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Re-evaluation of the Placentia Bay-Grand Banks Area of the Newfoundland and Labrador Shelves Bioregion to Identify and Describe Ecologically and Biologically Significant Areas

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Fisheries and Oceans Canada (DFO) Science has developed guidance on the identification of Ecologically or Biologically Significant Areas (EBSAs) and has endorsed the scientific criteria of the Convention on Biological Diversity (CBD) for identifying ecologically or biologically significant marine areas as defined in Annex I of Decision IX/20 of its 9th Conference of Parties. Eleven EBSAs were identified in the Placentia Bay Grand Banks area in 2007 using a Delphic approach. Additional EBSAs were identified in the Newfoundland and Labrador Bioregion north of the PBGB area in 2013. This second set of EBSAs was identified based on a data driven approach that relied on the use of a Geographic Information System (GIS). To be consistent with the amount of geospatial information available for EBSAs identified in both areas within the Bioregion, Science was asked to re-evaluate the PBGB area and use a data-driven process similar to that of the 2013 EBSA identification process. A steering committee used the EBSA criteria of aggregation, fitness consequences and uniqueness, as well as previous Centre for Science Advice Secretariat (CSAS) guidance documents, to identify, compile, process and analyze data. Many meetings were held with scientific experts and 272 layers of biological and geomorphological features were created to define significant areas. All information was compiled in a GIS and a hierarchical approach was used to review individual data layers and groupings of data layers. Fourteen EBSAs were identified in two different categories: seven based on coastal data and seven based on offshore data. In comparing the new EBSAs to those identified in 2007, nine of them overlap spatially and are based on similar features; however, there were some variations in the boundaries. Two of the EBSAs that were identified in 2007 were no longer considered EBSAs in 2017, but portions of both of these areas were captured in part by other EBSAs. Five new EBSAs were identified in areas not previously considered.

INTRODUCTION

Under Canada's *Oceans Act* (1997), "conservation, based on an ecosystem approach, is of fundamental importance to maintaining biological diversity and productivity in the marine environment". This Act provides the legislative framework for an integrated ecosystem-approach to management in Canadian oceans, particularly in areas considered ecologically or biologically significant.

Fisheries and Oceans Canada (DFO) Science has developed guidance on the identification of Ecologically or Biologically Significant Areas (EBSAs) (DFO 2004) and has endorsed the scientific criteria of the Convention on Biological Diversity (CBD) for identifying ecologically or biologically significant marine areas as defined in Annex I of Decision IX/20 of its 9th Conference of Parties. In 2011 a DFO National Advisory Process was held to examine the lessons learned in previous applications of the national guidelines to identify EBSAs within the Department's five national Large Ocean Management Areas (LOMAs). This additional guidance (DFO 2011) was intended to address potential issues that may arise while moving forward with the identification of additional EBSAs outside the LOMAs.

In 2007, DFO Science, Newfoundland and Labrador (NL) Region provided advice to Oceans Division on EBSAs within the Placentia Bay Grand Banks (PBGB) LOMA (hereafter referred to as the "PBGB area" or "study area") using a Delphic approach. Information from documents detailing ecosystem overview and status, fish distribution and spawning, and single species assessments were compiled along with expert knowledge from NL scientists. The result of this exercise was the identification of 11 EBSAs and their significant features, along with a corresponding map, provided to the client via a CSAS Research Document (Templeman 2007).

In 2012, a process was undertaken to identify additional EBSAs north of the PBGB area (DFO 2013), hereafter referred to as the "2013 EBSA process". A steering committee (Appendix B) was formed to provide guidance on data identification, collection, processing and analysis and to delineate candidate EBSAs. This analysis relied on the use of a Geographic Information System (GIS) to process all relevant data into spatially referenced data layers for use in the identification and delineation of candidate EBSAs (Ollerhead et al. 2017). A CSAS meeting was held to peer review the candidate EBSAs and all relevant data, leading to the acceptance or rejection of each candidate EBSA, as well as the identification of additional EBSAs based on expert scientific knowledge (Wells et al. 2017).

In 2015, Oceans Division requested that Science provide additional information on the geospatial information that led to the delineation of the PBGB area EBSAs. During the Science Response advisory process (DFO 2016), it became clear that the amount of geospatial information available for EBSAs in the PBGB area was not as complete or consistent with the data available for EBSAs north of that area. This led to a 2016 request by Oceans Division for Science to replicate the 2013 EBSA identification process for the PBGB area. A steering committee was formed and the data collection process began. The EBSA criteria of aggregation, fitness consequences and uniqueness, as well as previous CSAS guidance documents (DFO 2004; 2011), were used to guide the process of data identification, collection, processing and analysis. All information was compiled in a GIS and candidate EBSAs were proposed for consideration at a CSAS peer review meeting on January 17-18, 2017. This research document discusses the methods used to identify and delineate the EBSAs and describes the final EBSAs based on feedback obtained at the CSAS meeting.

Advice on the identification of EBSAs, based on methods consistent with those used for other EBSA identification processes, will serve as a key component of the knowledge and advice for developing Canada's network of Marine Protected Areas (MPAs) to meet the domestic and international commitments noted above. In addition, this information will be of direct use to other federal Departments, as well as the Government of Newfoundland and Labrador and other organizations, who are responsible for the management of activities in the NL Shelves Bioregion within their mandate (e.g. resource extraction, marine shipping, ocean dumping, spill response, cable laying, land use planning, etc.).

MATERIALS AND METHODS

STUDY AREA

The biogeographic unit in which EBSAs were identified is the PBGB area. Within the biogeographic unit, the study area is set off the east (49.26 N, 53.47 W) and south (47.62 N, 59.31 W) coasts of the island of Newfoundland from the shoreline to Canada's Exclusive Economic Zone (EEZ) boundary. The northern boundary of the study area is the border between Northwest Atlantic Fisheries Organization (NAFO) Divisions 3K and 3L; the western boundary is the border between NAFO Divisions 4R and 3Pn; and the southern boundary is the border between NAFO Divisions 3P and 4V. The study area is inclusive of NAFO Divisions 3LNOP and is ~575,000 km^2 (Figure 1).

All data layers except those for pelagic seabirds included data that were outside the EEZ. This was done to ensure that ecological processes occurring along the shelf break were captured in a consistent manner. Interpolations were made using data that fell both outside and within the boundaries of study area. This was done to prevent edge effects in data analyses from having any impact on the study area. Interpolated data that fell outside of the study area boundaries were subsequently clipped from the data layer and excluded from the quantile classification and further analyses.

SOFTWARE

Numerous software packages were used in the preparation, management and processing of data. Spreadsheet, database and statistical packages were used to prepare and reformat the data for import and analysis in the GIS, including Microsoft Excel and Access. The R Project for Statistical Computing (The R Project 2012) was also used for data formatting and processing.

ArcGIS v10.2.2 (ESRI Inc. 2010) was used to create, store, analyze and display all spatially-referenced data used in the delineation of candidate and final EBSAs. Data from various sources were formatted for use within the GIS and processed to create spatially-referenced layers that were analyzed to identify the most ecologically and biologically important areas. The important areas identified in the GIS analysis were then compiled in a subsequent process to identify and delineate candidate EBSAs.

DATA PROCESSING AND SPATIAL ANALYSIS

Methods for processing and analyzing spatial data were similar to those used in the 2013 EBSA identification process. These included spatial interpolation techniques such as Kernel Density (KD), the upper 10th percentile rule and cell statistics analysis using a 20 km x 20 km grid cell size. KD analysis was the primary method used in the 2013 EBSA identification process, therefore, this method was chosen over Inverse Distance Weighted analyses (IDW) to remain consistent with the previous approach. A PCA was not done for this study area because, while this task was found to be useful for finding and describing large scale patterns within the study area for a previous EBSA identification exercise (Wells et al. 2017), it was not particularly helpful for finding ecologically important areas.

Kernel Density Analysis

Kernel Density analysis was performed on offshore point data which were measures of biomass, telemetry pings or number of sightings (i.e. counts). The analysis used a search radius of 31 km from each point for fish and marine mammal data and 25 km from each point for seabird data. Within this search radius the weighted value of each neighbouring point was then summed at the middle of each 20 x 20 km cell. The search radius used for the analysis of 31 km was consistent with the search radius used for datasets in the 2013 EBSA identification process (Ollerhead et al. 2017).

Upper 10th Percentile Rule (Finding Important Areas)

The upper 10th percentile decision rule (Figure 2) was applied to almost all offshore datasets and some select coastal datasets (see Tables 1 and 2), and allowed for the identification of high concentration areas, or important areas (IAs), for various species and species groups. In implementing this rule, modeled surfaces were classified into ten quantile classes after points (sets/counts) containing zeros were removed. Quantile classification in ArcGIS creates break points in the dataset and assigns an equal number of data values to each class. The uppermost class in a ten-quantile classification scheme for raster/gridded data represents the top 10% of the area of the modelled surface where the highest magnitude of a species/group was found within the study area. These IAs were then extracted from the interpolated surface and exported to a new polygon layer. The number of classes (10) was chosen to remain consistent with the 2013 EBSA process (DFO 2013). This was decided by the steering committee to be the best representation of IAs for various species or species groups across several taxonomic categories.

The ArcGIS software bug that was discovered following the 2013 EBSA process (Ollerhead et al. 2017, Wells et al. 2017) was rectified during this process by careful quality control of each data layer. This was achieved by checking the number of values in each quantile class prior to further processing. Therefore, all data layers used to delineate candidate EBSAs displayed the actual upper 10th percentile.

For a small subset of the data layers processed, the upper 10th percentile decision rule was not applied (see individual data descriptions below). Some layers were data-poor and required additional expert input to be useful in the EBSA delineation exercise.

Individual biological data layers were reviewed by species group or data type by the EBSA steering committee. Species or subject matter experts also reviewed the data to aid in the verification of areas considered significant based on the EBSA criteria, as well as in the identification of data gaps or outliers.

Cell Statistics and Composite Layers

Cell statistics were used in the analysis process to compile offshore data layers in a way in which areas where the highest number of IAs occur could be viewed and differentiated from areas where fewer IAs occurred. Cell statistics is a tool in ArcGIS which performs statistics on raster datasets which have identical cell sizes and processing extents. For this analysis the offshore datasets were analyzed to find the sum of layers present in each 20 x 20 km grid cell within the study area.

Each data layer was given a cell value of 1 for any grid cell that the layer's top 10th percentile was present in. Little work has been done in the NL region to compare the relative significance of one ecosystem component versus another. Ecologically Significant Species criteria have been developed by DFO Science (DFO 2006) but to date only one species (eelgrass) has been assessed against the criteria (DFO 2009). Given that all components of an ecosystem are important to its overall function, it was decided to give all layers a weight of one for all Cell Statistics analyses.

For the offshore only, layers with common taxa or characteristics were logically grouped and cell statistics were used to create one data layer for each group (see Data Groups in Table 1). As well, all offshore data layers combined (i.e. all layers listed in Table 1) were summed using cell statistics to form composite layers. As spring and fall Research Vessel (RV) survey data (see Data Descriptions below) were available for the majority of the PBGB area (NAFO Divisions 3LNO), two composite layers were created using cell statistics: one with all offshore data layers including spring RV data only, and one with all offshore data layers including both spring and fall RV data (Figure 3). Survey coverage differs between spring and fall (i.e. fall data are not available for NAFO Division 3P) so areas of importance identified for some species using fall data only are possibly biased, particularly when areas of importance are found in 3P during spring. However, it is difficult to determine if this is a seasonal effect and, for this reason, fall data were included in a composite layer with spring data to ensure all possible important areas were considered. A fall-only composite layer was not created because of the lack of coverage for the full study area.

Following the cell statistics process, composite layers were further analyzed by creating layers that represented percent thresholds. This was done by manually calculating the cut-off value for a certain percentage within the range of summed values in the composite layer. The subset of the layer which represented that percentage of the value range of the total layer was then extracted using the extract by attributes tool in the ArcGIS spatial analyst extension. The percent thresholds that were used were 50%, 60% and 70% and these thresholds represented different minimums depending on the number of features that were included in the composite (see Table 3).

INFORMATION SOURCES

All data used in the identification and delineation of EBSAs in the PBGB area included metadata such as type, origin, scale, spatial and temporal range, as well as the methodologies used to collect the data (see Tables 1 and 2). Data representing 272 layers of biological and geomorphological features were collected from a variety of sources, with the majority coming from DFO and Environment and Climate Change Canada, Canadian Wildlife Service (ECCC, CWS). Some data were obtained from other government departments, non-governmental organizations, and academia. Online data repositories and published literature were also mined for relevant information. For some species there were multiple sources of information [e.g. for capelin there were RV survey data and spawning site data]. Because these different layers often applied to different EBSA criteria (i.e. RV survey data identify areas of aggregation while spawning site data identify areas of fitness consequences), they were reviewed and treated separately during the EBSA identification process.

Some data sets were considered but not processed or included in the analysis for various reasons (see below). Tables 1 and 2 contain a list of all data layers considered, as well as data groupings, treatments for final analysis, and lists of functional groups for fish, marine mammals, and birds. For lists of common and scientific names referred to in this report, see Appendices C through G.

At-risk species were recognized based on Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designations (see Table 4) and were treated separately (i.e. not combined with functional groups). A subset of these species is protected legally under the *Species at Risk Act* (SARA). Unfortunately, data layers could not be created for all at-risk species due to limited availability of data. However, literature searches were conducted for all data-poor species and relevant geospatial information was taken into account as part of the EBSA identification process.

In 2016, a Science Response process (hereafter referred to as the EBSA refinement process) was conducted in response to an Oceans Division request to provide geospatial information on EBSAs previously identified in the PBGB area (Templeman 2007). A Delphic approach was taken to re-collect information provided in Table 1 of Templeman 2007 by consulting with DFO Science and reviewing the original data sources for the 2007 process. This information was geospatially referenced where possible and compiled in a Geographic Information System (GIS) atlas (DFO 2016). These data layers (see Table 5) were included in this process as overlays for delineated EBSAs and in the descriptions for the EBSAs, but were not included in the cell statistics process, because the methods used to create each of those data layers differed from the methods used here.

EBSA IDENTIFICATION

EBSAs were identified using calculations based on relative measures to determine areas of high concentrations, which are assumed to be areas of higher biological importance. Some offshore data layers were not included in composite layers if they were redundant [e.g. sponge and coral Significant Benthic Areas (SBAs), important habitat for Blue Whale], if they were based on polygons that were digitized for the 2016 EBSA refinement process (total of 16 layers) or if they were acquired once all analyses were complete (e.g. North Atlantic International Sightings Survey data). All of these data layers (see Table 5) were reviewed as overlays on the final EBSAs to determine the amount of overlap and to determine how much of each feature was captured by specific EBSAs.

Several percent thresholds (50%, 60%, and 70%) within the composite layers were extracted to determine a cut-off value for summed IA layers in the composite layer (Figures 4 and 5). The 60 percent threshold visually lined up with hotspots identified from the first pass of visual identification of potential EBSAs. This essentially required that a minimum number of features be present for first consideration as an EBSA. The cut-off value for the 60 percent threshold was 11 IA data layers for the composite containing all layers plus spring RV data and 17 for the composite containing all layers plus spring and fall RV data. When the 70 percent threshold was evaluated, smaller non-connected grid cells were observed within the extracted area. A review of the data layers contributing to those smaller areas revealed that they were mostly dominated by seabird or marine mammal IAs, which tended to be larger contiguous areas. Conversely, if only 50 percent of the range of values was extracted, known important features of the study area (e.g. the Southeast Shoal) were not included and the total area covered was much smaller than expected. Therefore the 60% value threshold was deemed to be the best fit as a cut-off point.

This use of the composite layers enabled the identification of areas that were important to a number of species or functional groups and potentially met several EBSA criteria. However, an iterative process was used to identify EBSAs and refine boundaries at different data resolutions:

- Step 1 – identify EBSAs using the 60% composite layers. These EBSAs are effectively areas of high biomass (indicator for the aggregation criterion) for several species or species groups.
- Step 2 – review cell statistics layers for each data group (logical groupings based on common taxa or characteristics) to identify EBSAs or refine boundaries of EBSAs identified

during Step 1. This allowed for the identification of important areas at higher taxonomic levels (e.g. for all cetaceans, all at-risk species, etc.).

- Step 3 – review all individual data layers (column 2 of Tables 1 and 2) to identify EBSAs or refine boundaries of EBSAs identified during Steps 1 and 2. This final step ensured IAs for uniqueness or fitness consequences were identified.

Data in coastal areas (areas in the nearshore falling outside the footprint of the DFO RV survey) were treated separately and not included in the composite layer due to differences in scale. The identification of EBSAs in coastal areas involved reviewing all coastal layers simultaneously to determine if certain areas visually emerged as 'hotspots' (i.e. areas occupied by multiple species or species groups). Data layers were also reviewed to determine if there were unique features in the coastal zone. Scientific data layers were reviewed initially and Community Based Coastal Resource Inventory (CCRI; see below) data were then used to validate areas of importance.

EBSA boundaries were initially drawn as polygons using the free-hand tool in ArcGIS and were meant to encircle important features in the area. Once a full review of all data layers was complete the boundaries were refined/redrawn using the polygon tool.

Once EBSA boundaries were delineated, the individual data layers that were found within each EBSA were identified and described using relative descriptors that helped determine the size and number of features within an area; this aided in the application of the uniqueness criterion. The key features used to identify each EBSA are described below.

Most EBSAs were identified based on the aggregation criterion because of the nature of the available data and the methods used to analyze them. Datasets available for the PBGB area that enabled the identification of areas with specific fitness consequences for species or species groups included capelin spawning areas, seabird colonies and associated seaward foraging areas, and high concentration areas for at-risk species. Given the methodology used to identify IAs during this analysis, any areas identified based on the fitness consequences criterion are also assumed to be important aggregation areas for that species. Application of all criteria followed that of Wells et al. (2017). However, in this study, additional peer reviewed data layers (Table 5) were used to identify some features under the aggregation or fitness consequences criteria. With the exception of the Blue Whale and Leatherback Turtle important habitat layers, the uniqueness criterion was not applied to these layers. Some of the studies from which these data layers resulted were based on localized studies that may not have taken the full study area into account when identifying these features. Also, the polygons may have represented the full distribution for a species rather than the most important areas (i.e. the upper 10th percentile). For species that were kept separate from functional groups in this analysis (e.g. core species, at-risk species) and were represented on their own data layers, the IAs found on data layers we developed took priority over the peer reviewed polygons. In these cases, the peer reviewed polygons were used to validate the presence of a species in a given area. For species that were grouped with functional groups, RV survey point data were reviewed for the studied species to determine general patterns at the extent of the study area. However a full analysis was not done for these species.

When EBSAs were identified in the area north of the PBGB study area, key features were identified for each EBSA based on whether or not they were one of the main reasons why the EBSA was identified. Decisions regarding key features were made by experts during the peer review process. In order to make this process more objective, key features of EBSAs in the PBGB study area were identified based on the following criteria:

- the feature was described as moderate or above relative to the EBSA size; or

- the number of polygons in the EBSA compared to the entire study area was greater than 50%, regardless of size; or
- the only IA found within the study area was found within the EBSA, regardless of size.

Exceptions to the above criteria were made for some ecosystem features. The list of features that were exempted and the rationale for these exceptions are found in Table 6.

DATA DESCRIPTION

Original datasets were provided in point, polygon or raster format (see Ollerhead et al. 2017 for additional details). All data layers were standardized to the Universal Transverse Mercator (UTM), Zone 21, WGS 1984 projection and were assigned to one of two analytical categories based on the scale of data collection and extent: coastal or offshore. Coastal data were available at a higher resolution and often with limited spatial extent whereas offshore data covered a much larger area and were collected and analyzed at coarser spatial resolutions.

COASTAL DATA

A total of 113 coastal data layers were processed and reviewed for the purpose of EBSA identification. Some layers were used to verify and/or describe features, particularly if they were redundant with other data layers (e.g. Important Bird Areas, CCRI; see below for more information). Many coastal data layers did not require a great deal of processing prior to their evaluation for the identification of EBSAs.

Some of the coastal datasets used in the 2013 EBSA process also included data from within the PBGB area. These included the Community Coastal Resource Inventory Data, Atlantic Salmon angling data, capelin spawning data, waterfowl block survey data, common eider aerial survey data, seabird colony data and Important Bird Areas (IBAs). Unless otherwise noted, the processing, analysis and inclusion of these datasets for the purpose of identifying and delineating EBSAs was undertaken in the same manner as the 2013 EBSA process.

The Arctic Charr landings dataset did not contain data within the boundaries of the PBGB area and were therefore excluded from this process. American Eel logbook data were not considered because they likely reflected fishing effort rather than the significant presence of eels or their habitat.

Eelgrass Data

Eelgrass (Zostera marina) data were compiled from three sources into one centralized dataset and digitized as one eelgrass layer in ArcGIS. This included polygon and line datasets from DFO Science, the Community Coastal Resource Inventory program (CCRI, see below) and a paper map from Rao et al. 2014, which was georeferenced and digitized. The final data layer was reviewed by K. Dalley, DFO Science (pers. communication).

Capelin Spawning Data

Capelin (*Mallotus villosus*) spawning sites were identified from three sources: DFO research by Dr. B. Nakashima; the CCRI program (see below); and literature searches (Kenchington et al. 2015, Penton and Davoren 2012). Internal DFO capelin research was a combination of spawning site surveys (B. Nakashima, pers. comm.) conducted between 2003 and 2007 and expert advice of F. Mowbray and B. Slaney, DFO Science Pelagics Section. CCRI capelin spawning data were incorporated because they augmented scientific data sources where no surveys had been conducted to date.

Some Capelin spawning beaches may be more significant than others in terms of their relative contribution to overall recruitment to the stock. A proxy for this contribution could be measured by number and density of eggs deposited at the site. Beach orientation and sediment grain-size have been shown to explain some of the variation seen between beaches (Nakashima and Taggart 2002), however these variables have not measured for the entire coastline of Newfoundland where Capelin spawning is known to occur and therefore we were not able to determine which sites were more important than others. For that reason, all Capelin spawning sites were included in one data layer and used in the EBSA identification process.

Atlantic Salmon Angling Data

Atlantic Salmon (Salmo salar) angling data were obtained for the Salmon Fishing Areas (SFAs) which fell in the PBGB area (zones 5-12) for the years 1994-2015. Based on the expert opinion of G. Veinott, DFO Science Salmonids Section, an average of the most recent five years was examined (2011-15 inclusive). There were 83 rivers with angling data in the PBGB area. To be consistent with the upper 10th percentile rule, the top 10 percent of the salmon angling data was used to identify salmon IAs. This resulted in 8 rivers with the highest total catch being used in creating the polygon layer. Expert opinion was used on the delineation of two additional rivers to be included because of their genetic uniqueness and perceived vulnerability. The extent/cutoff for the salmon river marine estuary/initial marine migration area was defined as headland to headland (DFO 2015). This process resulted in 5 polygons containing 10 salmon rivers.

Waterfowl Block Survey Data

All waterfowl data layers were provided by ECCC, CWS. Counts of numerous species of waterfowl were obtained predominantly via aerial surveys within defined, variably sized survey blocks typically bounded by headlands. Data were collected for the Atlantic region from 1960 to 2012, though survey blocks located within the study area were surveyed in the 1990s. Surveys predominantly occurred in the spring and fall, and counts were compiled by polygon within the database. Maximum counts of individuals per species survey block polygon were obtained and used as a basis for the creation of multi-species waterfowl composite layers (functional groups).

Data provided by ECCC, CWS had species classified by functional group. Individual layers for at-risk species also were presented separately. Waterfowl functional groups were created for Bay Ducks, Dabbling Ducks, Geese and Sea Ducks (Appendix C). The only at-risk waterfowl species for which sufficient data were available in the PBGB area is Harlequin Duck (*Histrionicus histrionicus*) (Special Concern; *Species at Risk Act* 2002).

Polygon extraction of the highest concentration areas was performed using the upper 10th percentile rule for each functional group, as well as for Harlequin Duck (an at-risk species). Due to the low amount of data for most functional groups and species, ECCC, CWS expertise helped establish the following method to identify blocks to be used in the study area. For each functional group/species the total dataset (all data available for Atlantic Canada) was classified into deciles and any blocks that fell in the study area which were in the uppermost decile were used. If no blocks in the study area fell in the uppermost decile, the top ranking block in the PBGB area was used.

Common Eider Aerial Survey Data

Common Eider (Somateria mollissima), a sea duck, is the focus of ongoing targeted aerial surveys by ECCC, CWS. Although Common Eider is included in the waterfowl block survey data (within the Sea Duck functional group), targeted Common Eider surveys are timed and conducted in a manner that better captures wintering concentrations, with data resolved to point locations of individuals and flocks. Targeted surveys were conducted in the winters of 2003, 2006, 2009, 2012 and 2015. ECCC, CWS expertise recommended that only winter 2012 data be considered because it was geographically comprehensive and flocks were concentrated in areas representative of other years. Using winter 2012 point data, kernel density surfaces were created based on counts of individuals. Polygon extraction of the highest concentration areas was performed using the upper 10th percentile rule. It should be noted that Common Eider colonies within the PBGB area are captured within the seabird colony data (below), which are obtained during the breeding season using a combination of survey approaches.

Seabird Colony Data

Seabird colony data, based on maximum counts of breeding individuals by species, by location, were provided by ECCC, CWS (Table 2). Data were obtained through various survey approaches, including ground and aerial surveys, depending on species sensitivities, distributions and nesting strategies. The dataset ranged from 1928-2010; however, only data after 1960 were used as this subset better covers the study area and, since 1960, colonies have been surveyed using standardized approaches on a more regular basis. These count data were used to generate a kernel density surface. The highest concentration areas of the grid surface were extracted for each species using the upper 10th percentile rule. The resulting colony 'neighbourhoods' encompass multiple colonies of varying population size, including small colonies. Colony 'neighbourhoods' hosting significant concentrations of seabirds for more than one species were identified as IAs. These significant colony 'neighbourhood' areas were attributed the name of the largest colony associated with the pattern. The point associated with the largest colony in a given area served as the input layer for seaward (offshore) seabird colony buffer layers detailed in the following section. The colonies, located in terrestrial habitats used by colonial nesting birds during breeding, are inherently linked with adjacent marine areas within which birds meet their foraging requirements.

Seabird colony buffer distances were based on published literature, regional tracking studies, and ECCC, CWS expertise (Thaxter et al. 2012, Bird Life International 2010, Rob Ronconi, pers. comm.). Buffered areas varied by species (Appendix D), but only those areas important for multiple species (i.e. significant colonies) to a radius of 60 km were used to inform delineation of associated EBSA seaward boundaries.

Important Bird Areas (IBAs)

IBA data were downloaded from the IBA Canada website (Bird Studies Canada and Nature Canada 2016). This dataset was used to validate the location of mainly coastal bird hotspots within the study area but was not explicitly used to identify EBSAs or delineate EBSA boundaries (as per Wells et al. 2017).

Community Coastal Resource Inventory Data

Traditional Ecological Knowledge (TEK) for the NL Shelves Bioregion was collected as part of the CCRI project, led by Oceans Division. The CCRI is focused on marine based information which includes "marine resources near shore and land resources connected to the sea and the marine environment" (DFO 1998). Data were collected through 22 projects from 1996 to 2008 along the coasts of NL. Ten of these projects fall within the EBSA study area: Bay de Verde Peninsula, Bay D'Espoir Connaigre, Bonavista, Burin Peninsula, Northeast Avalon, Placentia-St. Mary's Bays, South Coast, Southeast Avalon, Southwest Coast, and Trinity-Placentia Bays.

The CCRI data is qualitative presence-only data based on TEK collected through interviews with individuals having direct knowledge of local areas. (i.e. fishers or those with specialized local knowledge). Layers representing Aquatic Plants, Groundfish, Pelagic Fish, Shellfish, and Marine Mammals were entered into a GIS and used to produce 77 CCRI data layers. As with Wells et al. (2017), the CCRI data layers were used to validate or supplement scientific data during the EBSA identification process; however, these layers were not used during the identification process because they provide information on species' presence only and are geographically biased (mainly focused in areas of human use).

OFFSHORE DATA

Offshore data were processed to identify features at a scale representative of the average length of an RV survey trawl as well as the large spatial extent of the datasets. All 123 offshore data layers were processed to 20 km x 20 km raster grids. A 20 km cell size was chosen to be representative of the resolution of the data collected in the offshore and was presumed to be sufficient to depict major distributional features. Offshore data were used to define offshore EBSAs as well as to augment the boundaries of EBSAs created using coastal data.

Most species considered in offshore datasets were combined to form functional groups (fish, cetaceans, seabirds and corals). However, at-risk species and core species (fish only) were analyzed separately. By grouping species in this way, data layers represented the highest concentration areas (or IAs) for the dominant species in that group. For example, Golden Redfish, Longfin Hake and Arctic Cod are the dominant species in the plankpiscivore group. Therefore, the distributions seen on the plankpiscivore layer are mostly represented by these three species. Dominant species are indicated with an asterisk in Appendices and account for >90% of the biomass (fish) or records (seabirds) in their respective functional groups. In the case of cetaceans, dominant species are the most frequently sighted species in their functional group.

Fish and Shellfish

For fish and shellfish, analyses determined that biomass data from DFO RV surveys was the best indicator of trends over time. Fish data layers were partitioned based on their relative importance to the overall ecosystem. Core species are those with high dominance in the fish community that have important roles in the food web and are, or have been, commercially relevant. Core species and at-risk species (Table 1) were treated separately from all other species, which were grouped by functional role (Appendix E).

Multispecies surveys have been conducted by DFO RV since the early 1970s. The data used in our analyses were extracted from spring and fall surveys conducted between 1977 and 2016, inclusively. An Engel Hi-Lift Otter Trawl was used to conduct surveys until spring 1995, after which the gear was switched to a Campelen shrimp trawl (McCallum and Walsh 1997). These two gear types differ in their characteristics (i.e. catchability) and conversion factors only exist for a small group of commercial species. Therefore, Engel data cannot be scaled to comparable Campelen catches and all analyses on the RV data treated the two datasets separately.

Spring data were available for all NAFO Divisions within the PBGB area (3LNOPsn) whereas fall data were only available for NAFO Divisions 3LNO. A lack of coverage in NAFO Divisions 3N and 3O in the fall prior to 1990 meant that only data from 1990-94 were used for Engel fall layers. Spring and fall layers were not combined because of different survey coverage during these two survey times as well as changes in seasonal distributions for the majority of species. Campelen and Engel layers were not combined because of changes in distributions of species over time and differences in the catchability of the two trawls. Because four time series exist (Campelen fall, Campelen spring, Engel fall, Engel spring), a species may be represented in the cell statistics analysis by up to 4 data layers. The marine ecosystem in the PBGB area has undergone major changes in the distribution and abundance of most species as a result of environmental changes and exploitation (e.g. Koen-Alonso et al. 2010 and references within; Halliday and Pinhorn 2009). The decline and collapse of many important groundfish stocks occurred during the late 1980s and early 1990s. The Campelen/Engel data series can be coarsely interpreted as reflecting pre- and post-collapse conditions of the NL ecosystem, although other factors also contribute to their differences (e.g. gear catchability). For this reason, these data layers were equally weighted in the cell statistics analysis (Wells et al. 2017).

Data layers for core fish species, fish functional groups, and at-risk species were included in cell statistics analysis and for evaluation during the EBSA delineation process. RV data from the Campelen period were also used to perform diversity, richness, and evenness analyses. For the production of the data layers considered in this analysis, each one of these season/gear specific-series was averaged over their time period (Ollerhead et al. 2017).

Core Fish Species

Several core species are fished commercially and contribute significantly to the overall biomass of RV survey data. These species were extracted from the overall dataset and analyzed independently of the functional groups. The selection of the core species was based on expert opinion and included Greenland Halibut (Turbot) (*Reinhardtius hippoglossoides)*, Capelin *(Mallotus villosus)*, Witch Flounder *(Glyptocephalus synoglossus)*, Yellowtail Flounder (*Limanda ferruginea*), Sand Lance (*Ammodytes dubius*), Shrimp *(Pandalus spp.)*, and Snow Crab *(Chionoecetes opilio).*

For each species, a kernel density surface was created for spring and fall from point data based on kilograms per tow recorded for each trawl set within the study area over the duration of the time series (Engel or Campelen). Polygon extraction was based on the upper 10th percentile rule. Shrimp and Snow Crab data were available only from the Campelen RV survey.

Fish Functional Groups

The remaining fish species in the survey dataset were divided into fish functional groups. These groupings are based on general size characteristics and known food habitats (Koen-Alonso pers. comm.). For a complete list of species considered in each functional group, see Appendix E:

- Small benthivores – maximum mean size <45 cm
- Medium benthivores – maximum mean size >45 cm and < 80cm
- Large benthivores – maximum mean size >80 cm
- Piscivores
- Plankpiscivores (planktivores/piscivores)
- Planktivores

Functional groups did not contain data for core species or at-risk species. For each functional group, a kernel density surface was created for spring and fall from the point data based on the kilograms per tow recorded for each trawl set within the study area over the duration of the time series (Engel or Campelen). The upper 10th percentile of the density surface was extracted and converted to a polygon layer.

At Risk Fish Species

At-risk fish species are species recognized by COSEWIC as endangered, threatened or of special concern. A subset of these species is also protected under *SARA* (*Species at Risk Act*

2002). The species considered at risk, and for which there were enough data to generate a data layer, include Atlantic Cod (*Gadus morhua*), Redfish (*Sebastes fasciatus* and *Sebastes mentella*, grouped due to species identification issues), American Plaice *(Hippoglossoides platessoides*), Smooth Skate (*Malacoraja senta*), Winter Skate (*Leucoraja ocellata*), Northern Wolffish (*Anarhichas denticulatus*), Atlantic Wolffish (*Anarhichas lupus*), Spotted Wolffish (*Anarhichas minor*), Roundnose Grenadier (*Macrourus berglax*), White Hake (*Urophycis tenuis*), Thorny Skate (*Amblyraja radiata*) and Roughhead Grenadier (*Macrourus berglax*) (see Table 4 for a full list of at-risk species).

A kernel density surface was created for spring and fall from point data based on kilograms per tow recorded for each trawl set within the study area over the duration of the time series (Engel or Campelen). The upper 10th percentile of the density surface was extracted and converted to a polygon layer. A kernel density was only created for spring data for Winter Skate because of sparse data in the fall survey. It should also be noted that insufficient data for Cusk and several shark species (see Table 4) precluded kernel density analysis for any season or gear type.

Juvenile Fish and Fish Spawning Areas

Juvenile and spawning fish data were not used because a number of studies have been done on juvenile and spawning areas for many of the core and at-risk fish species considered for this analysis. Therefore, juvenile and spawning areas were digitized from published literature when available. These digitized data layers were not included in the cell statistics analysis.

The 2016 EBSA refinement exercise (DFO 2016) noted several spawning, juvenile or nursery areas identified for multiple species during a 2008 internal EBSA review process (Table 5). Given that these areas would have fitness consequences for many at risk or core fish species, they were included as overlays for this EBSA identification process but were excluded from cell statistics analyses.

Nursery areas for Yellowtail Flounder, Atlantic Cod, and American Plaice were digitized from Walsh et al. (2001). This paper described areas (small and large) that would protect juvenile Yellowtail Flounder, juvenile American Plaice and juvenile Atlantic Cod on the southern Grand Banks.

A Black Dogfish polygon was digitized for the 2008 review based on Kulka (2006). This area is a potential pupping location. Smooth Skate juvenile/nursery areas were also digitized for the 2008 review based on Kulka et al. (2006).

Data layers indicating spawning areas for American Plaice, Haddock and Redfish were also included as overlays (see Table 5 for sources). As well, a Capelin spawning area was noted on the Southeast shoal (Fuller and Myers 2004).

Total Biomass, Diversity, Richness, Evenness

DFO RV multispecies survey data from the Campelen gear time series (1995-2016) were used to investigate areas of high biomass, diversity, richness and evenness in the PBGB area for fish and invertebrates. Data layers from these surveys were used for reference purposes to determine if EBSAs effectively captured important areas highlighted by these indices. However, these indices were not used in the cell statistics analysis or to aid in the identification of EBSAs as diversity is not one of the EBSA criteria established by DFO (DFO 2004). Additionally, it should be noted that invertebrate layers were considered preliminary as further processing and examination of these data are required prior to making conclusive statements regarding spatial trends in invertebrate biomass, diversity, richness and evenness.

Total biomass was calculated per tow (kg/tow) and the values were averaged per 20 km x 20 km grid cell. The Shannon-Wiener Index was used to calculate species diversity with the following formula:

$$H' = -\sum_{i=1}^{s} P_i \ln P_i$$

where P_i is the proportion of the number of individuals of the ith species (n_i/N where n is the number of individuals of a given species per tow, and N is the total number of individuals from any species per tow) captured per tow. And S is the total number of species found in a given tow (Magurran 2004). Diversity (H') was calculated per tow and then averaged per 20 km x 20 km grid cell.

Species richness is the number of different species represented in a given sample or area. The survey data points were aggregated by 20 km x 20 km grid cell and the total number of species in each was counted. Evenness is the ratio of observed diversity to maximum diversity, where maximum diversity (H_{max}) would be found in a situation where all species had equal abundances (Magurran 2004).

$$E = H'/H_{max} = H'/\ln S$$

Evenness was calculated per tow and averaged per 20 km x 20 km grid cell. All of these indices were calculated for spring and fall separately and also for two different species groupings (all fish and all invertebrates). All data layers were classified into 5 quantiles for review against identified EBSAs.

Marine Mammals

Individual data layers for each seal species were created given the differences in survey methods and areas of importance for each species. Cetaceans were considered by functional groups, but separate data layers were created for at-risk species when possible (see Table 1, Table 4 and Appendix F).

Harp Seal Telemetry Data

Harp Seal movement patterns were derived from telemetry data (G. Stenson unpublished data). Data were filtered using the algorithm developed by Freitas et al. (2008). Kernel density surfaces were created for biologically meaningful periods throughout the year. These were: post-molt (May to mid-June), spring migration (mid-June to July), fall migration (December), summer feeding (August-November) and winter feeding (January-March). For each of these layers, probability contours (percent volume thresholds) were calculated for 50%, 80%, 90%, and 95% volume. Polygon extraction of the top 10% volume threshold was used for the analysis to maintain consistency with methods used for other taxonomic groups. Only winter feeding was present in the study area

Hooded Seal Telemetry Data

Hooded Seal telemetry data were taken from Anderson et al. (2012). Data were available for males, females and juveniles during April-June and August-February. Separate kernel density surfaces were created for each of these categories. Kernel density calculations were based on First-Passage Time (FPT) (Anderson et al. 2012), which is defined as the time required for an individual seal to cross a circle of a particular radius (Johnson et al. 1992; Fauchald and Tveraa 2003) and is a measure of residency time (Fauchald and Tveraa 2003). Based on expert advice the final layers considered for analysis were females (both time periods), males (August-February) and juveniles (August-February). Final polygon extraction was based on the upper 10th percentile rule. All polygons which fell into the study area were then combined to form one

Hooded Seal layer. An important nearshore migratory route was also delineated by G. Stenson (DFO, Science) and added to the final IA layer.

Grey Seal Telemetry Data

Grey Seal movement patterns were digitized from telemetry data for 20 individuals tracked from 1993-2014 (D. Bowen, unpublished data, M. Hammill, unpublished data). Polyline tracks for each individual were used to perform a kernel density analysis. The upper tenth percentile was then extracted. Subsequent expert advice allowed for the modification of this area, and the addition of areas of importance.

Harbour Seal

A map illustrating Harbour Seal distribution and abundance in Newfoundland, from Sjare et al. (2005), was orthorectified and digitized into polygons. Further consultation with an expert resulted in editing of these polygons to certain buffered distances from the shore. Two additional areas were also included based on expert opinion.

Cetaceans Survey and Sightings Data

Aerial survey data and sightings data from a combined database were obtained from the Marine Mammals section, DFO Science. This dataset consisted of effort-corrected data, such as DFO aerial surveys (2002 and 2003) and Trans North Atlantic Sightings Survey (TNASS) data, as well as non-effort-corrected data which came from non-targeted cetacean survey observers. The effort-corrected data made up less than 3% of all sightings. Kernel density estimates were made for datasets that were partitioned by functional group (Appendix F). However, individual data layers were created for most at-risk species (Table 1, Table 4). Some at-risk species (Fin Whale and Harbour Porpoise) were grouped with functional groups. Fin Whales have similar distributions and foraging habits as Humpback Whales so they remained in the Mysticetes functional group. At the time of the analysis, there was not enough information on diet or distribution for Harbour Porpoise to produce a reliable data layer for this species, even though it is listed as Threatened under *SARA*. Therefore, this species was grouped with all other small cetaceans. For all cetaceans, final polygon extraction was based on the upper 10th percentile rule and later modified by expert advice (Dr. J. Lawson, DFO, pers. comm.). This expert advice allowed for the removal of areas that were more likely due to effort.

North Atlantic International Sightings Survey (NAISS) data from August and September of 2016 were acquired after the full analysis (kernel density surfaces and cell statistics) was complete. This data was therefore divided into functional groups and digitized as point data to be used for validation purposes.

Blue Whale Important Habitat

Habitat important to the Blue Whale in the Western North Atlantic has been identified by DFO Science (DFO 2018) for the purpose of defining critical habitat under the *Species at Risk Act.* This information was available to the steering committee prior to publication so this data layer was used as an overlay for describing this feature within EBSAs but was not used to identify or delineate EBSAs.

Leatherback Turtle Important Habitat

Leatherback Turtles are counted during cetaceans aerial surveys but little data exists for this species. A point file of leatherback sightings from the 2016 NAISS survey data was created to highlight locations where they have been found in the study area. Important Leatherback habitat was also included as an overlay based on satellite tracking data (DFO 2012).

Seabird Data

Pelagic Seabird Surveys

Data layers for Seabirds were generated at the functional group level (see Appendix D and Table 1). Ship-following generalists were not considered for the identification, delineation or description of EBSAs, given that their presence can be more indicative of fishing activity than important areas in the ecosystem. Pelagic Seabird Survey data are collected year-round and were obtained from ECCC, CWS in raster format displaying linear density (number of birds/km travelled). This is an effort-corrected estimate which was calculated by dividing kernel density estimates by square root of the number of days an individual 5 km by 5 km cell was visited (by an observer). The original rasters were classified into quantiles and polygon extraction was based using the upper 10th percentile rule. Prior to cell statistics being performed, the polygons were transformed into rasters fitting the 20 km x 20 km grid of the PBGB area.

Murre Distributional Maps

Distributional maps for Common Murre (*Uria aalge*), Thick-billed Murre (*Uria lomvia*) and Sooty Shearwater (*Puffinus griseus*) were provided by Memorial University for the 2013 EBSA process (Ollerhead et al. 2017). These maps were based on seasonal telemetry data and consisted of isopleth contour surfaces for home ranges (kernel home range; KHR) for murre species from breeding colonies in Newfoundland and Labrador through the eastern Canadian Arctic and Sooty Shearwater from breeding colonies in the South Atlantic Ocean, all of which use key habitat areas in the Northwest Atlantic (Montevecchi et al. 2012). Data were available for fall (September-October), spring (March-April), and late winter (January-February) for Common Murre. The datasets from these three layers were merged into one dataset which represented the distribution of this species during the months that they are found in the study area. Data were available for early winter (November-December) for Thick-billed Murre. Data were available from April-September for Sooty Shearwater. Areas that extended into the study area were considered as part of the EBSA identification process for the PBGB area. The 90 percent isopleth contour, representing the top 10 percent of the total dataset, was extracted for further analysis.

Corals

Coral data originated from DFO RV surveys and surveys conducted by the Remotely Operated Platform for Ocean Sciences (ROPOS). In addition, areas that were identified as Significant Benthic Areas (SBAs) (Kenchington et al. 2016a, 2016b) were taken into consideration.

Coral species were aggregated into functional groups based on habitat function: large gorgonians, small gorgonians, sea pens, stony cup corals, black corals and soft corals (Appendix G). SBAs (Kenchington et al. 2016a, 2016b) were only available for the first three functional groups, plus sponges (see below). ROPOS data were not grouped by functional group.

DFO RV survey data were collected in NAFO Divisions 3LNOPs from 2000-15 and were processed to create kernel density surfaces of total catch weight for each of the functional groups and the areas of highest concentration were selected and extracted using the upper 10th percentile rule.

ROPOS surveys were conducted in three submarine canyons on the slope of the Grand Banks south of Newfoundland: Halibut Channel, Haddock Channel, and Desbarres Canyon in 2007 (Baker et al. 2012). These data were available in point form and indicated the top 10% for four species (see Table 5). These datasets were spatially limited to a small part of the study area and were therefore used only to validate areas of occurrence for those species identified.

Only the DFO RV survey data layers were included in the cell statistics analyses (see below) to avoid redundancy, to ensure that all functional groups were included, and because the majority of areas identified as SBAs (Kenchington et al. 2016b) were found within the IAs (i.e. upper 10th percentile) mapped using the RV survey data.

Sponges

Sponge (Porifera) data were collected on DFO RV surveys from 2000-15 and were found throughout the entire 3LNOPs study area. All species of sponges were processed together based on the best level of confidence in sponge taxonomy which is Phylum (Kenchington et al. 2010). A kernel density surface was created and the upper 10th percentile rule was applied to identify and extract the highest concentration areas. Areas identified as sponge SBAs (Kenchington et al. 2016b) were also considered for this taxonomic group.

Data Limitations and Considerations

Data for many species, particularly fish, were limited in some areas (e.g. depths greater than 1500 m, see Brodie 2005). Data in coastal areas were also limited in scope and availability, with the exception of some data that identified areas of aggregation and feeding for seabirds and waterfowl. Shorebird species were excluded from analyses because data for these species are sparse. However, Piping Plover data are relatively comprehensive and critical habitat has been identified for this species; therefore, Piping Plover habitat contained within EBSAs is described in the results section. Because of the above-mentioned data limitations, the level of confidence in the boundaries delineated for coastal EBSAs may be lower than for those in more data-rich areas. No EBSAs were identified in waters deeper than approximately 2000m due to lack of biological data.

RESULTS

EBSA DESCRIPTIONS

Fifteen candidate EBSAs were identified in the study area by the Steering Committee and proposed for peer review at the January 2017 CSAS meeting (Figure 6). In two cases, based on feedback during the peer review, two areas were merged to become one (Bonavista Bay/Cape Freels merged to form Bonavista Bay, and Placentia Bay/Burin Peninsula merged to form Placentia Bay); and one new area was proposed and accepted (Baccalieu Island). All other candidate EBSAs were accepted but boundaries were modified for all of those remaining, with the exception of the South Coast EBSA. Fourteen EBSAs were ultimately identified and delineated in the study area (see Figure 7 and Tables 7 and 8): seven in coastal areas (Bonavista Bay, Smith Sound, Baccalieu Island, Eastern Avalon, St. Mary's Bay, Placentia Bay and South Coast) and seven in offshore areas (Northeast Slope, Virgin Rocks, Haddock Channel Sponges, Lilly Canyon-Carson Canyon, Southeast Shoal, Southwest Slope and Laurentian Channel). These EBSAs represent a total area of 130,783 km^2, which is approximately 36.7% of the entire study area (i.e. inside the EEZ). Physical features and the size of each EBSA are provided in Tables 9 and 10.

Data outside Canada's EEZ were included in the analysis for most ecosystem features so EBSAs extending beyond this boundary line were delineated based on step one of the EBSA identification process only (i.e. using the top 60% composite layer). These areas were delineated to indicate areas of overlap with EBSAs identified by the CBD (CBD 2014; see Figure 8) but no further investigation or description of these areas was completed, as this was outside the terms of reference for this project.

All data layers were reviewed to determine if unique features were identified within EBSA boundaries. Two potentially unique features were not found within the boundaries of any EBSA. The only IA for Geese, located on the west side of the Burin Peninsula, was not included in any EBSA as confidence in its uniqueness and persistence was limited. The only important Great Cormorant colony found within Canadian waters in the study area, was found on Brunette Island in Fortune Bay. Though Brunette Island and islands in the immediate vicinity host at least 8 other colonial bird species, the location is considered important for this species only. Also, the only IA for North Atlantic Right Whales was found mostly outside of the South Coast EBSA. Given that this species is very wide ranging and mobile species, and given the nature of the data (sightings data), it was decided that it would not be appropriate to identify such a specific area as an EBSA based on this species.

The following descriptions indicate the key features (Appendix H) that resulted in the identification and delineation of the 14 EBSAs within the EEZ. Other important features that were noted to occur within the boundaries of each EBSA are listed in Appendix I but are not described below, nor are they included in Tables 7 or 8. All offshore data layers can be found in Appendix J. For maps indicating underwater features that are used in the descriptions below, see Figure 9. These features were delineated by Gordon Fader of Atlantic Marine Geological Consulting Ltd. by applying the same methodology used to map seabed features of the Scotian Shelf and Bay of Fundy (WWF-Canada 2009).

Coastal EBSAs

Seven EBSAs were identified in coastal areas (Table 7, Figures 7 and 10-16). The primary data layers that were used to delineate these areas included Eelgrass habitat, Salmon, Capelin spawning areas, seabird colonies and waterfowl areas. Data for the entire coast of Newfoundland are unavailable for many ecosystem features, particularly fish species. This is particularly true when considering the variability and scale of local ecological dynamics occurring in nearshore environments.

The distribution and abundance of breeding and foraging seabirds usually reflects the availability of prey in the marine ecosystems on which the birds depend (Birkhead and Furness 1985, Hunt 1991). Clearly, globally significant and persistent seabird colonies found on the east coast of Newfoundland are sustained by persistently highly productive waters nearby. The breeding season foraging ranges of piscivorous colonial seabirds were used as a proxy to indicate areas where a high abundance of forage species for these birds is likely to occur. In the absence of long-term tracking studies at individual colonies, use of mean maximum foraging range provides the most appropriate prediction of spatial use during breeding (Soanes et al. 2016; Bogdanova et al. 2014; Thaxter et al. 2012; Cairns 1987). More information on the main prey types for these species can be found in Appendix K. These foraging buffers were used to delineate the seaward extension of some coastal EBSAs, and in most cases this meant that IAs identified in offshore data layers were captured by the EBSA boundaries. Therefore, all offshore data layers were also reviewed within the boundaries of each coastal EBSA and key ecosystem features were identified based on the criteria described above. Important Bird Areas were reviewed and descriptions were incorporated into identified EBSAs. Though they were not used in the analyses, IBAs were used as a confirmatory step in the EBSA identification process. CCRI data were also reviewed to determine what species were present in each EBSA (Appendix I), but these data were also not used in the identification of EBSAs.

Bonavista Bay (3L)

The Bonavista Bay EBSA (Figures 7 and 10) consists of the entire Bonavista Bay area from Cape Freels North to the headland just east of King’s Cove. This area originally included two

EBSAs and it was determined that the spatial resolution of the coastal datasets were not conducive to the delimitation of nearshore processes at the scale at which they likely occur. Therefore, it was determined that it would be more appropriate to combine the two areas, expand the boundary to the bay scale and describe the key features within the single resulting area as best as possible.

The northern boundary extends seaward along the northern edge of the study area adjacent to the Fogo Shelf EBSA, which was identified during the 2013 EBSA process. The seaward extension in the north end of the Bonavista Bay EBSA was delineated based on the pelagic seabird layer group, which indicated that IAs for 4 of the 7 pelagic seabird functional groups are found in this area. The EBSA boundary was extended southward nearly perpendicular to the study area boundary to meet the headland just east of King's Cove. While the foraging buffer for terns (20 km) was not used to delineate this boundary, this EBSA does capture most of the area that would have been delineated using that approach. This EBSA was delineated based on the size, number and diversity of seabird colonies in the area, as well as eelgrass habitat, capelin spawning beaches and important salmon areas (Figure 10).

During the 2013 EBSA process, it was suggested that the ecological importance of the Fogo Shelf EBSA likely extends south of the study area boundary into NAFO Division 3L. This was mostly based on the fact that the Cape Freels Coastline and Cabot Island IBA occurs there and contains one of the largest concentrations of wintering Common Eiders in Newfoundland. This was confirmed by the presence of a Common Eider IA south of Cape Freels North. Other features of the Fogo Shelf EBSA are also found in the Bonavista Bay area such as Capelin spawning, Salmon, Cetaceans, Seals, Sea Ducks and numerous seabird colonies representing multiple species.

Capelin spawning occurs on many beaches throughout this EBSA with the highest concentration of spawning beaches located from Cape Freels North to Greenspond, all along the Eastport Peninsula, throughout Southern Bay and Sweet Bay and along the headland east of King's Cove. Small pockets of eelgrass habitat are also found throughout the coastal areas of this EBSA. A large area of eelgrass is found approximately halfway between Cape Freels North and New-Wes-Valley. Several other eelgrass beds are found in pockets between Newman Sound and Southern Bay, mainly at the heads of bays and coves. Newman Sound is an important nursery area for demersal fishes (Gregory et al. 2016 and references within).

Three of the 7 IAs for Sea Ducks are found in this EBSA and these areas are concentrated between Cape Freels North and Greenspond and near Centreville-Wareham-Trinity out to Lewis Island and Deer Island. While there are no Black-legged Kittiwake colonies in the upper tenth percentile within the boundaries of this EBSA, the area is within the foraging range (60 km) of two colonies totalling roughly 2250 birds at the tip of the Bonavista Peninsula.

The boundary of Terra Nova National Park is found within this EBSA, as are the Eastport MPAs. These MPAs include the waters surrounding two small islands where the objective is to maintain a viable population of American lobster and to ensure the conservation and protection of threatened or endangered species. The Terra Nova Migratory Bird Sanctuary, which is also found within this EBSA, consists of the upper portions of two tidal inlets that are nearly totally enclosed by lands within the Terra Nova National Park. The northern portion consists of Broad Cove and Southwest Arm. The other section is the most westerly portion of Newman Sound. Terra Nova River is an important salmon river found within this EBSA. It is also the only river in Atlantic Canada where spawning populations of sea lamprey have been found (Dempson and Porter 1993, Bradbury et al. 1999).

Killer whales, Mysticetes (primarily Humpback and Minke Whales) and Harbour Seal IAs are also found in this area. They likely use this area for feeding during summer and fall months.

Smith Sound (3L)

The Smith Sound EBSA (Figures 7 and 11) extends from the headland east of Port Rexton south to the headland east of Shoal Bay and includes Smith Sound and the Southwest Arm of Random Sound. This EBSA was delineated based on the numerous capelin spawning beaches, eelgrass beds, seabirds and marine mammals in the area (Figure 11).

Smith Sound is a long continuous channel that encircles Random Island and is known to have one of the most extensive beds of eelgrass habitat on the island of Newfoundland (R. Gregory, pers. comm.). The Smith Sound area was identified as an EBSA by Templeman (2007), mainly based on the fact that it was the largest known spawning area for northern cod at that time. The spawning population of northern cod has since dispersed from this area and has not been observed there since 2009 (Rose et al. 2011).

Capelin are known to spawn throughout large portions of Smith Sound, including Northwest Arm and Southwest Arm, and south to Big Island which is just north of Shoal Bay. The foraging ranges of several piscivorous seabird species (Atlantic Puffin, Black-legged Kittiwake and terns) overlap with this area. IAs for Killer Whale and Mysticetes were also found outside the Sound in Trinity Bay.

Baccalieu Island (3L)

The Baccalieu Island EBSA (Figures 7 and 12) is centered on the island itself and extends north to Bonavista and south to Pouch Cove. This EBSA was identified because of important seabird colonies that are found on the Island (Figure 12). The foraging range of Atlantic Puffin, Black-legged Kittiwake and Common Murre (60km) was used to delineate the seaward boundary. There are also several other key features in surrounding waters including IAs for Capelin, Shrimp, Plank-Piscivorous fish, Spotted Wolffish and marine mammals.

The Baccalieu Island IBA hosts the world's largest known nesting colony of Leach's Storm-Petrel. Approximately 3.4 million breeding pairs have been estimated, which represents approximately 40% of the global population and about 70% of the western Atlantic population of this species.

The island also supports continentally and globally significant populations of Atlantic Puffin (30,000 pairs - approximately 7% of the eastern North America population); Black-legged Kittiwake (~13,000 - approximately 5 to 7% of the western Atlantic breeding population); and Northern Gannet (1,712 pairs - approximately 2.4% of the North American population). The island has the greatest abundance and species diversity of seabirds in eastern North America. Other seabirds nesting on the island include Common Murre, Thick-billed Murre, Razorbill, Black Guillemot, Northern Fulmar, Herring Gull and Great Black-backed Gull (IBA Site Summary). Baccalieu Island is the largest protected seabird island in Newfoundland and Labrador – the Baccalieu Island Ecological Reserve.

The enduring presence of such significant populations of mostly piscivorous seabirds is a strong indicator that surrounding waters are persistently highly productive and provide ample food for these colonies to thrive. This is confirmed by the presence of Capelin spawning areas at each of the three headlands captured within the boundaries of this EBSA. Also, Capelin and Shrimp IAs are found within the foraging range of these seabirds. Plank-Piscivore and Spotted Wolffish IAs are also found in this EBSA. All fish and shrimp IAs are located near the seaward boundary of the EBSA. DFO RV trawl survey data are not collected in shallow nearshore waters (i.e. closest set to Baccalieu Island is ~20 km away) so information on all fish and shrimp species are not available in these areas. However, acoustic surveys have been conducted closer to shore in this area and have confirmed the presence of Capelin aggregations (Mowbray 2014).

Killer Whales and Mysticetes IAs are found here based on sightings data. These cetacean species are also likely taking advantage of the highly productive waters in the area.

Eastern Avalon (3L)

The Eastern Avalon EBSA (Figures 7 and 13) is located on the eastern side of the Avalon Peninsula and extends from the southern boundary of Chance Cove Provincial Park north to Pouch Cove. The seaward boundary was delineated based on the foraging range (60km) of piscivorous seabirds that occupy colonies within Witless Bay. This EBSA was identified based on a combination of coastal data, including capelin spawning beaches, waterfowl areas and seabird colonies (Figure 13), with additional key features identified based on offshore data.

Eelgrass habitat is not particularly common in this EBSA but one area is found in Deadmans Bay and Blackhead Bay, just north of Cape Spear. Capelin spawning is more prevalent along the coast in this EBSA. The most northerly Capelin spawning beach is in Flatrock and the most southerly one is in Cappahayden. 27 other spawning sites have been identified between these two sites.

American Plaice IAs were found toward the outer boundary of this EBSA (and extending out on Grand Bank) during the Engel time series. IAs for this species have primarily been distributed on the Southeast Shoal and in Halibut Channel during the Campelen years. As with all EBSAs on the east coast of Newfoundland, Killer Whales and Mysticetes are commonly sighted in the Eastern Avalon EBSA.

At least 10 species of seabirds have important colonies in this area, including the only significant Northern Fulmar colony in the study area, near Bauline East. Furthermore, this area contains the Witless Bay Islands IBA, which supports the largest colony of Atlantic Puffins in eastern North America. Significant colonies for six species are found on islands within Witless Bay. In addition to the only Northern Fulmar colony in the top decile being found here, two of three Atlantic Puffin colonies, three of five Razorbill colonies, five of fourteen Black-legged Kittiwake colonies, one of two Common Murre colonies, and both Thick-billed Murre colonies in the top decile for each respective species are located within this EBSA.

A high count of dabbling ducks observed within one coastal block polygon within the EBSA is believed primarily to be the result of anthropogenic rather than natural food resources in the vicinity of the city of St. John’s. Consequently, this information was not considered in the evaluation of this EBSA.

In addition, pelagic seabird transect survey data confirm IAs for several seabird functional groups in this EBSA: plunge-diving piscivores, pursuit-diving piscivores and surface shallow-diving piscivores. These birds rely on forage fish prey in the waters surrounding these islands and adjacent areas on the Grand Bank. Acoustic surveys have shown that Capelin are found in this area, with some years having higher densities than others (Mowbray 2014). This was confirmed by the presence of Capelin IAs in this area, however only the Engel fall IA took up a large portion of the EBSA.

St. Mary’s Bay (3L)

The St. Mary’s Bay EBSA (Figures 7 and 14) includes St. Mary’s Bay and Cape St. Mary’s and was primarily identified using coastal data. The eastern boundary is the headland of St. Mary’s Bay just east of St. Shott’s and the western boundary is on the opposite headland near St. Bride’s. The seaward extension of this EBSA was delineated based on the foraging range (60 km) of piscivorous seabirds that nest at Cape St. Mary’s.

This area is known to be important to several species of seabirds and waterfowl, specifically wintering sea ducks, and it also contains a number of Capelin spawning beaches, eelgrass beds and important Salmon rivers (Figure 14). There are several large areas known to be important for Capelin spawning from Cape St. Mary's, throughout St. Mary's Bay, and all the way east to St. Vincent's-St. Stephen's-Peter's River. Eelgrass habitat is found in four areas throughout the Bay: North Harbour, Colinet Arm, Harricott Bay and O'Donnells. Salmonier River, which drains into this Bay, has been found to contain part of a genetically distinct population of Salmon that inhabits rivers on the Avalon and Burin Peninsulas (Bradbury et al. 2015, Moore et al. 2014).

This EBSA contains two features unique to the study area. The waters surrounding Cape St. Mary's contain the only IA for the endangered Harlequin Duck in the study area. These non-breeding concentrations occur mainly during the winter months. The only Northern Gannet colony in the upper tenth percentile in the study area is also found in this EBSA at Cape St. Mary's. This colony represents approximately 2% of the global population and approximately 12% of the North American population. This is one of several reasons for Cape St. Mary's being recognized as an IBA. In addition to Northern Gannet, the Cape St. Mary's IBA hosts at least an additional 25,000 breeding pairs of seabirds, with Common Murre and Black-legged Kittiwake being the most abundant.

Several additional features were identified based on offshore with the EBSA boundary delineated to reflect the foraging range of seabirds. Capelin IAs are found here towards the outer boundary while Mysticetes are found in high concentrations near the headlands and into the Bay. Hooded Seals are also found outside the Bay (and all along the south coast of Newfoundland) as they migrate through the area from the Gulf of St. Lawrence to Greenland during late May to June. While the Leatherback Turtle important habitat polygon does extend slightly into this EBSA, the core area for this species is Placentia Bay, which was also identified as an EBSA (see below).

Placentia Bay (3Ps)

The Placentia Bay EBSA (Figures 7 and 15) boundary extends across the mouth of the Bay from St. Lawrence on the west side to the St. Mary's Bay EBSA boundary on the east side. It primarily was identified based on coastal data, but the seaward boundary was extended south to capture IAs for corals and sponges as well as Leatherback Turtle important habitat. This EBSA has important salmon rivers, Capelin spawning beaches, eelgrass habitat and seabird colonies (Figure 15) in the nearshore, and many other key features just outside the bay (Table 7, Appendix H).

Piper's Hole River and Cape Rodger River, which drain into this bay, have been found to contain part of a genetically distinct population of salmon that inhabits rivers along the Avalon and Burin Peninsulas (Bradbury et al. 2015, Moore et al. 2014). Capelin spawning beaches are heavily concentrated on the east side of the bay but a few are also found on the west side on Sound Island and Woody Island and in Butts Hole and the beach just to the south of it. Spawning beaches also exist in Little Lawn Harbour, Herring Cove and Blue Beach Cove on the southern tip of the Burin Peninsula. Eelgrass habitat is found in many coves and harbours throughout the bay, however the invasive Green Crab is having an impact on the health of this important habitat in this area (Matheson et al. 2016).

Leatherback Turtles are known to frequent the entire bay, with 18% of all sightings from the 2016 NAISS survey found within the boundaries of this EBSA (J. Lawson, unpublished data). Furthermore, Placentia Bay was identified as the only area in the study area that contains important habitat for Leatherback Turtles (DFO 2012). Another large area of important habitat is identified in the DFO (2012) report which extends slightly into the study area and is captured by the South Coast EBSA (see below) but the size of that area is insignificant compared to the area found within Placentia Bay. This EBSA also captures part of a larger area denoted as important for Blue Whales (DFO 2018). While no Blue Whales were sighted in the bay during the 2016 NAISS survey, one IA was identified on the southern tip of the Burin Peninsula based on sightings and survey data. Mysticetes and Hooded Seal IAs are also found throughout the bay out to the headlands.

Large gorgonian coral, soft coral and sponge IAs are found near the seaward boundary of the Placentia Bay EBSA. They are mostly found in parts of Halibut Channel, St. Pierre Channel and in the Placentia Bay nearshore region (see Figure 9).

This EBSA contains the Placentia Bay IBA which was identified based partly on the large numbers of shearwaters that are lured into Placentia Bay to feed on spawning capelin. More than 100,000 individuals of Greater Shearwater have been recorded, which is a globally significant concentration. Note that Great Shearwater and Sooty Shearwater do not breed anywhere in the Northern Hemisphere. As such, large numbers of individuals of these species travel to this specific area primarily to access abundant and predictable prey resources during their non-breeding season. Almost 40% of the tern species colonies identified in the upper tenth percentile are found in Placentia Bay. Terns, Common Murre and Black-legged Kittiwake forage throughout the bay. Some 1000 to 2000 Common Eiders often winter around the Virgin Rocks, Placentia Bay (Rao et al. 2009).

Two areas noted for high concentrations of ichthyoplankton in the Bay, which were identified during the 2016 EBSA refinement exercise (DFO 2016 taken from Bradbury et al. 2003), were also used as overlays to ensure they were captured by the candidate EBSA boundary. One area extends along the western side of Placentia Bay from the coast to the center of the Bay, and from Southeast Bight to Burin. The second area occurs at the head of the Bay (Swift Current/Come By Chance area) and extends all the way out and across the Bay as far south as Fox Harbour. Furthermore, Lawson and Rose 2000 found that there are several important spawning areas for Atlantic Cod within the boundaries of this EBSA. One spawning aggregation was found near Bar Haven Island near the head of the bay, another at Oderin Bank in the center of the bay and another just off Cape St. Mary’s.

South Coast (3P)

The South Coast EBSA (Figures 7 and 16) is located along the South coast of Newfoundland from Cape Ray to just east of the island of Ramea. The western boundary matches the boundary between NAFO Divisions 4R and 3Pn while the southern boundary extends seaward by roughly 35-40 km to include the northwest portion of the Laurentian Channel and Rose Blanche Bank. During initial review of the composite layer (spring RV survey data only, Figure 3) and the Marine Mammals group layer, this EBSA was originally identified as two separate areas. After considering unpublished data and expert opinion (J. Lawson, pers. comm.), the two areas were joined based on the fact that this area is known to be important habitat for the endangered Blue Whale and other marine mammals (Figure 16).

Other key features noted in this area include three fish functional groups (planktivores, piscivores and plankpiscivores), two seabird functional groups (surface shallow-diving coastal piscivores and surface shallow-diving piscivores), and two seal species (Hooded Seals and Grey Seals). Atlantic Cod, Redfish and Shrimp IAs are also found in this EBSA. Cod and Redfish are found toward the west (Rose Blanch Bank area) while Shrimp are found toward the east. Sea pen and sponge SBAs are found in this EBSA. The largest sea pen SBA is found at the northern end of the Laurentian Channel just southwest of Rose Blanche Bank while the only sponge SBA is relatively small and found just below the 200 m contour roughly 7 km southwest of Grand Bay-West (Kenchington et al. 2016b).

A review of coastal data revealed that several eelgrass beds are found along the coast with the largest beds located between Cape Ray and Channel-Port aux Basques. The two most important Common Eider colonies occur in this EBSA, however they are relatively small (<30 individuals each) in comparison to the larger colonies (up to hundreds of individuals) found in other parts of Atlantic Canada. There are two IBAs in this area. The Grand Bay West to Cheeseman Provincial Park IBA was identified because it provides coastal dune nesting habitat and intertidal foraging habitat for the globally vulnerable and nationally endangered Piping Plover. The Big Barasway IBA also supports a significant population of Piping Plover.

The large Black Dogfish area identified by Kulka (2006) extends into the western portion of this EBSA. The Smooth Skate area identified by Kulka et al. (2006) almost covers the entire EBSA.

Offshore EBSAs

Seven candidate EBSAs were identified in the offshore portion of the study area, mostly based on the composite layer with spring RV data only (Table 8, Figures 7 and 17-24). Data layers used to identify offshore areas included those for corals and sponges, at-risk species, core fish species, fish functional groups, seabird functional groups and marine mammals (Appendix H).

In the offshore, using a combination of data and expert knowledge, much of the shelf edge and slope along the Grand Banks was highlighted as ecologically important based on measures of high productivity and diversity relative to the shelf itself. The most significant areas of aggregation were often associated with areas of unique bathymetry, such as banks, channels, slopes, shoals, troughs, canyons and fjords. Some areas along the shelf edge and slope fall outside the study area, but nonetheless were delineated as EBSAs (see below). A brief description of the physical environment, including oceanographic processes, can be found in Appendix L.

Northeast Slope (3L)

The Northeast Slope EBSA (Figures 7 and 18) is found on the northeast edge of Grand Bank and extends from the Trinity Basin east and south along the shelf edge and slope to the Sackville Spur. This EBSA was delineated based on the composite layer (spring RV survey data only, Figure 17). The northwest boundary was extended westward based on the composite layer including both spring and fall RV survey data, as well as IAs for sponges, Atlantic Cod, Shrimp, Greenland Halibut, and Spotted Wolffish. The northeast portion of this EBSA, which includes the Labrador Slope and part of the Trinity Trough, is adjacent to the southern boundary of the Orphan Spur EBSA (DFO 2013). The key data layers that contributed to this area include those for Capelin, Shrimp, Greenland Halibut, Witch Flounder, American Plaice, Atlantic Cod, all three species of Wolffish, Thorny Skate, Smooth Skate, Roughhead Grenadier, all six fish functional groups, sea pens, black corals, soft corals, sponges, Common and Thick-billed Murre and Hooded Seals. Several other species or functional groups are also found here, as can be seen in Appendix I.

Most species or functional groups were identified here based on the aggregation criterion. However, six species were identified based on the uniqueness criterion: two core fish species (Greenland Halibut, Shrimp), three at-risk species (Northern & Spotted Wolffish and Roughhead Grenadier) and a coral functional group (black corals). This was the only IA for Greenland Halibut on the Engel fall data layer. While Greenland Halibut were found outside this EBSA boundary on other data layers (i.e. Campelen fall, Campelen spring, Engel spring), the majority of all high concentration areas for Greenland Halibut were found in this area. Similarly for Shrimp, the IA on the Campelen fall data layer was found in this area, but extends southwest and southeast beyond the EBSA boundary. One of two Shrimp IAs on the Campelen spring data layer had a similar distribution. The other, much smaller, IA for Shrimp is found along the South Coast of Newfoundland. Most of the IAs for all the threatened Northern Wolffish data layers (except Campelen spring) are found within this EBSA and extend from the Trinity Basin area along the shelf edge and onto the Labrador Slope. Spotted Wolffish (also threatened) show a similar distribution and this area was confirmed as being important for this species by Kulka et al. 2004. Roughhead Grenadier (special concern under COSEWIC) IAs are found on the Slope in this EBSA with distributions extending to the Sackville Spur. The only Roughhead Grenadier IAs found in the study area on the Engel fall data layer were found in this EBSA. Finally, black corals, which are a rare, non-aggregating species, were found in this EBSA. Only two black coral IAs were found in the study area: in this EBSA along the Labrador Slope and in the SW Slope EBSA (see below); both were small in size.

Five other at-risk species were found here as key biological features, meaning the fitness consequences criterion applies to them, along with the three at-risk species discussed above. American Plaice IAs were generally distributed across the Grand Bank during Engel years, with one large IA being found on the shelf edge in the NE Slope EBSA. In the Campelen years IAs identified for this species shifted southward towards the Southeast Shoal, with the exception of one small IA which was found in the NE Slope EBSA. Large IAs for Atlantic Cod were found in this EBSA in three of four data layers. Cod IAs on the Campelen spring layer were found in 3NOP only. Atlantic Wolffish IAs are found in two main areas in the study area – the NE Slope EBSA and the SE Shoal EBSA. A few other IAs are found outside of these EBSAs but not consistently across data layers like those found in the NE Slope and SE Shoal areas. Smooth Skate and Thorny Skate IAs were found in the NE Slope EBSA during the Engel years but IAs for these species were only found in more southern areas (SW Slope, Laurentian Channel for both species; SE Shoal for Thorny Skate) during the Campelen years.

Other core fish species found here include Capelin and Witch Flounder. Capelin IAs were mainly found throughout the northern portion of NAFO Division 3L, including the NE Slope EBSA, on all data layers except Engel spring, which showed a more southerly distribution. It was noted by Carscadden et al. 2013 that Capelin distributions have changed over the last few decades. However, the methods used to find IAs may not be sufficient to see the finer-scale spatial and temporal changes for this species that appear to be influenced by factors such as temperature and population abundance. Witch Flounder IAs were mainly found throughout the NE Slope EBSA, the SW Slope EBSA and the Laurentian Channel EBSA and this pattern was consistently found on all data layers for this species.

The majority of fish functional group IAs were found in EBSAs that were identified on shelf edges and slopes, including the NE Slope EBSA. Small benthivore IAs were found in this EBSA on all four data layers. Planktivore IAs were found here only on Campelen data layers. Medium benthivores and piscivores were found here on only fall data layers. Large benthivores were found here only on the Engel fall data layer. Plankpiscivores were found here on all data layers except Campelen spring. Piscivore IAs were found here only on fall layers. A review of all Piscivore IAs revealed that the Laurentian Channel and SW Slope are more important areas for this functional group.

Other than black corals, two other coral groups, plus sponges, are found in this EBSA. Large gorgonian IAs were found in patches along the Labrador Slope in this EBSA and the same areas were identified as SBAs (Kenchington et al. 2016b). Soft coral IAs were found all along the Labrador Slope to the EEZ boundary. Sponge IAs were found near the Trinity Moraine/Trinity Basin end of this EBSA, however this IA was not confirmed by the presence of a sponge SBA.

During non-breeding, Common Murre are found in the eastern half of this EBSA, as well as areas north and south, with concentrations occurring there during early and late winter. Thick-billed Murre are found throughout the middle of this EBSA and as far south as the Virgin Rocks EBSA during early winter (Figure 35). Finally, Hooded Seals are found in this EBSA in the

Labrador Slope area as well as areas north and south. They feed primarily on squid, Arctic Cod, Atlantic Cod, Greenland Halibut and Redfish in the deep waters along the shelf edge during the winter (December to late February) prior to pupping and in late April-May after pupping has finished (Hammill and Stenson 2000, Stenson, pers. comm.).

Virgin Rocks (3LO)

The Virgin Rocks EBSA (Figures 7 and 19) is found at the center of the Grand Bank and includes a unique geomorphological feature that covers several square kilometers. Shallow shoals of jagged underwater ridges and rocks are nearly exposed in some areas – as shallow as 3.6 m from the surface of the water (Rao et al. 2009).

This EBSA was originally delineated based on the composite layer (spring RV survey data only, Figure 17), meaning a high diversity of species aggregate here. A review of individual data layers revealed that most IAs were located south of the Virgin Rocks. However, it was decided to modify the boundary to encompass areas north, south, east and west of the Virgin Rocks feature. The radius of the circle (~50 km) was chosen based on the distance from the center of the Virgin Rocks to the outer edge of the grid cell in the top 60% of the spring composite layer (see Figure 4).

A subsequent review of all data layers revealed that the key features in this area are core fish species, at-risk species and pelagic seabirds. Core fish species include Sand Lance and Capelin, which constitute important prey for predatory seabirds, fish and cetaceans also found in high concentrations in this area (Table 8, Appendix H). It is worth noting however, that Capelin IAs were only found here on the Engel spring data layer. In Campelen years (1995-2016), Capelin IAs were generally found further north. Given that Capelin distributions have changed over the last few decades (Carscadden et al. 2013), the methods used to find IAs may not be sufficient to see the finer-scale spatial and temporal changes for this species that appear to be influenced by factors such as temperature and population abundance.

American Plaice IAs on Engel fall data layer cover a large portion of the Grand Bank and includes the Virgin Rocks. An IA for Sooty Shearwater covers most of this EBSA and extends east and south to the EEZ. A Thick-billed Murre IA also covers this EBSA and extends north to the study area boundary. While none of the pelagic seabird IAs were considered key features of this EBSA, it is worth nothing that IAs for 5 seabird functional groups were found here (Appendix I). Finally, an IA for Killer Whales was found at the center of this EBSA.

This area was identified as a Special Marine Area by CPAWS (Rao et al. 2009) and is described in that report as an area with high plankton productivity and diverse and productive kelp beds. This area also has important spawning habitat for Atlantic Cod, American Plaice and Yellowtail Flounder, and is a congregation area for capelin and seabirds.

Lilly Canyon-Carson Canyon (3N)

The Lilly Canyon-Carson Canyon EBSA (Figures 7 and 20) is found just inside the EEZ on the western edge of Grand Bank. This EBSA was delineated based on the composite layer (spring RV survey data only, Figure 17) and includes the Lilly Canyon and Carson Canyon, which were previously identified as an EBSA (Templeman 2007). The new EBSA boundary includes the shelf and slope areas surrounding the canyons. The key species with IAs in this EBSA include Snow Crab, Greenland Halibut, American Plaice, Redfish, Roughhead Grenadier, Thorny Skate, Common Murre, Sooty Shearwater, soft corals, sponges, Blue Whales and Harp Seals. The key functional groups include small and large benthivores (fish), shallow pursuit generalist seabirds and surface shallow-diving piscivores. Most features were identified based on either the aggregation or fitness consequences criteria; however, Roughhead Grenadier was identified here based on uniqueness. The IAs for this species on the Campelen fall data were mainly found in this EBSA, although one small area was found at the east end of the NE Slope EBSA, extending beyond the EEZ.

As this EBSA is relatively small compared to other offshore EBSAs, most key features were found throughout the entire EBSA. IAs were found here on two or more data layers for most fish species (Appendix H). Small benthivore IAs were found here on all four data layers. IAs for some species (i.e. Harp Seals, Sooty Shearwater, Common Murre) were found in this EBSA and over large parts of the eastern Grand Bank, including the shelf edge and slope. Soft corals are found mostly in the southern end of this EBSA on the shelf edge. Sponge IAs were found in deeper waters near the EEZ boundary, while a small sponge SBA was identified between the 200 m and 500 m bathymetric contour in Carson Canyon near the north end of the EBSA. This area is also known to have a high proportion of Iceland Scallops (Ollerhead et al. 2004, DFO 2016).

Southeast Shoal (3NO)

The Southeast Shoal EBSA (Figures 7 and 21) is found just inside the EEZ on the southeast portion of Grand Bank. It includes the portion of the Southeast Shoal inside the EEZ as well as part of the Outer Shelf Zone of the Grand Bank. This area was originally a smaller area delineated based on the 60% composite layer (spring RV survey data only, Figure 17) but the area was extended to incorporate IAs for Atlantic Wolffish and American Plaice, two at-risk species (Appendix K).

Most species and functional groups were identified here based on the aggregation criterion but there are some unique features of the SE Shoal and the area has fitness consequences for several species.

In terms of fitness consequences, this area has previously been noted as an important feeding, spawning and juvenile area for Yellowtail Flounder (Frank et al. 1992, Walsh 1992, Walsh et al. 2001, Kulka et al. 2003, Fuller and Myers 2004, DFO 2016), an important nursery area for American Plaice (Walsh et al. 2001, Walsh et al. 2004) and a spawning area for Capelin (Carscadden et al. 1989, Fuller and Myers 2004). Furthermore, the SE Shoal is the only EBSA that contains IAs for Yellowtail Flounder, making it unique. Walsh et al. (2001) stated that the SE Shoal is the single nursery area of the entire stock of Yellowtail Flounder. In their report, they proposed both small and large closed areas based on their distribution. American Plaice IAs were found here and south of the EEZ during Campelen years but were mostly distributed further north over the Grand Bank in earlier years. American Plaice spawning also occurs in this EBSA but a small portion of this spawning area extends into the Southwest Slope EBSA (see below).

Capelin IAs were found in a small portion of this EBSA (and further south outside the EEZ) in the spring data layers. The SE Shoal has been identified as the only known Capelin offshore spawning site on Grand Bank (Templeman 2007, Fuller and Myers 2004). However, at least one earlier study has indicated that Capelin appear to spawn at various places on offshore bank areas provided that suitable bottom conditions are available at proper depths (Pitt 1958).

Several at-risk species, other than those discussed above, have IAs in this EBSA. These include Atlantic Wolffish, Northern Wolffish, Thorny Skate and White Hake (Appendix H). As mentioned above, Atlantic Wolffish IAs are found in two main areas in the study area – here and in the NE Slope EBSA. The only IA for White Hake based on Engel fall data was found here, although this may not be representative as the Engel trawl was less efficient than the Campelen trawl at catching small fish (Kulka et al. 2005).

Core fish species that have key IAs here include Sand Lance and Witch Flounder. Sand Lance IAs are distributed across 3NOP during Engel and Campelen years, with some IAs falling within the SE Shoal EBSA. Witch Flounder are mainly found in the Laurentian Channel, SW Slope and NE Slope EBSAs, with some IAs falling within the SE Shoal EBSA boundary.

Medium and large benthivore fish functional group IAs are found on the northeast side of this EBSA but are not unique to this area.

Though not unique to this area, this EBSA encompasses a large portion of the largest contiguous cluster visible on the IA layer for shallow pursuit generalist seabirds (Figure 34), likely indicative of occurrence of forage fish resources in this area.

While the Mysticetes functional group IA was not a key feature of this area, Whitehead and Glass 1985 described the significance of this area to humpback whales and other cetacean species. They noted that, during the summer months, humpbacks concentrated on the central part of the shoal over concentrations of prey, which were likely spawning capelin.

Walsh et al. 2001 also indicated that the SE Shoal contains the highest benthic biomass on the Grand Bank.

Southwest Slope (3OPs)

The Southwest Slope EBSA (Figure 7 and 22) extends along the southwest slope of Grand Bank from the southern end of the Laurentian Channel to the boundary of the EEZ. It ranges in depth from 200m to just over 2000m. This EBSA was delineated based on the 60% composite layer (spring RV survey data only, Figure 17), meaning it contains important areas for a number of species and taxonomic groups. The boundary was extended to the south to capture IAs for corals and species at risk. This EBSA had a high number of key features, similar to the NE Slope EBSA. While the NE Slope EBSA had more unique and aggregating features, the SW Slope had more features based on fitness consequences. In the SW Slope EBSA, at-risk fish species, corals and fish functional groups were the main groups driving the patterns appearing in the composite layer (Appendix H). Witch Flounder IAs are found here along with IAs for 11 at-risk species: American Plaice, Atlantic Cod, Northern Wolffish, Redfish, Roundnose Grenadier, Smooth Skate, Thorny Skate, White Hake, Winter Skate and Blue Whale. IAs for 5 fish functional groups are found here, including small and large benthivores, planktivores, plankpiscivores and piscivores. Coral IAs include those for black corals, small and large gorgonian corals, stony cup corals and sea pens. Finally, surface shallow-diving piscivorous seabird IAs are found here.

Many of the IAs for individual species are found throughout the entire length of the SW Slope EBSA (Witch Flounder, Redfish, Thorny Skate, White Hake, Blue Whale). The same can be said for several of the fish functional groups (small and large benthivores, plankpiscivores, piscivores). However, the IAs for some species were mainly concentrated in the northwest end of the EBSA (Atlantic Cod, Winter Skate) while others like Northern Wolffish were concentrated in the southeast end of the EBSA. American Plaice IAs were found at both ends. Other IAs were found all along the SW Slope but not beyond the edge of Halibut Channel (Smooth Skate, planktivores fish functional group). Surface, shallow-diving piscivore seabird IAs were found from the center of the EBSA and extending toward the southeast, with the largest IA directly south of Whale Deep.

Most of the coral IAs were generally found beyond the 200 m depth contour. A small black coral IA was found near the southeast end. Large gorgonian coral IAs were mostly found in the northwest end of the EBSA but one large IA was found in same area as the IAs for black coral and surface shallow-diving piscivorous seabirds. Stony cup corals were found all along the slope as far as Halibut Channel. Another small IA is found at the north end extending into

French territorial zone/Laurentian Channel. Sea pen IAs are found in patches all throughout the length of the EBSA.

In 2007, a research team completed a deep-sea cruise at three stations that all fall within the boundaries of the SW Slope EBSA: Haddock Channel, Halibut Channel and Debarres Canyon. The objective of this cruise was to collect *in situ* observations of deep-sea corals in the area. Over 160,000 coral colonies were enumerated and 28 species were found over 7 ROPOS dives (Baker et al. 2012). This study confirmed the presence of many of the coral species and groups that were found here during DFO RV surveys.

In terms of uniqueness, all known small gorgonian IAs in the study area were located in this EBSA. However, a small SBA for small gorgonian corals also occurs in 3L (see Kenchington et al. 2016b, Figure 54), and is not included within the boundary of any EBSA. The majority of IAs for Roundnose Grenadier were found throughout the entire EBSA (see Appendix H). Finally, a Haddock feeding and spawning area, as well as a Redfish spawning area (Ollerhead et al. 2004) that was digitized during the 2016 EBSA refinement process (DFO 2016) was included as an overlay in this area and is captured almost entirely by the candidate EBSA boundary.

The American Plaice spawning area digitized from the 2016 EBSA refinement process (DFO 2016) is mainly concentrated in the SE Slope EBSA, however a small portion of it extends into the SW Slope EBSA. The Atlantic Halibut areas acquired during the 2016 EBSA refinement process also fall within the boundaries of this EBSA. A review of RV survey point data for this species revealed that they are found in many other areas throughout the study area. These areas include the SE Shoal, the Laurentian Channel, and areas outside the EEZ boundary.

Haddock Channel Sponges (3O)

The Haddock Channel Sponges EBSA (Figures 7 and 23) is found in the southern portion of the Avalon Channel and extends into the Haddock Channel. It was identified as an EBSA because it is the largest area identified as a sponge SBA in the entire PBGB area (Kenchington et al. 2016b). Only two other species were considered key features of this area based on Engel data: Capelin and American Plaice (Appendix H).

Laurentian Channel (3P)

The Laurentian Channel EBSA (Figures 7 and 24) extends through the Laurentian Channel south of Newfoundland. The northwest boundary extends slightly across the boundary between NAFO Subdivisions 3Ps and 3Pn whereas the southern boundary ends just north of the Laurentian Fan. This EBSA is split by the EEZ maritime boundary between Canada and the French territory of St. Pierre and Miquelon. The EBSA boundary was delineated based on the composite layer (spring RV survey data only, Figure 17) meaning it contains IAs for a diverse set of species (see Appendix H).

While it may appear that this EBSA is an extension of the SW Slope EBSA, the key features for each EBSA differed enough to recognize the areas separately (see Table 8). Also, the physical features of both of these areas differ substantially. The SW Slope EBSA extends along the edge of Grand Bank and down a steep slope to depths of almost 2000 m. The Laurentian Channel EBSA extends from the edge of St. Pierre Bank and Burgeo Bank and includes the relatively flat Channel itself which is up to 400 m deep. The Laurentian Channel area is comprised primarily of mud, clay, sand and gravel (DFO 2010), which is partially why the area supports high concentrations of sea pens. Habitat types of the SW Slope are more varied and support a high number and diversity of many types of corals and sponges (Edinger et al. 2011).

Most key features of the Laurentian Channel EBSA were identified based on the aggregation criterion, including Greenland Halibut, Witch Flounder, all six fish functional groups, sea pens, small gorgonian corals and Blue Whale (Appendix H). IAs for several at-risk species are also found here including Smooth Skate, Thorny Skate, White Hake, Winter Skate and Blue Whale. Some species or functional groups were found throughout the entire Laurentian Channel EBSA including Witch Flounder, Smooth Skate and the following fish functional groups: planktivores, plankpiscivores and piscivores. IAs for some species or groups were found in the southern two-thirds of the EBSA above the 400 m bathymetric contour (Thorny Skate and large benthivores). An IA for medium benthivores showed a similar distribution but extended up onto St. Pierre Bank. Small benthivore IAs were found in the north half of the EBSA only. For White Hake, a couple of small IAs were found in the center of the EBSA above the 400 m bathy contour while another IA extended into the French territorial zone and the SW Slope EBSA. A sea pen IA was found in the channel below the 200 m depth contour. There is also one large sea pen SBA centered in the EBSA and a smaller sea pen SBA in the north end that extends beyond the northern boundary. A small gorgonian IA was found in the southern end of the EBSA and a small SBA for this group was found in the same area. Blue Whale important habitat was identified both at the northern and southern ends of this EBSA, however most of this area has been identified as highly suitable habitat for Blue Whale (Gomez et al. 2017).

The Laurentian Channel has a high occurrence of Black Dogfish, and some studies have inferred that it may be a place where pupping occurs (Kulka 2006). The southeastern boundary of the polygon created during a 2008 review (DFO 2016) based on RV survey data from 1971-2005 ends at the French EEZ. Recent survey point data show a similar pattern but extend beyond this area into SW Slope and Hermitage Channel. A KD analysis was not done for this species and IAs were not extracted based on the upper tenth percentile so there is uncertainty regarding the uniqueness of IAs for this species, especially given that additional data have been collected since the original polygon was created in 2008. Smooth Skates also use the Laurentian Channel as an important juvenile/nursery area (Kulka et al. 2006).

The polygon created for Spiny Dogfish during a 2008 review (DFO 2016) extends beyond the southern boundary of this EBSA into the SW Slope. The point data for this species show a similar pattern but are also found in areas outside the polygon. Again, given that no further analysis was done for this species, we cannot comment on the uniqueness of this area for this species.

The Laurentian Channel was one of two IAs identified for Greenland Halibut on the Campelen spring layer, meaning it is somewhat of a unique feature for the study area. However, the NE Slope EBSA seems to be consistently more important for this species. The only IAs identified for Winter Skate are located in the southern end of this EBSA but extend through French territorial waters and onto St. Pierre Bank, as well as into the northern end of the SW Slope EBSA (Appendix K).

While there was no data layer for Porbeagle Shark, it is known that they are found in this area in spring and migrate to areas further south during late fall (Campana et al. 2012). A portion of one of their known mating grounds occurs in the southern part of the Laurentian Channel (Campana et al. 2012, Simpson and Miri 2013).

EBSAs Outside The EEZ

The 60% composite layers (both for spring and spring/fall) were used to delineate areas outside the EEZ (Figure 8). While describing these areas in detail is beyond the scope of this report, the overlap or adjacency of these areas with EBSAs that were identified by CBD is noteworthy (CBD EBSA Website). Further to that, it is interesting to note that the areas in the 60% composite layer on the Southeast Shoal mostly fall outside (between) the boundaries of the two areas identified by the CBD. Further investigation into the features of these areas is required to determine the reason for this observation.

TOTAL BIOMASS, DIVERSITY, RICHNESS AND EVENNESS

Diversity, richness and evenness indices were mapped for DFO RV survey data for all fish (Figure 25) and all identified invertebrates (Figure 26). Although layers were created for spring and fall, only the spring layers are included here because similar patterns were seen with both series' and the spring survey has better coverage (i.e. trawls are conducted in all NAFO Divisions, 3LNOP).

When the EBSAs were displayed over these layers for fish, it became evident that most offshore EBSAs corresponded to areas of high biomass, diversity, richness and evenness. The highest fish biomass areas were found in the SW Slope and the SE Shoal EBSAs. The slope portion of the NE Slope EBSA also had high total fish biomass. The highest diversity areas in the study area were the Laurentian Channel and NE Slope EBSAs, as well as the Hermitage Channel, which was not included within any EBSA boundary. Areas highest in species richness included most areas along the shelf edge and slope. The EBSAs with the highest species richness appear to be the Laurentian Channel, South Coast, SW Slope, Lilly Canyon-Carson Canyon and NE Slope EBSAs. The highest species evenness was seen in the Laurentian Channel and the western portion of the NE Slope EBSA.

While further examination of the invertebrate dataset is required before making conclusive statements about the patterns resulting from the preliminary data layers, it is interesting to note that a different pattern emerged when compared with the fish layers.. The highest total biomass areas appear to be found throughout NAFO Division 3L, mostly in the western portion of this area, but otherwise had an irregular pattern. Some high biomass areas seem to be present in the SE Shoal EBSA and in the Laurentian Channel EBSA. The highest invertebrate diversity and evenness appear to be on Grand Bank, outside of most EBSAs, with the exception of the Virgin Rocks EBSA. The highest species richness appears to be found in the Laurentian Channel, and all around the slope of Grand Bank.

COMPARISON OF 2017 EBSAS TO 2007 EBSAS

The EBSAs identified using a Delphic approach in 2007 (Templeman 2007) were compared to the EBSAs identified in this study (Figure 27). Nine of the EBSAs identified during both exercises overlap and/or they are based on similar features (Laurentian Channel, Southwest Slope, Southeast Shoal, Lilly Canyon-Carson Canyon, Virgin Rocks, Northeast Slope, Placentia Bay, Eastern Avalon, Smith Sound), however there were some changes to the boundaries. The percent area of these nine 2007 EBSAs that was captured by the 2017 EBSAs varied from 28.75% to 100% (Table 11). The lowest overlap was between the Southeast Shoal EBSAs and this is in part due to the fact that the 2007 EBSA boundary extended beyond the EEZ boundary. When comparing the portions of the EBSAs within Canadian waters, the overlap is equal to 61.77%.

Two new EBSAs (South Coast and St. Mary's Bay) overlap with portions of the 2007 EBSAs. 7.37% of the Laurentian Channel is found within the 2017 South Coast EBSA and 2.42% of the Placentia Bay EBSA is found within the 2017 St. Mary's Bay EBSA. Three new EBSAs were identified in areas not previously considered (Bonavista Bay, Baccalieu Island and Haddock Channel Sponges).

The area contained within the 2007 Burgeo Bank EBSA had fewer important biological features relative to surrounding areas in this study, however 18.07% of this EBSA was found within the 2017 South Coast EBSA. The number of IAs in the Burgeo Bank area fell just below the 60%

threshold on the composite layers. However, it did meet the 70% threshold (see Figure 4), meaning there are still a number of IAs in this area. This area has been known to be a mixing and feeding area for Northern Gulf and Burgeo Bank cod (Templeman 1974, Méthot et al. 2005, DFO 2017). The only Atlantic Cod IA that was found in this area was on the Campelen spring layer. This large IA extended into the Laurentian and Hermitage Channels and up to the south coast of the island. While species other than cod have been known to occur here (Templeman 1984, Harvey et al. 2012), the area does not appear to be particularly unique or have significant fitness consequences for any other species (e.g. Harvey et al. 2012).

The 2007 St. Pierre Bank EBSA was based on the highest and only concentration of Sea Scallops on the Grand Banks. A data layer for Sea Scallops was not included in this analysis. A large portion (46.63%) of St. Pierre Bank is included in the Laurentian Channel EBSA, however the majority of the bank did not meet the 60% threshold on the composite layers and no other data layers in this area met the criteria for fitness consequences or uniqueness.

CONCLUDING REMARKS

Fourteen EBSAs were identified in two different categories throughout this process: seven were identified using coastal data and seven were identified using offshore data. 272 layers of biological and geomorphological features were used to define these significant areas, along with many hours of meetings with scientific experts. The use of the uppermost class (i.e. decile) for each data layer enabled the identification of the most important areas for a multitude of species within the region. This approach does not preclude the notion that areas other than those identified may be significant for individual species; rather, it identified areas significant to many species, and therefore the ecosystem as a whole.

Key features were described for each EBSA but it should be noted that many other species likely occur in each of them, even in addition to those listed in Appendix I. Identifying important areas for migratory species or those that are found everywhere is difficult using the methods we employed. However, given that most of the areas identified are highly productive and important for a large number of species, they are likely also important for highly mobile species such as seals, whales, and seabirds. A literature review has shown that many of the EBSAs (especially those at the shelf edge and along the slope) are known or probable areas of occurrence for transient at-risk species such as Bluefin Tuna (Block et al. 2005, COSEWIC 2011a), Atlantic Salmon (Reddin 1985, 2006), Porbeagle (COSEWIC 2014), Shortfin Mako (Campana et al. 2004, COSEWIC 2006), Northern Bottlenose Whale (COSEWIC 2011b, Martin et al. 2014), Leatherback Turtle (James et al. 2005) and Loggerhead Sea Turtle (COSEWIC 2010, Hays and Marsh 1997).

Similar to the 2013 EBSA process, we found that bathymetry was a key characteristic underlying the delineation of boundaries for many of the EBSAs. Strong gradients in bathymetry influence currents and other properties of the water column. The strong association of many EBSAs with features such as channels and the continental slope indicates that a robust approach to define critical properties to be used for conservation measures would require a more comprehensive and detailed analysis of local features than was possible in this study. The scale of these features is largely what drove the size of the EBSAs delineated, similar to the 2013 EBSA process, and this may be part of the reason why EBSAs from both processes were within a similar size range (Figure 28). 2013 offshore EBSAs averaged 19,127 km^2 and ranged from 6,232 km^2 (Notre Dame Channel) to 29,759 km^2 (Labrador Slope) while offshore EBSAs from this process averaged 12,831 km^2 and ranged from 490 km^2 (Haddock Channel Sponges) to 25,180 km^2 (Southwest Slope) (Table 10). Three coastal EBSAs were identified in 2013 and averaged 3,138 km^2 with a range from 358 km^2 (Gilbert Bay) to 6,007 km^2 (Nain Area). The seven coastal EBSAs identified in this process averaged 5,856 km^2 and ranged from 547 km^2 (Smith Sound) to 13,539 km^2 (Placentia Bay) (Table 9).

The boundaries for each EBSA were drawn based on the best available knowledge, using relevant, available data. As per EBSAs identified in previous processes (DFO 2013), areas selected for further protection or management should be examined in greater detail to identify all features in the area. The scale at which these features are associated with the area also warrant further investigation, potentially requiring refinement of the boundaries. Furthermore, the boundaries delineated here do not necessarily indicate a transition from an important area to a non-important area, rather they are meant to encircle an area that appears to be ecologically or biological significant. If management actions are ever taken in a particular EBSA, further investigation of the boundary should occur at that time, and will be dependent on the conservation objectives that are established for the area.

There are likely many ecosystem features in the study area for which data were not available. For example, large giant kelp beds are known to exist in areas on the south coast of Newfoundland, however spatial data were not available for these features (Rao et al. 2009). Spatial data for other benthic invertebrates such as scallops were also not incorporated into this analysis. Furthermore, productivity in nearshore waters along the east coast of Newfoundland has been studied and linked to the importance of nearshore spawning and nursery areas based on protective habitat (e.g. eelgrass and kelp beds) (Bradbury et al. 2008, Gregory et al. 2016, Warren et al. 2010). However, other than eelgrass, capelin spawning, and seabird data, there are limited spatial data that exist at a scale that covers the entirety of the coast in the study area. Furthermore, there has been little research done on trophic interactions at broad spatial scales in the study area, especially in the coastal zone. Further research on these and other important ecosystem components, including other benthic community types, would help to identify and describe these highly productive areas, as well as determine which of these areas are the most ecologically significant.

Similar to the 2013 EBSA process (Wells et al. 2017), naturalness and resilience were difficult to quantify or map. This is particularly true in this study area given high fishing pressures over the past century. Discovery by Europeans of fish resources in this area occurred in the 1490s (Lear 1998). Cod traps and lines were introduced in the late 1800s and otter trawls in the early 1900s. It is therefore difficult to characterize the naturalness of this area given 500 years of human use. Trawling patterns have changed over time due to moratoria in certain fisheries but in general, numerous persistent areas of trawling spread mainly along the shelf edge and between the banks (Kulka and Pitcher 2001). Resilience refers to the ability of an area to withstand or quickly recover from perturbations. It was difficult to quantify or characterize this property with the data available for this project. However, it would be expected that EBSAs defined on the basis of benthic ecosystem components (e.g. corals) are far less resilient to perturbations than areas defined by concentrations of mobile organisms like fish.

To conclude, these EBSAs were identified using a large and diverse data set. Steps were taken to maximize the spatial information derived from as many data sources as possible, while focusing on the EBSA criteria to drive the identification and delineation of areas. When data were unattainable, published literature and expert opinion were used to identify important areas, especially for those taxa with limited available information. The EBSAs identified here do not necessarily capture the most important areas for every individual ecosystem feature; rather, they are intended to capture significant areas in the broader ecosystem context.

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TABLES

Table 1: List of offshore biological data layers, data sources for each layer, and treatment of final layer for compound analysis and EBSA identification. All layers listed were included in Composite Layer unless otherwise noted.

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
Corals	• Large gorgonians • Small gorgonians • Stony cup corals • Black corals • Sea pens • Soft corals	Upper 10th percentile of KD of DFO RV (2000-2015, 3LNOPnPs) biomass data	• 2000-2015 (DFO RV)	point
Sponges	• All sponges	Upper 10th percentile of KD of DFO RV data (2000-2015, 3LNOPnPs) biomass data	• 2000-2015 (DFO RV)	point
Core Fish Species Campelen fall	• Capelin • Witch Flounder • Greenland Halibut • Snow Crab • Shrimp • Sand Lance • Yellowtail Flounder	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Campelen gear.	• 1995-2015	point
Core Fish Species Campelen spring	• Capelin • Witch Flounder • Greenland Halibut • Snow Crab • Shrimp • Sand Lance • Yellowtail Flounder	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Campelen gear.	• 1996-2015	point
Core Fish Species Engel fall	• Capelin • Witch Flounder • Greenland Halibut • Sand Lance • Yellowtail Flounder	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Engel gear.	• 1990-1994	point

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
Core Fish Species Engel spring	• Capelin • Witch Flounder • Greenland Halibut • Sand Lance • Yellowtail Flounder	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Engel gear.	• 1977-1995	point
At-risk Fish Species – Campelen fall	• Atlantic Cod • American Plaice • Roughhead Grenadier • Roundnose Grenadier • Smooth Skate • Thorny Skate • Northern Wolffish • Spotted Wolffish • Atlantic Wolfish • Redfish • White Hake	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Campelen gear.	• 1995-2015	point
At-risk Fish Species – Campelen spring	• Atlantic Cod • American Plaice • Roughhead Grenadier • Roundnose Grenadier • Smooth Skate • Thorny Skate • Northern Wolffish • Spotted Wolffish • Atlantic Wolfish • Redfish • White Hake • Winter Skate	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Campelen gear.	• 1996-2015	point

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
At-risk Fish Species – Engel fall	• Atlantic Cod • American Plaice • Roundnose Grenadier • Roughhead Grenadier • Smooth Skate • Northern Wolffish • Spotted Wolffish • Atlantic Wolfish • Thorny Skate • Redfish • White Hake	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Engel gear.	• 1990-1994	point
At-risk Fish Species – Engel spring	• Atlantic Cod • American Plaice • Roughhead Grenadier • Roundnose Grenadier • Smooth Skate • Thorny Skate • Northern Wolffish • Spotted Wolffish • Atlantic Wolfish • Redfish • White Hake • Winter Skate	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Engel gear.	• 1977-1995	point
Fish Functional Groups Campelen fall	• Small benthivores • Medium benthivores • Large benthivores • Planktivores • Plankpiscivores • Piscivores	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Campelen gear.	• 1995-2015	point
Fish Functional Groups Campelen spring	• Small benthivores • Medium benthivores • Large benthivores • Planktivores • Plankpiscivores • Piscivores	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Campelen gear.	• 1996-2015	point

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
Fish Functional Groups Engel fall	• Small benthivores • Medium benthivores • Large benthivores • Planktivores • Plankpiscivores • Piscivores	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Engel gear.	• 1990-1994	point
Fish Functional Groups Engel spring	• Small benthivores • Medium benthivores • Large benthivores • Planktivores • Plankpiscivores • Piscivores	Upper 10th percentile of KD of DFO fall RV surveys (kg / tow). Engel gear.	• 1977-1995	point
Seals	Grey Seal Telemetry Data	Upper 10th percentile of KD of tracking data for 20 individuals. Polygons modified further based on expert opinion	• 1993-2014	point
-	• Harbour Seal	Polygons digitized from georeferenced map in Sjare et al. (2005). Polygons modified further based on expert opinion	• 1973, 2000-2003	paper map
-	• Harp Seal movement	Upper 10th percentile of KD based on the full spatial extent of telemetry data. Polygons modified further based on expert opinion	• 1993-1997, 2004	point
-	• Hooded Seal movement (Males August-February; Juveniles August-February; Females April-June; Females August-February)	Upper 10th percentile of KD based on the full spatial extent of first passage time tracking data. Polygons modified and combined into one layer based on expert opinion.	• 2004-2008	point
Cetaceans	• Right whale • Killer whale • Blue whale • Mysticetes functional group • Squid eaters functional group • Small cetaceans functional group	Upper 10th percentile of KD of aerial survey data (DFO, TNASS) & observer data. All survey & observer data were combined. File was separated by at-risk species or functional group. 2016 NAISS (DFO) data were separated into at-risk species or functional groups and projected into a point dataset.	• 2002-2003 (DFO) • 2007 (TNASS) • 2016 (NAISS) • 1758-2016 (Observer Data)	point

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
Pelagic Bird Transect Survey Data Layers	• Plunge-diving piscivores • Pursuit-diving planktivores • Pursuit-diving piscivores • Shallow pursuit generalists • Surface, shallow-diving coastal piscivores • Surface, shallow-diving piscivores • Surface-seizing plankpiscivores	Upper 10th percentile of KD based on and pelagic bird transect surveys. Corrected for effort and spatial extent was restricted to Canadian waters.	• 1966-1987 (PIROP) • 2006-2011 (ECSAS)	raster
Murre and Sooty Shearwater Distribution Maps	• Common Murre fall* (September-October)	Upper 10th percentile extracted from Kernel Home Range distributions from 3 colonies in Eastern Canada. 3 Murre layers were combined for one final coverage layer which was used in the cell statistics analysis	• 2007-2011	polygon
-	• Common Murre spring* (March-April)	Upper 10th percentile extracted from Kernel Home Range distributions from 3 colonies in Eastern Canada. 3 Murre layers were combined for one final coverage layer which was used in the cell statistics analysis	• 2007-2011	polygon
-	• Common Murre late winter* (January-February)	Upper 10th percentile extracted from Kernel Home Range distributions from 3 colonies in Eastern Canada. 3 Murre raster layers were merged for one final coverage layer which was used in the cell statistics analysis.	• 2007-2011	polygon
-	• Sooty Shearwater (April-September)	Upper 10th percentile extracted from Kernel Home Range distribution from 1 colony.	• 2007-2009	polygon
-	• Thick-billed Murre Early Winter (November-December)	Upper 10th percentile extracted from Kernel Home Range distributions from 5 colonies in the Arctic and Eastern Canada	• 2007-2011	polygon

*Common Murre layers merged into one layer for inclusion in Composite Layer Cell Statistics

Table 2: List of coastal biological data layers, data sources for each layer, and treatment of final layer for EBSA identification. Coastal data layers not included in cell statistics.

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
Eelgrass	• Eelgrass habitat	CCRI, Rao et al. 2014, DFO Science. No treatment.	-	polygon/line
Fish	• Salmon angling rivers	Angling data for rivers in SFA's 5-12. Top 10% of rivers, using the most recent 5 years, used to determine locations for Salmon IAs. Polygons created and extended seaward to headlands.	• 1984-2011	point
-	• Capelin spawning sites	Beach and demersal capelin spawning sites. No treatment.	• 2003-2007	point
N/A	• Important Bird Areas (IBA)	IBA Canada. No treatment.	-	-
Waterfowl	• Harlequin Duck (SARA) • Seaducks • Geese • Dabbling Ducks • Bay Ducks	Surveys took place in the spring and fall and were collected as polygon data. Polygon blocks that that fall within the top decile within the study area were extracted; or, if none existed, the top ranking block was extracted. Block data are summarized as maximum counts of individuals (count).	• 1960-2008	polygon
Eider surveys	• Common Eiders	Extraction of upper 10^{th} percentile of KD of COEI survey winter data	• 2012	raster
Seabird Colonies	• Atlantic Puffin • Black-legged Kittiwake • Common Eider • Common Murre • Great Black-backed Gull • Great Cormorant • Herring Gull • Leach's Storm-Petrel • Northern Fulmar • Northern Gannet • Razorbill • Tern sp. • Thick-billed Murre	Upper 10^{th} percentile of KDE of colonies based on maximum counts (by species). Extraction of colonies within each top 10^{th} percentile area. Colony clusters within top decile, overlapping for more than one species, used to identify significant colonies. Buffers corresponding to mean maximum foraging range of species in question used to inform EBSA delineation.	• 1960-2010	raster and point

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
CCRI Groundfish	• American plaice • Atlantic cod • Cod • Flounder • Greenland Halibut • Haddock • Hagfish • Hake • Halibut • Lumpfish • Polluck • Redfish • Sand Lance • Sculpin • Skate • Sturgeon • Winter Flounder • Witch Flounder • Wolffish • Yellowtail	Qualitative presence only data based on Traditional Ecological Knowledge (TEK) This data was used as a confirmation for quantitative data layers or in data poor regions of the study area. No treatment.	• 1996-2004	polygon
CCRI Pelagics	• Arctic Char • Atlantic Saury • Brook Trout • Brown Trout • Capelin • Eel • Herring • Jellyfish • Mackerel • Salmon • Shark • Smelt • Sunfish • Swordfish • Trout • Tuna	Qualitative presence only data based on Traditional Ecological Knowledge (TEK) This data was used as a confirmation for quantitative data layers or in data poor regions of the study area. No treatment.	• 1996-2008	polygon

Data Group	Data Layers	Data Source/Treatment	Temporal Extent	Source Data Type
CCRI Shellfish	• Clam • Cockle • Crab • Giant scallop • Icelandic scallop • Lobster • Moonsnail • Mussel • Northern stone crab • Oyster • Periwinkle • Quahog • Rock crab • Scallop • Sea cucumber • Sea urchin • Shrimp • Snail • Snow crab • Soft shell clam • Squid • Toad crab • Whelk	Qualitative presence only data based on Traditional Ecological Knowledge (TEK) This data was used as a confirmation for quantitative data layers or in data poor regions of the study area. No treatment.	• 1996-2008	polygon
CCRI Aquatic Plants	• Eelgrass (point) • Eelgrass (polygon) • Irish Moss (point) • Irish Moss (polygon) • Kelp (point) • Kelp (polyline) • Kelp (polygon) • Rockweed (point)	Qualitative presence only data based on Traditional Ecological Knowledge (TEK) This data was used as a confirmation for quantitative data layers or in data poor regions of the study area. No treatment.	1996-2008	point/polyline/ polygon

Table 3: Minimum and maximum number of features included in each percent threshold composite layer (offshore data only).

Composite Layer	Minimum number of features	Maximum number of features
All layers + Spring RV data 50%	14	26
All layers + Spring RV data 60%	11	26
All layers + Spring RV data 70%	9	26
All layers + Spring and Fall RV data 50%	21	39
All layers + Spring and Fall RV data 60%	17	39
All layers + Spring and Fall RV data 70%	13	39

Table 4: List of species at risk considered for PBGB area EBSA identification process.

Common Name	Scientific Name	Population	COSEWIC Status	SARA Status
Acadian Redfish[a]	*Sebastes fasciatus*	Atlantic	Threatened	No Status
American Eel[b]	*Anguilla rostrata*	-	Threatened	No Status
American Plaice	*Hippoglossoides platessoides*	Newfoundland and Labrador	Threatened	No Status
Atlantic Bluefin Tuna[b]	*Thunnus thynnus*	-	Endangered	No Status
Atlantic Cod	*Gadus morhua*	Newfoundland and Labrador/Laurentian North	Endangered	No Status
Atlantic Salmon[bc]	*Salmo salar*	Northeast Newfoundland/South Newfoundland	Not at Risk/Threatened	No Status
Atlantic Sturgeon[b]	*Acipenser oxyrinchus*	Maritimes	Threatened	No Status
Atlantic Walrus[b]	*Odobenus rosmarus rosmarus*	Northwest Atlantic/-	Non-active/Special Concern	Extirpated/No Status
Atlantic Wolffish	*Anarhichas lupus*	-	Special Concern	Special Concern
Banded Killifish[b]	*Fundulus diaphanus*	Newfoundland	Special Concern	Special Concern
Barrow's Goldeneye[bc]	*Bucephala islandica*	Eastern Population	Special Concern	Special Concern
Basking Shark[b]	*Cetorhinus maximus*	Atlantic	Special Concern	No Status
Blue Shark[b]	*Prionace glauca*	Atlantic	Not at Risk	No Status
Blue Whale[bc]	*Balaenoptera musculus*	Atlantic	Endangered	Endangered
Cusk[b]	*Brosme brosme*	-	Endangered	No Status
Deepwater Redfish[a]	*Sebastes mentella*	Gulf of St. Lawrence-Laurentian Channel/Northern Population	Endangered/ Threatened	No Status
Fin Whale[bc]	*Balaenoptera physalus*	Atlantic	Special Concern	Special Concern
Harbour Porpoise[bc]	*Phocoena phocoena*	Northwest Atlantic	Special Concern	Threatened

Common Name	Scientific Name	Population	COSEWIC Status	SARA Status
Harlequin Duck[bc]	*Histrionicus histrionicus*	Eastern Population	Special Concern	Special Concern
Ivory Gull[e]	*Pagophila eburnea*	Newfoundland and Labrador	Endangered	Endangered
Killer Whale[bc]	*Orcinus orca*	Northwest Atlantic/Eastern Arctic	Special Concern	No Status
Leatherback Turtle[bc]	*Dermochelys coriacea*	Atlantic	Endangered	No Status
Loggerhead Turtle[bc]	*Caretta caretta*	-	Endangered	No Status
North Atlantic Right Whale[bc]	*Eubalaena glacialis*	-	Endangered	Endangered
Northern Bottlenose Whale[be]	*Hyperoodon ampullatus*	Scotian Shelf	Endangered	Endangered
Northern Wolffish	*Anarhichas denticulatus*	-	Threatened	Threatened
Porbeagle[b]	*Lamna nasus*	-	Endangered	No Status
Roughhead Grenadier	*Macrourus berglax*	-	Special Concern	No Status
Roundnose Grenadier	*Coryphaenoides rupestris*	-	Endangered	No Status
Shortfin Mako[b]	*Isurus oxyrinchus*	Atlantic	Threatened	No Status
Smooth Skate	*Malacoraja senta*	Funk Island Deep/Laurentian-Scotian	Endangered/Special Concern	No Status
Sowerby's Beaked Whale[be]	*Mesoplodon bidens*	-	Special Concern	Special Concern
Spotted Wolffish	*Anarhichas minor*	-	Threatened	Threatened
Thorny Skate	*Amblyraja radiata*	-	Special Concern	No Status
White Hake	*Urophycis tenuis*	Atlantic and Northern Gulf of St. Lawrence	Threatened	No Status
White Shark[b]	*Carcharodon carcharias*	Atlantic	Endangered	Endangered
Winter Skate[d]	*Leucoraja ocellata*	Eastern Scotian Shelf-Newfoundland	Endangered	No Status

[a]Data for Deepwater and Acadian Redfish species combined to generate one layer for these species.
[b]Survey data not available to generate a data layer for this species.
[c]Other data sources used to generate a data layer for this species.
[d]Data only available from spring Campelen time series.
[e]Data insufficient to create individual layer so species was grouped in functional group.

Table 5: List of additional offshore biological data layers used for overlay, verification and description of EBSAs. Data sources and types for each layer are described. None of these data layers were included in the Cell Statistics analysis for composite layers.

Data Group	Data Layers	Data Source	Source Data Type
Fish	• American Plaice spawning	- Walsh et al. 2001	Digitized polygon*
-	• Haddock	- Ollerhead et al. 2004	Digitized polygon*
-	• Halibut	- Kulka et al. 2003	Digitized polygon*
-	• Redfish spawning	- Ollerhead et al. 2004	Digitized polygon*
-	• Smooth Skate	- Kulka et al. 2006	Digitized polygon*
-	• Spotted Wolffish	- Kulka et al. 2003	Digitized polygon*
-	• Spiny dogfish adults	- Kulka 2006	Digitized polygon*
-	• Atlantic Wolffish	- Kulka et al. 2003	Digitized polygon*
-	• Yellowtail Flounder feeding	- Kulka et al. 2003	Digitized polygon*
-	• Yellowtail Flounder (large area)	- Walsh et al. 2001	Digitized polygon*
-	• Yellowtail Flounder (small area)	- Walsh et al. 2001	Digitized polygon*
-	• Black dogfish	- Kulka 2006	Digitized polygon*
Cetaceans	• Squid eaters functional group	NAISS	Survey points
-	• Small cetaceans functional group	NAISS	Survey points
-	• Mysticetes functional group	NAISS	Survey points
-	• Killer Whale	NAISS	Survey points
-	• Blue Whale	NAISS	Survey points
-	• Blue Whale important habitat	Unpublished data (in press)	Peer reviewed polygon
Seals	• Harp Seal	NAISS	Survey points
-	• Harbour Seal	NAISS	Survey points
Marine mammals	• Marine mammals	- Sjare et al. 2003, DFO 2016	Digitized polygons*
Leatherback Turtle	• Leatherback Turtle important habitat	DFO 2012	Peer reviewed polygon
-	• Leatherback Turtle	NAISS	Survey points
Corals	• Corals	- Edinger et al. 2007	Digitized polygon*
-	• Small gorgonians SBA	- Kenchington et al. 2016b	Peer reviewed polygon
-	• Sea pens SBA	- Kenchington et al. 2016b	Peer reviewed polygon
-	• Large gorgonians SBA	- Kenchington et al. 2016b	Peer reviewed polygon
-	• Pennatula abundance	- Baker et al. 2012	Peer reviewed points
-	• Keratosis abundance	- Baker et al. 2012	Peer reviewed points
-	• Flabellum abundance	- Baker et al. 2012	Peer reviewed points
-	• Acanella abundance	- Baker et al. 2012	Peer reviewed points

Data Group	Data Layers	Data Source	Source Data Type
Sponges	• Sponges SBA	- Kenchington et al. 2016b	Peer reviewed polygon
Other	• Ichthyoplankton	- Bradbury et al. 2003	Digitized polygon*
	• Goblin head research transect	- Haedrich and Gagnon, 1990	Digitized polygon*

*Polygons were digitized based on published sources during the 2008 review or for the 2016 EBSA refinement process.

Table 6: Exceptions to criteria for defining key ecosystem features, including related data layers.

Ecosystem feature	Data layers included	Exception	Rationale for exception
Eelgrass habitat	Eelgrass habitat	All eelgrass habitat considered as key features.	Eelgrass is an ecologically significant species (DFO 2009). Eelgrass plays an important role in the physical structuring of the nearshore marine environments and eelgrass meadows have extremely high levels of primary production. If the species were to be perturbed severely, the ecological consequences would be substantially greater than an equal perturbation of most other species associated with this community. For these reasons, eelgrass was considered as a key feature of any EBSA in which it was found.
Capelin spawning	Capelin spawning sites	All capelin spawning sites considered as key features.	The size of Capelin spawning sites relative to the size of most EBSAs is not a good measure of its ecological significance. Capelin spawning sites are indicators of the presence of these forage fish at specific time of the year but during that time these sites are highly productive and ecologically significant. Capelin play a crucial role in the ecosystem in providing a link between zooplankton and large vertebrates (Buren et al. 2014; Lavigne 1996). For this reason, the spawning locations of these important forage fish were considered key features of any EBSA in which they were found.
SBAs	Large gorgonian SBAs, small gorgonian SBAs, sea pen SBAs, sponge SBAs	All SBAs considered key features.	SBAs are, by definition, benthic areas that are ecologically and biologically significant. The EBSA criteria are applied, along with other criteria that determine sensitivity of the area to proposed or ongoing fishing activity, to identify significant benthic areas (Fisheries and Oceans Canada). As these areas have already undergone rigorous peer review, it was decided that they would be considered key features of any EBSA they were found in.
Seabird colonies (including foraging buffers)	Atlantic Puffin, Common Murre, Thick-billed Murre, Razorbill, Black-legged Kittiwake, tern sp., and Northern Gannet colonies and foraging buffers, to a maximum of 60km	Clusters of colonies, or very large individual colonies in terms of numbers When within top decile for more than one species, included as key features. The inner 60 km of the Northern Gannet foraging range can be considered a key feature.	The spatial size or geographic extent of a seabird colony (or cluster of colonies) as it relates to the size of an EBSA is not a good measure of its ecological significance. The number of colonies in one area, or the number of individuals (e.g. breeding pairs) or the number of co-occurring species are better indicators of ecological significance and persistence, so these values were used to determine if colonies were ecologically significant according to EBSA criteria, and therefore key to a certain EBSA. Further, some seabird species are recognized as indicators of marine health and productivity (e.g. Davoren and Montevecchi 2003). This may be especially useful to EBSA assessment in the absence of distribution, abundance and persistence information relating to the local seabird prey community (e.g. capelin, herring).

Ecosystem feature	Data layers included	Exception	Rationale for exception
Seabird colonies (including foraging buffers)	Northern Fulmar, Leach's Storm-Petrel, and Northern Gannet colonies and foraging buffers	As foraging ranges of these species are very large, foraging buffers delineated by mean maximum foraging range would largely surpass the scale of all other key features. As such, they are not considered key features.	The foraging ranges of these species are very large and as a result cover huge portions of the study area. However, Northern Gannet in particular, is generally more reliant on local rather than distant resources within its foraging range. Its presence can be interpreted generally as indicative of local resource availability, constituting evidence valuable for EBSA identification. Northern Fulmar is very susceptible to vessel attraction, specifically active fishing vessels, with consequent reliance on anthropogenic food. Through telemetry, Leach's Storm-Petrel has been shown to travel from colonies to distant foraging areas beyond the shelf break, and should be seen as an indicator of marine productivity at those locations, and at larger spatial scales.
Seabird colonies (including foraging buffers)	Great Black-backed Gull and Herring Gull colonies and foraging buffers	Not considered key features.	These large gull species are generalists with broad diets, including varying and opportunistic reliance on anthropogenic food resources (e.g. fisheries offal, fish processing, refuse). As such, they are not considered prime indicators of marine ecosystem health and productivity, but rather may be more suited to the monitoring of pollutants in the coastal environment (Steenweg 2010).
Waterfowl areas	Dabbling Ducks coastal waterfowl survey block polygons	Not considered a key feature, though one found within EBSA.	Dabbling Ducks are more abundant in northern areas and the area in the Eastern Avalon EBSA is not considered particularly significant when compared to other parts of the bioregion.
Bird IBAs	All IBAs	Not considered key features.	Given the same general data were used to inform their identification, IBAs were used as a confirmatory tool to validate areas of importance for marine birds IBA narrative information also was used to help describe areas identified as EBSAs. However, as IBAs were not used to identify or delineate EBSAs, they were not considered to be key features of any EBSA.

Table 7: List of Coastal EBSAs indicating key features used to identify and delineate the EBSAs as defined by the Uniqueness, Aggregation and Fitness Consequences criteria, as well as presence of at-risk species.

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
Bonavista Bay (3L)	• Sea Lamprey spawning population	• Eelgrass habitat • Salmon • Sea duck functional group • Killer Whale • Mysticetes functional group • Harbour Seal	• Capelin spawning • Sea Lamprey spawning • Significant colonies/foraging - Black-legged Kittiwake - Tern sp.	• Salmon • Killer Whale
Smith Sound (3L)	• Expansive eelgrass bed	• Eelgrass habitat • Killer Whale • Mysticetes functional group • Small cetaceans functional group	• Capelin spawning • Significant colonies/foraging - Atlantic Puffin - Black-legged Kittiwake - Tern sp.	• Killer Whale
Baccalieu Island (3L)	-	• Killer Whale • Mysticetes functional group • Capelin • Shrimp • Plankpiscivores (fish) • Spotted Wolffish • Pursuit-diving piscivores (seabird functional group) • Surface-seizing plankpiscivores (seabird functional group)	• Capelin spawning • Significant colonies/foraging - Atlantic Puffin - Razorbill - Black-legged Kittiwake	• Spotted Wolffish • Killer Whale
Eastern Avalon (3L)	• Atlantic Puffin colonies • Common Murre colonies • Thick Billed Murre colonies • Northern Fulmar colonies	• Eelgrass habitat • Capelin • American Plaice • Killer Whale • Mysticetes functional group • Plunge-diving Piscivores (seabird functional group) • Pursuit-diving piscivores (seabird functional group) • Surface, shallow-diving piscivores (seabird functional group)	• Capelin spawning • Significant colonies/foraging - Atlantic Puffin - Common Murre - Razorbill - Thick-billed Murre - Black-legged Kittiwake - Northern Fulmar	• American Plaice • Killer Whale
St. Mary's Bay (3L)	• Common Murre colonies • Northern Gannet colonies	• Eelgrass habitat • Salmon	• Capelin spawning • Significant colonies/foraging - Common Murre	• Salmon • Harlequin Duck

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
	• Harlequin Duck	• Common Eider (sea duck) • Harlequin Duck (sea duck; SARA SC) • Capelin • Mysticetes functional group • Hooded Seal • Leatherback Turtle • Plunge-diving piscivores (seabird functional group)	- Razorbill - Black-legged Kittiwake - Northern Gannet**	• Leatherback Turtle
Placentia Bay (3Ps)	• Leatherback Turtle	• Eelgrass habitat • Salmon • Large gorgonian corals • Sponges • Hooded Seal • Mysticetes functional group • Leatherback Turtle • Blue Whale • Plunge-diving piscivores (seabird functional group) • Shearwater sp. (shallow pursuit generalist seabird species; non-breeding only) • Icthyoplankton • Marine Mammals	• Capelin spawning • Significant colonies/foraging - Common Murre - Razorbill - Black-legged Kittiwake - Northern Gannet** - Tern sp.	• Salmon • Leatherback Turtle • Blue Whale

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
South Coast (3P)	• Common Eider colonies	• Eelgrass habitat • Shrimp • Atlantic Cod • Redfish • Piscivores (fish) • Planktivores (fish) • Plankpiscivores (fish) • Black Dogfish • Smooth Skate • Sea pens • Sponges • Surface, shallow-diving coastal piscivores (seabird functional group) • Surface, shallow-diving piscivores (seabird functional group) • Blue Whale • Hooded Seal • Grey Seal	• Common Eider colonies	• Atlantic Cod • Redfish • Blue Whale

*As per Wells et al. 2017, fitness consequences would apply to all areas where at-risk species IAs were found.

**60 km buffer could be considered a key feature for Northern Gannet, though mean maximum foraging range can be much greater.

Table 8: List of Offshore EBSAs indicating key features used to identify and delineate the EBSAs as defined by the Uniqueness, Aggregation and Fitness Consequences criteria, as well as presence of at-risk species.

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
Northeast Slope (3L)	• Shrimp • Greenland Halibut • Northern Wolffish • Spotted Wolffish • Roughhead Grenadier • Black corals	• Capelin • Shrimp • Greenland Halibut • Witch Flounder • American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Spotted Wolffish • Thorny Skate • Smooth Skate • Roughhead Grenadier • Piscivores (fish) • Planktivores (fish) • Plankpiscivores (fish) • Small benthivores (fish) • Medium benthivores (fish) • Large benthivores (fish) • Large gorgonian corals • Sea pens • Black corals • Soft corals • Sponges • Common Murre (seabird; pursuit-diving piscivore; non-breeding) • Thick-billed Murre (seabird; pursuit-diving piscivore; non-breeding) • Hooded Seal	-	• American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Spotted Wolffish • Thorny Skate • Smooth Skate • Roughhead Grenadier
Virgin Rocks (3LO)	• Unique geomorphological feature	• Sand Lance • Capelin • American Plaice • Sooty Shearwater • Thick-billed Murre • Killer Whale	-	• American Plaice • Killer Whale

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
Lilly Canyon-Carson Canyon (3N)	• Roughhead Grenadier	• Snow Crab • Greenland Halibut • American Plaice • Redfish • Roughhead Grenadier • Thorny Skate • Small benthivores (fish) • Common Murre • Sooty Shearwater • Shallow pursuit generalists (seabirds) • Surface, shallow-diving piscivores (seabirds) • Blue Whale • Harp Seals (winter feeding) • Soft corals • Sponges	-	• American Plaice • Redfish • Roughhead Grenadier • Thorny Skate • Blue Whale
Southeast Shoal (3NO)	• Offshore Capelin spawning • Yellowtail Flounder (juveniles, spawning, feeding) • American Plaice spawning	• Sand Lance • Yellowtail Flounder • Witch Flounder • American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Thorny Skate • White Hake • Medium benthivores (fish) • Large benthivores (fish) • Shallow pursuit generalists (seabirds)	• Capelin spawning • Yellowtail Flounder (juveniles, spawning, feeding) • American Plaice spawning	• American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Thorny Skate • White Hake

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
Southwest Slope (3OPs)	• Small gorgonian corals • Roundnose Grenadier • Haddock feeding and spawning • Redfish spawning	• Witch Flounder • Atlantic Halibut • American Plaice • Atlantic Cod • Northern Wolffish • Redfish • Roundnose Grenadier • Smooth Skate • Thorny Skate • White Hake • Winter Skate • Small benthivores (fish) • Large benthivores (fish) • Planktivores (fish) • Plankpiscivores (fish) • Piscivores (fish) • Surface, shallow-diving piscivores (seabirds) • Blue Whale • Black corals • Small gorgonian corals • Large gorgonian corals • Stony cup corals • Sea pens	• American Plaice spawning • Redfish spawning • Haddock feeding and spawning	• American Plaice • Atlantic Cod • Redfish • Northern Wolffish • White Hake • Smooth Skate • Roundnose Grenadier • Thorny Skate • Winter Skate • Blue Whale
Haddock Channel Sponges (3O)	• Largest sponge SBA on the shelf in the study area	• Sponges • Capelin • American Plaice	-	• American Plaice

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
Laurentian Channel (3P)	• Greenland Halibut • Winter Skate	• Greenland Halibut • Witch Flounder • Smooth Skate • Spotted Wolffish • Thorny Skate • White Hake • Winter Skate • Black Dogfish • Spiny Dogfish • Small benthivores (fish) • Medium benthivores (fish) • Large benthivores (fish) • Planktivores (fish) • Plankpiscivores (fish) • Piscivores (fish) • Sea pens • Small gorgonian corals	-	• White Hake • Smooth Skate • Spotted Wolffish • Thorny Skate • Winter Skate • Blue Whale

*As per Wells et al. 2017, fitness consequences would apply to all areas where at-risk species IAs were found.

Table 9: Physical features and sizes (km^2) of Coastal EBSAs.

EBSA (NAFO Div)	Physical Features	EBSA Size (km^2)
Bonavista Bay (3L)	Bonavista Bay/Fjord Province including Cape Freels North extending south to King's Cove.	3,140.90
Smith Sound (3L)	Trinity Bay/Fjord Province including the headland east of Port Rexton south to the headland east of Shoal Bay; includes Smith Sound and the Southwest Arm of Random Sound.	547.32
Baccalieu Island (3L)	Outer Fjord Province and Avalon Channel extending from Bonavista south to Pouch Cove and including Baccalieu Island.	6,921.95
Eastern Avalon (3L)	Avalon Channel from Pouch Cove south to the southern boundary of Chance Cove Provincial Park.	5,947.60
St. Mary's Bay (3L)	Cape St. Mary's and St. Mary's Bay and surrounding waters from St. Bride's to St. Shott's.	3,988.55
Placentia Bay (3Ps)	Placentia Bay nearshore region, St. Pierre Channel and Halibut Channel from St. Lawrence to St. Bride's.	13,538.82
South Coast (3PnPs)	Includes northern portion of the Laurentian Channel as well as Rose Blanche Bank and waters just east of Ramea.	6,913.03

Table 10: Physical features and sizes (km^2) of Offshore EBSAs.

EBSA (NAFO Div)	Physical Features	EBSA Size (km^2)
Northeast Slope (3KL)	Includes the Trinity Moraine and portions of the Trinity Basin, Trinity Trough, Labrador Slope, Sackville Spur, Grand Banks Extension.	19,730.84
Virgin Rocks (3LN)	Includes Virgin Rocks/Eastern Shoals and portions of the Downing Channelized Zone and Outer Shelf Zone/Grand Bank.	7,294.17
Lilly Canyon-Carson Canyon (3N)	Includes Lilly Canyon and Carson Canyon as well as portions the Outer Shelf Zone/Grand Bank, Grand Banks Extension, and the Grand Banks Slope.	2,180.33
Southeast Shoal (3NO)	Includes portions of the Outer Shelf Zone/Grand Bank and the Southeast Shoal (inside the EEZ).	15,401.84
Southwest Slope (3Ops)	Includes portions of the Outer Shelf Zone/Grand Bank, Grand Banks Slope, Haddock Channel, Green Bank, Halibut Channel, St. Pierre Bank, and the Laurentian Fan.	25,180.96
Haddock Channel Sponges (3O)	Includes portions of the Avalon and Haddock Channels.	489.89
Laurentian Channel (3PnPs)	Includes the Laurentian Channel and portions of St. Pierre Bank and Hermitage Channel.	19,544.53

Table 11: Percent area of 2007 EBSAs captured within 2017 EBSA boundaries.

2007 EBSA	2017 EBSA	Percent overlap
Eastern Avalon	East Coast	100
Smith Sound	Smith Sound	100
Placentia Bay Extension	Placentia Bay	92.53
Southwest Shelf Edge and Slope	Southwest Slope	88.99
Virgin Rocks	Virgin Rocks	83.68
Laurentian Channel and Slope	Laurentian Channel	77.96
Lilly Canyon Carson Canyon	Lilly Canyon-Carson Canyon	76.95
Northeast Shelf and Slope	Northeast Slope	61.90
St. Pierre Bank	Laurentian Channel	46.63
Southeast Shoal and Tail of the Banks	Southeast Shoal	28.75
Burgeo Bank	South Coast	18.07
Laurentian Channel and Slope	South Coast	7.37
Placentia Bay Extension	St. Mary's Bay	2.42
Southeast Shoal and Tail of the Banks	Lilly Canyon-Carson Canyon	0.38

FIGURES

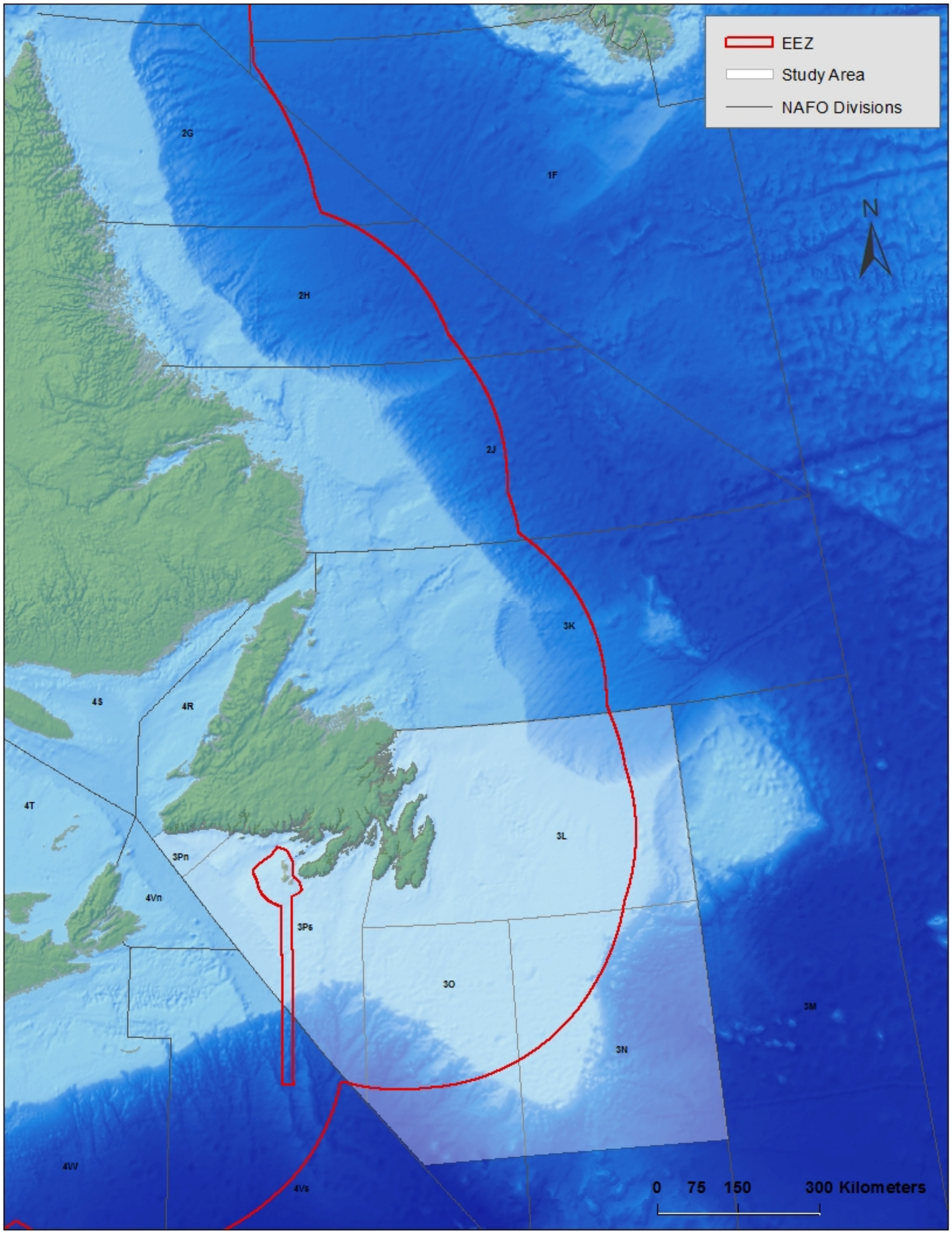

Figure 1: Placentia Bay Grand Banks study area showing NAFO Divisions 3LNOP boundaries and the EEZ boundary.

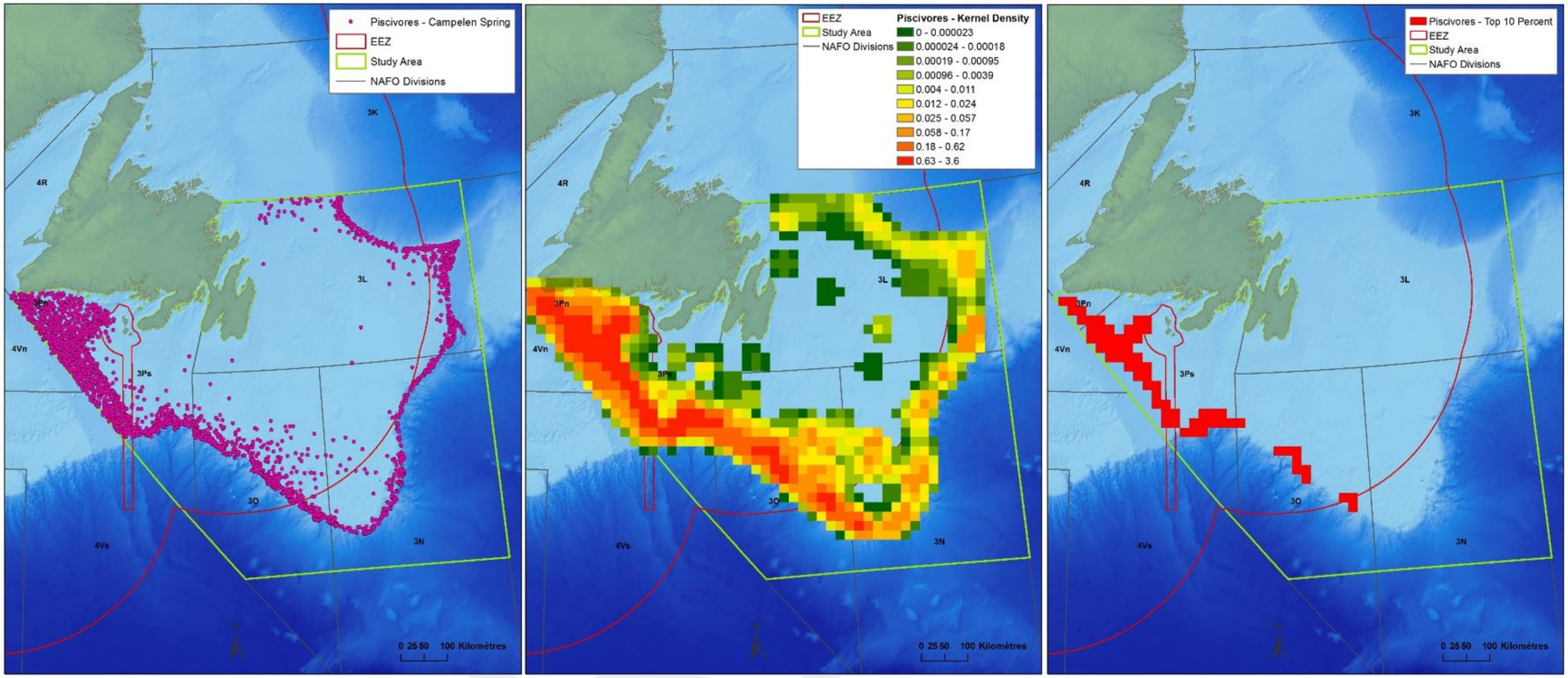

Figure 2: Illustration of GIS data processing flow for the piscivores fish functional group using Campelen spring data: initial point layer (left); kernel density surface generated from the point layer (middle); upper tenth percentile (i.e. high concentration area) polygon layer (right).

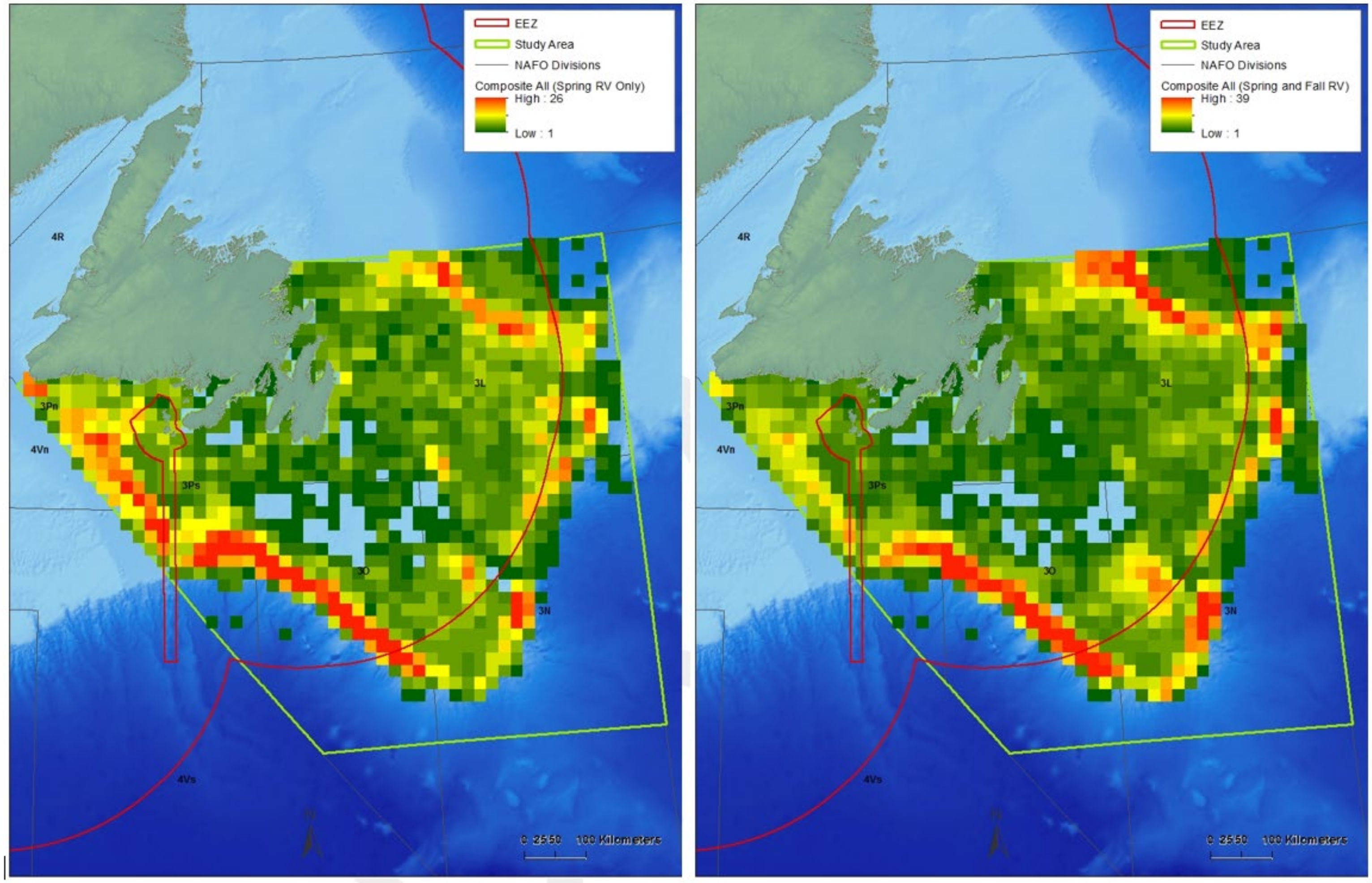

Figure 3: Cell statistics results for composite layers: spring RV data only plus all other offshore data layers (left); spring and fall RV data plus all other offshore data layers (right).

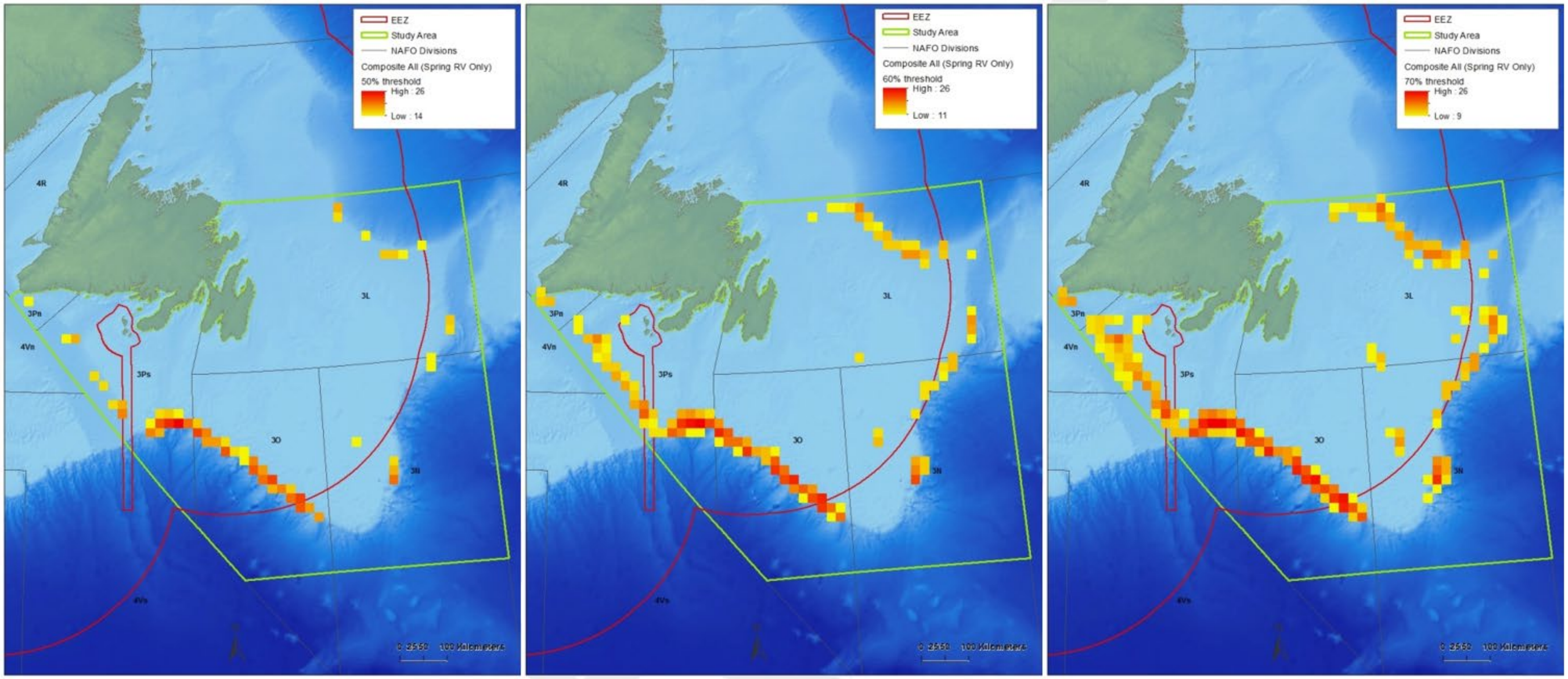

Figure 4: Maps showing areas extracted from spring only composite based on the following thresholds: 50% (left), 60% (middle), and 70% (right).

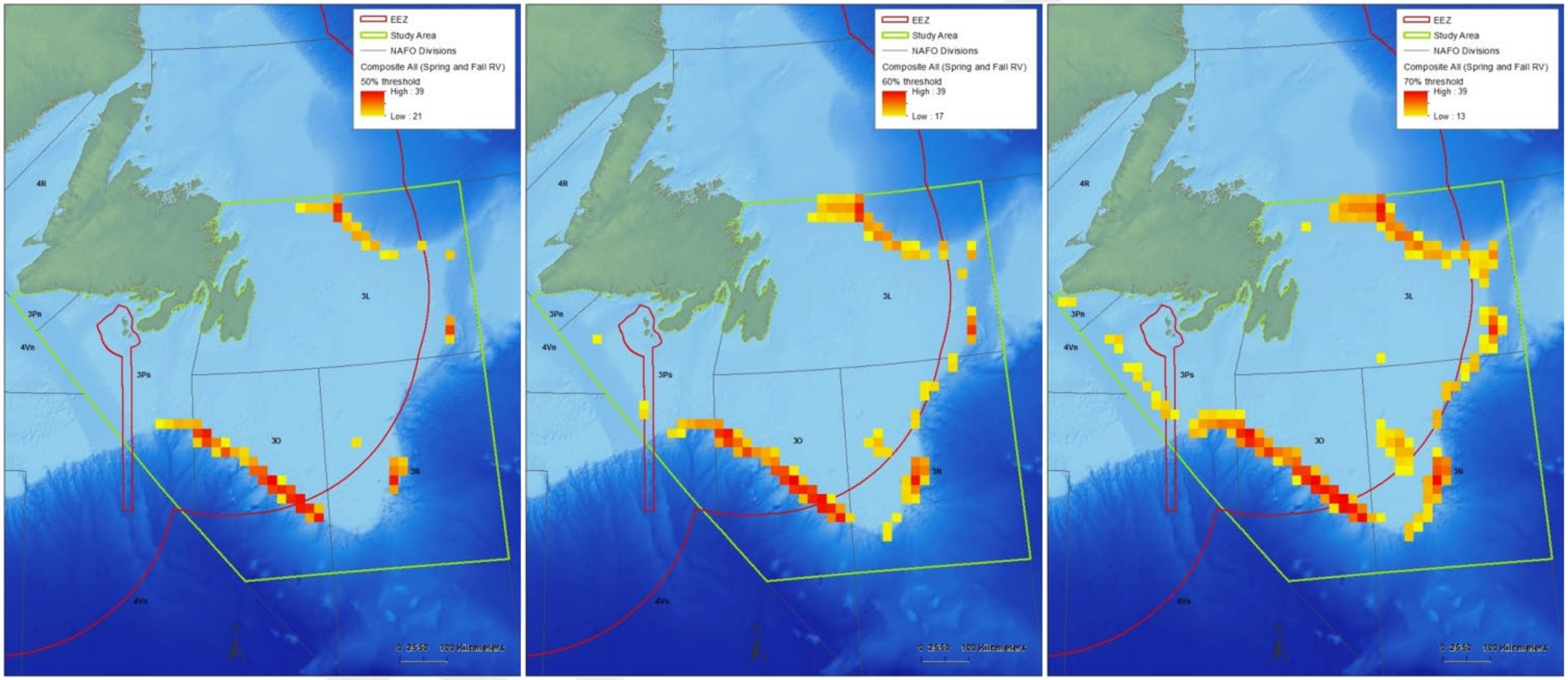

Figure 5: Maps showing areas extracted from spring and fall composite based on the following thresholds: 50% (left), 60% (middle), and 70% (right).

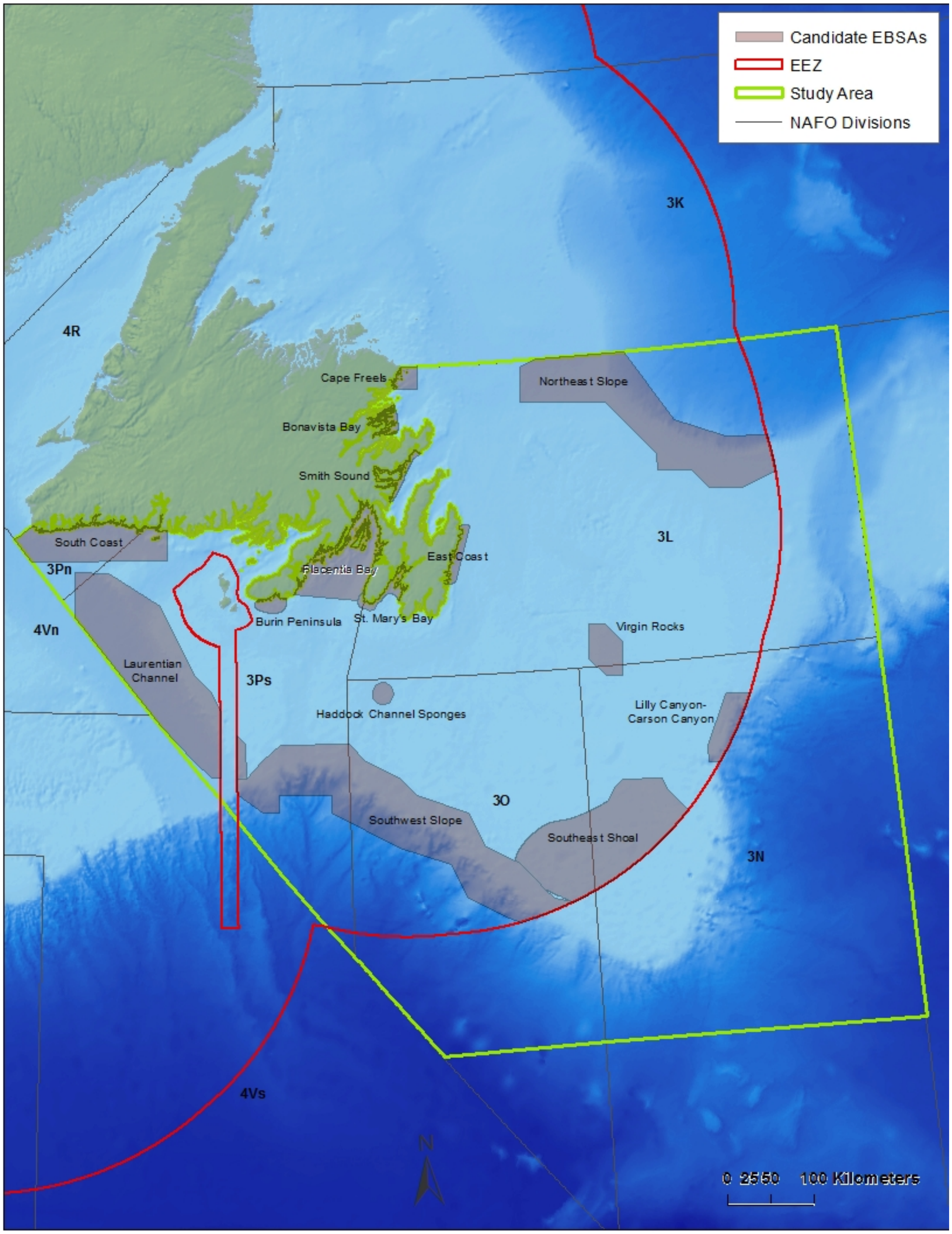

Figure 6: Map showing candidate EBSAs identified by steering committee prior to CSAS meeting.

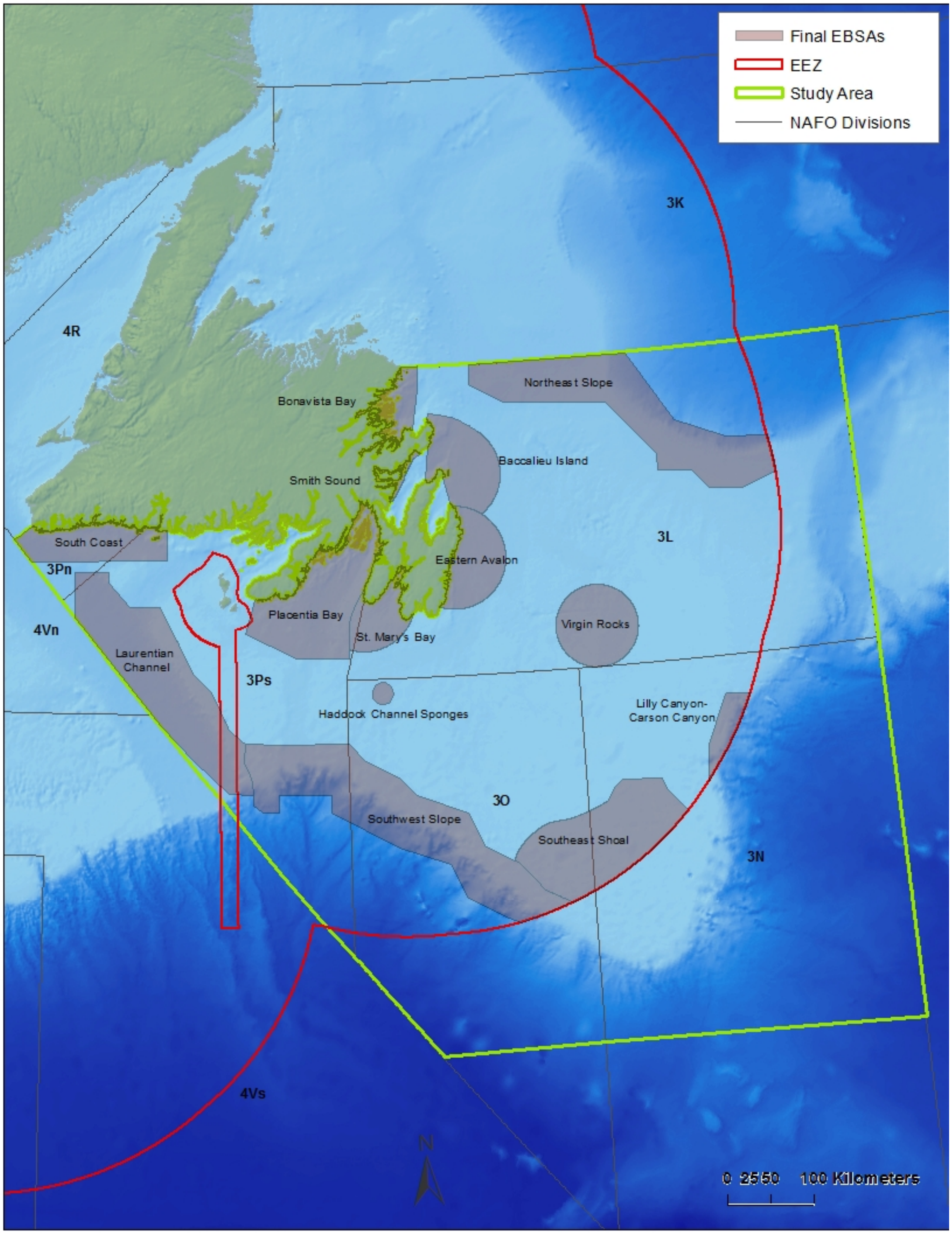

Figure 7: Map showing final EBSAs based on feedback from CSAS meeting.

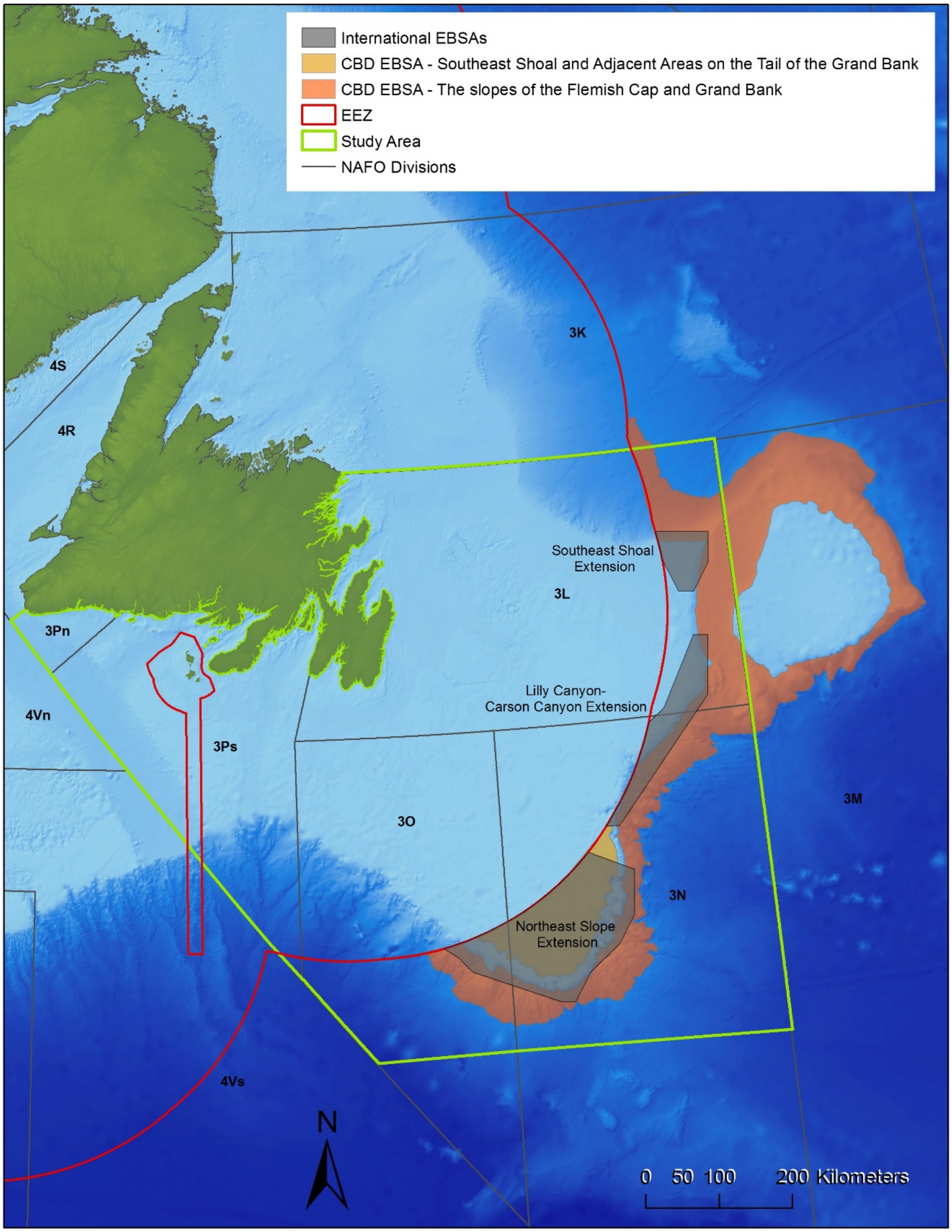

Figure 8: EBSAs identified in international waters based on composite layers.

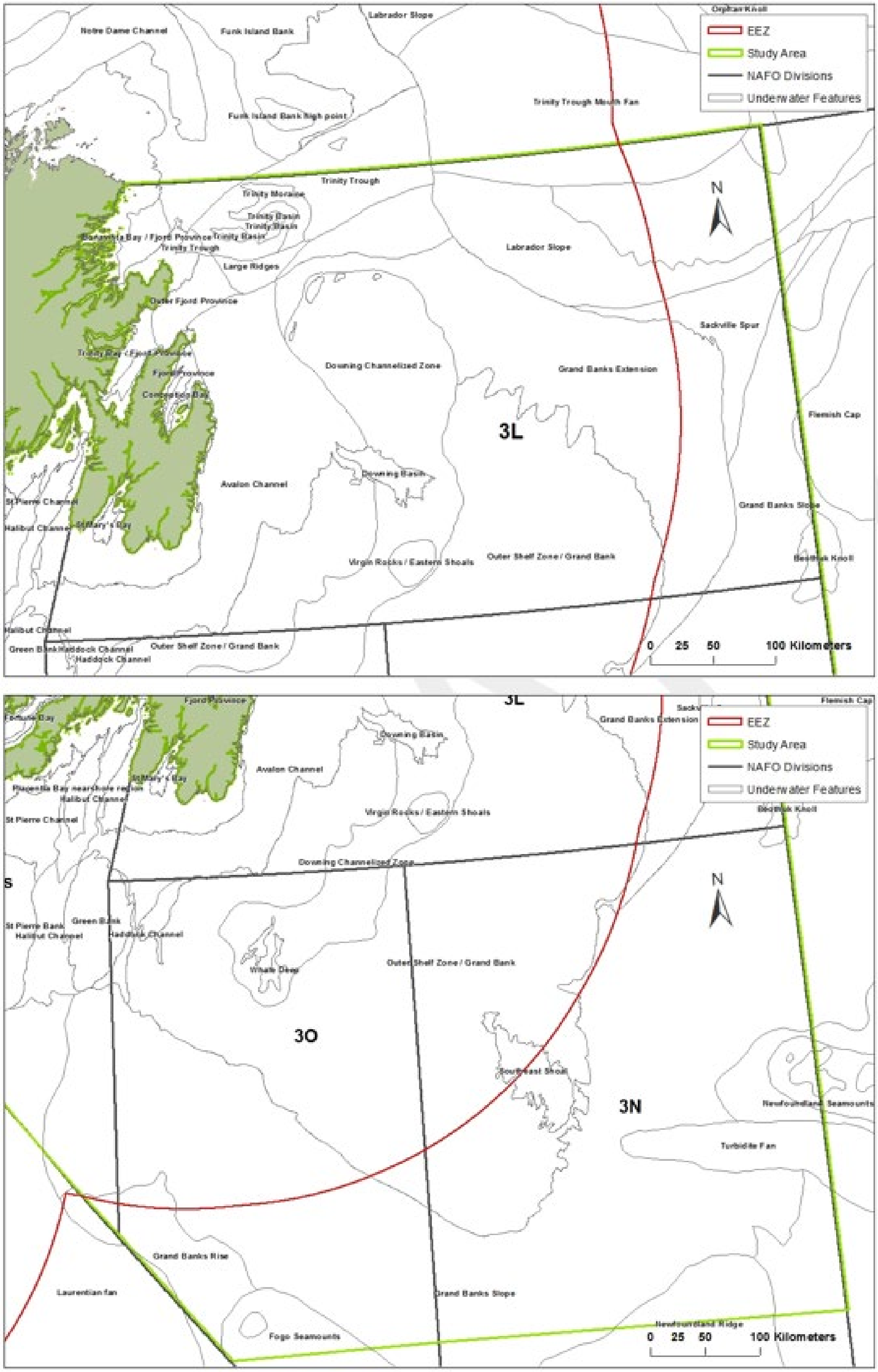

Figure 9: Underwater features of the PBGB Study Area: NAFO Division 3L (top); NAFO Divisions 3NO (bottom).

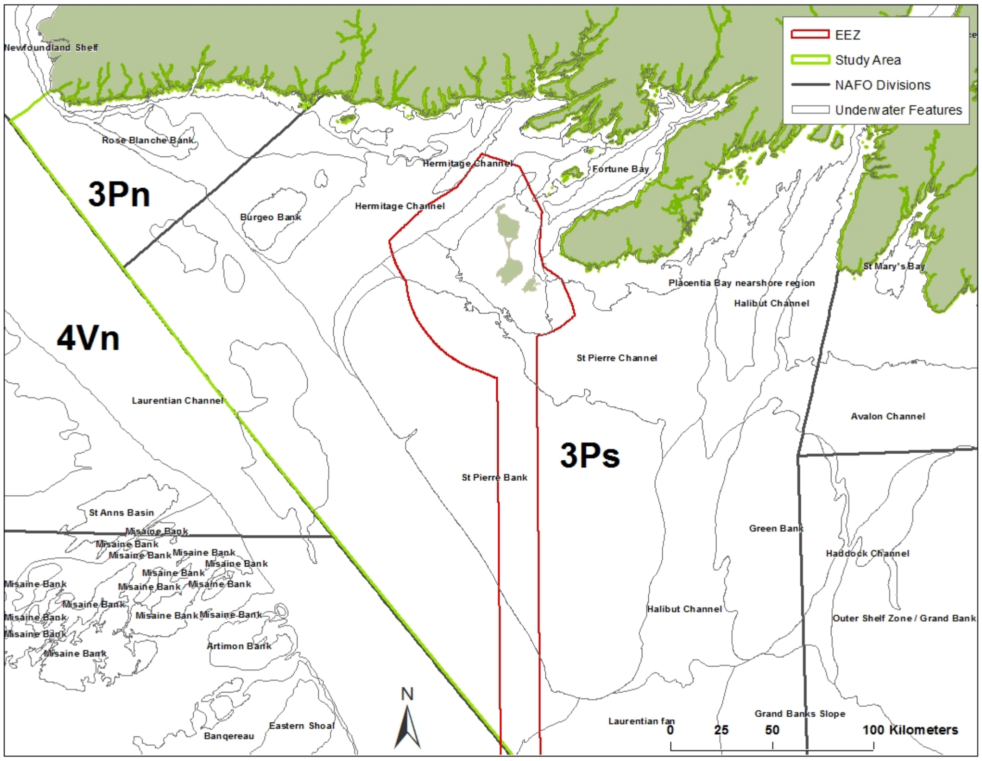

Figure 9 continued: Underwater features of the PBGB Study Area: NAFO Division 3P.

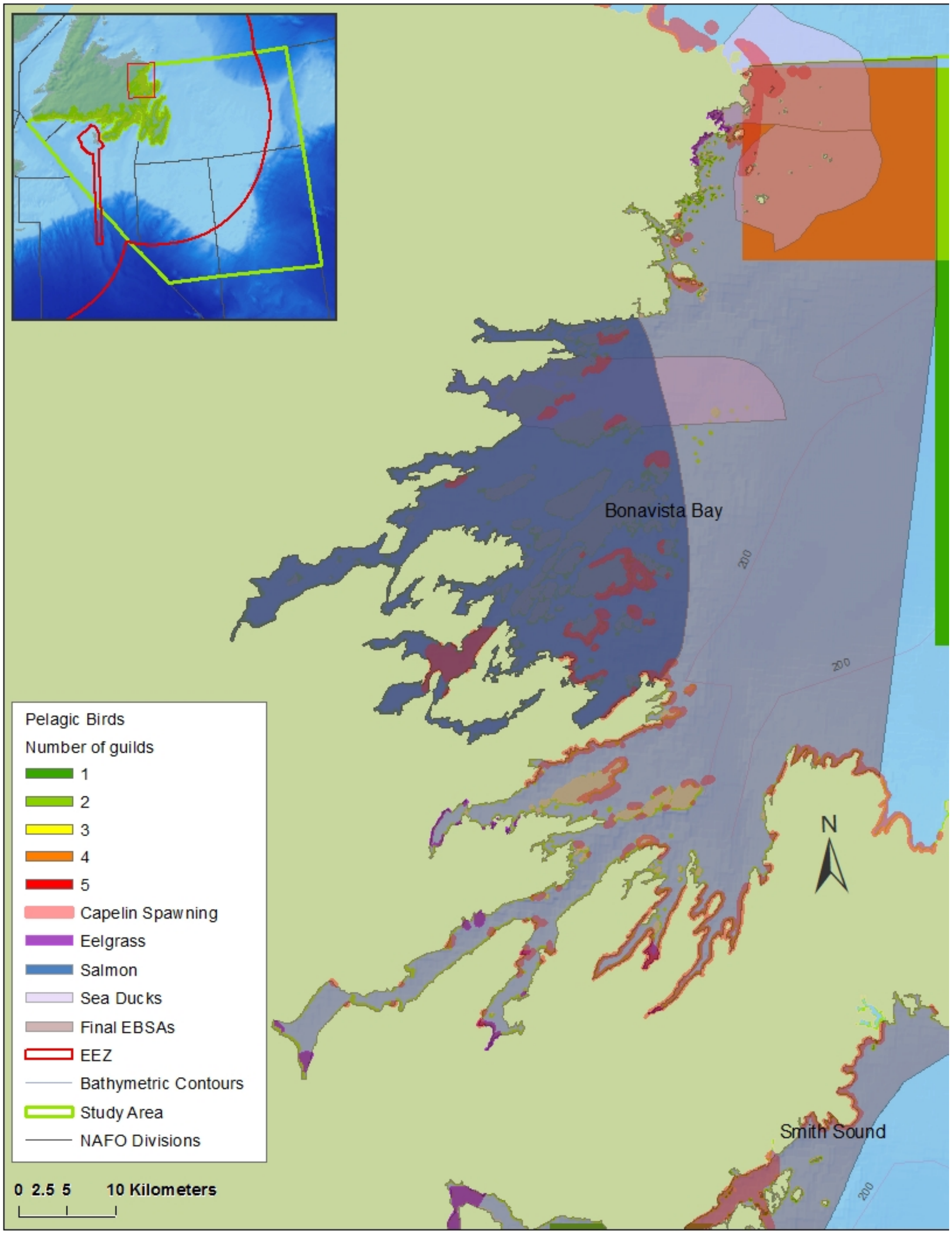

Figure 10: Map of Bonavista Bay EBSA showing cell statistics results for the pelagic seabird group layers, Capelin spawning areas, eelgrass habitat, Salmon areas and Sea Duck areas.

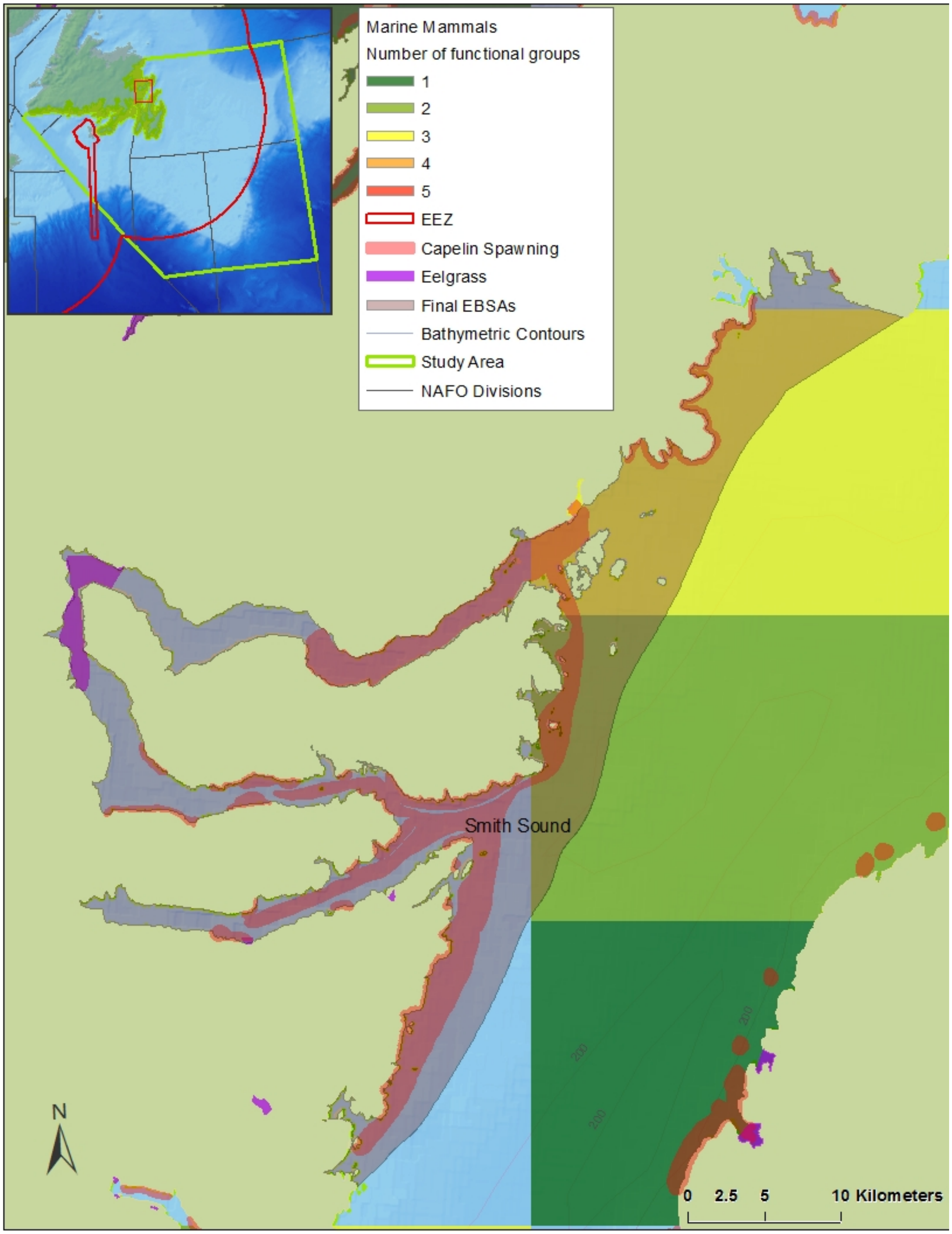

Figure 11: Map of Smith Sound EBSA showing cell statistics results for the Marine Mammals group layers, Capelin spawning areas and eelgrass habitat.

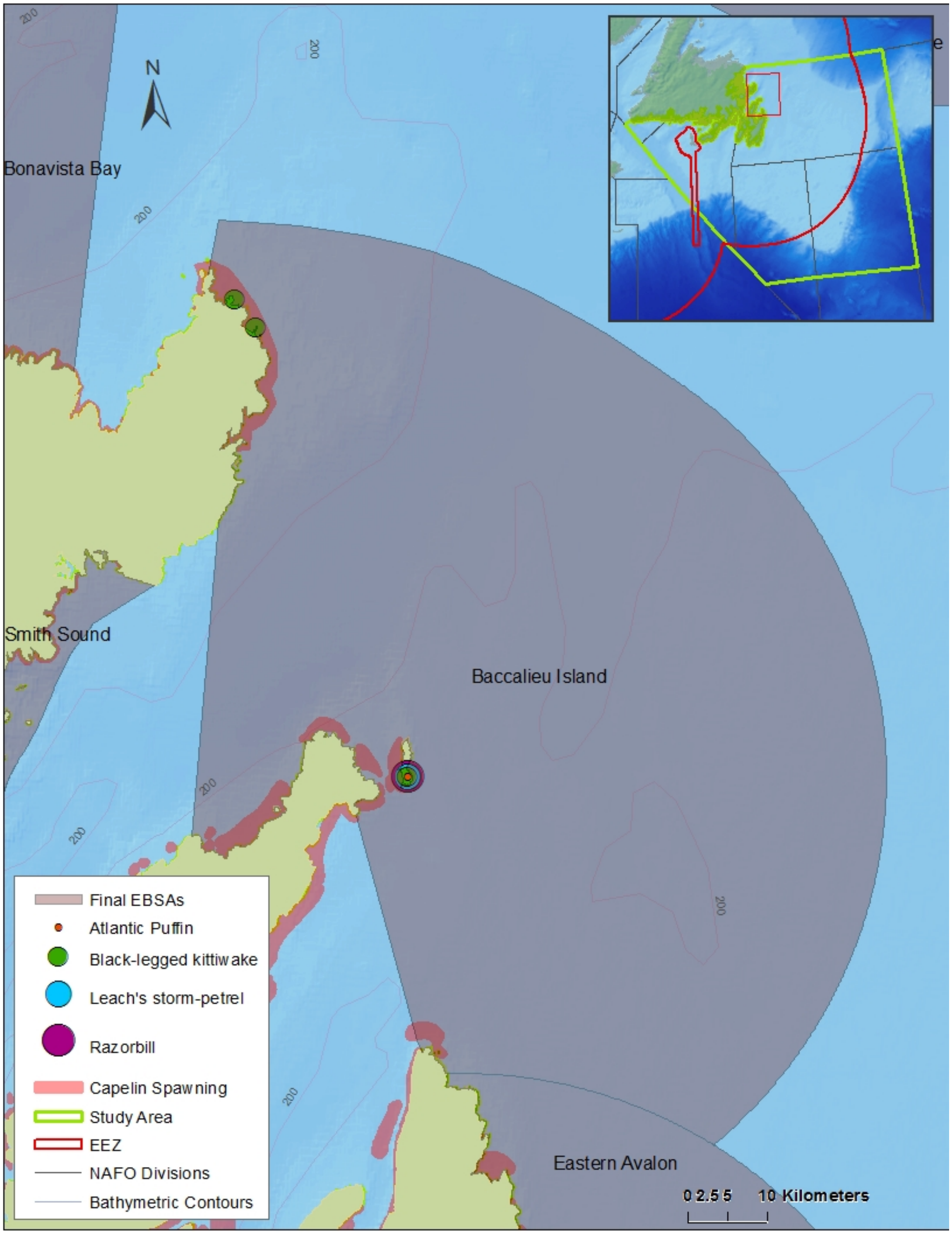

Figure 12: Map of Baccalieu Island EBSA showing seabird colonies and capelin spawning areas.

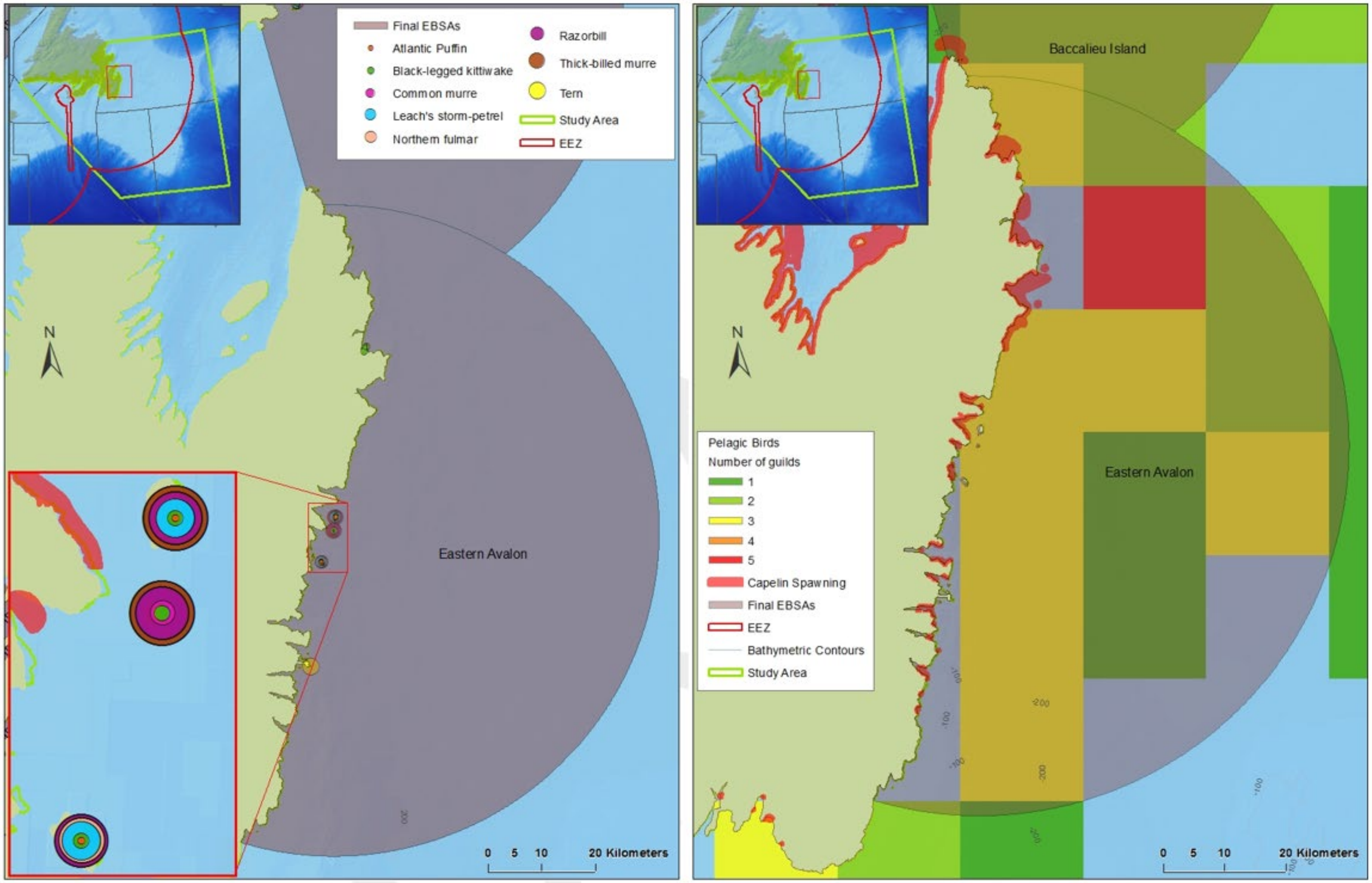

Figure 13: Map of Eastern Avalon EBSA showing seabird colonies (left), as well as Capelin spawning areas and cell statistics results for the pelagic seabird group layers (right).

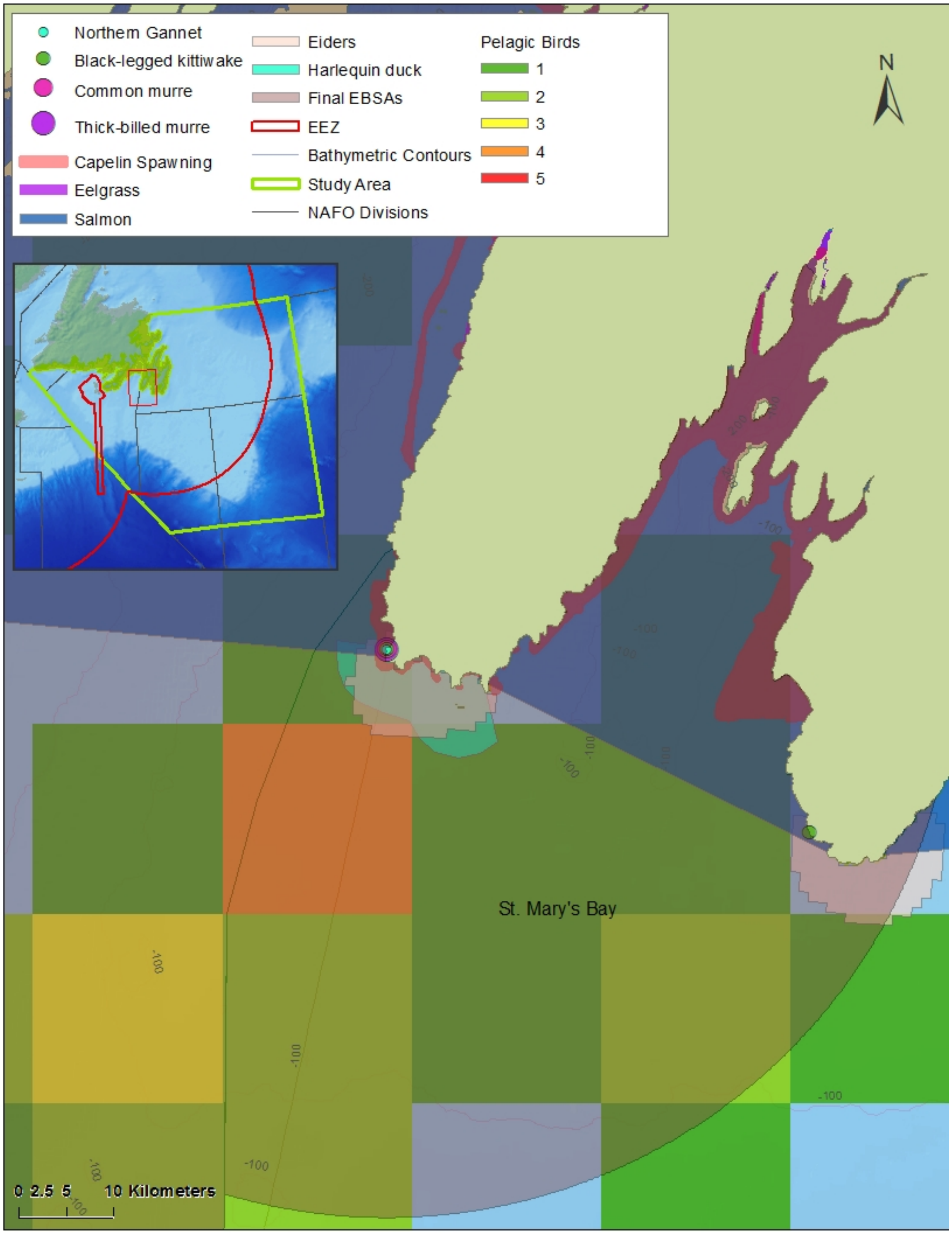

Figure 14: Map of St. Mary's Bay EBSA showing cell statistics results for pelagic seabirds group layers, areas for Harlequin Ducks and Common Eiders, seabird colonies, capelin spawning areas, salmon areas and eelgrass habitat.

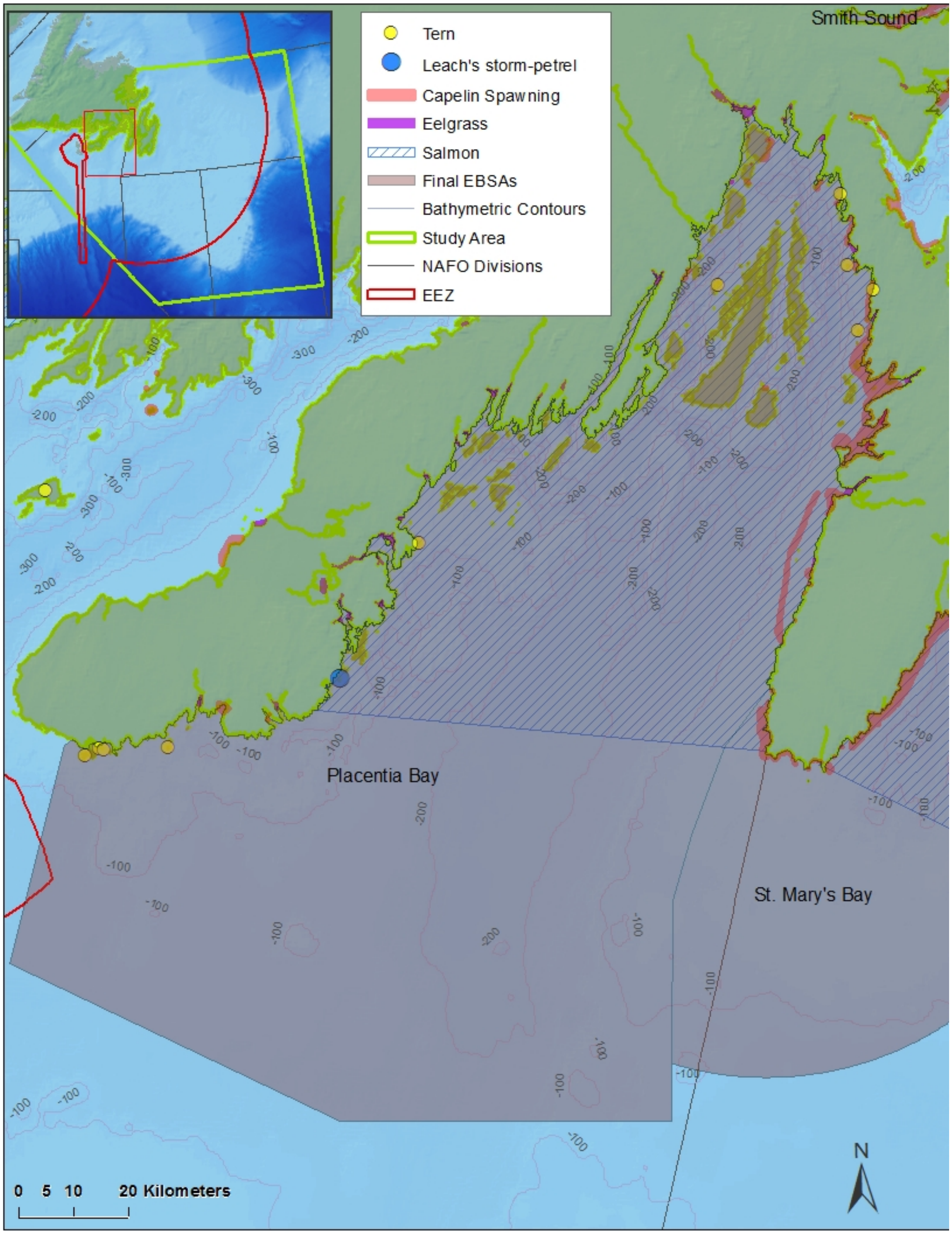

Figure 15: Map of Placentia Bay EBSA showing salmon areas, eelgrass habitat, capelin spawning beaches and seabird colonies.

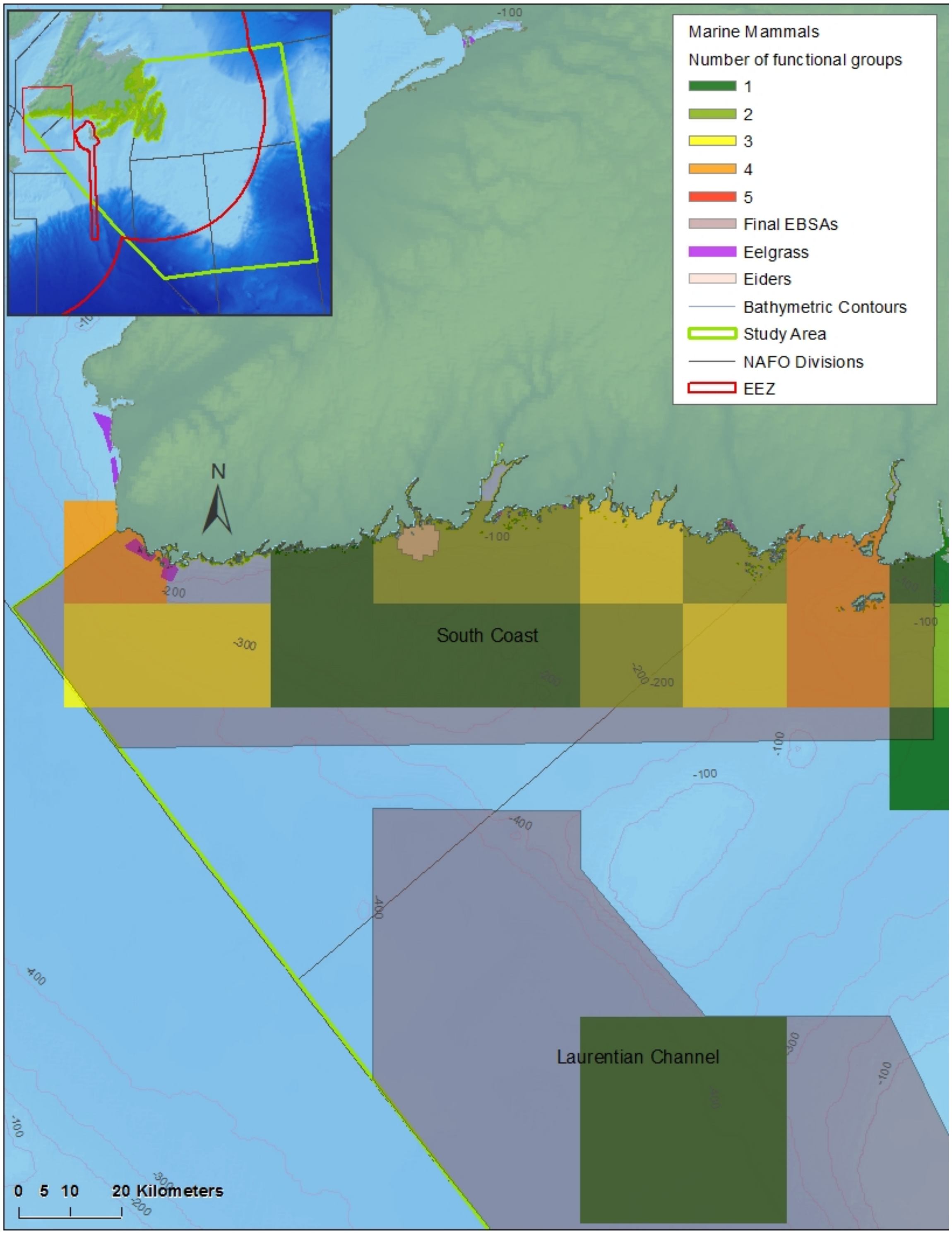

Figure 16: Map of South Coast EBSA showing the results of cell statistics for Marine Mammals group layers, eelgrass habitat and Common Eider areas.

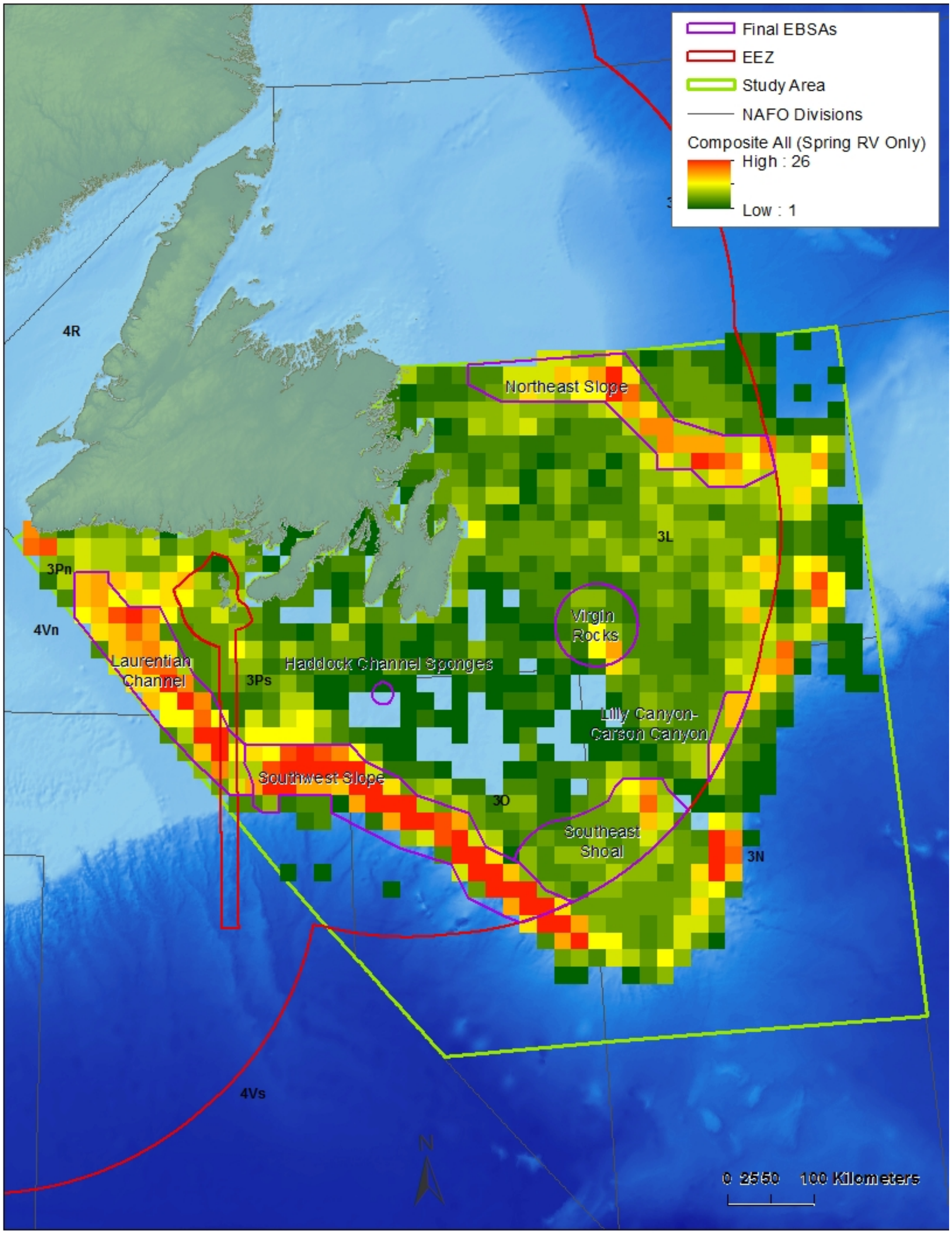

Figure 17: Map of offshore EBSAs showing cell statistics results for all offshore data layers including spring RV survey data only.

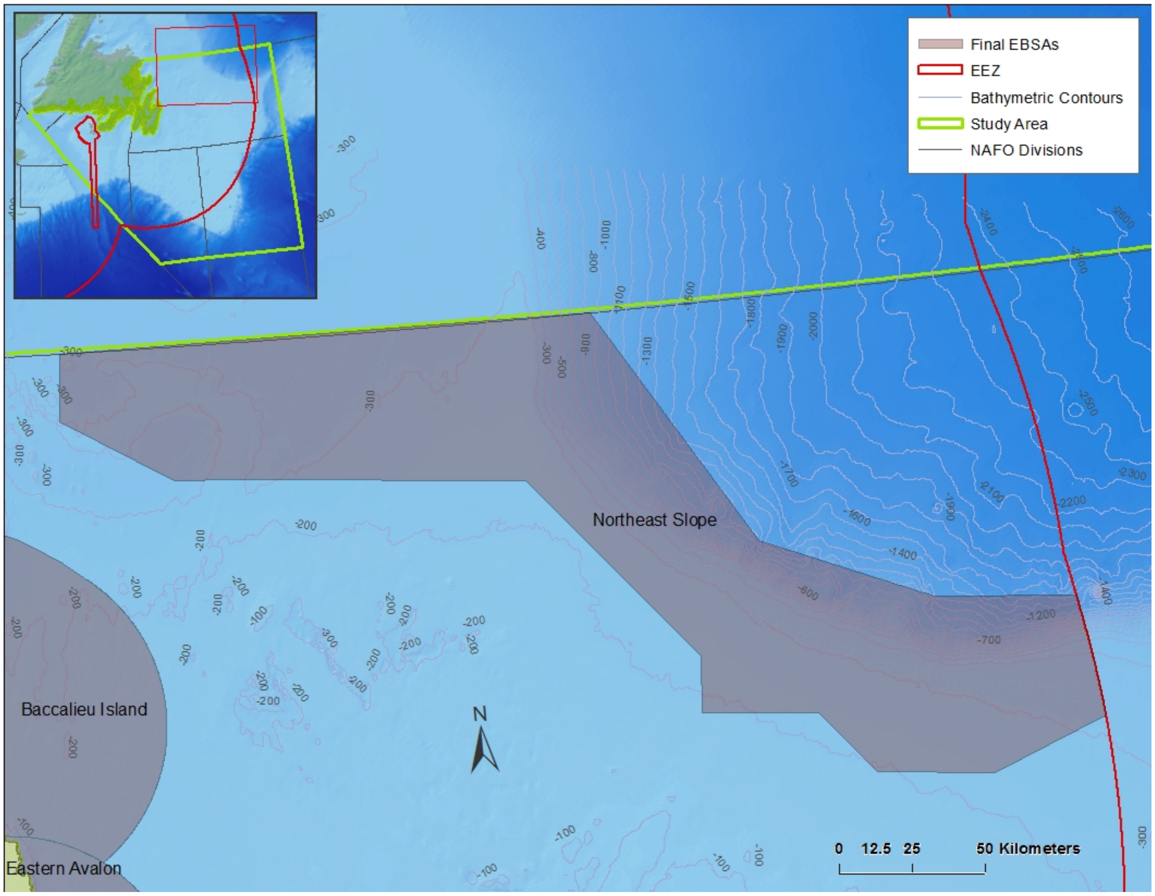

Figure 18: Map of Northeast Slope EBSA.

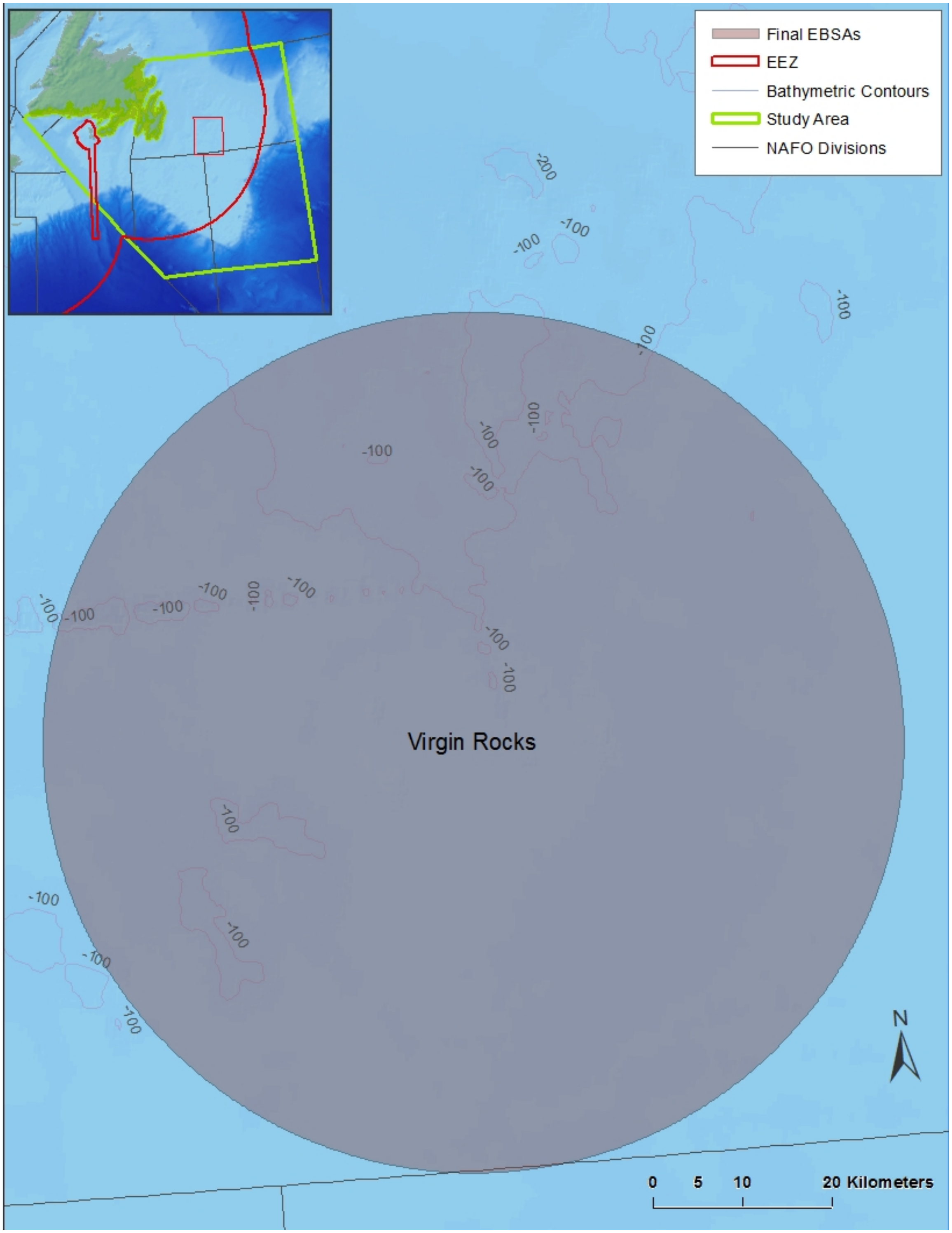

Figure 19: Map of Virgin Rocks EBSA.

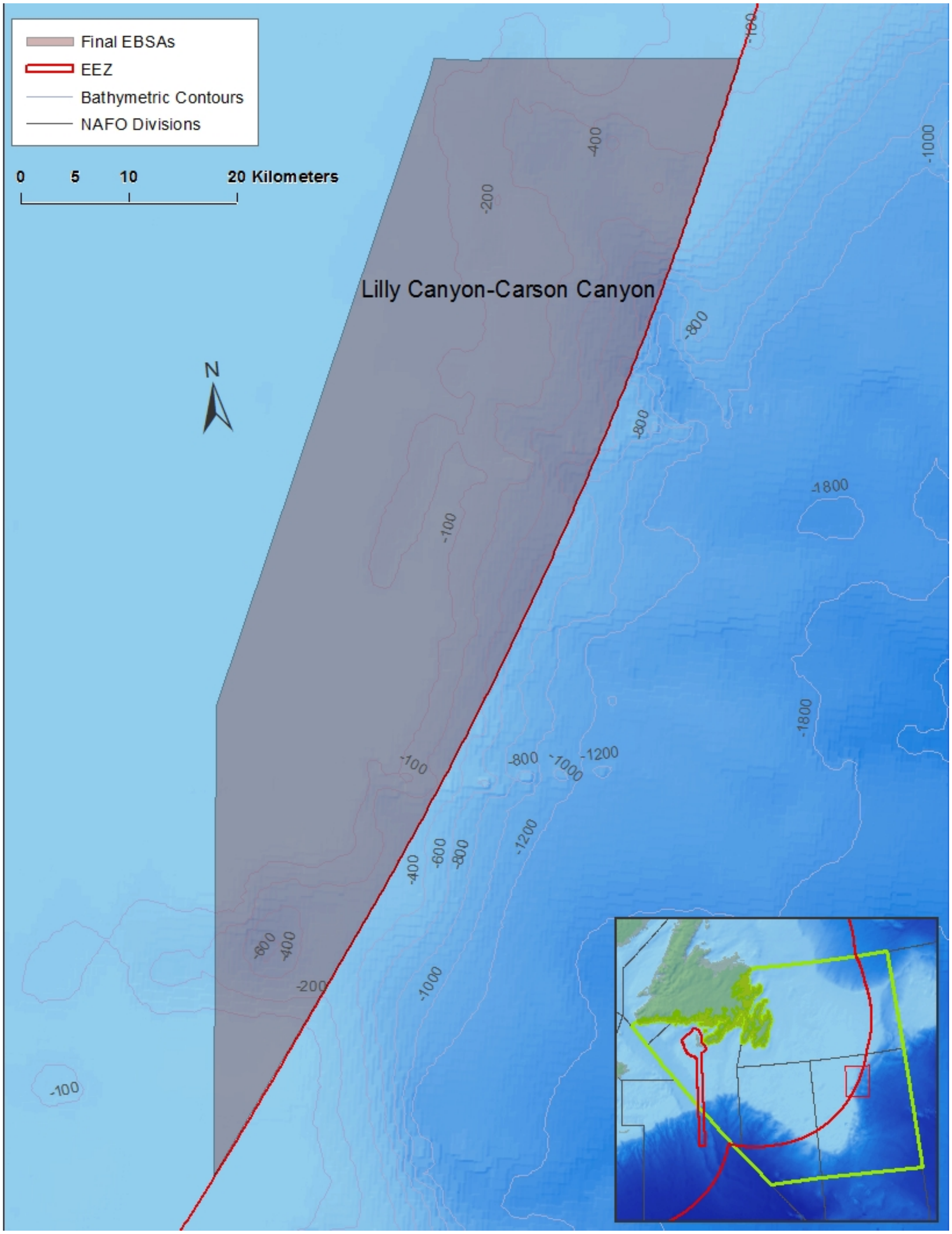

Figure 20: Map of the Lilly Canyon-Carson Canyon EBSA.

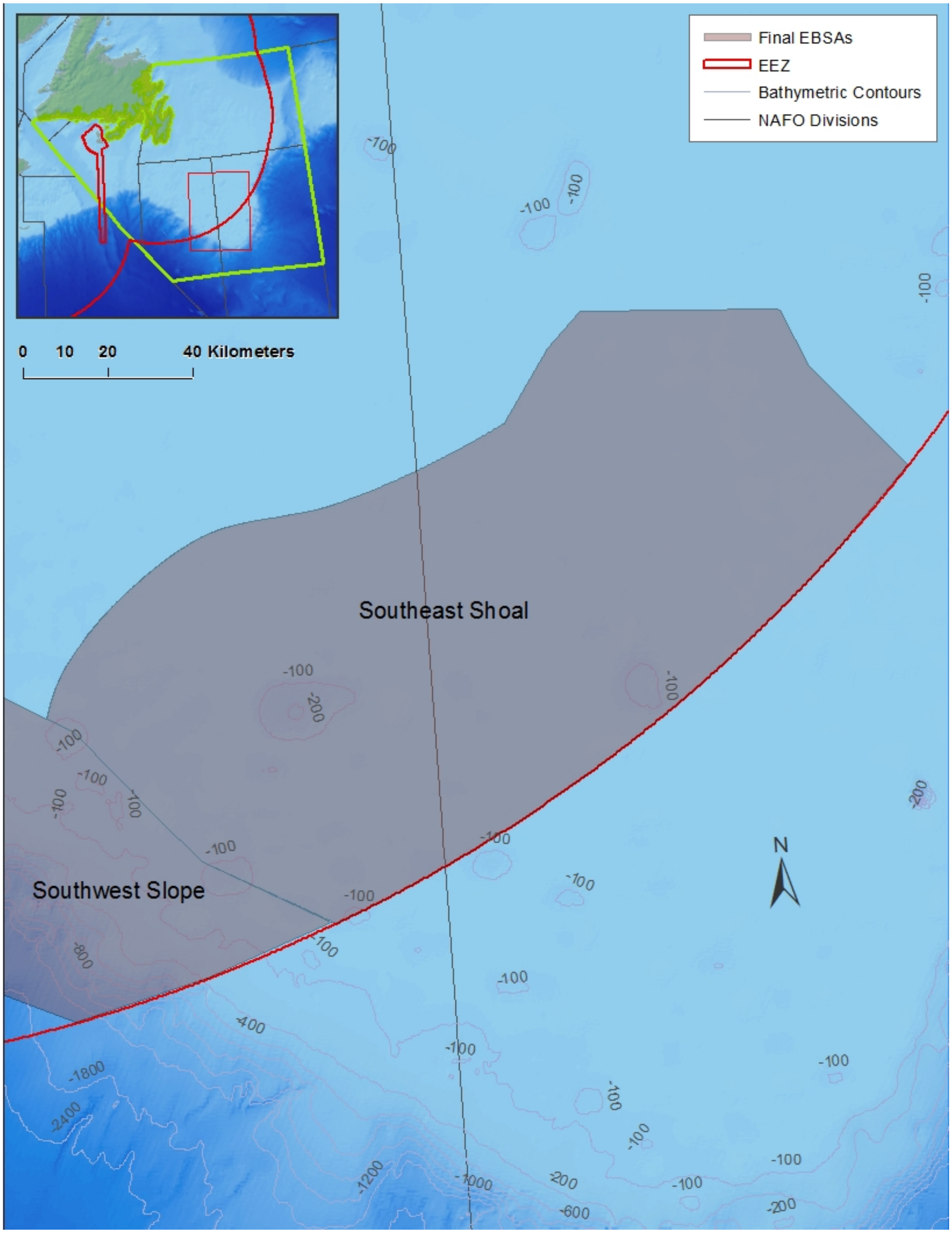

Figure 21: Map of the Southeast Shoal EBSA.

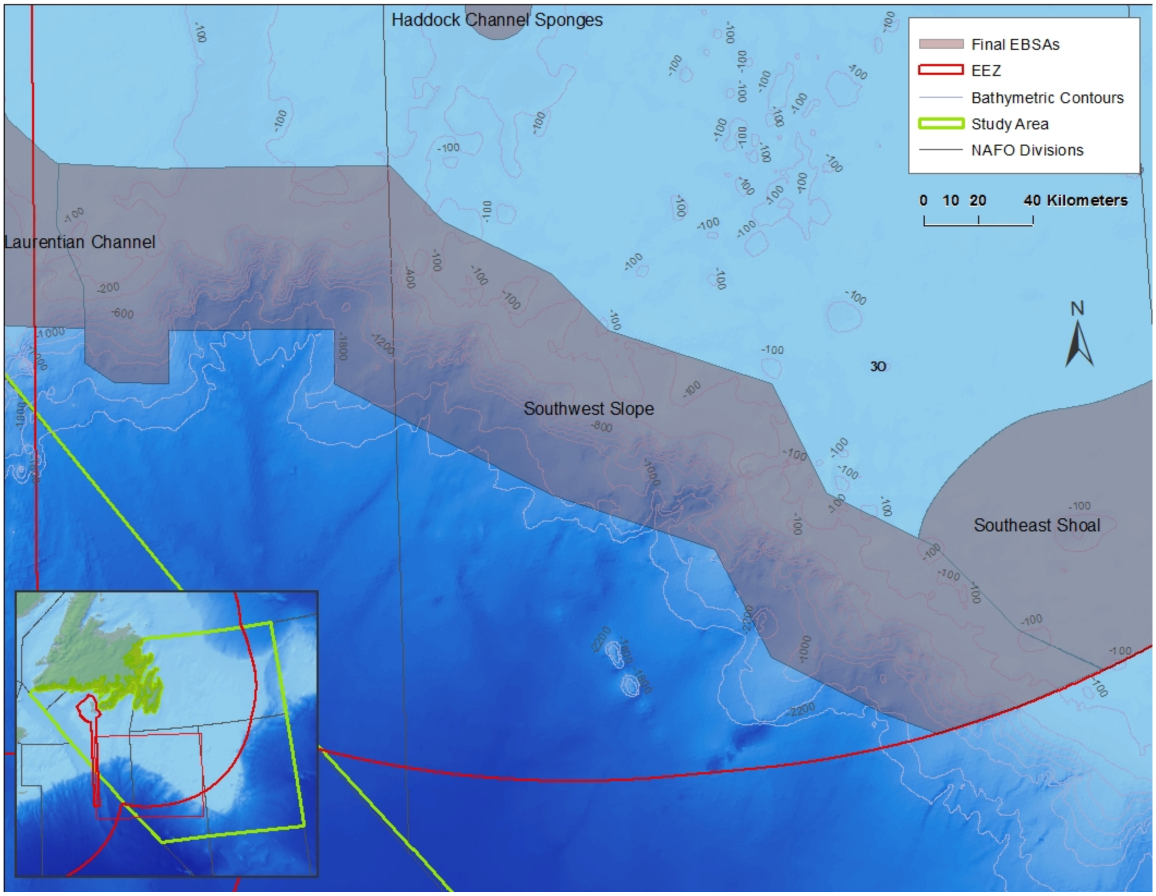

Figure 21: Map of Southwest Slope EBSA.

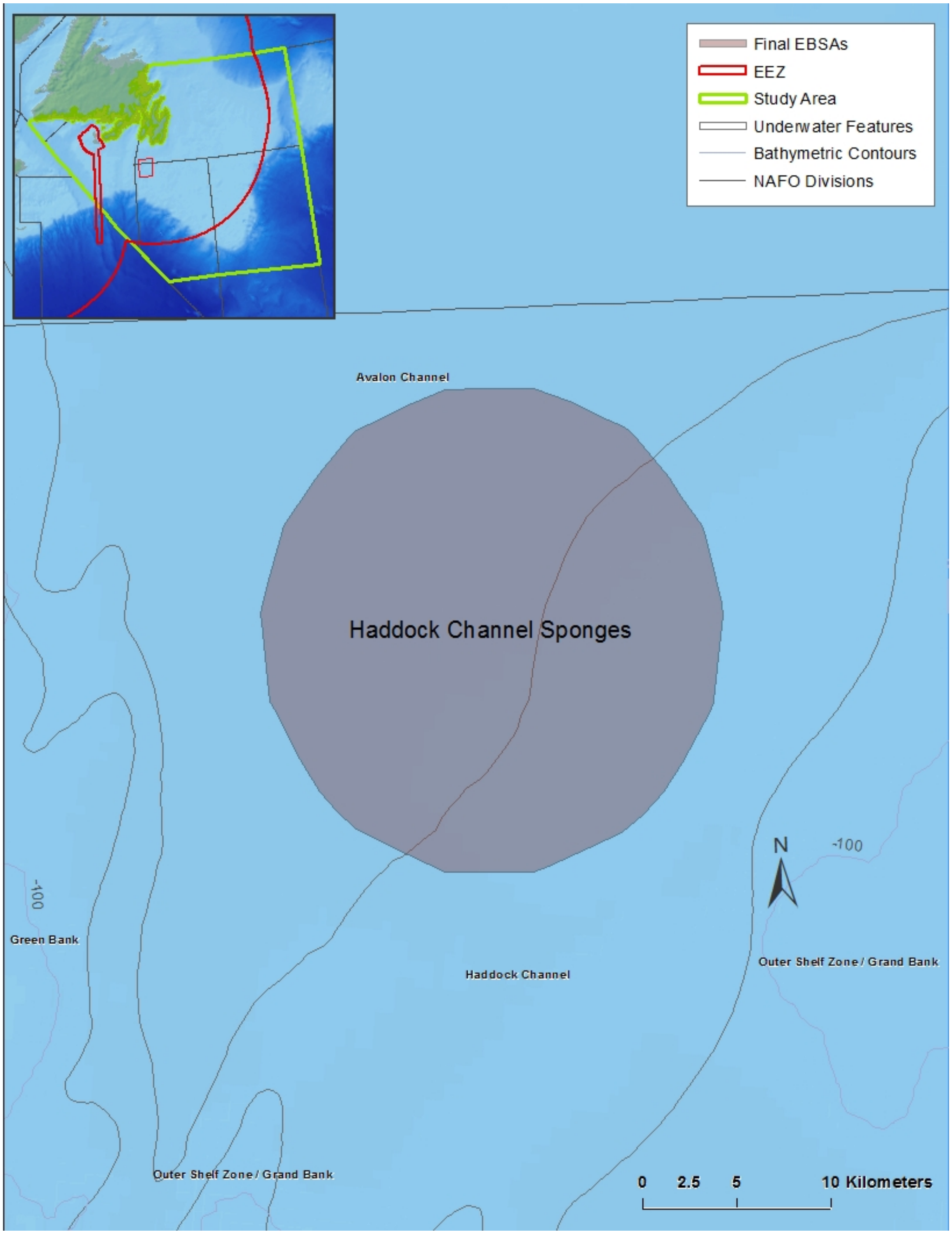

Figure 22: Map of Haddock Channel Sponges EBSA.

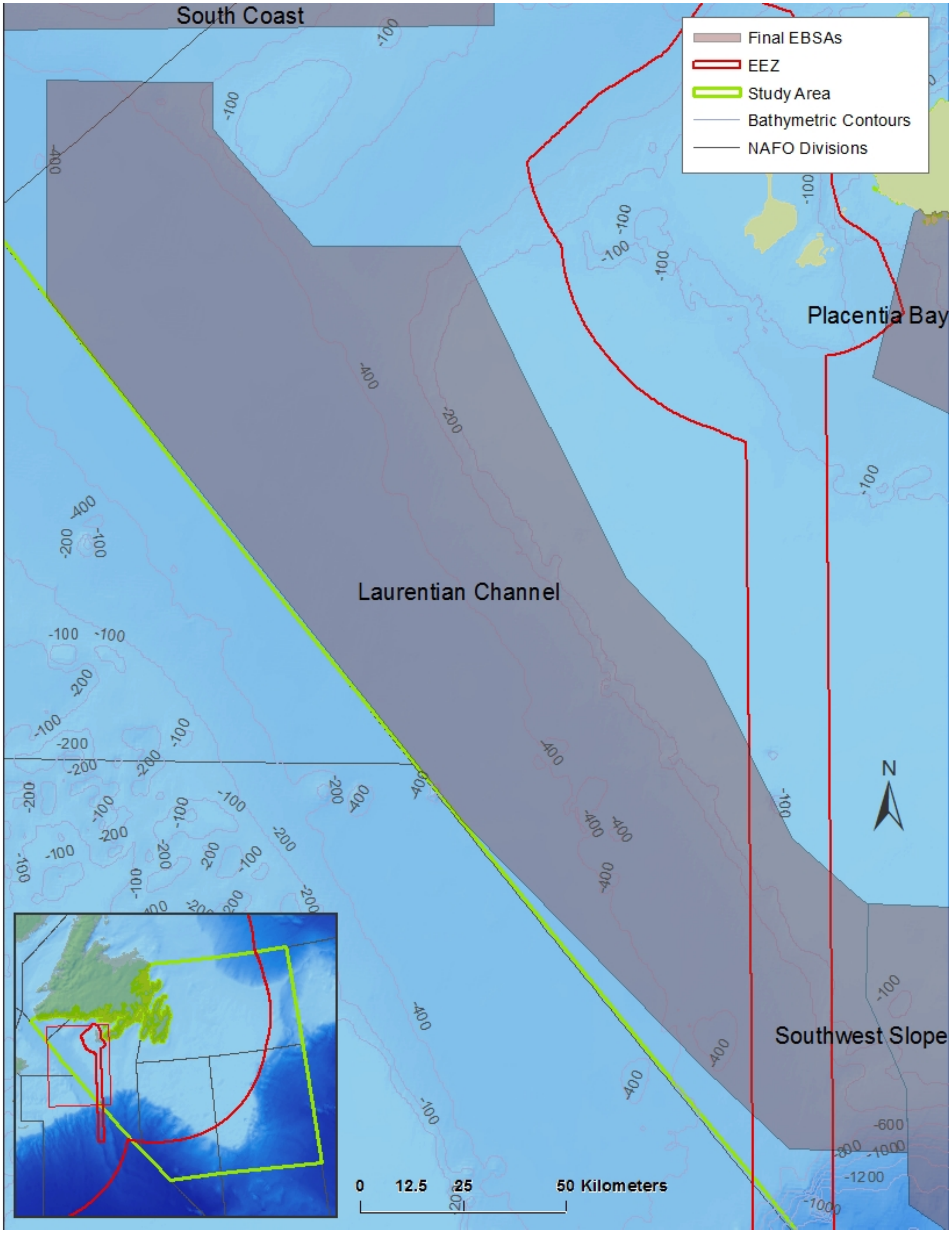

Figure 23: Map of Laurentian Channel EBSA.

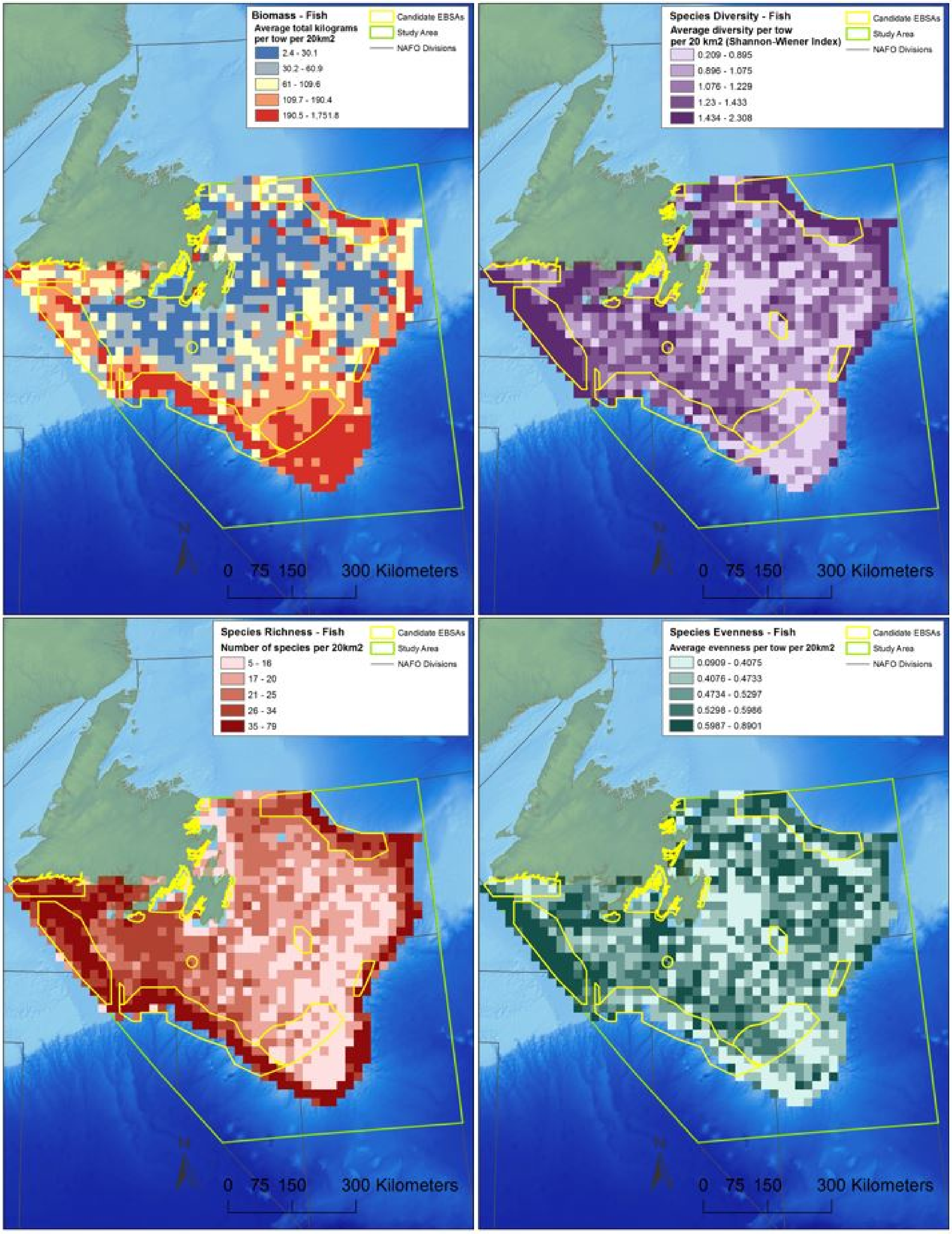

Figure 24: Map of all EBSAs showing areas of total biomass (top left), diversity (top right), richness (bottom left) and evenness (bottom right) for fish (Campelen spring).

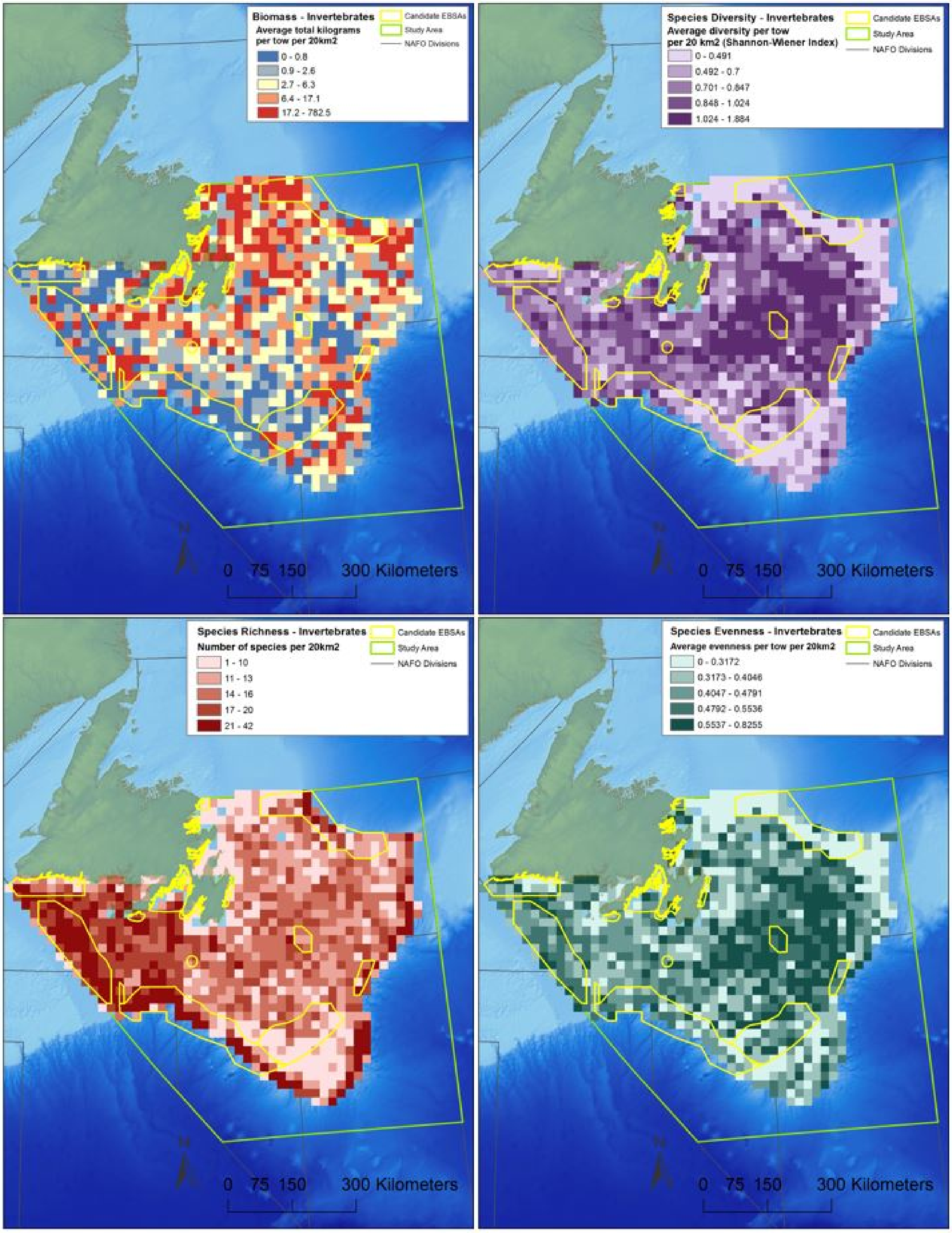

Figure 25: Map of all EBSAs showing areas of total biomass (top left), diversity (top right) richness (bottom left) and evenness (bottom right) for invertebrates (Campelen spring).

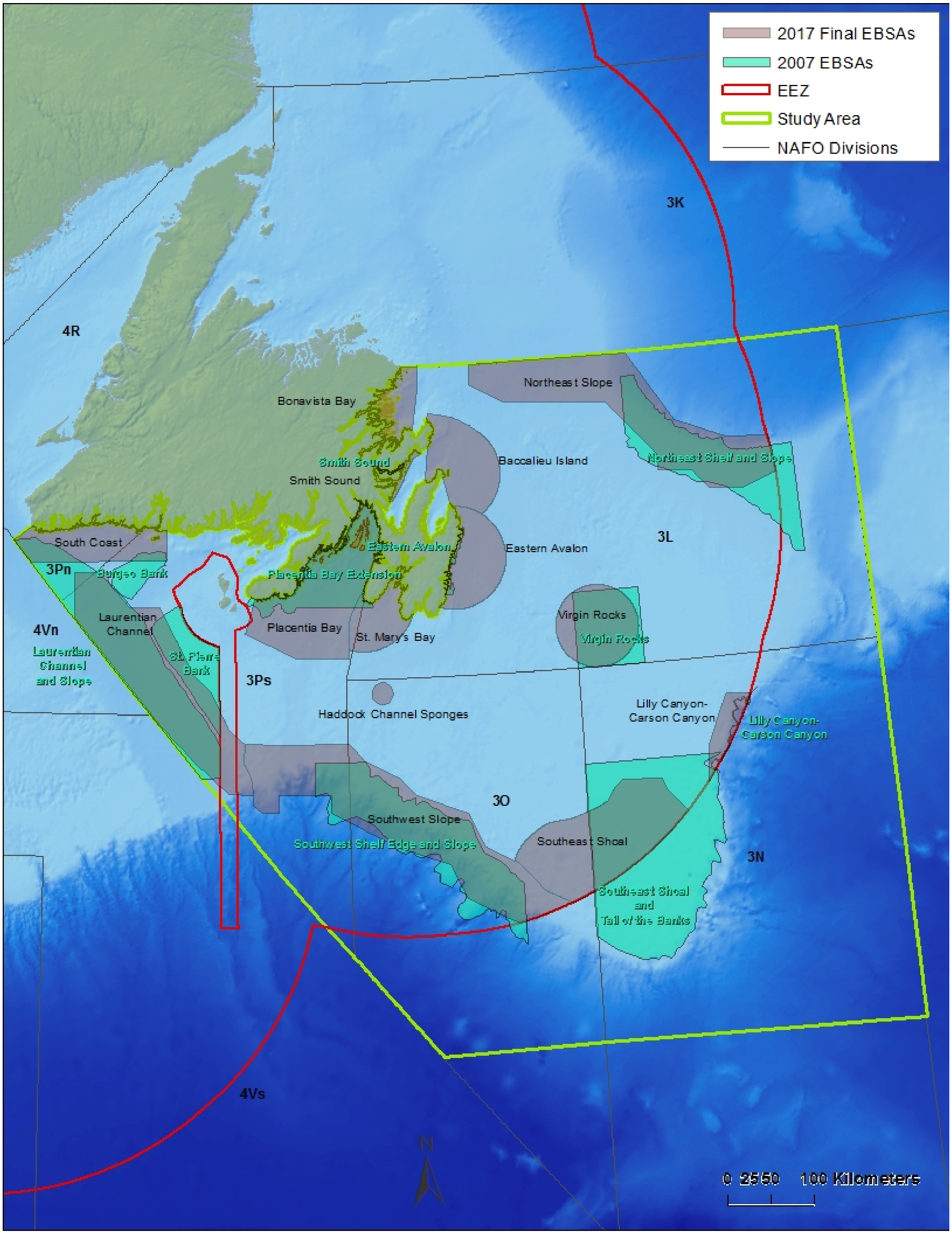

Figure 26: Comparison of 2007 EBSAs with EBSAs identified under this project.

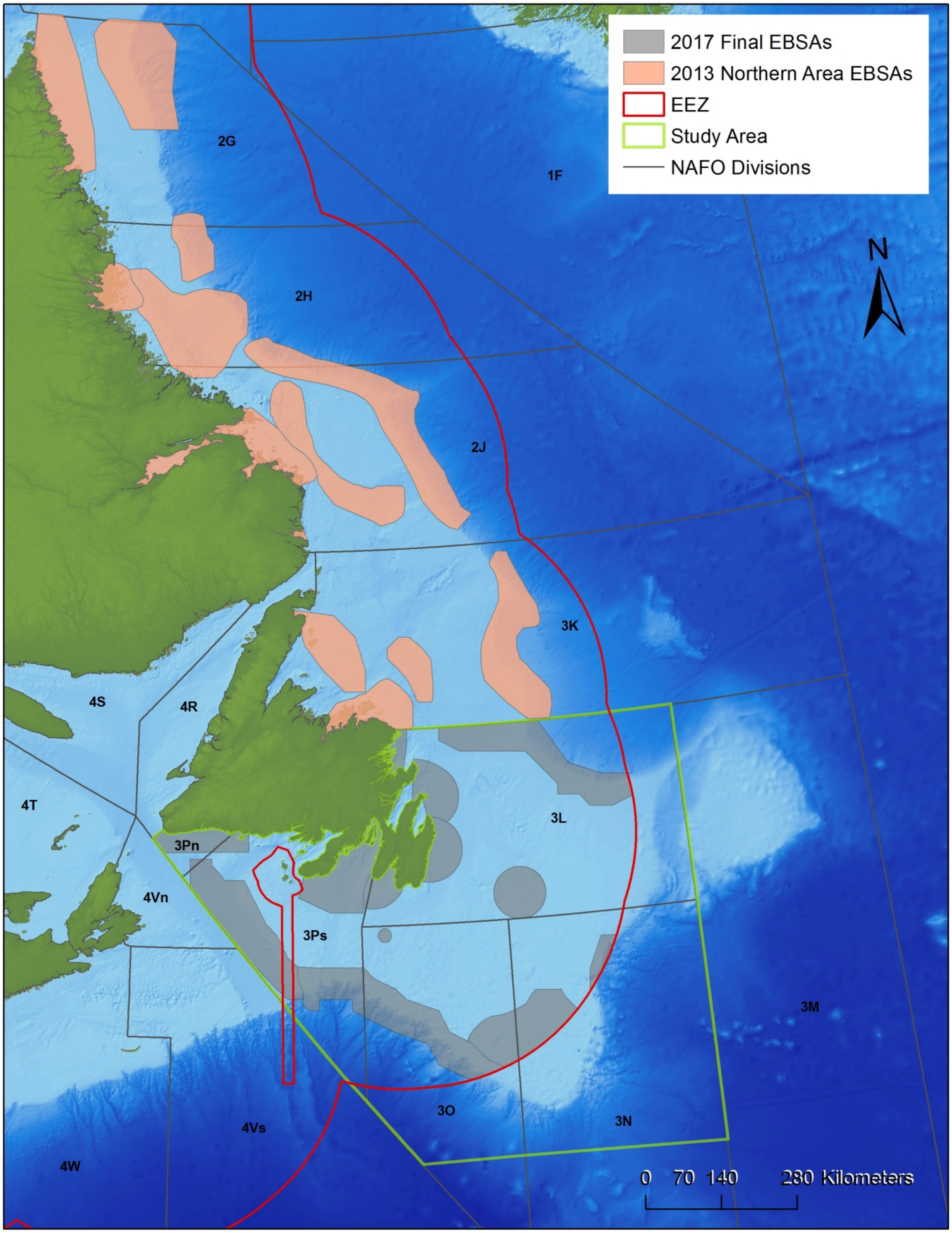

Figure 27: Map of all EBSAs in the NL Shelves bioregion.

APPENDIX A – LIST OF ACRONYMS

Acronym	Definition
CBD	Convention on Biological Diversity
CCRI	Community-Based Coastal Resource Inventory
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSAS	Canadian Science Advisory Secretariat
CWS	Canadian Wildlife Service
DFO	Fisheries and Oceans Canada
EBSA	Ecologically and Biologically Significant Area
ECCC	Environment and Climate Change Canada
ECSAS	Eastern Canada Seabirds at Sea
EEZ	Exclusive Economic Zone
FPT	First Passage Time
GIS	Geographic Information System
IBA	Important Bird Area
KD	Kernel Density
LOMA	Large Ocean Management Area
NAFO	Northwest Atlantic Fisheries Organization
NAISS	North Atlantic International Sightings Survey
NL	Newfoundland and Labrador
MPA	Marine Protected Area
PBGB	Placentia Bay-Grand Banks
PIROP	Programme Intégré de Recherches sur les Oiseaux Pélagiques
ROPOS	Remotely Operated Platform for Ocean Sciences
RV	Research Vessel
SARA	*Species at Risk Act*
SBA	Significant Benthic Area
SFA	Salmon Fishing Area
TEK	Traditional Ecological Knowledge
TNASS	Trans North Atlantic Sightings Survey
UTM	Universal Transverse Mercator
WGS	World Geodetic System
WWF	World Wildlife Fund

APPENDIX B – STEERING COMMITTEE MEMBERS

Name	Affiliation
Melissa Abbott	Oceans Division
Karel Allard	ECCC, Canadian Wildlife Service
Robin Anderson	Ecological Sciences Section, DFO Science
Tony Bowdring	Oceans Division
Keith Clarke	Ecological Sciences Section, DFO Science
Roanne Collins	Finfish Species at Risk Section, DFO Science
Kent Gilkinson	Ecological Sciences Section, DFO Science
Robert Gregory	Ecological Sciences Section, DFO Science
Mardi Gullage	Oceans Division
Danny Ings	Groundfish Section, DFO Science
Robyn Jamieson	Environmental Sciences Division, DFO Science
Mariano Koen-Alonso	Ecological Sciences Section, DFO Science
Neil Ollerhead	Ecological Sciences Section, DFO Science
Erika Parrill	Canadian Science Advisory Secretariat
Pierre Pepin	Biological & Physical Oceanography Section, DFO Science
Andry Ratsimandresy	Aquaculture Section, DFO Science
Martha Robertson	Salmonids Section, DFO Science
Garry Stenson	Marine Mammals Section, DFO Science
Krista Tucker	Ecological Sciences Section, DFO Science
Vonda Wareham	Ecological Sciences Section, DFO Science
Margaret Warren	Ecological Sciences Section, DFO Science
Nadine Wells	Ecological Sciences Section, DFO Science

APPENDIX C – WATERFOWL FUNCTIONAL GROUP SPECIES LIST

Functional Group	Common Name	Scientific Name
Bay Ducks	Lesser Scaup	*Aythya affinis*
-	Redhead	*Aythya americana*
-	Greater Scaup	*Aythya marila*
-	Ring-Necked Duck	*Aythya collaris*
Dabbling Ducks	Wood Duck	*Aix sponsa*
-	Northern Pintail	*Anas acuta*
-	American Wigeon	*Anas americana*
-	Northern Shoveler	*Anas clypeata*
-	American Green-Winged Teal	*Anas crecca*
-	Blue-Winged Teal	*Anas discors*
-	Mallard	*Anas platyrhynchos*
-	American Black Duck*	*Anas rubripes*
-	Gadwall	*Anas strepera*
Geese	Brant	*Branta bernicla*
-	Canada Goose*	*Branta canadensis*
-	Snow Goose	*Chen caerulescens*
Sea Ducks	Common Goldeneye	*Bucephala clangula*
-	Barrow's Goldeneye	*Bucephala islandica*
-	Bufflehead	*Bucephala albeola*
-	Harlequin Duck	*Histrionicus histrionicus*
-	Long-tailed Duck	*Clangula hyemalis*
-	Hooded Merganser	*Lophodytes cucullatus*
-	Black Scoter	*Melanitta americana*
-	White-winged Scoter	*Melanitta fusca*
-	Surf Scoter	*Melanitta perspicillata*
-	Common Merganser	*Mergus merganser*
-	Red-breasted Merganser	*Mergus serrator*
-	Common Eider	*Somateria mollissima*
-	King Eider	*Somateria spectabilis*
-	Stellar's Eider	*Polysticta stelleri*
-	Unspecified Eider	-
-	Unspecified Merganser	-
-	Unspecified Goldeneye	-
-	Unspecified Scoter	-

*denotes dominant species (accounting for >90% of records in the functional group)

APPENDIX D – SEABIRD FUNCTIONAL GROUP SPECIES LIST INCLUDING FORAGING BUFFER DISTANCES

Seabird Foraging Groups	Group	Species	Scientific Name	Colony Buffer Distance
Surface-seizing plankpiscivore species	Storm-Petrels	Leach's Storm-Petrel	*Oceanodroma leucorhoa*	200
-	-	Wilson's Storm-Petrel	*Oceanites oceanicus*	-
-	-	Genus: Storm-Petrel (Oceanodroma)	Oceanodroma	-
-	-	Genus: Storm-Petrel (Oceanites)	Oceanites	-
-	-	White-faced Storm-Petrel	*Pelagodroma marina*	-
-	-	Wedge-rumped Storm-Petrel	*Oceanodroma tethys*	-
-	-	Band-rumped Storm-Petrel	*Oceanodroma castro*	-
-	-	unidentified Storm-Petrel (not identified to species)	-	-
-	Phalaropes	Red Phalarope	*Phalaropus fulicarius*	-
-	-	Red-necked Phalarope	*Phalaropus lobatus*	-
-	-	unidentified phalaropes (not identified to species)	-	-
Surface, shallow-diving piscivore/generalist species	Large Gulls	Herring Gull*	*Larus argentatus*	60
-	-	Great Black-backed Gull*	*Larus marinus*	60
-	-	Glaucous Gull*	*Larus hyperboreus*	-
-	-	Iceland Gull*	*Larus glaucoides*	-
-	-	Lesser Black-backed Gull	*Larus fuscus*	-
-	-	Slaty-backed Gull	*Larus schistisagus*	-
-	-	Thayer's Gull	*Larus thayeri*	-
-	-	Kumlien's Gull	*Larus glaucoides kumlieni*	-
-	-	unspecified white-winged gull	-	-
-	-	unidentified large gull (not identified to species)	-	-
-	Small Gulls	Black-legged Kittiwake*	*Rissa tridactyla*	60
-	-	Ivory Gull	*Pagophila eburnea*	-
-	-	Bonaparte's Gull	*Chroicocephalus philadelphia*	-
-	-	Black-headed Gull	*Chroicocephalus ridibundus*	-
-	-	Laughing Gull	*Leucophaeus atricilla*	-
-	-	Little Gull	*Hydrocoloeus minutus*	-

Seabird Foraging Groups	Group	Species	Scientific Name	Colony Buffer Distance
-	-	Ring-billed Gull	*Larus delawarensis*	-
-	-	Franklin’s Gull	*Leucophaeus pipixcan*	-
-	-	Sabine’s Gull	*Xema sabini*	-
-	-	unspecified small gull	-	-
-	Terns	Arctic Tern	*Sterna paradisaea*	20
-	-	Common Tern	*Sterna hirundo*	20
-	-	Roseate Tern	*Sterna dougallii*	20
-	-	Black Tern	*Chlidonias niger*	-
-	-	Bridled Tern	*Onychoprion anaethetus*	-
-	-	Caspian Tern	*Hydroprogne caspia*	20
-	-	Least Tern	*Sternula antillarum*	-
-	-	Royal Tern	*Thalasseus maximus*	-
-	-	Sandwich Tern	*Thalasseus sandvicensis*	-
-	-	Forster’s Tern	*Sterna forsteri*	-
-	-	Gull-billed Tern	*Gelochelidon nilotica*	-
-	-	unidentified terns (not identified to species)	-	20
-	Skuas and Jaegers	Parasitic Jaeger	*Stercorarius parasiticus*	-
-	-	Pomarine Jaeger	*Stercorarius pomarinus*	-
-	-	Long-tailed Jaeger	*Stercorarius longicaudus*	-
-	-	unidentified jaegers (not identified to species)	-	-
-	-	South Polar Skua	*Stercorarius maccormicki*	-
-	-	Great Skua	*Stercorarius skua*	-
-	-	unidentified skuas (not identified to species)	-	-
Surface, shallow-diving coastal piscivore species	Loons	Common Loon	*Gavia immer*	-
-	-	Arctic Loon	*Gavia arctica*	-
-	-	Red-throated Loon	*Gavia stellata*	-
-	-	Pacific Loon	*Gavia pacifica*	-
-	-	unidentified loons (not identified to species)	-	-
-	Grebes	Red-necked Grebe	*Podiceps grisegena*	-
-	-	Horned Grebe	*Podiceps auritus*	-

Seabird Foraging Groups	Group	Species	Scientific Name	Colony Buffer Distance
-	-	Eared Grebe	*Podiceps nigricollis*	-
-	-	unidentified grebes (not identified to species)	-	-
-	Cormorants	Double-crested Cormorant	*Phalacrocorax auritus*	-
-	-	Great Cormorant	*Phalacrocorax carbo*	30
-	-	unidentified cormorants (not identified to species)	-	-
Pursuit-diving piscivore species	Large Auks	Common Murre	*Uria aalge*	60
-	-	Thick-billed Murre	*Uria lomvia*	60
-	-	Razorbill	*Alca torda*	30
-	-	Atlantic Puffin	*Fratercula arctica*	60
-	-	Black Guillemot	*Cepphus grylle*	-
-	-	unidentified murres (not identified to species)	-	-
Shallow pursuit generalist species	Shearwaters	Greater Shearwater*	*Puffinus gravis*	-
-	-	Sooty Shearwater*	*Puffinus griseus*	-
-	-	Manx Shearwater	*Puffinus puffinus*	-
-	-	Cory's Shearwater	*Calonectris diomedea*	-
-	-	Audubon's Shearwater	*Puffinus lherminieri*	-
-	-	Little Shearwater, Dusky, Allied	*Puffinus assimilis*	-
-	-	Townsend's Shearwater	*Puffinus auricularis*	-
-	-	Wedge-tailed Shearwater	*Puffinus pacificus*	-
-	-	unidentified shearwaters (not identified to species)	-	-
-	Albatrosses	Yellow-nosed Albatross	*Thalassarche chlororhynchos*	-
Pursuit-diving planktivore	-	Dovekie*	*Alle alle*	-
Plunge-diving piscivore	-	Northern Gannet*	*Morus bassanus*	300
Ship-following generalist	-	Northern Fulmar	*Fulmarus glacialis*	300

*denotes dominant species (accounting for >90% of records in the functional group)

APPENDIX E – FISH FUNCTIONAL GROUP SPECIES LISTS

Table D1: List of species in the small benthivores functional group. Dominant species are indicated with an asterisk.

Common Name (as displayed in NL DFO Archive)	Scientific Name
ALFONSINO (NCN) CAU.LON.	*Caulolepis longidens*
ALLIGATORFISH (NS)	*Agonidae*
ALLIGATORFISH,ARCTIC	*Aspidophoroides olriki*
ALLIGATORFISH,COMMON	*Aspidophoroides monopterygius*
ALLIGATORFISH,NORTHERN	*Agonus decagonus*
ANGLEMOUTHS (NS)	*Cyclothone sp.*
ANGLEMOUTHS (NS)	*Gonostoma sp.*
ARGENTINE,LARGE EYED	*Nansenia groenlandica*
ATLANTIC GYMNAST	*Xenodermichthys (aleposomus) copei*
BATFISH,ATLANTIC	*Dibranchus atlanticus*
BIGSCALEFISHES, RIDGEHEADS	*Melamphaidae*
BLACK SWALLOWER	*Chiasmodon niger*
BLACKSMELT,GOITRE	*Bathylagus euryops*
BLACKSMELTS (NS)	*Bathylagus sp.*
BUTTERFISH (NS)	*Stromateidae*
CARDINALFISH,SHERBORN'S	*Rhectogramma sherborni*
DEEPSEA SCULPIN,PALLID	*Cottunculus thompsoni*
DEEPSEA SCULPIN,POLAR	*Cottunculus microps*
EELPOUT,SOFT	*Melanostigma atlanticum*
FANGTOOTH (Ogrefish) Ana	*Anoplogaster cornuta*
FEELERFISH,NOTCH	*Bathypterois dubius*
FOURBEARD ROCKLING	*Enchelyopus cimbrius*
FOURLINE SNAKEBLENNY	*Eumesogrammus praecisus*
GRENADIER,COMMON (MARLIN)*	*Nezumia bairdi*
GRENADIER,ROUGHNOSE	*Trachyrhynchus murrayi*
GRENADIERS (NS)	*Macrouridae*
GRUBBY	*Myoxocephalus aeneus*
GUNNELS (NS)	*Pholidae*
HATCHETFISHES (NS)	*Sternoptychidae*
HOOKEAR SCULPIN (NS)	*Artediellus sp.*
LEPIDION (NCN)	*Lepidion(haloporphyrus) eques*
LIGHTFISHES (NS)	*Gonostomidae*
LIZARDFISH,OFFSHORE	*Synodus poeyi*
LOOSEJAW	*Malacosteus niger*
LUMPFISH (NS) EUM.SP.	*Eumicrotremus sp.*
MAILED SCULPINS (NS)*	*Triglops sp.*
MANEFISH, ATLANTIC	*Caristius groenlandicus*
PLATYTROCTES APUS	*Platytroctes apus*
SCULPIN, ARCTIC	*Myoxocephalus scorpioides*
SCULPIN,ARCTIC STAGHORN	*Gymnocanthus tricuspis*
SCULPIN,SPATULATE	*Icelus spatula*
SCULPINS (NS)	*Cottidae*
SEA DEVIL, WARTED	*Cryptosaras couesi*
SEARSIIDAE	*Searsiidae*
SEASNAILS (NS)	*Liparidae*
SHANNY,DAUBED	*Lumpenus maculatus*

Common Name (as displayed in NL DFO Archive)	Scientific Name
SLIMEHEAD	*Hoplostethus sp.*
SMELTS, DEEPSEA (NS)	*Bathylagidae*
SPINYFIN	*Diretmus argenteus*
TAPIRFISH, SHORTSPINE	*Macdonaldia rostrata*
THREEBEARD ROCKLING (NS)	*Gaidropsarus sp.*
TWOHORN SCULPIN (NS)	*Icelus sp.*
WOLF EEL (NS)	*Lycenchelys sp.*

Table D2: List of species in the medium benthivores functional group. Dominant species are indicated with an asterisk.

Common Name (as displayed in NL DFO Archive)	Scientific Name
BIGEYES (NS)	*Priacanthidae*
BLENNIES (NS)	*Lumpenus sp.*
DUCKBILL EEL	*Nessorhamphus ingolfianus*
EELPOUT (NS)	*Lycodes sp.*
EELPOUT,ARCTIC	*Lycodes reticulatus*
EELPOUT,ESMARK'S	*Lycodes esmarki*
EELPOUT,VAHL'S	*Lycodes vahlii*
FISH DOCTOR (GREEN OCEAN	*Gymnelis viridis*
FLOUNDER,WINTER	*Pseudoplueronectes americanus*
GRENADIER,LONGNOSE	*Coelorhynchus carminatus*
HAKE,BLUE	*Antimora rostrata*
HAKE,RED (SQUIRREL)	*Urophycis chuss*
HALOSAURUS (NS)	*Halosauridae*
LIPOGENYS	*Lipogenys gillii*
LONGNOSE EEL	*Synaphobranchus kaupi*
LUMPFISH,COMMON*	*Cyclopterus lumpus*
MORA (NCN) HAL.AFF.	*Halargyreus affinis*
MORA (NCN) HAL.JOH.	*Halargyreus johnsonii*
MORAS	*Moridae*
SCULPIN, RIBBED (HORNED)	*Myoxocephalus sp.*
SCULPIN,FOURHORN	*Myoxocephalus quadricornis*
SCULPIN,LONGHORN	*Myoxocephalus octodecemspinosus*
SCULPIN,SHORTHORN	*Myoxocephalus scorpius*
SEA RAVEN	*Hemitripterus americanus*
SHARK,DEEPSEA CAT	*Apristurus profundorum*
SKATE,DEEPWATER (ROUND)	*Raja fyllae*
SKATE,LITTLE	*Raja erinacea*
SKATE,SOFT	*Raja mollis*
SNAKE BLENNY	*Lumpenus lumpretaeformis*
SNIPE EEL (NCN)	*Serrivomer brevidentatus*
SNIPE EEL,SHORTNOSE	*Serrivomer beani*
SNUBNOSE EEL	*Simenchelys parasiticus*
WHITING,BLUE	*Micromesistius poutassou*

Table D3: List of species in the large benthivores functional group. Dominant species are indicated with an asterisk.

Common Name (as displayed in NL DFO Archive)	Scientific Name
ANGLER,COMMON(MONKFISH)*	*Lophius americanus*
CHIMAERA,DEEPWATER	*Hydrolagus affinis*
CHIMAERA,KNIFENOSE	*Rhinochimaera atlantica*
CHIMAERA,LONGNOSE	*Harriotta raleighana*
CHIMAERAS (NS)	*Chimaeriformes (holocephali) (order)*
DEEPSEA ANGLER,BIG	*Ceratius holboelli*
HADDOCK*	*Melanogrammus aeglefinus*
HAGFISH, ATLANTIC	*Myxine glutinosa*
POUT,OCEAN (COMMON)	*Macrozoarces americanus*
SEA DEVILS (NS)	*Ceratiidae*
SKATE,ABYSSAL	*Raja bathyphila*
SKATE,ARCTIC	*Raja hyperborea*
SKATE,BARNDOOR	*Raja laevis*
SKATE,JENSEN'S	*Raja jenseni*
SKATE,SPINYTAIL*	*Raja (bathyraja) spinicauda*
SKATE,WHITE	*Raja lintea*
SKATES (NS) RAJA SP.	*Raja sp.*
SMOOTHHEADS (NS)	*Alepocephalidae*
SNIPE EEL,ATLANTIC	*Nemichthys scolopaceus*
SPINY EELS (NS)	*Notacanthidae*
STURGEON,ATLANTIC	*Acipenser oxyrhynchus*
TAPIRFISH,LARGE SCALE	*Notacanthus nasus*
WOLFFISHES (NS)	*Anarhichadidae*
WRYMOUTH	*Cryptacanthodes maculatus*

Table D4: List of species in the piscivores functional group. Dominant species are indicated with an asterisk.

Common Name (as displayed in NL DFO Archive)	Scientific Name
ANGLERS	*Lophiformes (pediculati) (order)*
BARRACUDINAS (NS)	*Paralepididae*
COD,GREENLAND (ROCK)	*Gadus ogac*
COD,POLAR	*Arctogadus glacialis*
CODS,HAKES,ETC.	*Gadiformes (anacanthini) (order)*
DAGGERTOOTH	*Anotopterus pharao*
DOGFISH,BLACK*	*Centroscyllium fabricii*
DOGFISH,SPINY	*Squalus acanthias*
DRAGONFISH,BOA	*Stomias boa ferox*
DRAGONFISHES,SCALED (NS)	*Stomiatidae*
FROSTFISH	*Benthodesmus simonyi*
GADOIDS (NS)	*Gadidae*
GREENEYE,LONGNOSE	*Parasudis truculentus*
GULPER (NCN) SAC.AMP.	*Saccopharynx ampullaceus*
HAKE (NS) MER.SP.	*Merluccius sp.*
HAKE (NS) UROP.SP.	*Urophycis sp.*
HAKE,OFFSHORE SILVER	*Merluccius albidus*
HAKE,SILVER*	*Merluccius bilinearis*
HALIBUT (ATLANTIC)	*Hippoglossus hippoglossus*

Common Name (as displayed in NL DFO Archive)	Scientific Name
LAMPREY, SEA	*Petromyzon marinus*
LANCETFISH, SHORTNOSED	*Alepisaurus brevirostis*
LANCETFISH,LONGNOSE	*Alepisaurus ferox*
LANCETFISHES (NS)	*Alepisauridae (plagyodontidae)*
LING,BLUE	*Molva brykelange*
POLLOCK	*Pollachius virens*
SALMON,ATLANTIC	*Salmo salar*
SAWTAILFISH,RIBBON	*Idiacanthus fasciola*
SCABBARDFISH,BLACK	*Aphanopus carbo*
SHARK,PORTUGUESE	*Centroscymnus coelolepis*
VIPERFISH	*Chauliodus sloani*

Table D5: List of species in the plankpiscivores functional group. Dominant species are indicated with an asterisk.

Common Name (as displayed in NL DFO Archive)	Scientific Name
BEARDFISHES (NS)	*Polymixiidae*
COD,ARCTIC*	*Boreogadus saida*
GULPER,PELICAN	*Eurypharynx pelecanoides*
HAKE,LONGFIN*	*Urophycis chesteri*
REDFISH,GOLDEN(MARINUS)*	*Sebastes marinus*
ROCKFISHES (NS)	*Scorpaenidae*
SCOPELOSAURUS (NS)	*Scopelosauridae*
SEASNAIL (NS) CAR.SP.	*Careproctus sp.*

Table D6: List of species in the planktivores functional group. Dominant species are indicated with an asterisk.

Common Name (as displayed in NL DFO Archive)	Scientific Name
ALEWIFE (GASPERAUX)	*Alosa pseudoharengus*
ARGENTINE,ATLANTIC*	*Argentina silus*
ARGENTINE,STRIATED	*Argentina striata*
ARGENTINES (NS)	*Argentinidae*
BILLFISH	*Scomberesox saurus*
HERRING,ATLANTIC	*Clupea harengus*
HERRING,BLACK	*Bathytroctes sp.*
LANTERNFISHES (NS)	*Myctophidae*
MACKEREL,ATLANTIC	*Scomber scombrus*
MENHADEN, ATLANTIC*	*Brevoortia tyrannus*
RONDELETIIDAE	*Whalefishes, redmouth*
SHAD, AMERICAN	*Alosa sapidissima*
SHANNY,RADIATED	*Ulvaria subbifurcata*
STICKLEBACK,FOURSPINE	*Apeltes quadracus*
STICKLEBACK,THREESPINE	*Gasterosteus aculateus*
STICKLEBACKS (NS)	*Gasterosteiformes (order)*

APPENDIX F – CETACEAN FUNCTIONAL GROUPS SPECIES LIST

Species/Functional Group	Common Name	Scientific Name
Blue Whale	Blue whale	*Balaenoptera musculus*
North Atlantic Right Whale	Right Whale	*Eubalaena glacialis*
Killer Whale	Killer Whale	*Orcinus orca*
Mysticetes	Fin whale	*Balaenoptera physalus*
-	Sei whale	*Balaenoptera borealis*
-	Humpback whale*	*Megaptera novaeangliae*
-	Minke whale*	*Balaenoptera acutorostrata*
-	Unknown large whale	*N/A*
-	Unknown baleen whale	*N/A*
Small cetaceans	Bottlenose dolphin	*Tursiops truncatus*
-	Common dolphin*	*Delphinus delphis*
-	Harbour porpoise*	*Phocoena phocoena*
-	Northern bottlenose whale*	*Hyperoodon ampullatus*
-	Stenella spp.	*Stenella spp.*
-	Striped dolphin	*Stenella coeruleoalba*
-	Unknown dolphin	*N/A*
Squid-eating cetaceans	Atlantic long-finned pilot whale	*Globicephala melas*
-	*Sowerby's beaked whale*	*Mesoplodon bidens*
-	Mesoplodon spp.	*Mesoplodon spp.*
-	Risso's dolphin	*Grampus griseus*
-	Sperm whale	*Physeter macrocephalus*

*Dominant species in functional group.

APPENDIX G – CORALS FUNCTIONAL GROUPS SPECIES LISTS

Coral Functional Group	Scientific Name
Black corals	*Antipatharian spp.*
-	*Stauropathes arctica*
Stony cup corals	*Desmophyllum dianthus*
-	*Flabellum spp.*
-	*Flabellum angulare*
-	*Flabellum alabastrum*
-	*Flabellum mandrewi*
	Fungiacyathus marenzelleri
	Scleractinian sp.
-	*Vaughanella margaritata*
Large gorgonians	*Acanthogorgia armata*
-	*Keratoisis grayi (=K. ornata)*
-	*Paragorgia arborea*
-	*Paramuricea sp.*
-	*Paramuricea grandis*
-	*Primnoa resedaeformis*
-	*Paramuricea placomus*
Small gorgonians	*Acanella arbuscula*
-	*Anthothela grandiflora*
-	*Chrysogorgia spp.*
-	*Radicipes gracilis*
-	*Swifta sp.*
Sea pens	*Anthoptilum grandiflorum*
-	*Distichoptilum gracile*
-	*Funiculinia quandrangularis*
-	*Halipteris finmarchica*
-	*Pennatula spp.*
-	*Pennatula aculeata*
-	*Pennatula grandis*
-	*Pennatula phosphorea*
-	*Umbellula spp.*
-	*Protoptilum carpeteri*
-	*Unknown sea pen spp.*
Soft corals	*Anthomastus agaricus*
-	*Anthomastus grandiflorus*
-	*Anthomastus purpureus*
-	*Drifa sp.*
-	*Drifa glomerata*
-	*Duva florida*
-	*Gersemia spp.*
-	*Gersemia cf. fruitcosa*
-	*Heteropolypus cf. insolitus*
-	*Nephtheidae spp.*

APPENDIX H – KEY FEATURES OF EACH EBSA

Data descriptors:

- Edge = a polygon from a particular data layer is generally found outside the boundary of the EBSA but a relatively small portion of it extends inside the boundary (i.e. on the edge).
- Insignificant = species found in a very small area (less than 5%) within the EBSA.
- Minor = species found in a few small areas or in part of one moderately sized area (more than 5% but less than 30% of the EBSA).
- Moderate = species found in several small areas or more than one moderately sized area within the EBSA (at least 30% but less than 70% of the EBSA).
- Significant = species found throughout a large portion (greater than 70% but not the entire EBSA) of the EBSA.
- Whole = species found throughout the entire EBSA.
- Partial = part of a polygon from a particular data layer found within the boundary of the EBSA, but part of the polygon extends outside the EBSA boundary.

Notes:

- In Associated data source columns, Campelen spring, Campelen fall, Engel spring and Engel fall refer to DFO RV survey time series. See methods for further explanation.
- For Coastal EBSAs, coastal data are listed first then offshore data. The opposite is true for Offshore EBSAs. Data layers are ordered as follows: eelgrass, fish, corals, marine mammals, seabirds/waterfowl, CCRI.
- Polygons are defined as a continuous area of grid cells that are adjoined at the edges. Adjacent grid cells that are connected by their corners are considered a separate polygon.

COASTAL EBSAS

Bonavista Bay (3L)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Eelgrass habitat	-	Insignificant	12 of 202
Salmon	Salmon angling data	Moderate	1 of 8
Capelin spawning beaches	Capelin spawning sites	Minor	-
Tern sp. colonies	Colony max counts	-	11 of 26
Black-legged Kittiwake foraging	Colony foraging buffer	Significant	-
Tern sp. foraging	Colony foraging buffer	Significant	-
Sea Ducks	Waterfowl block surveys	Moderate	3 of 7 (1 partial)
Killer Whales	Sightings data	Moderate	1 of 15 (partial)
Mysticetes functional group	Sightings data	Significant	1 of 13 (partial)
Harbour Seals	Sightings data	Moderate	3 of 14

Smith Sound (3L)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Eelgrass habitat	-	Insignificant	-
Capelin spawning beaches	Capelin spawning sites	Moderate	-
Atlantic Puffin foraging	Colony foraging buffer	Moderate	-
Black-legged Kittiwake foraging	Colony foraging buffer	Moderate	-
Tern sp. foraging	Colony foraging buffer	Moderate	-
Killer Whales	Sightings data	Moderate	1 of 15 (partial)
Mysticetes functional group	Sightings data	Moderate	1 of 13 (partial)
Small cetaceans functional group	Sightings data	Moderate	1 of 19 (partial)

Baccalieu Island (3L)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Capelin spawning	Capelin spawning sites	Insignificant	-
Atlantic Puffin colonies	Colony max counts	-	1 of 3
Atlantic Puffin foraging	Colony foraging buffer	Significant	-
Leach’s Storm-Petrel colonies	Colony max counts	-	1 of 5
Black-legged Kittiwake foraging	Colony foraging buffer	Whole	-
Razorbill foraging	Colony foraging buffer	Moderate	-
Capelin	Campelen fall	Insignificant	2 of 4 (2 partial)
Capelin	Campelen spring	Minor	2 of 10 (2 partial)
Shrimp	Campelen fall	Minor	1 of 1 (1 partial)
Shrimp	Campelen spring	Minor	1 of 2 (1 partial)
Plankpiscivores (fish)	Campelen fall	Moderate	2 of 5 (2 partial)
Plankpiscivores (fish)	Engel fall	Insignificant	1 of 4 (1 partial)
Spotted Wolffish	Campelen fall	Minor	1 of 5 (1 partial)
Spotted Wolffish	Engel spring	Minor	1 of 2 (1 partial)
Killer Whales	Sightings data	Moderate	2 of 15 (2 partial)
Mysticetes functional group	Sightings data	Moderate	1 of 13 (1 partial)
Pursuit-diving piscivores (seabirds)	Pelagic bird surveys	Significant	2 of 19 (2 partial)
Surface-seizing plankpiscivores (seabirds)	Pelagic bird surveys	Significant	1 of 24 (1 partial)

Eastern Avalon (3L)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Eelgrass habitat	-	Insignificant	-
Capelin spawning beaches	Capelin spawning sites	Minor	-
Atlantic Puffin colonies	Colony max counts	-	2 of 3
Black-legged Kittiwake colonies	Colony max counts	-	5 of 14
Common Murre colonies	Colony max counts	-	1 of 2
Northern Fulmar colonies	Colony max counts	-	1 of 1
Razorbill colonies	Colony max counts	-	3 of 5
Thick-billed Murre colonies	Colony max counts	-	2 of 2
Atlantic Puffin foraging	Colony foraging buffer	Whole	-
Black-legged Kittiwake foraging	Colony foraging buffer	Whole	-
Common Murre foraging	Colony foraging buffer	Whole	-
Tern sp. foraging	Colony foraging buffer	Moderate	-
Razorbill foraging	Colony foraging buffer	Moderate	-
Thick-billed Murre foraging	Colony foraging buffer	Whole	-
Capelin	Campelen spring	Insignificant	1 of 10 (1 partial)
Capelin	Engel fall	Moderate	1 of 6
Capelin	Engel spring	Insignificant	1 of 8 (1 partial)
American Plaice	Engel fall	Minor	1 of 12 (1 partial)
American Plaice	Engel spring	Moderate	1 of 12 (1 partial)
Killer Whale	Sightings data	Moderate	2 of 15 (2 partial)
Mysticetes functional group	Sightings data	Moderate	2 of 13 (2 partial)
Plunge-diving piscivores (seabirds)	Pelagic seabird surveys	Moderate	3 of 20 (2 partial)
Pursuit-diving piscivores (seabirds)	Pelagic seabird surveys	Significant	1 of 19 (partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Moderate	2 of 27 (1 partial)

St. Mary's Bay (3L)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Eelgrass habitat	-	Insignificant	-
Capelin spawning beaches	Capelin spawning sites	Minor	-
Salmon	Angling data	Moderate	3 of 8 (2 partial)
Northern Gannet colonies	Colony max counts	-	1 of 1
Common Murre colonies	Colony max counts	-	1 of 2
Harlequin Duck	Waterfowl block surveys	Minor	1 of 1
Black-legged Kittiwake foraging	Colony foraging buffer	Whole	-
Common Murre foraging	Colony foraging buffer	Whole	-
Razorbill foraging	Colony foraging buffer	Moderate	-
Capelin	Campelen fall	Minor	1 of 4 (1 partial)
Capelin	Engel spring	Moderate	1 of 8 (1 partial)
Mysticetes functional group	Sightings data	Moderate	2 of 13 (2 partial)
Hooded Seals	Telemetry + expert advice	Moderate	1 of 6 (partial)
Leatherback Turtle important habitat	Peer reviewed	Insignificant	1 of 2 (partial)
Plunge-diving Piscivore (seabirds)	Pelagic bird surveys	Significant	1 of 20 (partial)

Placentia Bay (3Ps)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Eelgrass habitat	-	Insignificant	-
Capelin spawning beaches	Capelin spawning sites	Insignificant	-
Salmon	Angling data	Moderate	-
Tern sp. colonies	Colony max counts	-	10 of 26
Common Murre foraging	Colony foraging buffer	Moderate	-
Black-legged Kittiwake foraging	Colony foraging buffer	Significant	-
Tern sp. foraging	Colony foraging buffer	Moderate	-
Icthyoplankton	Peer reviewed	Minor	2 of 2
Large gorgonian corals	SBAs	Insignificant	1 of 5
Sponges	RV survey data	Moderate	1 of 4
Sponges	SBAs	Insignificant	1 of 4
Plunge-diving Piscivores (seabirds)	Pelagic seabird surveys	Moderate	4 of 20 (2 partial)
Hooded Seals	Telemetry + expert advice	Moderate	3 of 6 (2 partial)
Mysticetes functional group	Sightings data	Moderate	2 of 13 (1 partial)
Blue Whale important habitat	Peer reviewed	Significant	1 of 3 (partial)
Leatherback Turtle important habitat	Peer reviewed	Significant	1 of 2 (partial)
Marine Mammals Sjare 2003	Peer reviewed	Minor	3 of 3

South Coast (3P)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Eelgrass Habitat	-	Insignificant	-
Common Eider colonies	Colony max counts	-	2 of 2
Shrimp	Campelen spring	Minor	1 of 2
Atlantic Cod	Campelen spring	Moderate	1 of 7 (partial)
Atlantic Cod	Engel spring	Minor	1 of 18 (partial)
Redfish	Campelen spring	Minor	1 of 6
Redfish	Engel spring	Moderate	2 of 5 (2 partial)
Piscivores (fish)	Campelen spring	Moderate	1 of 4 (partial)
Piscivores (fish)	Engel spring	Minor	1 of 6 (partial)
Plankpiscivores (fish)	Campelen spring	Minor	1 of 2 (partial)
Plankpiscivores (fish)	Engel spring	Moderate	1 of 9 (partial)
Planktivores (fish)	Campelen spring	Significant	2 of 8 (2 partial)
Planktivores (fish)	Engel spring	Moderate	2 of 4 (1 partial)
Surface, shallow-diving coastal piscivores (seabirds)	Pelagic seabird surveys	Minor	2 of 4 (1 partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Moderate	1 of 27 (partial)
Hooded Seals	Telemetry + expert advice	Significant	1 of 6 (partial)
Blue Whale	Sightings data	Moderate	2 of 5 (1 partial)
Grey Seals	Telemetry + expert advice	Significant	2 of 6 (2 partial)
Sea pens	SBAs	Minor	3 of 13 (1 partial)
Sponges	SBAs	Insignificant	1 of 4
Black Dogfish	Peer reviewed	Minor	1 of 1 (partial)
Smooth Skate	Peer reviewed	Significant	1 of 1 (partial)
Blue Whale important habitat	Peer reviewed	Significant	2 of 3 (2 partial)

OFFSHORE EBSAS

Northeast Slope (3L)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Capelin	Campelen spring	Minor	2 of 10 (2 partial)
Capelin	Campelen fall	Moderate	1 of 4 (partial)
Capelin	Engel fall	Minor	2 of 6 (1 partial)
Shrimp	Campelen spring	Significant	1 of 2 (partial)
Shrimp	Campelen fall	Moderate	1 of 1 (partial)
Greenland Halibut	Campelen spring	Moderate	1 of 2 (partial)
Greenland Halibut	Campelen fall	Significant	3 of 5 (2 partial)
Greenland Halibut	Engel spring	Significant	1 of 3 (partial)
Greenland Halibut	Engel fall	Significant	1 of 1 (partial)
Witch Flounder	Campelen spring	Minor	1 of 6 (partial)
Witch Flounder	Campelen fall	Moderate	1 of 6 (partial)
Witch Flounder	Engel spring	Moderate	3 of 8 (1 partial)
Witch Flounder	Engel fall	Minor	4 of 10 (2 partial)
American Plaice	Campelen spring	Minor	1 of 4
American Plaice	Campelen fall	Minor	1 of 4
American Plaice	Engel fall	Moderate	1 of 12 (partial)
Atlantic Cod	Campelen fall	Moderate	1 of 4 (partial)
Atlantic Cod	Engel spring	Moderate	3 of 18 (2 partial)
Atlantic Cod	Engel fall	Moderate	2 of 5 (1 partial)
Northern Wolffish	Campelen fall	Minor	3 of 6 (2 partial)
Northern Wolffish	Engel spring	Moderate	2 of 7 (2 partial)
Northern Wolffish	Engel fall	Minor	2 of 3 (1 partial)
Spotted Wolffish	Campelen spring	Insignificant	1 of 2
Spotted Wolffish	Campelen fall	Moderate	3 of 5 (2 partial)
Spotted Wolffish	Engel spring	Minor	1 of 2 (partial)
Spotted Wolffish	Engel fall	Moderate	3 of 3 (1 partial)
Spotted Wolffish	Peer reviewed	Moderate	1 of 1 (partial)
Thorny Skate	Engel spring	Moderate	3 of 10 (1 partial)
Thorny Skate	Engel fall	Moderate	2 of 12 (1 partial)
Atlantic Wolffish	Campelen spring	Insignificant	1 of 5 (partial)
Atlantic Wolffish	Campelen fall	Minor	1 of 6 (partial)
Atlantic Wolffish	Engel spring	Minor	1 of 7 (partial)
Atlantic Wolffish	Engel fall	Minor	2 of 4 (1 partial)
Roughhead Grenadier	Campelen spring	Minor	2 of 4 (1 partial)
Roughhead Grenadier	Campelen fall	Insignificant	1 of 3 (partial)
Roughhead Grenadier	Engel spring	Moderate	4 of 5 (1 partial)
Roughhead Grenadier	Engel fall	Minor	2 of 2 (1 partial)
Smooth Skate	Engel spring	Minor	1 of 4 (partial)
Smooth Skate	Engel fall	Insignificant	2 of 4 (2 partial)
Piscivores (fish)	Campelen fall	Insignificant	1 of 2 (partial)
Piscivores (fish)	Engel fall	Minor	2 of 4 (2 partial)
Planktivores (fish)	Campelen spring	Minor	2 of 8
Planktivores (fish)	Campelen fall	Moderate	5 of 7 (2 partial)
Plankpiscivores (fish)	Campelen fall	Minor	2 of 5 (2 partial)
Plankpiscivores (fish)	Engel spring	Minor	3 of 9 (1 partial)
Plankpiscivores (fish)	Engel fall	Moderate	1 of 4 (partial)
Small benthivores (fish)	Campelen spring	Minor	2 of 16 (1 partial)
Small benthivores (fish)	Campelen fall	Minor	1 of 11 (partial)
Small benthivores (fish)	Engel spring	Moderate	3 of 9 (2 partial)
Small benthivores (fish)	Engel fall	Moderate	3 of 8 (2 partial)
Medium benthivores (fish)	Campelen fall	Moderate	3 of 9 (2 partial)
Medium benthivores (fish)	Engel fall	Moderate	1 of 10 (partial)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Large benthivores (fish)	Engel fall	Moderate	2 of 5 (1 partial)
Black corals	RV survey data	Insignificant	1 of 2
Soft corals	RV survey data	Moderate	1 of 10 (partial)
Large gorgonian corals	SBAs	Minor	3 of 11
Sea pens	SBAs	Moderate	1 of 13 (partial)
Sponges	RV survey data	Minor	2 of 4
Thickbilled Murre	Telemetry data (early winter)	Moderate	1 of 1 (partial)
Common Murre	Telemetry data (early and late winter)	Moderate	1 of 1 (partial)
Hooded Seals	Telemetry + expert advice	Moderate	2 of 6 (2 partial)

Virgin Rocks (3LO)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Sand Lance	Campelen spring	Moderate	1 of 14 (partial)
Sand Lance	Campelen fall	Moderate	1 of 7 (partial)
Sand Lance	Engel spring	Moderate	1 of 14 (partial)
Capelin	Engel spring	Moderate	3 of 8 (2 partial)
American Plaice	Engel spring	Moderate	3 of 12 (2 partial)
Killer Whale	Sightings data	Moderate	1 of 15
Sooty Shearwater	Telemetry (Apr-Sept)	Significant	1 of 1 (partial)
Thick-billed Murre	Telemetry (early winter)	Significant	1 of 1 (partial)

Lilly Canyon-Carson Canyon (3N)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Snow Crab	Campelen spring	Moderate	1 of 9 (partial)
Snow Crab	Campelen fall	Significant	1 of 7 (partial)
Greenland Halibut	Campelen fall	Moderate	2 of 5 (2 partial)
Greenland Halibut	Engel spring	Moderate	1 of 3 (partial)
American Plaice	Campelen spring	Minor	1 of 4 (partial)
American Plaice	Campelen fall	Moderate	2 of 4 (2 partial)
Redfish	Campelen spring	Minor	2 of 6 (2 partial)
Redfish	Campelen fall	Moderate	2 of 5 (2 partial)
Roughhead Grenadier	Campelen fall	Moderate	2 of 3 (2 partial)
Thorny Skate	Campelen spring	Minor	1 of 4 (partial)
Thorny Skate	Campelen fall	Minor	1 of 7 (partial)
Thorny Skate	Engel spring	Significant	1 of 10 (partial)
Small benthivores (fish)	Campelen spring	Minor	1 of 16 (partial)
Small benthivores (fish)	Campelen fall	Moderate	2 of 10 (2 partial)
Small benthivores (fish)	Engel spring	Moderate	1 of 9 (partial)
Small benthivores (fish)	Engel fall	Minor	1 of 8 (partial)
Sooty Shearwater	Telemetry (Apr-Sept)	Whole	1 of 1 (partial)
Common Murre	Telemetry (spring and fall)	Whole	1 of 1 (partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Moderate	2 of 29 (2 partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Moderate	2 of 27 (2 partial)
Blue Whale important habitat	Peer reviewed	Moderate	1 of 3 (partial)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Harp Seals	Winter feeding (telemetry)	Whole	1 of 1 (partial)
Soft corals	RV survey data	Moderate	1 of 10 (partial)
Sponges	RV survey data	Moderate	1 of 4 (partial)
Sponges	SBAs	Insignificant	1 of 4

Southeast Shoal (3NO)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Sand Lance	Campelen fall	Insignificant	2 of 7 (2 partial)
Sand Lance	Engel spring	Minor	3 of 14 (2 partial)
Sand Lance	Engel fall	Minor	1 of 4 (partial)
Yellowtail Flounder	Campelen fall	Minor	1 of 1 (partial)
Yellowtail Flounder	Campelen spring	Moderate	1 of 5 (partial)
Yellowtail Flounder	Engel spring	Significant	1 of 2 (partial)
Yellowtail Flounder	Engel fall	Moderate	1 of 1 (partial)
Witch Flounder	Campelen spring	Insignificant	1 of 6 (partial)
Witch Flounder	Campelen fall	Moderate	1 of 6 (partial)
Witch Flounder	Engel spring	Minor	1 of 8 (partial)
Witch Flounder	Engel fall	Minor	2 of 10 (1 partial)
American Plaice	Campelen spring	Moderate	1 of 4 (partial)
American Plaice	Campelen fall	Minor	1 of 4 (partial)
American Plaice	Engel fall	Insignificant	1 of 12 (partial)
Atlantic Cod	Campelen fall	Moderate	1 of 4 (partial)
Atlantic Cod	Engel spring	Moderate	2 of 18 (2 partial)
Atlantic Cod	Engel fall	Moderate	1 of 5 (partial)
Northern Wolffish	Campelen spring	Minor	1 of 2 (partial)
Northern Wolffish	Campelen fall	Minor	1 of 6
Northern Wolffish	Engel spring	Minor	1 of 7 (partial)
Thorny Skate	Campelen spring	Moderate	1 of 4 (partial)
Thorny Skate	Campelen fall	Moderate	3 of 7 (2 partial)
Thorny Skate	Engel spring	Minor	2 of 10 (2 partial)
Thorny Skate	Engel fall	Minor	3 of 12 (2 partial)
White Hake	Campelen fall	Insignificant	2 of 2 (2 partial)
White Hake	Engel fall	Minor	1 of 1
Atlantic Wolffish	Campelen spring	Minor	1 of 5 (partial)
Atlantic Wolffish	Campelen fall	Moderate	2 of 6 (1 partial)
Atlantic Wolffish	Engel spring	Significant	1 of 4 (partial)
Atlantic Wolffish	Engel fall	Moderate	1 of 4 (partial)
Medium benthivores (fish)	Campelen spring	Minor	2 of 7 (1 partial)
Medium benthivores (fish)	Campelen fall	Minor	1 of 9 (partial)
Medium benthivores (fish)	Engel spring	Minor	1 of 4 (partial)
Medium benthivores (fish)	Engel fall	Moderate	1 of 10 (partial)
Large benthivores (fish)	Campelen spring	Insignificant	2 of 7 (2 partial)
Large benthivores (fish)	Campelen fall	Moderate	2 of 2 (2 partial)
Large benthivores (fish)	Engel spring	Insignificant	1 of 6 (partial)
Capelin spawning	Capelin spawning sites	Insignificant	-
American Plaice spawning	Peer reviewed	Moderate	1 of 1 (partial)
Atlantic Wolffish	Peer reviewed	Significant	1 of 1 (partial)
Yellowtail feeding	Peer reviewed	Moderate	1 of 1 (partial)
Juvenile Yellowtail (large) area	Peer reviewed	Minor	1 of 1 (partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Moderate	2 of 29 (1 partial)

Southwest Slope (3OPs)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Witch Flounder	Campelen fall	Minor	4 of 6 (4 partial)
Witch Flounder	Campelen spring	Moderate	4 of 6 (2 partial)
Witch Flounder	Engel spring	Moderate	1 of 8 (partial)
Witch Flounder	Engel fall	Minor	3 of 10 (2 partial)
Atlantic Cod	Campelen spring	Moderate	1 of 7 (partial)
Atlantic Cod	Engel spring	Moderate	3 of 18 (1 partial)
American Plaice	Campelen spring	Moderate	2 of 4 (2 partial)
American Plaice	Campelen fall	Insignificant	1 of 4 (partial)
American Plaice	Engel fall	Insignificant	1 of 12 (partial)
Redfish	Campelen spring	Significant	1 of 6 (partial)
Redfish	Campelen fall	Moderate	2 of 5 (1 partial)
Redfish	Engel spring	Significant	1 of 5 (partial)
Redfish	Engel fall	Moderate	2 of 2 (1 partial)
Northern Wolffish	Campelen spring	Insignificant	1 of 2 (partial)
Northern Wolffish	Campelen fall	Insignificant	1 of 6
Northern Wolffish	Engel spring	Insignificant	2 of 7 (1 partial)
Northern Wolffish	Engel fall	Insignificant	1 of 3 (partial)
White Hake	Campelen spring	Moderate	2 of 4 (2 partial)
White Hake	Campelen fall	Moderate	1 of 2 (partial)
White Hake	Engel spring	Minor	4 of 5 (1 partial)
Smooth Skate	Campelen spring	Insignificant	1 of 3 (partial)
Smooth Skate	Campelen fall	Minor	4 of 5 (3 partial)
Smooth Skate	Engel spring	Moderate	2 of 4 (1 partial)
Smooth Skate	Engel fall	Minor	2 of 4 (2 partial)
Roundnose Grenadier	Campelen spring	Minor	5 of 5 (2 partial)
Roundnose Grenadier	Campelen fall	Insignificant	1 of 1
Roundnose Grenadier	Engel spring	Minor	4 of 5 (3 partial)
Roundnose Grenadier	Engel fall	Minor	2 of 4
Thorny Skate	Campelen spring	Moderate	2 of 4 (2 partial)
Thorny Skate	Engel spring	Moderate	3 of 10 (3 partial)
Thorny Skate	Campelen fall	Minor	3 of 7 (2 partial)
Thorny Skate	Engel fall	Minor	2 of 12 (1 partial)
Winter Skate	Campelen spring	Insignificant	1 of 2 (partial)
Winter Skate	Engel spring	Insignificant	1 of 1 (partial)
Large benthivores (fish)	Campelen spring	Significant	2 of 7 (2 partial)
Large benthivores (fish)	Campelen fall	Moderate	1 of 2 (partial)
Large benthivores (fish)	Engel spring	Significant	1 of 6 (partial)
Large benthivore (fish)	Engel fall	Moderate	2 of 5 (1 partial)
Small benthivores (fish)	Campelen spring	Moderate	7 of 16 (3 partial)
Small benthivores (fish)	Campelen fall	Minor	3 of 11
Small benthivores (fish)	Engel spring	Moderate	3 of 9 (1 partial)
Small benthivores (fish)	Engel fall	Moderate	3 of 8 (1 partial)
Piscivores (fish)	Campelen spring	Moderate	4 of 4 (3 partial)
Piscivores (fish)	Campelen fall	Moderate	1 of 2 (partial)
Piscivores (fish)	Engel spring	Minor	3 of 6 (1 partial)
Piscivores (fish)	Engel fall	Moderate	1 of 4 (partial)
Plankpiscivores (fish)	Campelen spring	Significant	1 of 2 (partial)
Plankpiscivores (fish)	Campelen fall	Significant	1 of 5 (partial)
Plankpiscivores (fish)	Engel spring	Moderate	2 of 9 (2 partial)
Plankpiscivores (fish)	Engel fall	Moderate	2 of 8 (1 partial)
Planktivores (fish)	Campelen spring	Moderate	3 of 8 (2 partial)
Planktivores (fish)	Campelen fall	Moderate	1 of 7 (partial)
Planktivores (fish)	Engel spring	Minor	2 of 8 (1 partial)
Planktivores (fish)	Engel fall	Minor	3 of 4 (2 partial)
Blue Whale important habitat	Peer reviewed	Moderate	1 of 3 (partial)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Black corals	RV survey data	Insignificant	1 of 2
Large gorgonian corals	RV survey data	Moderate	3 of 10
Large gorgonian corals	SBAs	Moderate	5 of 5 (2 partial)
Stony cup corals	RV survey data	Minor	4 of 5 (1 partial)
Sea pens	RV survey data	Minor	5 of 7 (1 partial)
Sea pens	SBAs	Minor	4 of 7 + 1 edge
Small gorgonian corals	RV survey data	Minor	4 of 4 (2 partial)
Small gorgonian corals	SBAs	Minor	3 of 11
American Plaice spawning	Peer reviewed	Insignificant	1 of 1 (partial)
Corals	Peer reviewed	Significant	1 of 2 (partial)
Haddock feeding and spawning	Peer reviewed	Moderate	1 of 1 (partial)
Atlantic Halibut	Peer reviewed	Insignificant	3 of 3
Redfish spawning	Peer reviewed	Moderate	1 of 1 (partial)
Spiny Dogfish adults	Peer reviewed	Minor	1 of 1 (partial)

Haddock Channel Sponges (3O)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Sponges	SBAs	Whole	1 of 4
Capelin	Engel spring	Moderate	1 of 8 (partial)
American Plaice	Engel fall	Moderate	1 of 22 (partial)

Laurentian Channel (3P)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Greenland Halibut	Campelen spring	Moderate	1 of 2 (partial)
Greenland Halibut	Engel spring	Insignificant	1 of 3 (partial)
Witch Flounder	Campelen spring	Significant	1 of 6 (partial)
Witch Flounder	Engel spring	Moderate	3 of 8 (1 partial)
White Hake	Campelen spring	Minor	3 of 4 (1 partial)
White Hake	Engel spring	Edge	0 of 5 (1 edge)
Smooth Skate	Campelen spring	Moderate	1 of 3
Smooth Skate	Engel spring	Minor	1 of 4 (partial)
Thorny Skate	Campelen spring	Moderate	1 of 4 (partial)
Thorny Skate	Engel spring	Minor	1 of 10 (partial)
Winter Skate	Campelen spring	Minor	2 of 2 (1 partial)
Winter Skate	Engel spring	Minor	1 of 1 (partial)
Large benthivores (fish)	Campelen spring	Moderate	5 of 7
Large benthivores (fish)	Engel spring	Moderate	2 of 6 (1 partial)
Medium benthivores (fish)	Campelen spring	Minor	1 of 7 (partial)
Medium benthivores (fish)	Engel spring	Moderate	2 of 4 (2 partial)
Small benthivores (fish)	Campelen spring	Moderate	2 of 16 (1 partial)
Small benthivores (fish)	Engel spring	Moderate	1 of 9 (partial)
Planktivores (fish)	Campelen spring	Moderate	2 of 8 (2 partial)
Planktivores (fish)	Engel spring	Significant	1 of 4 (partial)
Plankpiscivores (fish)	Campelen spring	Significant	1 of 2 (partial)
Plankpiscivores (fish)	Engel spring	Minor	4 of 9 (1 partial)
Piscivores (fish)	Campelen spring	Significant	2 of 7 (2 partial)
Piscivores (fish)	Engel spring	Significant	3 of 6 (1 partial)
Sea pens	RV survey data	Significant	1 of 7 (partial)
Sea pens	SBAs	Moderate	2 of 13 (2 partial)
Small gorgonian corals	SBAs	Insignificant	1 of 5 (partial)
Black Dogfish	Peer reviewed	Significant	1 of 1 (partial)

Key features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Smooth Skate	Peer reviewed	Significant	1 of 1 (partial)
Spiny Dogfish adults	Peer reviewed	Moderate	1 of 1 (partial)
Blue Whale important habitat	Peer reviewed	Minor	2 of 3 (2 partial)

APPENDIX I – OTHER FEATURES OF EACH EBSA

Data descriptors:

- Edge = a polygon from a particular data layer is generally found outside the boundary of the EBSA but a relatively small portion of it extends inside the boundary (i.e. on the edge).
- Insignificant = species found in a very small area (less than 5%) within the EBSA
- Minor = species found in a few small areas or in part of one moderately sized area (more than 5% but less than 30% of the EBSA)
- Moderate = species found in several small areas or more than one moderately sized area within the EBSA (at least 30% but less than 70% of the EBSA)
- Significant = species found throughout a large portion (greater than 70% but not the entire EBSA) of the EBSA
- Whole = species found throughout the entire EBSA
- Partial = part of a polygon from a particular data layer found within the boundary of the EBSA, but part of the polygon extends outside the EBSA boundary
- In Associated data source columns, Campelen spring, Campelen fall, Engel spring and Engel fall refer to DFO RV survey time series. See methods for further explanation.
- For Coastal EBSAs, coastal data are listed first then offshore data. The opposite is true for Offshore EBSAs. Data layers are ordered as follows: eelgrass, fish, corals, marine mammals, seabirds/waterfowl, CCRI.
- Polygons are defined as a continuous area of grid cells that are adjoined at the edges. Adjacent grid cells that are connected by their corners are considered a separate polygon.

COASTAL EBSAS

Bonavista Bay (3L)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Bird IBAs	-	Minor	2 of 17 (1 partial)
Common Eiders	Winter aerial block survey	Insignificant	2 of 8
Plunge-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 20 (partial)
Pursuit-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 19 (partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	1 of 29
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	2 of 17 (1 partial)
Great Black-backed Gull colonies	Colony max counts	-	10 of 70
Great Black-backed Gull foraging	Colony foraging buffer	Whole	-
Herring Gull foraging	Colony foraging buffer	Significant	-
Leach's Storm-Petrel foraging	Colony foraging buffer	Whole	-
Northern Gannet foraging	Colony foraging buffer	Whole	-
Northern Fulmar foraging	Colony foraging buffer	Whole	-
CCRI Irish Moss	-	Insignificant	-
CCRI Kelp	-	Insignificant	-
CCRI Dolphin & Porpoise (polygon)	-	Minor	15 of 39
CCRI Seal (polygon)	-	Significant	23 of 59 (3 partial)
CCRI American Plaice	-	Insignificant	-
CCRI Cod	-	Moderate	-
CCRI Flounder	-	Minor	-
CCRI Lumpfish	-	Minor	-
CCRI Skate	-	Minor	-
CCRI Turbot	-	Minor	-
CCRI Winter Flounder	-	Minor	-
CCRI Witch Flounder	-	Minor	-
CCRI Eel	-	Insignificant	-
CCRI Capelin	-	Insignificant	-
CCRI Salmon	-	Insignificant	-
CCRI Herring	-	Minor	-
CCRI Mackerel	-	Minor	-
CCRI Smelt	-	Insignificant	-
CCRI Tuna	-	Insignificant	-
CCRI Giant Scallops	-	Insignificant	-
CCRI Lobster	-	Insignificant	-
CCRI Mussel	-	Insignificant	-
CCRI Rock Crab	-	Insignificant	-
CCRI Sea Urchin	-	Insignificant	-
CCRI Snow Crab	-	Moderate	-
CCRI Squid	-	Insignificant	-
CCRI Toad Crab	-	Insignificant	-
CCRI Whelk	-	Insignificant	-

Smith Sound (3L)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Great Black-backed Gull colonies	Colony max counts	-	4 of 70
Herring Gull colonies	Colony max counts	-	3 of 42
Tern sp. colonies	Colony max counts	-	1 of 26
Great Black-backed Gull foraging	Colony foraging buffer	Whole	-
Herring Gull foraging	Colony foraging buffer	Whole	-
Leach's Storm-Petrel foraging	Colony foraging buffer	Whole	-
Northern Gannet foraging	Colony foraging buffer	Whole	-
Northern Fulmar foraging	Colony foraging buffer	Whole	-
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 27
Small cetaceans functional group	Sightings data	Minor	1 of 19 (partial)
CCRI Irish Moss	-	Insignificant	-
CCRI Kelp	-	Minor	-
CCRI Dolphin Porpoise (poly)	-	Minor	-
CCRI Seal (poly)	-	Moderate	-
CCRI Turtle (poly)	-	Insignificant	-
CCRI Coral (poly)	-	Insignificant	-
CCRI Arctic Cod	-	Insignificant	-
CCRI American Plaice	-	Insignificant	-
CCRI Cod	-	Significant	-
CCRI Flounder	-	Moderate	-
CCRI Hake	-	Insignificant	-
CCRI Halibut	-	Insignificant	-
CCRI Lumpfish	-	Moderate	-
CCRI Redfish	-	Insignificant	-
CCRI Sand Lance	-	Insignificant	-
CCRI Skate	-	Minor	-
CCRI Turbot	-	Moderate	-
CCRI Winter Flounder	-	Minor	-
CCRI Eel	-	Insignificant	-
CCRI Brook Trout	-	Insignificant	-
CCRI Brown Trout	-	Insignificant	-
CCRI Capelin	-	Moderate	-
CCRI Salmon	-	Moderate	-
CCRI Herring	-	Moderate	-
CCRI Jellyfish	-	Minor	-
CCRI Mackerel	-	Moderate	-
CCRI Shark	-	Insignificant	-
CCRI Smelt	-	Insignificant	-
CCRI Sunfish	-	Insignificant	-
CCRI Tuna	-	Minor	-
CCRI Clam	-	Insignificant	-
CCRI Cockle	-	Insignificant	-
CCRI Giant Scallop	-	Insignificant	-
CCRI Icelandic Scallop	-	Insignificant	-
CCRI Lobster	-	Minor	-
CCRI Moonsnail	-	Insignificant	-
CCRI Mussel	-	Insignificant	-
CCRI Periwinkle	-	Insignificant	-
CCRI Rock Crab	-	Insignificant	-
CCRI Scallop	-	Insignificant	-
CCRI Sea Cucumber	-	Insignificant	-
CCRI Sea Urchin	-	Insignificant	-
CCRI Shrimp	-	Insignificant	-
CCRI Snail	-	Insignificant	-

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
CCRI Snow Crab	-	Minor	-
CCRI Soft Shell Clam	-	Insignificant	-
CCRI Squid	-	Minor	-
CCRI Whelk	-	Minor	-

Baccalieu Island (3L)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
Bird IBAs	-	Insignificant	3 of 17 (1 partial)
Black Legged Kittiwake colonies	Colony max counts	-	3 of 14
Herring Gull colonies	Colony max counts	-	1 of 42
Razorbill colonies	Colony max counts	-	1 of 5
Tern sp. colonies	Colony max counts	-	1 of 26
Great Black-backed Gull foraging	Colony foraging buffer	Moderate	-
Herring Gull foraging	Colony foraging buffer	Moderate	-
Leach’s Storm-Petrel foraging	Colony foraging buffer	Whole	-
Northern Gannet foraging	Colony foraging buffer	Whole	-
Northern Fulmar foraging	Colony foraging buffer	Whole	-
Tern sp. foraging	Colony foraging buffer	Minor	-
CCRI Kelp (poly)	-	Insignificant	-
CCRI Irish Moss (poly)	-	Insignificant	-
CCRI Seals (point)	-	-	21 of 239
CCRI Dolphin Porpoise (point)	-	-	5 of 39
CCRI Otter (point)	-	-	1 of 9
CCRI Turtle (point)	-	-	1 of 29
CCRI Otter (poly)	-	Insignificant	-
CCRI Dolphin Porpoise (poly)	-	Minor	-
CCRI Seal (poly)	-	Minor	-
CCRI Turtle (poly)	-	Insignificant	-
CCRI Coral (poly)	-	Insignificant	-
CCRI American Plaice	-	Minor	-
CCRI Cod	-	Minor	-
CCRI Flounder	-	Insignificant	-
CCRI Halibut	-	Minor	-
CCRI Lumpfish	-	Insignificant	-
CCRI Sand Lance	-	Insignificant	-
CCRI Skate	-	Insignificant	-
CCRI Turbot	-	Minor	-
CCRI Winter Flounder	-	Insignificant	-
CCRI Witch Flounder	-	Minor	-
CCRI Yellowtail Flounder	-	Minor	-
CCRI Eel	-	Insignificant	-
CCRI Capelin	-	Minor	-
CCRI Salmon	-	Insignificant	-
CCRI Herring	-	Insignificant	-
CCRI Jellyfish	-	Minor	-
CCRI Mackerel	-	Insignificant	-
CCRI Share	-	Insignificant	-
CCRI Sunfish	-	Insignificant	-
CCRI Tuna	-	Minor	-
CCRI Icelandic Scallop	-	Insignificant	-
CCRI Lobster	-	Insignificant	-
CCRI Mussel	-	Insignificant	-
CCRI Periwinkle	-	Insignificant	-
CCRI Rock Crab	-	Insignificant	-

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA compared to # in entire study area
CCRI Sea Urchin	-	Insignificant	-
CCRI Snail	-	Insignificant	-
CCRI Snow Crab	-	Minor	-
CCRI Squid	-	Insignificant	-
CCRI Toad Crab	-	Insignificant	-
CCRI Whelk	-	Insignificant	-
Common Eiders	Winter aerial block survey	Insignificant	1 of 8
Sea Ducks	Waterfowl block surveys	Insignificant	3 of 7
Squid-eating cetaceans functional group	Sightings data	Insignificant	3 of 19 (3 partial)
Small cetaceans functional group	Minor	Insignificant	3 of 19 (3 partial)
Snow Crab	Campelen spring	Minor	1 of 9 (1 partial)
Greenland Halibut	Engel spring	Insignificant	1 of 3 (1 partial)
Planktivores (fish)	Campelen fall	Minor	1 of 7 (1 partial)
Small benthivores (fish)	Campelen fall	Minor	1 of 11 (1 partial)
Atlantic Cod	Campelen fall	Insignificant	1 of 4 (1 partial)
Atlantic Cod	Engel fall	Insignificant	1 of 18 (1 partial)
American Plaice	Engel spring	Insignificant	1 of 12 (1 partial)
Northern Wolffish	Engel spring	Minor	1 of 7 (1 partial)
Spotted Wolffish	Peer reviewed	Insignificant	1 of 1 (1 partial)
Plunge-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 20 (1 partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	2 of 29 (1 partial)
Surface, shallow-diving coastal piscivores (seabirds)	Pelagic seabird surveys	Insignificant	1 of 4 (1 partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	2 of 27 (1 partial)

Eastern Avalon (3L)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Great Black-backed Gull colonies	Colony max counts	-	8 of 70
Herring Gull colonies	Colony max counts	-	6 of 42
Leach's Storm-Petrel colonies	Colony max counts	-	2 of 5
Tern sp. colonies	Colony max counts	-	1 of 26
Great Black-backed Gull foraging	Colony foraging buffer	Whole	-
Herring Gull foraging	Colony foraging buffer	Whole	-
Leach's Storm-Petrel foraging	Colony foraging buffer	Whole	-
Northern Gannet foraging	Colony foraging buffer	Whole	-
Northern Fulmar foraging	Colony foraging buffer	Whole	-
Sea Ducks	Waterfowl block surveys	Minor	1 of 7 (partial)
Dabbling Ducks	Waterfowl block surveys	Minor	1 of 1 (partial)
Bird IBAs	-	Insignificant	3 of 17 (1 partial)
Large gorgonian corals	RV survey data	Insignificant	1 of 10 (1 partial)
Snow Crab	Campelen fall	Edge	0 of 8 (edge)
Plankpiscivores (fish)	Campelen fall	Minor	1 of 5 (1 partial)
Medium benthivores (fish)	Campelen fall	Insignificant	1 of 9 (1 partial)
Small cetaceans functional group	Sightings data	Minor	2 of 19 (1 partial)
Grey Seals	Telemetry + expert advice	Minor	2 of 6 (1 partial)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Pursuit-diving planktivores (seabirds)	Pelagic seabird surveys	Minor	2 of 26
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	1 of 29 (partial)
Surface-seizing plankpiscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 24 (partial)
CCRI Irish Moss	-	Insignificant	-
CCRI Kelp	-	Minor	-
CCRI Dolphin & Porpoise (points)	-	-	11 of 112
CCRI Otter (points)	-	-	3 of 9
CCRI Seal (points)	-	-	6 of 239
CCRI Turtle (points)	-	-	3 of 29
CCRI Coral	-	Insignificant	2 of 21
CCRI Cod	-	Minor	-
CCRI Flounder	-	Minor	-
CCRI Haddock	-	Insignificant	-
CCRI Halibut	-	Insignificant	-
CCRI Lumpfish	-	Minor	-
CCRI Skate	-	Insignificant	-
CCRI Winter Flounder	-	Insignificant	-
CCRI Brown Trout	-	Insignificant	-
CCRI Capelin	-	Insignificant	-
CCRI Salmon	-	Minor	-
CCRI Herring	-	Insignificant	-
CCRI Jellyfish	-	Insignificant	-
CCRI Mackerel	-	Minor	-
CCRI Lobster	-	Insignificant	-
CCRI Periwinkle	-	Insignificant	-
CCRI Rock Crab	-	Insignificant	-
CCRI Scallop	-	Insignificant	-
CCRI Sea Urchin	-	Insignificant	-
CCRI Shrimp	-	Insignificant	-
CCRI Snow Crab	-	Minor	-
CCRI Squid	-	Insignificant	-
CCRI Toad Crab	-	Insignificant	-
CCRI Whelk	-	Insignificant	-

St. Mary's Bay (3Ps)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Black-legged Kittiwake colonies	Colony max counts	-	2 of 14
Great Black-backed Gull colonies	Colony max counts	-	1 of 70
Herring Gull colonies	Colony max counts	-	4 of 42
Razorbill colonies	Colony max counts	-	1 of 5
Atlantic Puffin foraging	Colony foraging buffer	Insignificant	-
Great Black-backed Gull foraging	Colony foraging buffer	Significant	-
Herring Gull foraging	Colony foraging buffer	Significant	-
Leach's Storm-Petrel foraging	Colony foraging buffer	Whole	-
Northern Gannet foraging	Colony foraging buffer	Whole	-
Northern Fulmar foraging	Colony foraging buffer	Whole	-
Thick-billed Murre foraging	Colony foraging buffer	Insignificant	-
Common Eiders	Winter aerial block survey	Minor	2 of 8 (1 partial)
Bird IBAs	-	Minor	3 of 17 (2 partial)
Large gorgonian corals	RV survey data	Edge	0 of 10 (edge)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Soft corals	RV survey data	Edge	0 of 10 (edge)
Medium benthivores (fish)	Campelen fall	Insignificant	1 of 9 (1 partial)
Medium benthivores (fish)	Campelen spring	Minor	1 of 7 (1 partial)
Pursuit-diving planktivores (seabirds)	Pelagic seabird surveys	Minor	1 of 26 (partial)
Pursuit-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	2 of 19 (2 partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	1 of 29 (partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 27 (partial)
Killer Whales	Sightings data	Minor	1 of 15
Small cetaceans functional group	Sightings data	Insignificant	1 of 19 (partial)
Harbour Seals	Peer reviewed + expert advice	Minor	1 of 14
Blue Whale important habitat	Peer reviewed	Insignificant	1 of 3 (partial)
CCRI Irish Moss	-	Insignificant	-
CCRI Kelp	-	Insignificant	-
CCRI Dolphin & Porpoise (points)	-	-	13 of 112
CCRI Otter (points)	-	-	2 of 9
CCRI Seal (points)	-	-	32 of 239
CCRI Turtle (points)	-	-	4 of 29
CCRI American Plaice	-	Moderate	-
CCRI Cod	-	Moderate	-
CCRI Flounder	-	Moderate	-
CCRI Haddock	-	Insignificant	-
CCRI Lumpfish	-	Minor	-
CCRI Pollock	-	Insignificant	-
CCRI Sculpin	-	Insignificant	-
CCRI Skate	-	Insignificant	-
CCRI Winter Flounder	-	Minor	-
CCRI Yellowtail	-	Insignificant	-
CCRI Swordfish	-	Insignificant	-
CCRI Eel	-	Insignificant	-
CCRI Brook Trout	-	Insignificant	-
CCRI Brown Trout	-	Insignificant	-
CCRI Capelin	-	Minor	-
CCRI Salmon	-	Insignificant	-
CCRI Herring	-	Minor	-
CCRI Mackerel	-	Minor	-
CCRI Shark	-	Insignificant	-
CCRI Smelt	-	Insignificant	-
CCRI Sunfish	-	Insignificant	-
CCRI Giant Scallop	-	Insignificant	-
CCRI Icelandic Scallop	-	Insignificant	-
CCRI Lobster	-	Minor	-
CCRI Mussel	-	Insignificant	-
CCRI Periwinkle	-	Insignificant	-
CCRI Quahog	-	Insignificant	-
CCRI Rock Crab	-	Insignificant	-
CCRI Sea Urchin	-	Insignificant	-
CCRI Snow Crab	-	Moderate	-
CCRI Squid	-	Insignificant	-
CCRI Toad Crab	-	Insignificant	-
CCRI Whelk	-	Insignificant	-

Placentia Bay (3Ps)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Black-legged Kittiwake colonies	Colony max counts	-	2 of 14
Great Black-backed Gull colonies	Colony max counts	-	15 of 70
Herring Gull colonies	Colony max counts	-	21 of 42
Leach's Storm-Petrel colonies	Colony max counts	-	1 of 5
Common Eiders	Winter aerial block survey	Insignificant	1 of 8
Pursuit-diving planktivores (seabirds)	Pelagic seabird surveys	Minor	1 of 26 (partial)
Pursuit-diving piscivores (seabirds)	Pelagic seabird surveys	Insignificant	1 of 19 (partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	2 of 29 (1 partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Insignificant	2 of 27 (2 partial)
Surface, shallow-diving coastal piscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 4
Bird IBAs	-	Minor	4 of 17 (1 partial)
Blue Whales	Sightings data	Insignificant	1 of 5
Killer Whales	Sightings data	Insignificant	1 of 15 (partial)
Grey Seals	Telemetry + expert advice	Minor	1 of 6 (partial)
Harbour Seals	Peer reviewed + expert advice	Minor	4 of 14
Small cetaceans functional group	Sightings data	Insignificant	1 of 19 (partial)
Large gorgonian corals	RV survey data	Minor	1 of 10
Soft corals	RV survey data	Minor	1 of 10
Snow Crab	Campelen spring	Minor	1 of 9 (partial)
Planktivores (fish)	Campelen spring	Minor	1 of 8 (partial)
Medium benthivores (fish)	Campelen spring	Minor	1 of 7 (partial)
Medium benthivores (fish)	Engel spring	Minor	1 of 4 (partial)
American Plaice	Engel spring	Insignificant	1 of 12 (partial)
Great Black-backed Gull foraging	Colony foraging buffer	Significant	-
Herring Gull foraging	Colony foraging buffer	Significant	-
Leach's Storm-Petrel foraging	Colony foraging buffer	Whole	-
Northern Gannet foraging	Colony foraging buffer	Whole	-
Northern Fulmar foraging	Colony foraging buffer	Whole	-
Razorbill foraging	Colony foraging buffer	Insignificant	-
CCRI Irish Moss	-	Insignificant	-
CCRI Kelp	-	Insignificant	-
CCRI Dolphin Porpoise (point)	-	-	14 of 112
CCRI Otters (point)	-	-	2 of 9
CCRI Seals (point)	-	-	36 of 239
CCRI Turtle (point)	-	-	14 of 29
CCRI Dolphin Porpoise (poly)	-	Insignificant	-
CCRI Seal (poly)	-	Insignificant	-
CCRI Coral (poly)	-	Insignificant	-
CCRI American Plaice	-	Insignificant	-
CCRI Cod	-	Minor	-
CCRI Flounder	-	Minor	-
CCRI Haddock	-	Insignificant	-
CCRI Lumpfish	-	Insignificant	-
CCRI Pollock	-	Insignificant	-
CCRI Skate	-	Insignificant	-
CCRI Winter Flounder	-	Insignificant	-
CCRI Trout	-	Insignificant	-

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
CCRI Eel	-	Insignificant	-
CCRI Capelin	-	Insignificant	-
CCRI Salmon	-	Insignificant	-
CCRI Herring	-	Insignificant	-
CCRI Mackerel	-	Insignificant	-
CCRI Shark	-	Insignificant	-
CCRI Sunfish	-	Insignificant	-
CCRI Tuna	-	Insignificant	-
CCRI Crab	-	Insignificant	-
CCRI Giant Scallops	-	Insignificant	-
CCRI Icelandic Scallops	-	Insignificant	-
CCRI Lobster	-	Insignificant	-
CCRI Mussel	-	Insignificant	-
CCRI Rock Crab	-	Insignificant	-
CCRI Scallop	-	Insignificant	-
CCRI Sea Urchin	-	Insignificant	-
CCRI Snow Crab	-	Minor	-
CCRI Squid	-	Insignificant	-
CCRI Whelk	-	Insignificant	-

South Coast (3P)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Common Eiders	Winter aerial block survey	Minor	1 of 8
Great Black-backed Gull colonies	Colony max counts	-	23 of 70
Herring Gull colonies	Colony max counts	-	1 of 42
Tern sp. colonies	Colony max counts	-	1 of 26
Great Black-backed Gull foraging	Colony foraging buffer	Whole	-
Herring Gull foraging	Colony foraging buffer	Moderate	-
Leach's Storm-Petrel foraging	Colony foraging buffer	Moderate	-
Northern Gannet foraging	Colony foraging buffer	Moderate	-
Tern sp. foraging	Colony foraging buffer	Minor	-
Bird IBAs	-	Insignificant	2 of 17
Smooth Skate	Campelen spring	Insignificant	1 of 3 (partial)
Atlantic Wolffish	Engel spring	Minor	1 of 4 (partial)
Medium benthivores (fish)	Campelen spring	Minor	1 of 7
Medium benthivores (fish)	Engel spring	Insignificant	1 of 9 (partial)
Sea pens	RV survey data	Minor	1 of 7 (partial)
Soft corals	RV survey data	Minor	1 of 10 (partial)
Plunge-diving piscivores (seabirds)	Pelagic seabird surveys	Insignificant	1 of 20 (partial)
Pursuit-diving piscivores (seabirds)	Pelagic seabird surveys	Insignificant	1 of 19 (partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	2 of 29 (1 partial)
Right Whale	Sightings data	Insignificant	1 of 1 (partial)
Harbour Seals	Peer reviewed + expert advice	Insignificant	1 of 14
Killer Whale	Sightings data	Minor	2 of 15 (1 partial)
Leatherback Turtle important habitat	-	Insignificant	1 of 2 (partial)
CCRI Kelp	-	Insignificant	-
CCRI Dolphin & Porpoise (points)	-	-	26 of 112
CCRI Seal (points)	-	-	55 of 239

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
CCRI Cod	-	Minor	-
CCRI Flounder	-	Insignificant	-
CCRI Haddock	-	Insignificant	-
CCRI Halibut	-	Minor	-
CCRI Lumpfish	-	Insignificant	-
CCRI Redfish	-	Insignificant	-
CCRI Witch Flounder	-	Insignificant	-
CCRI Trout	-	Insignificant	-
CCRI Eel	-	Insignificant	-
CCRI Brook Trout	-	Insignificant	-
CCRI Capelin	-	Insignificant	-
CCRI Salmon	-	Insignificant	-
CCRI Herring	-	Insignificant	-
CCRI Mackerel	-	Insignificant	-
CCRI Smelt	-	Insignificant	-
CCRI Clam	-	Insignificant	-
CCRI Lobster	-	Insignificant	-
CCRI Mussel	-	Insignificant	-
CCRI Northern Stone Crab	-	Insignificant	-
CCRI Quahog	-	Insignificant	-
CCRI Rock Crab	-	Insignificant	-
CCRI Scallop	-	Insignificant	-
CCRI Sea Urchin	-	Insignificant	-
CCRI Snow Crab	-	Insignificant	-
CCRI Squid	-	Insignificant	-

OFFSHORE EBSAS

Northeast Slope (3L)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Leach's Storm-Petrel foraging	Colony foraging buffer	Moderate	-
Snow Crab	Campelen spring	Minor	2 of 9 (2 partial)
Snow Crab	Campelen fall	Minor	1 of 8 (partial)
Redfish	Campelen fall	Insignificant	1 of 5 (partial)
Roundnose Grenadier	Engel spring	Minor	1 of 5 (partial)
Roundnose Grenadier	Engel fall	Insignificant	1 of 3 (partial)
Pursuit-diving planktivores (seabirds)	Pelagic seabird surveys	Minor	3 of 26 (partial)
Pursuit-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	2 of 19 (partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Insignificant	1 of 29 (partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	6 of 27 (2 partial)
Surface-seizing plankpiscivores (seabirds)	Pelagic seabird surveys	Minor	3 of 24 (3 partial)
Harp Seals	Winter feeding (telemetry)	Minor	1 of 1 (partial)
Killer Whale	Sightings data	Edge	1 of 15
Mysticetes functional group	Sightings data	Minor	1 of 13 (partial)
Squid-eating cetaceans functional group	Sightings data	Minor	2 of 5 (2 partial)
Small cetaceans functional group	Sightings data	Insignificant	1 of 19 (partial)
Large gorgonian corals	RV survey data	Minor	3 of 10 (2 partial)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Corals	Peer reviewed	Minor	1 of 2 (partial)
Northern Fulmar foraging	Colony foraging buffer	Significant	-
Northern Gannett foraging	Colony foraging buffer	Insignificant	-

Virgin Rocks (3LO)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Northern Fulmar foraging	Colony foraging buffer	Whole	-
Northern Gannet foraging	Colony foraging buffer	Significant	-
Leach's Storm-Petrel foraging	Colony foraging buffer	Moderate	-
Atlantic Cod	Engel spring	Minor	2 of 18 (2 partial)
Yellowtail Flounder	Campelen spring	Insignificant	1 of 5 (partial)
Thorny Skate	Engel fall	Minor	1 of 12 (partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	1 of 29 (partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 27 (partial)
Surface-seizing plankpiscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 24 (partial)
Pursuit-diving planktivores (seabirds)	Pelagic seabird surveys	Insignificant	1 of 26 (partial)
Pursuit-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	2 of 19
Common Murre	Telemetry (all fall)	Edge	0 of 1
Common Murre	Telemetry (all seasons)	Edge	0 of 1

Lilly Canyon-Carson Canyon (3N)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Sand Lance	Campelen spring	Minor	1 of 14 (partial)
Sand Lance	Campelen fall	Edge	1 of 7 (partial)
Sand Lance	Engel spring	Minor	1 of 14 (partial)
Atlantic Cod	Campelen spring	Minor	2 of 7 (2 partial)
Atlantic Cod	Campelen fall	Minor	1 of 4 (partial)
Northern Wolffish	Campelen fall	Minor	1 of 6 (partial)
Spotted Wolffish	Campelen fall	Minor	1 of 5 (partial)
Medium benthivores (fish)	Campelen fall	Insignificant	1 of 9 (partial)
Medium benthivores (fish)	Engel fall	Minor	1 of 10 (partial)
Mysticetes functional group	Sightings data	Insignificant	1 of 13 (partial)
Killer Whale	Sightings data	Edge	1 of 15
Large gorgonians	RV survey data	Edge	1 of 10
Soft corals	RV survey data	Minor	2 of 10 (2 partial)

Southeast Shoal (3NO)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Capelin	Campelen spring	Minor	1 of 10 (partial)
Capelin	Engel spring	Insignificant	1 of 8 (partial)
Redfish	Campelen spring	Insignificant	1 of 6 (partial)
Piscivores (fish)	Campelen spring	Insignificant	1 of 4 (partial)
Piscivores (fish)	Campelen fall	Insignificant	1 of 2 (partial)
Planktivores (fish)	Campelen fall	Insignificant	1 of 7 (partial)
Plankpiscivores (fish)	Campelen fall	Insignificant	1 of 5 (partial)
Pursuit-diving Piscivores (seabirds)	Pelagic seabird surveys	Insignificant	1 of 26 (partial)
Surface-seizing plankpiscivores (seabirds)	Pelagic seabird surveys	Minor	1 of 24 (partial)
Harp Seals	Winter feeding (telemetry)	Minor	1 of 1 (partial)
Killer Whale	Sightings data	Minor	1 of 15
Mysticetes functional group	Sightings data	Minor	1 of 13 (partial)
Small cetaceans functional group	Sightings data	Minor	3 of 19 (2 partial)
Juvenile Yellowtail (small) area	Peer reviewed	Edge	1 of 1 (partial)

Southwest Slope (3OPs)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Snow Crab	Campelen fall	Insignificant	1 of 8 (partial)
Capelin	Campelen spring	Insignificant	1 of 10 (partial)
Capelin	Engel spring	Insignificant	1 of 8 (partial)
Sand Lance	Campelen spring	Edge	1 of 14
Yellowtail Flounder	Campelen fall	Insignificant	1 of 5 (partial)
Atlantic Wolffish	Campelen spring	Minor	2 of 5 (1 partial)
Atlantic Wolffish	Campelen fall	Insignificant	1 of 6
Medium benthivores (fish)	Campelen spring	Minor	1 of 9 (partial)
Medium benthivores (fish)	Engel spring	Minor	1 of 4 (partial)
Plunge-diving piscivores (seabirds)	Pelagic seabird surveys	Insignificant	2 of 20 (1 partial)
Pursuit-diving planktivores (seabirds)	Pelagic seabird surveys	Insignificant	3 of 26 (2 partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Insignificant	1 of 29
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	3 of 27 (1 partial)
Surface-seizing plankpiscivores (seabirds)	Pelagic seabird surveys	Edge	1 of 24
Blue Whale	Sightings data	Minor	1 of 5 (partial)
Squid-eating cetaceans functional group	Sightings data	Minor	2 of 5 (1 partial)
Small cetaceans functional group	Sightings data	Minor	2 of 19 (1 partial)
Soft corals	RV survey data	Minor	2 of 10
Leach’s Storm-Petrel foraging	Colony foraging buffer	Minor	-
Pennatula (corals)	ROPOS high abundance	-	77 of 77
Keratoisis (corals)	ROPOS high abundance	-	34 of 34
Flabellum (corals)	ROPOS high abundance	-	47 of 47
Acanella (corals)	ROPOS high abundance	-	81 of 81

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Northern Fulmar foraging	Colony foraging buffer	Moderate	-
Northern Gannet foraging	Colony foraging buffer	Significant	-
Atlantic Wolffish	Peer reviewed	Edge	1 of 1 (partial

Haddock Channel Sponges (3O)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Leach's Storm-Petrel foraging	Colony foraging buffer	Whole	-
Northern Fulmar foraging	Colony foraging buffer	Whole	-
Northern Gannett foraging	Colony foraging buffer	Whole	-

Laurentian Channel (3P)

Other features within the EBSA	Associated data source	Description of data relative to EBSA size	# of polygons in this EBSA/# in entire study area
Great Black-backed Gull	Colony foraging buffer	Edge	-
Herring Gull	Colony foraging buffer	Edge	-
Leach's Storm-Petrel	Colony foraging buffer	Significant	-
Northern Gannet	Colony foraging buffer	Significant	-
Sand Lance	Campelen spring	Insignificant	2 of 14 (1 partial)
Sand Lance	Engel spring	Insignificant	1 of 14 (partial)
Yellowtail Flounder	Campelen spring	Insignificant	1 of 5 (partial)
American Plaice	Campelen spring	Minor	1 of 4 (partial)
American Plaice	Engel spring	Minor	2 of 12
Atlantic Cod	Campelen spring	Minor	3 of 7 (2 partial)
Atlantic Cod	Engel spring	Edge	0 of 18 (1 edge)
Redfish	Campelen spring	Insignificant	1 of 6
Redfish	Engel spring	Minor	2 of 5 (1 partial)
Atlantic Wolffish	Engel spring	Insignificant	1 of 4 (partial)
Roundnose Grenadier	Engel spring	Insignificant	1 of 5 (partial)
Northern Wolffish	Engel spring	Insignificant	2 of 7 (1 partial)
Spotted Wolffish	Engel spring	Insignificant	1 of 2 (partial)
Plunge-diving piscivores (seabirds)	Pelagic seabird surveys	Minor	2 of 20 (1 partial)
Pursuit-diving planktivores (seabirds)	Pelagic seabird surveys	Insignificant	2 of 26 (1 partial)
Shallow pursuit generalists (seabirds)	Pelagic seabird surveys	Minor	4 of 29 (2 partial)
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Insignificant	1 of 27 (partial)
Surface-seizing plankpiscivores (seabirds)	Pelagic seabird surveys	Minor	4 of 24
Small cetacean functional group	Sightings data	Minor	1 of 19
Small gorgonian corals	RV survey data	Insignificant	1 of 4 (partial)
Stony cup corals	RV survey data	Minor	1 of 5 (partial)
Soft corals	RV survey data	Insignificant	1 of 10

APPENDIX J: OFFSHORE DATA LAYERS

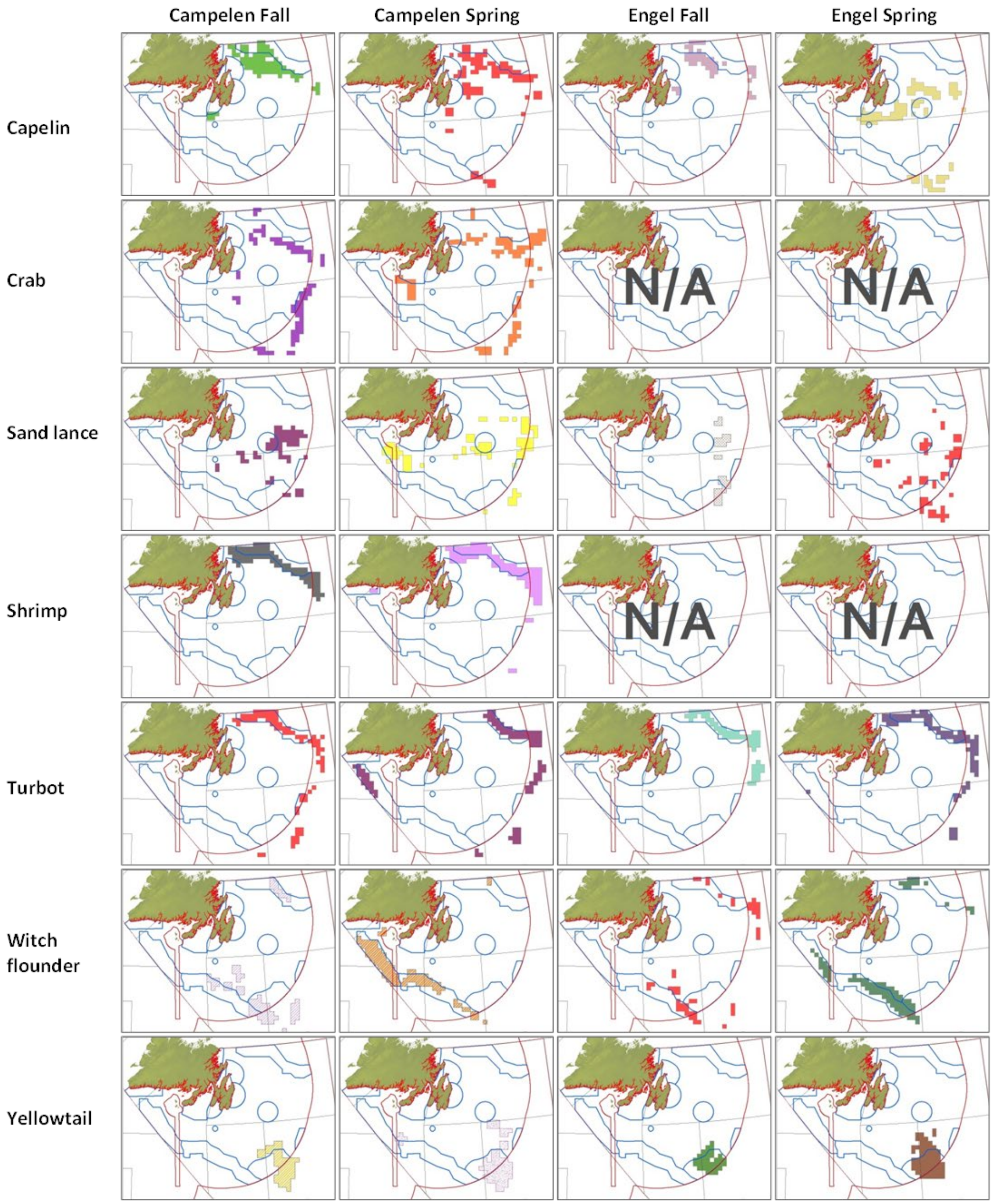

Figure 28: Data layers for core fish species from DFO RV survey datasets.

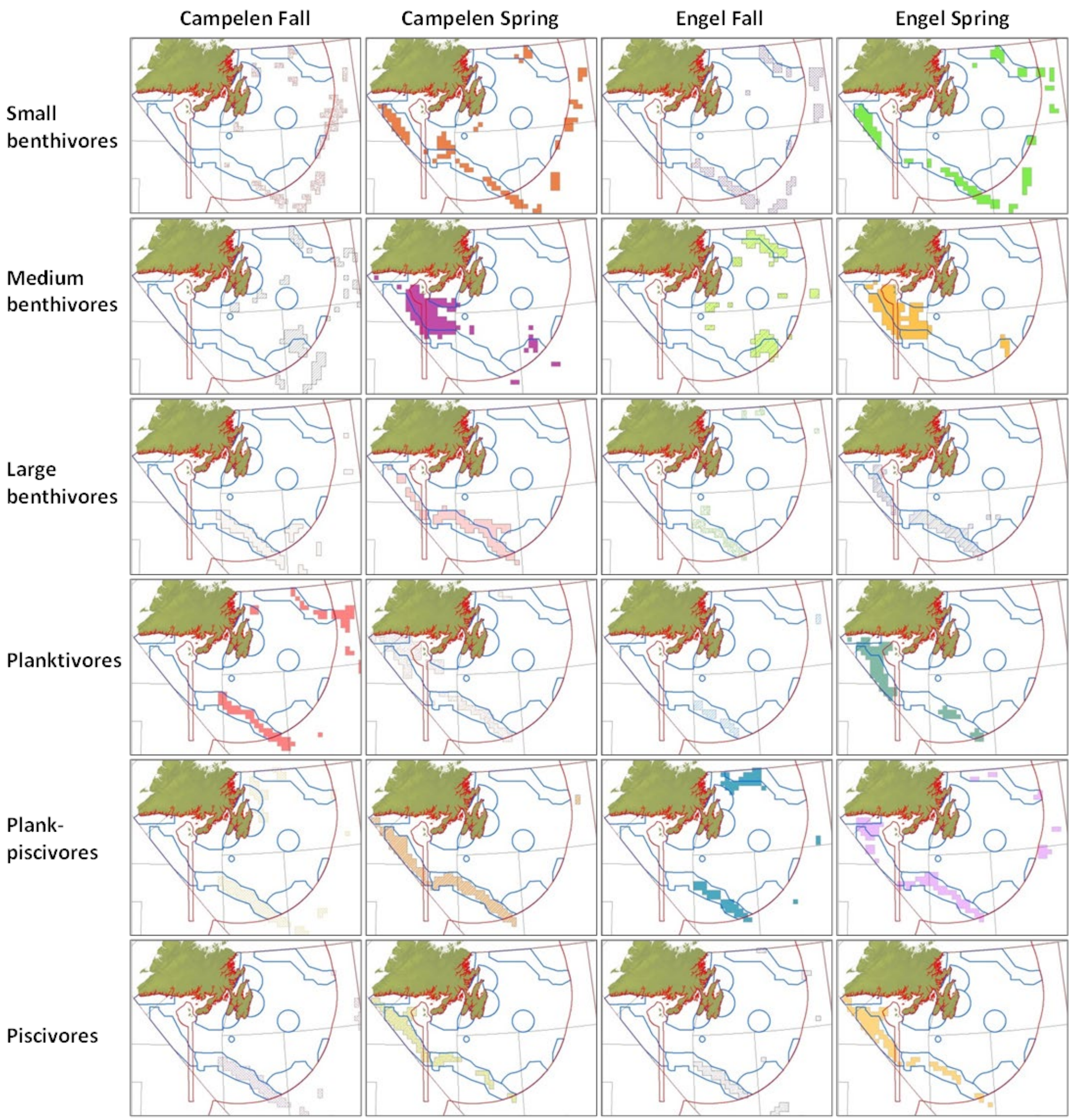

Figure 29: Data layers for core fish functional groups from DFO RV survey datasets.

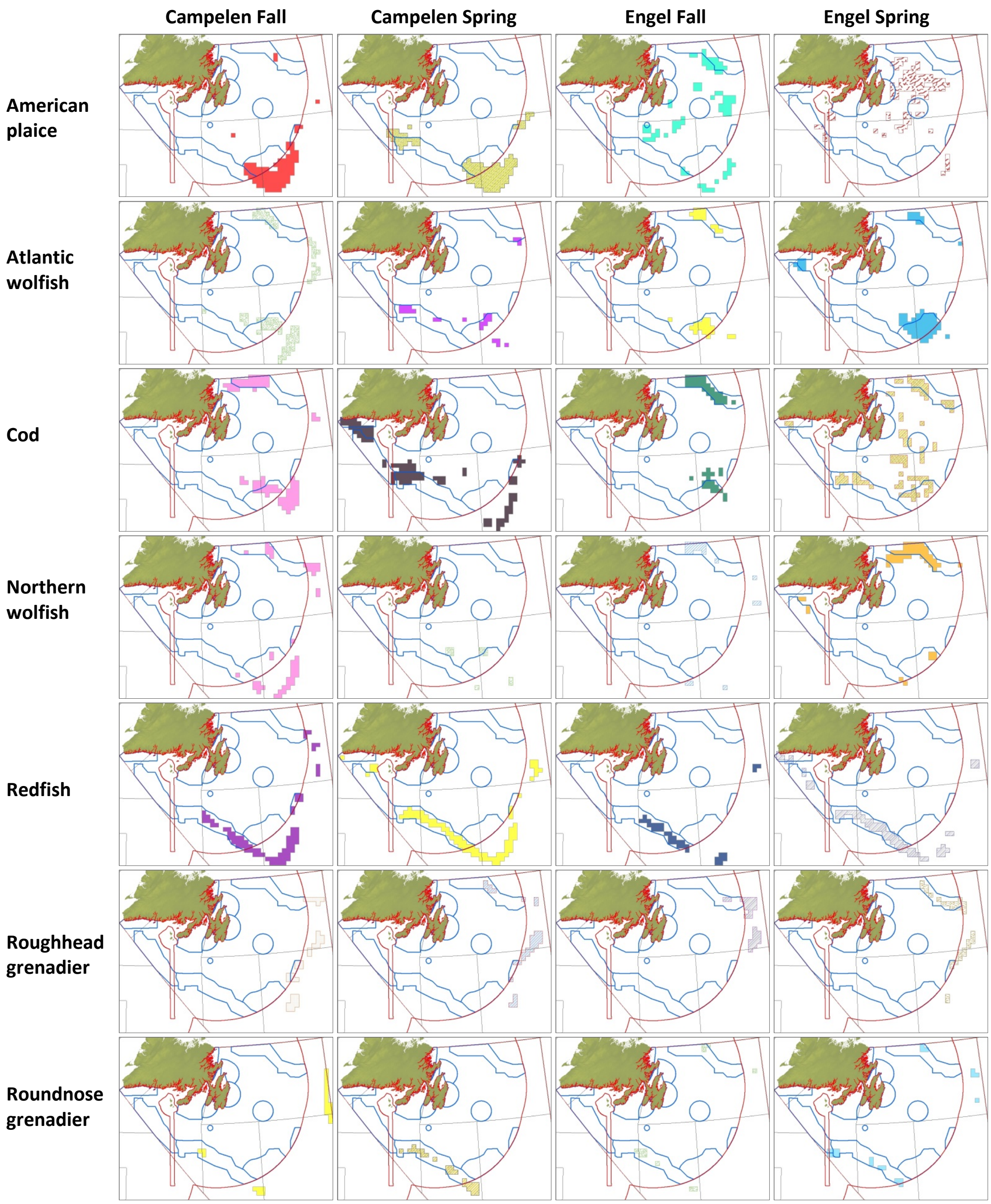

Figure 30: Data layers for at risk fish species from DFO RV survey datasets.

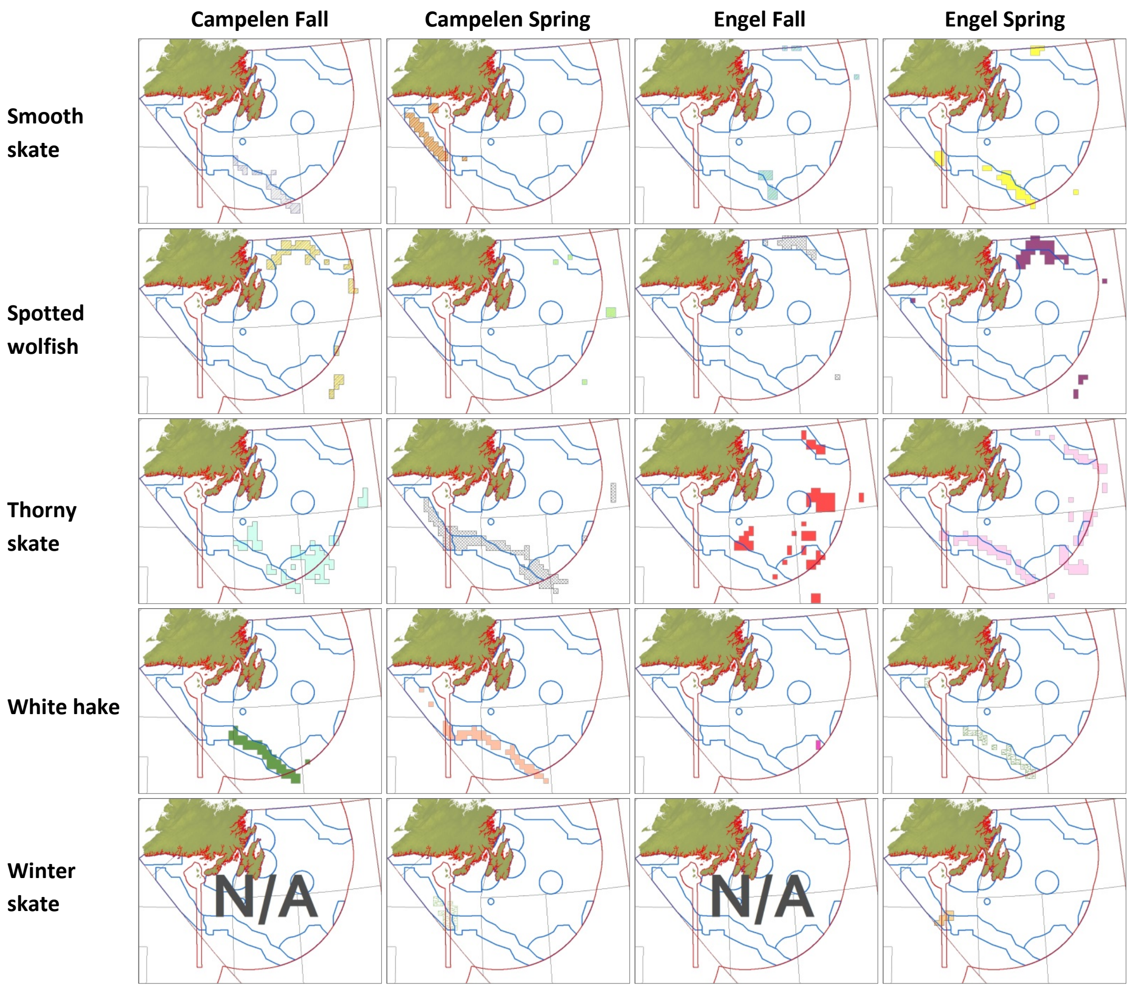

Figure 31 continued: Data layers for at risk fish species from DFO RV survey datasets.

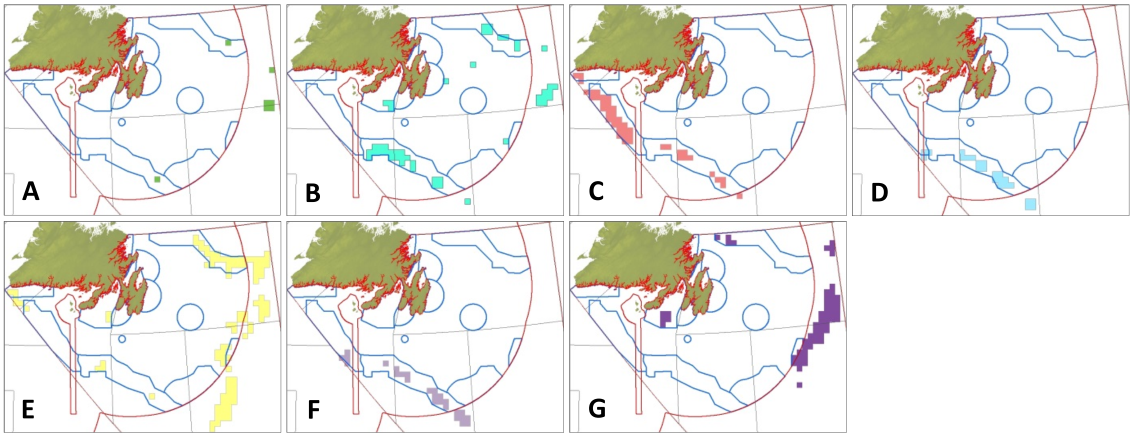

Figure 31: Data layers for coral functional groups and sponges; a. black corals, b. large gorgonian corals, c. sea pens, d. small gorgonian corals, e. soft corals, f. stony cup corals, g. sponges.

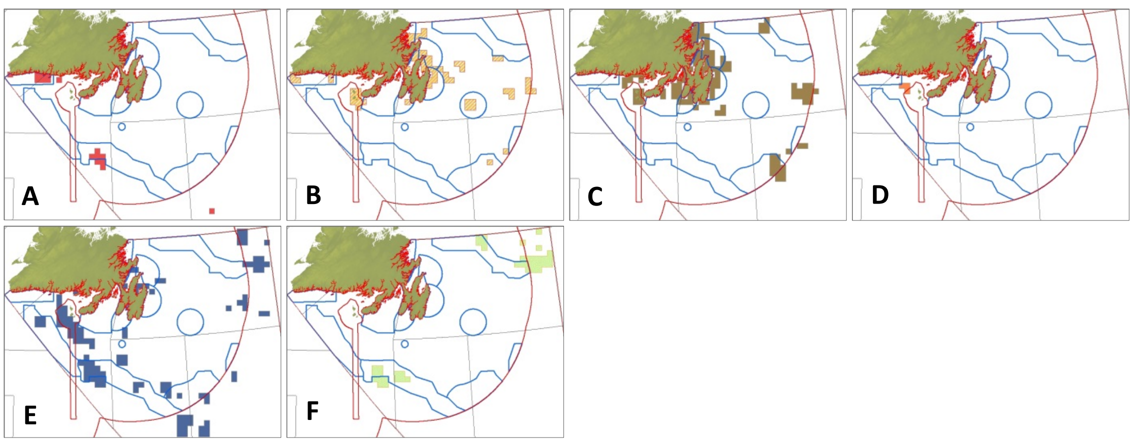

Figure 32: Data layers for Cetaceans; a. Blue whale, b. Killer whale, c. Mysticetes, d. Right whale, e. Small cetaceans, f. Squid eaters.

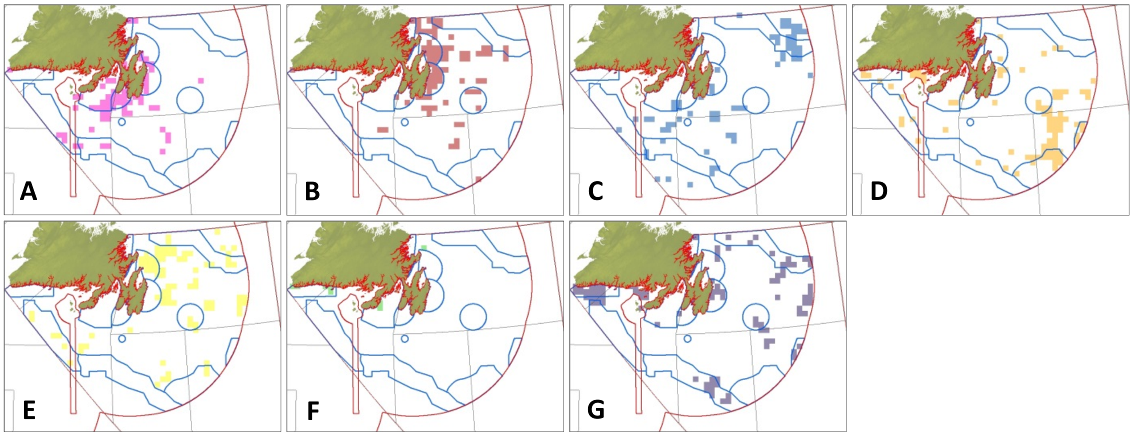

Figure 33: At-sea survey-derived data layers for Pelagic Birds; a. Plunge-diving piscivores, b. Pursuit-diving piscivores, c. Pursuit-diving planktivores, d. Shallow pursuit generalists, e. Surface-seizing plankpiscivores, f. Surface, shallow-diving coastal piscivores, g. Surface, shallow-diving piscivores

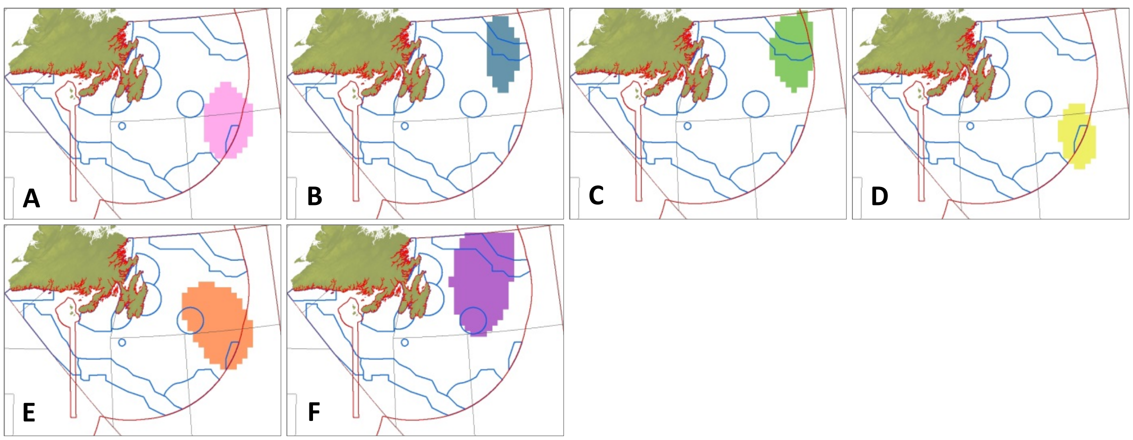

Figure 34: Telemetry-derived data layers for murres and Sooty Shearwater; a. Common murre fall, b. Common murre early winter, c. Common murre late winter, d. Common murre spring, e. Sooty shearwater, f. Thick billed murre early winter

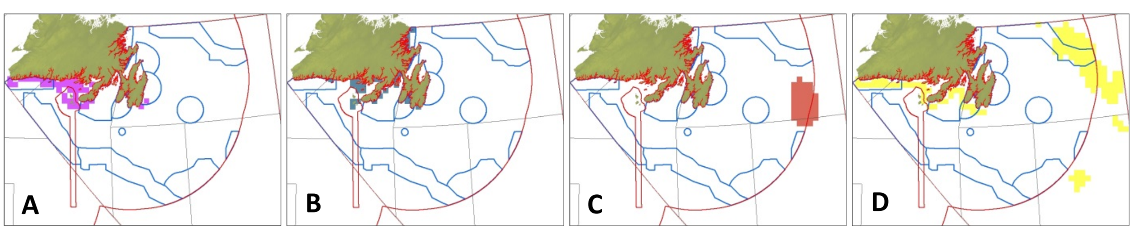

Figure 35: Data layers for Seals; a. Grey seal, b. Harbor seal, c. Harp seal, d. Hooded seal

APPENDIX K: BREEDING SEASON DIET INFORMATION FOR MAINLY PISCIVOROUS COLONIAL SEABIRDS

Extracted and estimated from Birds of North America species accounts and associated references, using data obtained within the bioregion when available (Birds of North America Website).

Species	Mean Max. Foraging Range (km)	Max. Foraging Depth (m)	Breeding Season Main Prey
Atlantic Puffin	60	68	Capelin (*Mallotus villosus*), herring (*Clupea harengus*), white hake (*Urophysis tenuis*) - derived from chick diet information
Razorbill	30	140	Sandlance (*Ammodytes* spp.), capelin, daubed shanny (*Lumpenus maculatus*), herring, white hake - derived from chick diet information
Common Murre	60	180	Capelin, sandlance - derived from chick diet information
Thick-billed Murre	60	210	Daubed shanny, capelin, sandlance - diet similar to Common Murre, but more varied and flexible; derived from chick diet information
Black-legged Kittiwake	60	1	Capelin, sandlance
Tern sp.	20	0.5	Capelin, sandlance, white hake, herring, crustaceans, euphausiids, also daubed shanny - derived from chick diet information; adults are generalists and opportunists; chicks predominantly fed fish
Northern Gannet	300	22	Capelin, mackerel (*Scomber scombrus*), herring, Atlantic saury (*Scomberesox saurus*), post-smolt Atlantic salmon (*Salmo salar*), sandlance short-finned squid (*Illex illecebrosus*)

APPENDIX L: PHYSICAL AND OCEANOGRAPHIC DESCRIPTION OF THE STUDY AREA

GENERAL DESCRIPTION

We provide in this paragraph a brief synopsis of circulation in the region from Loder et al (1998) (which provides a more complete description). The Placentia Bay-Grand Banks study area is part of the North Atlantic influenced by the North Atlantic subpolar gyre. The Labrador Current is a multi-branch western boundary current of this system that influences shelf-slope waters. The Labrador Current originates in the Labrador Sea and continues to the northeast Newfoundland Shelf and southward into the Grand Banks region with the exception of a small flow through the Strait of Belle Isle to the Gulf of St. Lawrence and an eastward transport north of the Flemish Cap. There are two distinct branches of the current off eastern Newfoundland, a low transport inshore flow around the Avalon Peninsula into the Southern Shelf and a high transport shelf-break branch flowing south through the Flemish Pass toward the Tail of the Grand Bank. At the Tail of the Grand Bank, the offshore branch further splits with flow along the southern Newfoundland Shelves and flow offshore (eastward) towards the Newfoundland Basin. Several hundred kilometers from the shelf edge is the Gulf Stream, the western boundary current of the North Atlantic subtropical gyre. The Gulf Stream influences the southern shelf regions indirectly through Slope Waters and transient rings.

Herein we describe the ocean circulation and conditions on and around the Newfoundland Shelves from a numerical description provided by an analysis system that optimally blends both observation data and a numerical model of ocean physics. This data assimilative reanalysis run entitled GLORYSv3 (Masina et al 2015) covers 1993-2014 using the NEMO Ocean Model and the Mercator-Ocean SAM data assimilation system. The reanalysis was averaged monthly and used to create a monthly climatology over the 20 year time span. The general description in the plots below represent the numerical description from GLORYSv3 interpolated to a plotted grid via the discovery and visualization tool, Ocean Navigator (*(GLORYSv3 climatology, http://navigator.oceansdata.ca, 2017)*. Here we focus on surface currents, temperature and salinities in the top 1m and bottom from GLORYSv3.

SURFACE CURRENTS

Figure 37 shows the GLORYSv3 climatology averaged over the month of April for the years 1993-2014 for surface velocity. The surface currents represented by the model generally follow the patterns described in Loder et al (1998) above. At the surface, currents appear to have a wider swath than at depth, possibly resulting from the influence of prevailing winds that may also mask eddy activity at the surface.

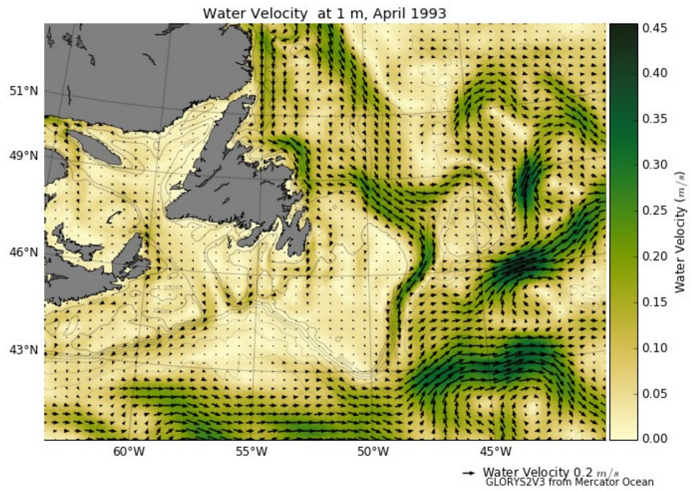

Figure 36: GLORYSv3 climatology represented for April (1993-2014) for surface velocity overlaid with arrows representing water velocity.

BOTTOM CURRENTS

At the bottom, flow in and around the Newfoundland Shelves is strongly topographically steered (i.e. following bottom topography contours). From the model (Figure 38) we see a portion of the velocities associated with the Gulf Stream and North Atlantic Drift extending to the sea bottom in deep water. The shelf slope circulation is clearly visible at the bottom along the 500/1000m isobaths from the Labrador Shelf down to the tail of the Grand Banks. Also in deeper water, the effects of persistent eddy activity in that area results in an apparent eddy pattern that changes over the climatological year. On the shelf, bottom velocities along the Newfoundland and Labrador shelves are associated with the inshore branch of the Labrador Current. Additional, stronger areas of circulation on the Grand Banks are just south of the Avalon Peninsula stretching east across the Banks.

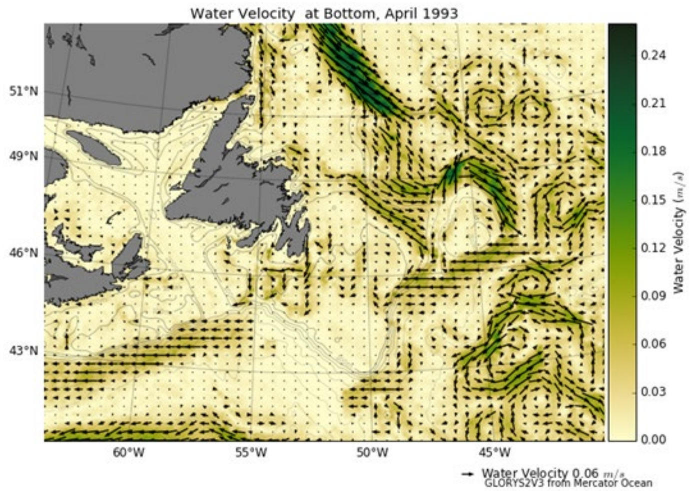

Figure 37: GLORYSv3 climatology represented for April (1993-2014) for bottom velocity overlaid with arrows representing water velocity.

SURFACE TEMPERATURE

Sea surface temperature from the GLORYSv3 reanalysis climatology is displayed in Figure 39. The model shows the coolest surface temperatures along the inshore and offshore branches of the Labrador Current. Additionally cooler temperatures occur along the Newfoundland and Labrador Shelves, Gulf of St. Lawrence and Scotian Shelf. The warmer waters of the Gulf Stream are captured here as well as the temporal frontal zone.

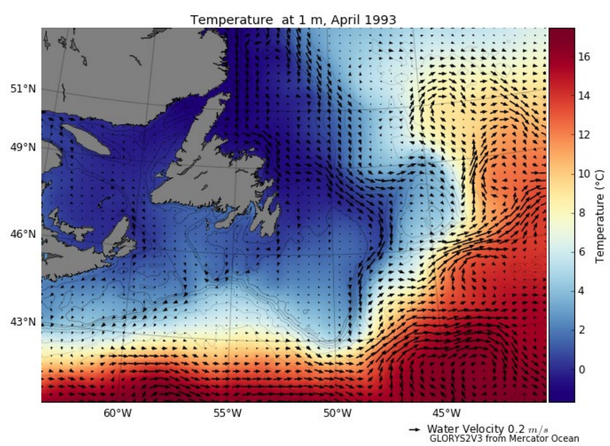

Figure 38: GLORYSv3 climatology represented for April (1993-2014) for surface temperature overlaid with arrows representing water velocity.

BOTTOM TEMPERATURE

From the model (Figure 40), we can see a band of warmer temperatures on the Southwest Shelf and extending onto the Southwest Shoal. There are cooler waters along the Labrador Coast and on the Grand Banks. Overall, the Laurentian Channel and south coast, along the northeast slope and slopes of the Grand Banks and Flemish cap are warmer relative to other areas.

In this region, the horizontal resolution of the ocean model is approximately 25 km which results in a gridded look in areas of large bottom temperature gradients (for example along the southwest slope of the Grand Banks). The circular artifacts in this plot are a result of the coarse model grid and interpolation techniques.

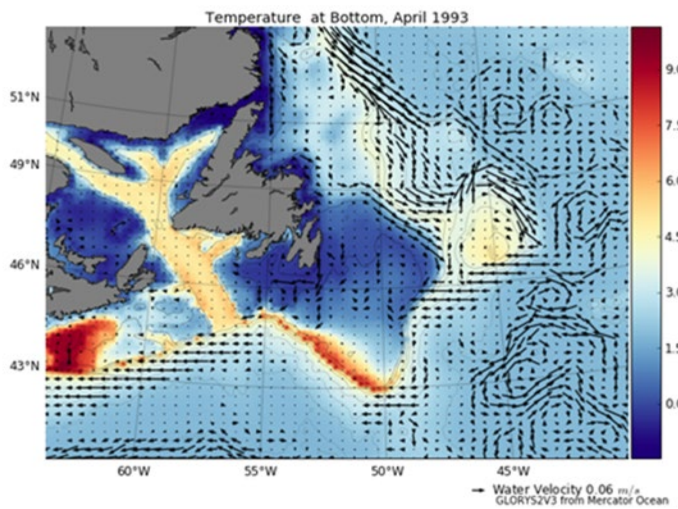

Figure 39: GLORYSv3 climatology represented for April (1993-2014) for bottom temperature overlaid with arrows representing water velocity.

SURFACE SALINITY

The model (Figure 41) represents an area of uniform salinity on the Grand Banks that seems to extend past the slopes and is bounded by the higher salinities from the Gulf Stream. There is an influx of fresh water into the Gulf of the St. Lawrence and mixing with the waters along the southeast coast/Laurentian Channel.

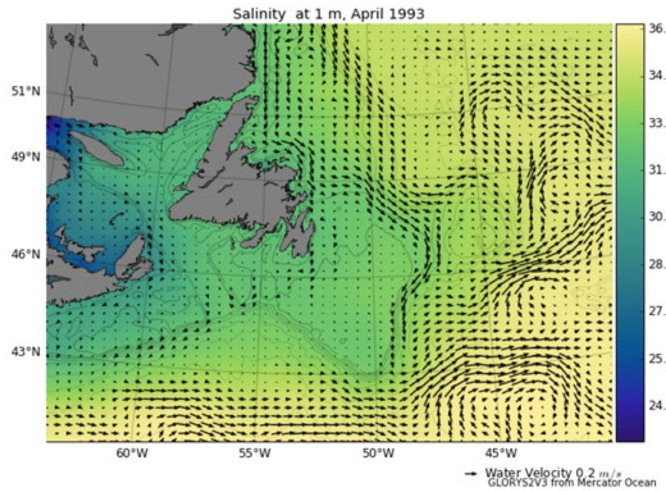

Figure 40: GLORYSv3 climatology represented for April (1993-2014) for surface salinity overlaid with arrows representing water velocity.

BOTTOM SALINITY

The model (Figure 42) shows areas of lower level bottom salinity in areas of the shelves (i.e. Grand Bank, parts of Scotian Shelf) and coastal areas for the April climatology. Bottom salinity in deeper waters have a uniformly higher salinity. It is notable that the inshore branch of the Labrador Current has considerably lower salinity than the rest of the Shelf area and Shelf slope regions.

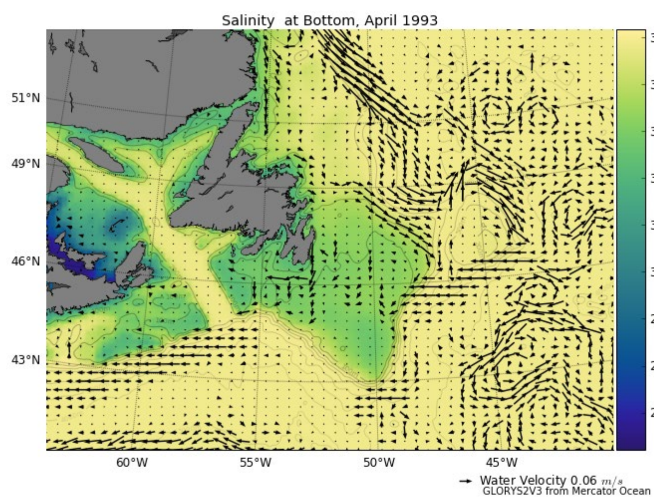

Figure 41: GLORYSv3 climatology represented for April (1993-2014) for bottom salinity overlaid with arrows representing water velocity.