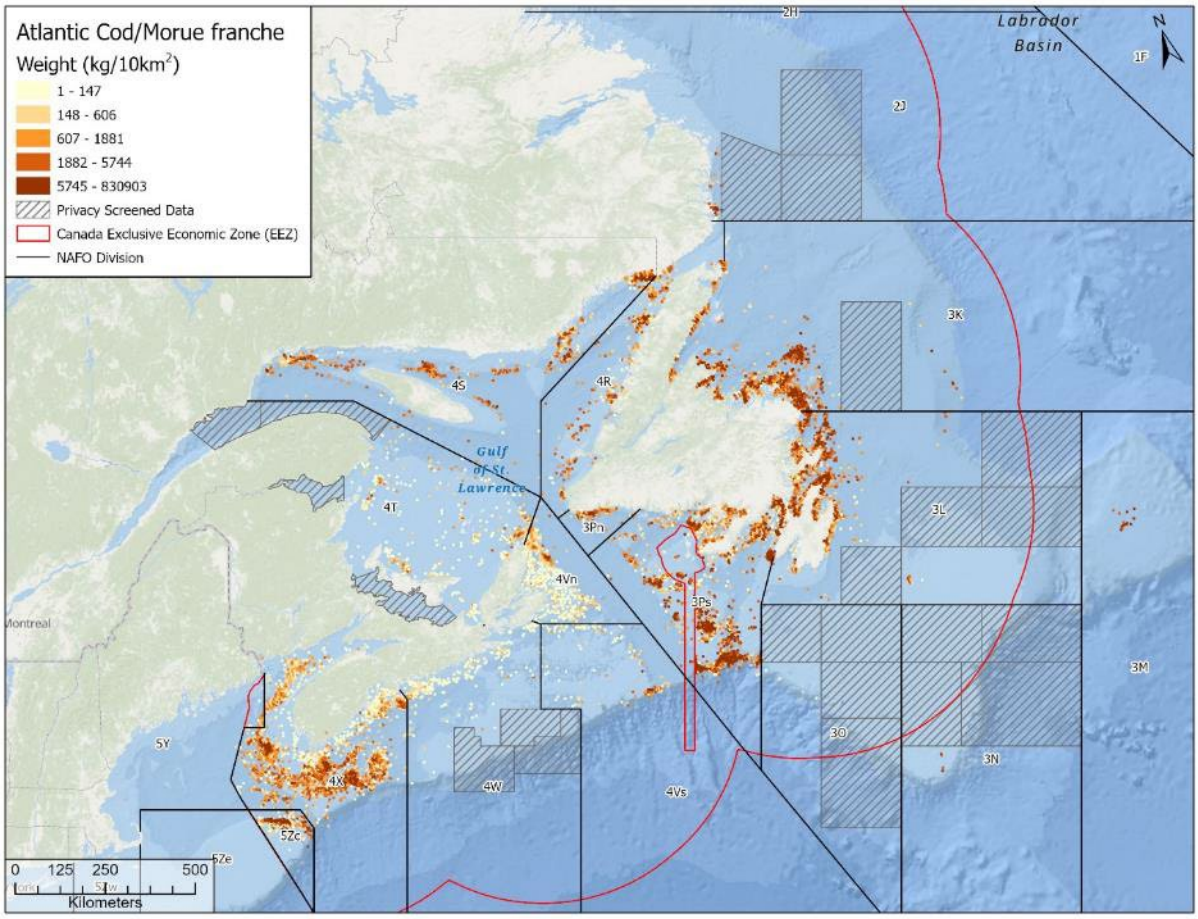

Figure 3 - Atlantic Cod (Gadus morhua)

Figure 3 - Atlantic Cod (*Gadus morhua*). The majority (~97%) of this fishery was performed using bottom longline, gillnet and bottom otter trawl. The remainder was performed using other gear types which include rectangular trap, trap net, hand line (baited), Scottish and Danish seine.

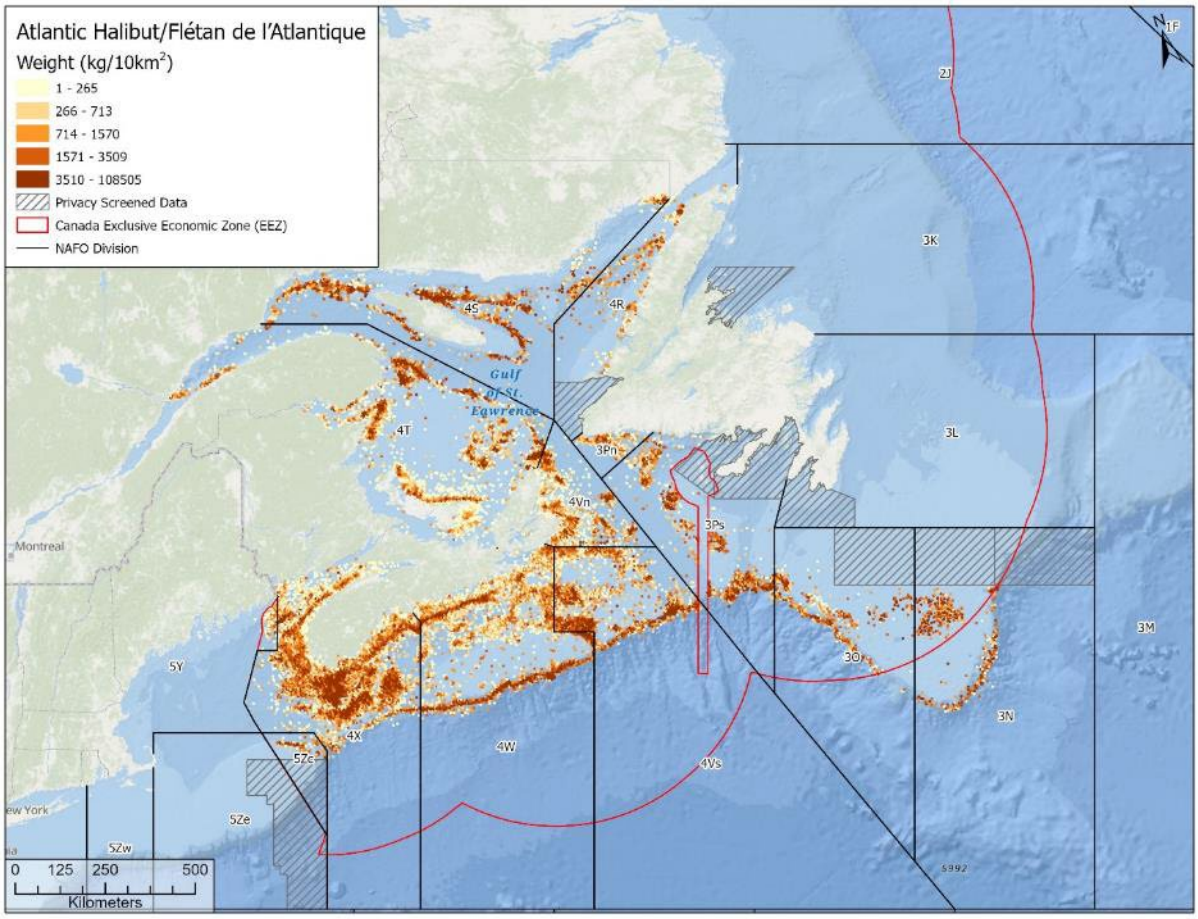

Figure 4 - Atlantic Halibut (Hippoglossus hippoglossus)

Figure 4 - Atlantic Halibut (*Hippoglossus hippoglossus*). The majority (~99%) of this fishery was performed using bottom longline. The remainder was performed using other gear types which include bottom otter trawl, Danish seine, gillnet and hand line (baited).

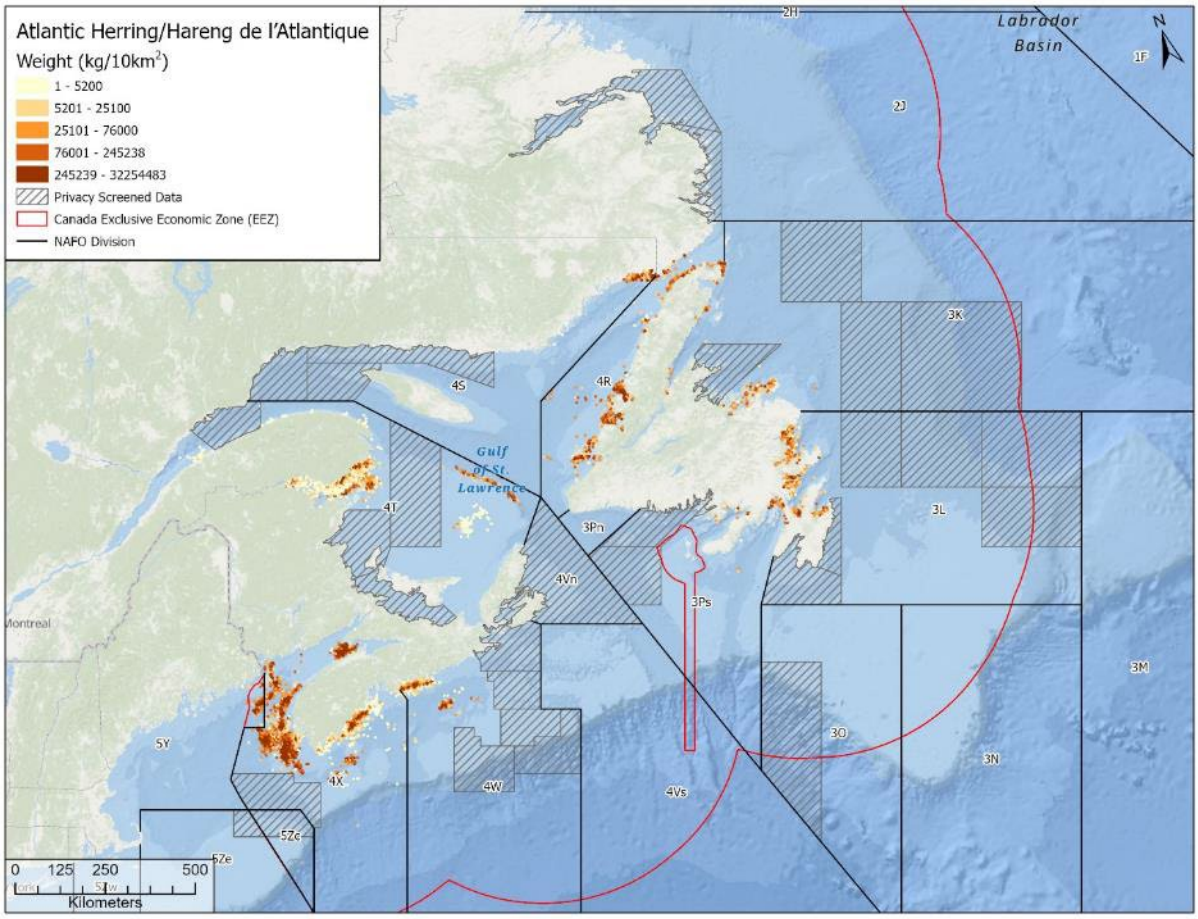

Figure 5 - Atlantic Herring (Clupea harengus)

Figure 5 - Atlantic Herring (*Clupea harengus*). The majority (~95%) of this fishery was performed using gillnet and purse seine. The remainder was performed using other gear types which include bottom otter trawl, beach and bar seine, tuck seine, pair seine, hand line (baited) and trap net.

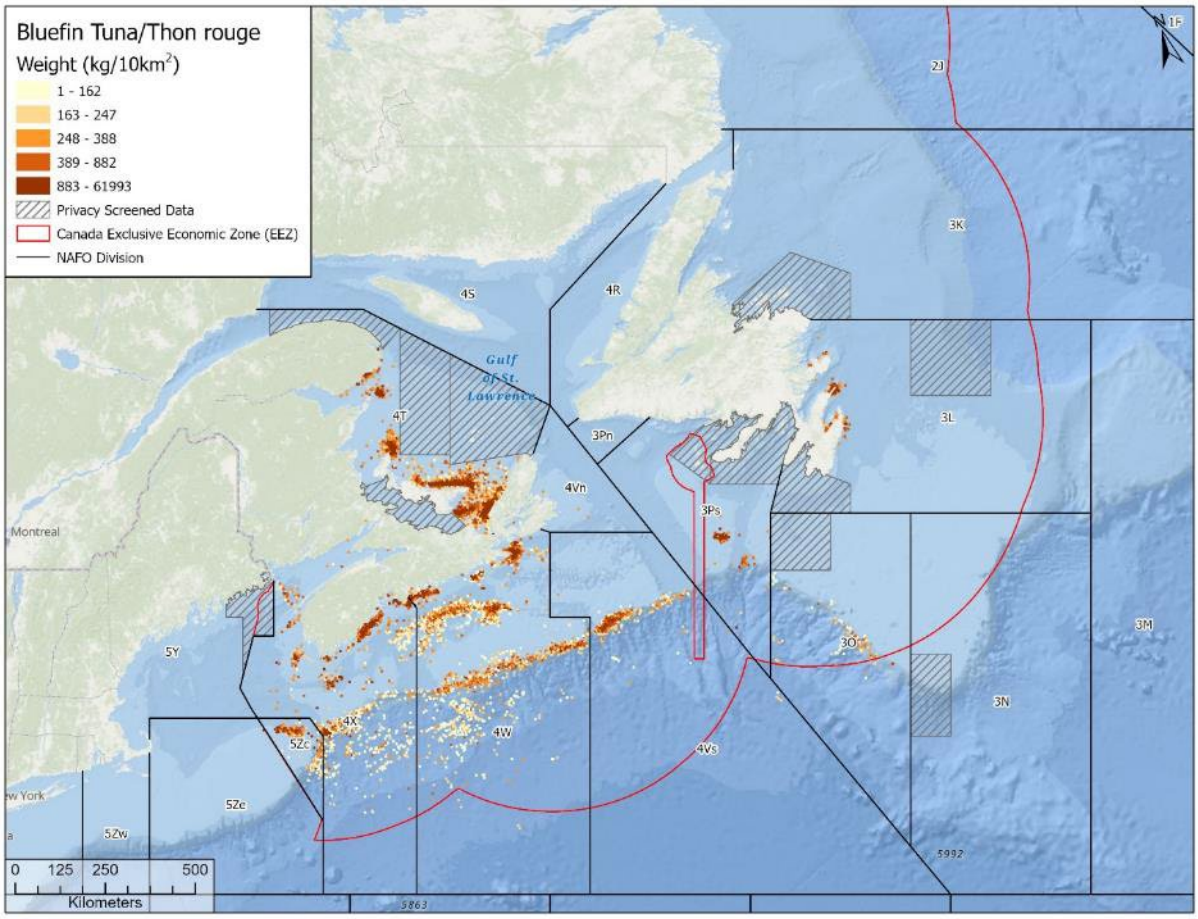

Figure 6 - Bluefin Tuna (Thunnus thynnus)

Figure 6 - Bluefin Tuna (*Thunnus thynnus*). The majority (~97%) of this fishery was performed using angling, pelagic longline, rod and reel (chumming) and troller lines. The remainder was performed using other gear types which include trap net and harpoon and spear (including electric harpoon).

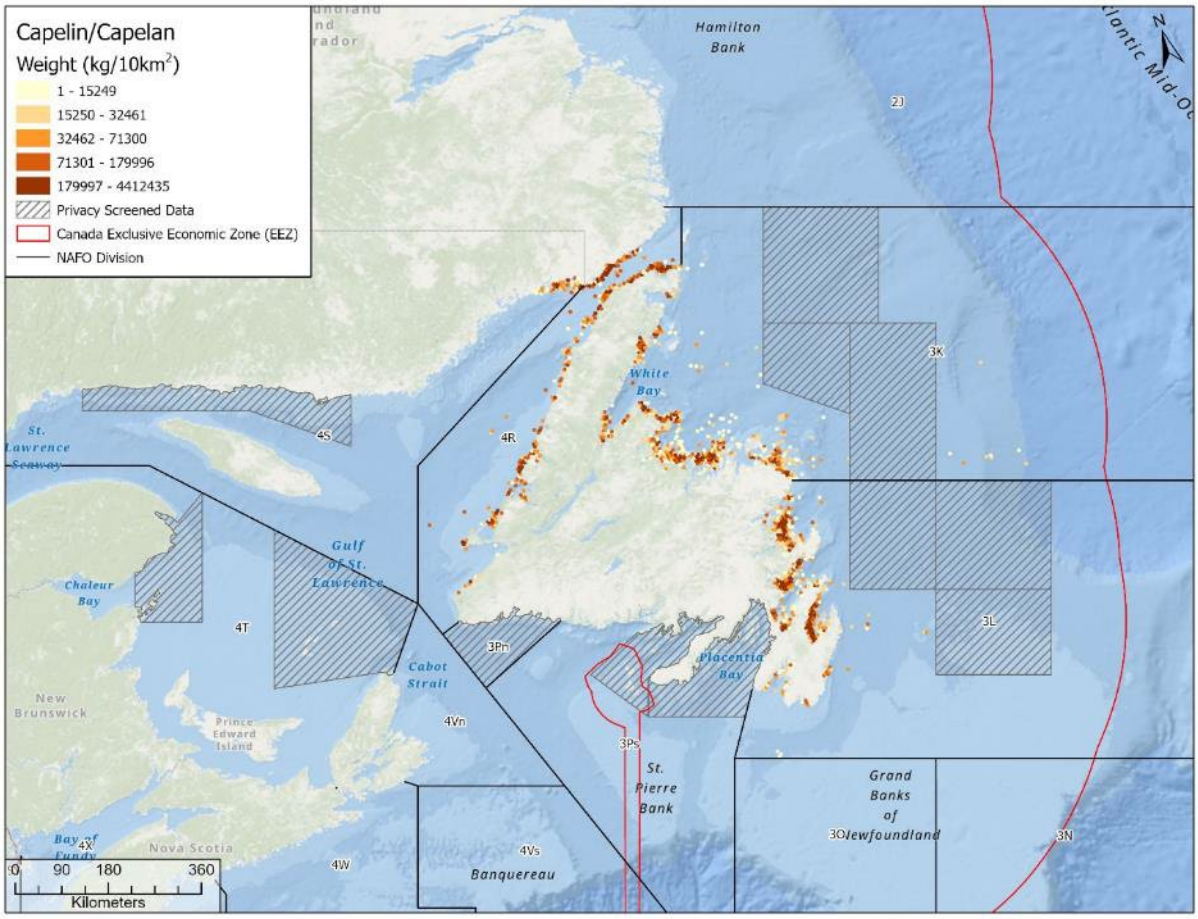

Figure 7 - Capelin (Mallotus villosus)

Figure 7 - Capelin (*Mallotus villosus*). The majority (~90%) of this fishery was performed using tuck seine and purse seine. The remainder was performed using other gear types which include beach and bar seine and trap net.

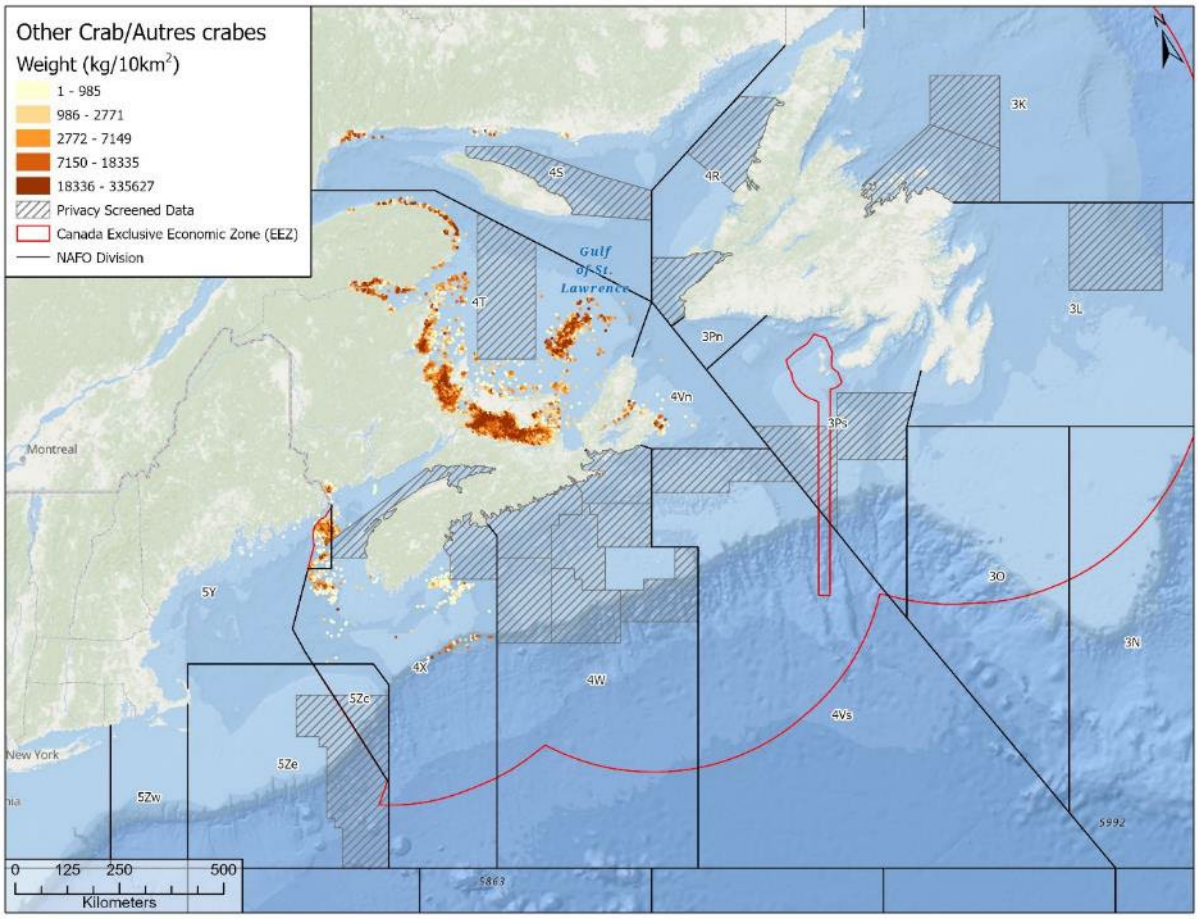

Figure 8 - Crab (other)

Figure 8 - Crab (other). This fishery is an amalgamation of species based on their similarities and/or lack of data on an individual scale. This fishery includes Atlantic Rock Crab (*Cancer irroratus*), Jonah Crab (*Cancer borealis*), Porcupine Crab (*Neolithodes grimaldi*), Red Crab (*Chaceon quinquedens*), Spider/Toad Crab (*Hyas araneus* & *Hyas coarctatus*) and Stone/King Crab (*Lithodes maja*). The majority (~92%) of this fishery was performed using pots. The remainder was performed using other gear types which include rock crab trap, conical trap, pyramidal trap, and mixed trap.

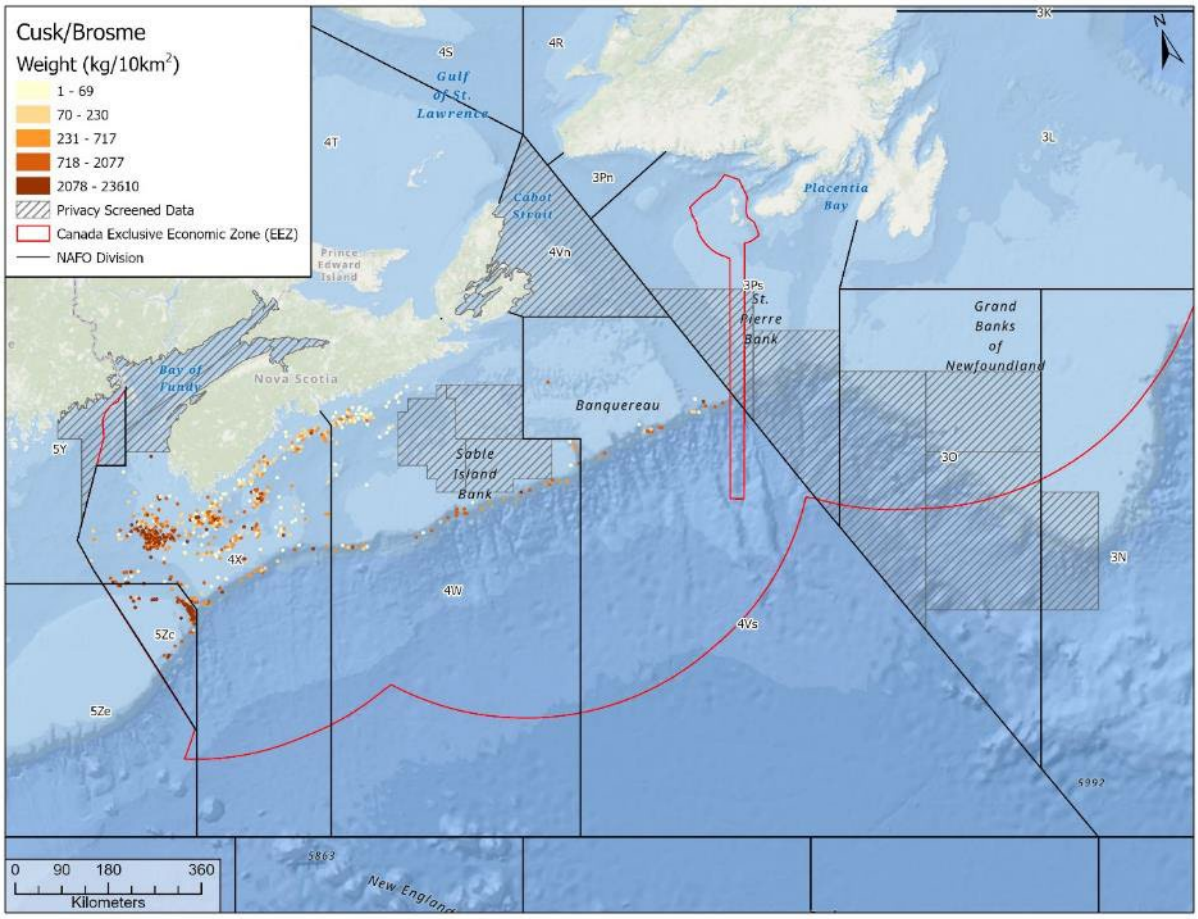

Figure 9 - Cusk (Brosme brosme)

Figure 9 - Cusk (*Brosme brosme*). The majority (~96%) of this fishery was performed using bottom longline. The remainder was performed using other gear types which include bottom otter trawl and gillnet.

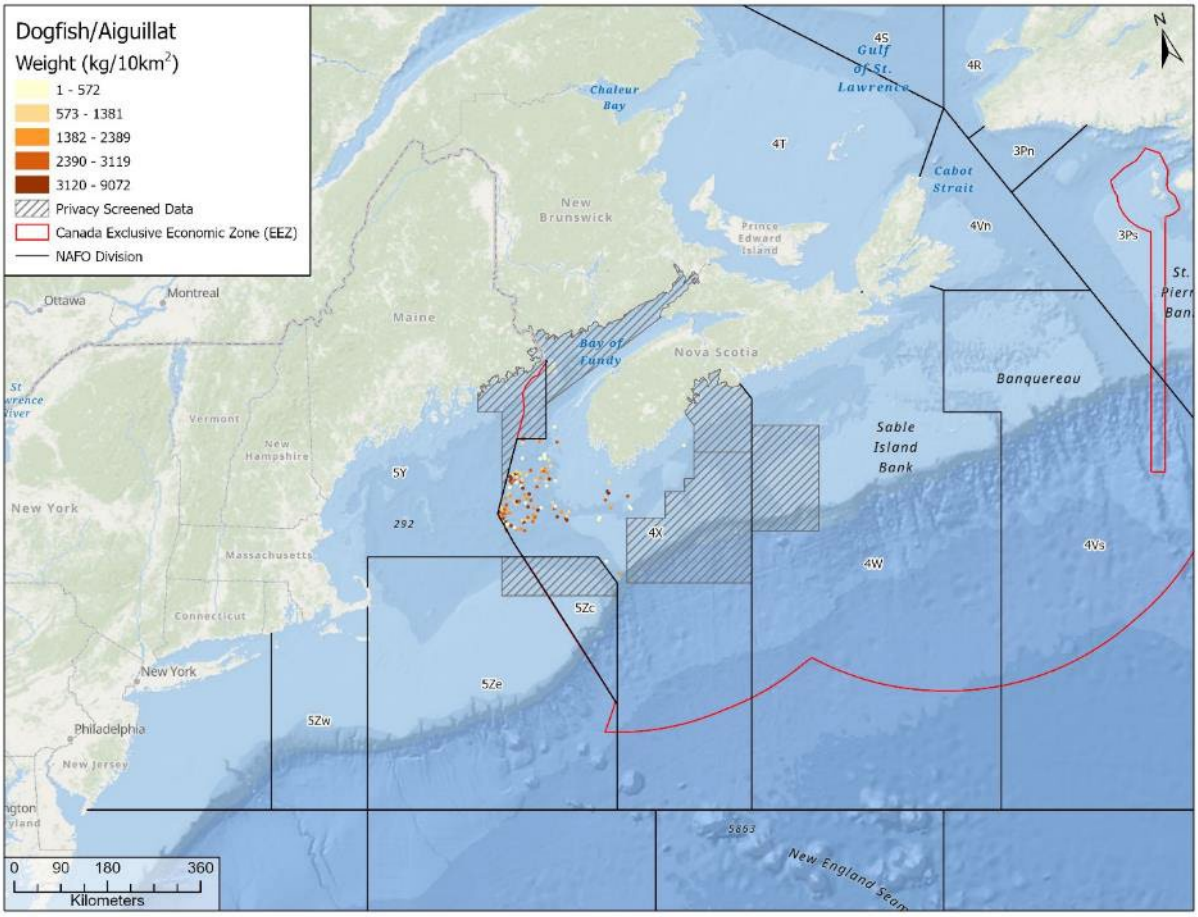

Figure 10 - Dogfish (Squalus acanthias)

Figure 10 - Dogfish (*Squalus acanthias*). The majority (~88%) of this fishery was performed using bottom otter trawl. The remaining ~12% was performed using bottom longline.

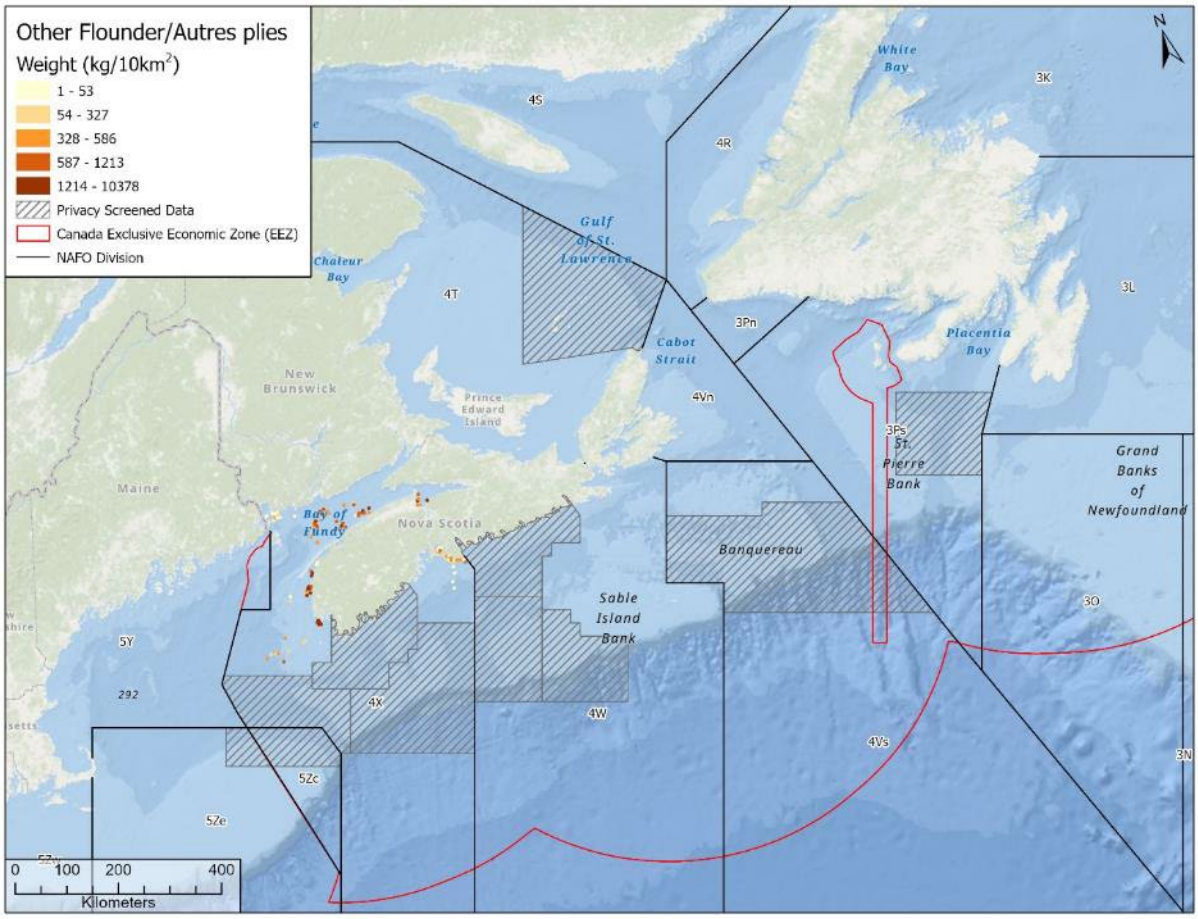

Figure 11 - Flounder (other)

Figure 11 - Flounder (other). This fishery is an amalgamation of species based on their similarities and/or lack of data on an individual scale. This fishery includes Windowpane Flounder (*Scopthalmus aquosus*) and Flounder (Unspecified). The entirety (100%) of this fishery was performed using gillnet and bottom otter trawl.

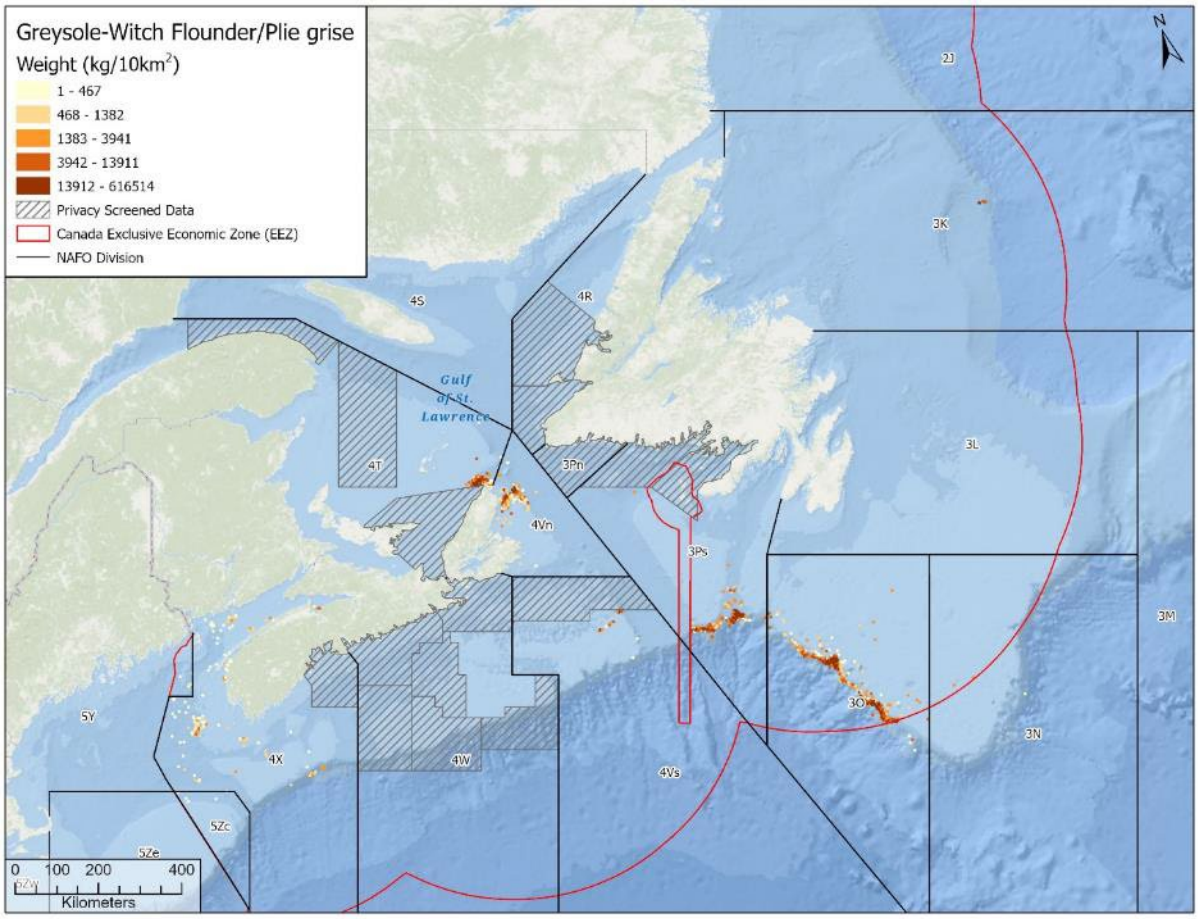

Figure 12 - Greysole/Witch Flounder (Glyptocephalus cynoglossus)

Figure 12 - Greysole/Witch Flounder (*Glyptocephalus cynoglossus*). The majority (~99%) of this fishery was performed using Danish seine and bottom otter trawl. The remainder was performed using other gear types which include Scottish seine, gillnet and bottom longline.

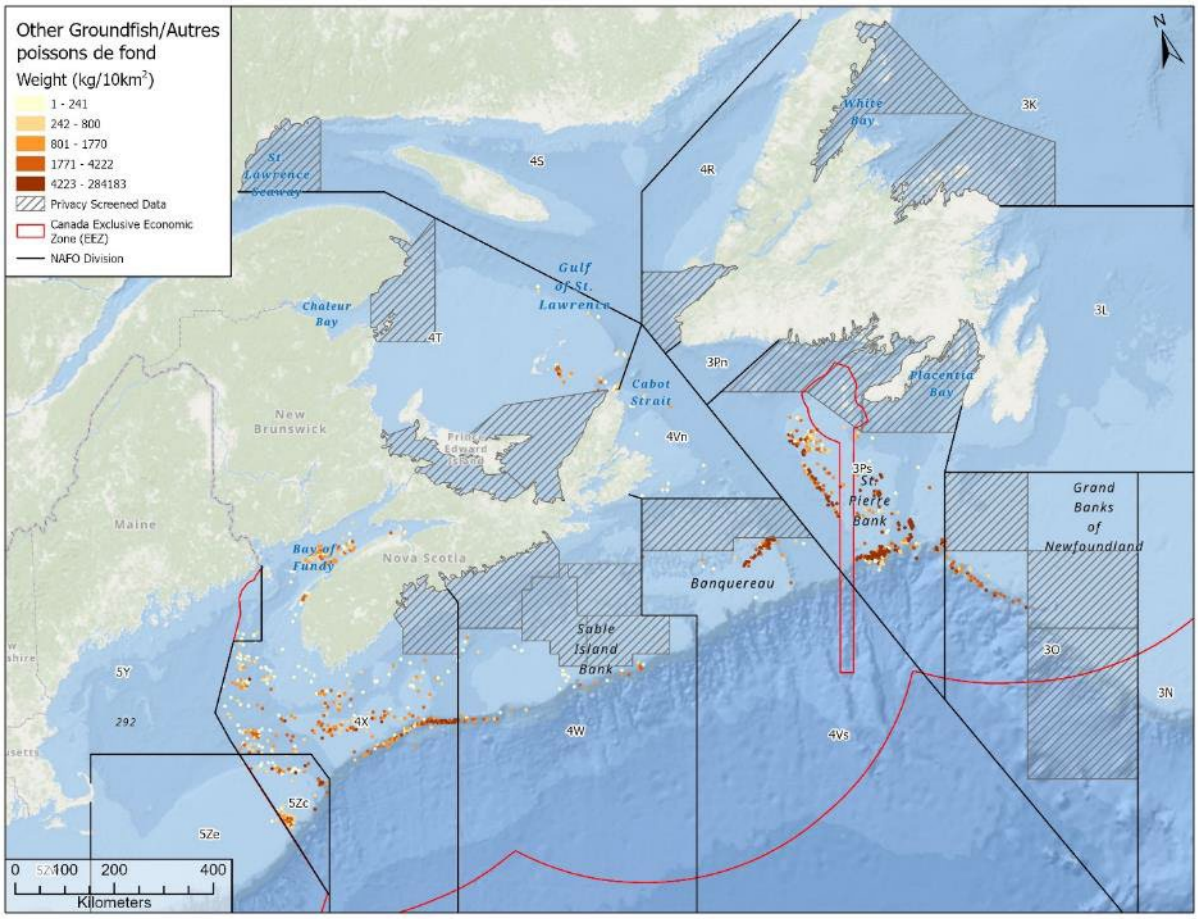

Figure 13 - Groundfish (other)

Figure 13 - Groundfish (other). This fishery is an amalgamation of species because of their similarities and/or lack of data on an individual scale. This fishery includes American Plaice (*Hippoglossoides platessoides*), Skate (*Dipturus batis*), Lumpfish (*Cyclopterus lumpus*), Monkfish (American Angler) (*Lophius piscatorius*) and unspecified other groundfish. The majority (~98%) of this fishery was performed using bottom otter trawl, gillnet and bottom longline. The remainder was performed using other gear types which include bottom pair trawl, Danish seine, Scottish seine and midwater trawl.

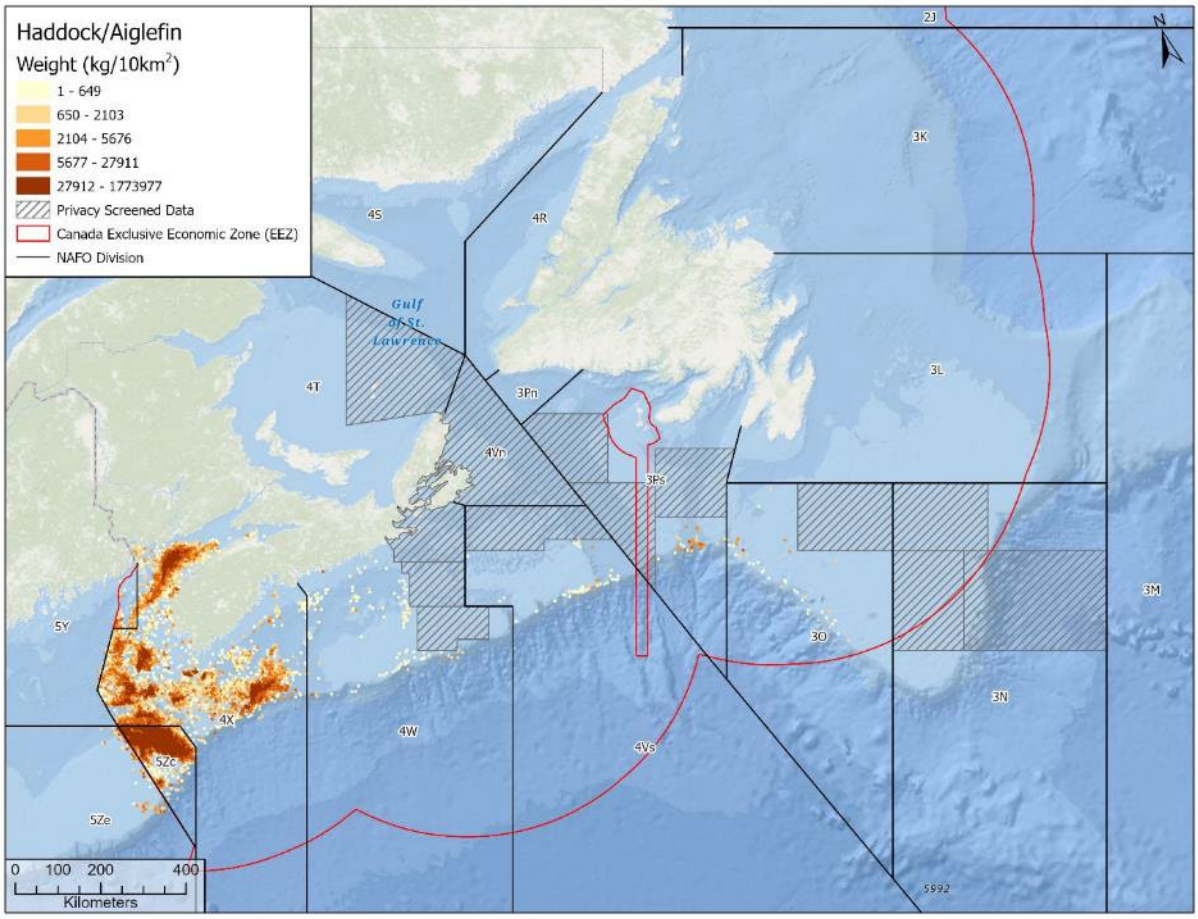

Figure 14 - Haddock (Melanogrammus aeglefinus)

Figure 14 - Haddock (*Melanogrammus aeglefinus*). The majority (~97%) of this fishery was performed using bottom trawl. The remainder was performed using other gear types which include Scottish seine, gillnet, bottom longline and hand line (baited).

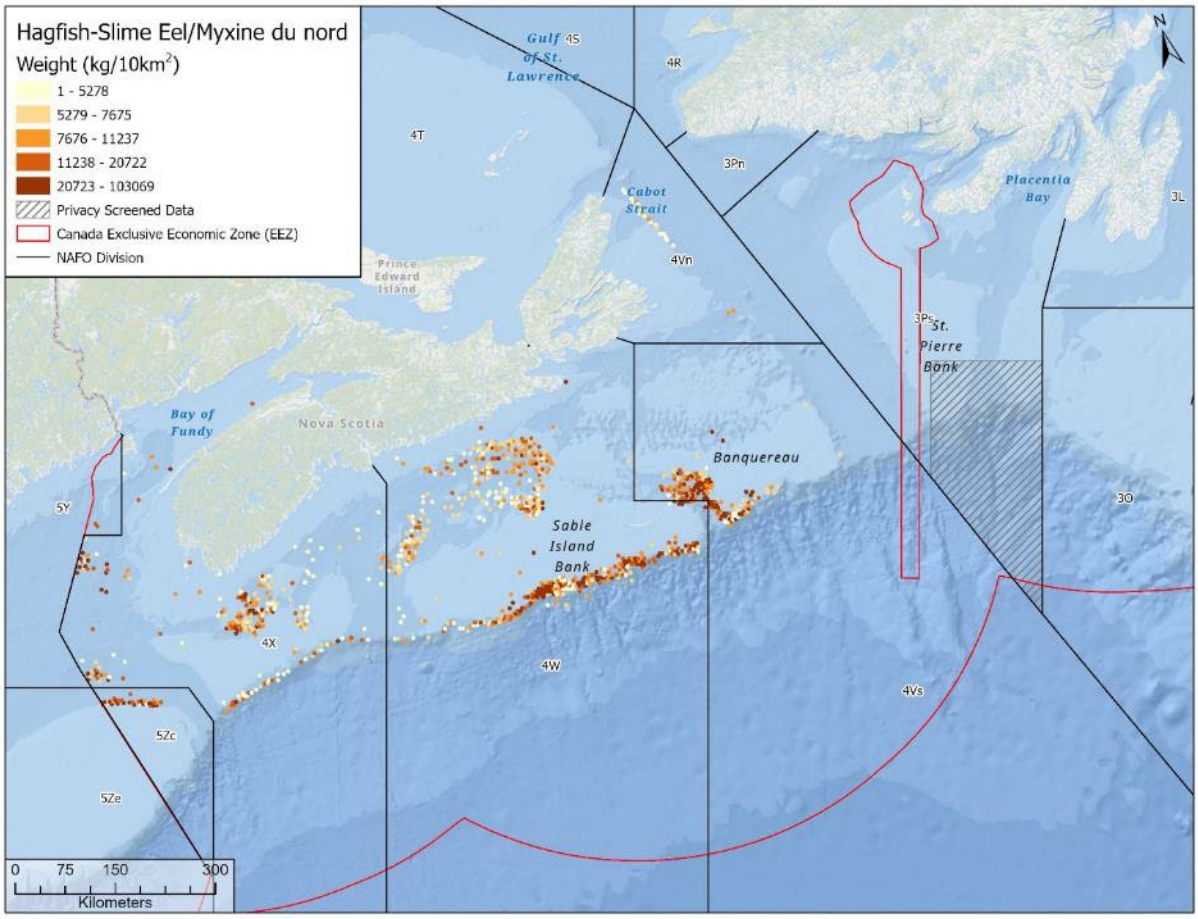

Figure 15 - Hagfish/Slime Eel (Myxini)

Figure 15 - Hagfish/Slime Eel (*Myxini*). The entirety (100%) of this fishery was performed using trap net.

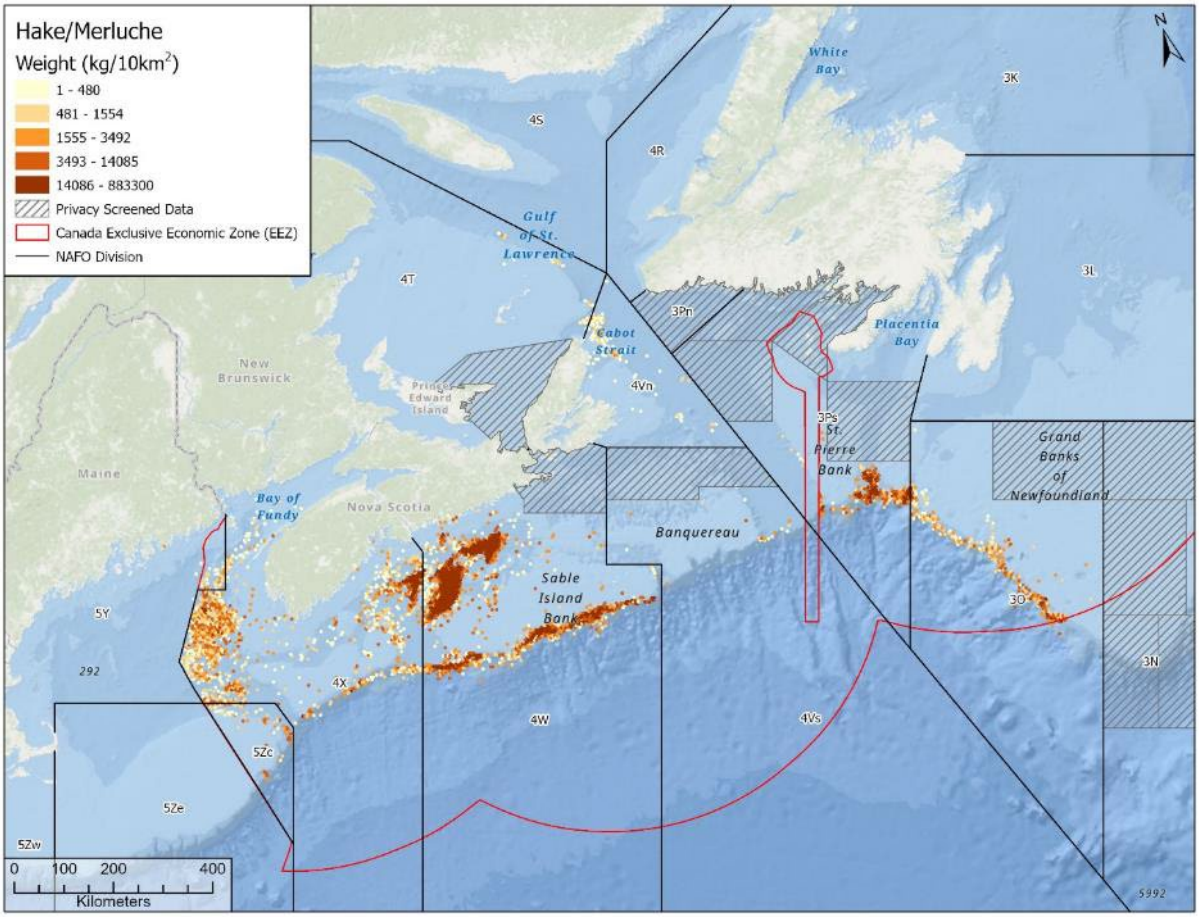

Figure 16 - Hake

Figure 16 - Hake. This fishery is an amalgamation of species because of their similarities and/or lack of data on an individual scale. This fishery includes Red Hake (*Urophycis chuss*), Silver Hake (*Merluccius bilinearis*) and White Hake (*Urophycis tenuis*). The majority (~99%) of this fishery was performed using bottom otter trawl, gillnet and bottom longline. The remainder was performed using other gear types which include midwater trawl, bottom pair trawl, Danish seine, Scottish seine and midwater trawl.

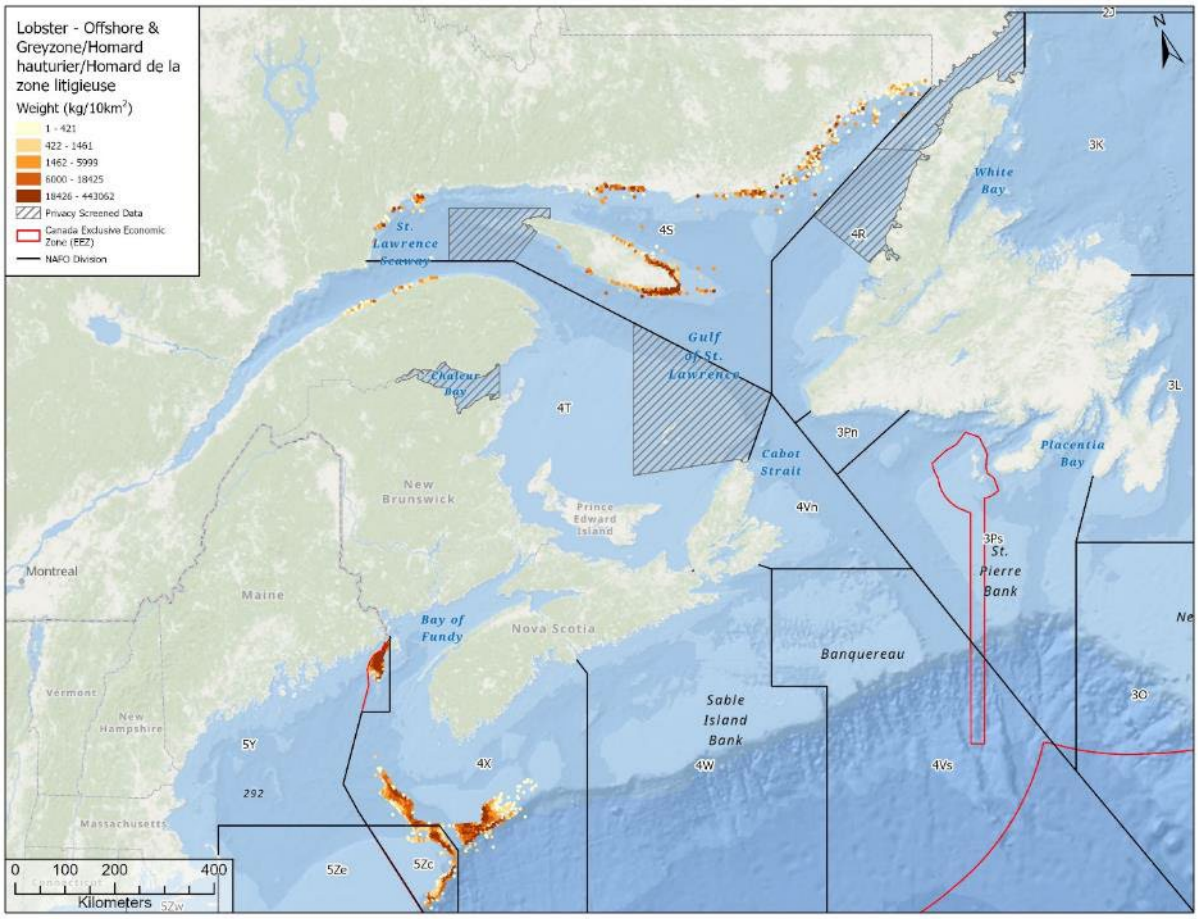

Figure 17 - Lobster (Homarus americanus)

Figure 17 - Lobster (*Homarus americanus*). The entirety (100%) of this fishery was performed using pots. The map excludes non-georeferenced Inshore Lobster catch using pots in Maritimes, Gulf and NL regions reported by statistical grid or Lobster Fishing Area.

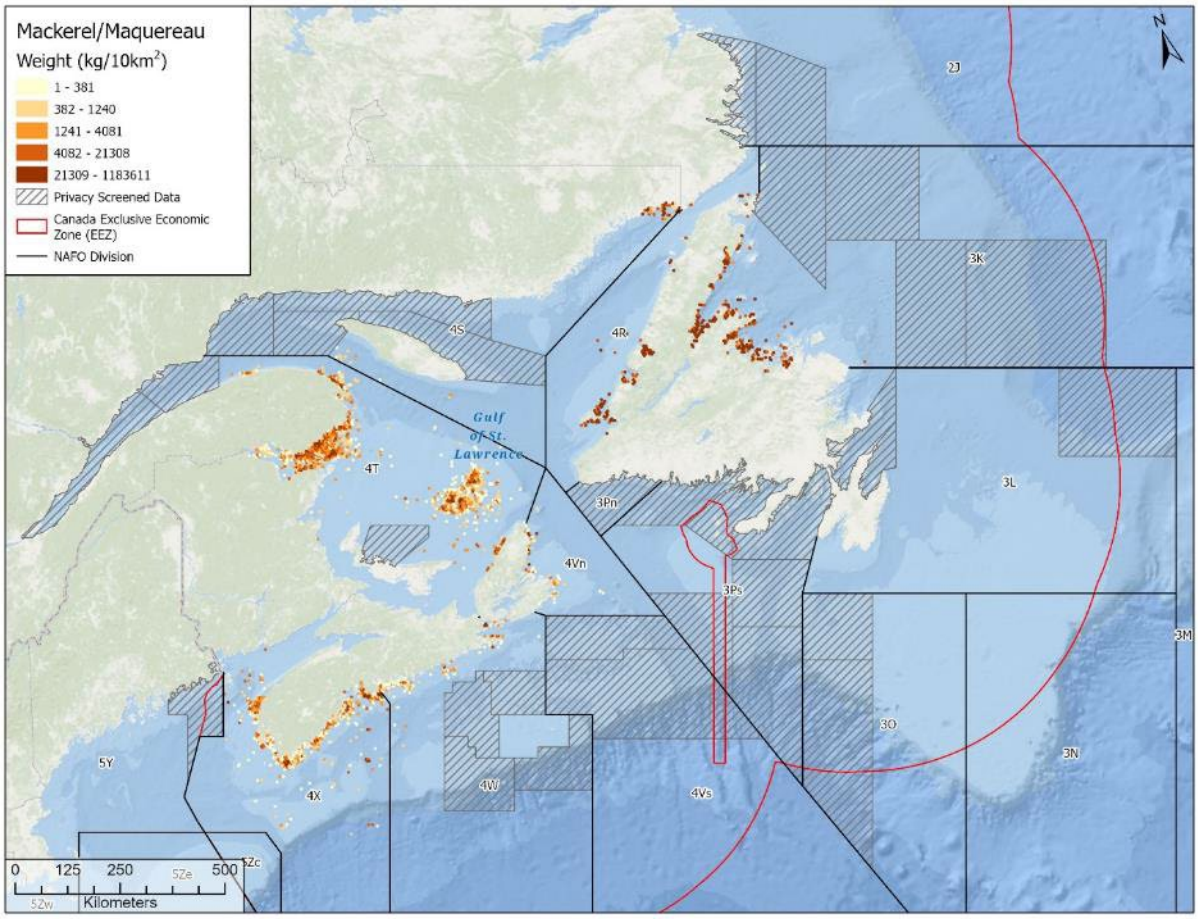

Figure 18 - Mackerel (Scomber scombrus)

Figure 18 - Mackerel (*Scomber scombrus*). The majority (~91%) of this fishery was performed using hand line (baited), gillnet and mechanical devices targeting mackerel. The remainder was performed using other gear types which include trap net, purse seine, tuck seine, beach and bar seine, longline and bottom trawl.

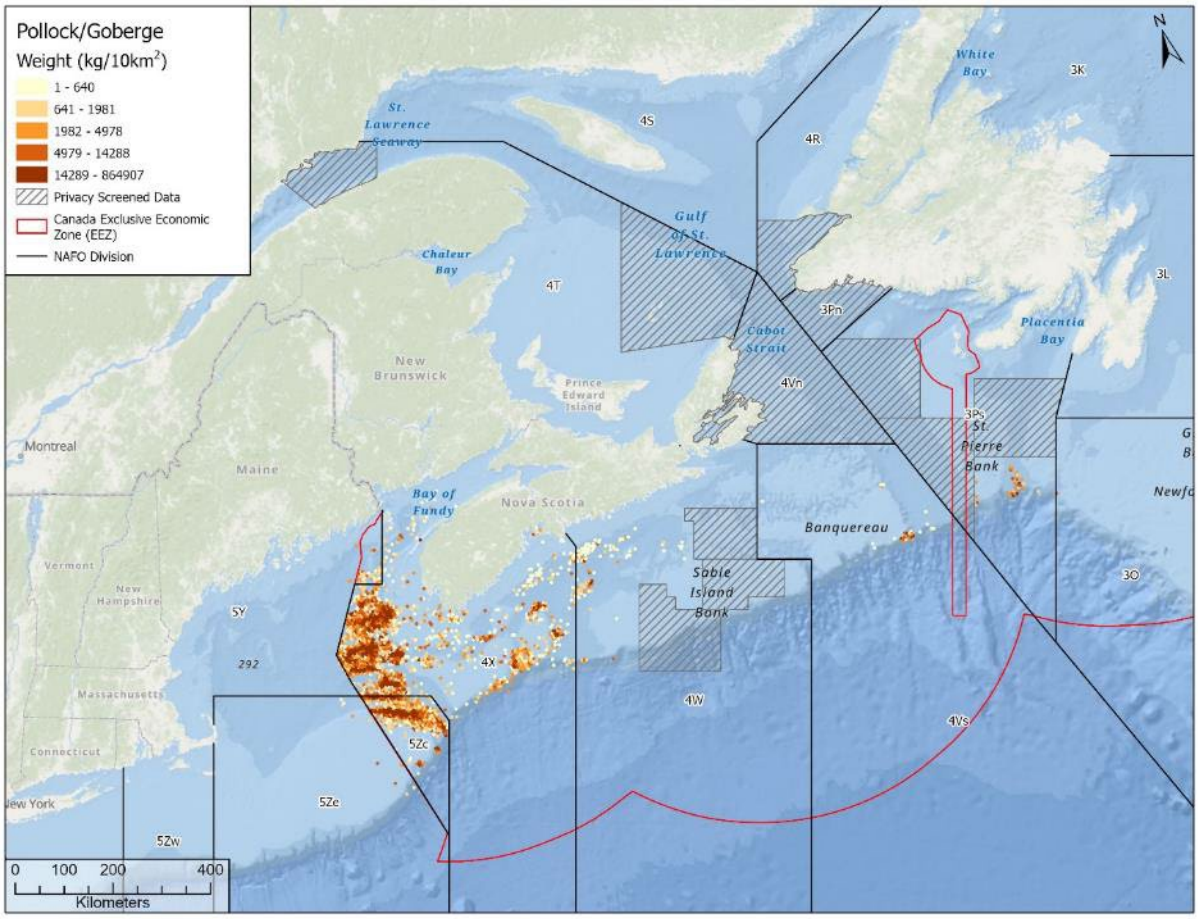

Figure 19 - Pollock (Pollachius virens)

Figure 19 - Pollock (*Pollachius virens*). The majority (~98%) of this fishery was performed using bottom trawl and gillnet. The remainder was performed using other gear types which include bottom longline and hand line (baited).

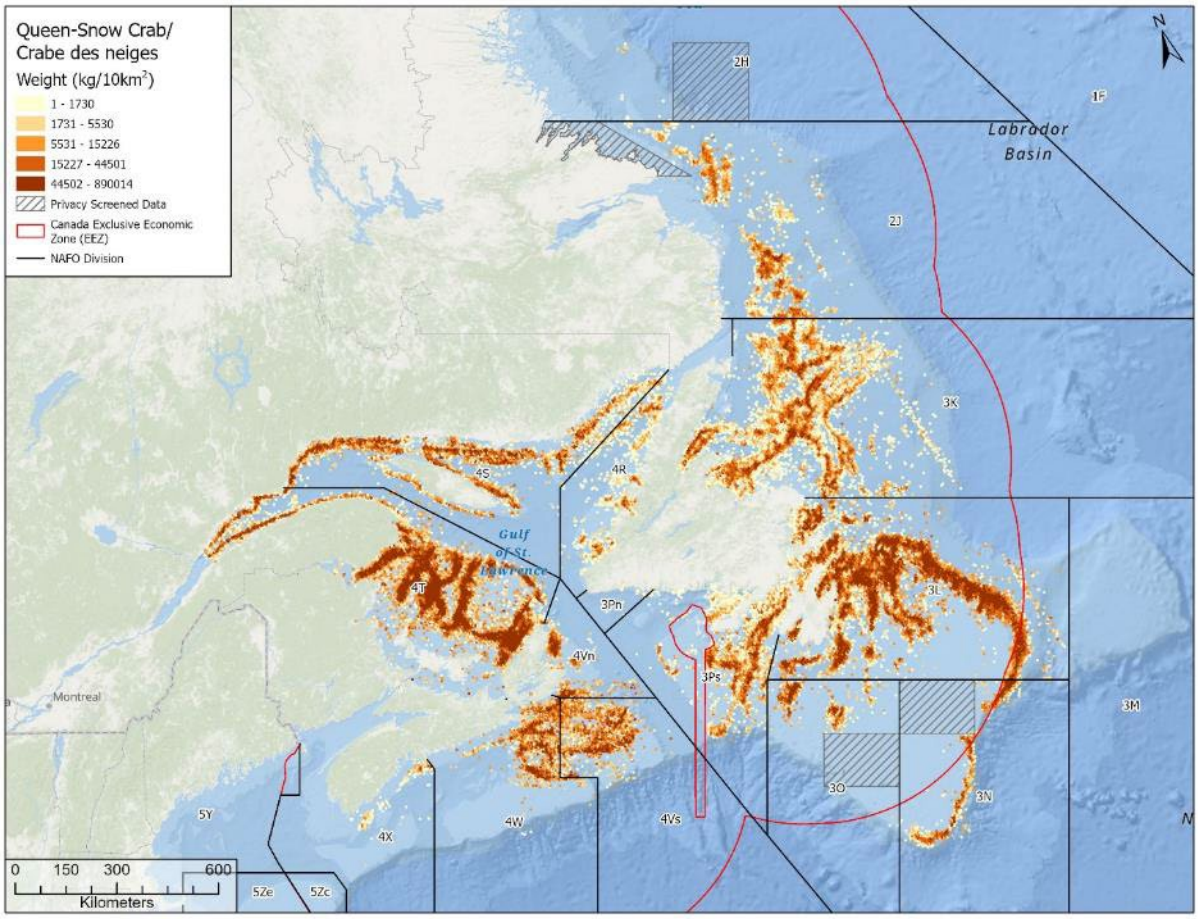

Figure 20 - Queen/Snow Crab (Chionoecetes opilio)

Figure 20 - Queen/Snow Crab (*Chionoecetes opilio*). The majority (almost 100%) of this fishery was performed using pots and various traps (conical, Japanese, pyramidal, rectangular or a mix of traps). The remainder was performed using other gear types which include bottom otter trawl and shrimp trawl.

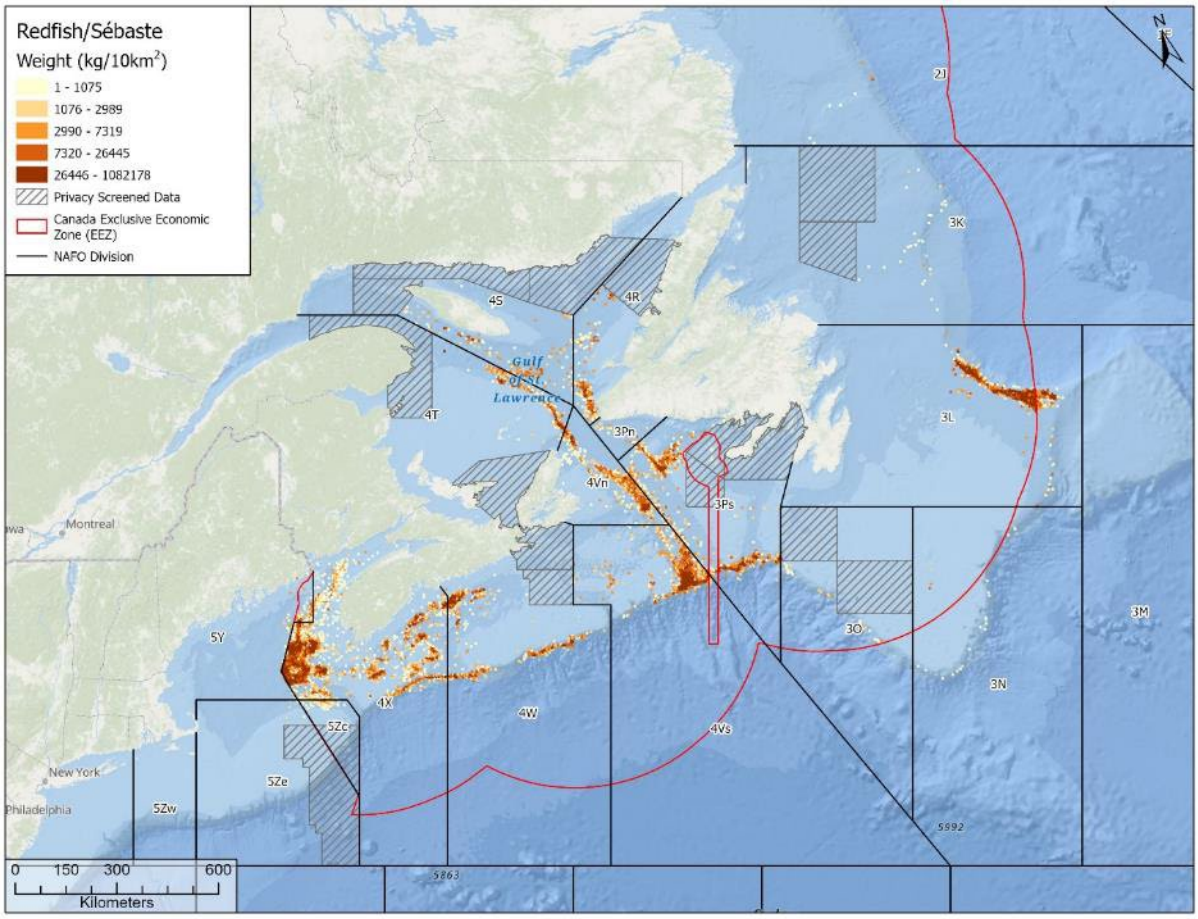

Figure 21 - Redfish (Sebastes fasciatus/Sebastes mentella)

Figure 21 - Redfish (*Sebastes fasciatus/Sebastes mentella*). The majority (~97%) of this fishery was performed using bottom trawl. The remainder was performed using other gear types which include Scottish seine, bottom longline, dredge (boat), Danish seine midwater trawl and gillnet.

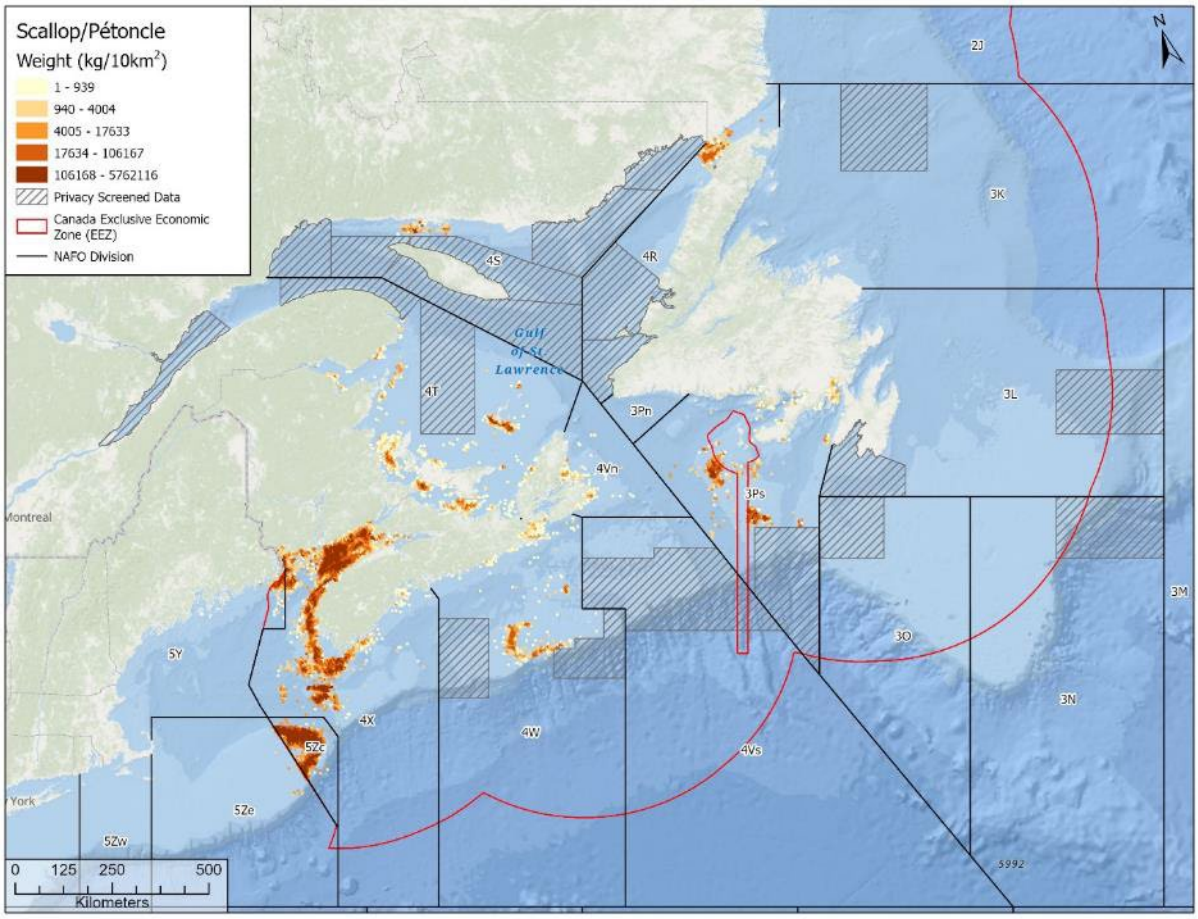

Figure 22 - Scallop (Placopecten magellanicus)

Figure 22 - Scallop. This fishery is an amalgamation of species because of their similarities and/or lack of data on an individual scale. This fishery includes Sea Scallop (*Placopecten magellanicus*) and Icelandic Scallop (*Chlamys islandica*). The entirety (100%) of this fishery was performed using dredge (boat).

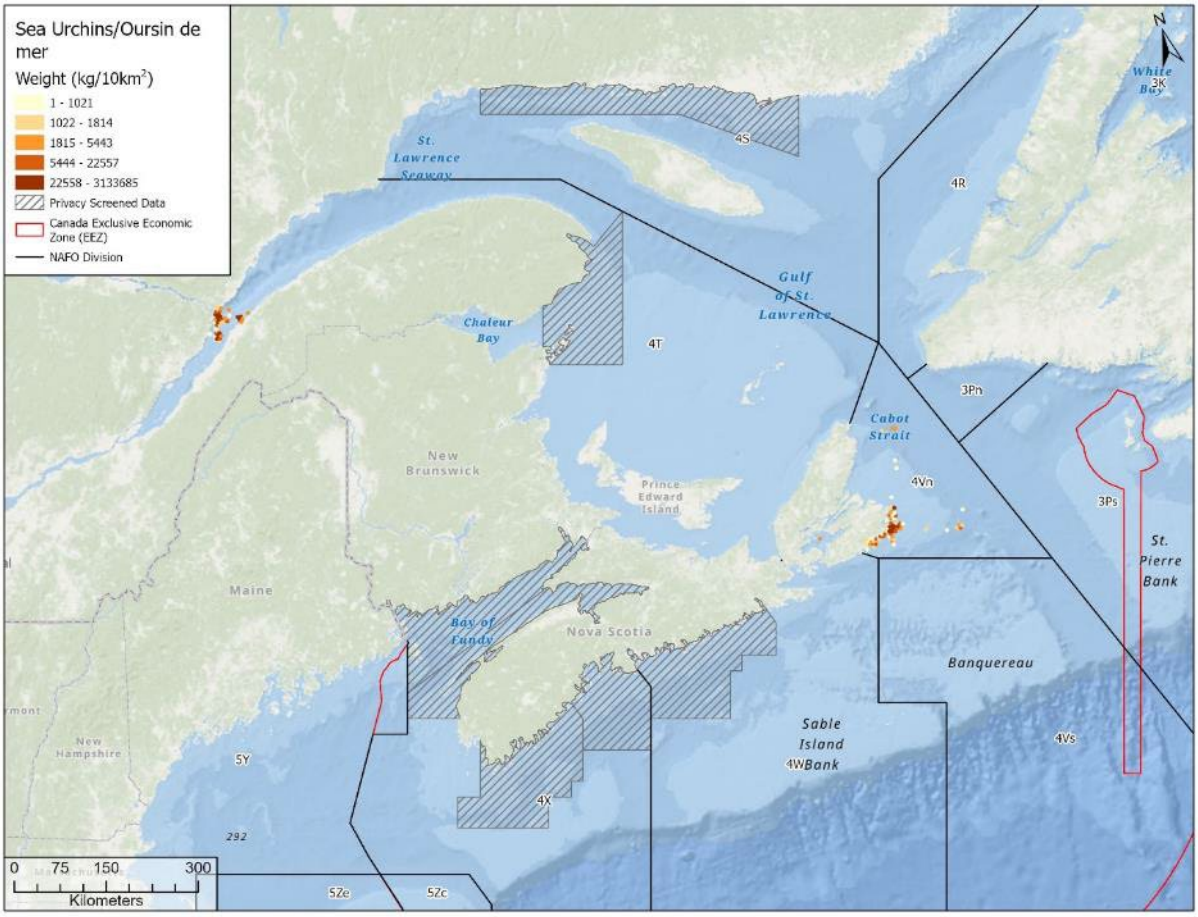

Figure 23 - Sea Urchin (Stronglyocentrotus droebachiensis)

Figure 23 - Sea Urchin (*Stronglyocentrotus droebachiensis*). The entirety (100%) of this fishery was performed using diving with hand tools and rope.

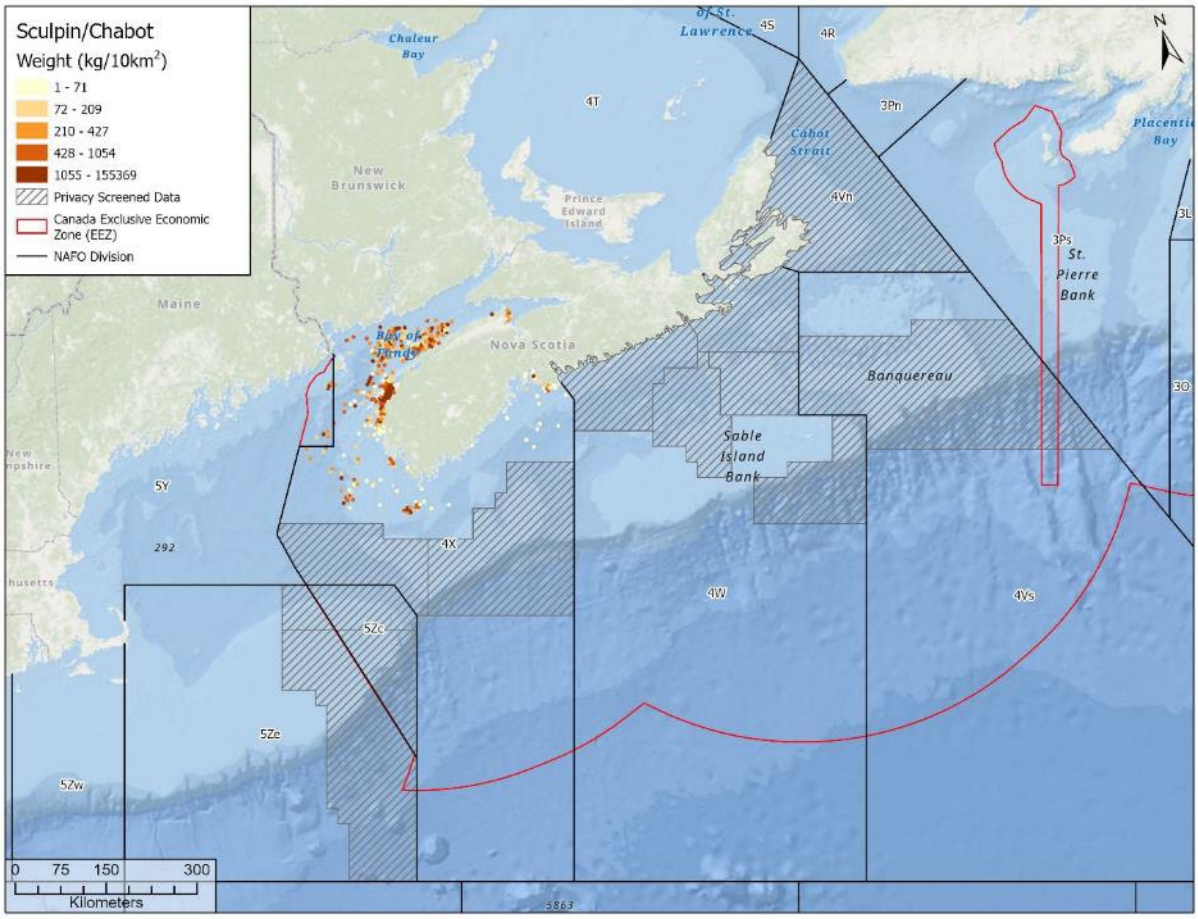

Figure 24 - Sculpin (Myoxocephalus Scorpius/Myoxocephalus octodecimspinosus)

Figure 24 - Sculpin (*Myoxocephalus Scorpius*/*Myoxocephalus octodecimspinosus*). The majority (~97%) of this fishery was performed using bottom otter trawl. The remainder was performed using other gear types which include gillnet, midwater trawl and bottom longline.

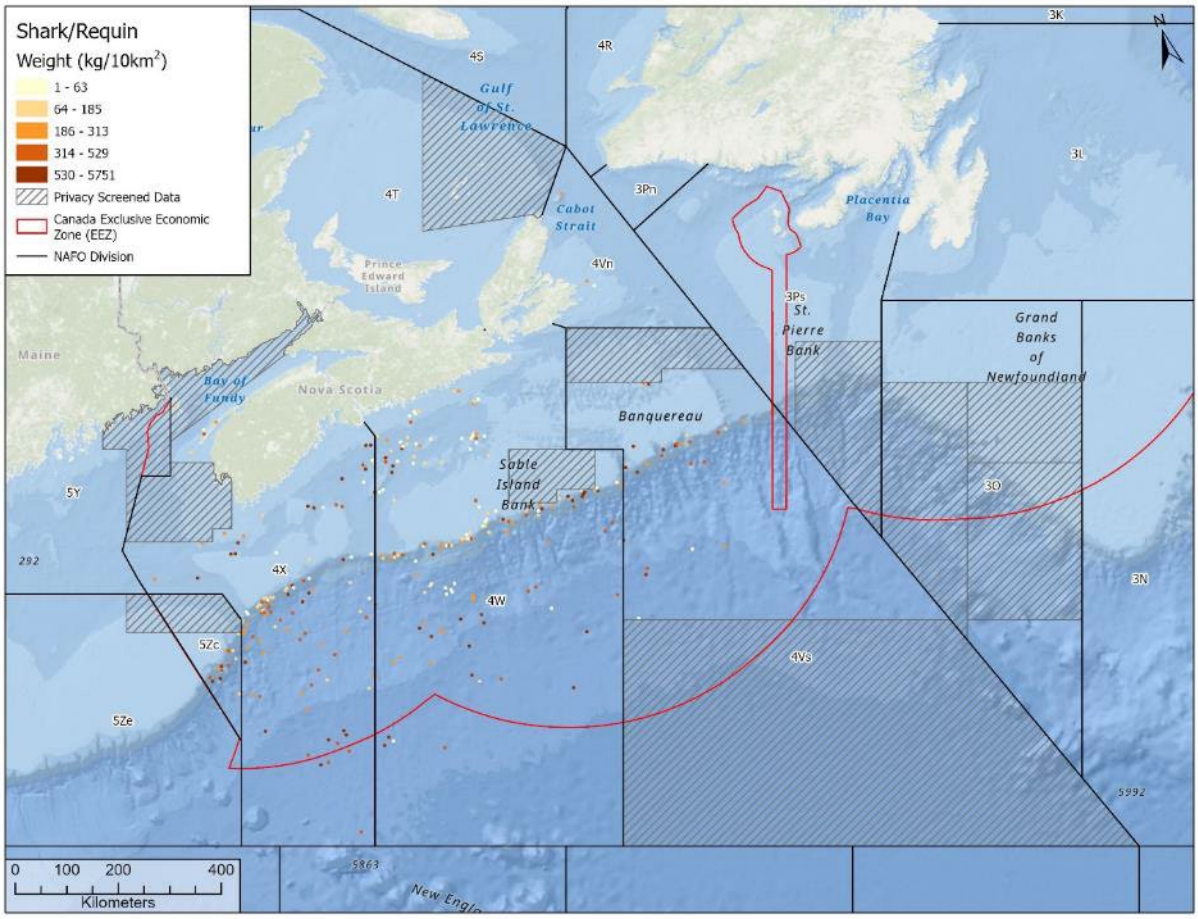

Figure 25 - Shark

Figure 25 - Shark. This fishery is an amalgamation of species because of their similarities and/or lack of data on an individual scale. This fishery includes Porbeagle Shark (*Lamna nasus*), Blue Shark (*Prionace glauca*), Mako Shark (*Isurus oxyrinchus*), Dusky Shark (*Carcharhinus obscurus*) and other unspecified sharks. The majority (~98%) of this fishery was performed using pelagic longline. The remainder was performed using other gear types which include gillnet, harpoon and spear.

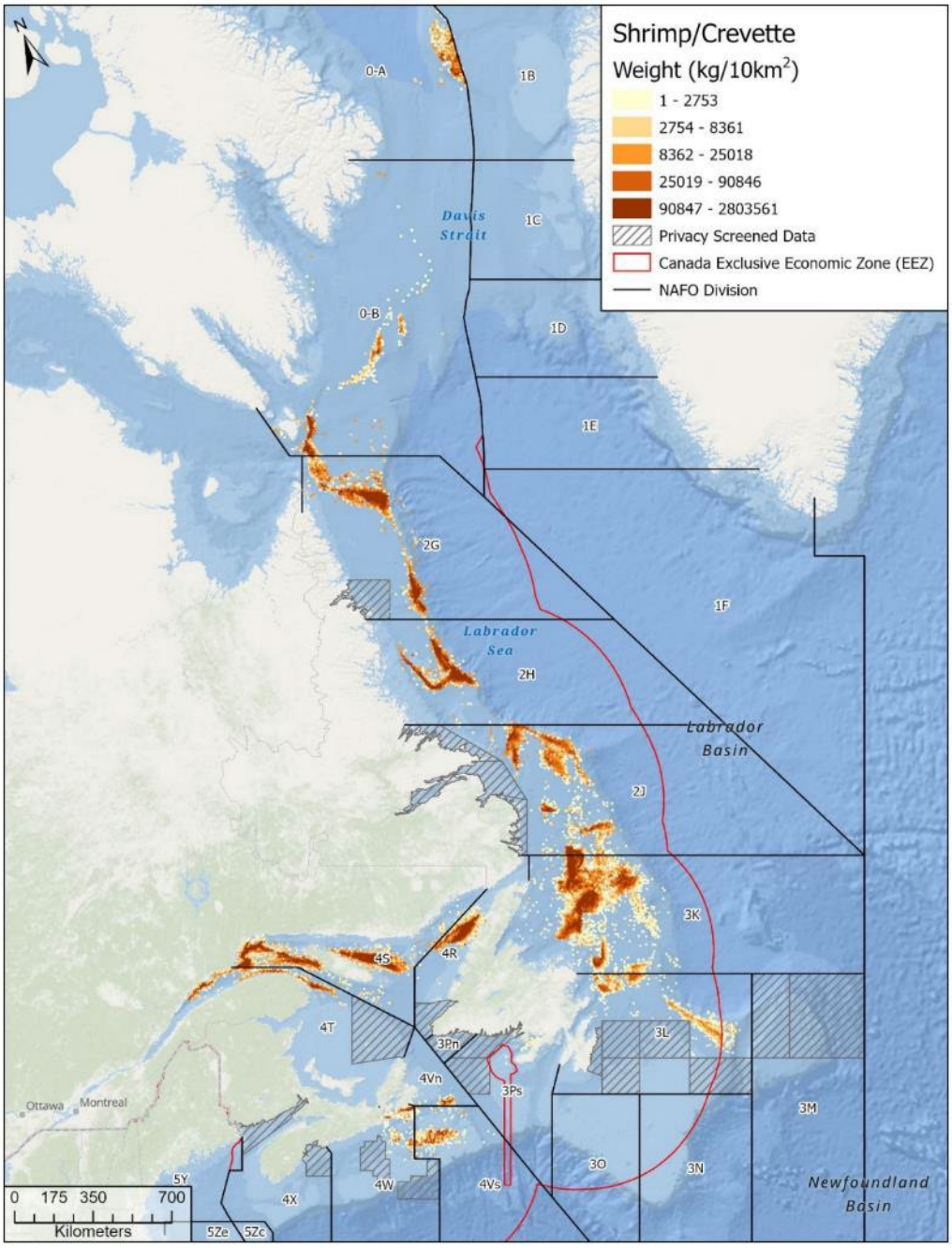

Figure 26 - Shrimp

Figure 26 - Shrimp. This fishery is an amalgamation of species because of their similarities and/or lack of data on an individual scale. This fishery includes Northern Shrimp (*Pandalus borealis*) and Striped Shrimp (*Pandalus montagui*). The majority (~98%) of this fishery was performed using shrimp trawl. The remainder was performed using other gear types which include pot, bottom otter trawl, Danish seine and Scottish seine.

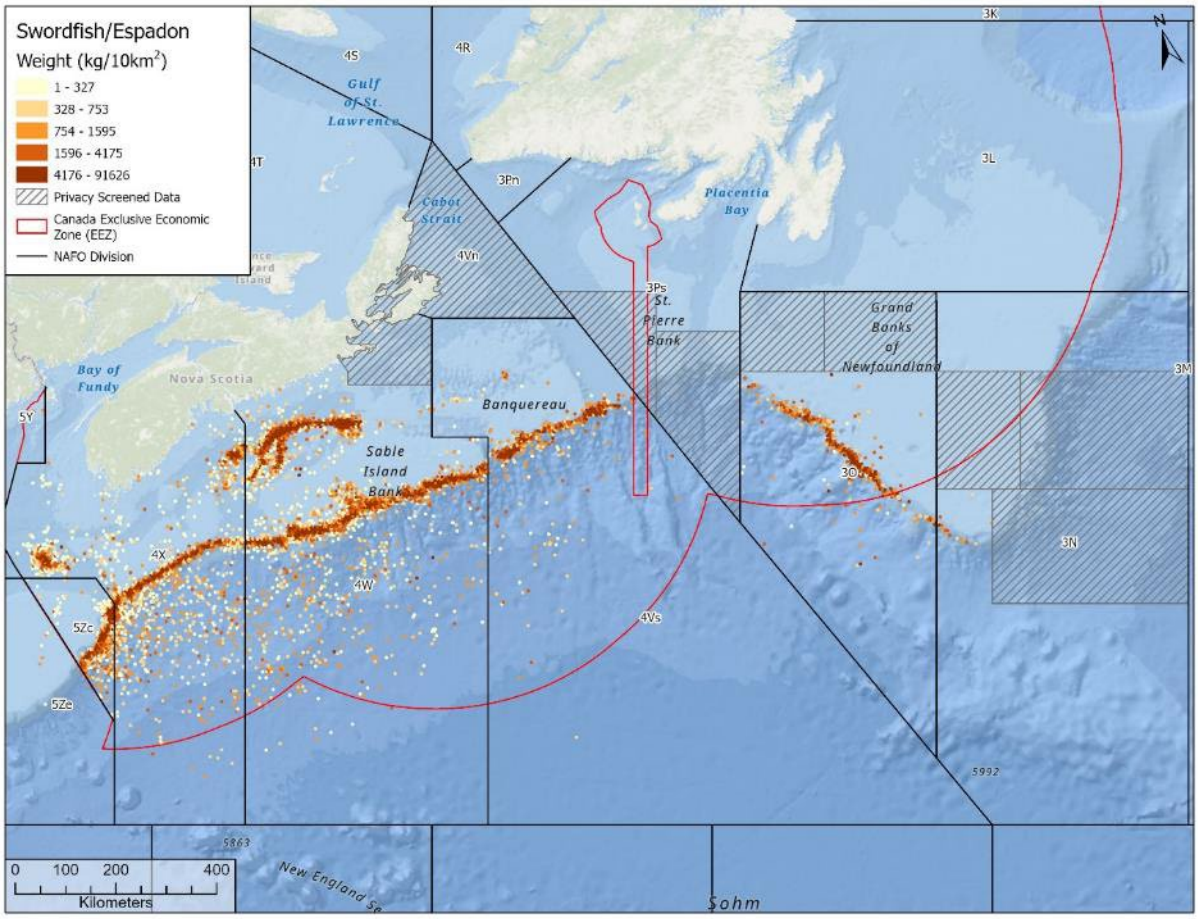

Figure 27 - Swordfish (Xiphias gladius)

Figure 27 - Swordfish *(Xiphias gladius)*. The majority (almost 100%) of this fishery was performed using pelagic longline and harpoon and spear. The remainder was performed using other gear types which include gillnet and angling.

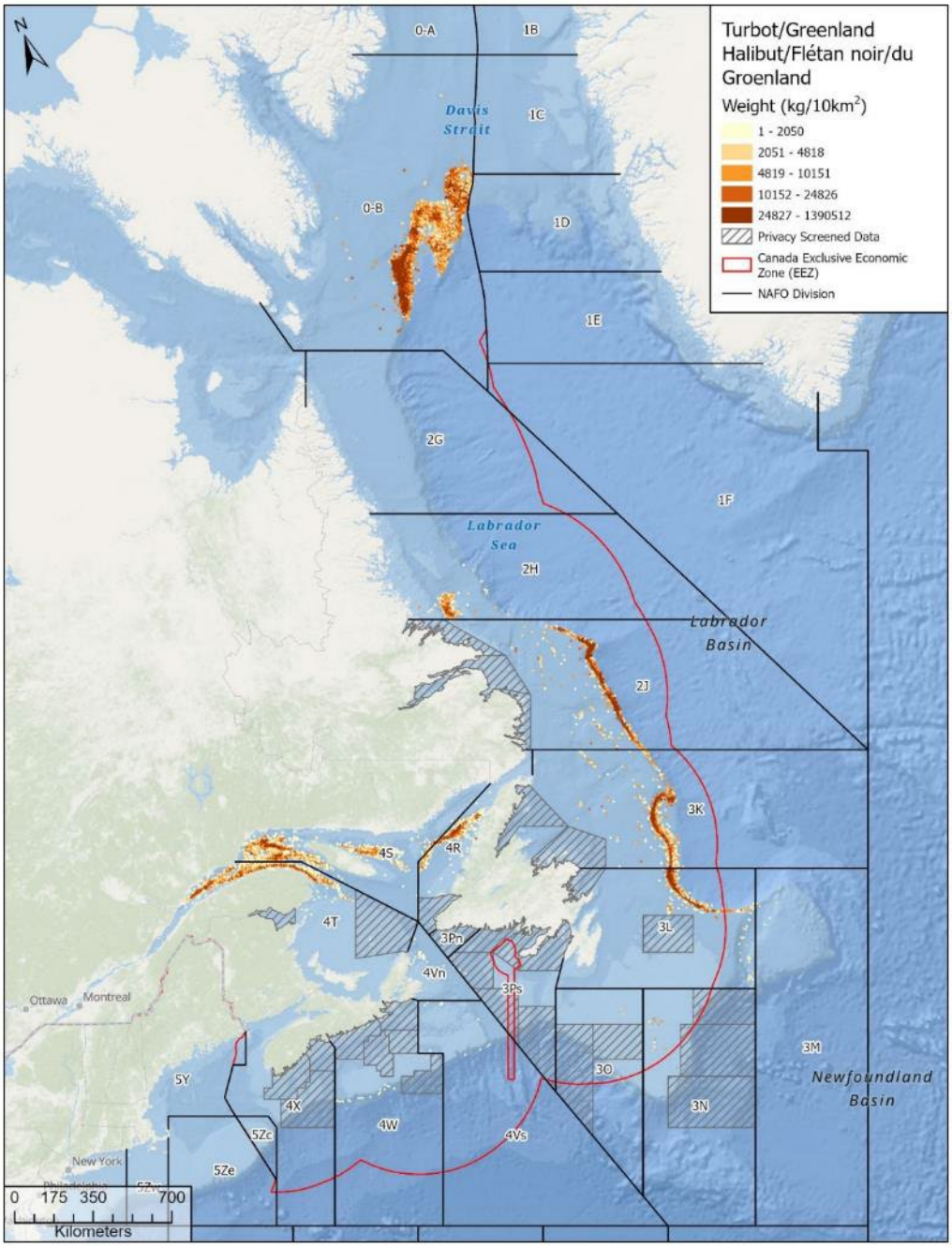

Figure 28 - Turbot/Greenland Halibut (Reinhardtius hippoglossoides)

Figure 28 - Turbot/Greenland Halibut (*Reinhardtius hippoglossoides*). The majority (almost 100%) of this fishery was performed using gillnet and bottom otter trawl. The remainder was performed using other gear types which include bottom longline, Danish seine, Scottish seine and tethered hooks.

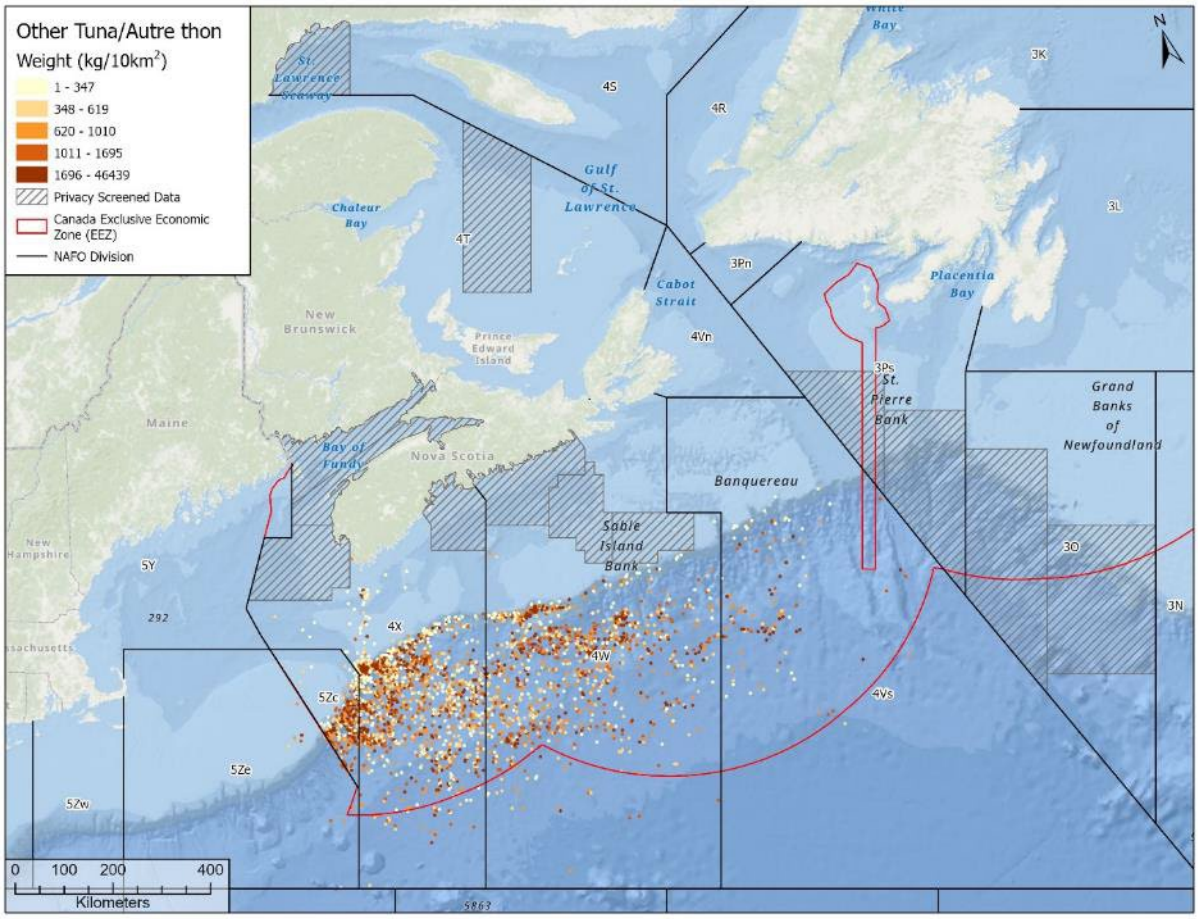

Figure 29 - Tuna (other)

Figure 29 - Tuna (other). This fishery is an amalgamation of species because of their similarities and/or lack of data on an individual scale. This fishery includes Albacore Tuna (*Thunnus alalunga*), Bigeye Tuna (*Thunnus obesus*), Skipjack Tuna (*Katsuwonus pelamis*) and Yellowfin Tuna (*Thunnus albacares*). The majority (~94%) of this fishery was performed using pelagic longline. The remainder was performed using other gear types which include angling, harpoon and spear (including electric harpoon) and troller lines.

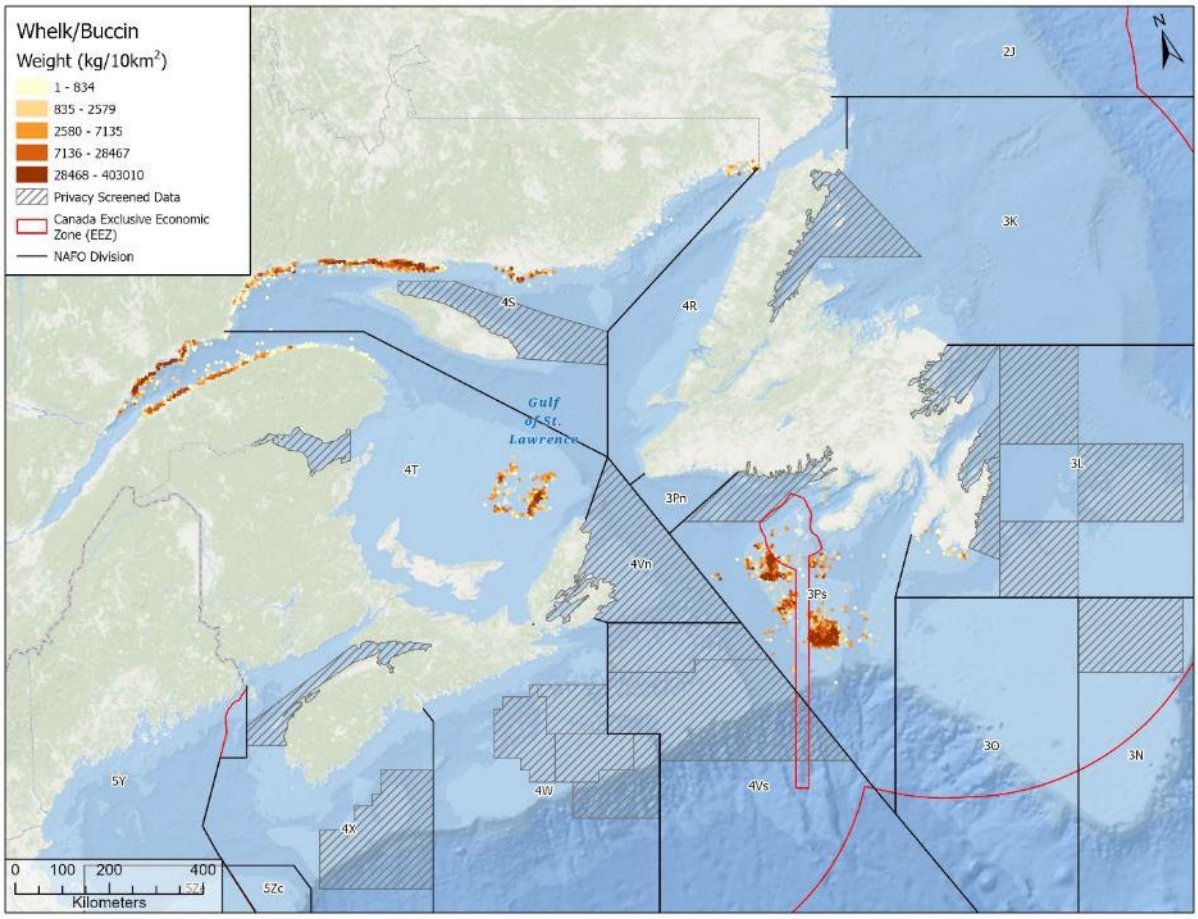

Figure 30 - Whelk (Buccinum undatum)

Figure 30 - Whelk (*Buccinum undatum*). The majority (almost 100%) of this fishery was performed using various traps which include whelk trap (3 foot), pots, conical trap (4 foot), pyramidal trap, and mixed trap. The remainder was performed using other gear types which include dredge (boat).

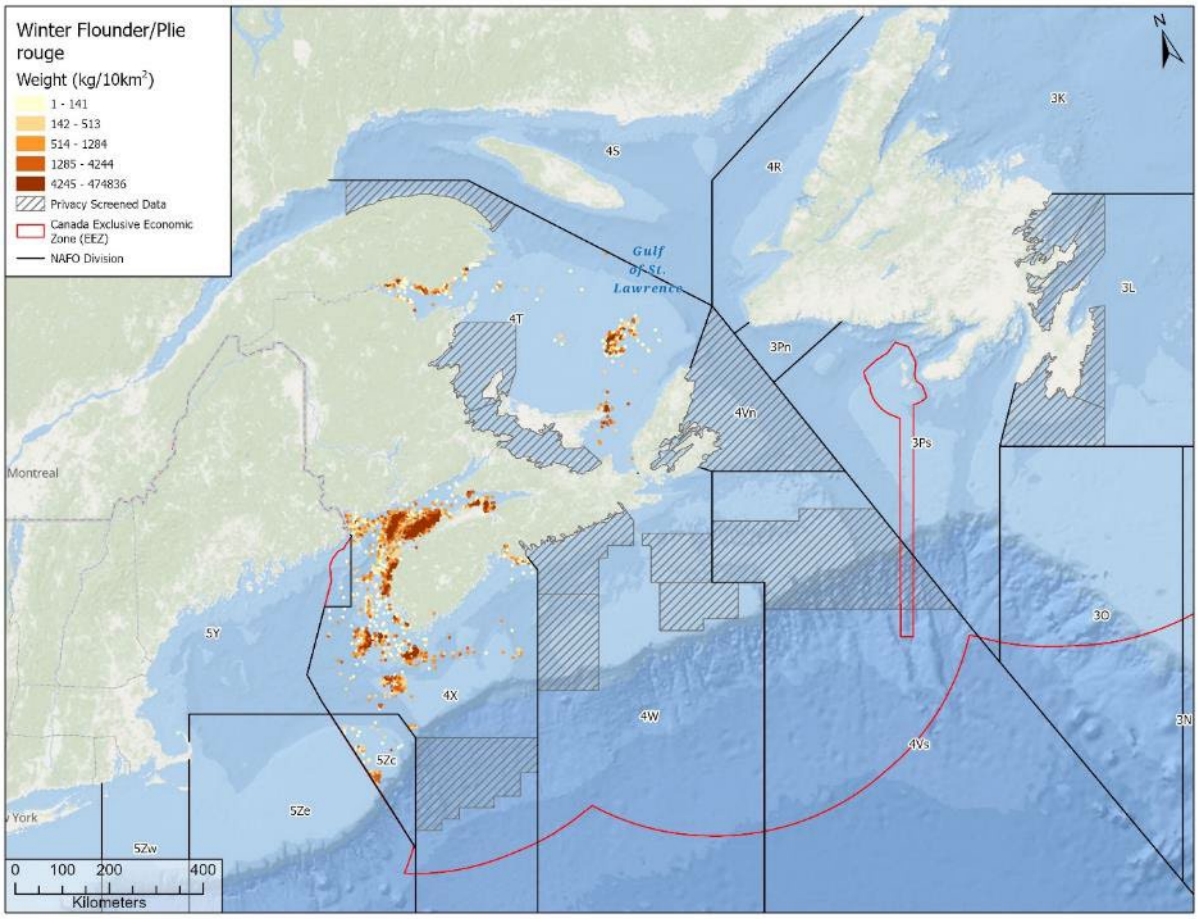

Figure 31 - Winter Flounder (Pseudopleuronectes americanus)

Figure 31 - Winter Flounder (*Pseudopleuronectes americanus*). The majority (~89%) of this fishery was performed using bottom trawl. The remainder was performed using other gear types which include gillnet, bottom longline, Scottish seine and midwater trawl.

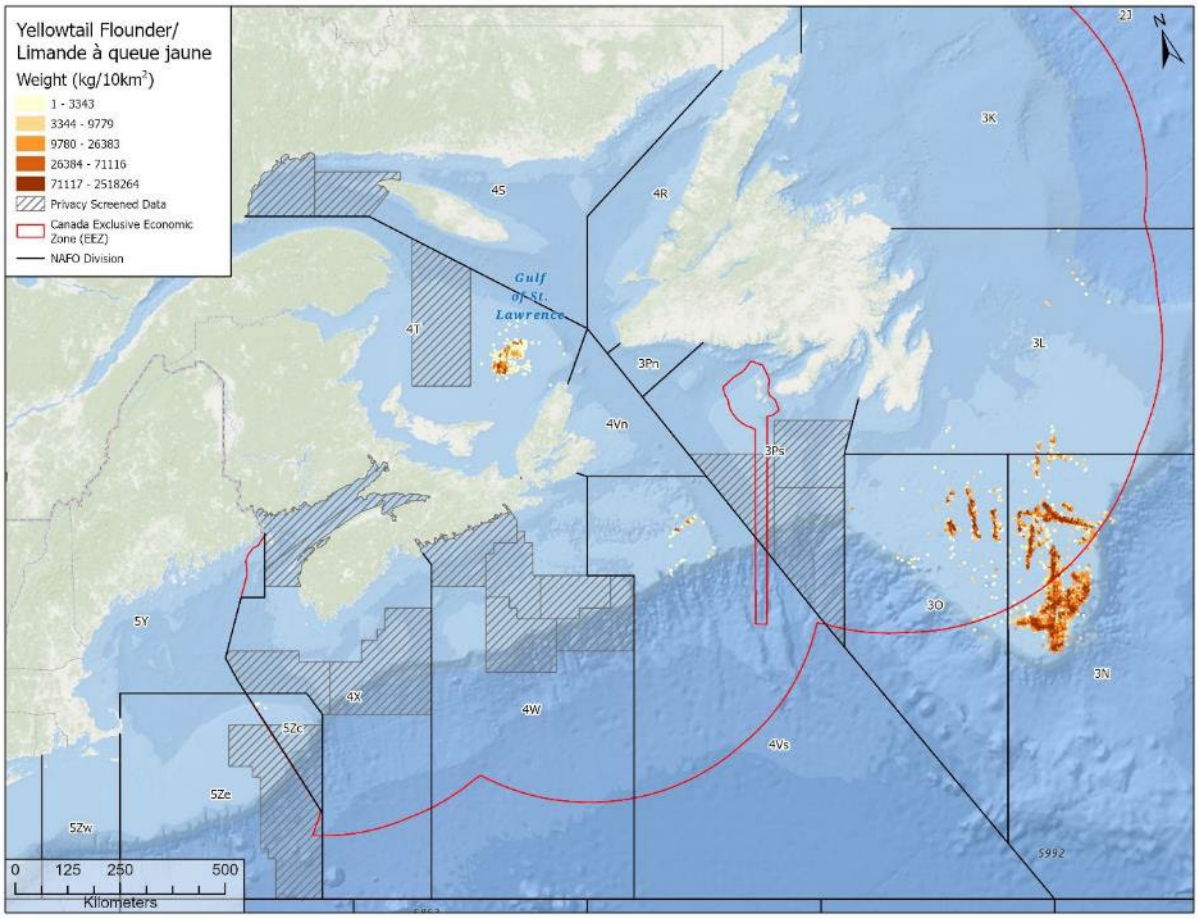

Figure 32 - Yellowtail Flounder (Limanda ferruginea)

Figure 32 - Yellowtail Flounder (*Limanda ferruginea*). The majority (~97%) of this fishery was performed using bottom otter trawl. The remainder was performed using other gear types which include Scottish seine, Danish seine and gillnet.

Commercial Maps by Gear Type

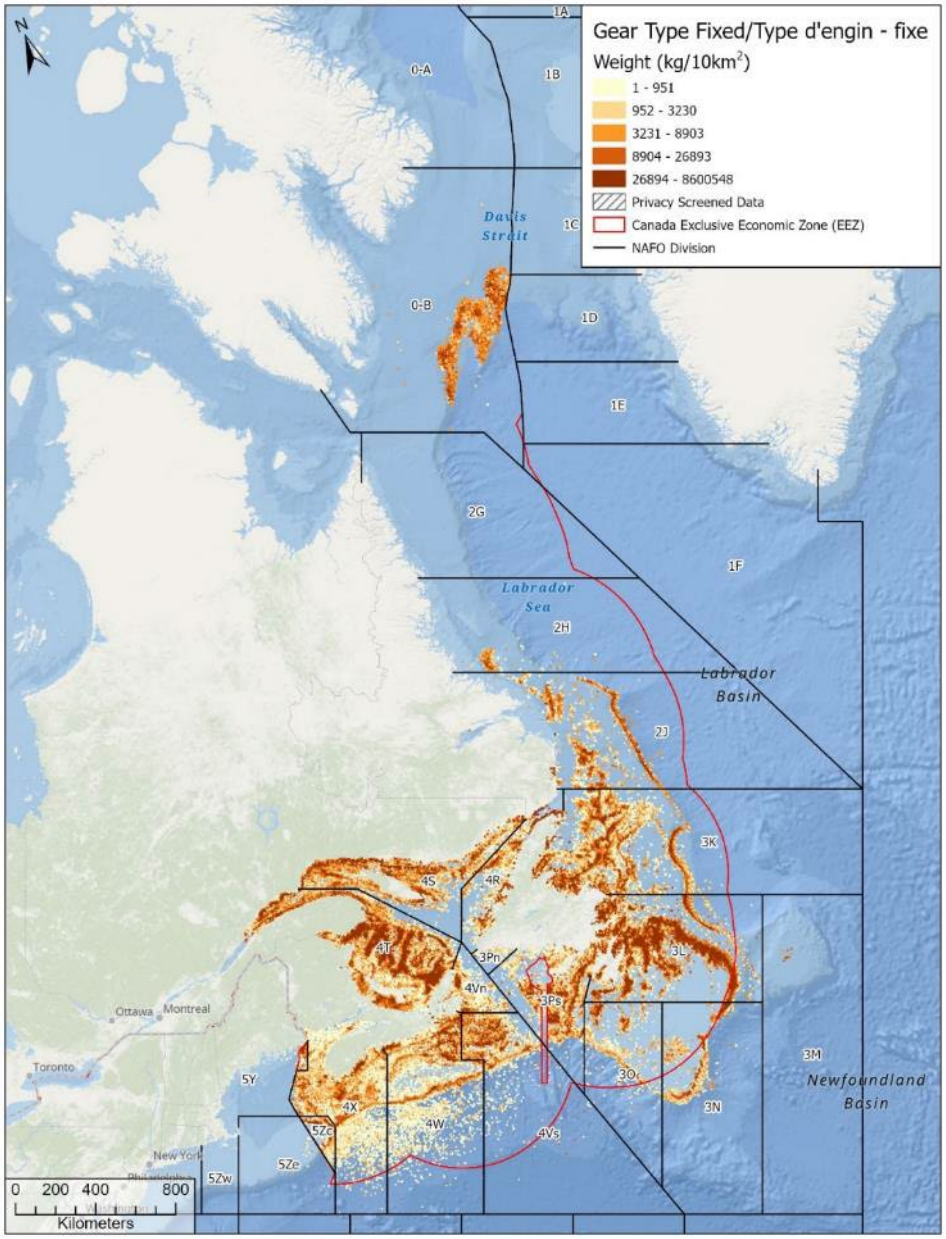

Figure 33 - All Fixed Gear

Figure 33 - All fishing records of all fixed gear types between 2012 and 2021. This includes angling/rod and reel, beach and bar seine, diving with hand tool, gillnet, handline (baited), harpoon and spear, longline (groundfish), longline (pelagic), pot, purse and tuck seine, trap gear, and trap net. Some gear types where there were similarities or there were too few records to display were amalgamated with other gear types, the distinctions of each can be found in their figure descriptions below.

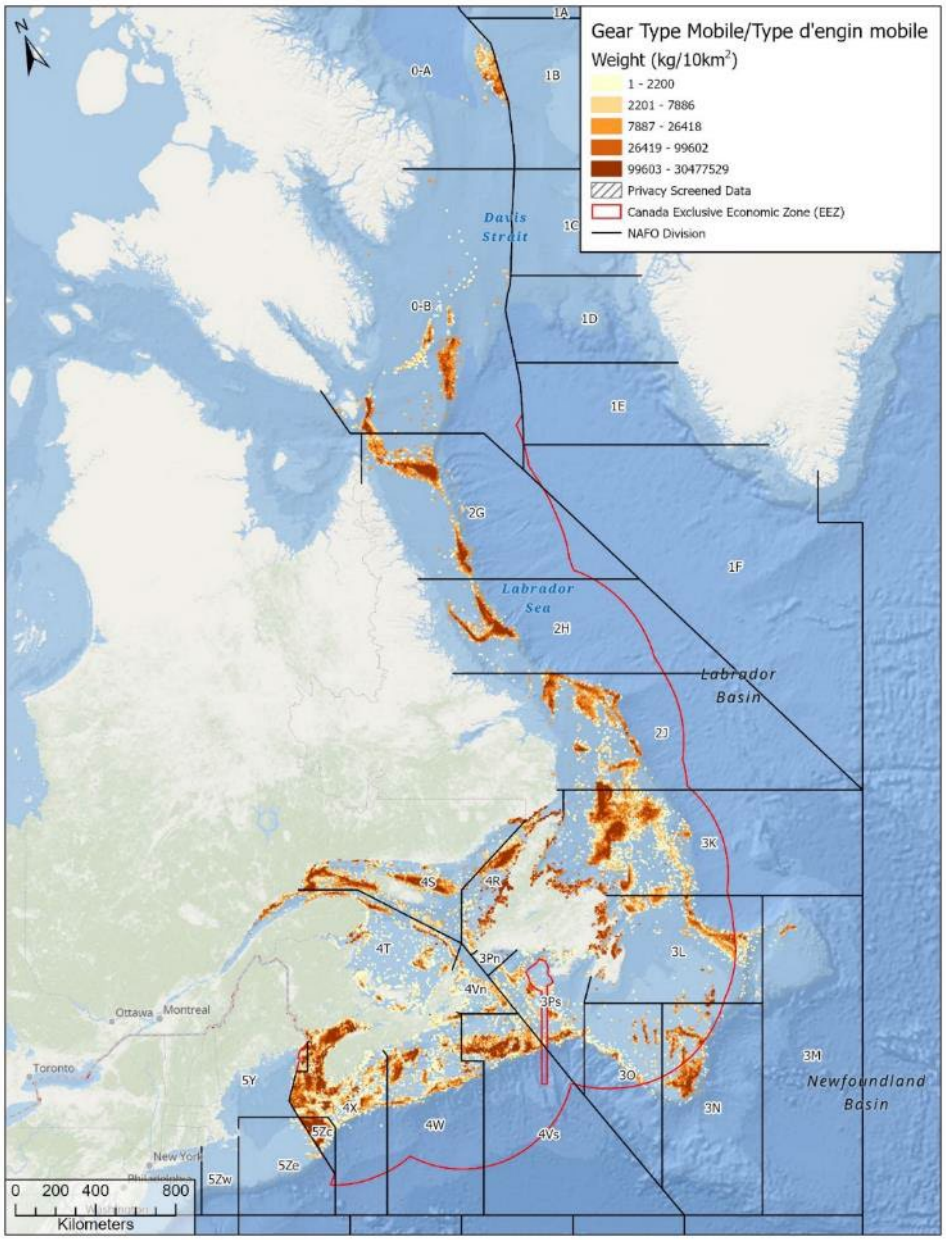

Figure 34 - All Mobile Gear

Figure 34 - All fishing records of all mobile gear types between 2012 and 2021. This includes bottom otter trawl, Danish and Scottish seine, dredge boat, shrimp trawl and troller lines. Some gear types where there were similarities or there were too few records to display were amalgamated with other gear types, the distinctions of each can be found in their figure descriptions below.

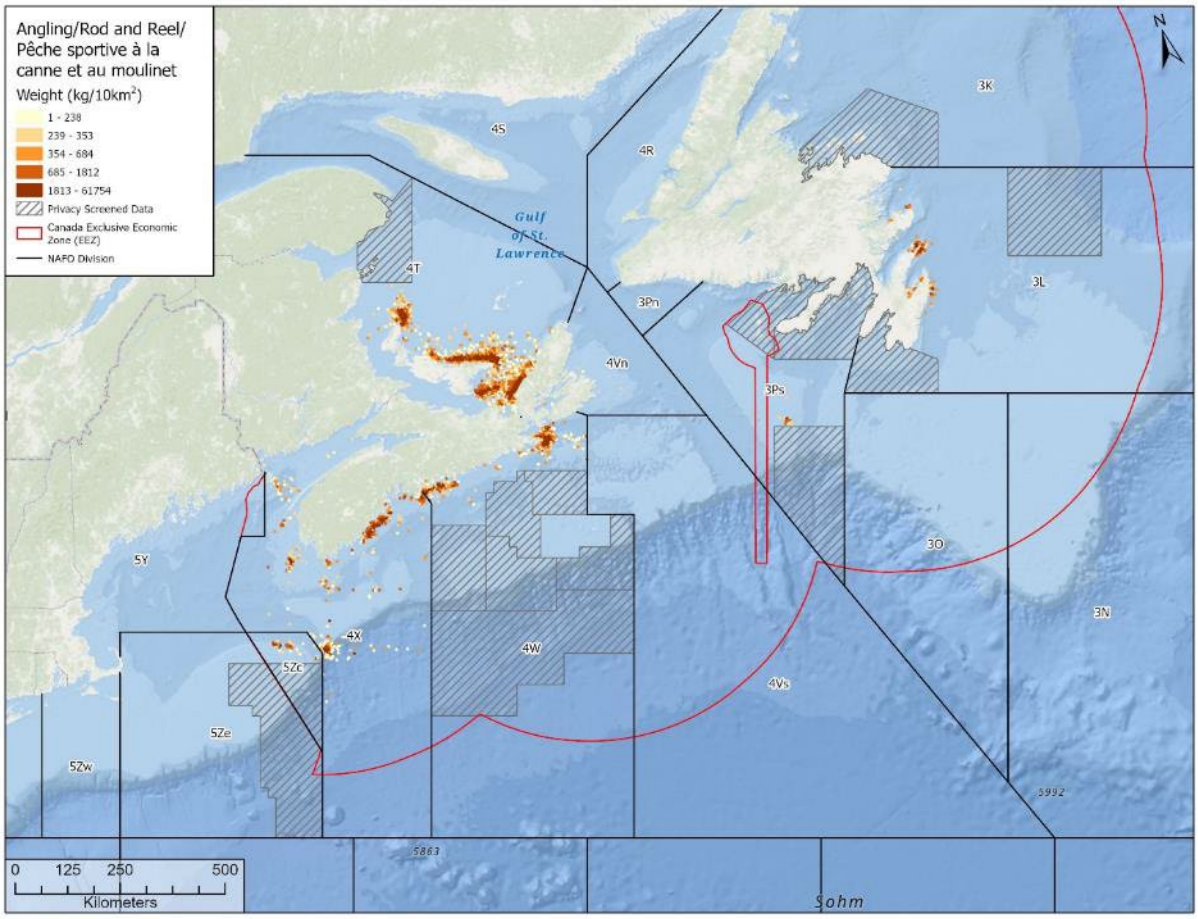

Figure 35 - Angling/Rod and Reel

Figure 35 - Angling/Rod and Reel. This fishery is an amalgamation of gear types because of their similarities and/or lack of data on an individual scale. This fishery includes angling, and rod and reel. The majority (almost 100%) of this fishery was performed targeting bluefin tuna, albacore tuna, bigeye tuna, yellowfin tuna and skipjack tuna. The remainder was performed targeting other species which include swordfish and Atlantic halibut.

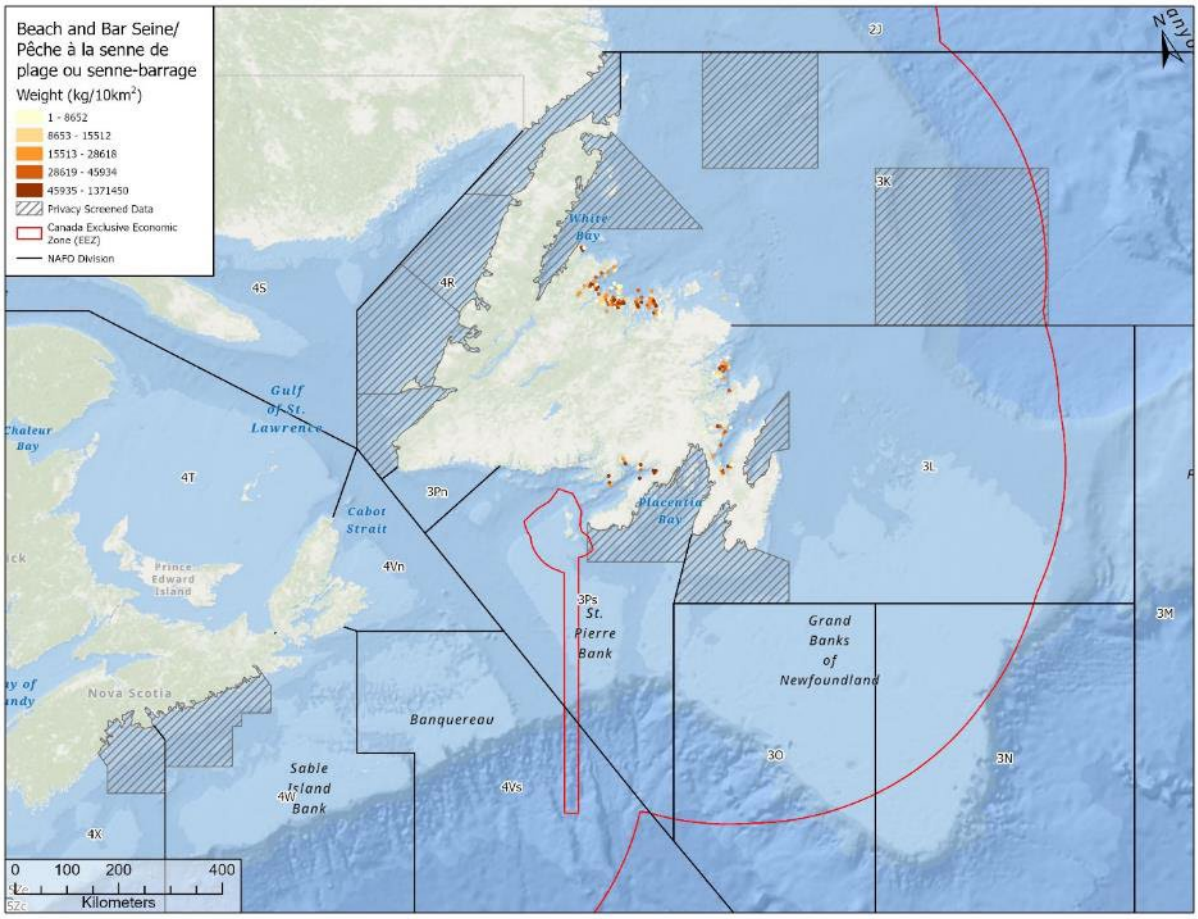

Figure 36 - Beach and Bar Seine

Figure 36 - Beach and Bar Seine. The entirety (100%) of this fishery was performed targeting capelin, Atlantic herring and mackerel.

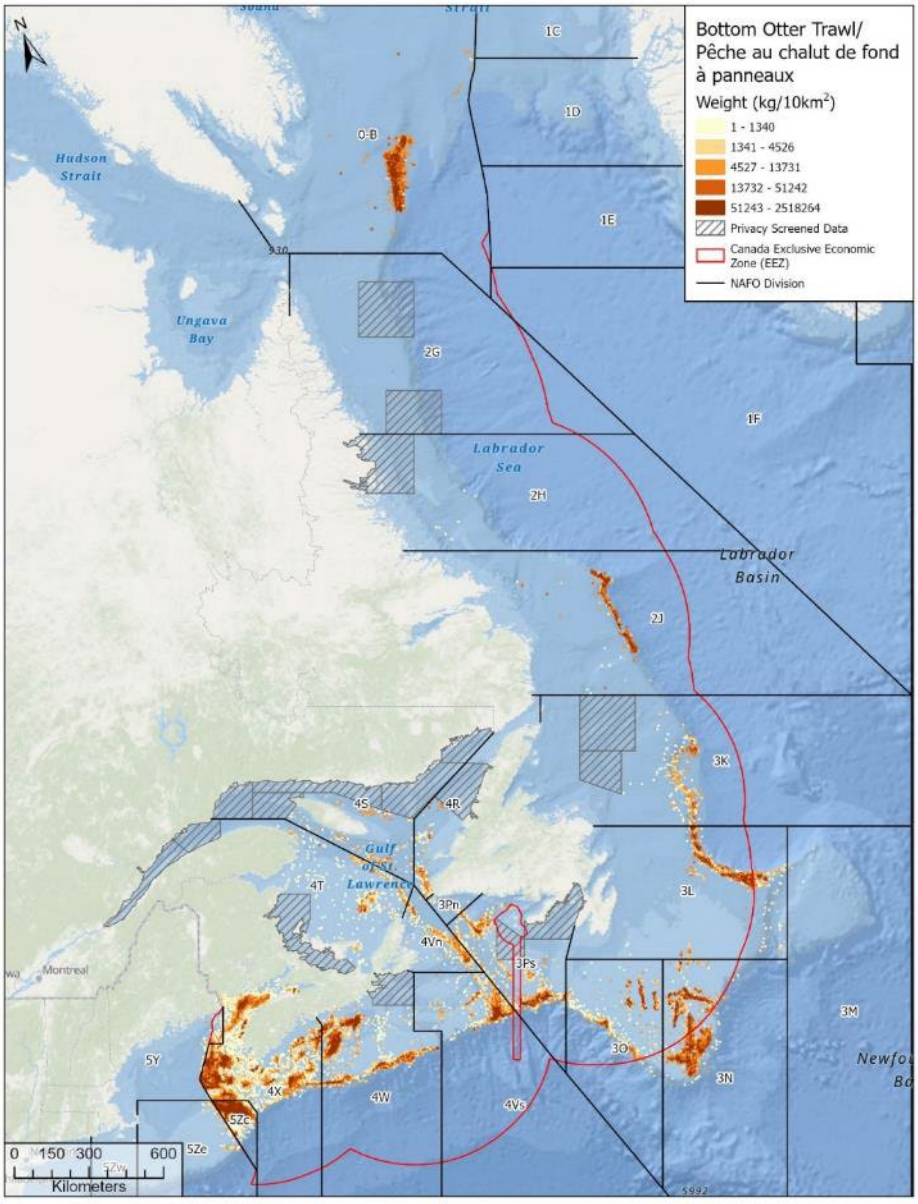

Figure 37 - Bottom Otter Trawl

Figure 37 - Bottom Otter Trawl. This fishery is an amalgamation of gear types because of their similarities and/or lack of data on an individual scale. This fishery includes bottom otter trawl (both side and stern) and bottom pair trawl. The majority (almost 100%) of this fishery was performed targeting groundfish such as haddock, redfish, hake (silver, white, red), yellowtail flounder, pollock, winter flounder, Atlantic cod, turbot/Greenland halibut, sculpin, greysole/witch flounder, skate, Atlantic halibut, monkfish/American angler, American plaice, dogfish, cusk, stripped wolffish and summer flounder. The remainder was performed targeting other species which include northern shrimp, squid, alewife/gaspareau, Atlantic herring, porbeagle shark, butter fish/dollarfish, American shad, mackerel, queen/snow crab and tilefish.

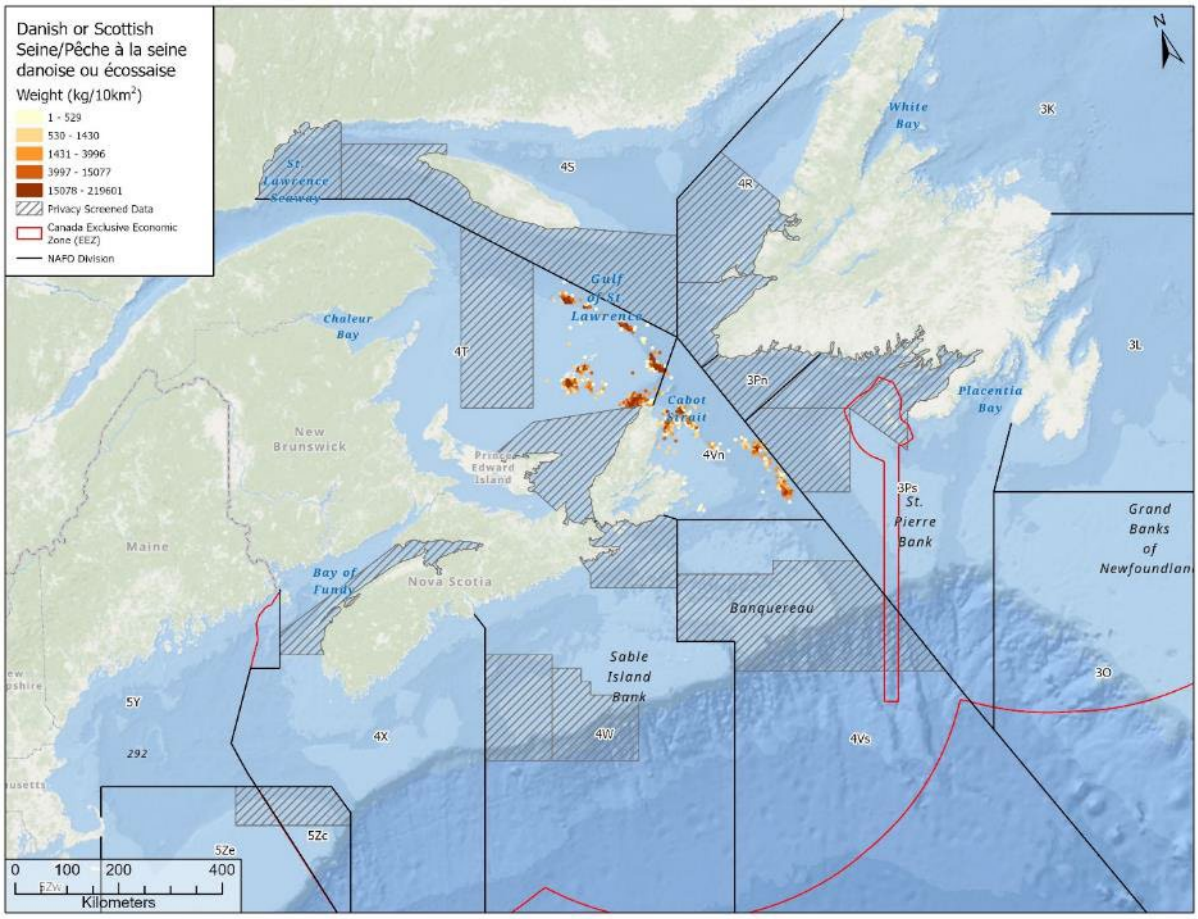

Figure 38 - Danish and Scottish Seine

Figure 38 - Danish and Scottish Seine. This fishery is an amalgamation of gear types because of their similarities and/or lack of data on an individual scale. This fishery includes Danish seine and Scottish seine. The entirety (100%) of this fishery was performed targeting groundfish such as redfish, greysole/witch flounder, yellowtail flounder, turbot/Greenland halibut, American plaice, white hake, Atlantic cod, monkfish/American angler, Atlantic halibut, winter flounder, pollock and haddock.

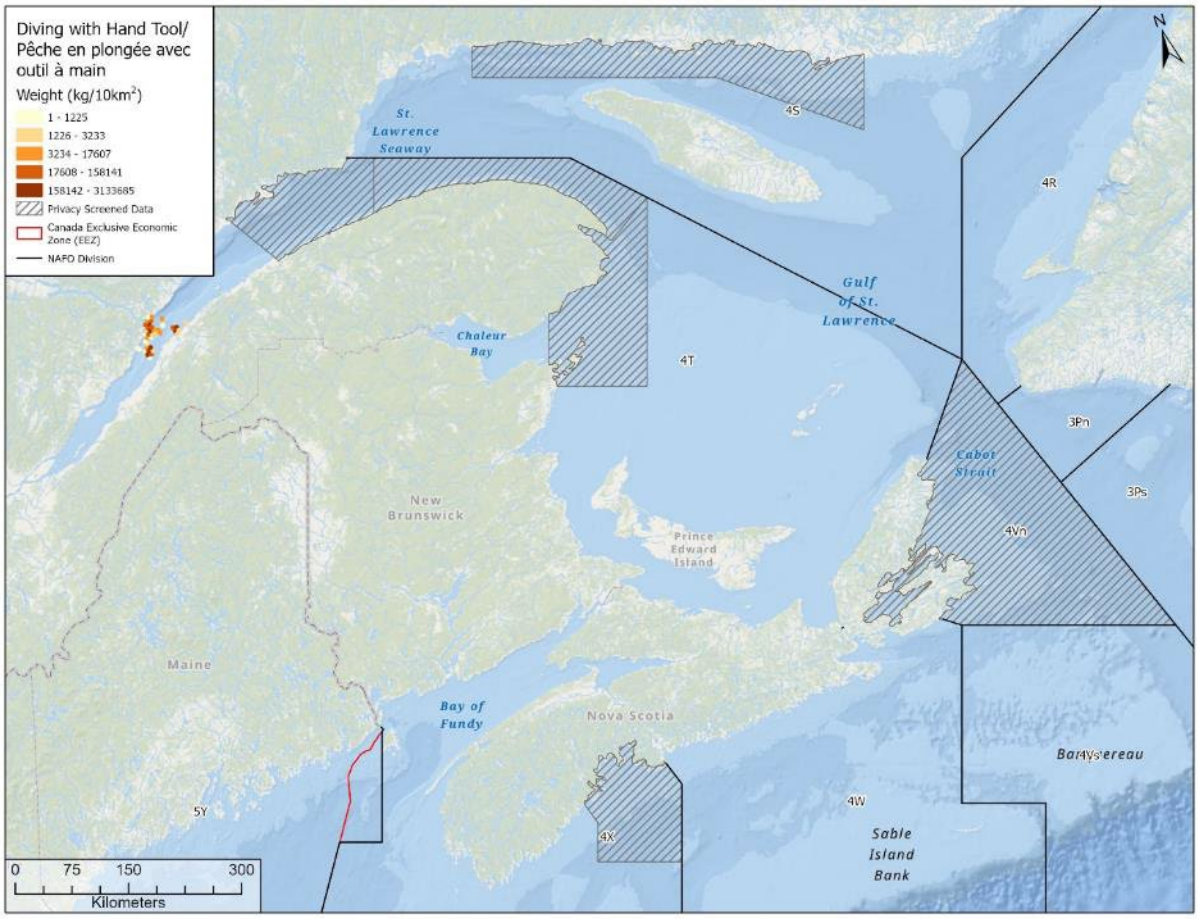

Figure 39 - Diving with Hand Tool

Figure 39 - Diving with Hand Tool. The entirety (100%) of this fishery was performed targeting sea urchins.

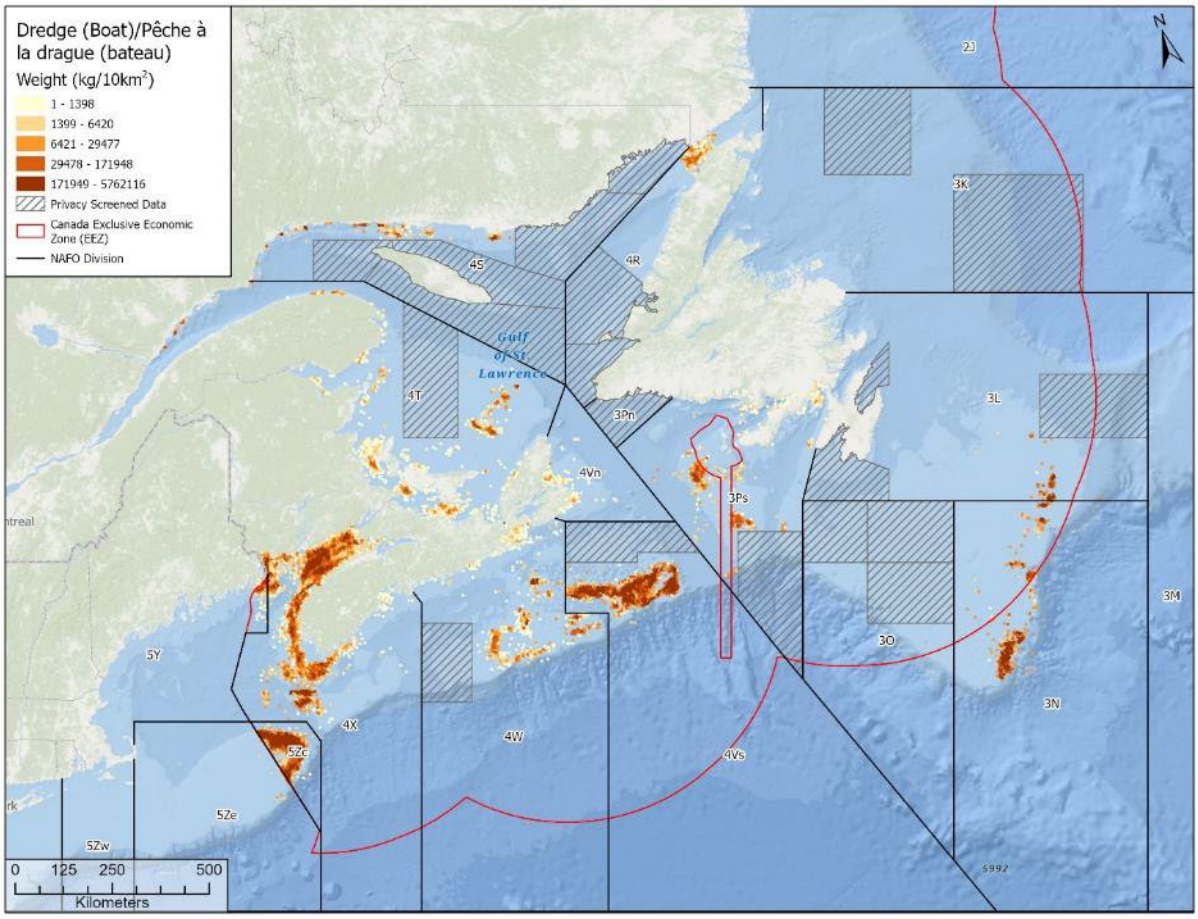

Figure 40 - Dredge (Boat)

Figure 40 - Dredge (Boat). The majority (~97%) of this fishery was performed targeting clams and scallop which include sea scallop, Icelandic scallop, Stimpson's surf clam (including mantle), propeller clam, bar clam, ocean Quahaug, razor clam and cockle. The remainder was performed targeting other species which include sea cucumber, redfish, monkfish/American angler, whelk and sea urchins.

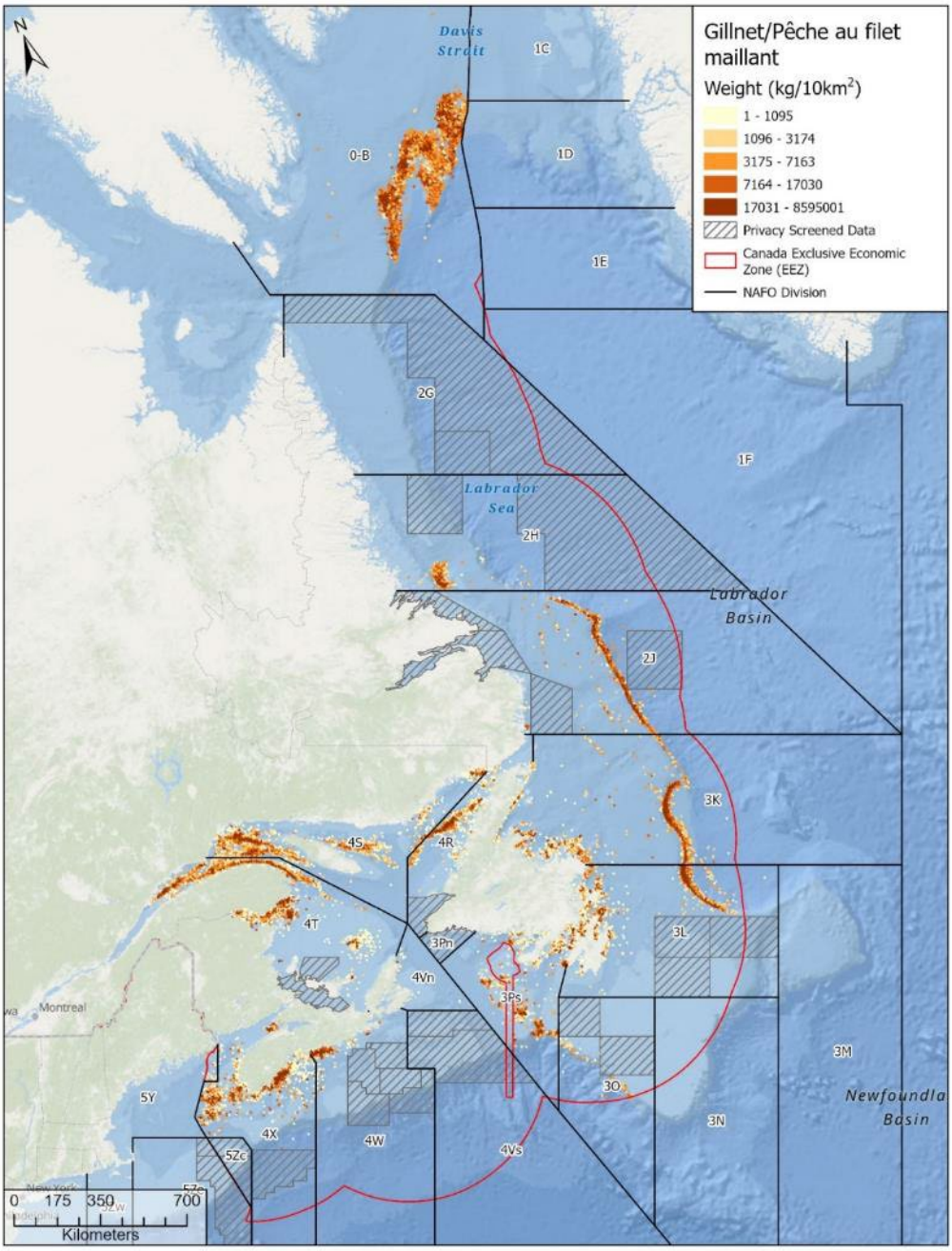

Figure 41 - Gillnet

Figure 41 - Gillnet (set, fixed and drift). The majority (~76%) of this fishery was performed targeting groundfish which include turbot/Greenland halibut, Atlantic cod, pollock, winter flounder, white hake, skate, sculpin, monkfish/American angler, lumpfish (including roe), redfish, Atlantic halibut, haddock, yellowtail flounder, cusk, American plaice, greysole/witch flounder, windowpane flounder and other general flounder. The remainder was performed targeting other species which include Atlantic herring at ~22%, mackerel, mako shark and alewife/gaspareau.

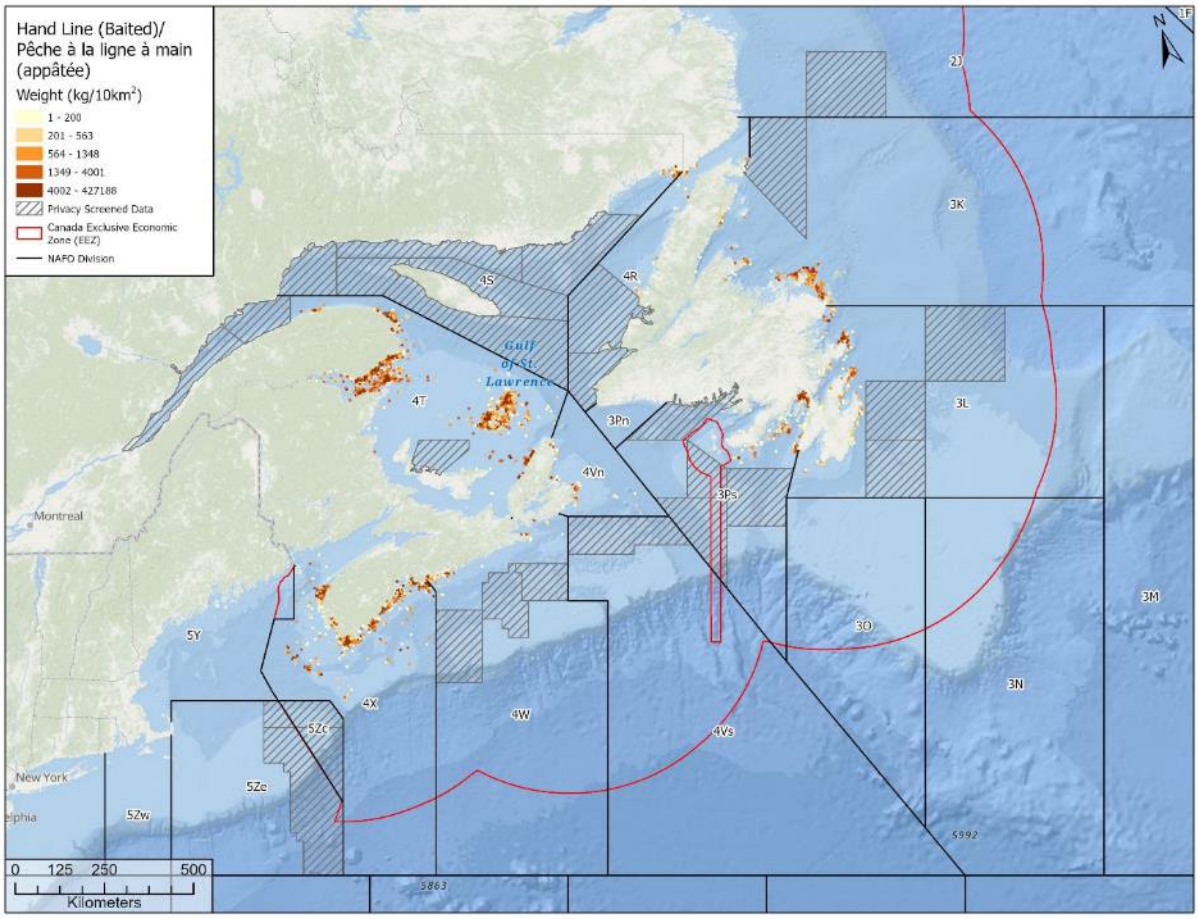

Figure 42 - Hand Line (Baited)

Figure 42 - Hand Line (Baited). The majority (~97%) of this fishery was performed targeting mackerel and Atlantic cod. The remainder was performed targeting other species which include pollock, Atlantic halibut, Atlantic herring, haddock and dogfish.

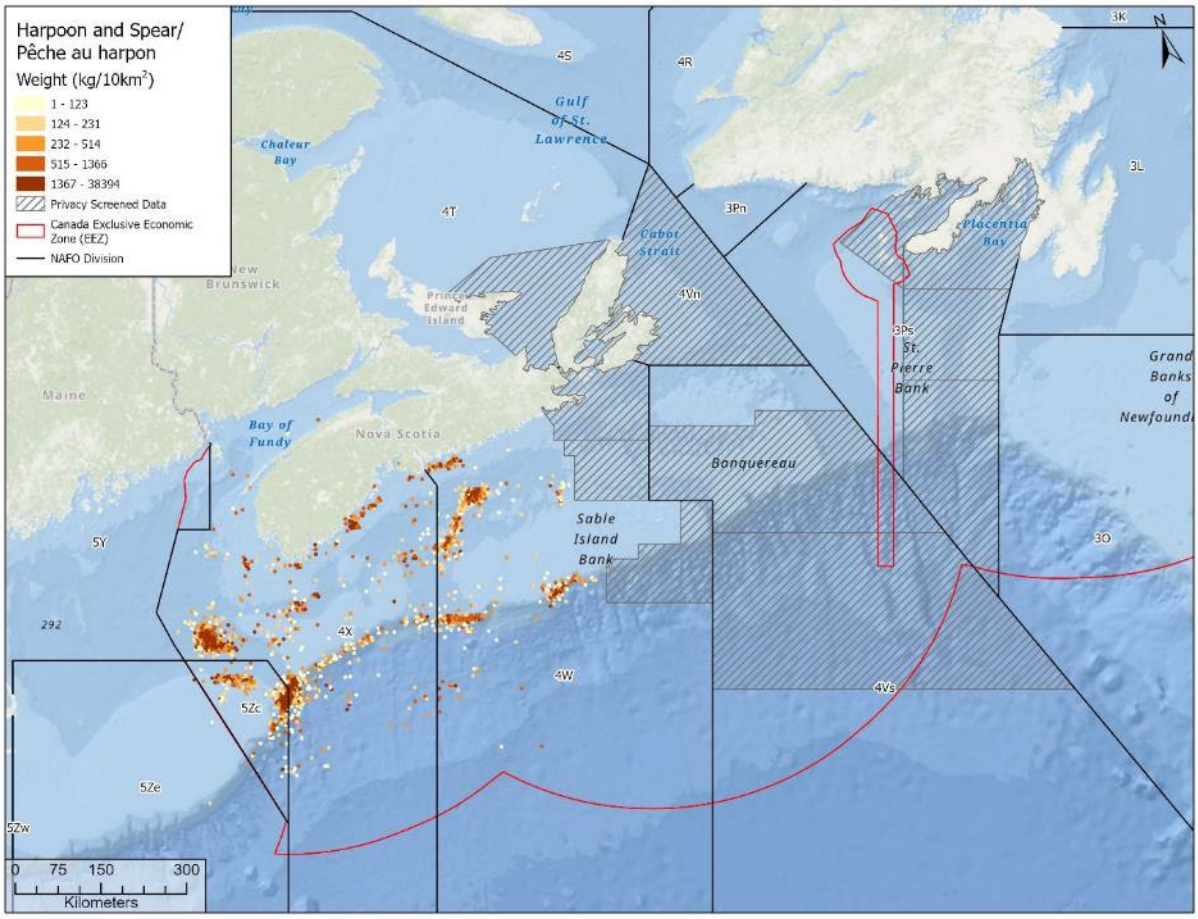

Figure 43 - Harpoon and Spear

Figure 43 - Harpoon and Spear. This fishery is an amalgamation of gear types because of their similarities and/or lack of data on an individual scale. This fishery includes harpoon, spear and electric harpoon. The majority (~94%) of this fishery was performed targeting swordfish and bluefin tuna. The remainder was performed targeting other species which include bigeye tuna, albacore tuna, yellowfin tuna, white marlin, mako shark, skipjack tuna, blue marlin and mahi mahi/dolphinfish.

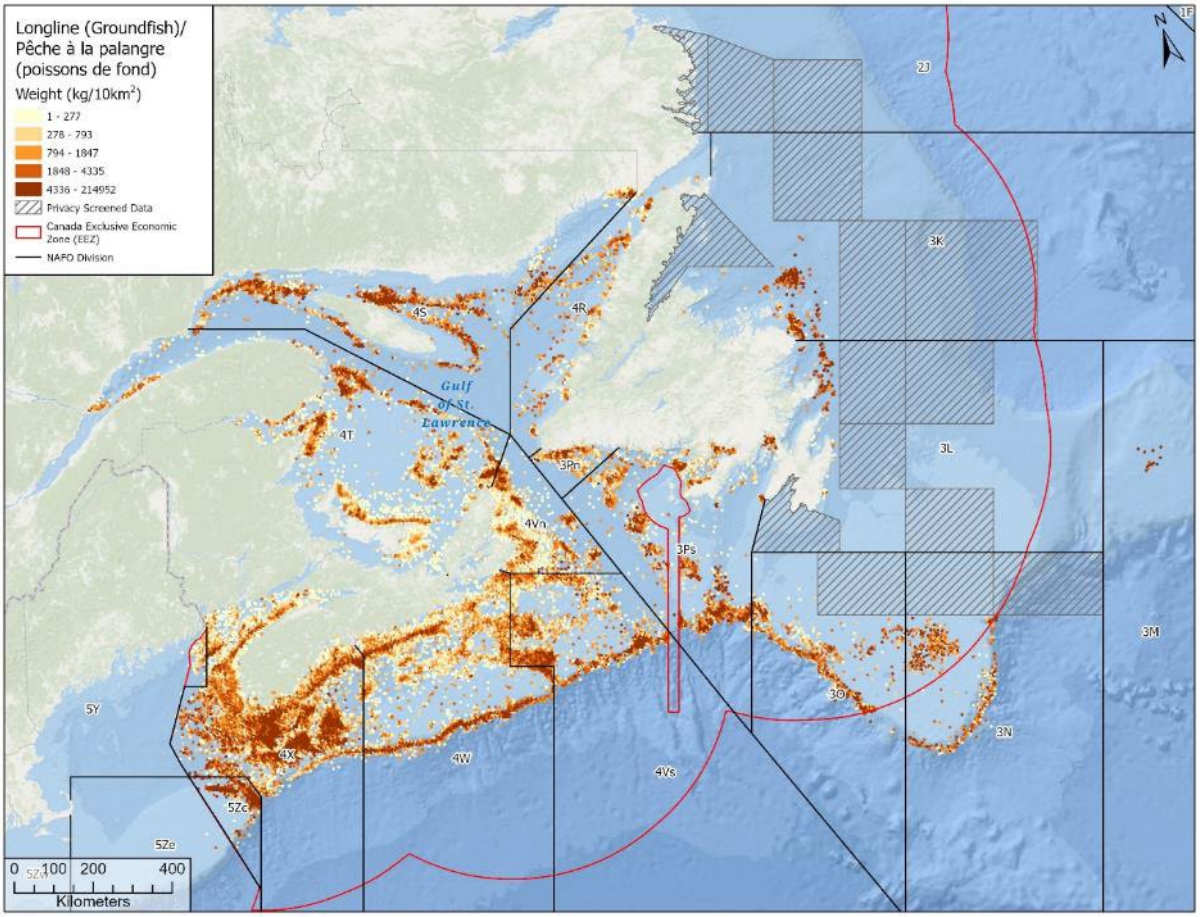

Figure 44 - Longline (Groundfish)

Figure 44 - Longline (Groundfish). The entirety (100%) of this fishery was performed targeting groundfish which include Atlantic halibut, Atlantic cod, haddock, hake (white, silver, red), cusk, skate, pollock, turbot/Greenland halibut, redfish, monkfish/American angler, dogfish, striped wolffish, winter flounder, sculpin, American plaice, yellowtail flounder, greysole/witch flounder and other general groundfish.

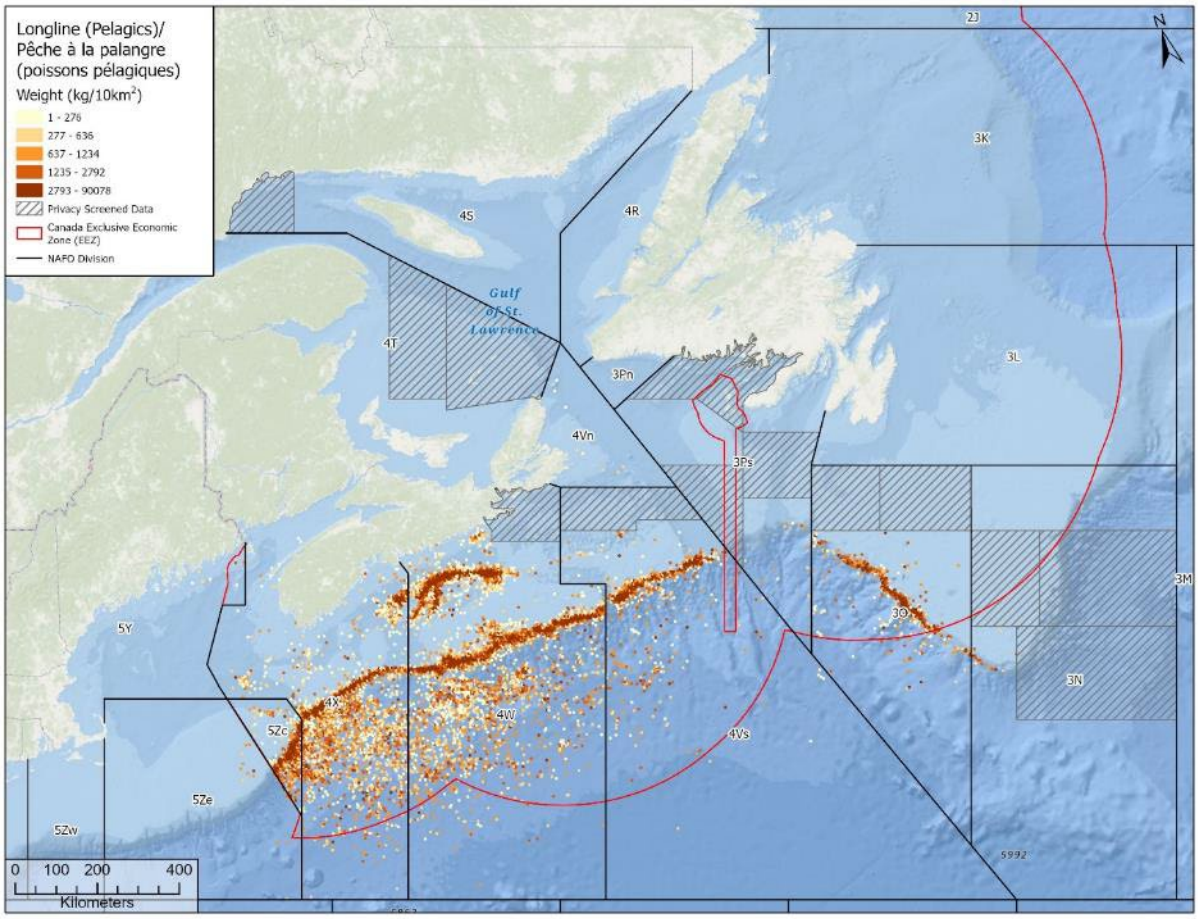

Figure 45 - Longline (Pelagics)

Figure 45 - Longline (Pelagic). The entirety (100%) of this fishery was performed targeting pelagic species which include swordfish, tuna (bigeye, bluefin, yellowfin, albacore, skipjack), shark (mako, porbeagle, dusky, blue), mahi mahi/dolphinfish, mackerel, white marlin and blue marlin.

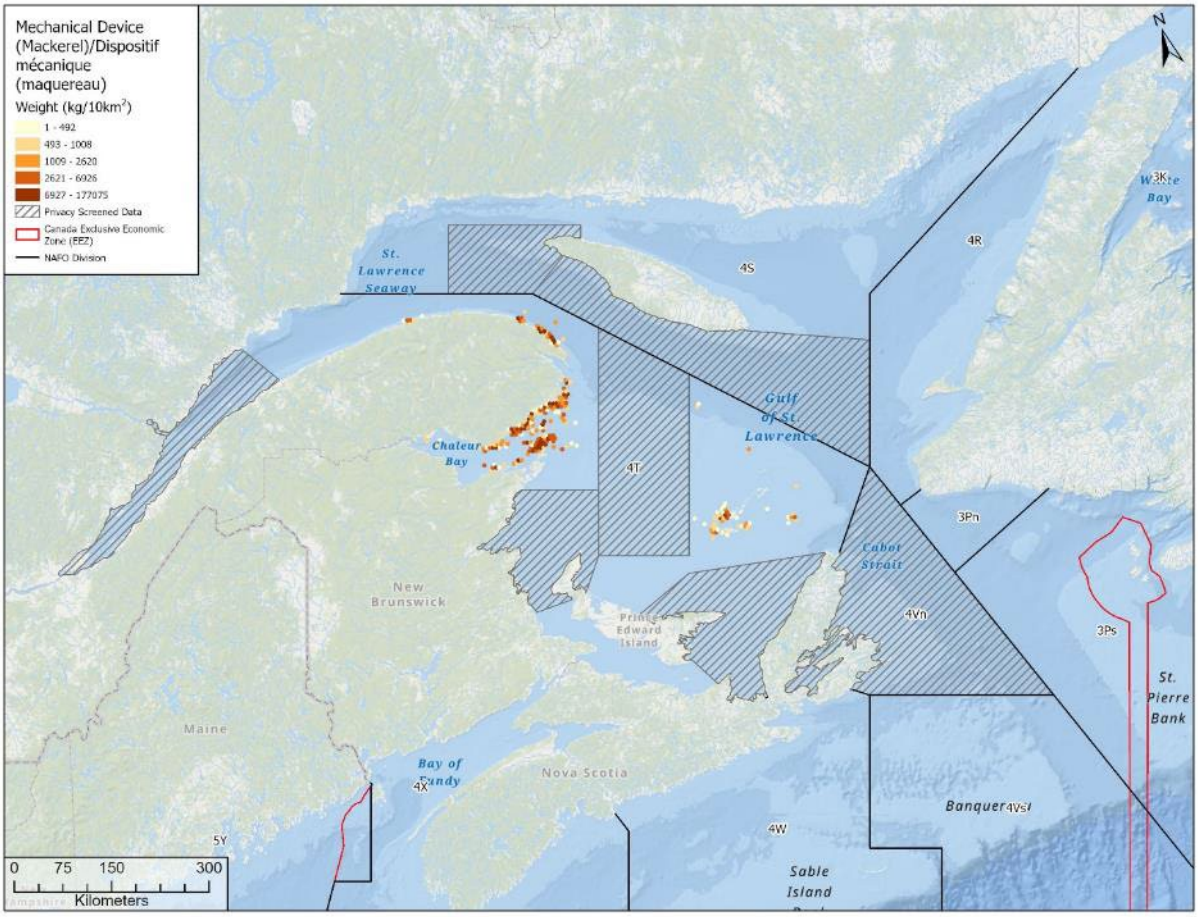

Figure 46 - Mechanical Device (Mackerel)

Figure 46 - Mechanical Device (Mackerel). The entirety (100%) of this fishery was performed targeting mackerel.

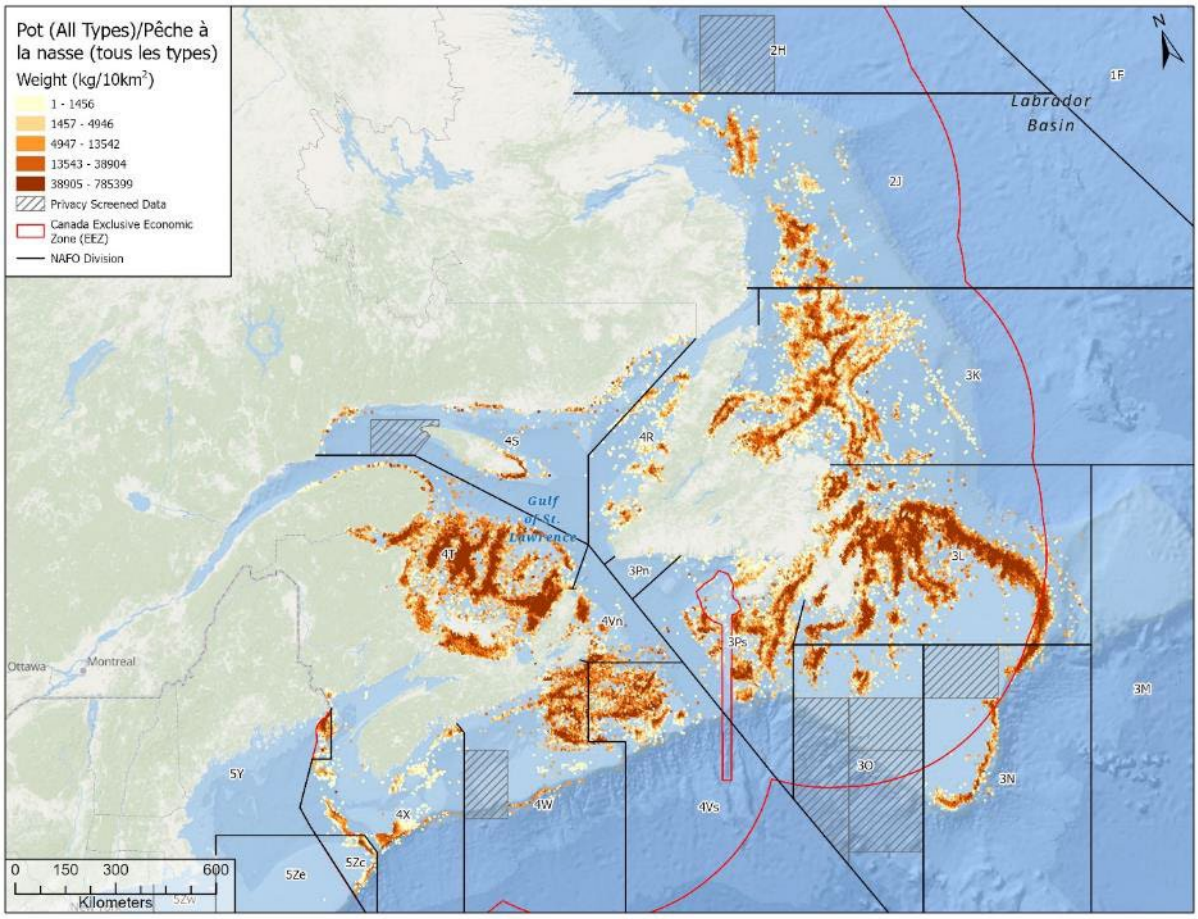

Figure 47 - Pot

Figure 47 - Pot. The majority (~75%) of this fishery was performed targeting Queen/snow crab. The remainder was performed targeting other species which include lobster, crab (Atlantic rock crab, Jonah crab, spider/toad crab, red crab, stone/King crab, porcupine crab), whelk, shrimp, sea scallop and winter flounder. The map excludes non-georeferenced inshore lobster catch in Maritimes, Gulf and NL regions.

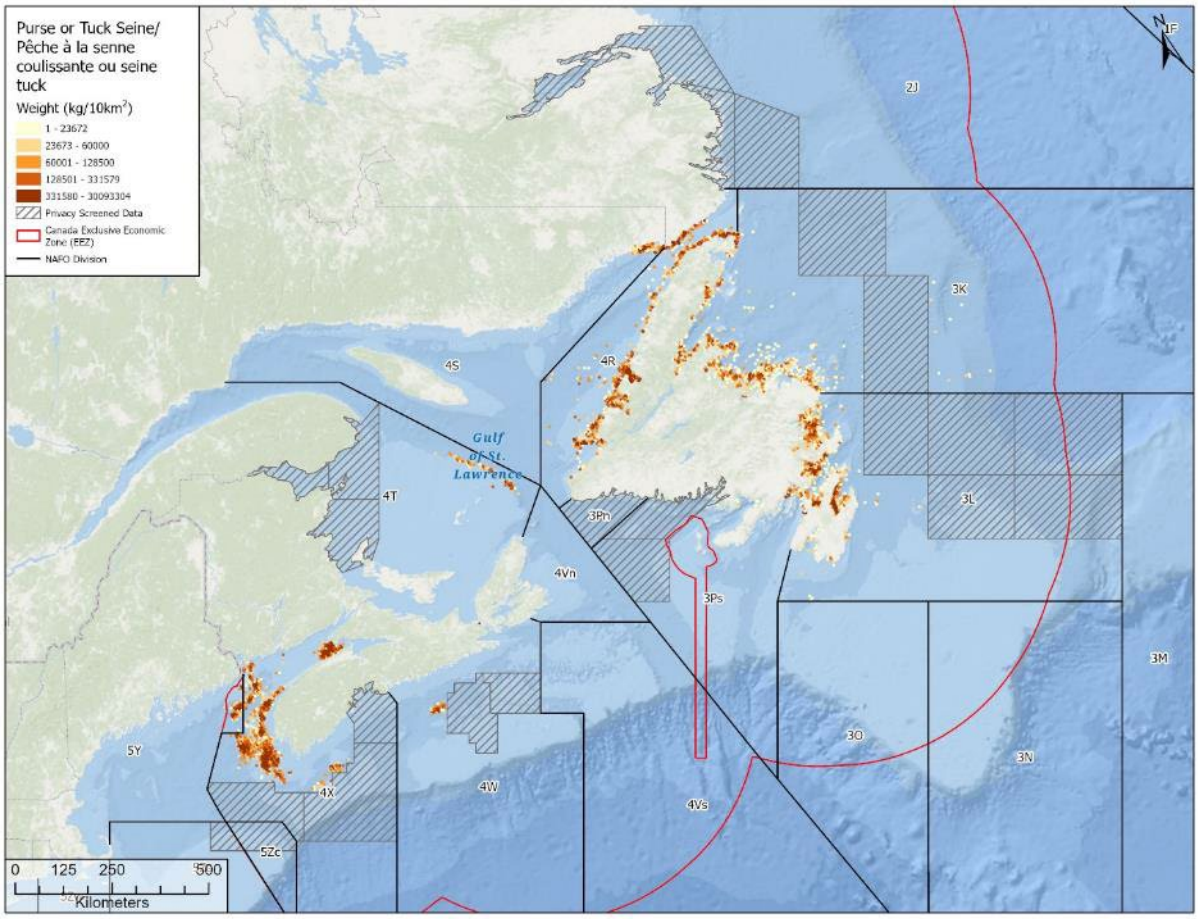

Figure 48 - Purse and Tuck Seine

Figure 48 - Purse and Tuck Seine. This fishery is an amalgamation of gear types because of their similarities and/or lack of data on an individual scale. This fishery includes purse seine and tuck seine. The majority (~96%) of this fishery was performed targeting Atlantic herring and capelin. The remainder was performed targeting other species which include mackerel.

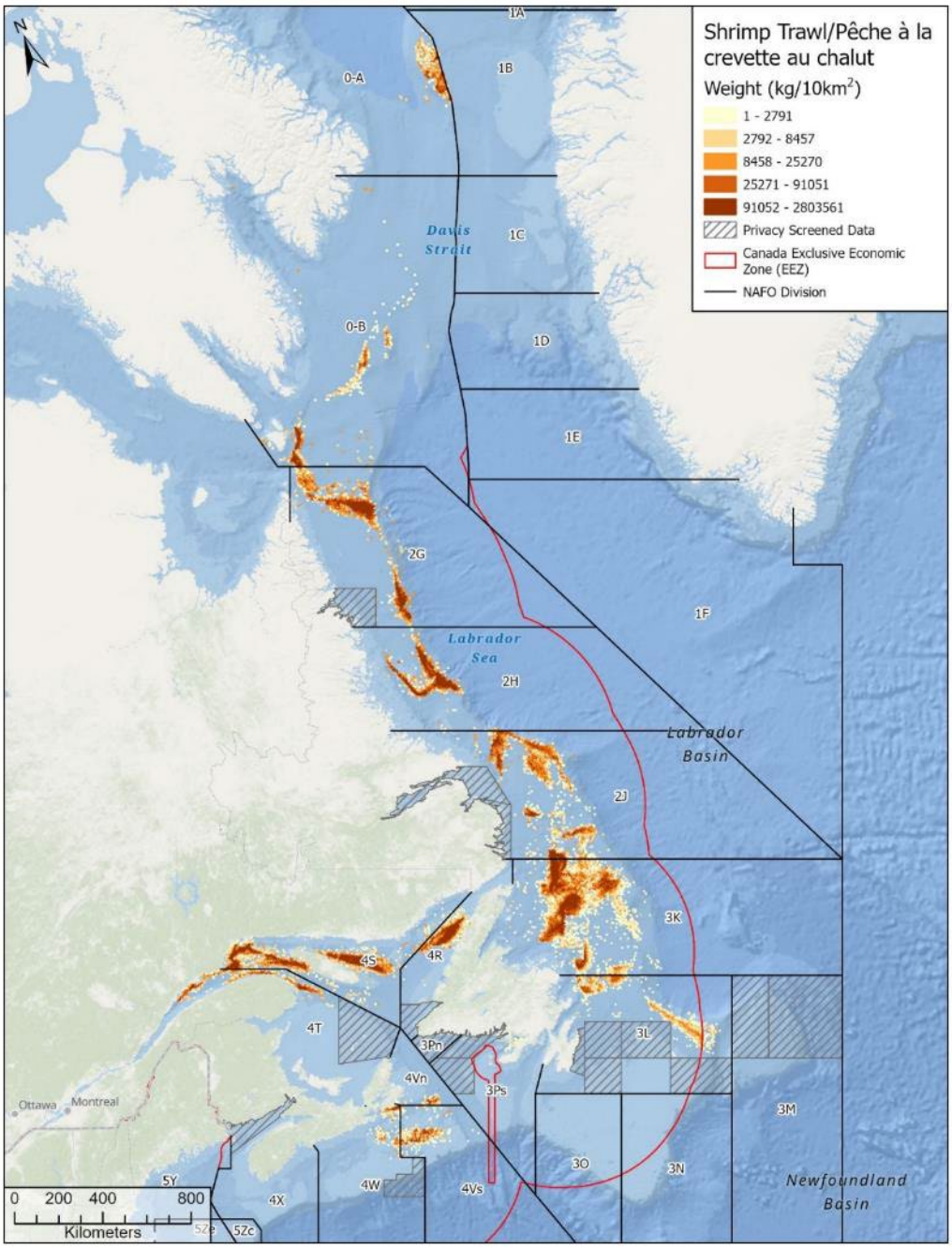

Figure 49 - Shrimp Trawl

Figure 49 - Shrimp Trawl. The majority (almost 100%) of this fishery was performed targeting shrimp (*Pandalus Borealis* and *Pandalus Montagui*). The remainder was performed targeting other species which include Queen/snow crab, Atlantic halibut, Jonah crab, capelin, skate, and Quahaug clam.

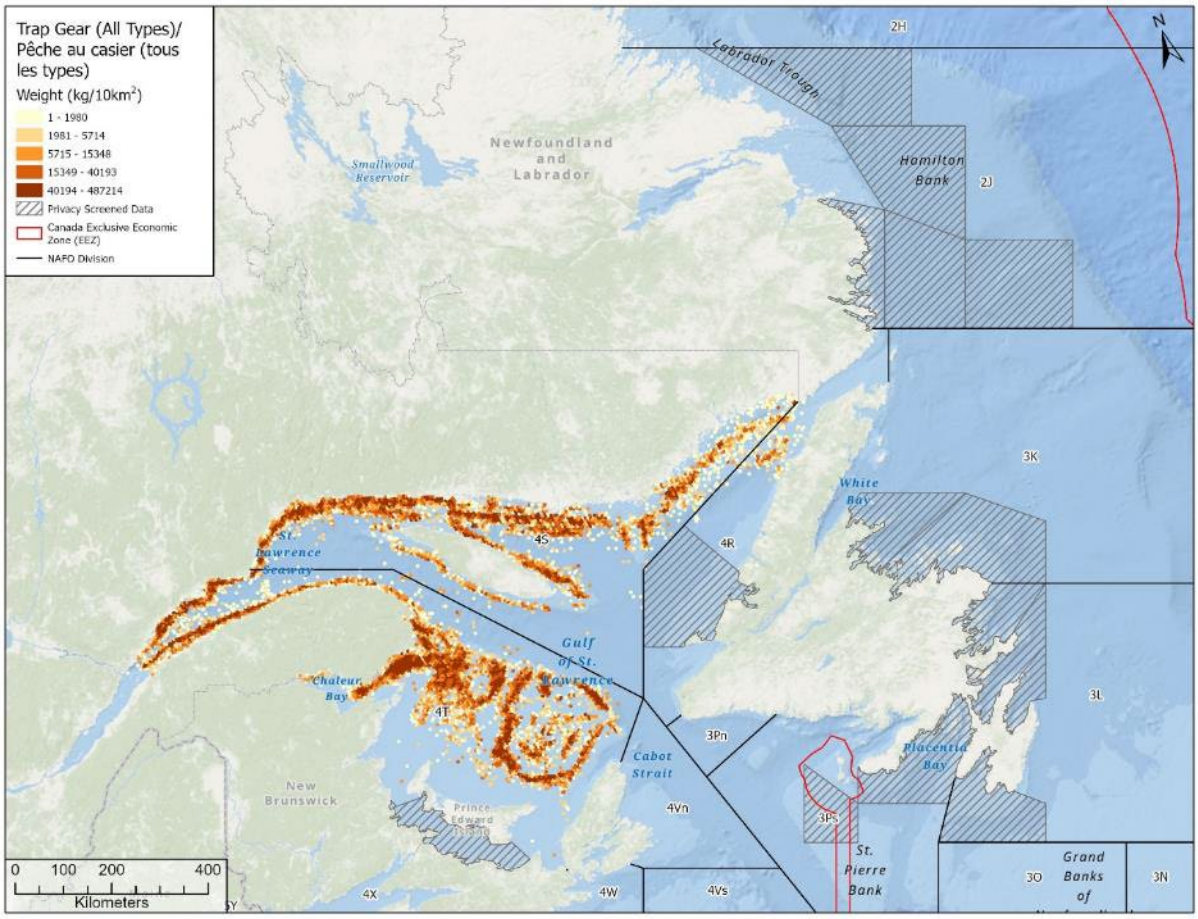

Figure 50 - Trap Gear (All Types)

Figure 50 - Trap Gear (All Types). This fishery is an amalgamation of gear types because of their similarities and/or lack of data on an individual scale. This fishery includes Japanese trap, rectangular trap, conical trap (including 4 ft), pyramidal trap, mixed trap, whelk trap (3 ft) and rock crab trap. The majority (~79%) of this fishery was performed targeting Queen/snow crab. The remainder was performed targeting other species which include whelk, Atlantic rock crab and spider/toad crab.

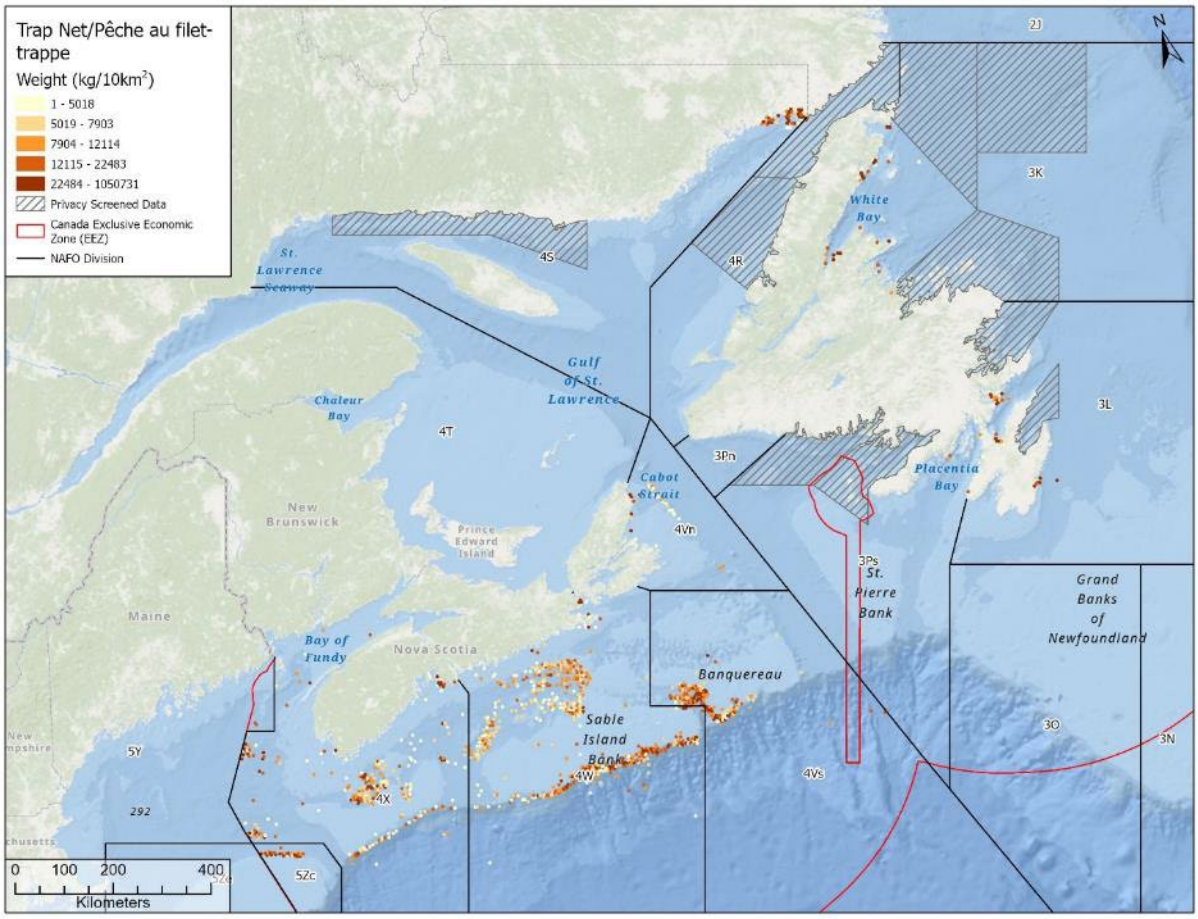

Figure 51 - Trap Net

Figure 51 - Trap Net. The majority (~86%) of this fishery was performed targeting hagfish/slime eel, Atlantic herring and mackerel. The remainder was performed targeting other species which include capelin, bluefin tuna and Atlantic cod.

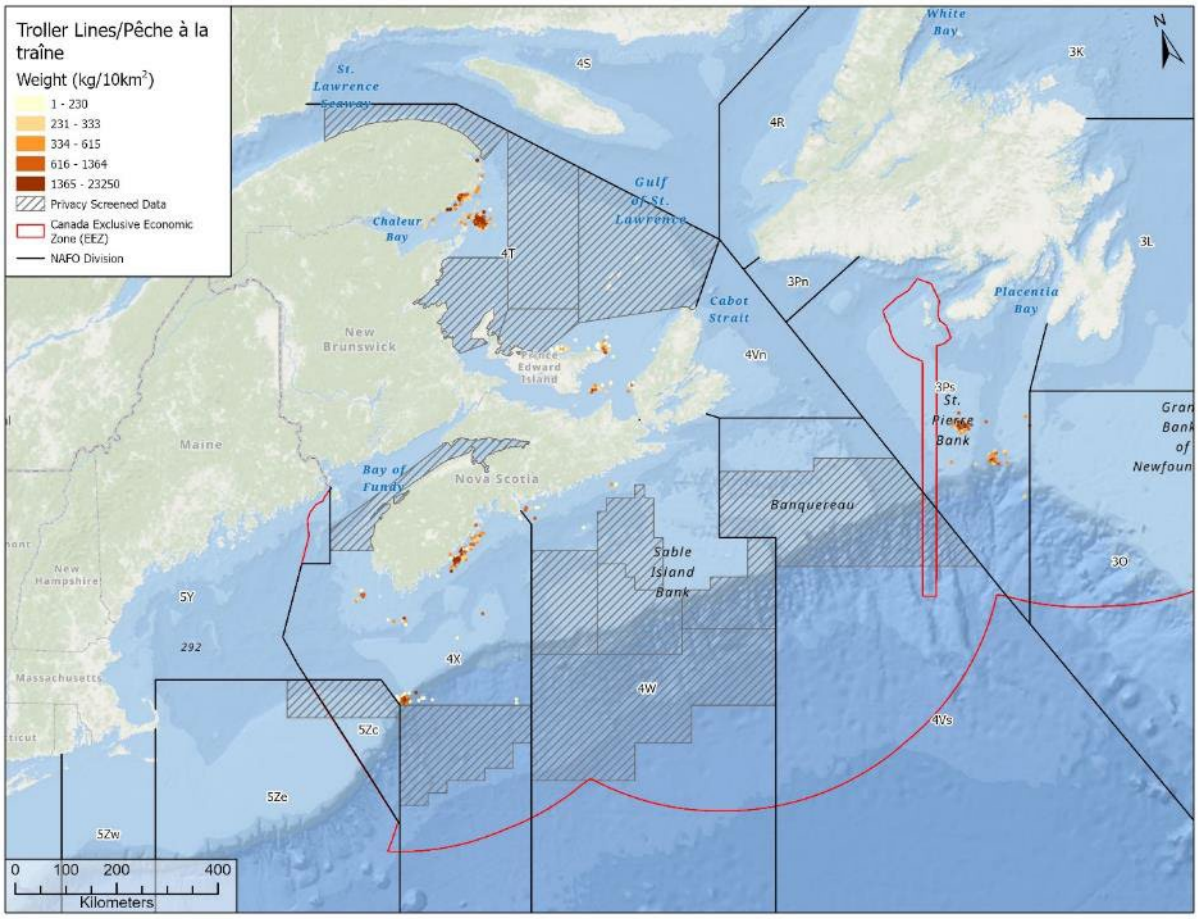

Figure 52 - Troller Lines

Figure 52 - Troller Lines. The majority (~91%) of this fishery was performed targeting bluefin tuna. The remainder was performed targeting other species which include albacore tuna, bigeye tuna and yellowfin tuna.

APPENDIX A

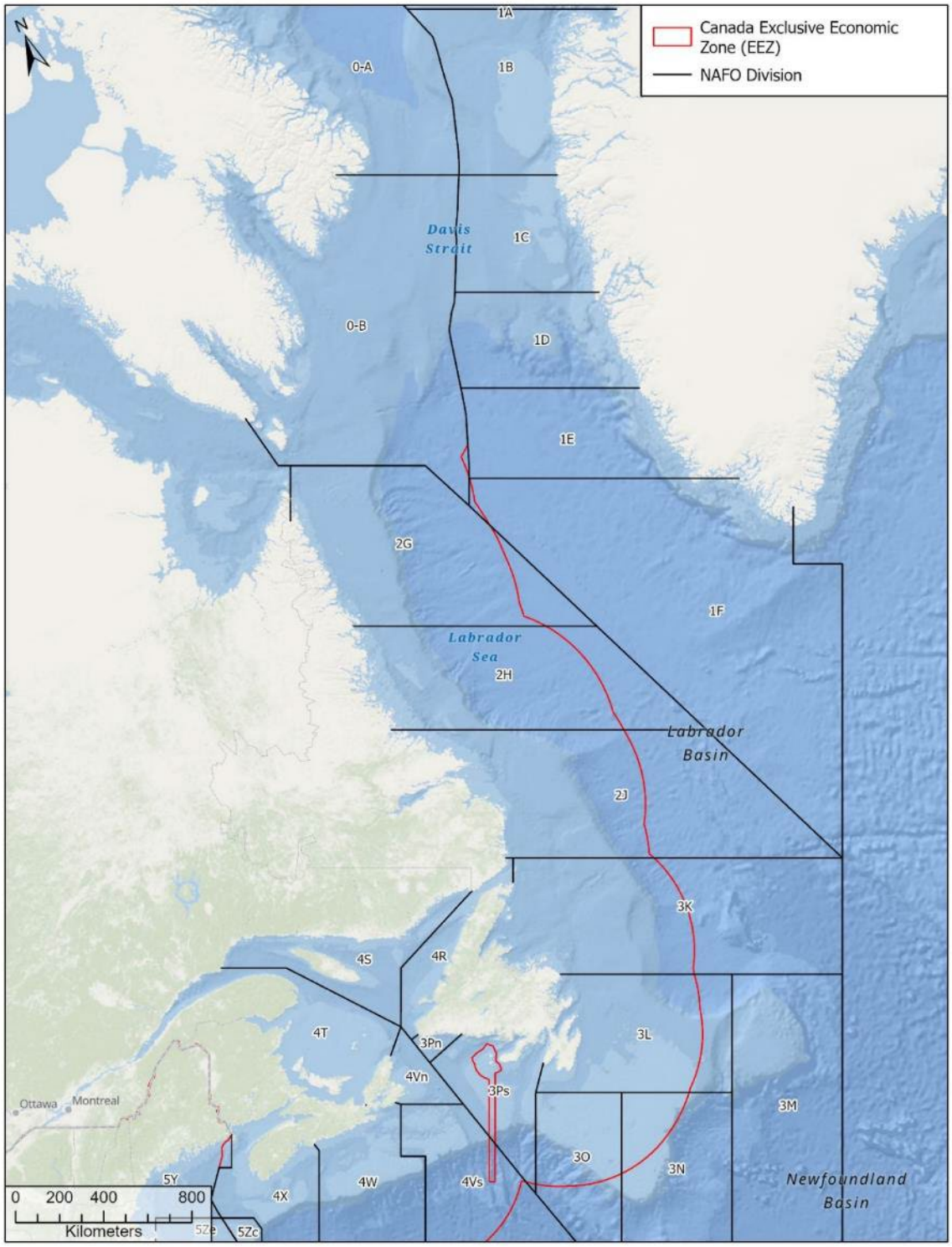

Figure 53 - Northwest Atlantic Fisheries Organization Divisions

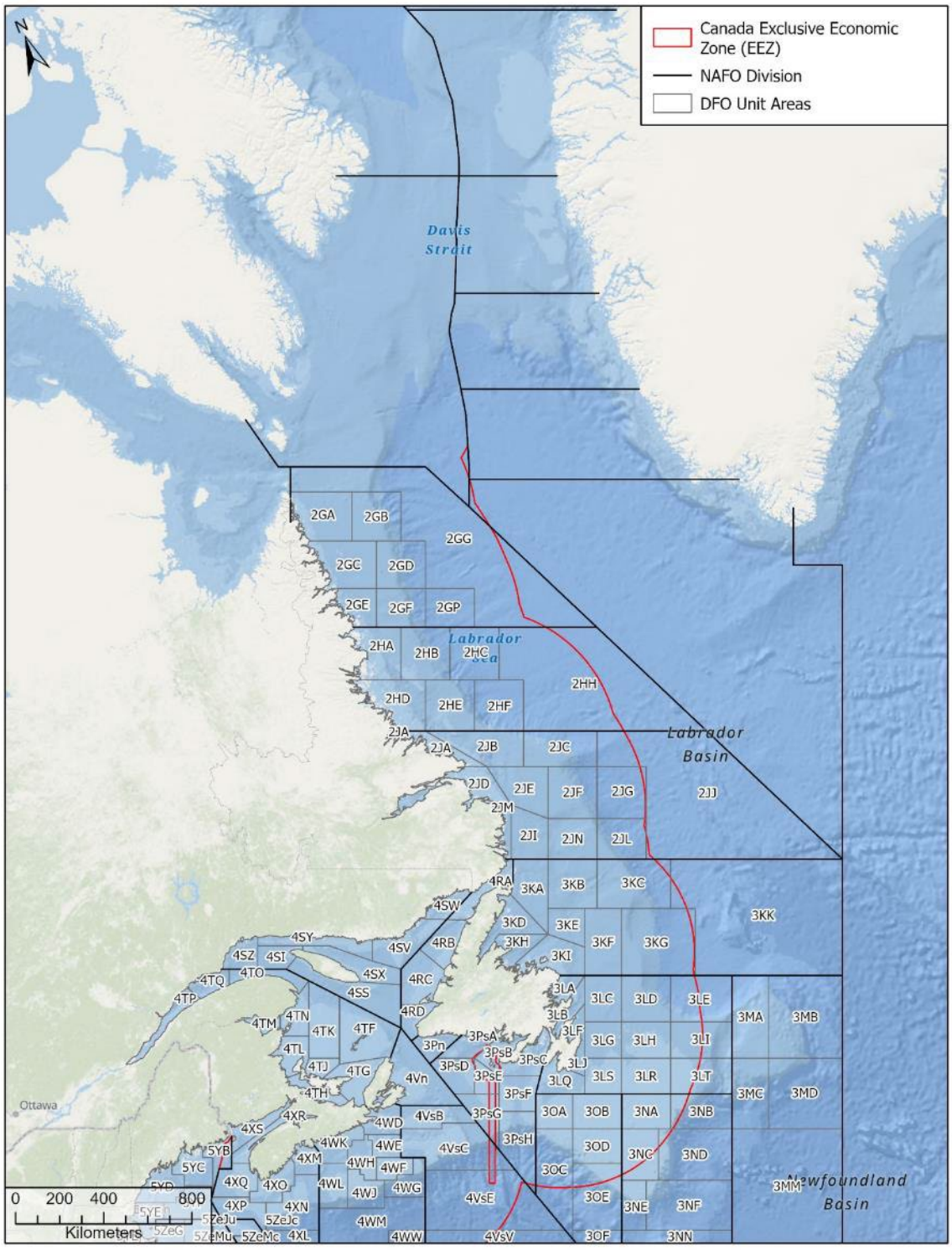

Figure 54 - Fisheries and Oceans Canada – Unit Areas

ACKNOWLEDGEMENTS

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