6.0 EXISTING BIOLOGICAL ENVIRONMENT

This section provides a description and regional overview of the existing biological environment, in order to support the identification and analysis of key aspects that may interact with the Project and therefore require assessment in the EIS.

The description that follows focusses on the various biological VCs that have been identified as key areas of focus for the EIS (Section 4.2), including Marine Fish and Fish Habitat, Marine and Migratory Birds, Marine Mammals and Sea Turtles, and Special Areas, which are addressed in separate sections of the chapter. Discussion of species at risk are included for each VC, as applicable. These components of the biological environment and subcomponents therein are described at differing levels of detail, depending on the type and level of available information and their relevance to the Project and EA. Species names are provided in Appendix G.

In terms of an overall study area for this chapter, although a primary focus of the description that follows is on the Project Area and LSAs for the various biological VCs involved (see Chapters 8 to 11), the description of the existing biological environment also covers the larger RSA (see Section 4.3.1), and areas beyond for regional context, where relevant and possible, based on the nature and coverage of the various sources of environmental baseline information identified, accessed and used.

6.1 Marine Fish and Fish Habitat

The Project Area includes the shelf and slope regions of the Grand Bank, areas of the Flemish Cap and parts of the Orphan Basin (Figure 6-1). Within this marine environment, habitats transition from relatively shallow shelf zones, through the continental slope to very deep abyssal regions. These areas are used by fish and invertebrate species of commercial, cultural, and/or ecological value and support regionally important areas of biodiversity and marine productivity. The abundance and distributions of these fish and invertebrate species are dependent on their linkages with other species across fish habitats and interactions with the physical parameters of the marine environment. This section considers fish species that are secure as well as those listed under SARA as SAR or identified by COSEWIC as Species of Conservation Concern (SOCC).

6.1.1 Approach and Key Information Sources

The Project Area falls within the geographic scope of the Eastern Newfoundland SEA (Amec 2014a), which provides a regional overview of the offshore marine ecosystem that includes the Grand Banks, Flemish Cap, and adjacent slope and abyssal habitats. As described in Chapter 5, the Project Area – Northern Section includes the northeastern shelf and slope of the Grand Banks, the Flemish Cap, Flemish Pass and, Orphan Basin. The Project Area - Southern Section includes the shelf and slope areas of the Grand Banks, the Flemish Pass, and Flemish Cap (Figure 6-1).

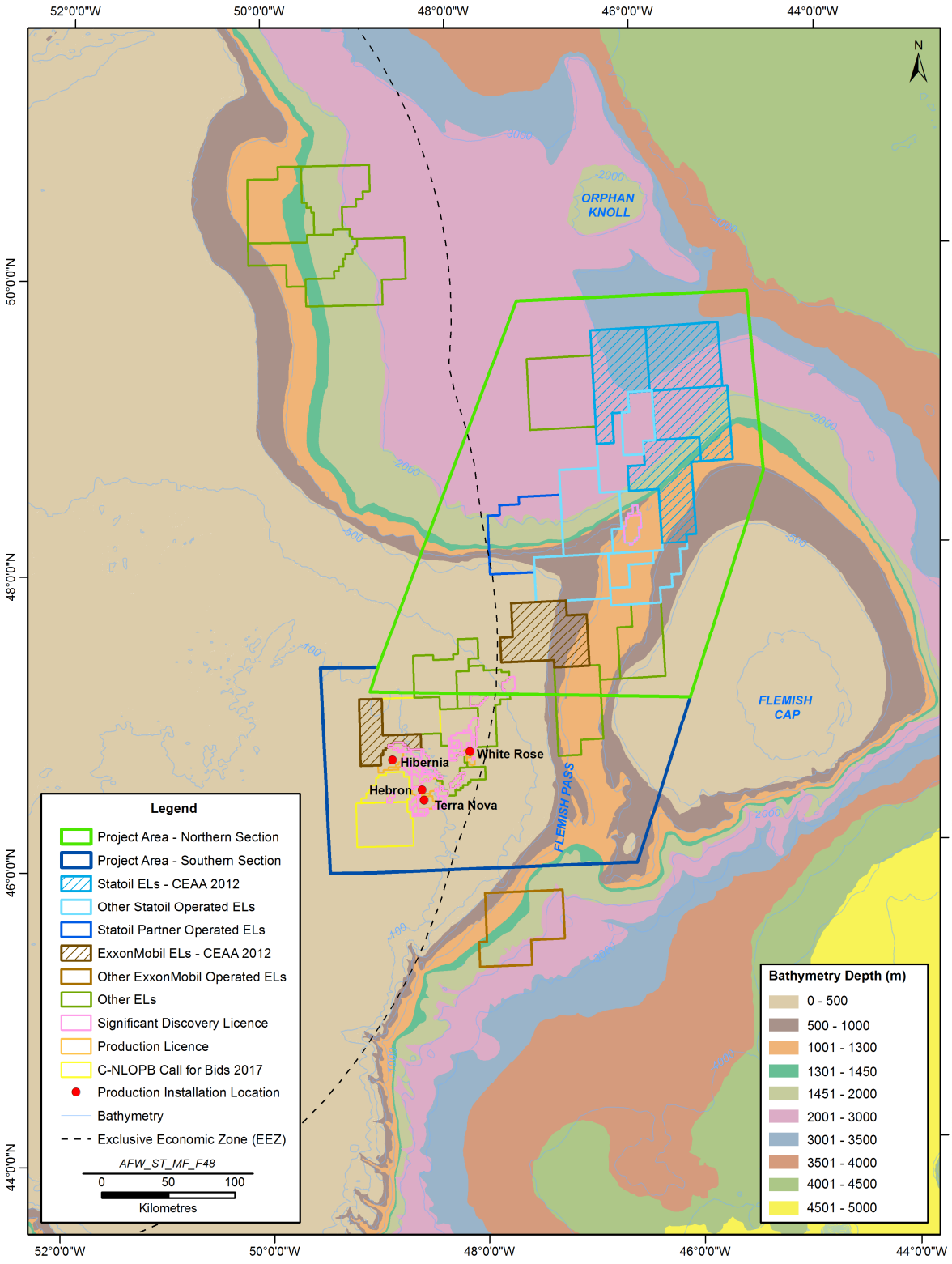


Figure 6-1 Primary Water Depth Zones of the Project Area and Surrounding Marine Environments

This section builds upon the fish and fish habitat information presented in the SEA by summarizing critical elements, augmenting SEA knowledge with more detailed or more recent information available in the literature (Table 6.1), and providing additional analyses specific to the Project Area. This section provides a holistic overview of fish and fish habitat and key species, from plankton to fish species, and their trophic interactions. Summarized data are based on representative studies or data that are applicable to both parts of the Project Area. Project Area specific data are provided where such information is available. For additional information (including descriptions of the overall characteristics and life histories of fish species) or regional ecological context, the reader is directed to the Eastern Newfoundland SEA document.

Table 6.1 Some Key Information Sources Used to Describe Marine Fish and Fish Habitat

Information Source	Relevant Studies and Documents
Eastern Newfoundland SEA	Amec 2014a
DFO Research Vessel Trawl Surveys[1]	Data provided by DFO; Carter et al. 1979; Wareham 2009
EU Bottom Trawl Surveys	Casas and González-Troncoso, 2013, 2015; Vázquez et al. 2013; Mandado 2014; Altuna et al. 2013; Knudby et al. 2013; Nogueira et al. 2016, 2017; Murillo et al. 2016; Alpoim and González-Troncoso 2016
Canadian Science Advisory Secretariat (CSAS) Reports and Stock Assessments	CSAS 2012, 2013, 2015, 2016
NASA Satellite Imagery of chl *a*[1]	Open access data source: http://neo.sci.gsfc.nasa.gov/view.php?datasetId=MY1DMM_CHLORA
NEREIDA Initiative	Barrio Frojàn et al. 2012; Altuna et al. 2013; Beazley et al. 2013a, 2013b; Beazley and Kenchington 2015
Deepwater Longline Survey	Murua and Cardenas 2005
COSEWIC Species Status Reports	http://www.cosewic.gc.ca/eng/sct5/index_e.cfm
International Union for Conservation of Nature and Natural Resources (IUCN)	http://www.iucnredlist.org/
SARA / COSEWIC Species Status Reports	https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/
Atlantic Zone Monitoring Program (AZMP)	Therriault et al. 1998; Pepin et al. 2013
NAFO Reviews	Vázquez et al. 2013, 2014; Wang and Greenan 2014
Continuous Plankton Recorder	Gibbons and Richardson 2009
Ecologically or Biologically Significant Area (EBSA) Reports	Templeman 2007
Vulnerable Marine Ecosystem (VME) and Fisheries Closure Area (FCA) Reports	Campbell and Simms 2009; DFO 2012; and NAFO 2013
[1]Data re-analyzed for Project Area	

Two regulatory regimes have jurisdiction over marine fish and fish habitat within the Project Area. The Government of Canada manages fish stocks within the 200-mile Exclusive Economic Zone (EEZ) and sedentary species occurring on the extended continental shelf. In these areas, the federal *Fisheries Act* (2012) provides protection to commercial, recreational, and Aboriginal fisheries by managing the fish resources and habitats that support these activities. Groundfish outside the EEZ and the benthic organisms beyond the extended continental shelf are managed by the North Atlantic Fisheries Organization (NAFO).

Within Canadian waters, the distribution and abundance of demersal fish and invertebrates are relatively well studied through annual standardized multi-species government research vessel (RV) surveys conducted by Fisheries and Oceans Canada (DFO). NAFO and the European Union (EU) undertake surveys in some areas of their jurisdiction, primarily areas targeted by commercial fisheries on the Flemish Cap and slope, which includes part of the Project Area. While data sets across the two jurisdictions are often not directly comparable in a quantitative manner and do not necessarily provide comprehensive and comparable coverage in all areas of interest, they collectively provide a sound qualitative understanding of the key faunal communities in and around the Project Area and the processes that influence their presence and distribution. While it is also acknowledged that some marine habitats (especially the very deep, abyssal regions) and assemblages (pelagic) are somewhat underrepresented in the available studies, the available data span much of the habitat heterogeneity in and around the Project Area and cover most of the area that is known to be used for commercial fishing purposes.

6.1.1.1 Canadian Research Vessel Multi-Species Surveys

Data for the monitoring and management of fish resources in Newfoundland and Labrador is derived from standardized scientifically-directed spring (NAFO Divisions 3LNOPs) and fall (NAFO Divisions 2J3KLNO) RV trawl surveys within the three fisheries management areas that overlap with the Project Area (NAFO Divisions 3KLM, see Section 7.1). Canadian RV surveys extend to the continental slope, to depths of 1,450 m, and provide insight into the distribution and abundance of commercially and/or ecologically important species. Although the surveys have been conducted for several decades, only the five years of recent, available data (2008-2012) were synthesized in this summary because the northwest Atlantic's ecosystem has experienced ecological shifts and remains in a state of flux (Dawe et al. 2012; Nogueira et al. 2016, 2017).

Data from Canadian RV surveys that sample commercial and non-commercial species were re-analyzed to identify fish and invertebrate species that are numerically dominant within the studied portions of the Project Area (representing more than ninety percent of the total cumulative catch inventory for the region). The assessment of species was conducted by creating generalized distribution maps using a SPANS GIS potential mapping surface function and extracting density data that are specific to the Project Area (Kulka 1998; Kulka and Pitcher 2011). This method follows that used in the Eastern Newfoundland SEA (Amec 2014a) and converts point estimates (individual survey set catch rates) into continuous surfaces (density subareas) that can be used to characterize a species' use of a habitat zone.

6.1.1.2 International Research Vessel Surveys

In addition to Canadian Research Vessel surveys, other international research programs have conducted standardized surveys beyond the Canadian EEZ. The principal international program is the EU bottom trawl surveys conducted in NAFO Division 3M since 1988. This random, stratified trawl survey is focused on the Flemish Cap and its adjacent slopes and covers depths from 129 m to 1,460 m (Vázquez et al. 2014). These data have been used to characterize fish assemblages in the region for the years 2004-2013 (based on 1,699 trawls) by Nogueira et al. (2016, 2017). These same data are used to describe the distributions of the important commercial species harvested from the Flemish Cap and slope from 2011-2015 (Casas and González-Troncoso 2011, 2013, 2015; Vázquez et al. 2013; Mandado 2014) and for distributions of some sessile benthic fauna (e.g., corals, sponges, sea pens; Vázquez et al. 2013; Murillo et al. 2016). While the data from these surveys are not accessible for re-analysis, the resulting scientific papers are useful for comparison to Canadian surveys and for determining commonalities and characterizing the Flemish Cap / slope components of the Project Area and surrounding marine environments.

6.1.1.3 Other Information Sources

The Eastern Newfoundland SEA and standardized trawl surveys form the foundation of the biological characterization of fish and fish habitat within the Project Area, but other sources of information also provide important insights. For example, the Atlantic Zone Monitoring Program (AZMP) is the largest monitoring program for the pelagic environment and conducts high frequency collections (trawl surveys, fixed point stations, cross-shelf sections) at a number of sites in the Northwest Atlantic (Therriault et al. 1998; Pepin et al. 2013; Johnson et al. 2014). The objective of the AZMP program is to collect information on the natural variability in physical, chemical, and biological properties of the Northwest Atlantic (Therriault et al. 1998; Pepin et al. 2013; Johnson et al. 2014). Additional information sources such as satellite imagery provide broad scale overviews of the Project Area's primary productivity. These scientific studies that may be somewhat more limited in scope (e.g., Barrio Frojàn et al. 2012; Beazley et al. 2013a) also contribute to an overall understanding of the processes that shape the faunal communities in the Project Area.

In the descriptions that follow, species names (common and scientific) are identified and provided in the tables of species provided throughout these sections, as opposed to in the text itself. This is especially the case for the discussion of relevant invertebrate species. For general reference, Appendix G provides a listing of some of the key marine fish (finfish) species that are known or likely to occur in the region (including their common and scientific names).

6.1.1.4 Use and Adequacy of Existing Environmental Information for EIS Purposes

As outlined in the preceding sections, the description of existing environmental conditions for marine fish and fish habitat is based on existing information and datasets. A variety of information sources are available and have been identified and used to describe the existing (baseline) environment, which cover each of the various sub-components of this VC, including plankton, plants and macroalgae, pelagic macroinvertebrates, benthic invertebrates (including corals and sponges), and finfish, including species at risk. The information sources accessed and used are described and

referenced throughout this chapter, and have been supplemented in certain instances with additional Operator-gathered environmental data. These information sources provide a good, regional understanding of existing conditions within the Project Area and Study Area, which is considered adequate and appropriate for EA purposes. In particular, no key information gaps have been identified that have prevented or impeded the assessment and evaluation of environmental effects and the identification and proposal of mitigation in the EIS (see Chapter 8).

Section 6.1.3 of the EIS Guidelines outline the particular aspects of the fish and fish habitat VC that are required to be described in the EIS, and in doing so, note that "a benthic habitat survey (ROV / camera), including transects of seafloor in the area of the well locations, may be required". As is typical for any exploration drilling program at this stage of its planning, and as described further in Chapter 2, specific wellsite locations for this Project have not yet been identified. These will be selected as Project planning progresses and available data is interpreted. As a well is drilled, additional information and data are collected that are then incorporated and included in the planning of potential subsequent wellsite locations. This concept and approach was noted in the original Project Description documentation submitted by the Operator to initiate the EA review, and is recognized in various instances in the EIS Guidelines issued by the CEA Agency (e.g., EIS Guidelines Sections 3.1, 6.1.3).

It is the current standard practice, and a requirement enforced by the C-NLOPB, that an imagery-based seabed survey is completed prior to drilling a well in deep-water locations offshore Newfoundland and Labrador. The purpose of the survey is to identify, and if present mitigate, potential effects to aggregations of habitat-forming corals. The Operator recognizes the importance of this well site-specific benthic information collected before drilling is conducted. As discussed in Section 2.5.2.1, the Operator is proposing a pre-drill coral survey and risk assessment approach that builds upon experience in the NCS (with similar environments), as outlined in the NOROG guideline (DNV 2013). The proposed pre-drill coral survey will cover a larger area than has been surveyed for historical drilling programs offshore Newfoundland and Labrador (i.e., approximately 100 m radius from the well location). For EL 1139, EL 1140, EL 1141, and EL 1142, based on the NOROG guideline (DNV 2013) approach, which considers drill cuttings modelling results and biological effects threshold levels, the survey would extend approximately 500-1,000 m from the well location. For the shallower waters, the survey area could approach 1,000-2,000 m from the well location. The results of this larger survey will be used in planning the location of the well and mitigations, and will also augment regional data sets where coral survey data are limited. DFO is currently reviewing the coral mitigation practices applied to offshore drilling. The Operator will develop a pre-drill coral survey plan, for review and acceptance by the C-NLOPB / DFO, which aligns with the outcomes of the ongoing DFO coral mitigation practices review.

The environmental effects predictions and the identification and application of mitigation in this EIS have also been undertaken in a conservative and therefore precautionary manner. The analysis inherently assumes that an environmental component may be present in the area and within the Project's environmental zone of influence, and therefore, is "available" for a Project-VC interaction. However, in many cases this interaction will not actually occur due to the lack of presence of an environmental component within the likely environmental zone of influence of the Project activity in question. The overall abundance and spatial, and/or temporal distributions of the various

components of the VC (including corals and other sensitive benthic habitats) therefore limits the potential for interactions with the Project's relatively short-term activities and localized disturbances. However, in all cases, the pre-drill coral survey and associated mitigations will be applied to all wells drilled as part of the Project, and not just those in areas with higher potential for corals, as identified through the existing and available information.

As a result of the available environmental baseline data for this VC, the conservative and precautionary approach used in the environmental effects assessment, and the planned application of mitigation, the existing environmental baseline datasets are considered adequate and appropriate for the EIS, and as noted in Chapter 8, the effects assessment predictions are made with an overall high level of confidence.

6.1.2 Trophic Linkages and Community Change

The function of each species within a habitat-specific interacts both directly and indirectly with other species in the ecosystem (Gomes et al. 1992; Templeman 2010; Dawe et al. 2012; Amec 2014a). In the Project Area, primary production is generated by photosynthetic phytoplankton and transferred progressively through the food chain via primary consumers such as zooplankton, planktivorous fish and invertebrates, and ultimately larger fish, marine mammals, and birds. The cycle is completed by detritivores, which consume dead flora and fauna and return nutrients back into the base of the food chain. Widespread changes to the abundance of either predators or prey can therefore cascade to other levels of the food chain. These linkages provide the mechanism in which alterations of abundance to an ecologically important species may affect many other species.

Community structure within any habitat-type can be highly variable in terms of abundances, interactions, and production and many of these can change on a daily, annual, or longer time scale. For example, recent studies have documented regime shifts that have occurred in the Eastern Newfoundland Offshore Area in the past several decades (Amec 2014a). Cold water temperatures coupled with overharvesting in the late 1980s into the mid-1990s were linked to a reduction in Northwest Atlantic groundfish species including cod and redfish (deYoung et al. 2004; Koen-Alonso et al. 2010; Dawe et al. 2012; Nogueira et al. 2017). As a consequence of the groundfish stock collapse in the 1990s, an increase in the abundance of their prey followed including pelagic fish and invertebrates such as sand lance, herring, shrimp, and snow crab. In more recent years, rising water temperatures and restrictions on harvesting are favoring the return of a groundfish dominated system (Koen-Alonso et al. 2010; Templeman 2010; Dawe et al. 2012; Nogueira et al. 2017). Multi-decadal warming trends have also been implicated in greater primary production in the upper layers (Martinez et al. 2016) and shifts of many species distributions toward the poles in response to warmer waters (Sundby et al. 2016).

Community structure and species distributions also naturally fluctuate over shorter timescales. For example, many species migrations occur on daily and seasonal cycles and communities can adjust their distribution in response to environmental conditions or prey densities / availability that oscillate at a variety of time scales. On an annual cycle, the Project Area is visited by large pelagic fish species (e.g., sharks, tunas) during the warm water season, while other occupants, such as capelin and cod, may leave the area as they migrate inshore to spawn and/or feed. Other species, including redfish,

Greenland halibut and snow crab, are more resident in nature and prefer to remain in more stable thermal habitats on the continental slope.

6.1.3 Key Marine Assemblages

Marine assemblages represent an amalgamation of organisms whose form and function are adapted to coexist within a specific environment in an ecosystem. In the vicinity of the Project Area, NAFO (2013) recognizes three general functional units:

1) The Grand Banks / Newfoundland Shelf
2) The Flemish Cap
3) The oceanic waters beyond the shelf break.

The continental slopes, which act as transition zones between each of these functional units, also represent an important habitat (Pepin et al. 2010).

Each functional unit has characteristic processes that influence their assemblages. For example, the Flemish Cap is considered to be a relatively closed marine ecosystem (Perez-Rodriquez et al. 2012) that is influenced by a mix of currents, has high substrate heterogeneity and has highly oxygenated waters that are rich in nutrients (Barrio Frojàn et al. 2012; Altuna et al. 2013). These conditions are thought to contribute to the elevated biodiversity found in these areas relative to the Newfoundland Shelf habitats (Altuna et al. 2013). Both the Flemish Cap and Newfoundland Shelf systems are regulated by fishing pressure but top down effects are thought to play a bigger role on the Flemish Cap (Perez-Rodriquez et al. 2013) whereas the Newfoundland Shelf is more heavily influenced by the state of lower trophic levels and ice dynamics (Buren et al. 2014).

The Project Area sits at the confluence of these functional units in a place dominated by the cold Labrador Current (Nogueira et al. 2017). The strong influence of the Labrador Current limits the temperature-related heterogeneity found there and restricts many “southern” species that occur nearby on the Tail of the Grand Banks. Instead, the primary habitat driver that defines assemblages in the Project Area is depth (Murua and Cardenas 2005; Barrio Frojàn et al. 2012; Nogueira et al. 2017). The effect of depth on pressure, salinity, oxygen, and temperature can influence communities through physiological mechanisms while depth-related effects on light penetration limits zones of primary productivity and requires foraging and refuge strategy adaptations by many species.

Within depth zones, habitat complexity and the intensity of fishing can further segregate faunal communities. For example, Barrio Frojàn et al. (2012) identified elevated species richness, abundance and biomass of taxa that are indicative of Vulnerable Marine Ecosystems (VMEs) within sponge grounds and in areas closed to fishing (see Section 6.4 - Special Areas). Similarly, some species of fish are also known to specifically occupy complex habitats (Baker et al. 2012).

The key species of a given interconnected marine assemblage is often determined based on dominance (numerical abundance or biomass), or through the number and strength of its linkages to other species. For example, the Eastern Newfoundland SEA (Amec 2014a) describes capelin and corals as classic examples of taxa whose presence affects the distribution and activities of many other species. In the following sections key species from each taxonomic group are identified, and

where possible, organisms are identified to species. In most cases, such species were determined based on numerical dominance or as a result of their conservation status.

6.1.4 Plankton, Plants and Macroalgae

The pelagic environment includes the entire ocean water column and habitat that shifts according to complex oceanographic dynamics rather than being a fixed geographical space (Pepin and Helbig, 2012; Hazen et al. 2013; Scales et al. 2014). It consists of multiple trophic levels and linkages between each level, from plankton through to marine vertebrates. It is influenced by a variety of processes at multiple scales as described below. Physical environmental parameters can elicit large-scale responses in the composition and dynamics of pelagic species assemblages (Johnson et al. 2014). However, species may also be influenced by their local adaptations and ecological roles, including foraging ecology and plasticity, trophic level, physiological tolerances, life history mode and developmental stage (Vilchis et al. 2006; Scales et al. 2014). The following sections provide overview descriptions of plankton, including fish larvae (ichthyoplankton) and pelagic invertebrates in the vicinity of the Project Area, similar to those described in the Eastern Newfoundland SEA (Amec 2014a, Section 4.2.1.3). The discussion that follows is, based on the nature of this environmental component and the existing information sources used, necessarily regional in scope, although any known features and processes that are specific to parts of the Project Area are highlighted where relevant. Non-larval marine vertebrates are discussed in subsequent sections.

Plankton comprise the largest and most diverse ecosystem component on earth, representing the microscopic organisms that are passively distributed by currents. Organisms in this group include picoplankton (organisms between 0.2 and 2.0 µm in diameter including prokaryotes and eukaryotes), phytoplankton (microscopic plants), zooplankton (small animals) including invertebrate and vertebrate embryos and larvae, as well as viruses and phages (Legendre and Rassoulzadegan 1995; Suttle 2005). Plankton include the most basal levels of the marine food web and include photosynthetic organisms that are consumed by planktivores, who in turn are often prey items for larger organisms. The majority of primary plankton productivity occurs in the light-infused epipelagic zone (0-200 m water depth) (Licandro et al. 2015) but this productivity is also transferred to the benthos on the ocean's bottom through sinking biomass and waste (Legendre and Rassoulzadegan 1995).

The oceanographic conditions of the Project Area are largely dominated by the subpolar gyre driven by the Labrador Current flowing southwards (Han et al. 2008; Wang and Greenan 2014). This outflowing from the Labrador Sea flows stronger in the fall and winter compared to the spring and summer and interfaces with the northward extension of the North Atlantic Current forming a boundary region in the Orphan Basin (Han et al. 2008). This boundary region reflects the transition from Arctic-influenced waters to Atlantic–influenced waters and coincides with increasing cell numbers of bacteria and small phytoplankton (Wang and Greenan 2014). Collectively, the primary production pattern of the North Atlantic is strongly related to light conditions and sea surface temperature, as well as vertical water column stabilization mechanisms and grazing (Melle et al. 2014). Moreover, in addition to a longitudinal gradient in the seasonal cycle of primary production, it differs between on-shelf and deep basin regions (Melle et al. 2014). For example, the spring bloom starts in early spring (late March or April) and peaks approximately a month later on the Grand Banks and Flemish Cap,

whereas on the more northern Labrador shelf the spring bloom does not initiate until May (Fuentes-Yaco et al. 2007, cited in Melle et al. 2014).

Satellite imagery of surface irradiance from *chlorophyll a* (a photosynthetic pigment used as a measure of photosynthetic activity) for the Project Area over the most recent 12 months illustrates this seasonal pattern of *chl a* abundance. Overall, winter concentrations of *chl a* are higher in the southern Grand Banks and Flemish Pass south of the Flemish Cap (coinciding with an earlier spring bloom within the northern extension of the Gulf Stream). In the Project Area, *chlororphyll a* concentrations are homogenously low with a slightly higher concentration in the southeastern region of the Project Area corresponding to the shallower area over the Flemish Cap as well as over upwelling regions associated with the southern slope section of the Orphan Knoll in the northeast region of the Project Area (Figure 6-2). During the spring season (March-June) the largest concentrations of *chlororphyll a* abundance shifts to more northern latitudes including large patches in the north, west, and southeastern regions of the Project Area (Figure 6-3). Meanwhile the bloom patches south of the Flemish Cap and in the southeastern sections of the Grand Banks start to weaken relative to the intense bloom during the winter. In the summer, the spring blooms dissipate and residual elevated *chlororphyll a* abundance is observed to the north and along slope upwelling regions (Figure 6-4), which is consistent with areas of greater productivity reported by Maillet et al. (2005). This pattern of greater productivity over upwelling slope regions is further pronounced in the fall, where the contours of slope margins are highlighted by slightly elevated *chlororphyll a* concentrations along the outer margin of the Newfoundland Shelf, Grand Banks and the northwest slope region of the Flemish Cap (Figure 6-5). Overall however, *chlororphyll a* levels are homogenously low in the summer and fall relative to patterns observed during peak bloom seasons.

As the seasonal pattern of the spring bloom escalates, it triggers a surge in zooplankton (microscopic drifting animals) that benefit from the abundance of their phytoplankton food source. Zooplankton, in particular copepods, euphasiids and krill, are a key food source for macroinvertebrates, fish, birds, and whales (Maillet et al. 2004). The composition and timing of this food source is critical to the populations they sustain. For example, the timing of spring bloom has been highly correlated to salmon productivity in the Northeastern Pacific (Malik et al. 2015), and has been associated with poor stock condition for herring in the North Sea (Illing et al. 2016), and Atlantic cod (Minto et al. 2014), Atlantic mackerel (Plourde et al. 2015) and northern capelin (Mullowney et al. 2016) in the Northwest Atlantic. However, as ocean temperatures rise, the northern extent of termperate species may increase (Sundby et al. 2016); how this will affect productivity of larval populations is uncertain.

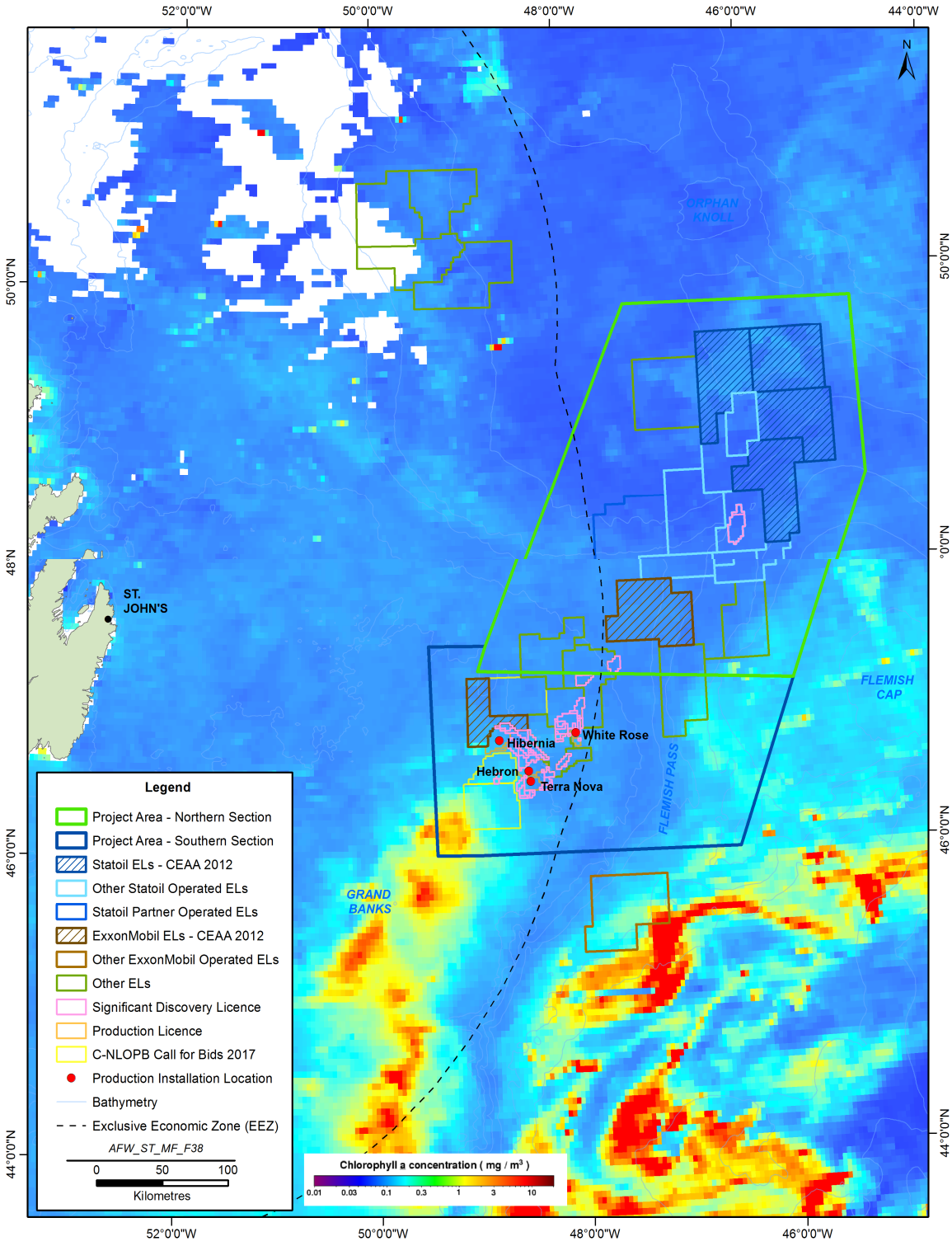


Figure 6-2 Distribution of Chlorophyll Irradiance Measured from NASA Satellite Imagery of the North Atlantic - Winter (December-February) 2016

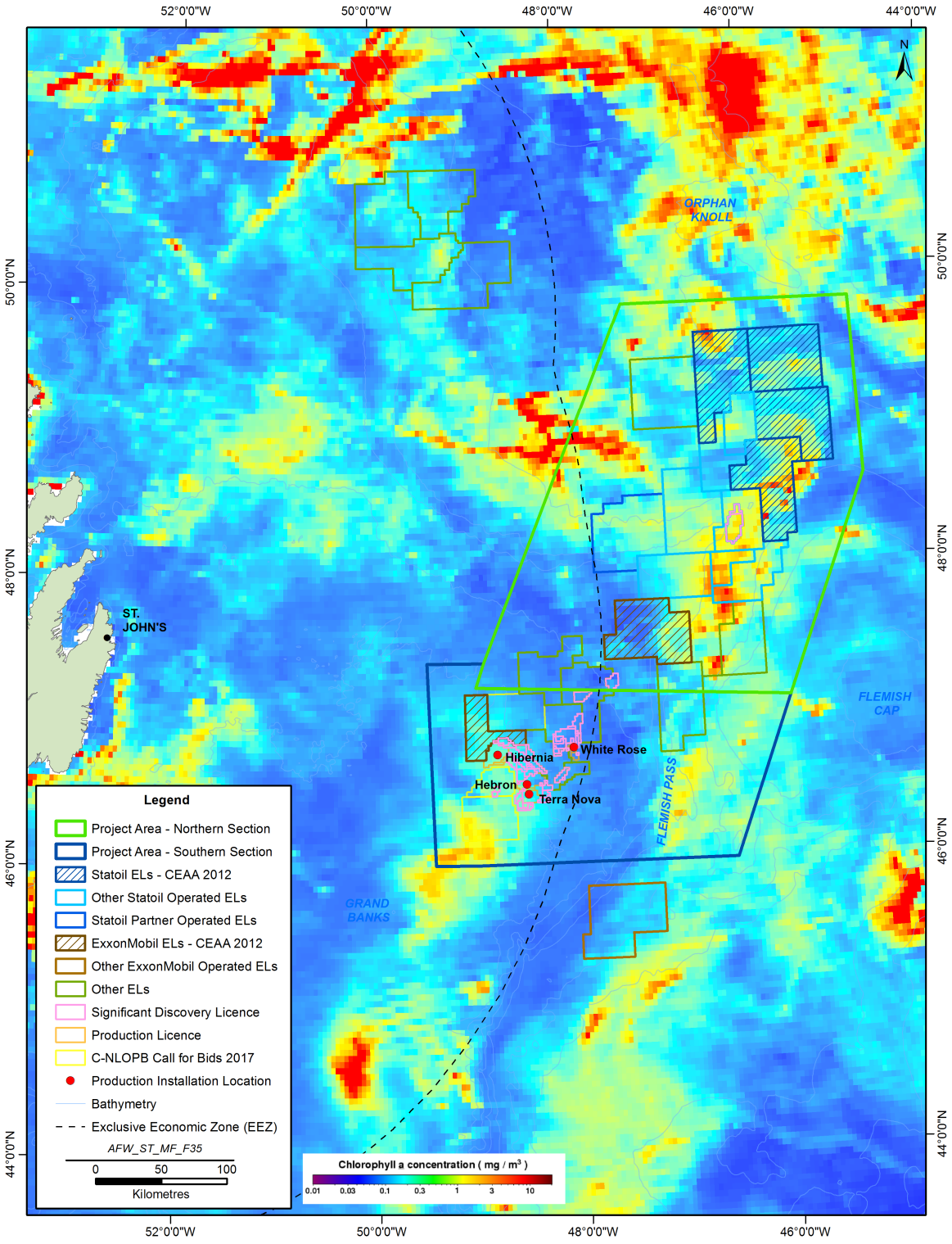


Figure 6-3 Distribution of Chlorophyll Irradiance Measured from NASA Satellite Imagery of the North Atlantic - Spring (March-May) 2016

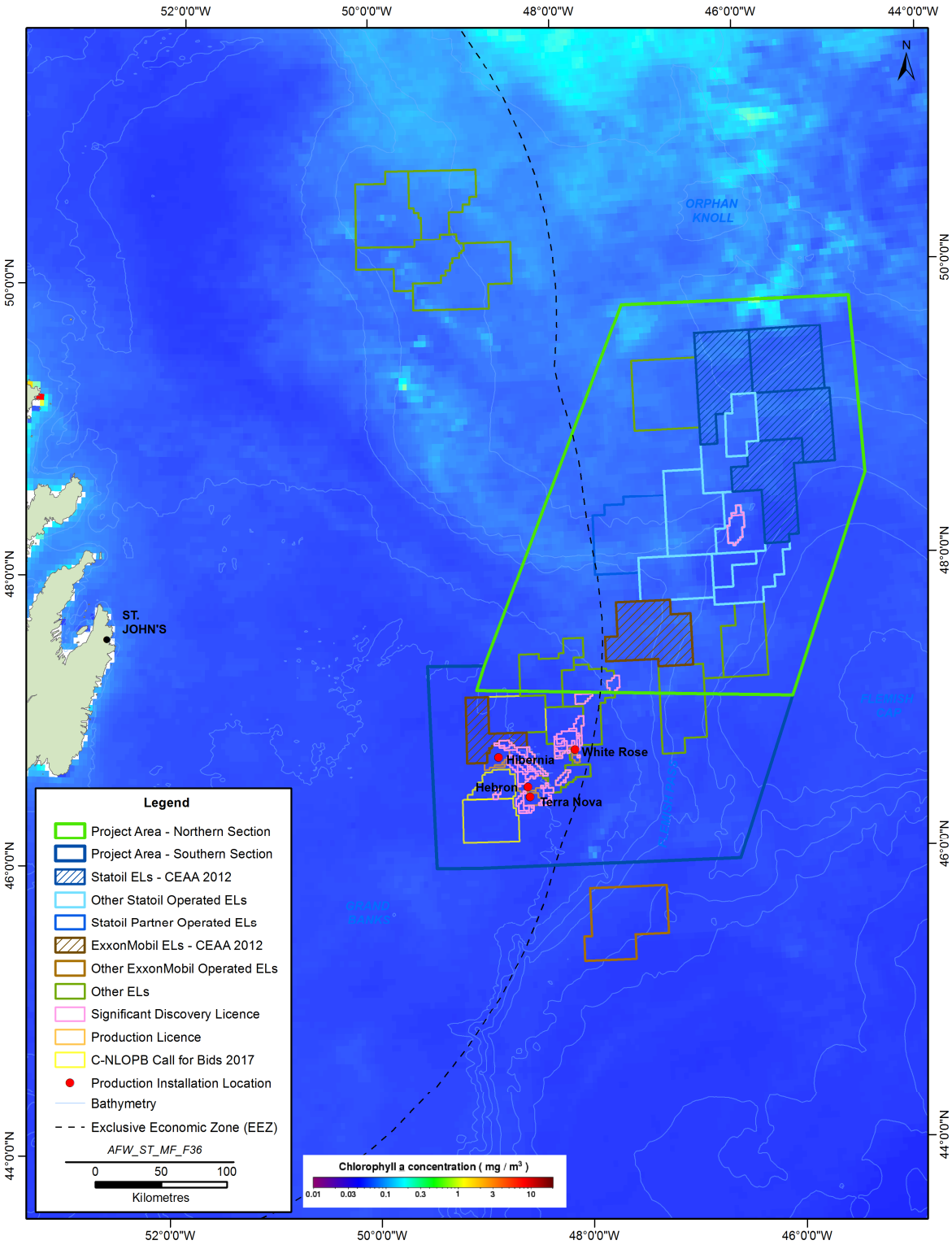


Figure 6-4 Distribution of Chlorophyll Irradiance Measured from NASA Satellite Imagery of the North Atlantic - Summer (June-August) 2016

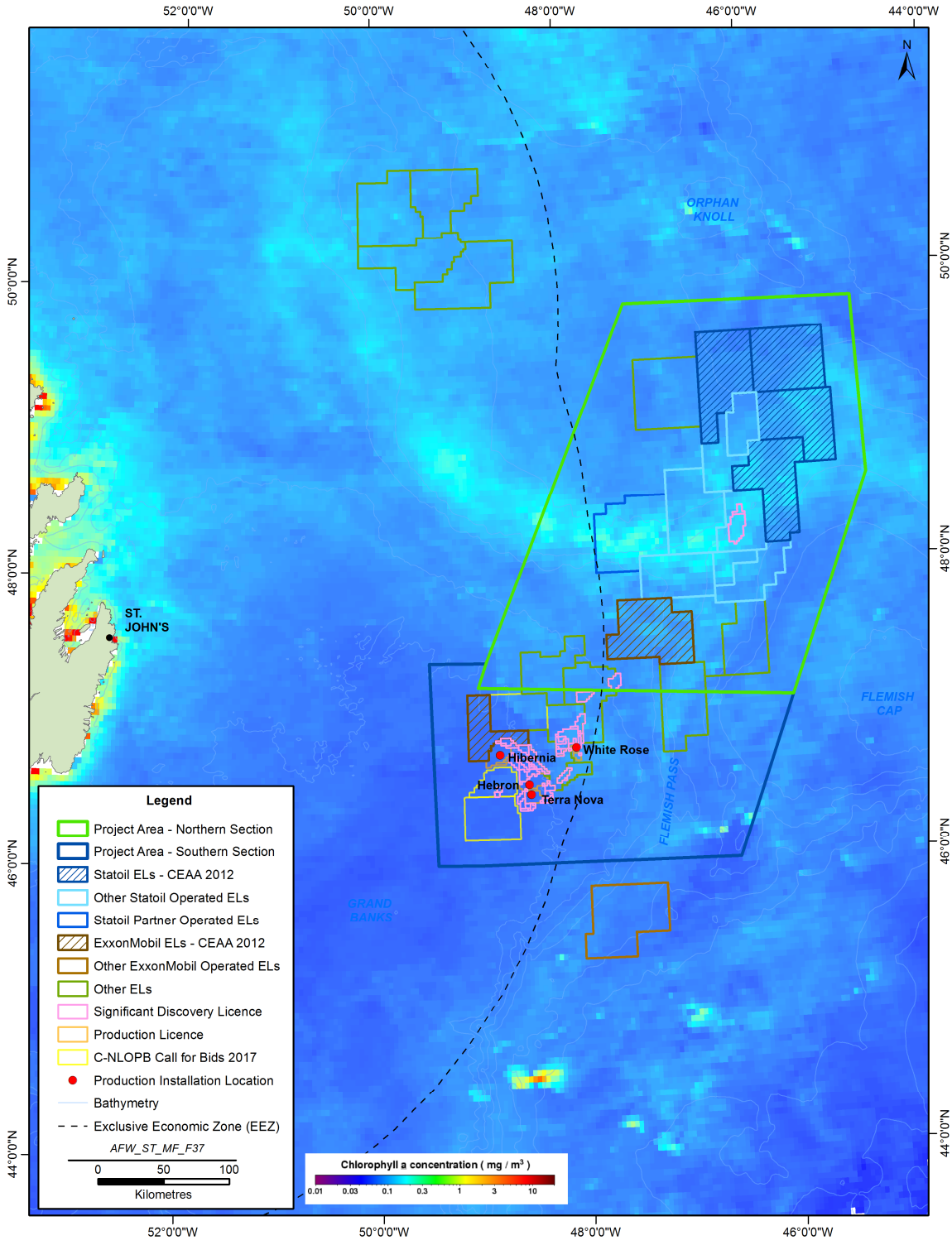


Figure 6-5 Distribution of Chlorophyll Irradiance Measured from NASA Satellite Imagery of the North Atlantic - Fall (September-November) 2016

A critical ecological function of photosynthesizing plankton is the uptake of atmospheric carbon dioxide (CO_2) in surface waters to produce organic carbon. In this form the fixed organic carbon is transported to the deep ocean by way of multiple processes collectively known as the "biological pump" (Longhurst and Harrison 1989; cited in Jónasdóttir et al. 2015). The primary pathway for carbon transfer is most commonly attributed to the passive sinking of organic detritus (Buesseler et al. 2007) However, as reviewed by Jónasdóttir et al. (2015), zooplankton also provide multiple pathways for carbon cycling, including grazing on phytoplankton and disruption of phytoplankton particle dynamics (Alldredge and Silver 1988; Koski et al. 2005), passing fecal pellets which sink more rapidly than organic detritus (Turner and Ferrante 1979; Ducklow et al. 2001; Turner 2002), and active transportation by vertical migration of the animals themselves (Steinberg et al. 2000, cited in Jónasdóttir et al. 2015). For example, the seasonal vertical migration of copepods in the North Atlantic facilitates the direct transport and metabolism of carbon rich lipids to benthic organisms with reduced attenuation, nearly doubling previous estimates of deep-ocean carbon sequestration (Jónasdóttir et al. 2015).

In terms of biomass, in the vicinity of the Newfoundland Shelf region the zooplankton community is dominated by three large species of copepod. The largest and most abundant is a boreal species *Calanus finmarchicus,* which is ubiquitous throughout the North Atlantic from the Gulf of Maine to the Barents Sea (Melle et al. 2014; Wang and Greenan 2014). Two other prevalent species, *Calanus glacialis* and *Calanus hyperboreus,* are found in association with influxes of Arctic water such as the Labrador Current (Wang and Greenan 2014). All three species spend the winter at depth in a pre-adult stage, and trillions of copepods migrate below the depth of the permanent thermocline into deep ocean basins (600-1,400 m) and overwinter in a state of diapause (Jónasdóttir et al. 2015). Development of *C. finmarchicus* includes 12 larval stages during their one-year life cycle, whereas the Arctic species have multi-year life cycles and spend two or more winters at depth (Wang and Greenan 2014). All three species migrate towards the surface to mature and reproduce in late winter or spring so that that early larval stages can feed during optimal phytoplankton growth season. As reproduction of these organisms is coupled to spring bloom dynamics and temperature, inter-annual differences in timing or abundance of these species are also influenced by changes in these physical and biological processes (Wang and Greenan 2014).

Within the Project Area and along the northeastern slope section of the Grand Banks, larval shrimp consume large amounts of phytoplankton, copepod eggs, and nauplii larvae during several months of development in the upper 50 meters of the water column (Stickney and Perkins 1981; Pedersen and Storm 2002; Harvey and Morrier 2003; Fuentes-Yaco et al. 2007). As development progresses, shrimp migrate towards the benthos and adults are primarily found on the benthos and consume pelagic detritus (Hopkins et al. 1993; Ramseier et al. 2000; Fuentes-Yaco et al. 2007). However, adult males migrate to the surface to feed diurnally on larger larval stages of copepods (copepodites) (Fuentes-Yaco et al. 2007). Every *P. borealis* shrimp develops as male, and after approximately three years, transitions to become female (i.e., protandric hermaphrodites) (Vázquez et al. 2014). Consistent with the variations in timing and abundance that are observed among the dominant Calanoid copepod species described above, there are strong correlations between the timing and intensity of the spring phytoplankton bloom with the size of young shrimp (Fuentes-Yaco et al. 2007). Since the early 1990s, shrimp size has been decreasing in many northwest Atlantic stocks. This has been hypothesized to be attributed to food limitation conditions manifesting from rising sea

temperatures that increase the metabolic demand for cold-blooded organisms (such as shrimp), thereby reducing the amount of food available to adequately sustain growth (Koeller et al. 2006; Fuentes-Yaco et al. 2007). However, Fuentes-Yaco et al. (2007) also hypothesized that changes in food availability along the Newfoundland shelf, among other factors such as inter-regional variation in primary productivity, could be mediating changes in shrimp sizes both temporally and geographically in the North Atlantic.

Similar to shrimp such as *P. borealis*, ichthyoplankton (fish larvae) also depend on the availability of copepods as a critical food source during their pelagic developmental period. In the Project Area-Northern Section and surrounding area, a multi-year plankton study was conducted on the Flemish Cap (1979-1981) where more than 90 percent of all ichthyoplankton surveyed were redfish larvae (*Sebastes sp*.) (Anderson 1994). Redfish release their larvae in association with the spring reproductive timing of the copepod *C. finmarchicus* as described above. The developmental stages of *C. finmarchicus* (from eggs through to juveniles) are the preferred prey item of *Sebastes* larvae, as indicated by gut content surveys which identified greater than 98 percent of prey were developing copepods (Anderson 1994). As larval *Sebastes* grow, so too does their variety of prey choices; fish larvae surveyed in early spring fed exclusively on two to three prey items (copepod eggs and nauplii), whereas by mid-summer a range of 12-27 prey choices of varying sizes were sampled in larval fish stomachs (Anderson 1994). However, the quality of prey items matters considerably, as feeding on many small prey items (such as larvae of smaller copepod species) in lieu of fewer larger items (such as larvae of larger species including *C. finmarchicus*) is regarded to be less beneficial for growth and survival (Anderson 1994).

Also observed during the same survey period was inter-annual variation in the timing of the production cycle of C*. finmarchicus* on the Flemish Cap (Anderson 1994). This was suspected of having been mediated by warmer surface temperatures, whereas spawning of *Sebastes sp.* occurred at the same time annually (Penney and Evans 1985; Anderson 1994). Similarly, Mullowney et al. (2016), proposed that reduced ice cover along the Newfoundland and Labrador shelf has been facilitating the earlier onset of spring blooms, and coupled with the later spawning of capelin has contributed to reduced stock recruitment observed in the mid-1990s. However, in recent years an increase in preferred and total zooplankton prey abundance at the time of later capelin spawning is thought to be supporting increasing capelin productivity (Mullowney et al. 2016).

Ichthyoplankton (redfish larvae in particular) tend to be distributed according to environmental variables such as temperature and salinity and therefore are more evenly distributed across pelagic habitats (Pepin and Anderson 1997). Likewise, Atlantic cod spawn for half the year (March to September) on the coast of Newfoundland, and developing pelagic eggs and larvae are able to survive the range of environmental conditions they are subjected to during that interval, although recruitment success varies (Bradbury et al. 2000). Based on their surveys of cod larval distribution across transects of the northeastern Newfoundland Shelf including the Project Area - Southern Section in May and June 1992, and drift models of egg and larval drift for Atlantic cod, Pepin and Helbig (1997) proposed a highly variable transport system that may facilitate movement of larval cod between coastal and offshore areas. This was supported by their observations that there was no substantial difference in the relative length frequency distribution of larvae between coastal and offshore areas, suggesting overall age distribution of larvae was relatively uniform across the entire

shelf (Pepin and Helbig 1997). Sources of variability for transport between regions include oceanographic features such as topographically induced gyre-like circulations and other hydrodynamic features that can potentially act as retention mechanisms for eggs and larvae among the Northern Cod complex of the northwest Atlantic (NAFO Management Divisions 3KNO, and Gulf of St. Lawrence) (Ruzzante et al. 1998).

Macroalgae (i.e., kelps, seaweeds, coralline algae) and sea grasses serve to enhance productivity and provide habitat for marine organisms in coastal waters. Factors influencing distribution of marine plants include substrate, nutrients, sedimentation, salinity, and temperature. Sunlight is a key factor in growth and survival of macroalgae and sea grass and therefore plant distribution is limited to photic zones (less than 50 m). The Project Area is generally too deep to support macroalgae and seagrass colonization and growth. While some seaweeds can be found on the Grand Bank up to 100 m, these areas have few plant species and low biomass (Amec 2014a).

6.1.5 Pelagic Macroinvertebrates

Pelagic macroinvertebrates include animals that live exclusively in the pelagic environment or swim up from the benthos to feed. In their review of available trawl data from the Flemish Cap including areas of the Project Area - Northern Section, Vázquez et al. (2013) compiled percentage of hauls for each species or group captured from 1977-2012 (no biomass, seasonal timing or locations were provided). As described by Vázquez et al. (2014), the benthic trawl surveys did not have uniform recording criteria during this timeframe - for invertebrates - and surveys were conducted as separate programs either by Canada or the EU. Depth of surveys also varied, and were limited to 730 m until 2003, when the depth range of the survey was doubled to 1,460 m (Vázquez et al. 2014).

Although sampling was variable and modified throughout this time period, the data provide a summary overview of the most prevalent Flemish Cap pelagic species of macroinvertebrates sampled during Canadian and EU surveys (1977-2012) as compiled by Vázquez et al. (2013) (Table 6.2). Among collected pelagic macroinvertebrates, species such as the northern shortfin squid and northern shrimp were observed in as many as 77 percent and 94 percent of survey trawls conducted in 2003, and the percentage of trawls capturing these species has subsequently declined to 17 and 59 percent respectively in 2012 (Vázquez et al. 2013). Coinciding with the catch frequency reduction of northern shrimp on the Flemish Cap, Canadian RV survey abundance data for the five years overlapping this period (2008-2012) indicate that, aside from a localized aggregation in the southwestern portion of the Project Area-Northern Section on the northeastern edge of the Grand Banks, the large majority of northern shrimp surveyed are concentrated further north along the Newfoundland Shelf (Figure 6-6). For the Project Area-Northern Section on the Flemish Cap (Figure 6-7), shrimp are mainly distributed on the slope edge, with relatively high aggregations on the eastern side of the Flemish Cap. For the Project Area-Southern Section, shrimp aggregations are mainly located on in the middle of the area on the Newfoundland Shelf.

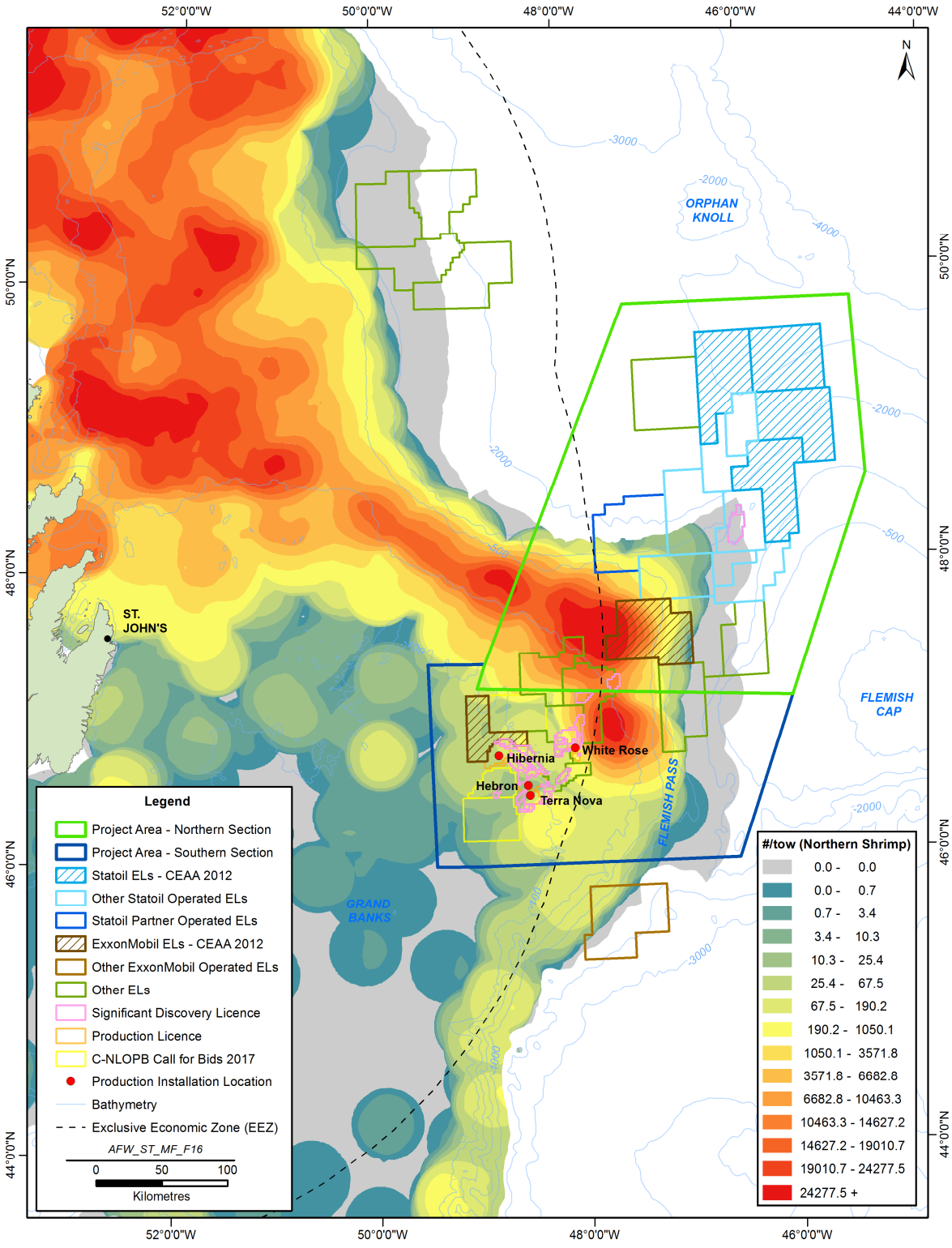


Figure 6-6 Northern Shrimp Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

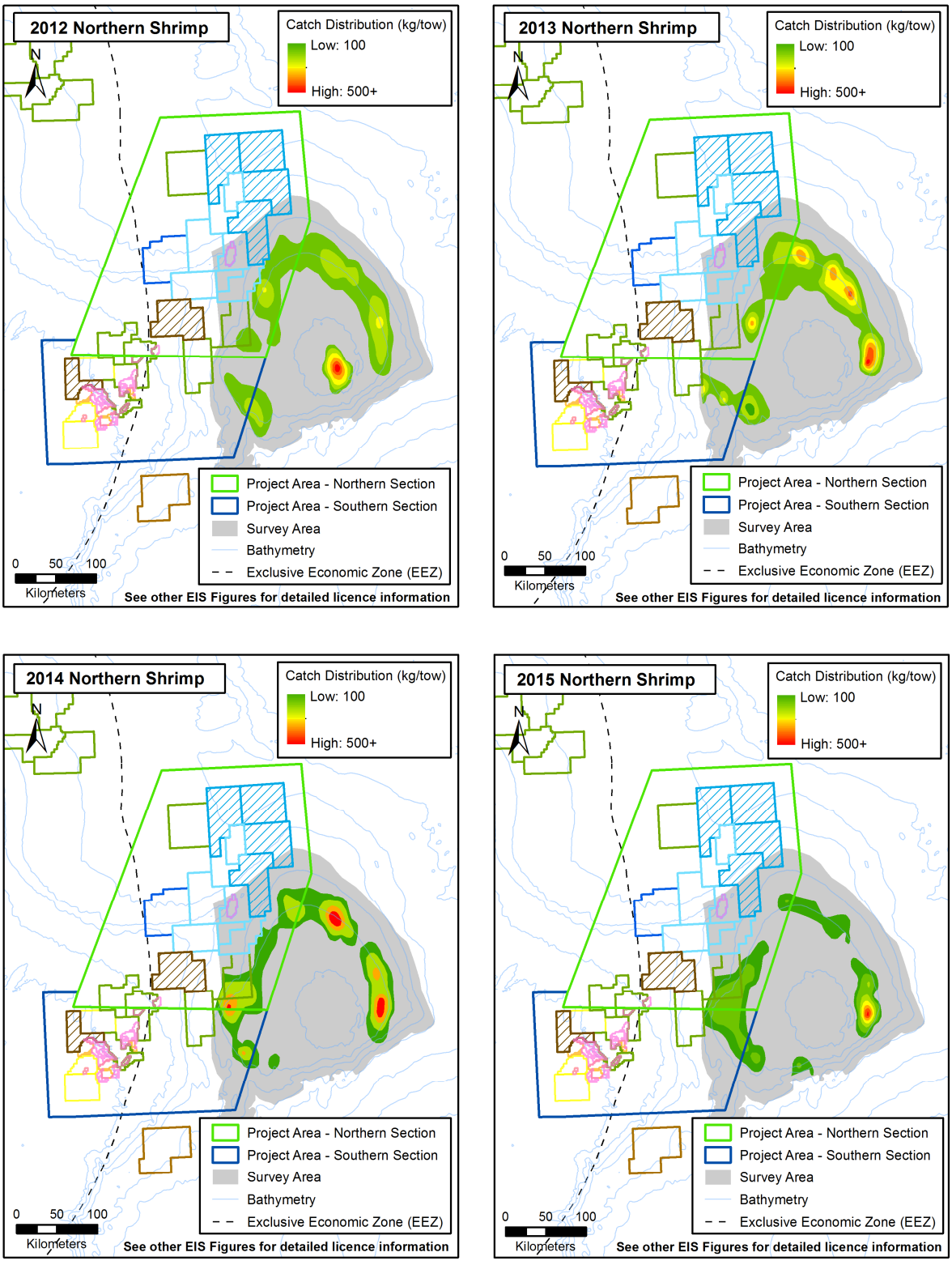


Figure 6-7 Northern Shrimp Distribution and Abundance on the Flemish Cap as Compiled from NAFO RV Trawl Survey Data (2012-2015)

Table 6.2 Summary of Prevalent Species of Macroinvertebrates that Feed in the Pelagic Environment Sampled Around the Flemish Cap in Canadian and EU Surveys (1977-2012)

Phylum, Class (Order)	Common Name	Scientific Name	% Survey years observed in total (/34 yrs)	% Pre-2003, ≤730 m depth (/24 yrs)	% 2003+, ≤1460 m depth (/10 yrs)
Mollusca, Cephalopoda	Squid	*Illex illecebrosus*	82	64	36
	Squid	*Histioteuthis reversa*	62	67	33
	Squid	*Semirossia* sp.	56	74	26
	Squid	*Histioteuthis* sp.	38	46	54
	Squid	*Histioteuthis bonnellii*	29	10	90
	Squid	*Gonatus fabricii*	29	10	90
	Squid	*Onychoteuthis banksii*	26	89	11
	Octopus	*Bathypolypus arcticus*	76	65	35
Arthropoda, Crustacea (Decapoda)	Shrimp	*Pandalus borealis*	79	63	37
	Shrimp	*Acanthephyra pelagica*	59	50	50
	Shrimp	*Pasiphaea tarda*	56	47	53
	Shrimp	*Eusergestes arcticus*	50	41	59
	Shrimp	*Sergia robusta*	50	41	59
	Shrimp	*Parapasiphae sulcatifrons*	44	33	67
	Shrimp	*Sabinea sarsii*	44	40	60
	Shrimp	*Sabinea hystrix*	44	33	67
	Shrimp	*Atlantopandalus propinqvus*	35	17	83
	Shrimp	*Pontophilus norvegicus*	35	17	83
	Shrimp	*Acanthephyra* sp.	32	36	64
	Shrimp	*Acanthephyra purpurea*	32	9	91
	Shrimp	*Spirontocaris liljeborgii*	29	60	40
	Shrimp	*Lebbeus polaris*	29	20	80
Arthropoda, Malacostraca (Mysida)	Mysid Shrimp	unidentified	26	0	100
Cnidaria, Scyphozoa	Jellyfish	unidentified	32	9	91
Source: Data compiled from Vázquez et al. (2013)					

In addition to the high proportion of small crustaceans (copepods and shrimp) that live in the pelagic environment (as described above), a variety of gelatinous animals can be found here. For example, pelagic tunicates include salps, pyrosomes and doliolids, are gelatinous, free-floating, filter feeding

animals found as single individuals or assembled into colonies. Salps and doliolids are a food source for bluefin tuna (Dragovich 1970; Fromentin and Powers 2005), sunfish (Potter and Howell 2011) and leatherback turtles (Eckert 2006; Dodge et al. 2011). There are several species of salp that live in the North Atlantic, including: *Cyclosalpa pinnata*, *Pegea bicaudata*, *P. confoederata*, *P. socia*, *Salpa cylindrica* and *S. maxima* (Madin 1982). Salps and doliolids contribute to pelagic biological pump processes in similar ways as microscopic zooplankton (Madin 1982).

Other groups of gelatinous animals include pelagic cnidarians and ctenophores (jellyfish). Jellyfish are both active swimmers and drifting animals that accumulate energy (sequester carbon) in a variety of ways. Some may contain photosynthetic symbionts (zooxanthellae), which sequester carbon as do other photosynthetic organisms such as phytoplankton. Whereas smaller developmental stages of jellyfish (such as ephyrae and small medusa) may consume small planktonic organisms. However, the majority of jellyfish are carnivorous and consume zooplankton (including larval fish and invertebrates) as well as grown fish (Gibbons and Richardson 2009). Jellyfish themselves are a food item for Atlantic bluefin tuna (Fromentin and Powers 2005), leatherback turtles (Heaslip et al. 2012) and sunfish (Potter and Howell 2011).

A review of 60-year time series data from the Continuous Plankton Recorder Survey found that in shelf areas peak jellyfish abundance in recent years occurs later in the summer, reflecting changes in sea surface temperature and advective processes that cause aggregations of these species to form. In contrast, peak jellyfish abundance in oceanic areas occurs earlier in the summer and is associated with peaks in phytoplankton and zooplankton abundance (Gibbons and Richardson 2009). In addition, in more recent years, the abundance of jellyfish has had a pronounced, basin-scale, synchronous increase that cannot be explained by any environmental variables such as zooplankton abundance, chlorophyll index, temperature changes or the North Atlantic Oscillation (Gibbons and Richardson 2009). In the region, the highest abundances of jellyfish are in the southern section along the shelf of the Grand Banks and Flemish Cap, with peak seasonal abundance observed from June to August (Gibbons and Richardson 2009). Recently, Sweetman and Chapman (2015) reported jellyfish may function as an unexpected catalyst to the biological pump process in the pelagic environment. These authors reported that accumulation of carbon (C) and nitrogen (N) on the sea floor in a Norwegian fjord due to jellyfish abundance was similar to, or exceeded C and N accumulation derived from the accumulation of phytoplankton detritus over the course of a year. Therefore, jellyfish may be an important contributor to biological pump processes within the Project Area and surrounding region.

Pelagic cephalopods or squid are also abundant raptorial predators that consume smaller invertebrates when they are juveniles and hunt pelagic fish and invertebrate species as they grow. However, cephalopods are also a food source to several species of pelagic vertebrates such as fish, sharks, seals, dolphins, and other toothed whales (Pauly and Trites 1998). For example, in 1,022 stomachs of porbeagle sharks that were surveyed between 1999 and 2001, cephalopods represented the second most important food category, comprising 12 percent of shark diet by weight (Joyce et al. 2002). More recently, squid were reported to represent more than 99 percent of porbeagle stomach contents analyzed in surveys south of the Project Area (Bowman et al. 2000). Squid prey in the North Atlantic are primarily longfin inshore and Northern shortfin squids. They can comprise of more than 50 percent of stomach content surveyed among species that feed intensively

on them including most of the sharks, hake, red grouper, goosefish, and bluefish (Bowman et al. 2000).

6.1.6 Benthic Invertebrates

Marine benthic invertebrates are comprised of a diverse group of taxa that live on the sea floor and have key roles in ocean ecosystems. Invertebrates enhance habitat complexity, influence nutrient cycling and biochemical processes, and are a critical component of the benthic food web (Barrio Frojàn et al. 2012; Beazley and Kenchington 2015; Murillo et al. 2016). This group of organisms occurs on the substrate surface (epifauna) or live within the substrate (infauna). Benthic invertebrate distributions are strongly influenced by environmental conditions (e.g., substrates, currents, temperature, nutrition) that allow them to thrive and conduct their feeding, growth, and reproduction activities.

Benthic species distributions are therefore highly dependent on the environmental conditions associated with various depths (Nesis 1970; Knudby et al. 2013; Gale 2013; Beazley and Kenchington 2015; Buhl-Mortensen et al. 2015; Murillo et al. 2016). As such, there are no typical benthic species for the Project Area, but rather there are assemblages of species associated with depth zones. Benthic invertebrate distribution may also be shaped by predator-prey relationships (Gale 2013) or associations with habitat engineering organisms (e.g., corals and sponges; Baker et al. 2012; Baillon et al. 2014a). Biological systems in deep-sea operate at a notably slower pace than in shallow waters (Smith et al. 1994). Many deep-sea species typically have low metabolic rates, are slow growing, and have late maturity, low levels of recruitment, and long life spans relative to their shallow water counterparts (Beazley et al. 2013a; McClain and Schalcher 2015; Murillo et al. 2016). Many benthic deep-sea invertebrate species are immobile, occurring in stable environmental conditions, and therefore are regarded as being sensitive to anthropogenic disturbance (Curtis et al. 2013; DeBlois et al. 2014; Barrio Frojàn et al. 2015; Cordes et al. 2016; Clark et al. 2016; Murillo et al. 2016). In some habitats (e.g., hydrothermal vents), species can re-colonize rapidly after disturbance (Van Dover et al. 2014), but in most deep-sea ecosystems, recovery can be very slow (William et al. 2010, Schalcher 2014; Clark et al. 2016; Van Reusel et al. 2016).

Information on benthic community composition in and around the Project Area is derived primarily from Canadian RV Surveys (as summarized in Amec 2014a), other research initiatives (e.g., Carter et al. 1979; Kenchington et al. 2001; Beazley and Kenchington 2015), and resource descriptions and environmental monitoring programs associated with oil and gas development (Husky Energy 2013; Suncor Energy 2013). The data are mainly focused on epifaunal communities that are accessible via trawls, ROV surveys, and camera surveys, and infaunal communities that are accessible via sediment grabs. The pooled data from various survey methods allow for an overall characterization and description of the Project Area (Amec 2014). Metrics of dominant species presented below are based on those used in surveys (abundance, biomass, survey presence), which vary across survey methods and studies. Figure 6-8 illustrates the key areas referenced in the following subsections, for general reference.

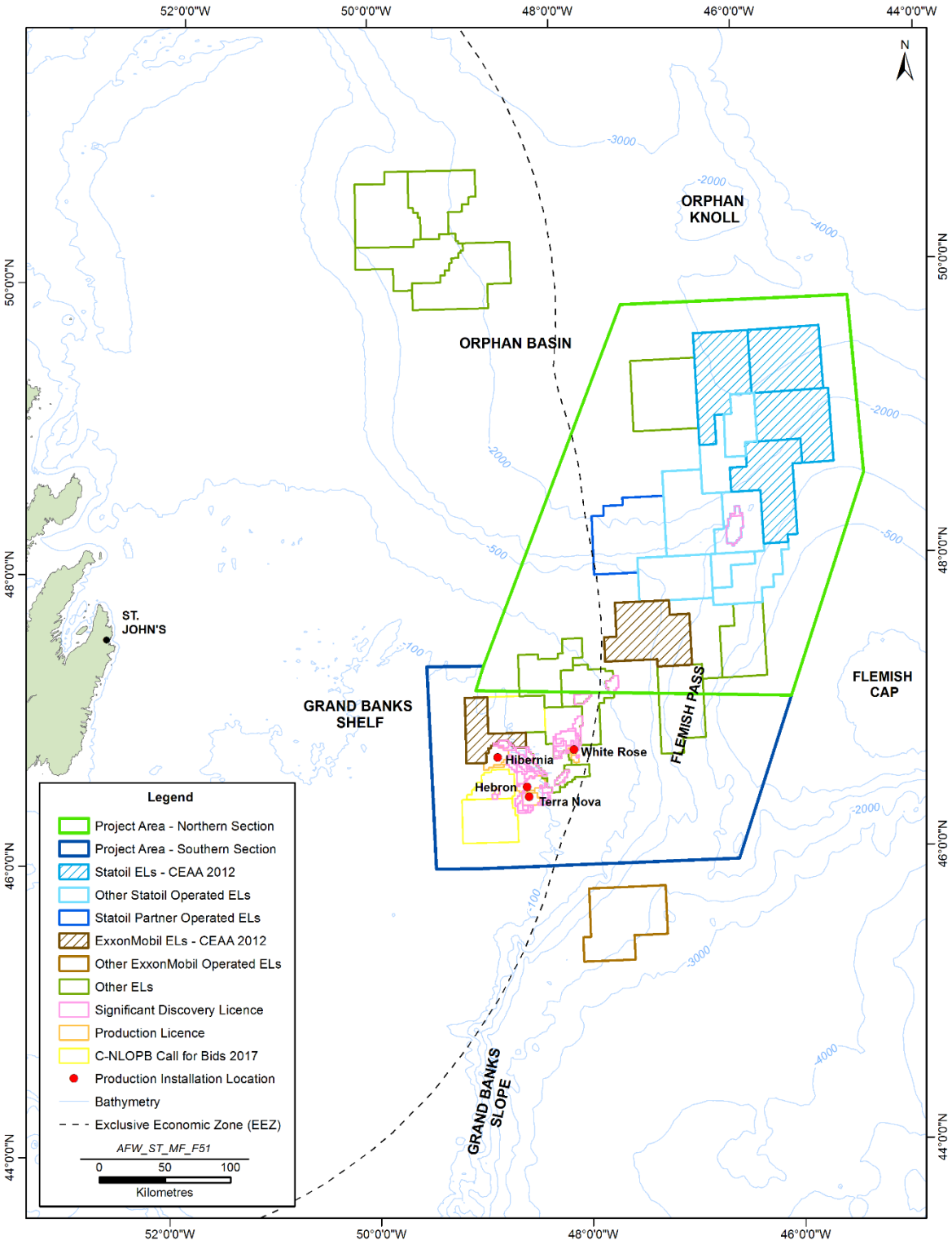


Figure 6-8 General Regions Used to Describe the Benthic Environment

6.1.6.1 Grand Banks Shelf (Project Area – Northern and Southern Sections)

Infaunal and epifuanal sampling programs within the Project Area are also representative of the northeast shelf of the Grand Banks for the Northern Section of the Project Area. Ongoing environmental effects monitoring programs at the Terra Nova and White Rose developments on the shelf of the Grand Bank (less than 500 m depths), in the vicinity of EL 1137, indicate that substrates sampled by sediment grabs are dominated by sand with lesser quantities of gravel and fines (Husky Energy 2013; Suncor Energy 2013). Polychaetes had greater than 75 percent relative abundance in infaunal benthic community analysis and were comprised of species in the families *Spionidae, Paraonidae, Cirratulidae* and *Syllidae* (Husky Energy 2013; Suncor Energy 2013). Bivalves, predominantly of the family *Tellindae*, were also relatively abundant (approximately 10 percent) in the White Rose area (Husky Energy 2013). Other infaunal species observed with relatively low abundance (less than 10 percent) included amphipods, bivalves, molluscs, barnacles, and isopods.

Dominant epifaunal species have been identified by a series of experimental trawling and underwater video grabs (Prena et al. 1999; Kenchington et al. 2001) on sandy areas of the northeast Grand Bank within the Southern Section of the Project Area in the surrounding area of EL1137. Video grabs conducted by Kenchington et al. (2001) indicated that species with the greatest abundance included polychaetes, Macoma clams, and sand dollars, whereas biomass was dominated by propeller clams, sand dollars, brittlestars, Macoma clams, and pale sea urchins. Trawl surveys in the same location by Prena et al. (1999) captured snow crab, basket stars, pale sea urchins in the greatest quantities. Similarly, video surveys by Schneider et al. (1987) observed brittlestars, sand dollars, Icelandic scallops and pale sea urchins as the dominant taxa. Soft corals, whelks and hermit crabs were also commonly captured. The available data from Canadian RV surveys are biased towards commercial invertebrate species and report snow crab mainly on the northeast shelf and slope within the Project Area in the vicinity of EL1135 and EL 1137. This species was detected at relatively low abundance (less than 1 percent) in comparison to total trawl catches. Shrimp species were also highly represented in the Canadian RV trawl surveys (approximately 85 percent total abundance) as discussed in previous sections (see Figure 6-6). Of the species observed on the Grand Bank, sand dollars and brittlestars appear to be the dominant benthic invertebrates within the region (Table 6.3).

Table 6.3 Dominant Invertebrate (Abundance and Biomass) Species Representative of the Grand Bank Shelf

Depth Zone	Survey type	Common Name	Scientific Name	Total Abundance (#/m²)	Contribution to Survey
Shelf / Slope Edge 70-100 m	Photograph Survey[1]	Brittlestar	Ophiuroidea (O)	0.40	25.2%
		Sand dollar	*Echinarachnius parma*	0.39	24.6%
		Icelandic scallop	*Chlamys islandica*	0.37	23.0%
		Pale sea urchin	*Strongylocentrotus pallidus*	0.27	16.9%
		Whelk	Buccinidae (F)	0.04	2.8%
		Crab	Majidae (F)	0.04	2.5%
		Polychaete	Sabellidae (F)	0.02	1.2%

Table 6.3 Dominant Invertebrate (Abundance and Biomass) Species Representative of the Grand Bank Shelf

Depth Zone	Survey type	Common Name	Scientific Name	Mean Abundance (#/0.5 m²)	Contribution to Survey
Shelf / Slope Edge 120-146 m	Benthic grab[2]	Polychaete	*Prionospio steenstrupi*	174.99	15.2%
		Polychaete	*Chaetozone setosa*	99.3	8.6%
		Polychaete	*Spio filicornis*	89.23	7.8%
		Polychaete	*Nothria conchylega*	nr	-
		Amphipod	*Priscillina armata*	nr	-
		Chalky macoma	*Macoma calcarea*	nr	-
		Sand dollar	*Echinarachnius parma*	nr	-
Depth Zone	**Survey type**	**Common Name**	**Scientific Name**	**Mean Biomass (mg/0.5 m²)**	**Contribution to Survey**
Shelf / Slope Edge 120-146 m	Benthic grab[2]	Propeller clam	*Cyrtodaria siliqua*	nr	-
		Sand dollar	*Echinarachnius parma*	155,283.30	-
		Brittlestar	*Ophiura sarsi*	nr	-
		Chalky macoma	*Macoma calcarea*	nr	-
		Pale sea urchin	*Strongylocentrotus pallidus*	nr	-
Depth Zone	**Survey type**	**Common Name**	**Scientific Name**	**Mean Biomass (g/m²)**	**Contribution to Survey**
Shelf / Slope Edge 120-250 m	Trawl[4]	2	*Echinarachnius parma*	257.7	65.0%
		Brittlestar	*Ophiura sarsi*	74.0	18.7%
		Pale sea urchin	*Strongylocentrotus pallidus*	34.7	8.7%
		Boreal astarte	*Astarte borealis*	6.8	1.7%
		Snow crab	*Chionoecetes opilio*	7.2	1.8%
		Soft coral	*Gersemia sp.*	2.6	0.6%
Depth	**Survey Type**	**Common Name**	**Scientific Name**	**No. of Trawls present**	**Contribution to Survey**
Shelf / Slope Edge 150-250 m	Trawl[3]	Sand dollar	*Echinarachnius parma*	55	31.3%
		Green sea urchin	*Strongylocentrotus droebachiensis*	34	19.3%
		Hydrozoan	*Sertularia fabricii*	20	11.4%
		Hydrozoan	*Thuiaria thuja*	14	8.0%

Notes:
Adapted from [1]Schneider et al. (1987); [2]Kenchington et al. (2001); [3]Murillo et al. (2016) and [4]Prena et al. (1999)
nr: not reported.
Number of trawls present is based on 176 trawls of the Flemish Cap and indicates presence among total number of trawls (Murillo et al. 2016).
Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.
Taxonomic groups: Order (O), Family (F)

6.1.6.2 Grand Bank Slope (Project Area – Southern Section)

The slopes of the Grand Banks have similar species assemblages to the slopes of the Flemish Cap. The sponges *Tentorium semisuberites* and *Polymastia uberrima* are characteristic species from the continental shelf to 650-700 m depth along the slopes of the Grand Banks in the vicinity of the Southern Section of the Project Area. Along sandy and clay-silt bottoms between 620-1,400 m depth there were no characteristic species because the area has been exposed to commercial trawling and exhibits relatively low species diversity. Sponge species, mainly from the order *Astrophorida,* are dominant on bottoms comprised of sand, silt and clay from 700-1,400 m depths and corresponds with relatively high average species richness (Table 6.4).

Table 6.4 Dominant Invertebrate Species Representative of the Slopes of the Grand Banks

Depth Zone	Survey Type	Common Name	Scientific Name	No. of Trawls present	Contribution to Survey
Shelf / Slope Edge 250-700 m	Trawl[1]	Sponge	*Polymastia uberrima*	21	11.9%
		Sponge	*Tentorium semisuberites*	17	9.7%
Shelf / Slope Edge 700-1,400	Trawl[1]	Sponge	*Stryphnus fortis*	20	11.4%
		Sponge	*Geodia parva-phlegraei*	10	5.7%
		Sponge	*Craniella cranium*	12	6.8%
		Sponge	*Geodia barretti*	9	5.1%
		Sponge	*Stelletta normani*	9	5.1%

Notes:
Adapted from Murillo et al. (2016). Number of trawls present is based on 176 trawls of the Flemish Cap and indicates presence among total number of trawls (Murillo et al. 2016).
nr: not reported.
Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.
Taxonomic groups: Order (O), Family (F)

6.1.6.3 Flemish Pass and Flemish Cap (Project Area – Northern and Southern Sections)

Benthic community structure on the Flemish Pass and Flemish Cap, including Sackville Spur (less than 2,000 m), has been surveyed through commercial bycatch logs and NAFO scientific trawling (Murillo et al. 2012, 2016; Vàzquez et al. 2013) and NEREIDA research survey program camera stations and scientific trawling (Barrio Frojàn et al. 2012; Beazley et al. 2013a; Beazley and Kenchington 2015; Greenan et al. 2016). Murillo et al. (2016) modelled the substrate based on box corer sediment sampling data from the area. The Flemish Cap is predominantly covered in sand and silty-sand with areas of gravel, becoming increasingly covered in silty-sand along the slopes (200-500 m). In deeper areas (500-2,000 m) of the Flemish Cap and Pass, the substrate is increasingly silty-clay or mud (Murillo et al. 2012; 2016).

The highest diversity of species on the Flemish Cap, including areas of EL1141 and EL1142, was observed between 500-1,000 m depths, with corals and sponges as the most dominant trawl

captured taxa, followed by echinoderms, arthropods, and molluscs (Vàzquez et al. 2013; Murillo et al. 2016). Nesis (1970) also observed increasing biomass with increasing depth up to 1,500 m. Comparisons of invertebrate species to environmental parameters allowed for identification of species groupings at varying depths. At relatively shallow depths (less than 500 m) where there were relatively colder, fresher waters, widely occurring species included sponges, crustaceans, sea anemones and seastars (Nesis 1970; Murillo et al. 2016). Along the slopes between 500-900 m depth, benthic assemblages were typified by a variety of coral species including black corals, cup corals, sea pens, soft corals and gorgonian corals (Table 6.5). The latter areas also had the highest average species richness of the area. Benthic assemblages along the silty-sand lower slope areas at 800-1,200 m depths were characterized by echinoderms and sea pens (Murillo et al. 2016). The natural communities along the northern edge of the Flemish Cap (620-1,400 m) could not be characterized for coral, sponge, and other deep-sea species because the area has been exposed to higher commercial trawling and exhibits relatively low species diversity. Further north along the Flemish Cap is the Sackville Spur which is a high-density area for deep-sea (1,000-1,700 m) sponge assemblages that are associated with high species richness and maximum bottom currents (Knudby et al. 2013; Barrio Frojàn et al. 2015; Beazley and Kenchington 2015; Murillo et al. 2016). The Sackville Spur also lies across license areas EL1141 and EL1142. Beazley and Kenchington (2015) identified 283 species in the Sackville Spur area, with sponges, echinoderms and cnidarians having the greatest diversity of species in the area. Infaunal sampling in the same areas by Barrio Frojàn et al. (2015) identified polychaetes, nematodes, brittle stars, sponges, and hydrozoans as characteristic species. Beazley and Kenchington (2015) noted that the benthic invertebrate community changed along the depth gradient, with the greatest changes occurring at 1,600-1,700 m associated with maximum abundances of structure-forming sponges.

Table 6.5 Dominant Invertebrate Species Representative of the Flemish Cap

Depth Zone	Survey Type	Common Name	Scientific Name	No. of Trawls present	Contribution to Survey
Shelf / Slope Edge <200 m	Trawl[1]	Demosponge	*Iphon piceum*	74	42.0%
		Crustacean	*Sabinea sarsii*	37	21.0%
Shelf / Slope Edge 200-340 m	Trawl[1]	Seastar	*Ceramaster granularis*	63	35.8%
		Subarctic sea anemone	*Hormathia digitata*	39	22.2%
Shelf / Slope Edge 300-500 m	Trawl[1]	Seastar	*Brisaster fragilis*	28	15.9%
		Seastar	*Ctenodiscus crispatus*	15	8.5%
Middle Slope 500-900 m	Trawl[1]	Cup coral	*Flabellum alabastrum*	43	24.4%
		Soft coral	*Heteropolypus sol*	41	23.3%
		Sea pen	*Funiculina quadrangularis*	39	22.2%
		Small gorgonian coral	*Acanella arbuscula*	29	16.5%
		Black coral	*Stauropathes artica*	23	13.1%

Table 6.5 Dominant Invertebrate Species Representative of the Flemish Cap

Depth Zone	Survey Type	Common Name	Scientific Name	No. of Trawls present	Contribution to Survey
Middle-Deep Slope 800-1,200 m	Trawl[1]	Sea pen	*Anthoptilum grandiflorum*	75	42.6%
		Sea urchin	*Phormosoma placenta*	44	25.0%
		Sea pen	*Halipteris finmarchica*	40	22.7%
		Sea pen	*Funiculina quadrangularis*	39	22.2%
		Sea pen	*Pennatula aculeata*	25	14.2%
		Seastar	*Bathybiaster vexillifer*	15	8.5%
		Seastar	*Zoroaster fulgens*	11	6.3%
Middle-Deep Slope 700-1,400 m	Trawl[1]	Sponge	*Stryphnus fortis*	20	11.4%
		Sponge	*Geodia parva-phlegraei*	10	5.7%
		Sponge	*Craniella cranium*	12	6.8%
		Sponge	*Geodia barretti*	9	5.1%
		Sponge	*Stelletta normani*	9	5.1%
Deep Slope 1,000-1,700 m	Video survey[2]	Sea cucumber	*Psolus* sp.	nr	22.4%
		Brittlestar	Ophiuroidea (C)	nr	11.8%
		Brittlestar	Ophiuroidea sp. 1	nr	12.8%
		Foraminiferid	Foraminiferida sp 1	nr	4.8%
		Brittlestar	*Ophiacantha anomala*	nr	3.9%
		Sponge	Porifera (P)	nr	3.2%
		Demosponge	*Hexadella dedritifera*	nr	4.3%

Notes:
Adapted from [1]Murillo et al. (2016) and [2]Beazley and Kenchington (2015). Number of trawls present is based on 176 trawls of the Flemish Cap and indicates presence among total number of trawls (Murillo et al. 2016).
Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.
Taxonomic group: Phylum (P), Class (C)

Epifaunal communities of the Flemish Pass were characterized during the NEREIDA program where Beazley and Kenchington (2015) identified 527 species from 400-1,400 m depths. Sponges and cnidarians represented the highest number of taxa followed by arthropods echinoderms, and molluscs (Table 6.6, Beazley and Kenchington 2015). Murillo et al. (2011) characterized coral distributions for the Grand Banks beyond the Canadian EEZ and observed that soft corals, gorgonian corals, sea pens, and black corals were characteristic species for the Flemish Pass. For deep areas of the Flemish Pass and Flemish Cap, habitat complexity decreases with depth with higher prevalence of mud substrates. The presence of structure forming sponges and corals is key to supporting benthic communities (Beazley et al. 2013a) because they provide habitat, refuge and foraging areas for a variety of species. Echinoderms, in particular suspension feeding brittlestars, are highly responsive to presence of structure forming sponge grounds (Beazley et al. 2013a;

Beazley and Kenchington 2015). In the Flemish Pass, this is evidenced by the shift in benthic communities (between 1,000-1,300 m) that corresponds to a distinct change in the density of sponges.

Table 6.6 Dominant Invertebrate Species Representative of the Flemish Pass

Depth Zone	Survey Type	Common Name	Scientific Name	Total Abundance	Contribution to Survey
Middle-Deep Slope 400-1,400 m	Photograph survey[1]	Sponges	Porifera (P)	11,091	37.2%
		Echinoderms	Echinodermata (P)	6,983	23.4%
		Cnidarians	Cnidaria (P)	3,019	10.1%
		Arthropods	Arthropoda (P)	2,152	7.2%
		Chordates	Chordata (P)	1,973	6.6%
		Annelids	Annelida (P)	1,145	3.8%
		Ectoprocts	Ectoprocta (P)	512	1.7%
		Molluscs	Mollusca (P)	483	1.6%
		Brachiopods	Brachiopoda (P)	362	1.2%
		Unidentified	Unidentified	2,072	6.9%
Middle-Deep Slope 400-1,400 m	Photograph survey	Sponges	Porifera (P)	182	34.5%
		Cnidarians	Cnidaria (P)	93	17.6%
		Arthropods	Arthropoda (P)	35	6.6%
		Echinoderms	Echinodermata (P)	34	6.5%
		Molluscs	Mollusca (P)	24	4.6%
		Chordates	Chordata (P)	12	2.3%
		Annelids	Annelida (P)	9	1.7%
		Ectoprocts	Ectoprocta (P)	8	1.5%
		Brachiopods	Brachiopoda (P)	2	0.4%
		Unidentified	Unidentified	120	22.8%

Notes:
Adapted from [1]Beazley et al. 2013a.
Total abundance is for 293 m² surveyed.
Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.
Taxonomic group: Phylum (P)

6.1.6.4 Orphan Basin (Project Area – Northern Section)

The eastern Orphan Basin area that includes EL1139 and EL1140 contains slope to abyssal habitats reaching approximately 4,000 m. Carter et al. (1979) characterized sediments and benthos of the Orphan Basin with a series of Van Veen sediment grabs and seabed photographs. The upper slope of the basin (300-700 m) was dominated by gravel and sandy mud substrates, where polychaetes, bivalves, and echinoderms (echinoids and brittlestars), were dominant (Table 6.7). Sponges, bryozoans and brachiopods were observed on cobbles and boulders in the area. The basin middle

slope (700-2,000 m) was predominately mud, with benthic communities comprised mainly of cnidarians, polychaetes, echinoids, and brittlestars. Benthic infauna in this area were comprised mostly of mollusc species. The lower slope of the Orphan Basin (2,000-2,500 m) was covered in a mixture of mud, sandy mud and gravels, with a relatively sparse benthic diversity of polychaetes, ophuroids and molluscs as the primary observed species. The lowest depths sampled (2,500 to over 3,000 m) were similar in benthic communities to the lower slope of the Orphan Basin with polychaetes, orphuroids and molluscs observed (Carter et al. 1979). A survey of drilling well sites in the Orphan Basin was conducted by the international SERPENT Project (d'Entremont et al. 2008) using ROV videos, and baited underwater cameras. Preliminary data indicate that sponges, cnidarians, crustaceans (*Lithodes* sp.) and ophuroids have been observed in the area (Gates et al. 2008).

Table 6.7 Dominant Invertebrate Species within the Orphan Basin[1]

Area	Survey Type	Common Name	Scientific Name
Shallow Slope 300-700 m	Photograph survey[1]	Polychaete	Polychaeta (C)
		Bivalve mollusc	Bivalvia (C)
		Sand dollar / sea urchins	Echinoidea (C)
		Brittlestar	Ophiuroidea (C)
		Sponges	Porifera (P)
		Bryozoan	Bryozoa (P)
		Brachiopod	Brachiopoda (P)
Middle-Deep Slope 700-2,000 m	Photograph survey[1]	Sea anemone	Actinaria (O)
		Polychaete	Polychaeta (C)
		Bivalve mollusc	Bivalvia (C)
		Gastropod	Gastropoda (C)
		Brittlestar	Ophiuroidea (C)
		Tusk shell	*Dentalium* sp.
		Sand dollar / sea urchins	Echinoidea (C)
Deep Slope 2,000-2,500 m	Photograph survey[1]	Polychaete	Polychaeta (C)
		Bivalve mollusc	Bivalvia (C)
		Brittlestar	Ophiuroidea (C)
		Sponges	Porifera (P)
		Brachiopod	Brachiopoda (P)
Deep Slope 2,500->3,000 m	Photograph survey[1]	Polychaete	Polychaeta (C)
		Bivalve mollusc	Bivalvia (C)
		Brittlestar	Ophiuroidea (C)

Notes:
[1]Abundance data not available
Adapted from [1]Carter et al. 1979.
Taxonomic group: Phylum (P), Class (C), Order (O)

6.1.6.5 Corals and Sponges

Habitat complexity in deep-sea environments is highly dependent on structure-forming organisms including corals, sea pens, and sponges (DFO 2015), which have direct and indirect influences on fish and invertebrate abundance and occurrence. These long lived and slow growing organisms become important refuges (Wareham 2009; Baker et al. 2012; Baillon et al. 2014a), nursery areas (Beazley et al. 2013a; DFO 2015), and foraging areas (Baker et al. 2012; DFO 2015) for many fish and invertebrate species. Remaining calcareous and siliceous structures from deceased coral and sponge species also add to habitat complexity through the creation of reefs and sediment stabilizing mats (Beazley et al. 2013a; DFO 2015). Habitat complexity within the Project Area decreases with depth. Therefore, patchy coral and sponge reef areas may provide “oases” in often barren deep-sea areas (Baker et al. 2012).

Due to the sessile and fragile nature of corals and sponges, they are considered to be vulnerable to habitat disturbances such as bottom trawling. Disturbances to the seabed may also disrupt the habitat complexity created by deceased sponge and coral structures that support other benthic invertebrate species (Barrio Frojàn et al. 2012). Sponges are a major component of sessile benthic communities in temperate as well as polar and tropical habitats and have a number of functional roles in marine ecosystems, such as filtering large quantities of water and acting as a major link between benthic and pelagic environments (Bell et al. 2008). Sponges are primarily suspension feeders and obtain the majority of their food and nutrients from filtering the water. As a consequence of their ecological importance and environmental sensitivity, many coral and sponge grounds are designated as Ecologically or Biologically Significant Area (EBSAs) or VMEs and are closed to fishing activities, including within the Project Area, areas on the Northeast Shelf and Slope, EBSA, the Sackville Spur, the Flemish Cap, Flemish Pass (See Section 6.4 – Special Areas for more details, Barrio Frojàn et al. 2012; Guijarro et al. 2016; Murillo et al. 2016).

Bottom trawling and video surveys have identified over 50 species of corals and sea pens within and around the Project Area (Table 6.8) along the shelf of the Flemish Cap, Flemish Pass and northeast slope of the Grand Banks (Wareham 2009; Murillo et al. 2011; Beazley et al. 2013a, Vàzquez et al. 2013; Baillon et al. 2014a, 2014b; Beazley and Kenchington 2015). Modelling of coral distributions against environmental parameters indicated that depth was the greatest predictor for coral presence (Guijarro et al. 2016). The Flemish Cap, within and in the surrounding areas of EL1141 and EL1142, has the greatest coral richness within the Project Area (Table 6.8; Figures 6-9 to 6-11) likely owing to the diversity of habitat types and depth gradients in comparison to the remaining area (Murillo et al. 2011, 2016). Within the Project Area, coral biomass is mainly distributed along the slopes of the Flemish Pass, Flemish Cap, and Grand Bank with fewer observations on the Grand Bank Shelf and on top of the Flemish Cap (Murillo et al. 2011). Coral biomass was highest between 600-900 m along the northern Flemish Cap (nearby EL1141 and EL1142), Flemish Pass and Northeast Grand Bank shelf (nearby EL1135) and was associated with warm, more saline waters with silty sand substrates (Murillo et al. 2011; Murillo et al. 2016). These environmental conditions may support primary production and food supply levels, which are important predictive factors of coral biomass (Guijarro et al. 2016). There have been several studies that have compared oceanographic conditions (such as temperature) to known coral distributions to assess environmental tolerances for cold water corals and predict coral distributions (Daives et al. 2008; Tittenson et al. 2009; Guinotte et al. 2014). For

example, *Lophelia pertusa* has been found in water temperatures ranging from 4°C-12°C with a mean temperature of 6.2°C-6.7°C. Other studies have found that Alyconiina, Antipatahtra, Calcazonia, and Sclerexonia corals are in water temperatures ranging from 1.5°C-8°C. (Guinotte and Davies 2014). These studies have found, however, that the most important such factor in determining habitat suitability is aragonite saturation (at least for hard corals) and oxygen concentrations (Tittenson et al. 2009).

Table 6.8 Corals Occurring within the Project Area and Adjacent Marine Environments

Order	Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	NE Grand Bank	Reference
Antipatharia	Black-wire corals	*Bathypathes* spp.	-	●	●		1
		Leiopathes sp.	-		●		2
		Stauropathes artica	480-970	●	●	●	1; 2; 5; 8
		Stauropathes magna	-		●		3
		Stichopathes sp.	243	●			2; 5; 8
Alcyonacea	Large gorgonians	*Acanella arbuscula*	480-1,442	●	●	●	1; 2; 5; 6
		Keratoisis ornata	-		●		1
		Keratoisis sp.	-	●	●		2; 3
		Keratoisis cf. siemensii	979-1,374	●			
		Paragorgia sp.	-	●			5
		Paragorgia arborea	250-750		●	●	1; 2
		Paragorgia johnsoni	1,079-1,351	●			2; 8
		Paramuricea sp.	-	●			2; 5
		Paramuricea spp.	335-1,351	●	●	●	1; 2; 3; 8
		Paramuricea grandis	1,094-1,216	●			8
		Paramuricea placomus	494-646	●			8
		Parastenella atlantica	1351	●			2; 8
		Placogorgia sp.	404-423	●			2; 8
		Primnoa resedaeformis	527	●		●	2; 5; 8
		Swiftia sp.	984-1,332	●			2; 5; 8
	Small gorgonians	*Acanthogorgia* sp.	-	●	●		3; 5
		Acanthogorgia armata	494-1,351		●		1; 8
		Anthothela sp.	-	●			5
		Anthothela grandiflora	707-1,351	●	●		1; 2; 6; 8

Table 6.8 Corals Occurring within the Project Area and Adjacent Marine Environments

Order	Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	NE Grand Bank	Reference
		Radicipes sp.	-	●			5
		Radicipes gracilis	416-1,370	●	●		1; 2; 8
	Soft corals	*Anthomastus grandiflorus*	612	●	●		1; 8
		Anthomastus sp.	-	●	●		2; 5
		Anthomastus spp.	1,095-1,370	●	●		2; 8
		Anthothela grandiflora	707-1,351	●			2; 8
		Clavulariidae species	228-1,290	●			2; 8
		Drifa glomerata	47-1,370	●			8
		Duva florida	56-1,374	●	●	●	1; 2; 5; 7; 8
		Gersemia sp.	-	●			5
		Gersemia fruticosa	110	●			8
		Gersemia rubiformis	46-246		●	●	1; 2; 8
		Heteropolypus sp.	-	●			5
		Heteropolypus cf. insolitus	-		●		6
		Heteropolypus sol	348-1,290	●			8
		Nephtheidae indet.	-	●	●	●	2
		Pseudoanthomastus agaricus	624-1,351	●			8
		Telestula septentrionalis	494-1,332	●			2; 8
Scleractinia	Solitary stony corals	*Flabellum alabastrum*	359-1,189	●	●	●	1; 2; 8
		Flabellum angulare	-		●		6
		Desmophylllum dianthus	-	●	●		2
Pennatulacea	Sea pens	*Anthoptilum* sp.	-	●	●		3; 5
		Anthoptilum grandiflorum	200-1,370	●	●	●	1; 2; 4; 8
		Distichoptilum gracile	727-1,020	●	●		2; 5; 8
		Funiculina quadrangularis	476-1,258	●	●		1; 2; 5; 8
		Halipteris sp.	-		●		3; 6
		Halipteris cf. christii	169-290	●			2; 5; 8

Table 6.8 Corals Occurring within the Project Area and Adjacent Marine Environments

Order	Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	NE Grand Bank	Reference
		Halipteris finmarchica	320-1,370	●	●	●	1; 2; 4; 5; 8
		Kophobelemnon stelliferum	657-1,258	●			2; 5; 8
		Kophobelemnon sp.	-		●		3; 6
		Pennatula sp.	-	●	●		3; 5; 6
		Pennatula aculeata	302-1,189	●	●	●	2; 5; 8
		Pennatula grandis	324-1,246	●	●	●	1; 2; 5; 8
		Pennatula phosphorea	-		●		1
		Protoptilum sp.	-	●			2
		Protoptilum carpenter	973	●			8
		Umbellula sp.	-	●			5
		Umbellula lindahli	402-1,370	●	●		1; 2; 8
		Unidentified Sea Pens	-	●	●		1
		Virgularia sp.	-	●			2
		Virgularia mirabilis	1,343	●			8

Notes:
Sources: Based on [1]Wareham (2009); [2]Murillo et al. (2011); [3]Beazley et al. (2013b), [4]Vázquez et al. (2013); [5]Baillon et al. (2014a); [6]Beazley and Kenchington (2015); [7]Greenan et al. (2016); [8]Murillo et al. (2016)
Listed depth ranges are from Murillo et al. (2016) and Buhl-Mortensen et al. (2015).

Although coral distributions are present along the slopes of the Project Area, there are few observations in deeper waters (1,500-4,000 m) within the Project Area – Northern Section (Gates et al. 2008; Beazley et al. 2013a). The lower number of observations at these depths is likely due to lack of surveys in these areas rather than low coral distribution. Modelled distributions are also not considered reliable at these depths (Guijarro et al. 2016) due to the differences in environmental parameters between shelf and deep areas and lack of observations to verify distributional model predictions. However, coral species observed within the shelf and slope habitats of the Project Area may occur within the deeper Orphan Basin area based on distribution in other areas. For example, the depth ranges of the gorgonian corals Acanella arbuscular and Acanthogorgia armata in Canada are greater than 1,400 m, with specimens observed at depths of 2,000 m globally (Buhl-Mortensen et al. 2015; Murillo et al. 2016). For areas where little information exists on coral distribution (EL1139, EL1140, EL1141, EL1142), the operator is committed to undertaking a pre-drill coral survey in advance of a drilling campaign, to collect data regarding corals in the areas of a potential wellsite (see Section 2.5.2.1).

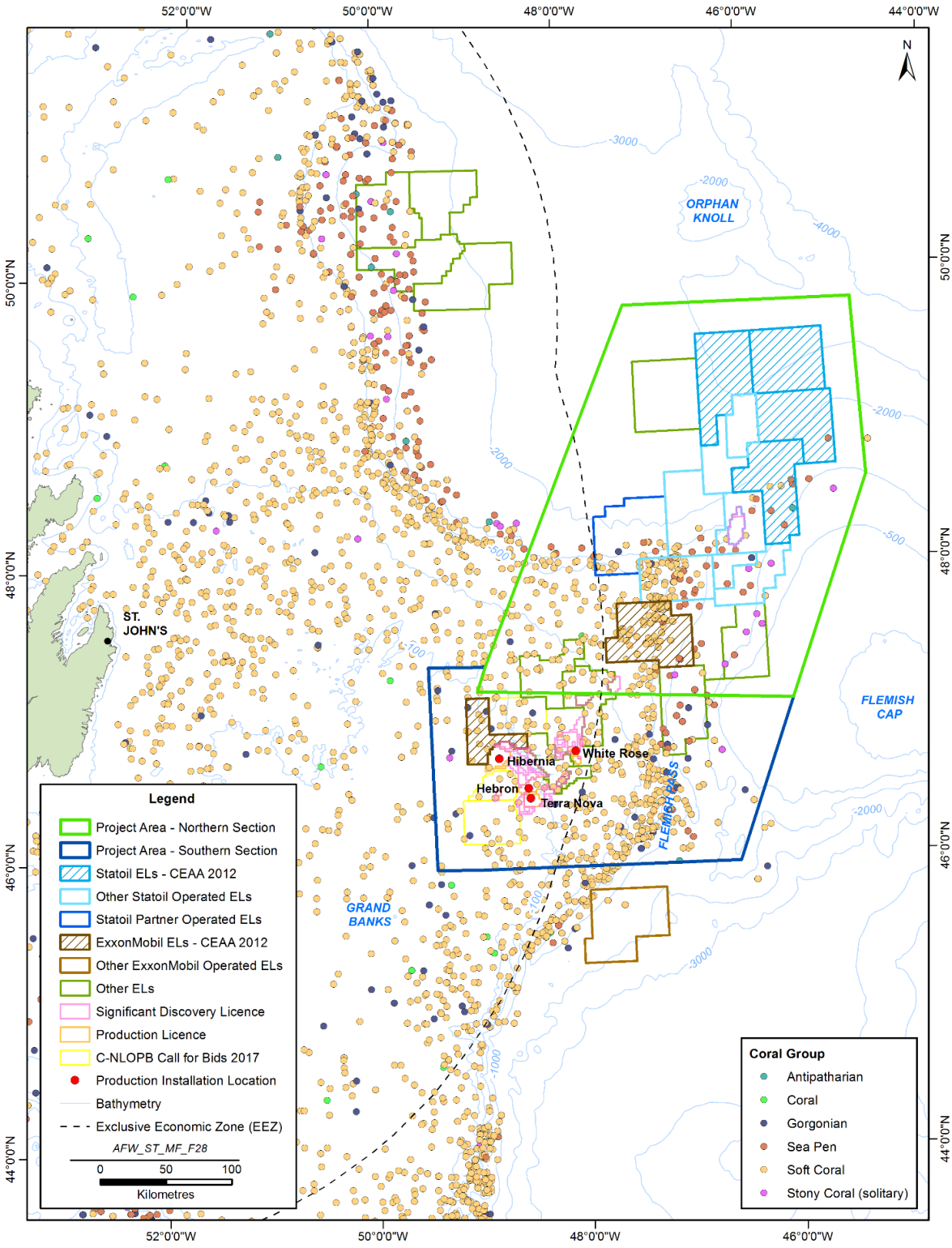


Figure 6-9 Summary of Regional Coral Distributions Compiled from Canadian RV Data and Literature Sources

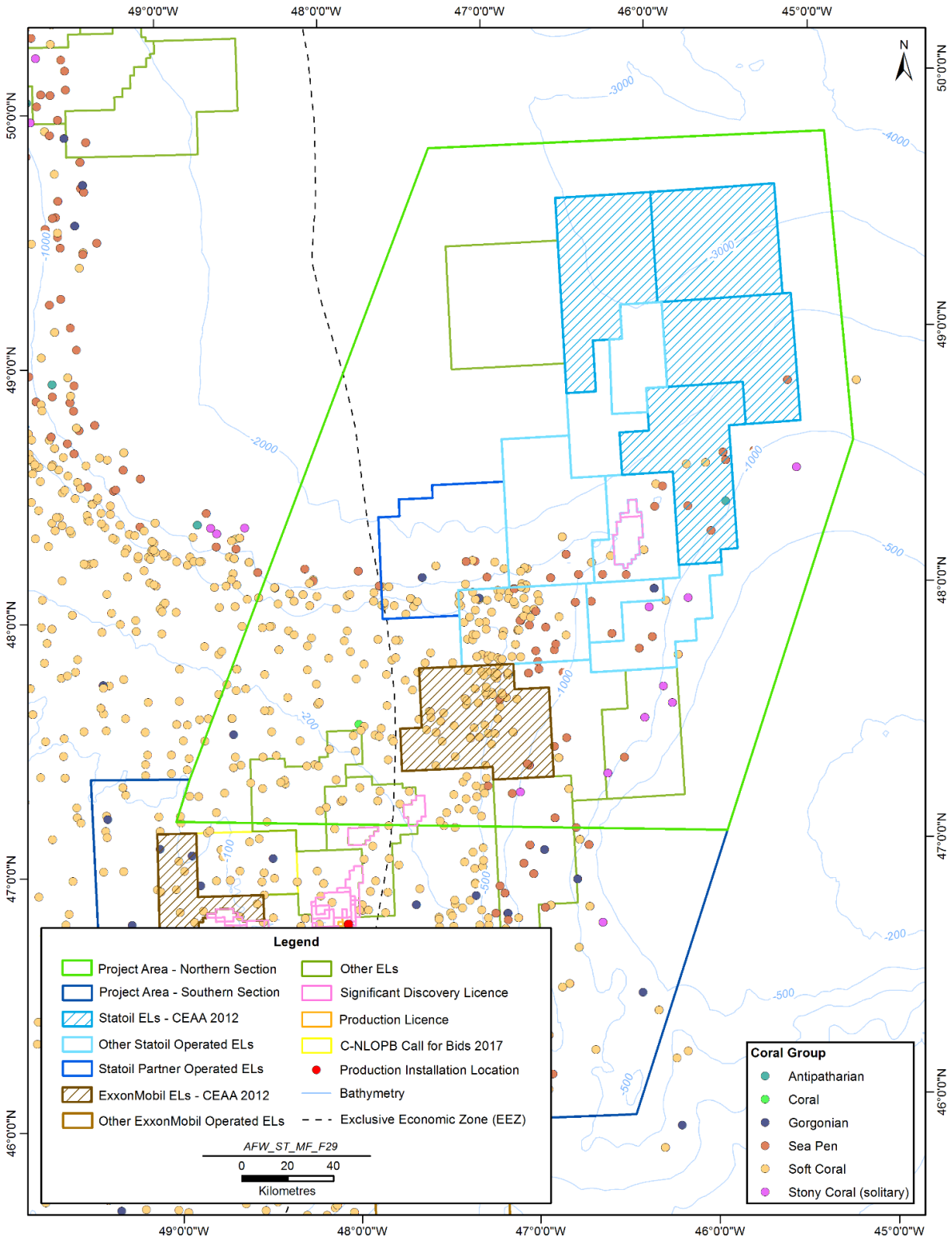


Figure 6-10 Summary of Coral Distributions in and Around the Project Area – Northern Section

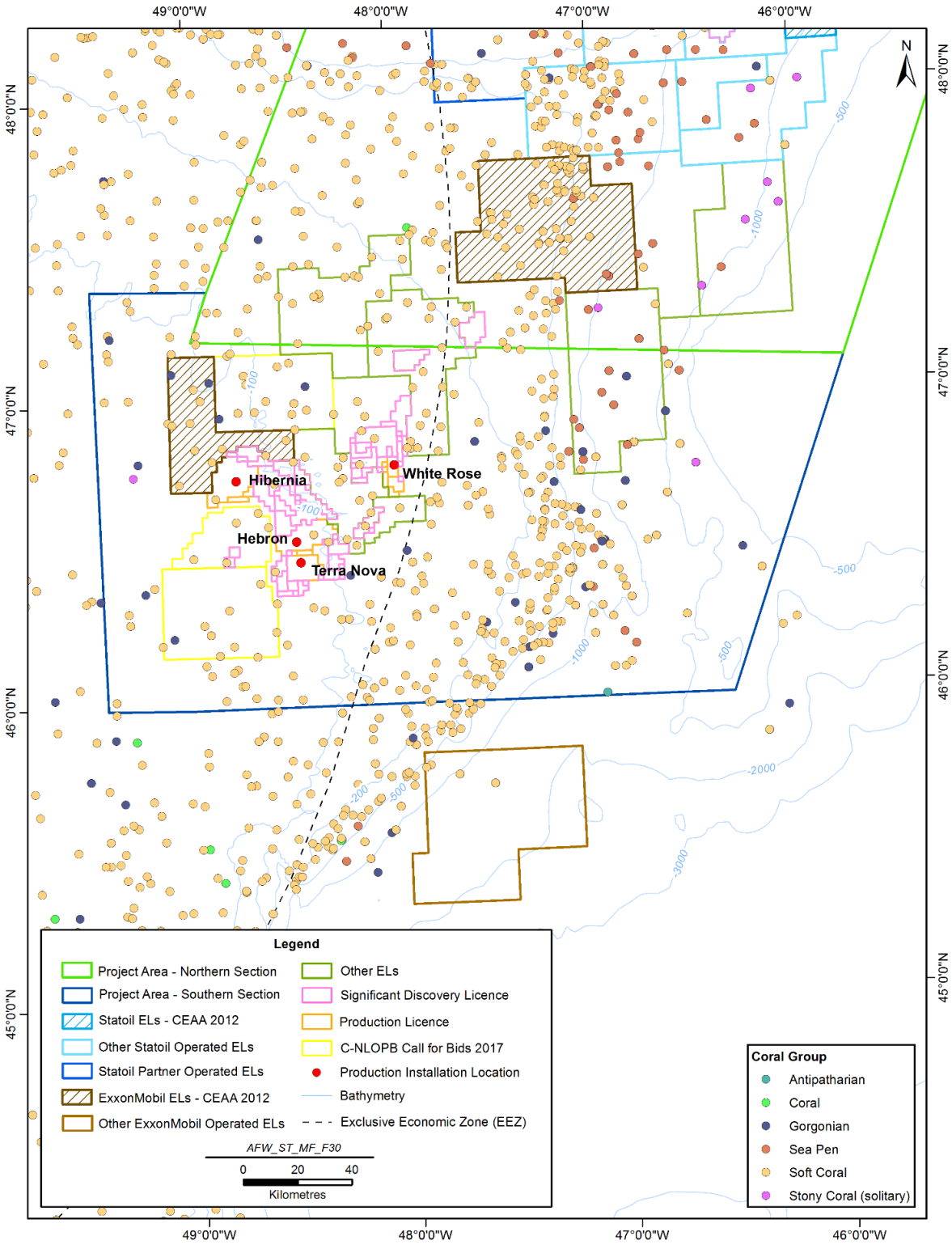


Figure 6-11 Summary of Coral Distributions in and Around the Project Area – Southern Section

As discussed in Section 2.5.2.1, the pre-drill coral survey proposed will cover a larger area than has been surveyed for historical drilling programs in the region (i.e. approximately 100 m radius from the well location). For EL1139, EL1140, EL 1141 and EL1142, based on the NOROG guideline (DNV 2013) approach that considers drill cuttings modelling results and biological effects threshold levels, the survey would extend approximately 500-1,000 m from the well location. For the shallower waters, the survey area could approach 1,000-2,000 m from the well location. The results of this larger survey will be used in planning the location of the well and mitigations, and will also augment regional data sets where coral survey data is limited.

At least 32 species of sponges (Table 6.9) have also been observed in and adjacent to the Project Area (Figures 6-12 to 6-14, Murillo et al. 2012; Beazley et al. 2013a; Knudby et al. 2013; Beazley and Kenchington 2015). Sponge samples captured by trawls may disintegrate before reaching the surface for identification (Knudby et al. 2013) due to their fragile nature and the damaging effects of trawls. As a result, many samples are not identified to species in DFO and NAFO trawl surveys and there is a potential that sponge species richness is somewhat different than reported.

Table 6.9 Sponge Species Occurring within the Project Area and Adjacent Environments

Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	Reference
Hexactinellida	*Aphrocallistes Beatrix*	404	●		5
	Asconema foliata	138-1,374	●	●	4; 5
	Asconema sp.	-	●		2
	Dictyaulus romani	1,079-1,332	●		5
	Euplectellidae indet.	-	●		4
Demospongiae	*Demospongiae* indet.	144-163	●	●	4; 5
	Desmacellida indet.	170-1,249	●		5
	Haliclona (Gellius) sp.	170-380	●		5
	Paratimea sp.	1,079-1,094	●		5
	Phakellia	1,216	●		5
	Spongionella pulchella	494-538	●		5
	Tethya aurantium	138-341	●		5
Polymastiida	*Polymastia andrica*	306-1,295	●		5
	Polymastia corticata	1,079	●		5
	Polymastia thielei	527-528	●		5
	Polymastia uberrima	138-666	●		5
	Quasillina richardi	138-759	●		5
	Radiella hemisphaerica	141-494	●		5
Spirophorida	*Craniella* spp.	-	●	●	2
	Craniella cranium	138-1,374	●		4; 5
	Craniella polyura	159-478			5

Table 6.9 Sponge Species Occurring within the Project Area and Adjacent Environments

Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	Reference
Astrophorida	*Ancorinidae* indet.	-	●		4
	Stelletta normani	759-1,374	●		4; 5
	Stelletta tuberosa	1079-1332	●		5
	Stryphnus fortis	759-1,374	●		5
	Stryphnus ponderosus	-	●		4
	Geodia barretti	979-1,374	●	●	3; 4; 5
	Geodia macandrewii	874-1,374	●		4; 5
	Geodia phlegraei	874-1,374	●		3; 4; 5
	Thenea muricata	567-1,374	●		4; 5
Hadromerida	*Hemiasterellidae* indet.	-	●		4
	Weberella bursa	478-1,370	●		4; 5
	Weberella sp.	-	●		4
	Rhizaniella sp.	452-1,351	●	●	1; 4; 5
	Stylocordyla borealis	335-866		●	1; 5
Poecilosclerida	*Asbestopluma* sp.	-	●		2
	Artemisina arcigera	154-620	●		5
	Chondrocladia sp.	404	●		2; 5
	Iophon piceum	138-1,351	●		4; 5
	Esperiopsis villosa	141-1,290	●		5
	Forcepia sp.	629-1,351	●		4; 5
	Hymedesmiidae sp.	-	●		2
	Crella sp.	119-1,249	●		4; 5
	Mycale lingua	119-1,351	●		4; 5
	Mycale loveni	148-777	●		5
	Myxilla sp.	1,216-1,332	●		4; 5
Halichondrida	*Halichondrida* indet.	-	●		4
	Hymeniacidon sp.	59-1,351	●		4; 5
	Axinella sp.	257-538	●		4; 5
	Axinella sp.	1,079-1,242	●		5

Notes:
Sources: Based on 1. Beazley et al. 2013a; 2. Beazley and Kenchington 2015; 3. Knudby et al. 2013; 4. Murillo et al. 2012; 5. Murillo et al. 2016
Listed depth ranges are from Murillo et al. (2016) and Buhl-Mortensen et al. (2015).

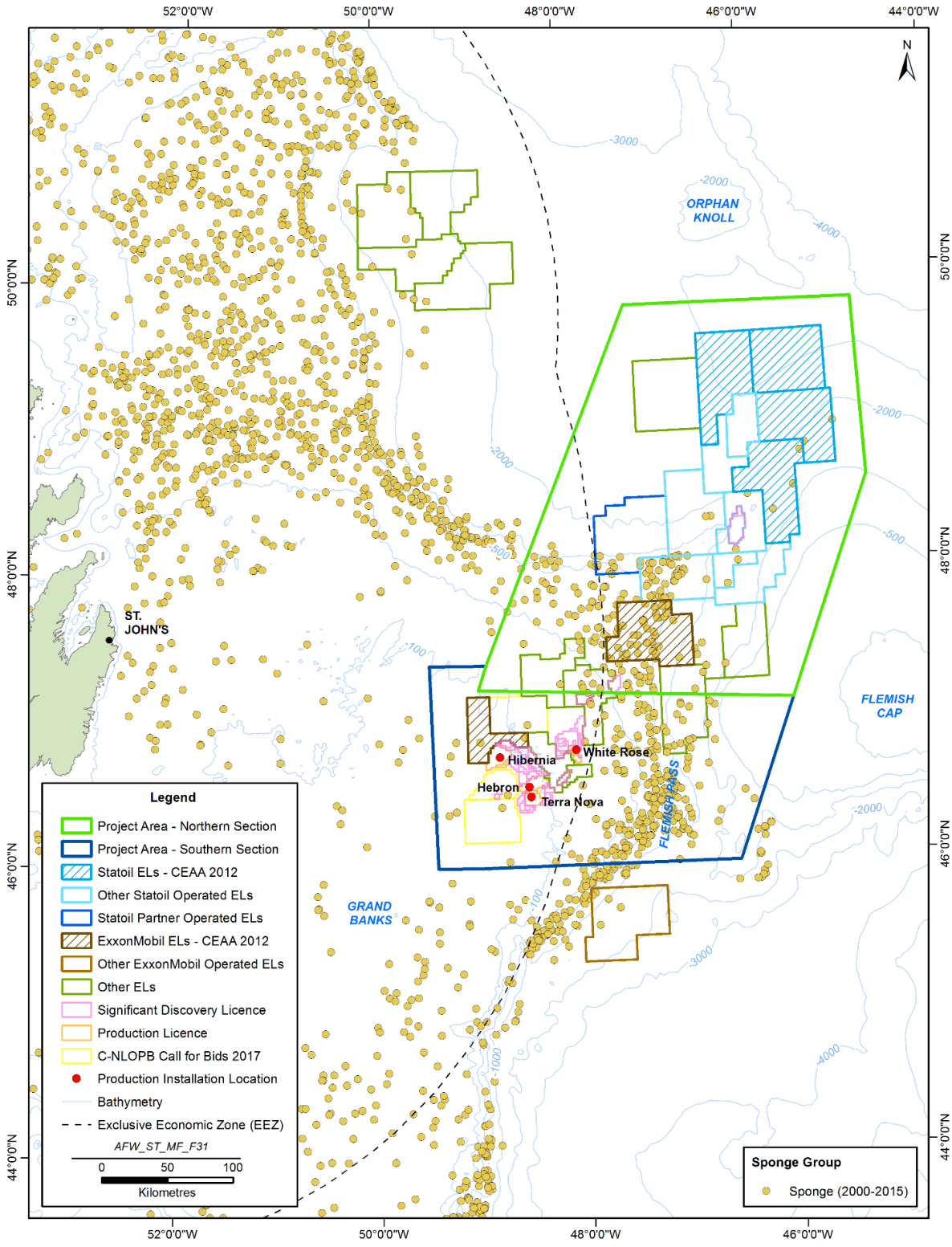


Figure 6-12 Summary of Regional Sponge Distributions Compiled from Canadian RV Data and Literature Sources

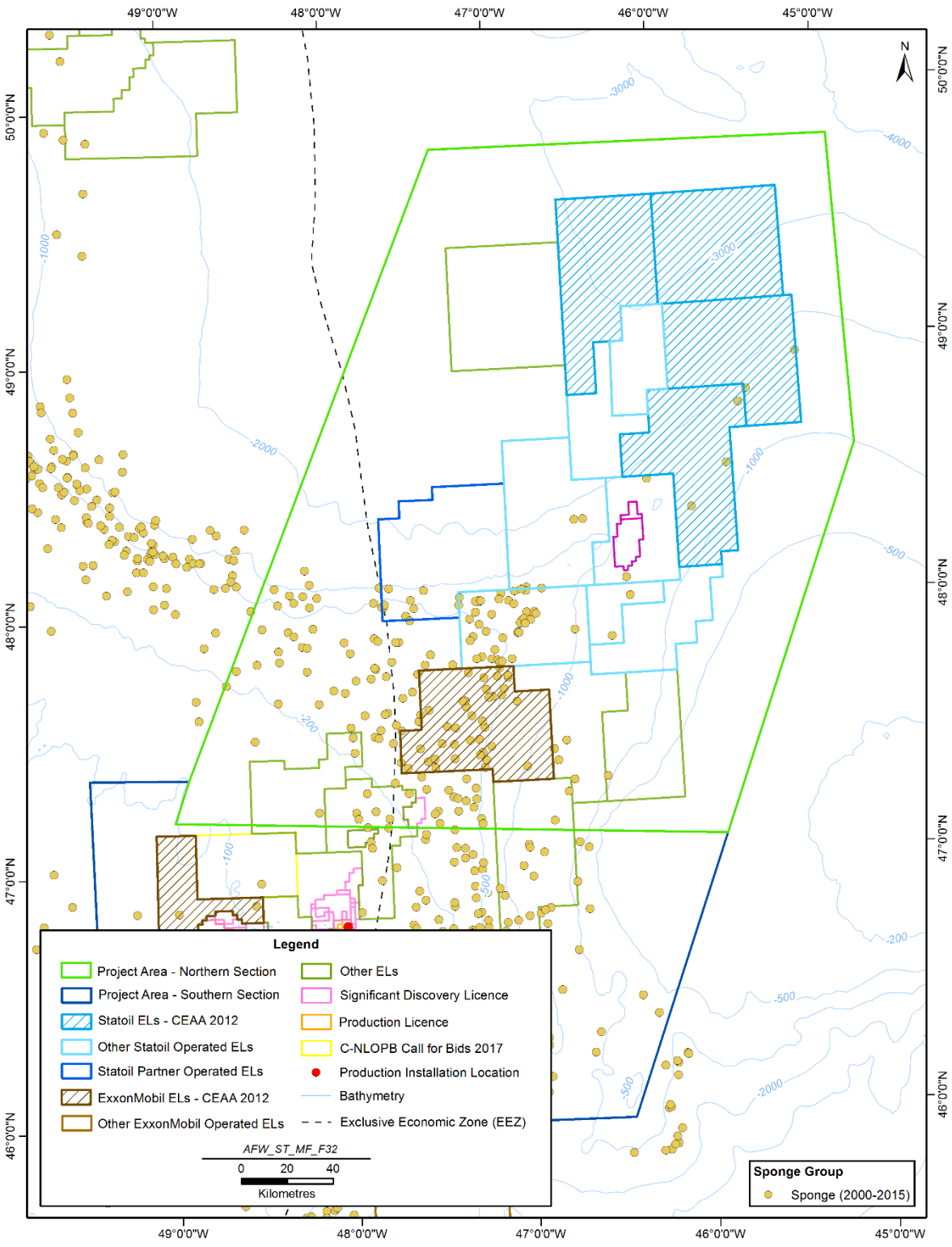


Figure 6-13 Summary of Sponge Distributions in and Around the Project Area – Northern Section

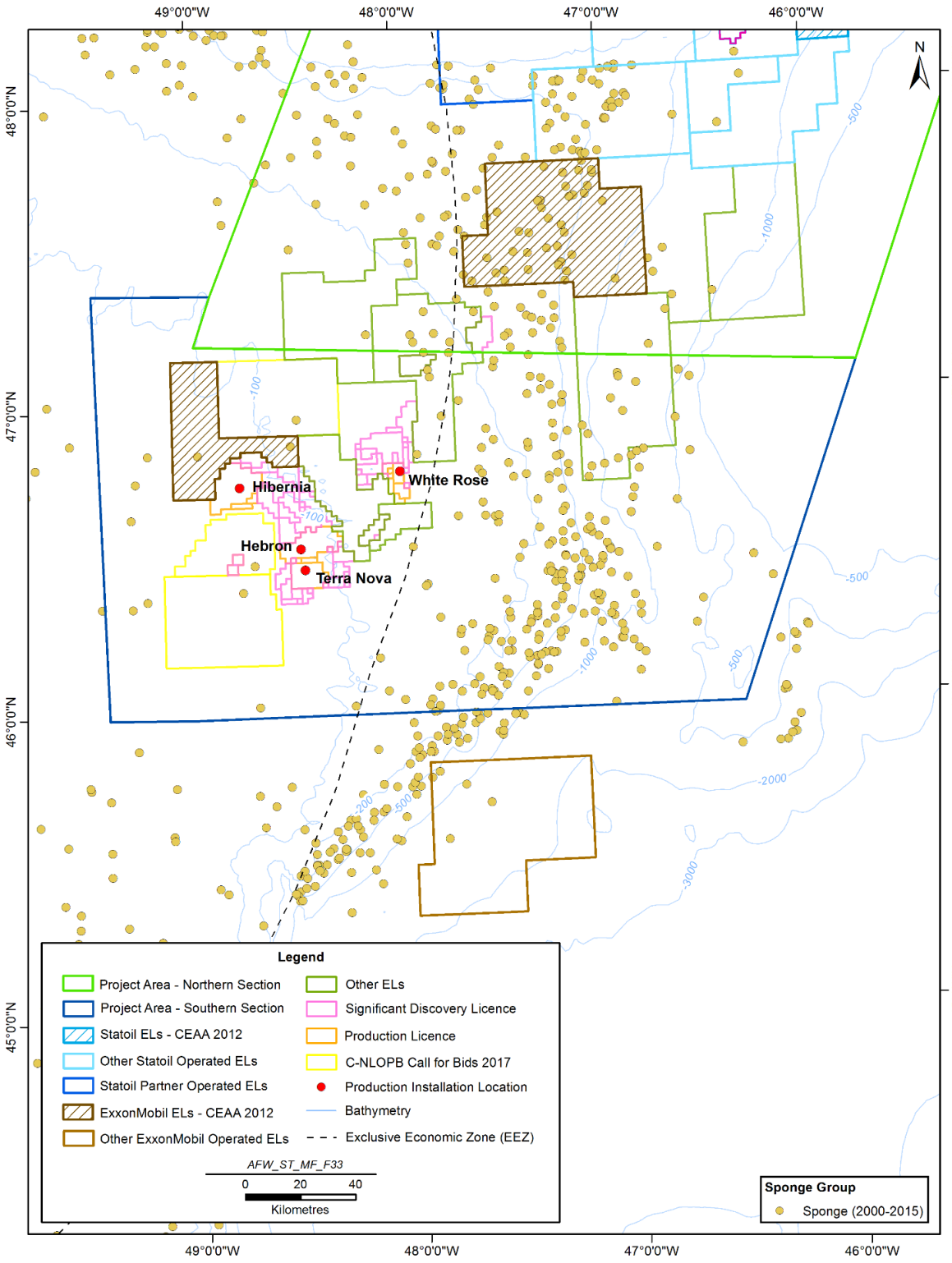


Figure 6-14 Summary of Sponge Distributions in and Around the Project Area – Southern Section

Of the identified species, many have wide depth ranges of 100-1,500 m indicating they can occupy slope and shelf areas in the region. Sponge surveys by Murillo et al. (2012) indicate that the highest sponge biomass was located on the slopes of the Grand Banks in the vicinity of EL1135, the slopes of the Flemish Cap, followed by the Flemish Pass. Sponge biomass in the Project Area – Southern Section was highest on the northeast slope of the Grand Banks between 800-1,450 m depths and on the southeastern slope of the Flemish Cap at 950-1,400 m depths (Murillo et al. 2012). In the Project Area – Northern Section, areas of high sponge presence were also observed on the north slope of the Flemish Cap and in the Sackville Spur area, in relatively deep waters (1,000-1,500 m) (Murillo et al. 2012) within and in the surrounding area of EL1141 and EL1142. The habitat forming sponges in the Flemish Pass at 400-1,400 m depth are also associated with the relatively high abundance and species diversity of invertebrate taxa. Within the Orphan Basin, sponges were mainly observed at 300-700 m depths and were not considered characteristic species of deeper areas of the survey (700-3,000 m).

Although individual sponge species presence has not been well reported, distribution maps indicate that highest presence is on the northeast Newfoundland and Labrador Shelf (Guijarro et al. 2016). Along the Grand Banks shelf itself sponges are not well distributed, but concentrated areas of sponges are present on the northeastern slope of the Grand Banks (Knudby et al. 2013; Guijarro et al. 2016). Deep waters (greater than 500-2,000 m) and food availability are considered the main environmental parameters for predicting sponge abundance and biomass based on predictive distributional modelling for the Grand Banks (Knudby et al. 2013; Guijarro et al. 2016). For example, the large sponge grounds on the Sackville Spur Spur Fisheries Closure Area (FCA) and VME (see Sections 6.4.4.1 and 6.4.4.2), that lies across EL1141 and EL1142 areas, coincides with maximum bottom currents (Beazley and Kenchington 2015; Murillo et al. 2016) that may transport food to the sessile, suspension-feeding sponges. Sedimentation is also a known driver of sponge distribution, with higher sponge species richness and abundance observed in higher settled sediment areas compared to lower settled sediment areas in temperate waters (Bell et al. 2015).

Table 6.10 provides an overview summary of the known and potential occurrence of corals and sponges in the various ELs that form part of this Project.

Table 6.10 Summary of Known and Potential Coral / Sponge Occurrence in the ELs that Comprise the Project

Exploration Licence	Known Presence and Distribution Based on Existing Information	Data Sources(s)	Summary of Known or Potentilal Presence and Distribution
EL 1135 (200-1,100 m)	*Sponges* • Demosponges • *Geodia* sp. *Corals* • soft corals • sea pens	• Canadian RV Data • Knudy et al (2013) • Guijarro et al (2016) • Wareham (2009)	• Distribution modelling indicates depth as main predictor for coral presence. • Depth and minimum bottom salinity key predictors for *Geodia* sp. presence. • Sponge and coral species distributed at species specific depths along the slope areas.

Table 6.10 Summary of Known and Potential Coral / Sponge Occurrence in the ELs that Comprise the Project

Exploration Licence	Known Presence and Distribution Based on Existing Information	Data Sources(s)	Summary of Known or Potentilal Presence and Distribution
EL 1137 (<200 m)	*Corals* • soft corals • gorgonian corals	• Canadian RV Data • Guijarro et al (2016) • Wareham (2009)	• Distribution modelling indicates depth as main predictor for coral presence. • Sponge and coral species distributed at species specific depths along the slope areas.
EL 1139 (2,700-3,400 m)	*Sponges* • unidentified species	• Carter et al (1979) • d'Entremont et al (2008)	• Regional datasets indicate presence of sponges (unidentified species) on rocks and small boulders.
EL 1140 (2,500-3,400 m)	*Sponges* • unidentified species	• Carter et al (1979) • d'Entremont et al (2008)	• Regional datasets indicate presence of sponges (unidentified species) on rocks and small boulders.
EL 1141 (1,100-2,900 m)	*Sponges* • Demospngiae • Astrophorida • *Geodia* sp. *Corals* • Sea pens • Solitary stony corals	• Canadian RV Data • Murillo et al (2012) • Knudy et al (2013) • Beazley et al (2015) • Wareham (2009)	• Distribution modelling indicates depth as main predictor for coral presence. • Sponge and coral species distributed at species specific depths along the slope areas. • Depth and minimum bottom salinity key predictors for *Geodia* sp. presence. • Special Area: Sackville Spur VME and Sackville Spur (6) NAFO FCA – area of extensive sponge grounds associated with warm, salty water mass that occurs between ~1,300 and 1,800 m. • Special Area: Northern Flemish Cap VME and Northern Flemish Cap (8) NAFO FCA – area of higher sea pen concentrations.
EL 1142 (800-2,600 m)	*Sponges* • Geodia sp. *Corals* • Sea pens • Soft coral • Solitary stony corals • Black-wire corals	• Canadian RV Data • Knudy et al (2013) • Beazley et al (2015) • Wareham (2009)	• Distribution modelling indicates depth as main predictor for coral presence. • Sponge and coral species distributed at species specific depths along the slope areas. • Depth and minimum bottom salinity key predictors for Geodia sp. presence. • Special Area: Sackville Spur VME and Sackville Spur (6) NAFO FCA – area of extensive sponge grounds associated with warm, salty water

Table 6.10 Summary of Known and Potential Coral / Sponge Occurrence in the ELs that Comprise the Project

Exploration Licence	Known Presence and Distribution Based on Existing Information	Data Sources(s)	Summary of Known or Potentilal Presence and Distribution
			mass that occurs between ~1,300 and 1,800 m. • Special Area: Northern Flemish Cap VME, Northwest Flemish Cap (12) and Northern Flemish Cap (9) NAFO FCAs – area of higher sea pen concentrations.

6.1.6.6 Video Surveys of Previous Statoil Exploration Wellsites in the Project Area

As part of its recent exploration drilling programs in the Eastern Newfoundland Offshore Area, Statoil has completed seabottom video surveys at a number of these wellsites, six of which have been carried out within the Project Area – Northern Section (Table 6.11, Figure 6-15). These surveys were completed in accordance with methods and requirements to identify coral colonies, defined to be either *Lopheliapertusa* reef complex or five or more corals larger than 30 cm in height or width, within 100 m of the well location. No coral colonies as defined above were identified in the video surveys.

Table 6.11 Previous Statoil Exploration Wells in the Project Area Where Seabottom Video Surveys Were Conducted and Analyzed

Well Name	Latitude	Longitude	Date Surveyed	Depth (m)
Baccalieu F-89	47° 58’ 24.6493” N	46° 12’ 52.2932” W	February 22, 2016	1,150
Bay de Loup M-62	47° 51' 48.6828" N	46° 25' 19.5067" W	February 23, 2016	1,170
Bay d’Espoir B-09	47° 58' 09.8601" N	46° 30' 19.8867" W	February 23, 2016	1,160
Cupids A-33	49° 02' 08.2606" N	46° 04' 43.9385" W	May 9, 2015 and November 21, 2015	2,845
Bay de Nord L-76	47° 55' 43.9403" N	46° 26' 42.6303" W	May 1, 2015 and September 9, 2015	1,170
Fitzroya A-12	48° 01' 00.1739" N	46° 46’ 43.1924” W	May 19, 2016	1,145

In order to provide some additional benthic information for representative habitats within the Project Area, sea bottom video footage for two of the wellsites - Baccalieu F-89 and Cupids A-33 – were, further analyzed to provide additional information.

A video transect from the Baccalieu F-89 seabed survey, located in the Flemish Pass area (Figure 6-15) was analyzed for macrofauna, macroflora and substrate. The transect was analyzed in 10 second intervals.

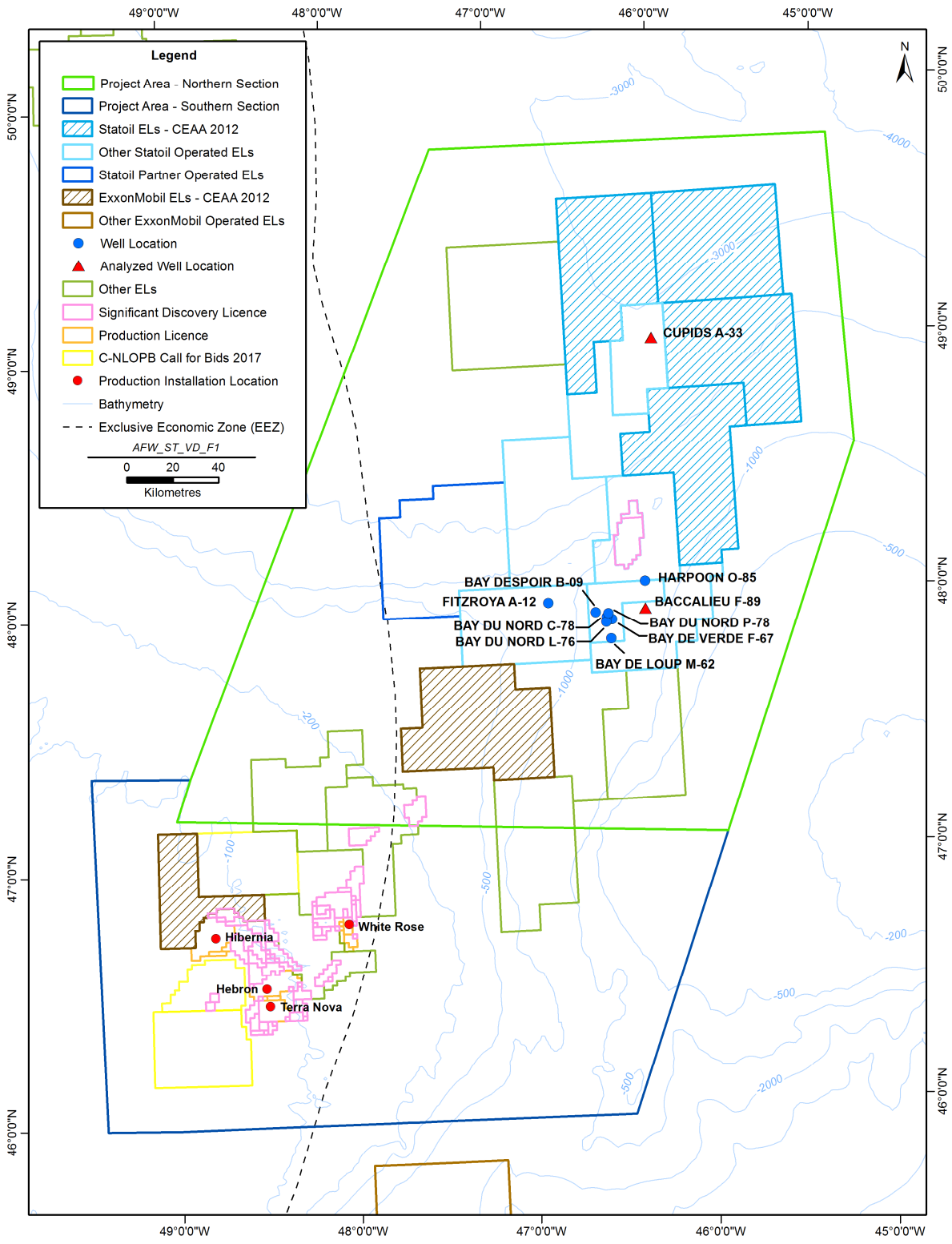


Figure 6-15 Recent Well Site Locations with Video Footage in the Project Area

Four 100 m survey transects were conducted along the four cardinal directions from the Cupids A-33 wellsite. The transects were analyzed for macrofauna and substrate in 5 m intervals based on transect distance and length (minutes) of survey.

In both cases, substrate was expressed as a percentage of coverage for each transect section. The particle size classes were based on the Wentworth-Udden particle scale (Kelly et al. 2009; Wentworth 1922). Species were identified to the lowest possible taxonomic level using available field guides (i.e., Scott and Scott 1988; Daigle et al. 2006; Christian et al. 2010; Beazley and Kenchington 2015). Identification was dependent on quality of video and prominence of identifying characteristics. Flora was expressed by a percentage of coverage for each section. Sedentary and mobile fauna were enumerated where possible and categorized under a semi-quantitative abundance scale (Simkanin et al. 2005; Kelly et al. 2009).

Substrate at the Baccalieu F-89 well site was visible at 95 sections of the survey video (92 percent of sections) and was comprised entirely of mud. Substrate along each of the transects at the Cupids A-33 wellsite was comprised mainly of mud substrate (96.5 percent average coverage) and lesser quantities (less than 5 percent average coverage) of medium (cobble and gravel) and coarse (rubble) substrates.

Seven macroinvertebrates and seven fish were observed along the Baccalieu F-89 well site transect (Table 6.12) with sea pens, an unidentified fish species and an echinoderm species as the most commonly observed organisms. One fish species and five invertebrate species were observed during the Cupids A-33 wellsite survey (Table 6.12). Grenadier, sponge species, echinoderm species and jellyfish were the most commonly observed species around this well site. Some observed organisms could not be identified to species.

Table 6.12 Dominant Species observed near two well sites in Northern Section of the Project Area

Site	Survey	Common Name	Scientific Name	% of Sections Present	Contribution to Survey
Baccalieu Well Site 1,150 m	ROV Video Survey	Sea pen	*Anthoptilum* sp.	73%	30%
		Unidentified Fish 1	Osteichthyes (C)	43%	18%
		Sea pen	*Halipteris* sp.	39%	16%
		Echinoderm Species	Echinodermata (P)	28%	12%
		Jellyfish Species 1	Cnidaria (P)	14%	6%
		Shrimp/Euphausiid	Crustacea (P)	13%	5%
		Unidentified Fish 3	Osteichthyes (C)	7%	3%
		Grenadier	Macouridae (F)	6%	2%
		Hake	Gadiformes (O)	5%	2%
		Lanternfish	Myctophidae (F)	4%	2%
		Blood star	*Henricia* sp.	3%	1%
		Jellyfish Species 2	Cnidaria (P)	2%	1%

Table 6.12 Dominant Species observed near two well sites in Northern Section of the Project Area

Site	Survey	Common Name	Scientific Name	% of Sections Present	Contribution to Survey
		Unidentified Fish 2	Osteichthyes (C)	3%	1%
		Unidentified Fish 4	Osteichthyes (C)	2%	1%
Cupids A-33 Well Site 2840-2850 m	ROV Video Survey	Grenadier	Macouridae (F)	6%	24%
		Sponge Species	Porifera (P)	5%	19%
		Echinoderm Species	Echinodermata (P).	5%	19%
		Jellyfish Species 1	Cnidaria (P)	5%	19%
		Sea pen	*Anthoptilum* sp.	4%	14%
		Shrimp/Euphausiid	Crustacea (P)	1%	5%
Taxonomic group: Phylum (P), Class (C), Order (O), Family (F), Genus (G) Percent of Sections Present is based on 103 surveyed sections for Baccalieu Well Site and 82 surveyed sections for Cupids A-33 Well Site					

Very little habitat complexity was observed along all transects. No macroflora (e.g., kelps or algae) were observed along the transects, as expected for a survey conducted at these water depths.

6.1.6.7 Key Reproduction Times and Areas for Benthic Invertebrates

Marine invertebrate reproduction varies greatly across and within taxonomic groups and is reflective of how environmental parameters affect reproduction cycles and larval dispersal. Although many species exhibit seasonal spawning linked to elevated food levels in the water column, aseasonal spawning has also been reported. Of species that show annual seasonal reproductive cycles, spawning coincides with both or either the phytoplankton bloom and detrital deposition periods from April to June and September to November respectively. Reproductive cycles may also be triggered by environmental cues including changing photoperiods (or, the period of time each day during which an organism receives illumination), temperatures (Sun et al. 2010), lunar cycles (Mercier and Hamel 2010; 2014), or inter and intra-species biochemical cues (Hamel and Mercier 1999; Soong et al. 2005). Invertebrate reproduction is further complicated by spawning cycle differences that can occur within species across spatial and depth scales (Kelly 2000; Mercier and Hamel 2010; Baillon et al. 2011) and makes identifying spawning times difficult across all species. Deep-sea invertebrate reproduction is also challenging to research due to limitations in sample collection (Baillon et al. 2011) that may affect assessments of maturity, fecundity, sex ratios, spawning cycles and spawning strategies. However, recent studies have evaluated the life history strategies of echinoderms, corals and sponges collected within and adjacent to the Project Area.

Studies of the reproductive cycles of the deep-sea blood star *Henricia lisa* by Mercier and Hamel (2008), for example, showed marked differences between specimens collected at 600 m and 1,300 m depths on the Flemish Cap. Blood stars collected from 600 m had a male biased sex ratio (3:1) and a biannual cycle associated with changing water temperatures in January and June. Equal sex

ratios were observed at blood stars collected from 1,300 m and an aseasonal reproductive cycle was observed. Differences in breeding cycles are suggested to be linked to more stable temperatures at 1,300 m supporting a more continuous spawning cycle (Mercier and Hamel 2008). This species was observed to exhibit both brooding and broadcast spawning that may support concentrations of individuals within the area in addition to dispersal to new areas. Studies of the seastar *Phormosoma placenta* also sampled from the Flemish Cap showed a synchronized spawning in November within a trawl sample, but trends were not apparent when considering all trawl sets, further supporting localized differences in spawning times (Baillon et al. 2011).

Several coral species from the Grand Bank and Flemish Cap have been studied with regards to their reproductive cycles. The soft coral *Drifa glomerata* exhibited larval production year-round in the laboratory; however, a seasonal larval release or planulation occurred in December to January, associated with increasing photoperiod and maximum temperatures at 150 m (Sun et al. 2010). A second planulation occurred in April to June, associated with the spring phytoplankton bloom (Sun et al. 2010). The soft coral *Gersemia fruticosa and* sea pen *Anthoptilum grandiflorum* have also shown a seasonal reproductive cycle with spawning in April to June, associated with the spring phytoplankton bloom (Sun et al. 2011; Baillon et al. 2014b). Mercier and Hamel (2011) studied the reproductive cycles of three species of gorgonian corals that have been observed between 500-1,400 m within the Project Area. The large gorgonian coral *Primnoa resdaeformis*, is a broadcast spawner which showed variations in its reproductive cycle across months, depths and locations. Differences in oocyte size across depths were suggested to be linked to higher availability of food at shallower depths. No seasonal spawning was observed in this species and its reproductive cycle may span more than a single year (Mercier and Hamel 2011). The corals *Keratoisis ornata* (broadcast spawner) and *Anthomastus grandifloras* (brooder) have a seasonal spawning or larval release from July to September and October to November respectively. These cycles are associated with seasonal warm seawater temperatures and high rates of detritus deposition in the fall. Mercier and Hamel (2010b) suggest that the temporal differences between these two species may be due to the lag in detritus deposition at greater depths.

Reproductive cycles of the sponge *Geodia barretti* collected from 80-200 m are also linked to available food levels. Spetland et al. (2007) observed only sexual reproduction of this species in the northeast Atlantic, with spawning coinciding with spring and autumn phytoplankton blooms. The secondary spawning, however, was only associated with one of the study areas, highlighting spatial differences in reproductive cycles within the same species.

Due to the low mobility of many benthic invertebrates and proximity among individuals required for spawning, areas for invertebrate spawning and larval settling are generally areas of high densities of invertebrates, corals and sponges. As discussed, live and deceased corals and sponges add habitat complexity to areas that act as settling substrate and nurseries for a variety of invertebrate and fish species. Within the Project Area, areas of high invertebrate densities have been identified through current and proposed VME and EBSAs along the northeast shelf and slope of the Grand Bank, the Flemish Cap, Flemish Pass and Sackville Spur (See Section 6.4 - Special Areas for further details).

6.1.7 Finfish (Demersal and Pelagic Species)

Finfish represent an abundant and ecologically and morphologically diverse group that is represented at all locations and depths of the Project Area and plays a variety of trophic roles. They range from small planktivorous fish such as capelin to large predatory sharks. Most species also change ecological roles throughout their lives, often starting as a component within the plankton community during larval phases and changing diet and habitat as they grow to maturity. Many of these species are also important ecologically, commercially and/or culturally.

This section describes key marine fish species in the Project Area and identifies species groups by depth zones / habitats, both within Canadian waters and beyond. Standardized scientific surveys available in both the Canadian and NAFO jurisdictions (Nogueira et al. 2017) provide the basis for examining demersal fish communities to depths up to approximately 1,460 m. Beyond these depths, understanding of fish communities is based predominantly on the representative findings of a deepwater longline research survey (to depths of 3,100 m within and outside Project Area) reported in Murua and Cardenas (2005).

6.1.7.1 Grand Bank Shelf and Slope (Project Area – Northern and Southern Sections)

Canadian RV survey data within the Project Area (Table 6.13) highlight dominant species at each depth zone. In the Project Area – Northern Section, capelin were the dominant species in shelf habitats, transitioning to redfish and lanternfish along the slope edge to middle slope, roundnose grenadier in the middle-deep slope and blue hake in the deep slope. In the Project Area – Southern Section sand lance were the dominant species in shelf habitats, transitioning to redfish on the shallow to middle slope, blue hake in the middle-deep slope and roundnose grenadier in the deep slope.

Table 6.13 Summary of Depth Categories used to Present Canadian RV Survey Data (2008-2012)

Project Area	Depth Zone	Area / Proportion of Survey	Mean Abundance/Tow	Number of Species to Make up 95% of Catch	Dominant Species (% of Total Catch)
Project Area – Northern Section (191 tows)	Shelf / Slope Edge (0-250 m)	8.8	569	6	Capelin (82.4%)
	Shallow Slope (250-600 m)	18.7	44	8	Deepwater redfish (52.4%)
	Middle Slope (601-1,000 m)	10.0	20	12	Lanternfish (46.6%)
	Middle-Deep Slope (1,001-1,300 m)	13.9	11	11	Roundnose grenadier (28.2%)

Table 6.13 Summary of Depth Categories used to Present Canadian RV Survey Data (2008-2012)

Project Area	Depth Zone	Area / Proportion of Survey	Mean Abundance/Tow	Number of Species to Make up 95% of Catch	Dominant Species (% of Total Catch)
	Deep Slope (1,301-1,450 m)	1.25	8	13	Blue hake (24.7%)
Project Area – Southern Section (276 tows)	Shelf / Slope Edge (0-250 m)	62.4	1,239	5	Sand lance (54.3%)
	Shallow Slope (250-600 m)	15.2	791	5	Deepwater redfish (88.0%)
	Middle Slope (601-1,000 m)	19.6	97	13	Deepwater redfish (38.6%)
	Middle-Deep Slope (1,001-1,300 m)	0.22	36	13	Blue hake (23.2%)
	Deep Slope (1,301-1,450 m)	2.56	28	17	Roundnose grenadier (29.8%)

Canadian RV surveys captured 99 fish species in the Project Area – Northern Section, with 13 species comprising 95 percent of individuals captured (Table 6.14). Of these, capelin, deepwater redfish, lanternfish and American plaice contribute over 85 percent of the catch. Key fish species for this area are reflective of the range of depths in the Project Area because they include shelf to deep-water species. In the Project Area – Southern Section eight species comprise 95 percent of individuals captured (Table 6.14) with sand lance, capelin, and deepwater redfish accounting for over 85 percent of the total catch. Key fish species in the Project Area – Southern Section are comprised of shelf species because it is comprised mainly of Grand Bank shelf areas. There are also higher abundances of shelf species (less than 600 m) in the Southern Section of the Project Area, as evidenced by lower number of species required to account for 95 percent of total catch in the area in comparison to the Project Area – Northern Section. The trend is reversed for deep-water habitats with fewer species required to account for 95 percent of total catch in deeper parts of the Project Area (600-1,450 m).

Table 6.14 Summary of Key Fish Species from all Canadian RV Survey Sets Collected within the Project Area 2008-2012 (Includes Shelf and Slope Species)

Project Area	Common Name	Scientific Name	Mean Abundance/Tow	Contribution to Total Catch
Project Area – Northern Section (191 tows)	Capelin	*Mallotus villosus*	863	46.3%
	Deepwater redfish	*Sebastes mentella*	544	29.2%
	Lanternfish	Myctophidae	144	7.7%
	American plaice	*Hippoglossoides platessoides*	59	3.2%
	Greenland halibut	*Reinhardtius hippoglossoides*	27	1.4%
	Blue hake	*Antimora rostrata*	23	1.2%
	Longnose eel	*Synaphobranchus kaupii*	22	1.2%
	Sand lance	*Ammodytes dubius*	20	1.1%
	Roughhead grenadier	*Macrourus berglax*	19	1.0%
	Common grenadier	*Nezumia bairdi*	18	1.0%
	Eelpout	*Lycodes* sp.	15	0.8%
	Vahl's eelpout	*Lycodes vahlii*	13	0.7%
	Sculpin	*Triglops* sp.	12	0.6%
Project Area – Southern Section (276 tows)	Sand lance	*Ammodytes dubius*	1,239	44.7%
	Capelin	*Mallotus villosus*	791	28.6%
	Deepwater redfish	*Sebastes mentella*	395	14.3%
	Sculpin	*Triglops* sp.	97	3.5%
	American plaice	*Hippoglossoides platessoides*	43	1.6%
	Lanternfish	Myctophidae	32	1.1%
	Hookear sculpin	*Artediellus* sp.	28	1.0%
	Yellowtail flounder	*Limanda ferruginea*	25	0.9%

Note:
Contribution to catch: Reported percentage of mean abundance per tow.

Capelin range from the shelf edge to inshore areas and is a key prey source for many other marine fish, bird and mammal species (Amec 2014a) (Figure 6-16). Along with lanternfish (Figure 6-17), densities of capelin are at regionally high levels in the Project Area. Sand lance, another key prey species, are primarily found in offshore areas with areas of high concentration on the eastern slope of the Grand Bank, mainly in the Project Area – Southern Section (Figure 6-18). While redfish is abundant relative to many species, they are not in high density in the region (Figure 6-19). Unlike capelin, redfish and lanternfish are primarily restricted to the shelf break. Redfish is an important commercial species but also a species of conservation concern (see Section 6.1.8), whereas lanternfish are an important food source in oceanic environments (Amec 2014a). American plaice are primarily restricted to shelf areas with relatively high concentrates in the south west corner of the Northern Section of the Project Area (Figure 6-20). In the Project Area – Southern Section, where

shelf species are numerically dominant, sculpin (*Triglops* sp., Figure 6-21) and hookear sculpin (Figure 6-22) and are also key species; yellowtail flounder are also present (Figure 6-23).

A comparison of depth zone summary catch statistics also helps in the identification of some key characteristics and illustrative trends (Tables 6.13 and 6.14). For example, the mean abundance of fish captured in Canadian RV trawls decreases greatly from the Shelf / Slope Edge Zone (less than 600 m) to the Deep Slope Zone (1,300-1,450 m). Across the same depth gradient, the number of species needed to comprise 95 percent of the catch more than doubles (Table 6.13). These trends collectively confirm that the plankton rich shallow waters are relatively more productive and are dominated by a smaller number of species.

For both sections of the Project Area, available data indicate that fish species assemblages change quickly between depth zones. Only the dominant species, including lanternfish, common grenadier (Figure 6-24) and Greenland halibut (Figure 6-25), are carried over from the shallowest depth zones to deeper habitats, although some species have distributions from shelf to shallow slope areas including deepwater redfish (Figure 6-19), Vahl's eelpout (Figure 6-26), and eelpouts (Figure 6-27). On the slope beyond the shallow slope (greater than 600 m), there is little assemblage composition change with depth as more species remain numerically dominant across several depth zones (such as redfish (Figure 6-19), blue hake (Figure 6-28), roughhead grenadier (Figure 6-29), and longnose eel (Figure 6-30); Table 6.14). Each of these species occurs in the Project Area and are principally confined to the continental slope habitats. Of these, Greenland halibut and the grenadiers are the principal commercial species. In Middle-Deep Slope (1,000-1,300 m) and Deep Slope habitats (1,300-1,450 m), species such as dragonfish, blacksmelts, ogrefish and viperfish occur but they play a more numerically subordinate role (less than three percent of catch) to other more widespread species such as the grenadiers, blue hake, longnose eel and Greenland halibut (Table 6.14). Numerically dominant fish species (95% of overall abundance) by depth zone recorded during Canadian RV surveys from 2008-2012 in the Project Area – Northern Section and Project Area – Southern Section are listed in Tables 6.15 and 6.16, respectively.

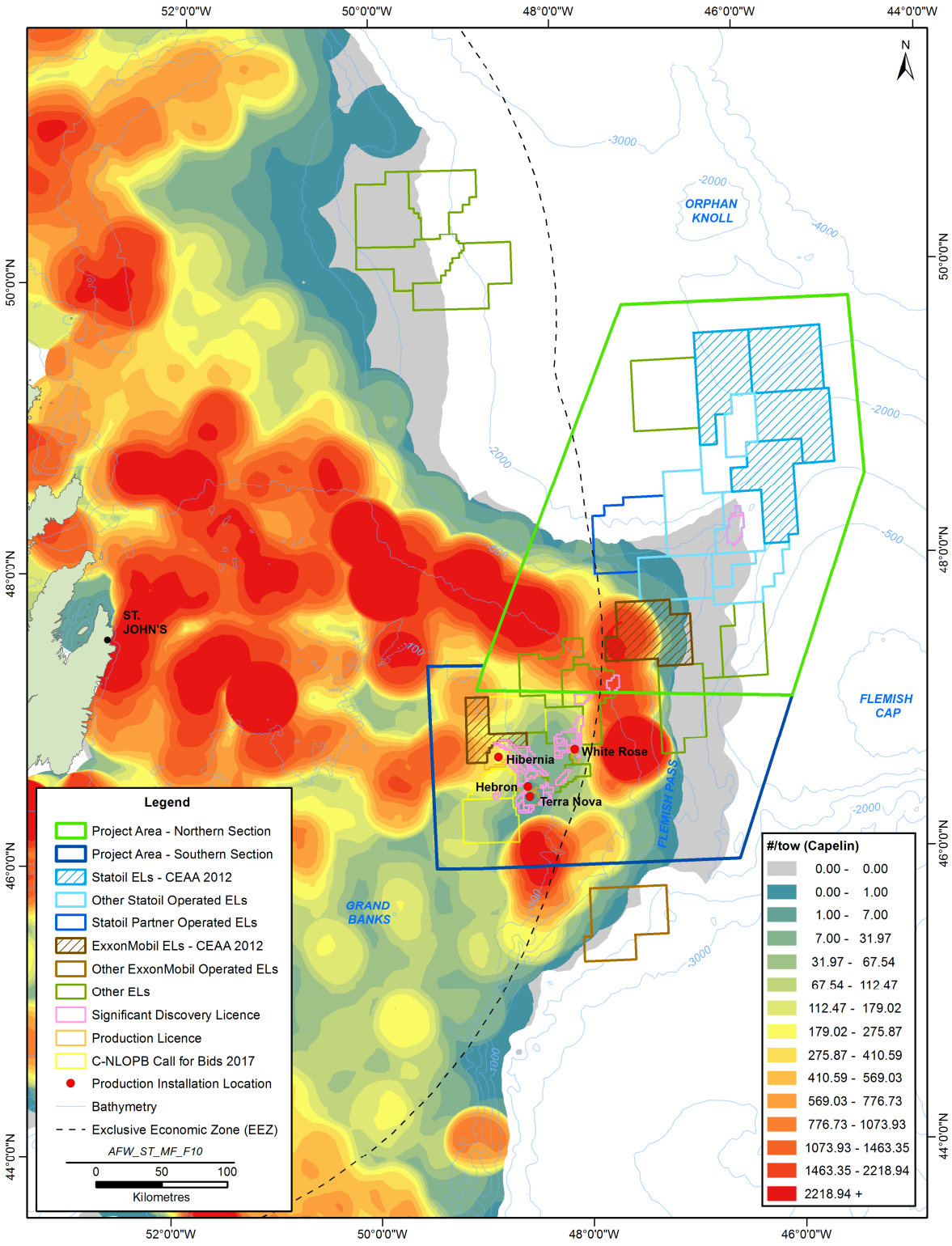


Figure 6-16 Capelin Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

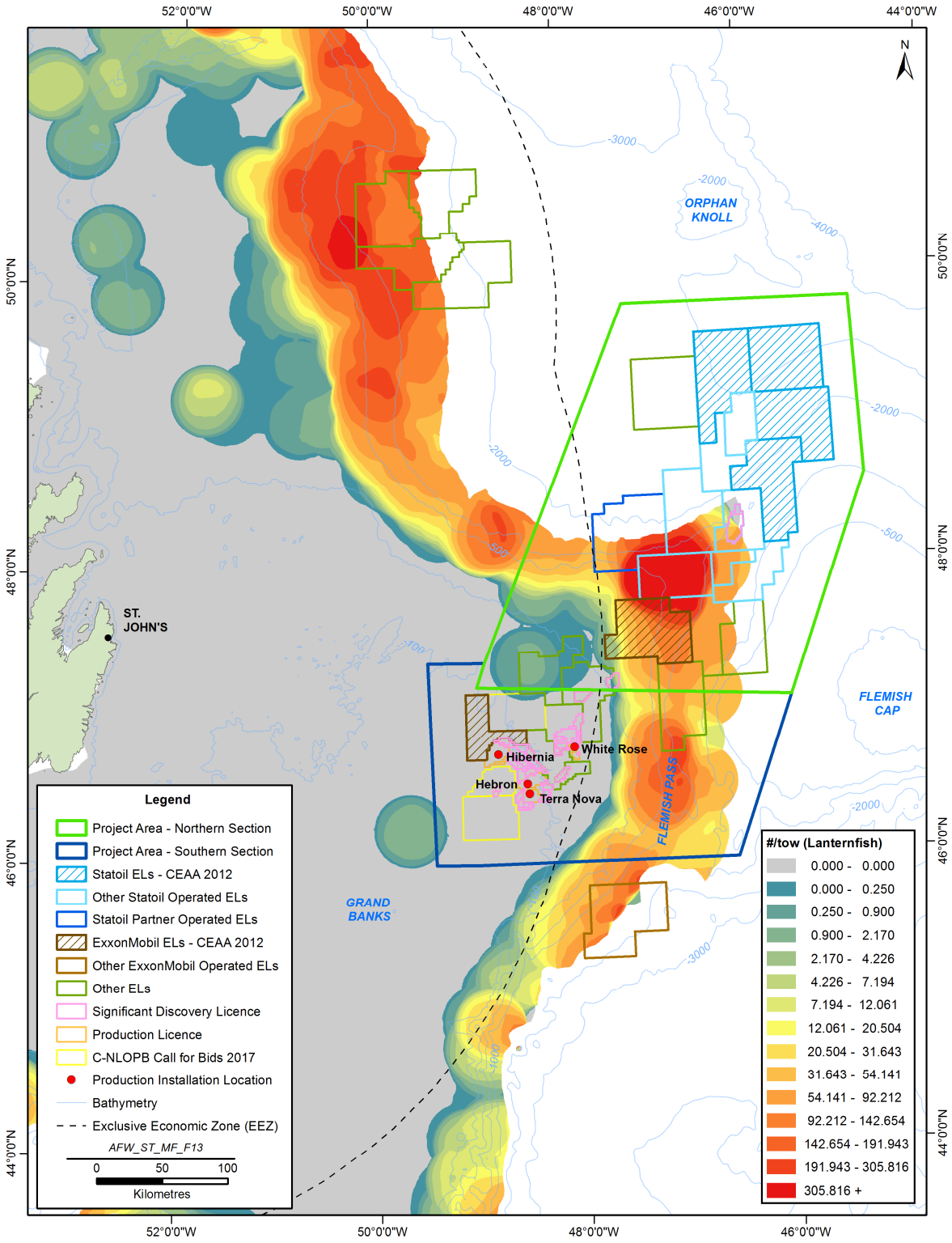


Figure 6-17 Lanternfish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

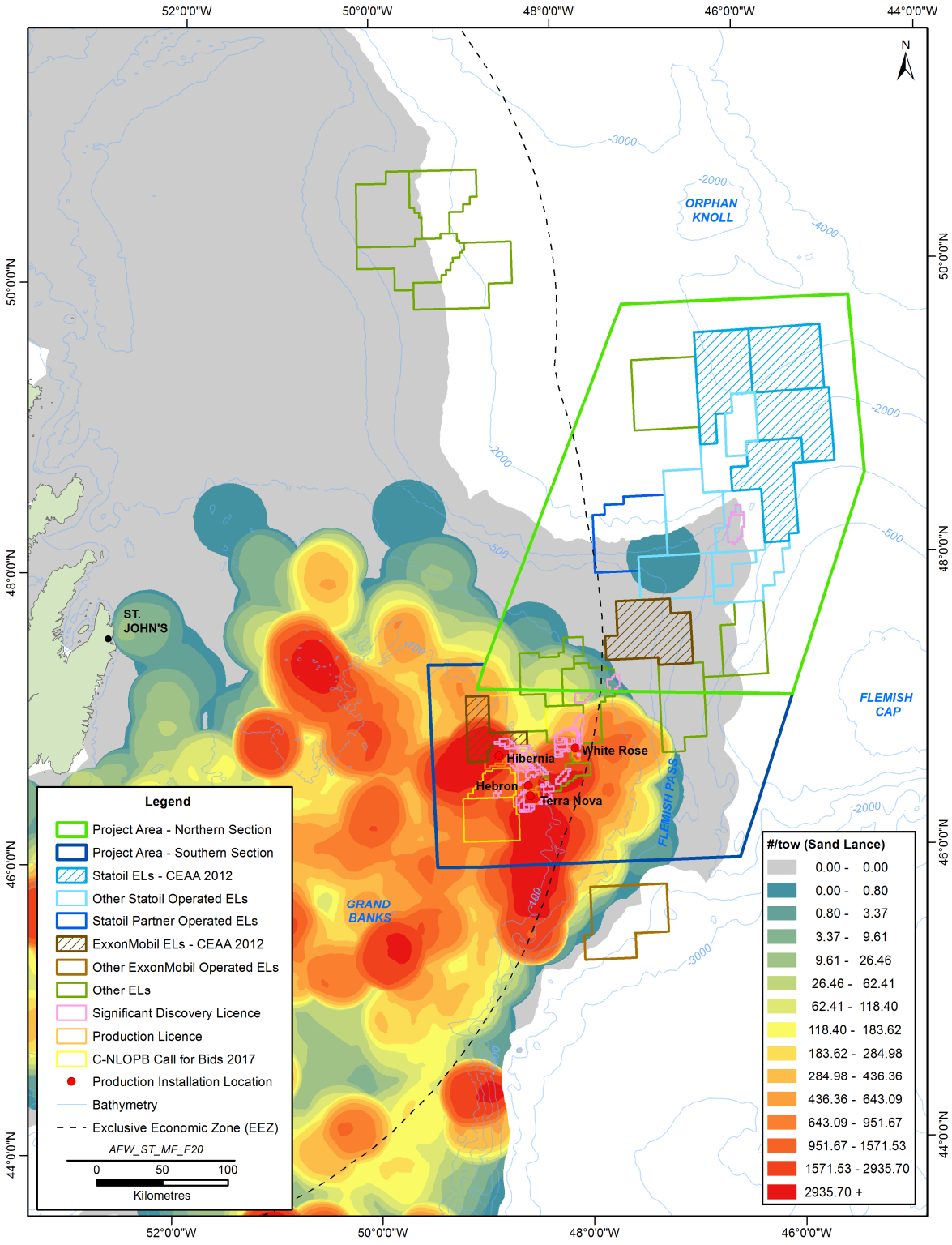


Figure 6-18 Sand Lance Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

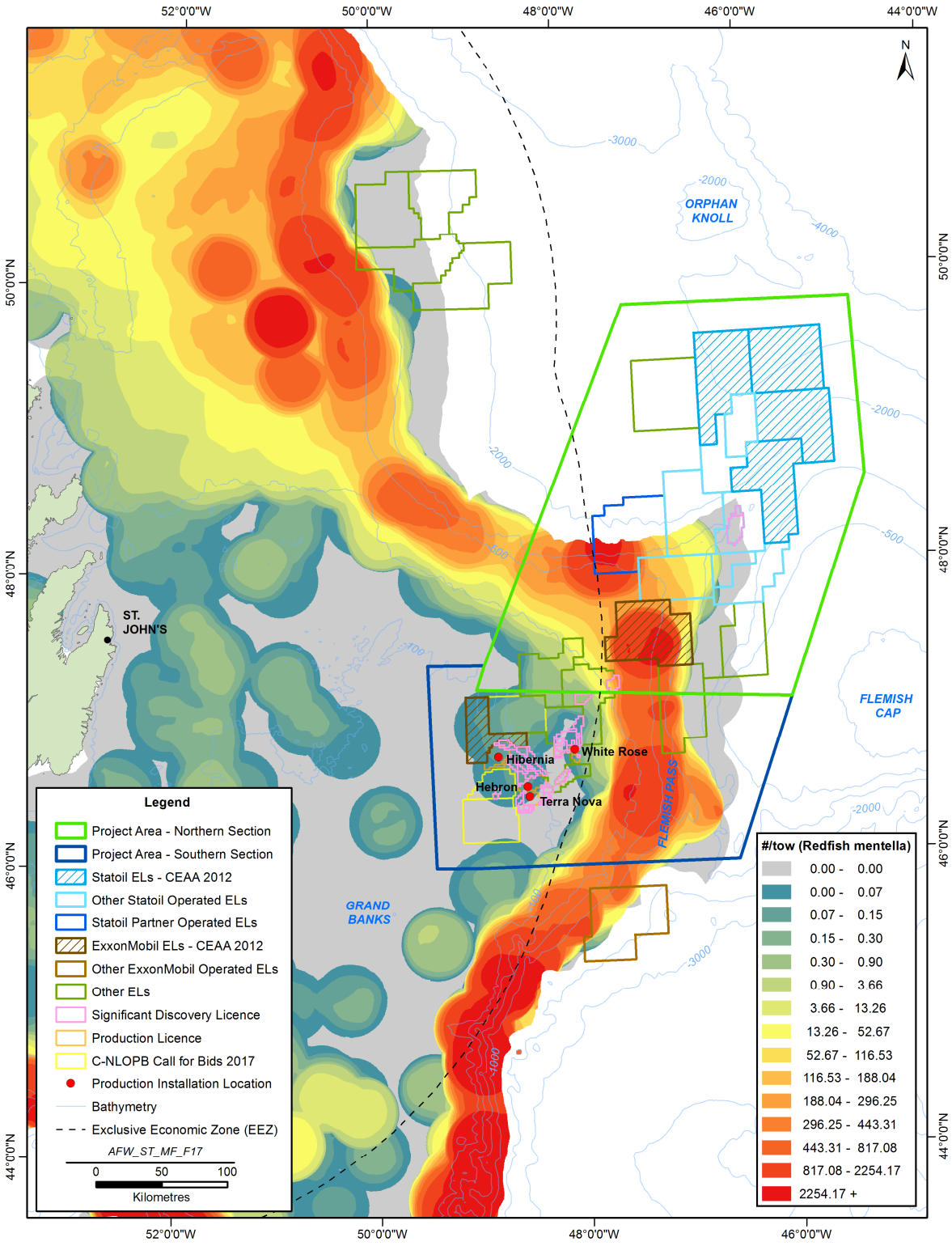


Figure 6-19 Deepwater Redfish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

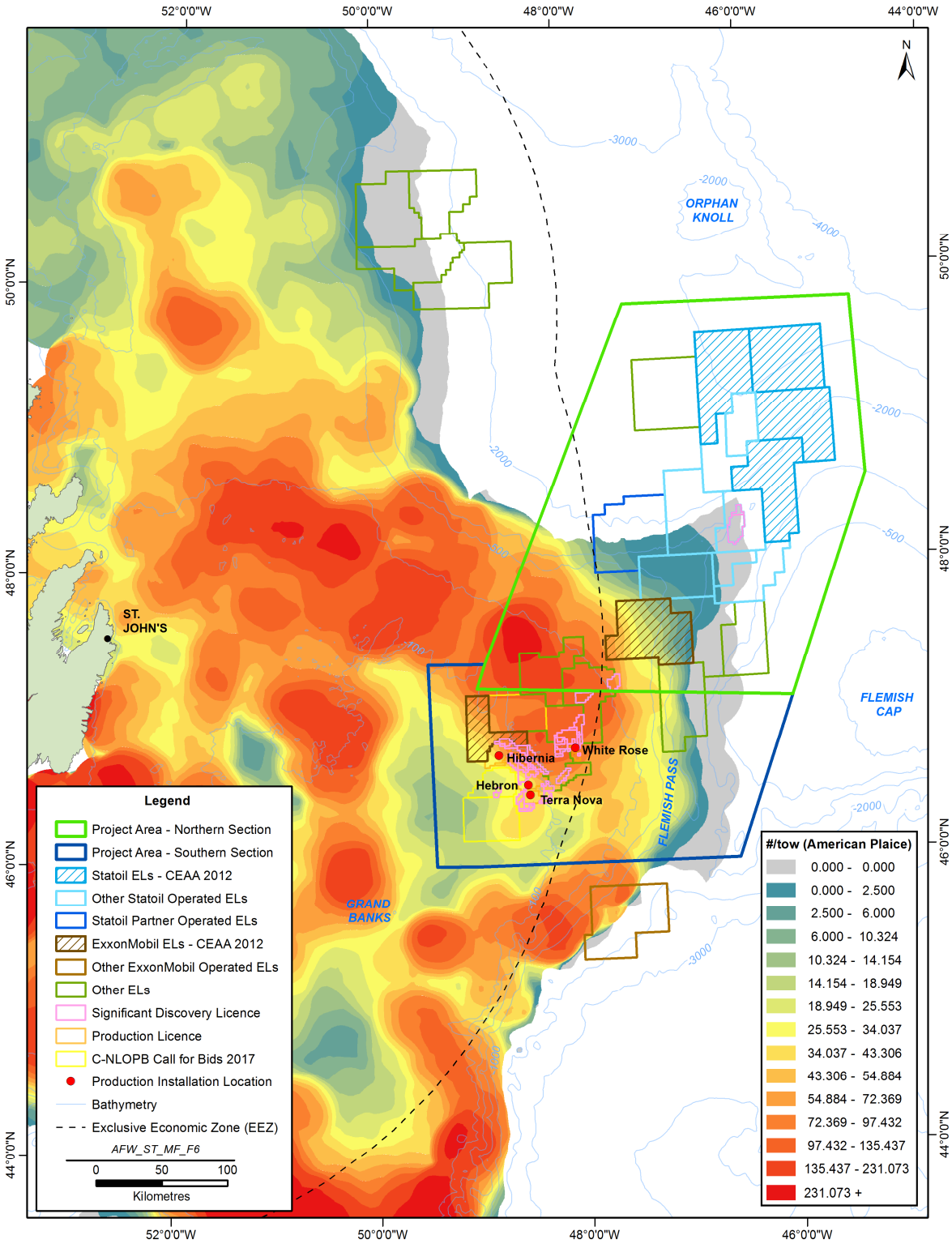


Figure 6-20 American Plaice Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

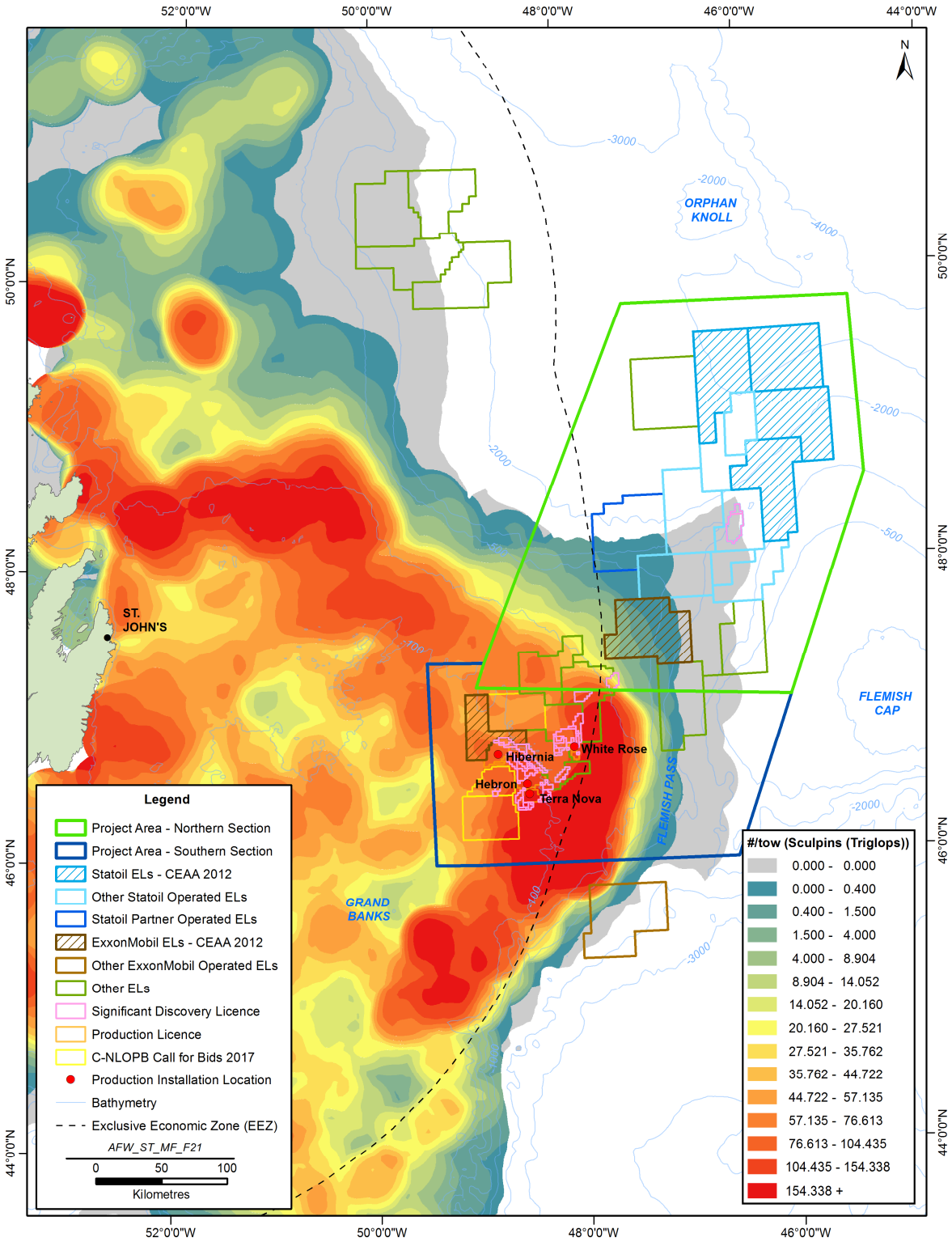


Figure 6-21 Sculpin (*Triglops* sp.) Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

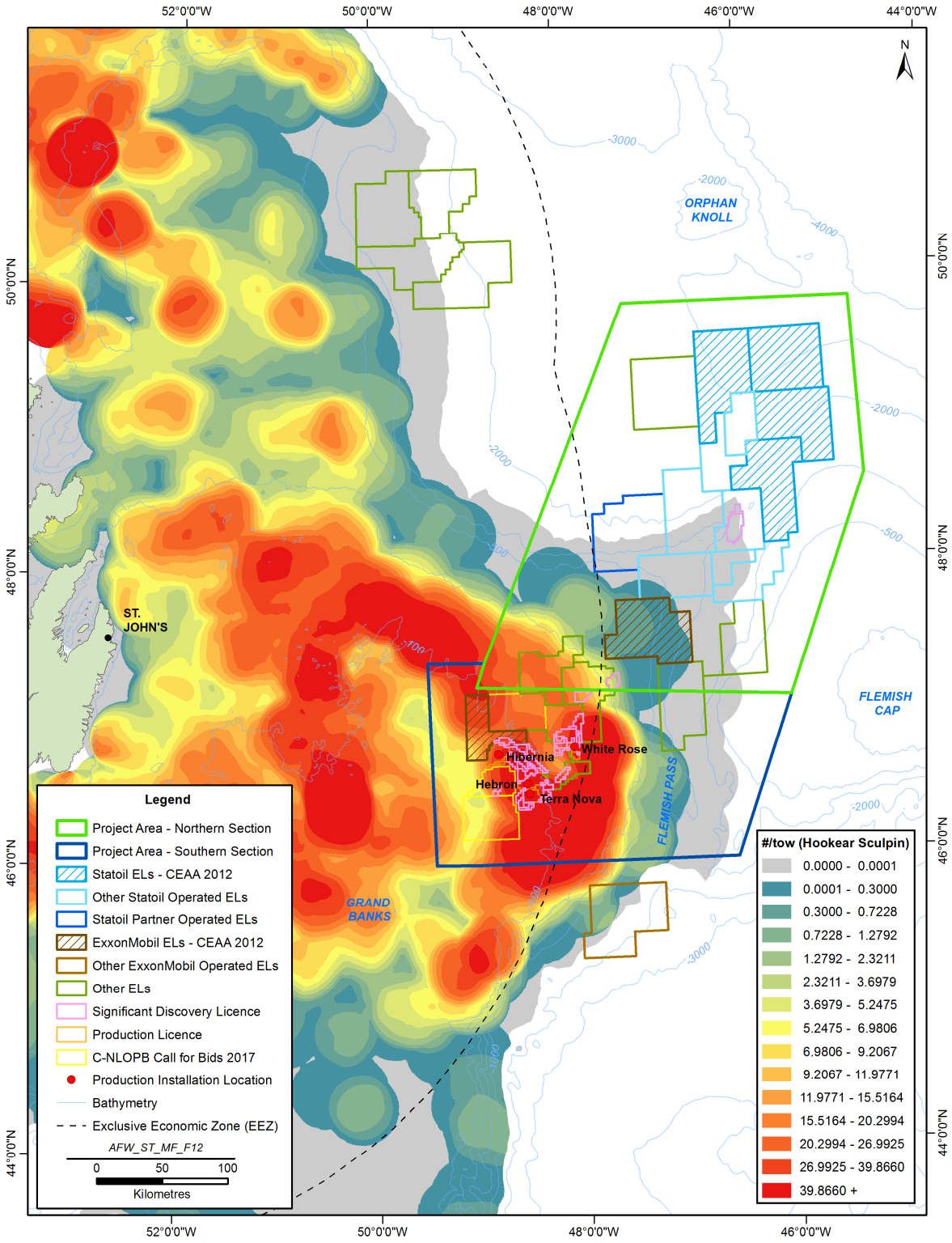


Figure 6-22 Hookear Sculpin Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

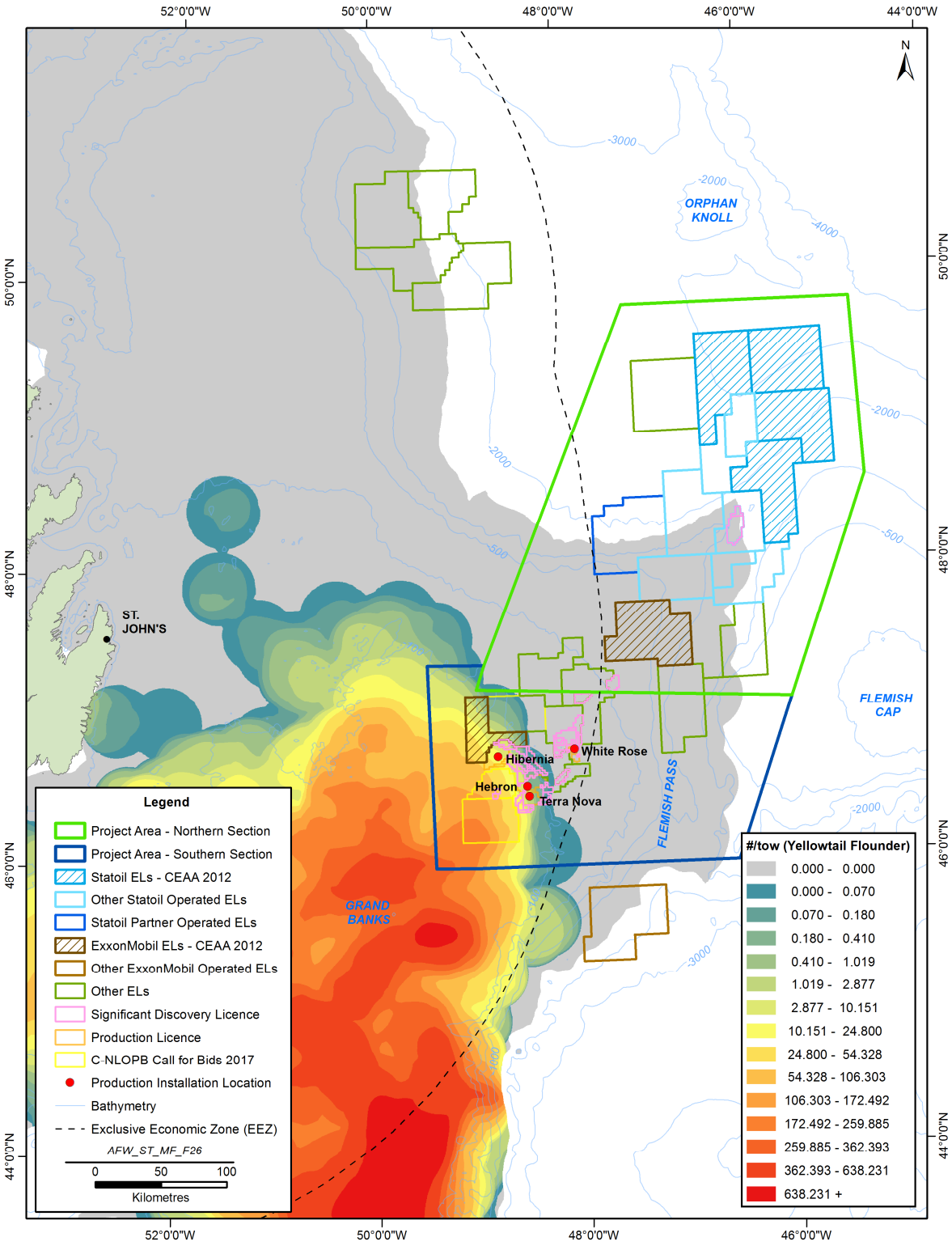


Figure 6-23 Yellowtail Flounder Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

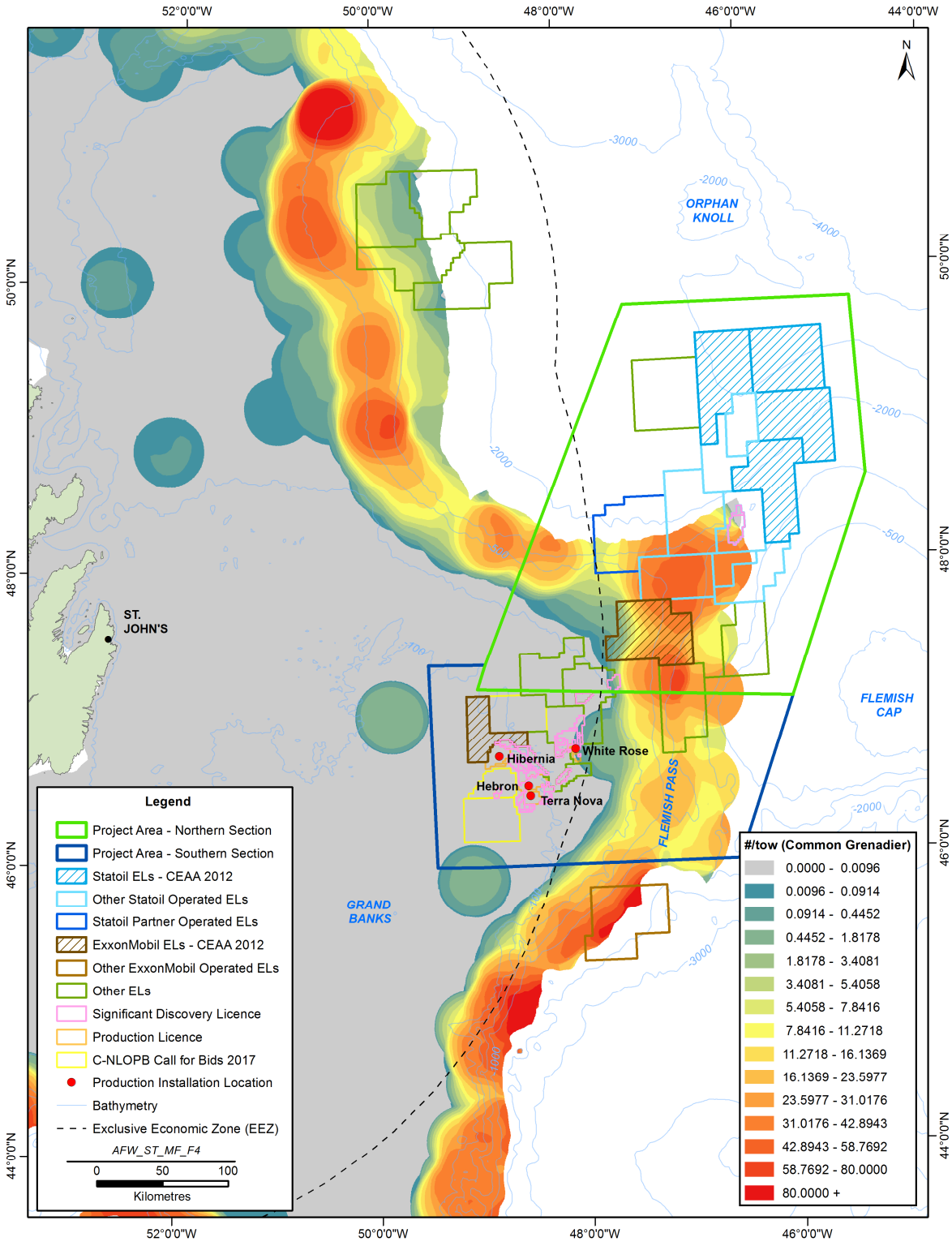


Figure 6-24 Common Grenadier Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

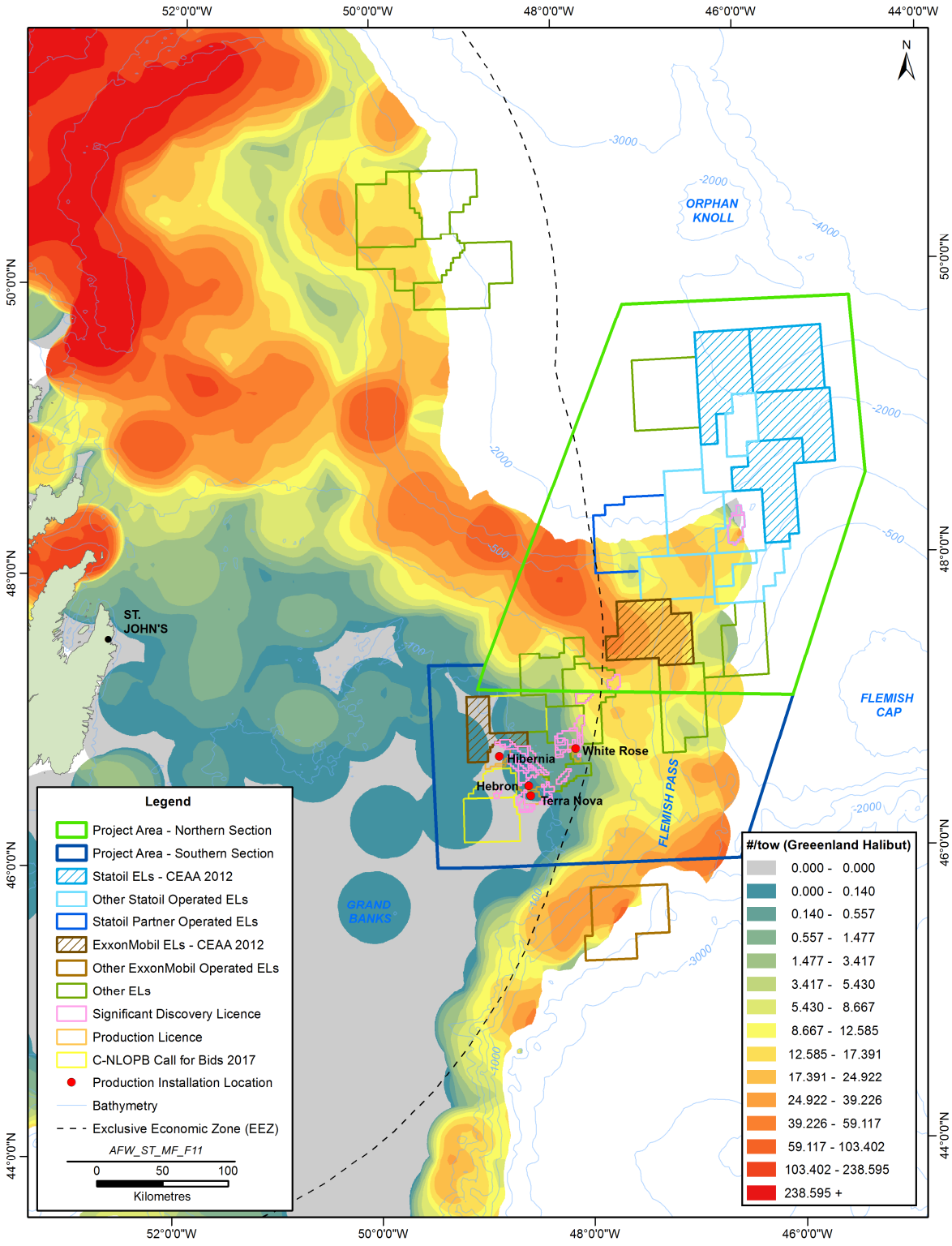


Figure 6-25 Greenland Halibut Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

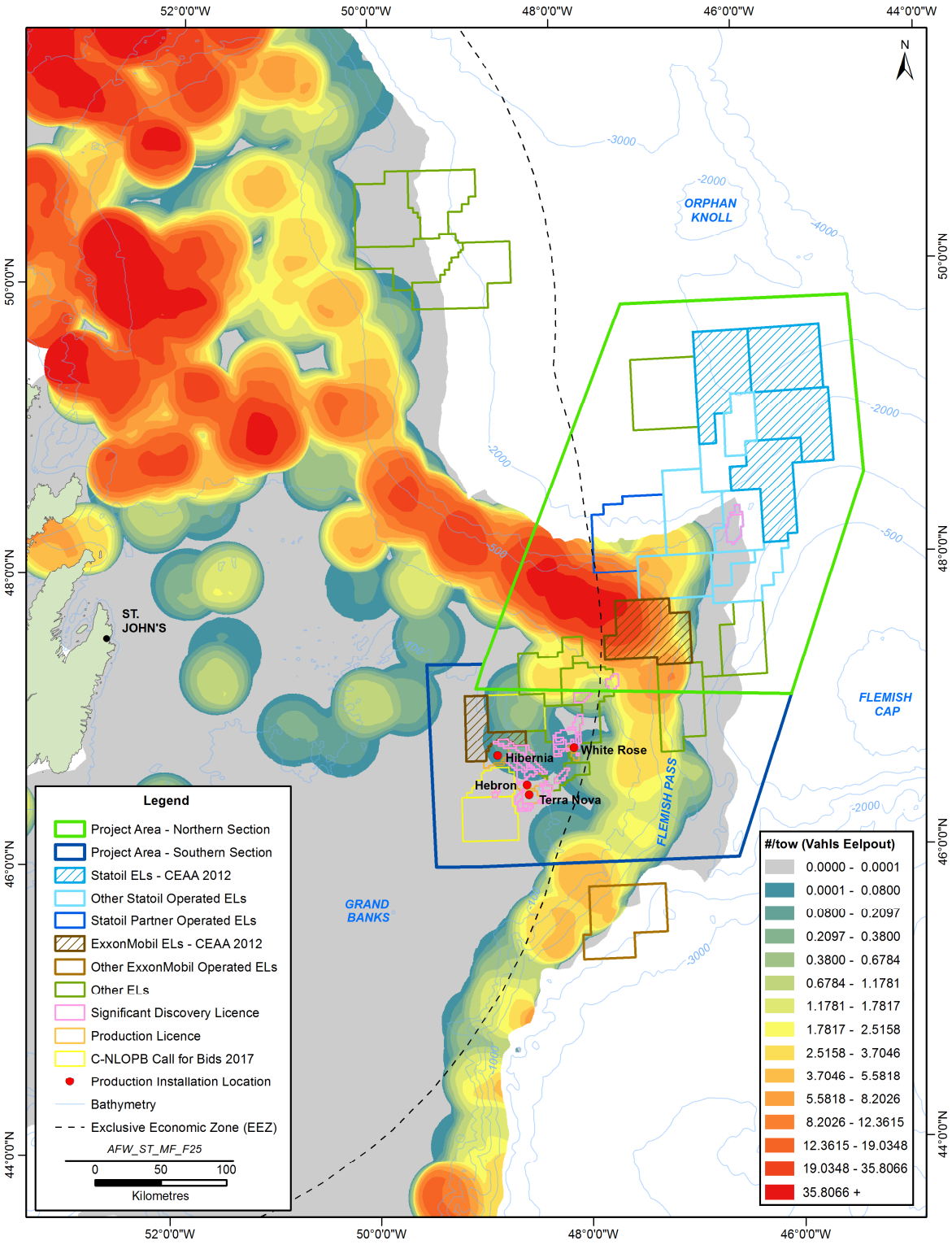


Figure 6-26 Vahl's Eelpout Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

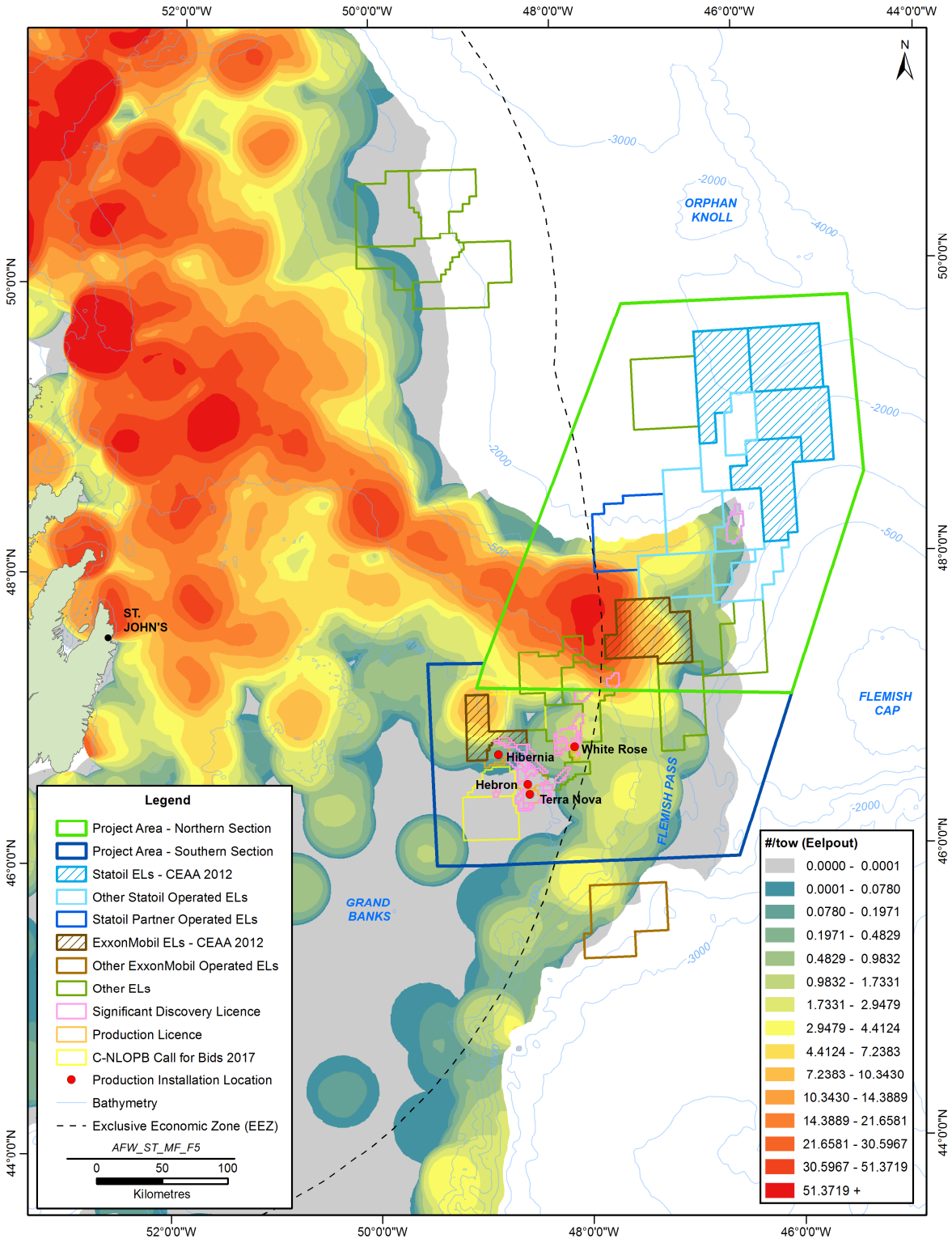


Figure 6-27 Eelpout (*Lycodes* sp.) Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

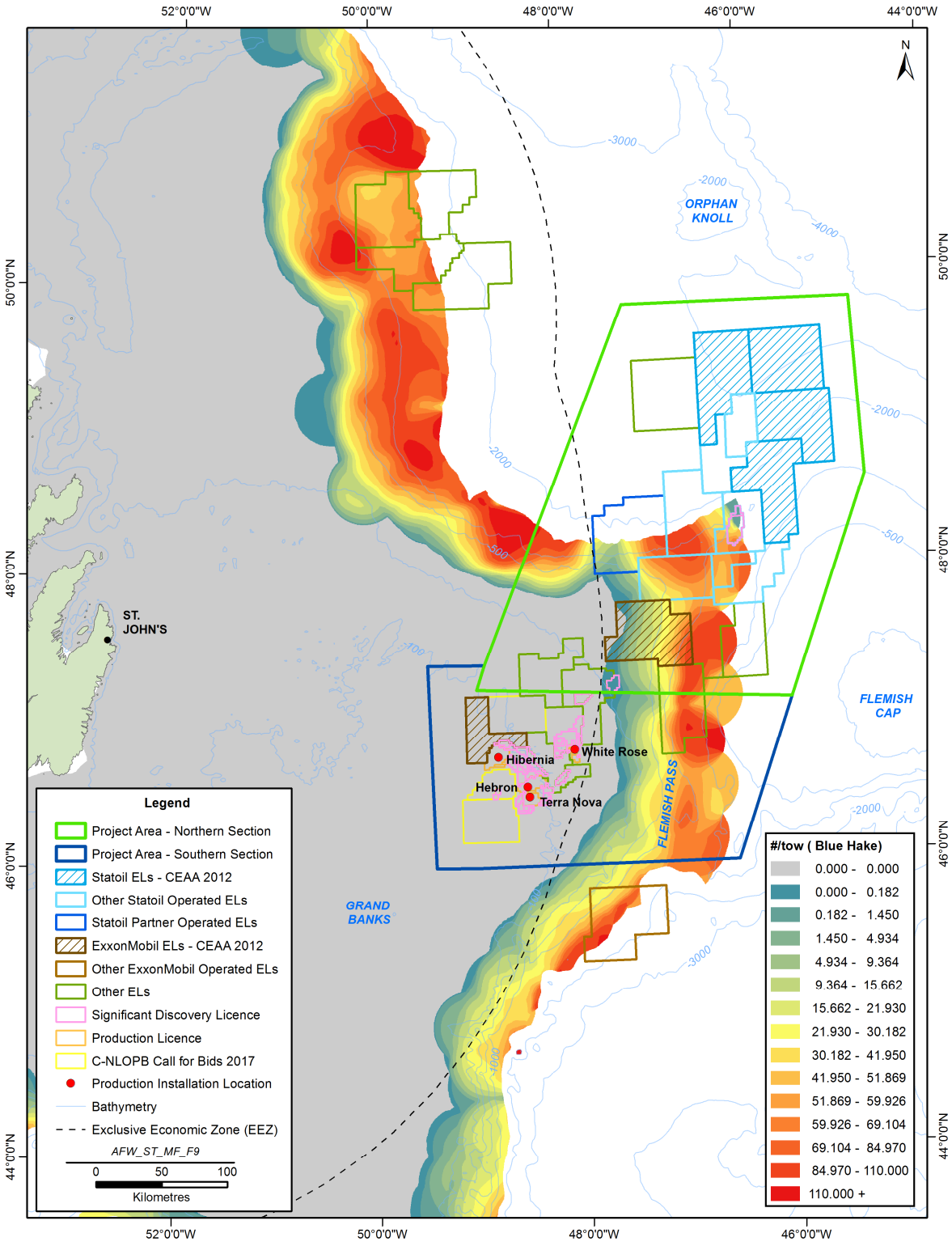


Figure 6-28 Blue Hake Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

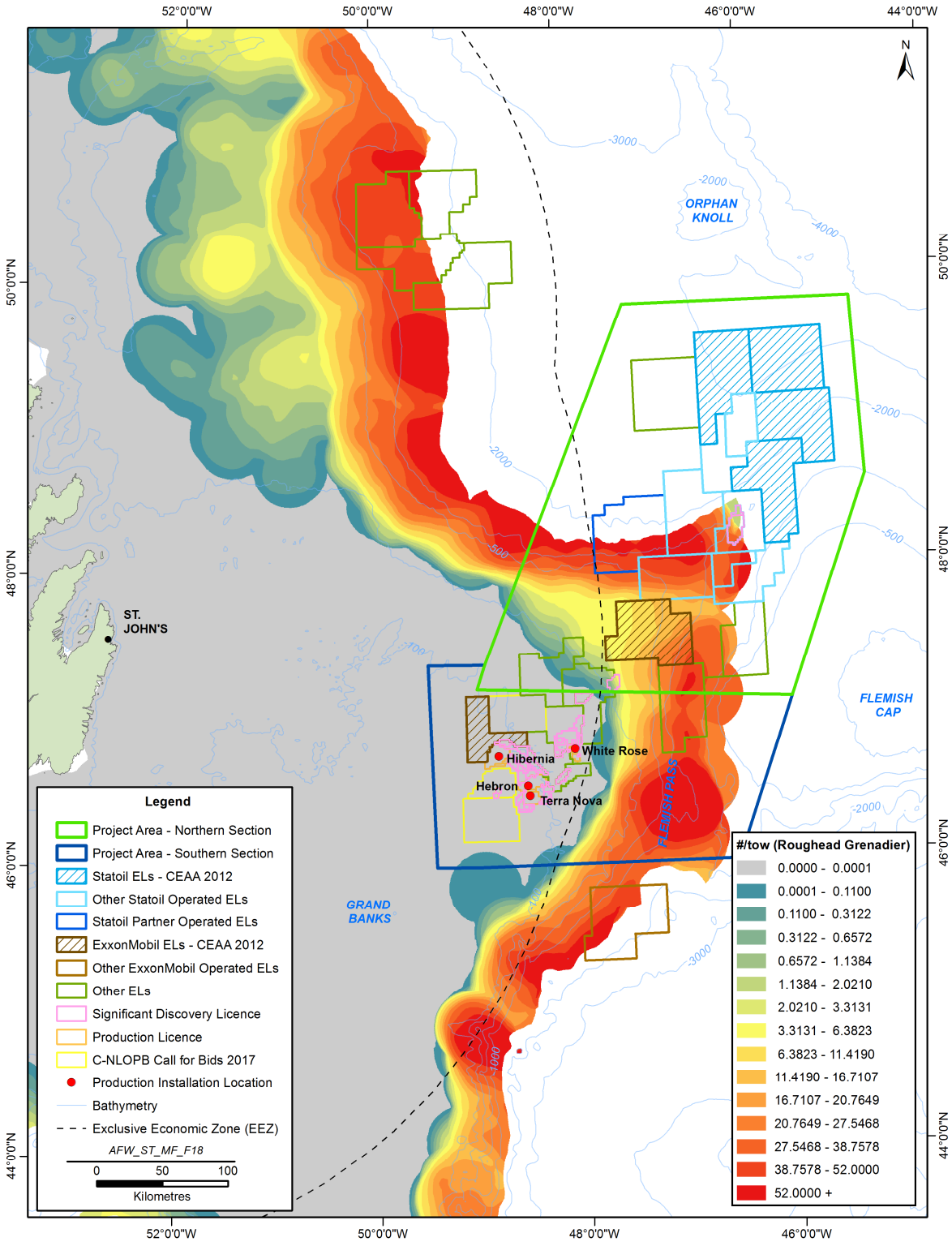


Figure 6-29 Roughhead Grenadier Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

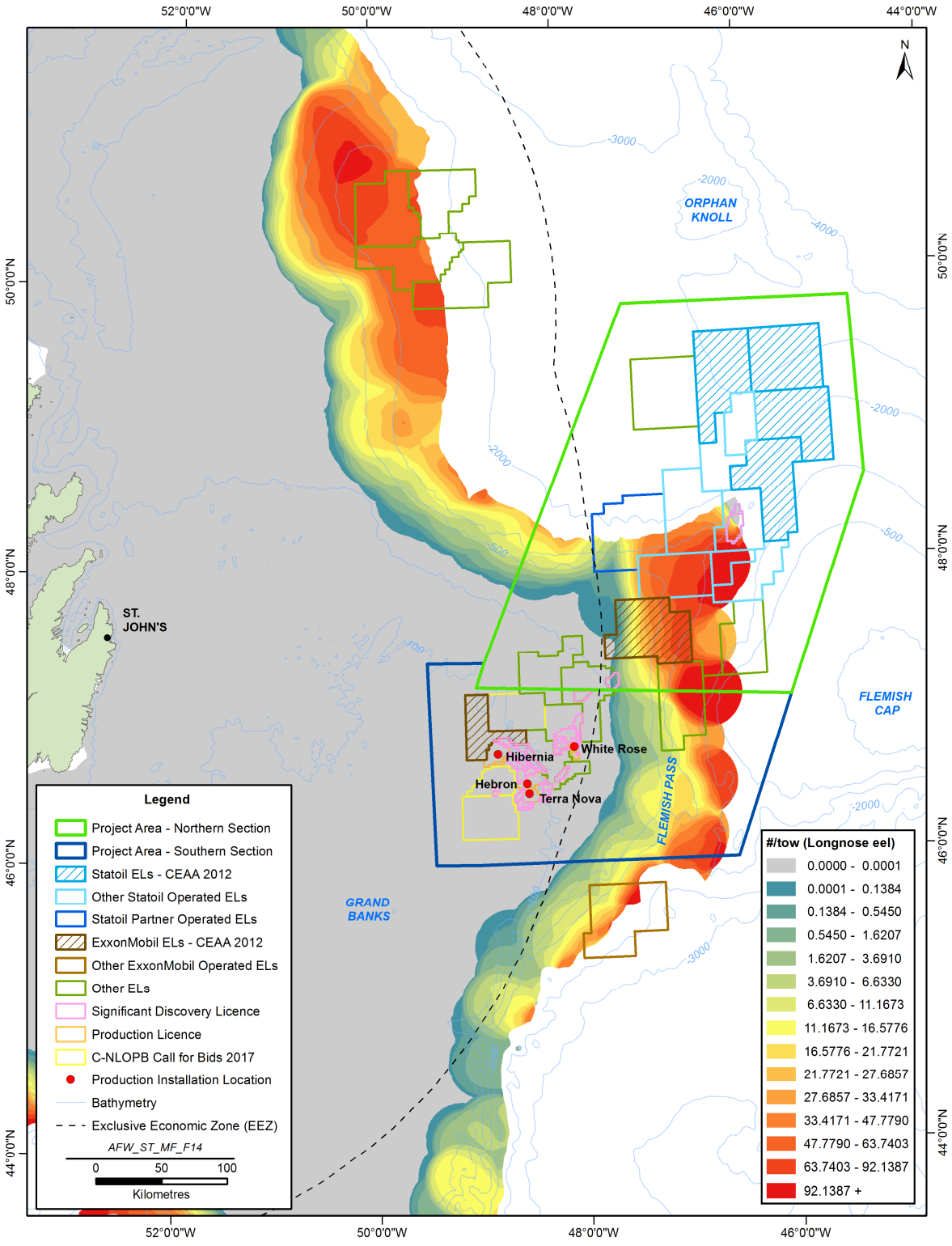


Figure 6-30 Longnose Eel Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2008-2012)

Table 6.15 Numerically Dominant Fish Species (95% of Overall Abundance) in the Project Area – Northern Section by Depth Zone (Canadian RV Surveys, 2008-2012)

Depth Zone	Common Name	Scientific Name	Mean Abundance/Tow (n=191)	Contribution to Total Catch
Shelf/Slope Edge (0-250 m)	Capelin	*Mallotus villosus*	569	82.4%
	American plaice	*Hippoglossoides platessoides*	44	6.4%
	Sand lance	*Ammodytes dubius*	20	2.9%
	Sculpin	*Triglops* sp.	11	1.6%
	Deepwater redfish	*Sebastes mentella*	8	1.1%
	Eelpout species	*Lycodes* sp.	5	0.8%
Shallow Edge (251-600 m)	Deepwater redfish	*Sebastes mentella*	528	52.4%
	Capelin	*Mallotus villosus*	294	29.2%
	Lanternfish	Myctophidae	79	7.8%
	Greenland halibut	*Reinhardtius hippoglossoides*	16	1.6%
	American plaice	*Hippoglossoides platessoides*	13	1.3%
	Vahl's eelpout	*Lycodes vahlii*	11	1.1%
	Eelpout	*Lycodes* sp.	9	0.9%
	Common grenadier	*Nezumia bairdii*	8	0.8%
Middle Slope (601-1,000 m)	Lanternfish	Myctophidae	61	46.6%
	Blue hake	*Antimora rostrata*	15	11.3%
	Longnose eel	*Synaphobranchus kaupii*	11	8.9%
	Common grenadier	*Nezumia bairdii*	9	6.6%
	Deepwater redfish	*Sebastes mentella*	8	6.3%
	Roughhead grenadier	*Macrourus berglax*	8	6.1%
	Greenland halibut	*Reinhardtius hippoglossoides*	4	3.3%
	Roundnose grenadier	*Coryphaenoides rupestris*	3	2.4%
	Barracudina	Paralepididae	2	1.6%
	Vahls eelpout	*Lycodes vahlii*	1	1.0%
	Atlantic halibut	*Hippoglossus hippoglossus*	1	0.9%
	Witch flounder	*Glyptocephalus cynoglossus*	1	0.9%
	Roundnose grenadier	*Coryphaenoides rupestris*	8	28.2%

Table 6.15 Numerically Dominant Fish Species (95% of Overall Abundance) in the Project Area – Northern Section by Depth Zone (Canadian RV Surveys, 2008-2012)

Depth Zone	Common Name	Scientific Name	Mean Abundance/Tow (n=191)	Contribution to Total Catch
Middle-Deep Slope (1,001-1,300 m)	Longnose eel	*Synaphobranchus kaupi*	5	17.0%
	Blue hake	*Antimora rostrata*	4	15.0%
	Lanternfish	Myctophidae	3	12.5%
	Roughhead grenadier	*Macrourus berglax*	2	7.9%
	Common grenadier	*Nezumia bairdii*	1	5.2%
	Greenland halibut	*Reinhardtius hippoglossoides*	1	4.4%
	Dragonfish	*Stomias boa ferox*	1	2.1%
	Viperfish	*Chauliodus sloani*	<1	1.1%
	Blacksmelts	*Bathylagus sp.*	<1	1.1%
	Ogrefish	Melamphaidae	<1	0.9%
Deep Slope (1,301-1,450 m)	Blue hake	*Antimora rostrata*	2	24.7%
	Roughhead grenadier	*Macrourus berglax*	1	19.1%
	Lanternfish	Myctophidae	1	13.3%
	Longnose eel	*Synaphobranchus kaupii*	1	13.2%
	Greenland halibut	*Reinhardtius hippoglossoides*	<1	7.1%
	Roundnose grenadier	*Coryphaenoides rupestris*	<1	6.4%
	Dragonfish	*Stomias boa ferox*	<1	2.9%
	Large scale tapirfish	*Notacanthus chemnitzii*	<1	2.3%
	Ogrefish	Melamphaidae	<1	1.7%
	Blacksmelts	*Bathylagus sp.*	<1	1.4%
	Threebeard rockling	*Gaidropsarus ensis*	<1	1.3%
	Shortspine tapirfish	*Polyacanthonotus rissoanus*	<1	1.1%
	Viperfish	*Chauliodus sloani*	<1	1.0%

Table 6.16 Numerically Dominant Fish Species (95% of Overall Abundance) in the Project Area – Southern Section by Depth Zone (Canadian RV Surveys, 2008-2012)

Depth Zone	Common Name	Scientific Name	Mean Abundance/Tow (n=276)	Contribution to Catch
Shelf (0-250 m)	Sand lance	*Ammodytes dubius*	1,239	54.3%
	Capelin	*Mallotus villosus*	791	34.7%
	Sculpin	*Triglops* sp.	97	4.2%
	American plaice	*Hippoglossoides platessoides*	36	1.6%
	Hookear sculpin	*Artediellus* sp.	28	1.2%
Shallow Slope (251-600 m)	Deepwater redfish	*Sebastes mentella*	370	88.0%
	Lanternfish	Myctophidae	16	3.8%
	Roughhead grenadier	*Macrourus berglax*	7	1.7%
	American plaice	*Hippoglossoides platessoides*	6	1.4%
	Thorny skate	*Amblyraja radiata*	4	0.9%
Middle Slope (601-1,000 m)	Deepwater redfish	*Sebastes mentella*	15	38.6%
	Lanternfish	Myctophidae	7	18.9%
	Roughhead grenadier	*Macrourus berglax*	6	15.8%
	American plaice	*Hippoglossoides platessoides*	2	4.9%
	Thorny skate	*Amblyraja radiata*	2	4.5%
	Common grenadier	*Nezumia bairdii*	1	3.9%
	White hake	*Urophycis tenuis*	1	2.8%
	Greenland halibut	*Reinhardtius hippoglossoides*	1	1.4%
	Atlantic cod	*Gadus morhua*	<1	1.2%
	Barracudina	Paralepididae	<1	1.1%
	Witch flounder	Glyptocephalus cynoglossus	<1	1.0%
	Blue hake	*Antimora rostrata*	<1	0.8%
	Vahl's eelpout	*Lycodes vahlii*	<1	0.6%
Middle-Deep Slope (1,001-1,300 m)	Blue hake	*Antimora rostrata*	2	23.4%
	Roundnose grenadier	*Coryphaenoides rupestris*	2	19.4%
	Roughhead grenadier	*Macrourus berglax*	1	15.1%
	Lanternfish	Myctophidae	1	11.1%

Table 6.16 Numerically Dominant Fish Species (95% of Overall Abundance) in the Project Area – Southern Section by Depth Zone (Canadian RV Surveys, 2008-2012)

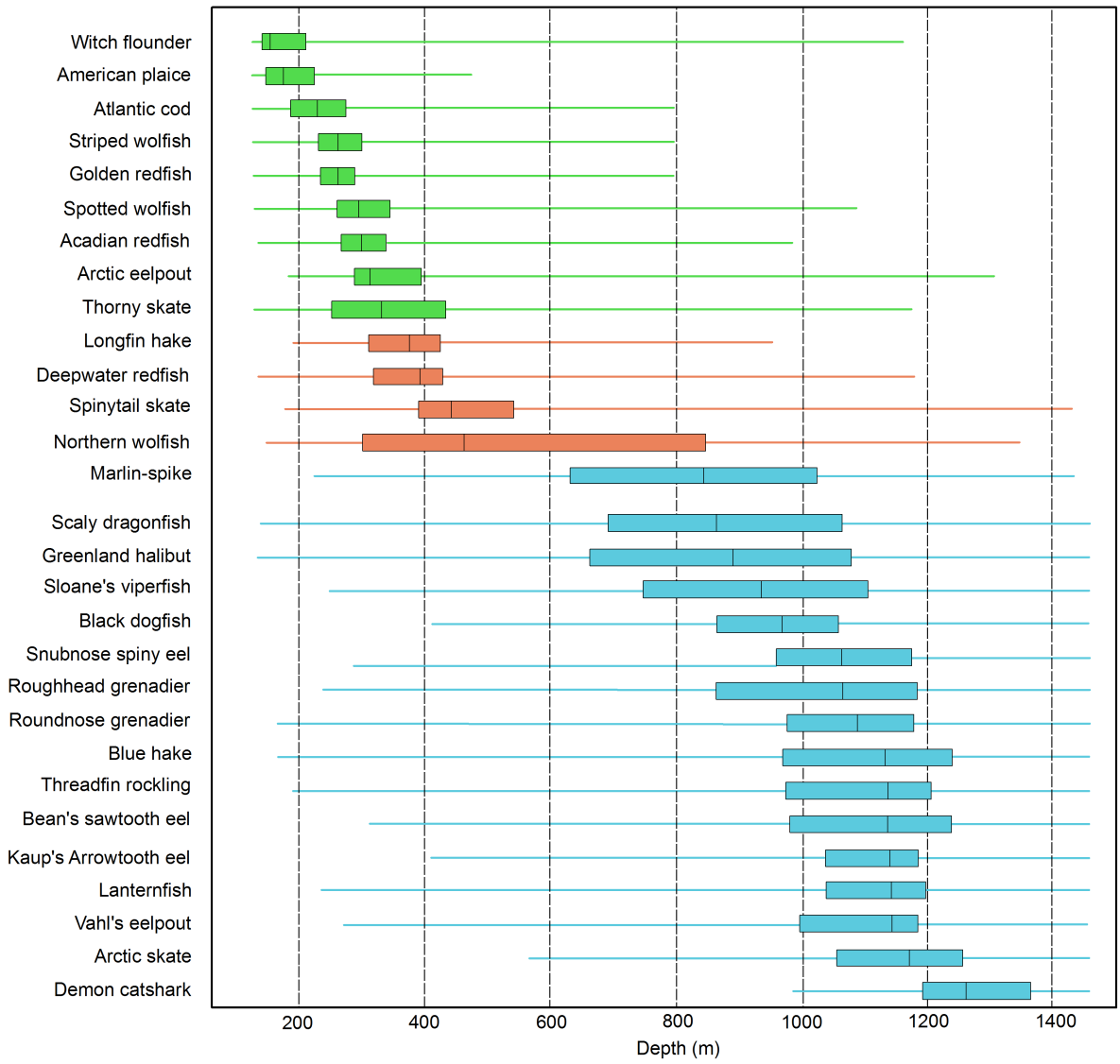
Depth Zone	Common Name	Scientific Name	Mean Abundance/Tow (n=276)	Contribution to Catch
	Longnose eel	*Synaphobranchus kaupi*	1	7.6%
	Black dogfish	*Centroscyllium fabricii*	1	6.2%
	Greenland halibut	*Reinhardtius hippoglossoides*	<1	3.6%
	Common grenadier	*Nezumia bairdii*	<1	3.2%
	Dragonfish	*Stomias boa ferox*	<1	1.7%
	Threebeard rockling	*Gaidropsarus ensis*	<1	1.4%
	Shortnose snipe eel	*Serrivomer beanii*	<1	1.4%
	Large scale tapirfish	*Notacanthus chemnitzii*	<1	0.8%
	Viperfish	*Chauliodus sloani*	<1	0.7%
Deep Slope (1,301-1,450 m)	Roundnose grenadier	*Coryphaenoides rupestris*	2	29.8%
	Blue hake	*Antimora rostrata*	1	14.5%
	Longnose eel	*Synaphobranchus kaupii*	1	13.0%
	Roughhead grenadier	*Macrourus berglax*	1	11.4%
	Greenland halibut	*Reinhardtius hippoglossoides*	<1	7.9%
	Lanternfish	Myctophidae	<1	5.4%
	Blacksmelts	*Bathylagus* sp.	<1	3.6%
	Common grenadier	*Nezumia bairdii*	<1	1.7%
	Shortnose snipe eel	*Serrivomer beanii*	<1	1.4%
	Grenadier species	Macrouridae	<1	1.0%
	Threebeard rockling	*Gaidropsarus ensis*	<1	1.0%
	Chimera	*Hydrolagus affinis*	<1	0.9%
	Dragonfish	*Stomias boa ferox*	<1	0.8%
	Black dogfish	*Centroscyllium fabricii*	<1	0.8%
	Black herring	*Bathytroctes* sp.	<1	0.8%
	Shortspine tapirfish	*Polyacanthonotus rissoanus*	<1	0.6%
	Butterfish	Stomiatidae	<1	0.6%

6.1.7.2 Flemish Cap (Project Area – Northern and Southern Sections)

Representative data from the EU RV surveys within and outside the Project Area provide insight into marine assemblages within portions of both sections of the Project Area. On the Flemish Cap and adjacent slopes, Nogueira et al. (2017) use EU RV survey data to categorize 29 species of fish across three depth zones: Shelf: 0-250 m, Middle Slope: 251-600 m, and Middle-Deep Slope: 601-1,460 m (Figure 6-31; Table 6.17). Like the Canadian RV surveys, the greatest change in fish community structure occurred between the Middle and Middle-Deep Slope, but less distinct changes also occurred between the Shelf and Middle Slope. The dominant species found in the shallow and middle slope assemblages were comprised of many different species as compared to those described in a similar depth range by the Canadian RV surveys. For example, American plaice, witch flounder, Atlantic cod, wolffish (Atlantic and spotted) and thorny skate were not listed as dominant species in the 0-500 m shallow/shelf depth zone in Canadian surveys, but both areas did share redfish, eelpouts and Greenland halibut as dominant shallow species. Similarly, capelin, lanternfish and Atlantic halibut were relatively important in Canadian waters but not listed as such in EU surveys. Some of these differences may be attributed to the condition of commercially fished stocks. For example, Nogueira et al. (2017) indicate that the recovery of Atlantic cod from overfishing has resulted in increased abundance of that species, as well as an expanded distribution. Recovery of this species within Canadian waters may be lagging behind the Flemish Cap area.

In the Middle-Deep slope, Flemish Cap fish assemblages qualitatively resemble those found beyond 500 m depth in Canadian RV surveys. Blue hake, Greenland halibut, roughhead and roundnose grenadiers, black dogfish, and longnose eels were common to both surveys.

Distributions of some commercially important species from the EU RV surveys (2010-2014) are summarized for the Flemish Cap as displayed in Figures 6-32 to 6-36 (Casas and González-Troncoso, 2013, 2015, Vázquez et al. 2013; Mandado 2014; Alpoim and González-Tronocoso 2016). Atlantic cod (Figure 6-32) and American plaice (Figure 6-33) are largely restricted to the shallow shelf (less than 500 m) areas of the Flemish Cap, whereas redfish Figure 6-34) are principally found on the slope edge. American plaice (Figure 6-33) distributions are mainly on the shallowest areas of the Flemish Cap outside the Project Area. Greenland halibut (Figure 6-35) and roughhead grenadier (Figure 6-36) are found in deeper margins of the Slope.



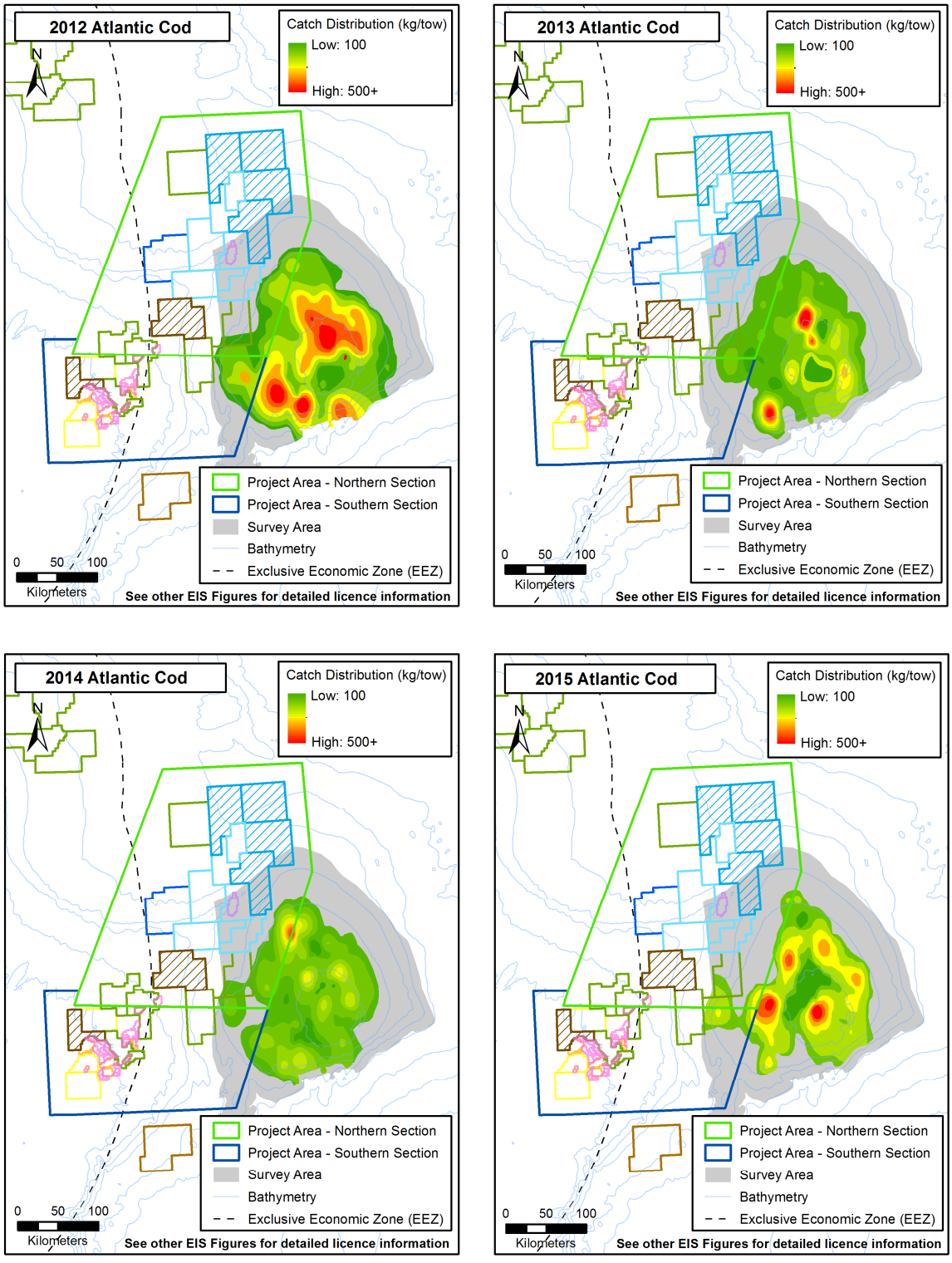
Note: Lines indicate the overall depth range whereas the boxes represent the mid quartiles.
Source: Reproduced from Noguiera et al. (2017)

Figure 6-31 Depth Distributions of Fish Captured in EU RV Surveys of the Flemish Cap and Adjacent Slope (2004-2012)

Table 6.17 Numerically Dominant Fish Species in the Project Area by Depth Zone (European Union RV Surveys, 2004-2013)

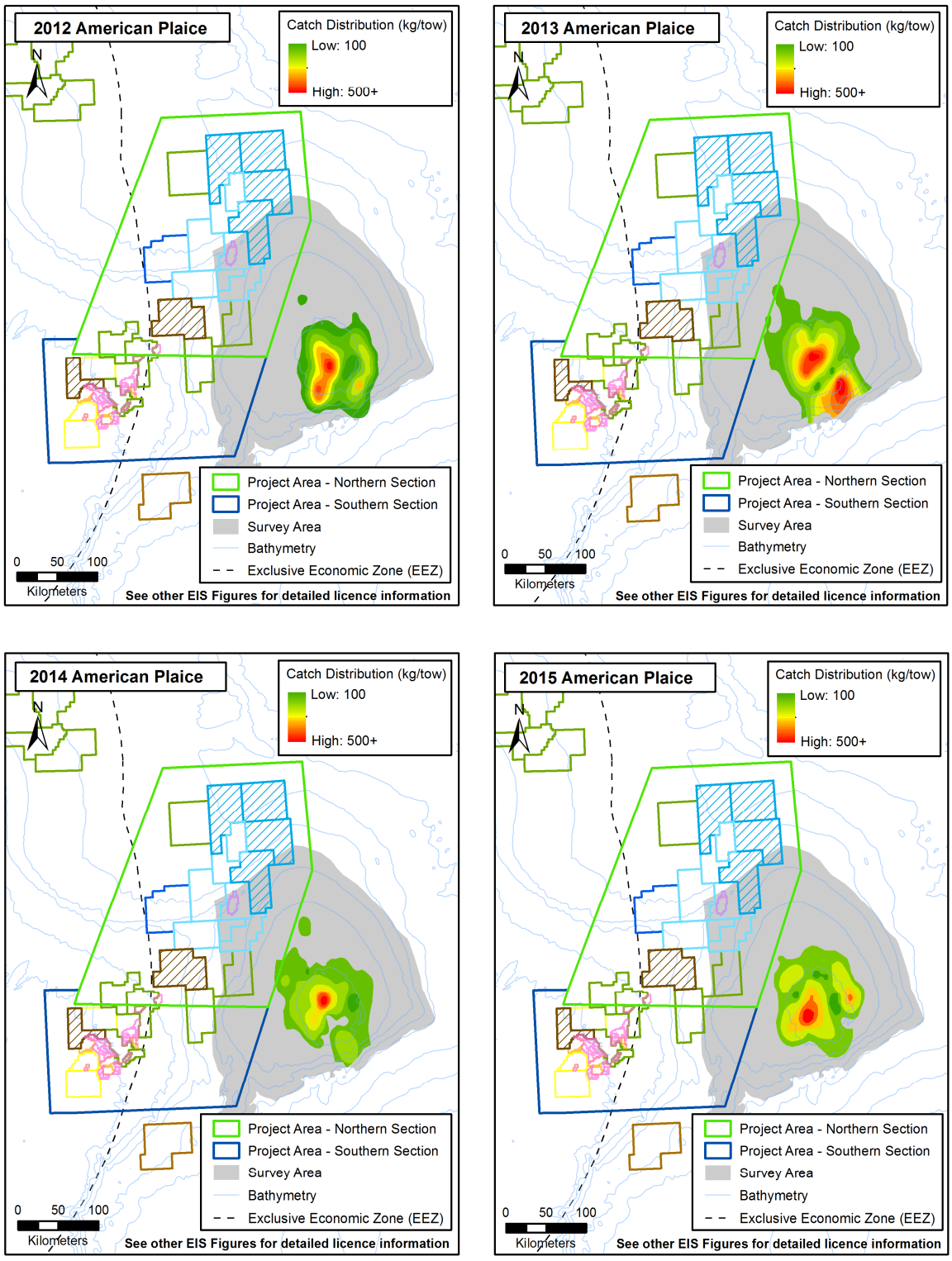
Depth Zone	Common Name	Scientific Name	Percent Abundance
Shelf/Slope Edge (< 250 m)	Acadian redfish	*Sebastes fasciatus*	51.2%
	Golden redfish	*Sebastes norvegicus*	39.5%
	Atlantic cod	*Gadus morhua*	7.6%
	American plaice	*Hippoglossoides platessoides*	0.3%
	Witch flounder	*Glyptocephalus cynoglossus*	0.2%
	Atlantic wolffish	*Anarhichas lupus*	0.2%
	Thorny skate	*Amblyraja radiata*	<0.1%
Shallow Slope (251-600 m)	Golden redfish	*Sebastes fasciatus*	46.3%
	Deepwater redfish	*Sebastes mentella*	32.3%
	Golden redfish	*Sebastes norvegicus*	17.9%
	Atlantic cod	*Gadus morhua*	1.4%
	Greenland halibut	*Reinhardtius hippoglossoides*	0.4%
	Spotted wolffish	*Anarhichas minor*	0.1%
	Thorny skate	*Amblyraja radiata*	0.1%
Middle-Deep Slope (601-1,350 m)	Greenland halibut	*Reinhardtius hippoglossoides*	20.6%
	Roundnose grenadier	*Coryphaenoides rupestris*	19.0%
	Longnose eel	*Synaphobranchus kaupii*	13.2%
	Blue hake	*Antimora rostrate*	12.1%
	Common grenadier	*Nezumia bairdii*	11.8%
	Roughhead grenadier	*Macrourus berglax*	7.4%
	Black dogfish	*Centroscyllium fabricii*	2.4%
	Deep-sea catshark	*Apristurus spp.*	0.4%

Source: Data presented in Nogueira et al. (2017) and is based on 1,699 *Lofoten* trawl 30 minute passes at 3 knots.



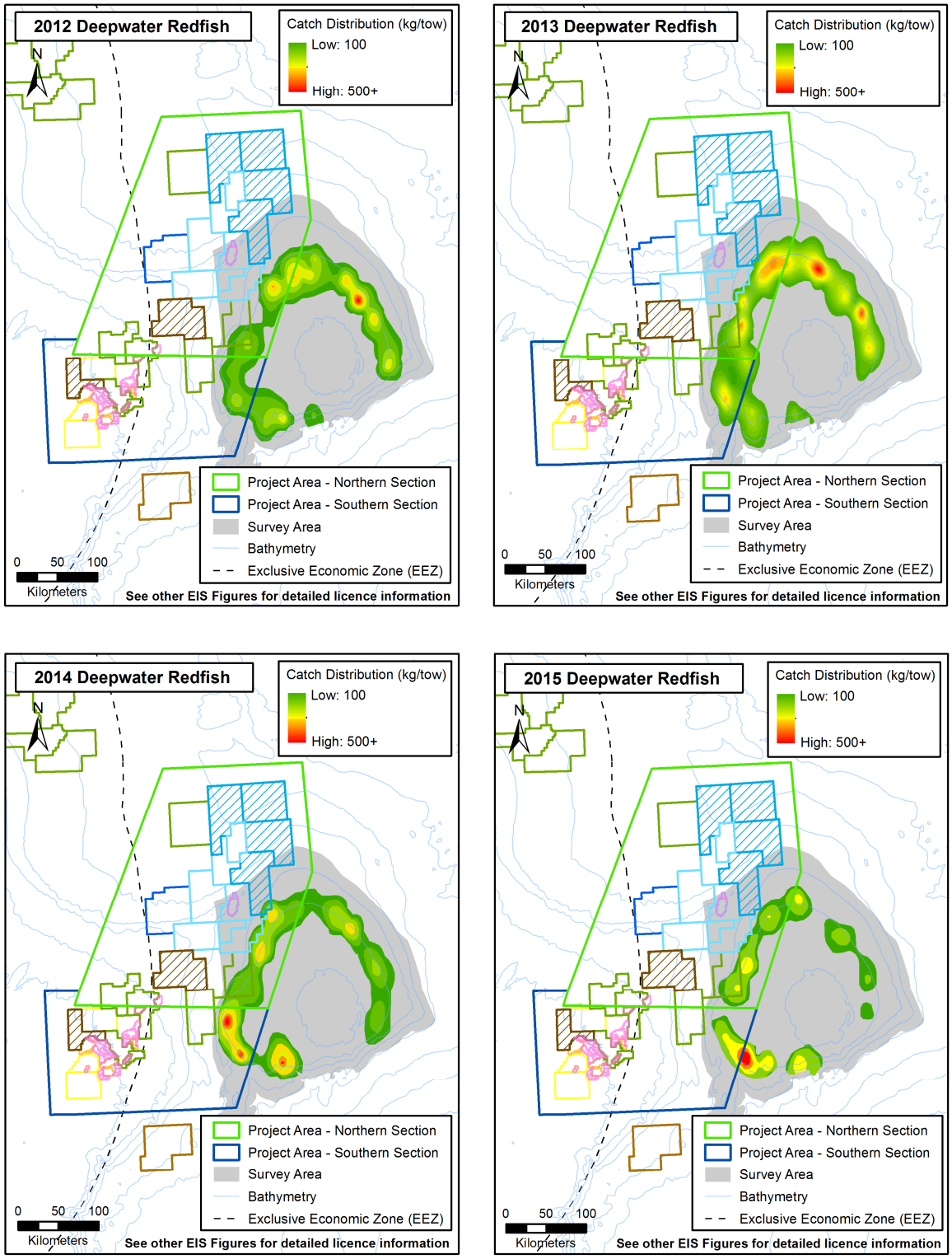
Source: Reproduced from Casas and González-Troncoso (2013, 2015); Vázquez et al. (2013); Mandado (2014); Alpoim and González-Troncoso (2016)

Figure 6-32 Distributions of Atlantic Cod on the Flemish Cap



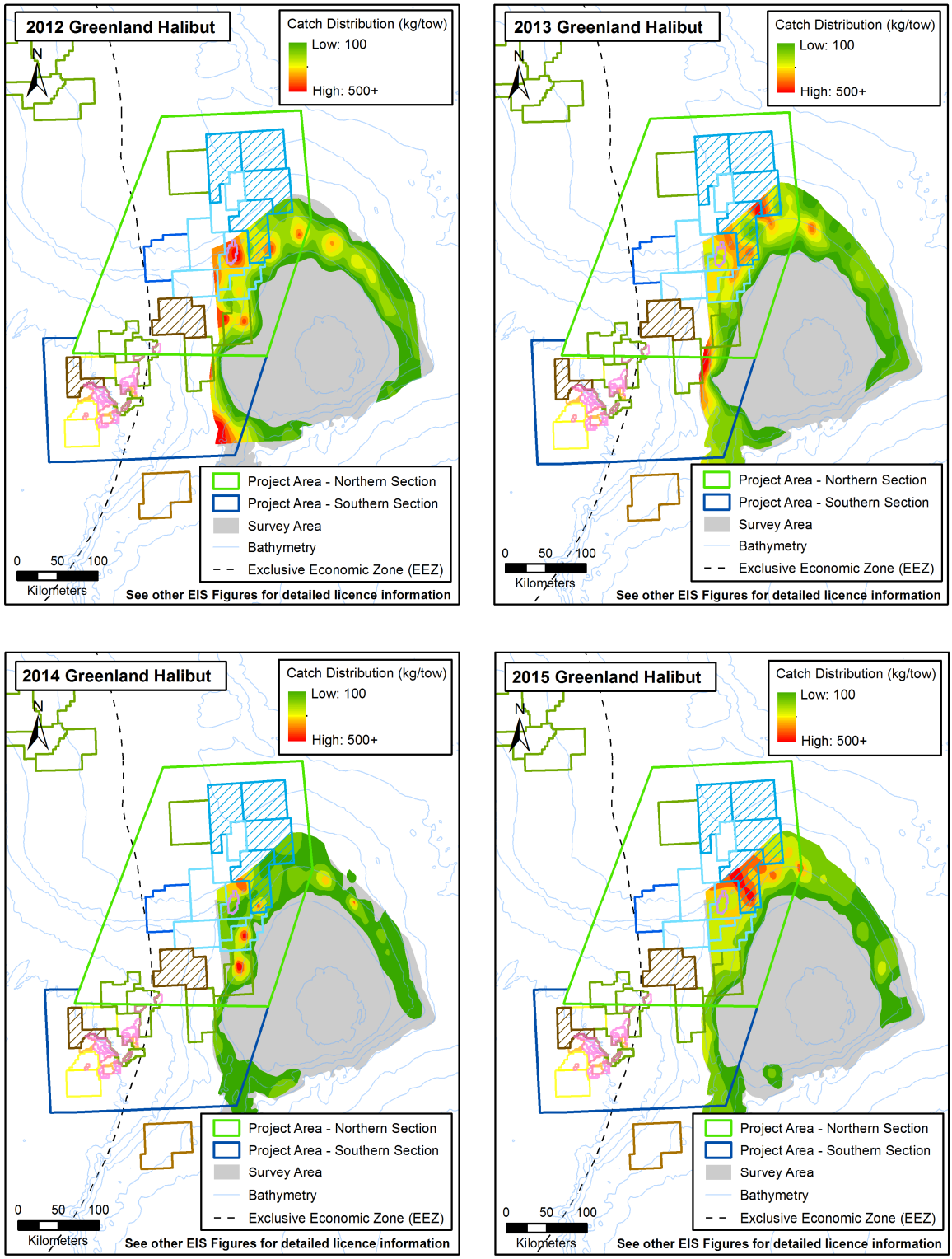
Source: Reproduced from Casas and González-Troncoso (2013, 2015); Vázquez et al. (2013); Mandado (2014); Alpoim and González-Troncoso (2016)

Figure 6-33 Distributions of American Plaice on the Flemish Cap



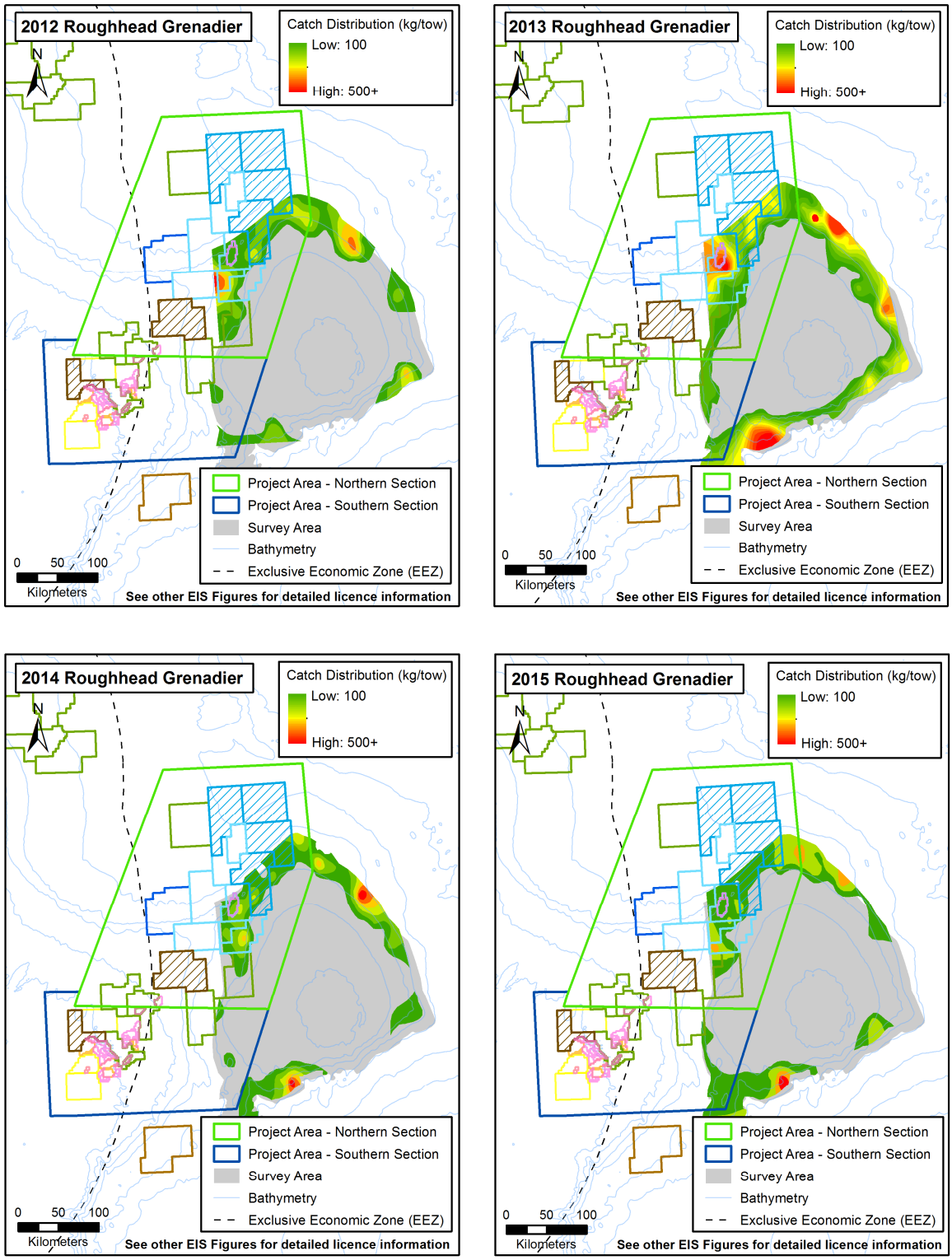
Source: Reproduced from Casas and González-Troncoso (2013, 2015); Vázquez et al. (2013); Mandado (2014); Alpoim and González-Troncoso (2016)

Figure 6-34 Distributions of Deepwater Redfish on the Flemish Cap



Source: Reproduced from Casas and González-Troncoso (2013, 2015); Vázquez et al. (2013); Mandado (2014); Alpoim and González-Troncoso (2016)

Figure 6-35 Distributions of Greenland Halibut on the Flemish Cap



Source: Reproduced from Casas and González-Troncoso (2013, 2015); Vázquez et al. (2013); Mandado (2014); Alpoim and González-Troncoso (2016)

Figure 6-36 Distributions of Roughhead Grenadier on the Flemish Cap

6.1.7.3 Flemish Cap and Grand Banks Slope (Project Area – Northern and Southern Sections)

Neither Canadian nor EU RV surveys sample habitats beyond 1,500 m (e.g., in ELs 1139, 1140, 1141, 1142). For these abyssal depths, the deep-water longline survey described in Murua and Cardenas (2005) provides relevant and representative information for the Flemish Cap and Grand Bank slopes (see Table 6.18). This survey extended from slope edge to 3,100 m of depth. In depth zones sampled by the RV trawl surveys described above, the longline survey was also dominated by Greenland halibut, blue hake, roughhead grenadier, black dogfish and skates. In the first depth zone beyond the RV surveys (1,500-2,000 m), blue hake, followed by small-eyed rabbitfish (a benthic species also known as the deepwater chimera), roughhead grenadier and skates were the dominant species. At depths of 2,000-3,100 m, blue hake and skates persisted but a new benthopelagic species, the armed grenadier, was most dominant. The 2,000 m depth boundary marked the deepest limits of Greenland halibut and roughhead grenadier and also was the shallow limit of armed grenadier. These species were never observed to co-occur within this study. This boundary coincides with a pronounced halocline that separates more saline, colder and less oxygenated North Atlantic deep water masses from more superficial Labrador Sea water. While Greenland halibut, roughhead grenadier and armed grenadier appear to have distinct preferences, other species such as blue hake appear to be able to occupy both water masses (Murua and Cardenas 2005).

Table 6.18 Dominant Species by Depth Zone Found in Flemish Cap and Grand Banks Slope Deepwater Longline Surveys

Depth Zone	Common Name	Scientific Name	Percent Abundance
Shallow-Middle Slope (< 800 m)	Greenland halibut	*Reinhardtius hippoglossoides*	87%
	Skates	Rajidae (F)	12%
	Other species	-	1%
Middle Slope (800-1,150 m)	Roughhead grenadier	*Macrourus berglax*	93%
	Greenland halibut	*Reinhardtius hippoglossoides*	3%
	Blue hake	*Antimora rostrata*	2%
	Skates	Rajidae (F)	1%
	Black dogfish	*Centroscyllium fabricii*	>1%
Middle-Deep Slope (1,150-1,500 m)	Roughhead grenadier	*Macrourus berglax*	42%
	Blue hake	*Antimora rostrata*	40%
	Greenland halibut	*Hippoglossoides platessoides*	11%
	Smalleyed rabbitfish	*Hydrolagus affinis*	3%
	Skates	Rajidae (F)	2%
	Black dogfish	*Centroscyllium fabricii*	2%
Deep Slope (1,500-2,000 m)	Blue hake	*Antimora rostrata*	64%
	Smalleyed rabbitfish	*Hydrolagus affinis*	22%
	Skates	Rajidae	8%
	Roughhead grenadier	*Macrourus berglax*	6%

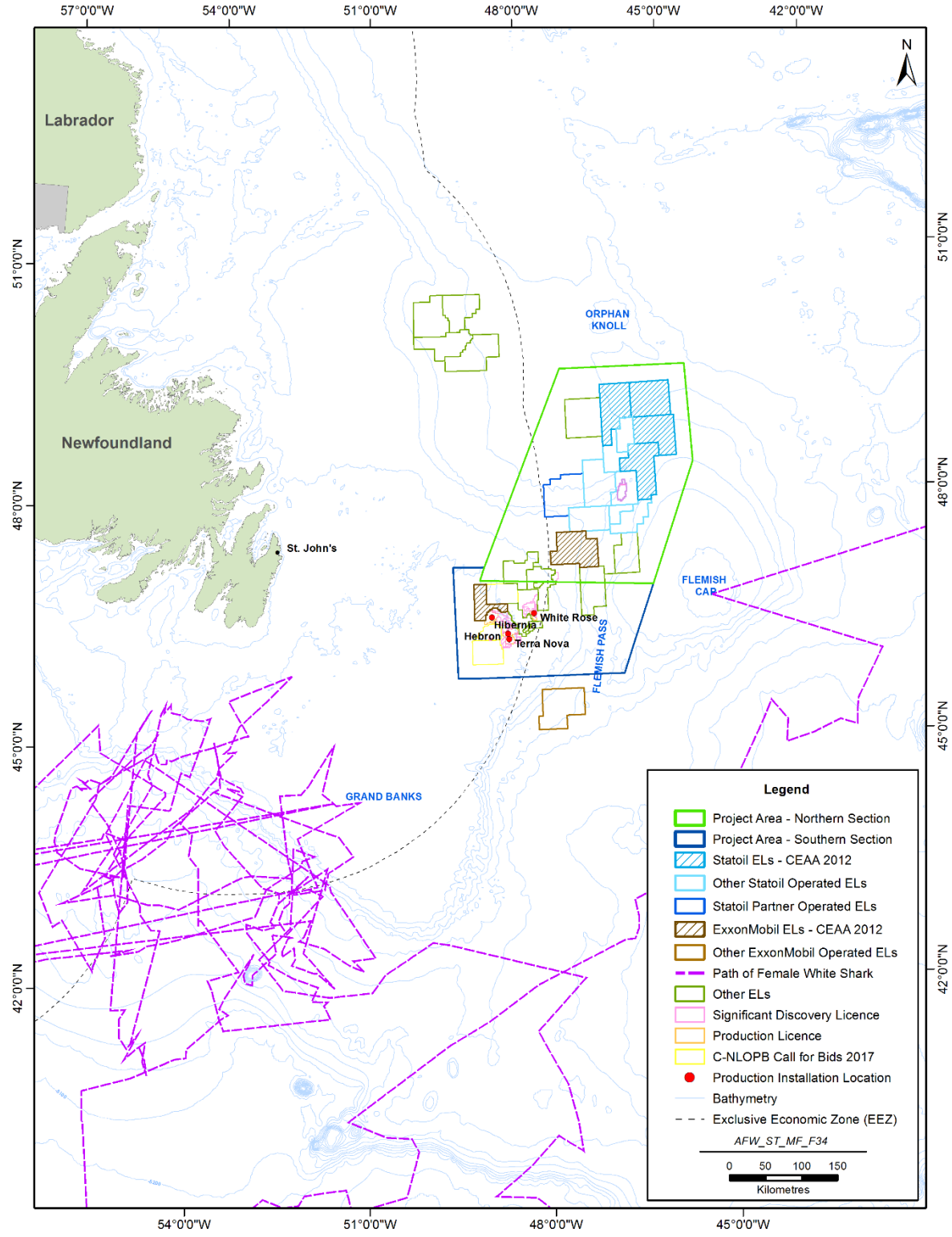
Table 6.18 Dominant Species by Depth Zone Found in Flemish Cap and Grand Banks Slope Deepwater Longline Surveys

Depth Zone	Common Name	Scientific Name	Percent Abundance
Deep Slope (2,000-3,000 m)	Armed grenadier	*Coryphaenoides armatus*	77%
	Blue hake	*Antimora rostrata*	18%
	Skates	Rajidae (F)	5%
Source: Murua and Cardenas (2005) Percent abundance is based on 64 longline hauls collected from 708-3,028 m.			

While Deep Slope and abyssal species are not well studied, it is apparent that their life history traits of slow growth, late maturity, and low reproductive rates leave them sensitive to habitat and population disturbances (Roberts 2002; Devine et al. 2006; Clark et al. 2016). For example, Devine et al. (2006) examined Canadian RV data for five deep slope species (blue hake, roughhead grenadier, roundnose grenadier, spinytail skate and spiny eel) that live in excess of 60 years, grow larger than a metre in length and mature in their late teens. The study determined that these species declined in abundance in excess of 87 percent over a 17-year period following exploitation of emerging continental slope fisheries. While the grenadiers were the target of directed commercial fisheries, the remaining species were largely caught as by-catch in Greenland halibut and redfish fisheries.

Pelagic species within the Project Area fall into two general forms: resident pelagic species (such as capelin and lanternfish) and migratory warm water pelagics (tunas, swordfish and several shark species). Resident species are able to conduct their life histories within the cold northern waters and, in many cases, are well-represented in the RV survey data. Capelin, for example, is a planktivorous fish that is largely restricted to the continental shelf (Figure 6-16), where they make seasonal migrations to inshore areas but have also reached the Flemish Cap during cold weather anomalies (Frank et al. 1996). In contrast, lanternfish are found in demersal habitats of deeper slope waters (Figure 6-17) and migrate upward in the water column on a daily basis to feed on plankton. Both species are important prey items in the pelagic and demersal food chains.

In contrast, migratory pelagics (including swordfish, sharks, tunas) are typically large bodied predators (Atlantic mackerel, herring and Atlantic saury are notable smaller, planktivorous exceptions) that seasonally migrate from temperate areas into northern waters to feed (see Figure 6-37 for example). During their northern migrations, these temperate species typically remain in areas under the influence of the Gulf Stream (Walli et al. 2009; Vandeperre et al. 2014), and therefore would be expected to be at relatively low abundance in the Project Area - areas principally exposed to the Labrador Current. Catches of mackerel and Atlantic herring are reported for the Flemish Cap (Nogueira et al. 2017) despite not being well-represented in trawl data and Canadian or EU RV surveys, but these catches are likely small relative to those catches reported for demersal species (Amec 2014a). Additional general life history, diet and distribution information on these and other species is available within the Eastern Newfoundland SEA (Amec 2014a).



Source: Adapted from Ocearch (2016)

Figure 6-37 Migratory Path of a Female White Shark from Temperate Habitats to the Vicinity of the Project Area

6.1.7.4 Migratory Atlantic Salmon (*Salmo salar*)

Information on Atlantic salmon (*Salmo salar*) migration and habitat patterns in the North Atlantic is provided here as baseline information to support the eventual analysis of potential effects on this migratory species, and its use for traditional activities by Indigenous Peoples (Section 7.3 and Chapter 12).

Atlantic salmon occur in approximately 2,500 rivers flowing into the North Atlantic Ocean and despite extensive research on the freshwater portion of their life history, less is known about their life history once they leave their natal rivers and undertake migrations in the North Atlantic Ocean (COSEWIC 2010a; Lefevre et al. 2012, Windsor et al. 2012). Anadromous Atlantic salmon typically leave their natal rivers during the spring as smolt and spend from one to four years in the marine environment before returning to spawn as adults (Gardner 1976; COSEWIC 2010a). During their first winter at sea, young salmon are called post-smolt; after their first winter, they are called adult salmon regardless of the number of subsequent winters at sea prior to returning to their home river.

Salmon post-smolt and adults feed on various plankton, crustaceans, and larval fish (Lacroix and Knox 2004; Sheehan et al. 2012) in the upper water layers (Reddin and Friedland 1993). Both post-smolt and adult salmon tend to spend most of their time within the upper water layers, generally in the upper 5-10 m (Reddin and Shearer 1987; Reddin and Friedland 1993; Hedger et al. 2017; Strom et al.), although recent research with satellite ‘pop-up’ tags are indicating that adults may also use deeper water (i.e., European salmon have been recorded making dives up to 900 m) (Hedger et al. 2017; Strom et al. 2017; Windsor et al. 2012). Salmon tagged from Campbellton River in Newfoundland were frequently present at depths of more than 5 m (Windsor et al. 2012).

The distribution and movement patterns of both post-smolt and adult salmon within the marine environment are highly complex and much information comes from studies related to commercial fisheries, research trawls, and tagging studies (Reddin and Friedland 1993; Reddin 2006). The North Atlantic Salmon Conservation Organization (NASCO) has been reanalyzing historic tag recovery data and has begun additional research using methods such as genetic population assignments, baseline microsatellite genetic data, stable isotopes, ‘pop-up’ satellite and acoustic tagging (Windsor et al. 2012); however, many of these analyses are ongoing. The available results of past and ongoing research provide insight to patterns of migration, food resources, distribution and abundance but also associations to environmental factors (Reddin and Freidland 1993; Reddin 2006). While there has been limited sampling directly in the Flemish Pass area, research trawl data near the Grand Bank and throughout the known range of Atlantic salmon in the North Atlantic provide information on behaviours and preferred habitats of both post-smolt and adults which can be assimilated to infer marine habitat use and preferences. A summary of overall habitat use in the North Atlantic Ocean and a description of the suitability of habitat near the Project Area is provided below.

Commercial and research vessel catches indicate that Atlantic salmon of all sea-ages occur seasonally over most of the northwest Atlantic (Reddin and Shearer 1987, Reddin and Friedland 1993, Redden 2006; Sheehan et al. 2012). Atlantic salmon smolt are generally considered to be “energy-deficient” and have low energy reserves for somatic growth upon leaving their natal river and during the early marine phase (Jonsson and Jonsson 2003). It has been suggested that post-smolt are therefore distributed according to prevailing surface currents either close to shore or in

open waters and that strong currents act as transportation vectors that facilitate migration to marine feeding areas (Jonsson et al. 1993) to reduce energy needs. Therefore, the migration routes of post-smolt from any river may be determined by general ocean currents near its confluence with the ocean.

In general, there are concentrations of both post-smolt and adult salmon in the Labrador Sea throughout the year where they feed and overwinter (general location shown in Figure 6-38). Reddin and Friedland (1993) indicate that post-smolt were observed in the Labrador Sea in autumn of all study years and that they were most abundant between 56°N and 58°N (i.e., northern Labrador Sea area). Post-smolt in the Labrador Sea originate from rivers over much of the geographical range of salmon in North America and most post-smolt overwinter in the southern portion of the Labrador Sea (Reddin and Friedland 1993). Catch data in Reddin and Friedland (1993) indicate that post-smolt do not overwinter in the Grand Bank area during the period 23 December – 21 March. Reddin (2006) notes that post-smolt may overwinter off the Grand Bank but states that corroborative evidence from directed research or indirectly by commercial vessels fishing during the winter is lacking.

Adult salmon, primarily multi-sea-winter (MSW) fish, are also found off west Greenland during summer and fall. Prior to their spring spawning migration to their home rivers, adult salmon have been found congregating in two general offshore locations: Reddin and Friedland (1993) describe these as approximately 480 km east of the Strait of Belle Isle (western edge of Labrador Sea area Figure 6-38) and slightly east of the 200 m depth contour along the eastern edge of the Grand Bank. These general locations are indicated in Figure 6-38. Based on catch data provided in Reddin and Shearer (1987) (see Figure 6-39), the area of congregation on the eastern edge of the Grand Bank would be located south of the Flemish Pass outside of the Project Area. Sampling near the Flemish Pass in winter and summer/autumn captured no salmon (Reddin and Shearer 1987). Low catches (>0.0-1.0 salmon per mile-hour of drift gillnet) of adult salmon were recorded during the spring (Redden and Shearer 1987).

Scales from post-smolt salmon can indicate the general geographic location of their natal river; younger post-smolt (i.e., those smolt that leave their natal river at a younger age) are typically from more southern rivers (Lear and Misra 1978). For example, Labrador mainly produces smolt of river age four and older while Newfoundland smolt typically have river ages of three and four. Rivers to the south of Newfoundland in Nova Scotia, Bay of Fundy, and the United States typically produce smolt of river ages one and two (Reddin 2006). Age data, as well as river recaptures of salmon tagged off the Grand Bank (see Figure 6-40), indicate that salmon that congregate along the eastern Grand Bank are generally from more southern regions such as the Maritimes.

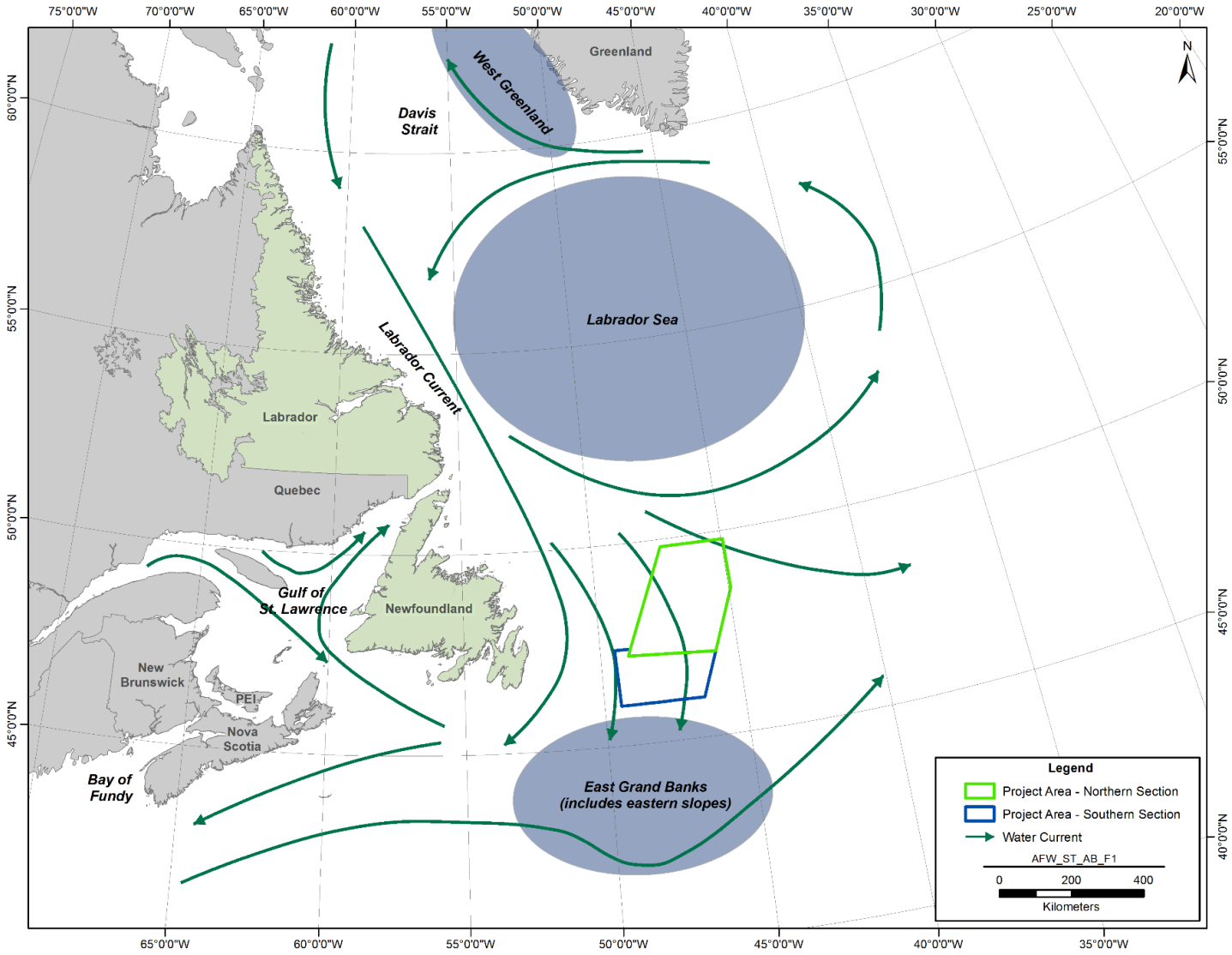
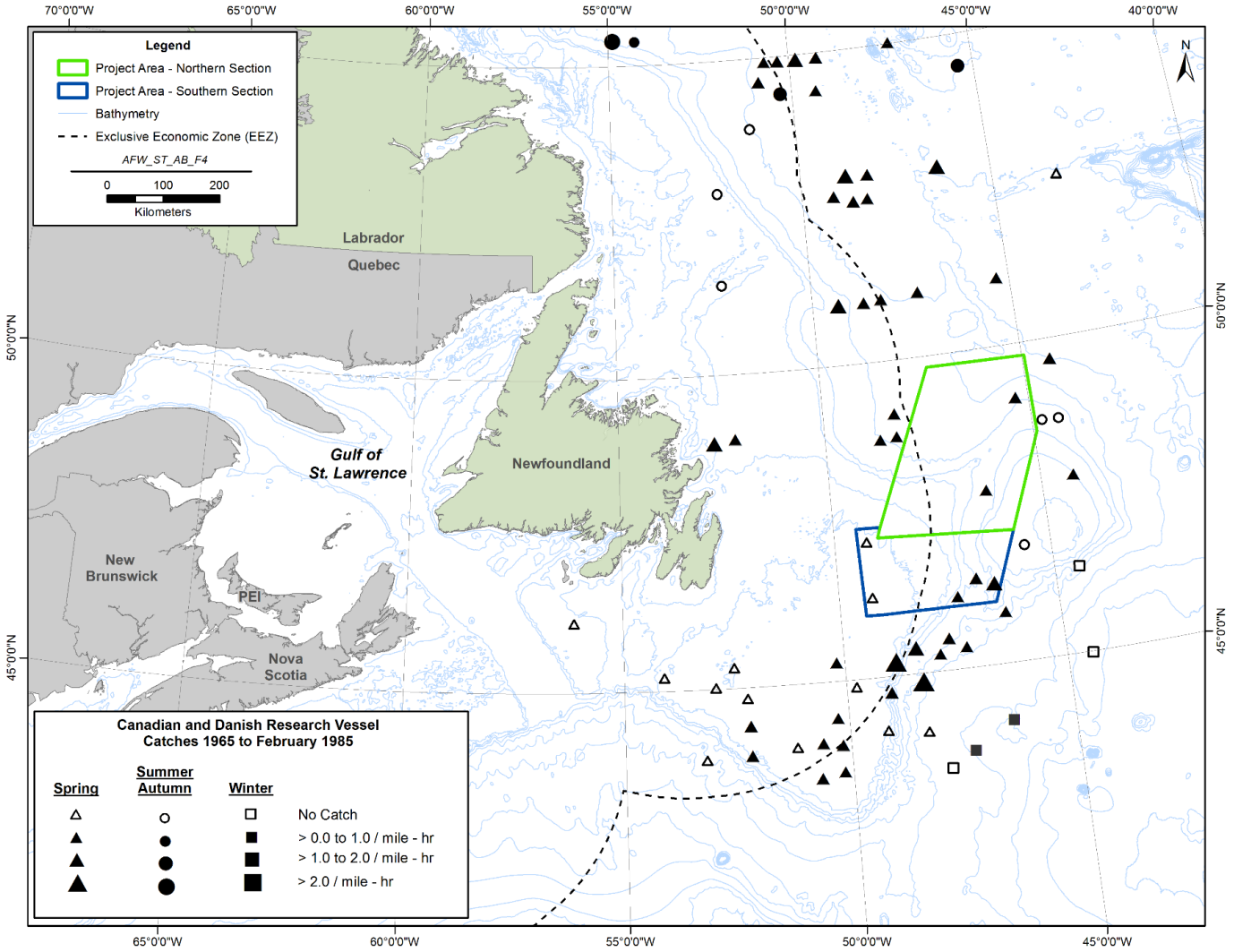
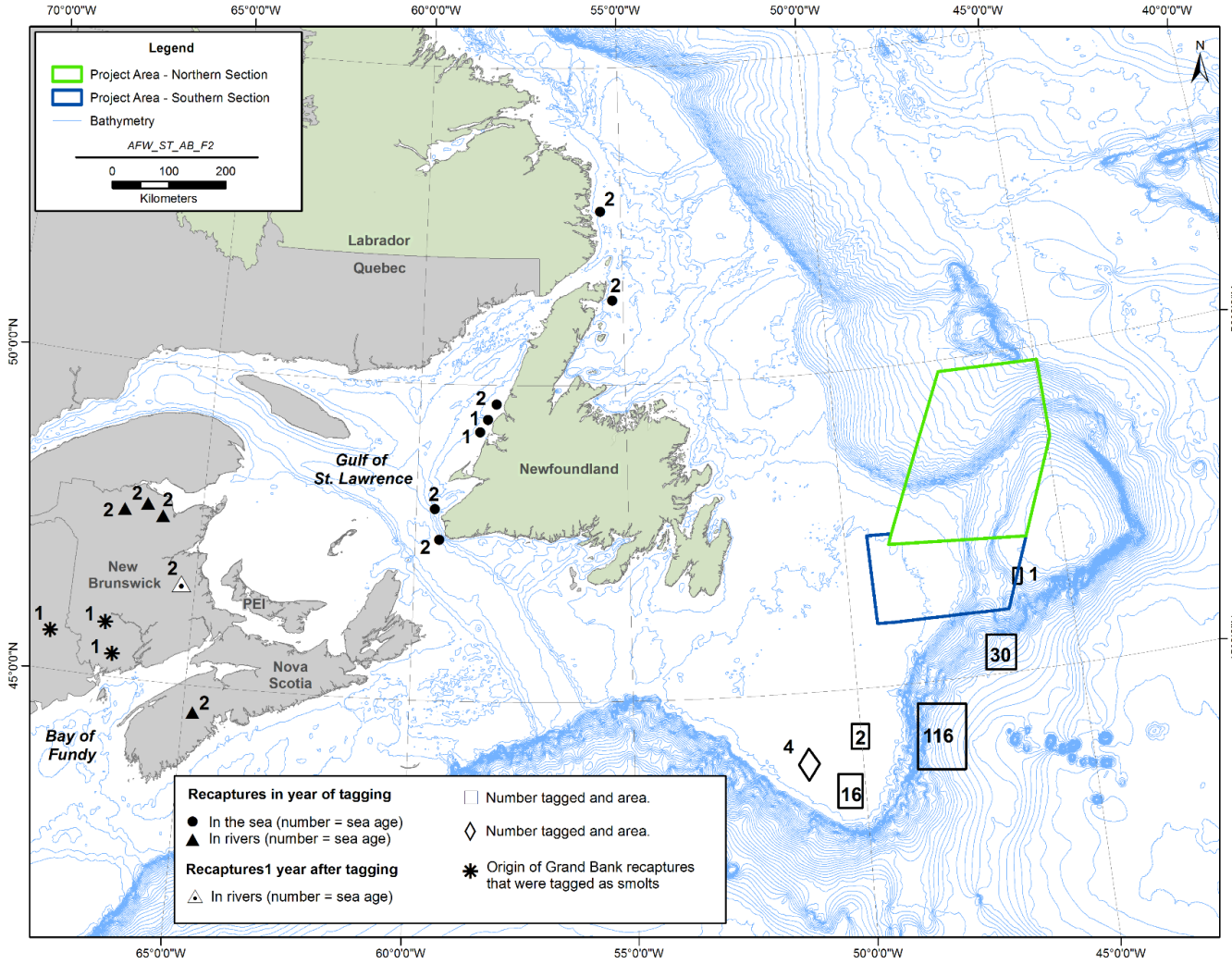


Figure 6-38 General Location of Currents and Summary Geographic Locations



Source: Reproduced from Reddin and Shearer (1987)

Figure 6-39 Research Vessel Catches of Atlantic Salmon in the Northwest Atlantic Ocean, 1965-1985



Note: Numbers associated with recaptures are sea-ages (Reproduced from Reddin 1985).

Figure 6-40 Numbers of Salmon Tagged on and East of the Grand Bank in May 1979 and 1980, and Subsequent Recaptures in the Coastal Fishery and in Rivers

Research to date provides an overview of general habitat use but also a description of suitable, preferred environmental conditions for salmon survival and growth. Changes in environmental conditions can spatially alter typical distributions and migration routes (Reddin and Shearer 1987) as well as marine survival (Reddin 2006). For example, catch data suggest that salmon modify movements at sea depending on sea surface temperature (SST). Reddin and Shearer (1987) and Reddin and Friedland (1993) found a statistically significant and marked relationship between commercial catch rates and the boundary limit of the 4°C isotherm. They showed that few salmon were located at lower temperatures and none below 3°C. The most appropriate temperature range for salmon, based on catch/abundances, has been determined to be 4°C-12°C SST in the Northwest Atlantic with an optimum between 4°C-8°C (Reddin and Friedland 1993). Reddin and Burfitt (1984) examined the relationships between salmon catch rate, SST and prey abundance and concluded that SST is the main predictor of Atlantic salmon distribution in the marine environment. Reddin and Shearer (1987) found that low SST appeared not only capable of deflecting Atlantic salmon from recognized migratory paths, but modified movements such that fish would avoid cold water even though warmer water was beyond. This avoidance behaviour was shown to affect fish habitat use during years when cold water extended south by forcing salmon to move further south as well (Reddin and Friedland 1993).

Additional information on the migration patterns of these Atlantic salmon populations is provided in Chapter 12, as part of the EIS analysis of whether salmon that are known to be used by Indigenous Peoples in Eastern Canada have the potential to interact with and be affected by the Project.

6.1.7.5 Key Spawning Times and Areas for Finfish

A variety of spawning strategies are pursued by fish in the Project Area, including broadcast spawning (Atlantic cod), oviviparous spawning (redfish) and depositing eggs in demersal cases (skates). Many resident species spawn within and around the Project Area, though several leave the area to spawn in distant places that include freshwater rivers (e.g., Atlantic salmon), beaches (e.g., capelin), or warm temperate or tropical waters (e.g., American eel, tunas and sharks). For poorly studied deep slope or abyssal species, many elements of their reproductive biology are yet to be documented.

A summary of spawning seasons and known spawning areas for key fish species is provided in Table 6.19. While a large number of fish species are spring and early summer spawners, a few (such as Greenland halibut) are winter spawners.

Table 6.19 Spawning Periods and Locations of Some Key Fish Species

Common Name	Scientific Name	Spawning Time1												Known Spawning Locations
		J	F	M	A	M	J	J	A	S	O	N	D	
Sand lance	*Ammodytes dubius*	■	■	■								■	■	Grand Bank[2,3]
Capelin	*Mallotus villosus*						■	■						Southeast shoal of Grand Bank[4] Coastal waters of Newfoundland

Table 6.19 Spawning Periods and Locations of Some Key Fish Species

Common Name	Scientific Name	Spawning Time1												Known Spawning Locations
		J	F	M	A	M	J	J	A	S	O	N	D	
Deepwater redfish	*Sebastes mentella*				■	■								Southwest Shelf Edge and Slope of Grand Bank[4,5]
American plaice	*Hippoglossoides platessoides*				■	■								Grand Bank
Sculpin	*Triglops* sp.								■	■	■	■		No particular spawning location
Lanternfish	Myctophidae				■	■	■	■						No particular spawning location
Atlantic cod[6]	*Gadus morhua*				■	■	■	■	■	■	■			Southeast shoal of Grand Bank and Virgin Rocks[4]
Greenland halibut	*Reinhardtius hippoglossoides*	■	■	■	■									Davis Strait
Blue hake	*Antimora rostrata*													Not known to spawn in Canadian waters[7]
Roughhead grenadier	*Macrourus berglax*	■	■	■	■									Grand Bank
Common grenadier	*Nezumia bairdii*	■	■	■	■									No particular spawning location

Note:
Shading indicates spawning periods.
Sources: [1] Scott and Scott (1988); [2] Winters 1983; [3] Gilman 1994; [4] Templeman (2007); [5] COSEWIC (2010b); [6] COSEWIC (2010c); [7] Kulka et al. (2003).

6.1.8 Species at Risk

Several fish species identified as species at risk or otherwise as being of special conservation concern are known to occur, or likely to occur, in the Project Area. This includes species that are designated and formally protected under either or both provincial and federal regulation, including NL ESA and SARA, or those identified as imperilled but not formally protected by conservation bodies including the COSEWIC or the International Union for the Conservation of Nature (IUCN).

Under the NL ESA the categories for protection designation of indigenous species, sub-species and populations are as follows:

- *Endangered*: A species that is facing imminent extirpation or extinction;
- *Threatened*: A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction; and
- *Vulnerable*: A species that has characteristics which make it sensitive to human activities or natural events.

SARA provides federal protection to facilitate the recovery of Threatened and Endangered species as well as promoting the management of other species to prevent them from becoming at risk in the future. Designations under SARA are guided by the advice provided by the COSEWIC. Species with formal protection are listed on Schedule 1 of SARA, designations are as follows:

- Extirpated: A species that no longer exists in the wild in Canada, but exists in the wild elsewhere;
- Endangered: A species that is facing imminent extirpation or extinction;
- Threatened: A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction; and
- Special Concern: A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Further information on these programs can be found within the Eastern Newfoundland SEA (Amec 2014a). In addition, although the information presented in this report is current at the time of writing, the designation status of species can be updated at any time, and therefore it is important to refer to the SARA Public Registry (www.sararegistry.gc.ca) for the most current information and requirements for Species at Risk in Canada.

Twenty-nine species with conservation designations may occur within the Project Area (Table 6.20); however, only five are listed under NL ESA or SARA legislation. These are the white shark (*SARA*: Endangered), Northern (SARA*:* Threatened), Spotted (SARA: Threatened) and Striped (SARA: Species of Concern) wolffishes and American eel (NL ESA: Vulnerable). Additionally, there are five new species that IUCN has added to this inventory since 2014 that may be found in the Project Area (Table 6.20). These are black dogfish, lanternfish, Atlantic hagfish, Atlantic halibut, and spiny tail skate. Three of these (black dogfish, lanternfish and Atlantic hagfish) only carry IUCN designations of “Least Concern”, whereas the Atlantic halibut and spinytail skate are designated by IUCN as Endangered and Vulnerable, respectively.

Table 6.20 Marine Fish Species at Risk that are Known to or May Occur within the Project Area

Species		Status / Designation [1,2]				Relevant Population (Where Applicable)	Update from SEA 2014[3]
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Striped wolffish	*Anarhichas lupus*		SC	SC			NC
Northern wolffish	*Anarhichas denticulatus*		T	T			NC
Spotted wolffish	*Anarhichas minor*		T	T			NC
American eel	*Anguilla rostrata*	V		T	E	Global (IUCN)	D
Blue shark	*Prionace glauca*			SC	NT	Atlantic (COSEWIC); Global (IUCN)	NC

Table 6.20 Marine Fish Species at Risk that are Known to or May Occur within the Project Area

Species		Status / Designation [1,2]				Relevant Population (Where Applicable)	Update from SEA 2014[3]
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Basking shark	*Cetorhinus maximus*			SC	V	Atlantic (COSEWIC); Global (IUCN)	NC
Black dogfish	*Centroscyllium fabricii*				LC	Global (IUCN)	NS, D
Atlantic cod	*Gadus morhua*			E	V	Newfoundland and Labrador (COSEWIC); Global (IUCN)	NC
Cusk	*Brosme brosme*			E			NC
Porbeagle	*Lamna nasus*			E	V	Global (IUCN)	NC
Shortfin mako	*Isurus oxyrinchus*			T	V	Atlantic (COSEWIC);	NC
						Global (IUCN)	NC
White shark	*Carcharodon carcharias*		E	E	V	Atlantic (COSEWIC/SARA); Global (IUCN)	NC
Roughhead grenadier	*Macrourus berglax*			SC			NC
Roundnose grenadier	*Coryphaenoides rupestris*			E	CE	Global (IUCN)	D
Lanternfish	*Myctophidae*				LC	Global (IUCN)	NS, D
Atlantic hagfish	*Myxine glutinosa*				LC	Global (IUCN)	NS, D
American plaice	*Hippoglossoides platessoides*			T		Newfoundland and Labrador (COSEWIC)	NC
Atlantic halibut	*Hippoglossus hippoglossus*			NR	E	Global (IUCN)	NS, D
Barndoor skate	*Dipturus laevis*			NR	E	Global (IUCN)	D
Smooth skate	*Malacoraja senta*			E	E	Funk Island Deep (COSEWIC); Global (IUCN)	NC
Spinytail skate	*Bathyraja spinicauda*				NT, V	Global, Northwest Atlantic (IUCN)	NS, D
Thorny skate	*Amblyraja radiata*			SC	V	Canada, Global (IUCN)	NC
Winter skate	*Leucoraja ocellata*			E	E	Eastern Scotian Shelf – Newfoundland (COSEWIC); Global (IUCN)	D

Table 6.20 Marine Fish Species at Risk that are Known to or May Occur within the Project Area

Species		Status / Designation [1,2]				Relevant Population (Where Applicable)	Update from SEA 2014[3]
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Atlantic salmon	*Salmo salar*			T, SC, E	LC	South Newfoundland, Quebec Eastern North Shore, Quebec Western North Shore, Anicosti Island, Inner St. Lawrence, Gaspe-Southern Gulf of St. Lawrence, Eastern Cape Breton, Nova Scotia Southern Upland (COSEWIC); Global (IUCN)	D
Atlantic bluefin tuna	*Thunnus thynnus*			E	E	Global (IUCN)	NC
Bigeye tuna	*Thunnus obesus*				V	Global (IUCN)	NC
Acadian redfish	*Sebastes fasciatus*			T	E	Atlantic (COSEWIC);	NC
						Global (IUCN)	NC
Deepwater redfish	*Sebastes mentella*			T	LC	Northern (COSEWIC);	NC
						Global (IUCN)	NC
Spiny dogfish	*Squalus acanthias*			SC	V	Atlantic (COSEWIC);	NC
						Global (IUCN)	NC

Notes:
[1] Not at Risk (NR), Least Concern (LC), Vulnerable (V), Near Threatened (NT), Special Concern (SC), Threatened (T), Endangered (E), Critically Endangered (CE)
[2] Multiple designations refer to multiple populations or sub-populations
[3] No change (NC), New Species (NS), New Designation (D)

Summary information on the biology and the distribution of these species within the Project Area is provided in Table 6.21. Several of the resident species are commercially harvested, such as Atlantic cod, American plaice, roughhead and roundnose grenadiers, and thorny skate. Others, like the skates, are common bycatch in commercial fisheries that target other species. Such species have experienced declines at least in part due to fishing pressure. Many large, long-lived and/or deep-water species, such as wolffish, sharks, skates and grenadiers have long life spans, slow reproductive periods and/or occur at naturally low densities, making them vulnerable to additional mortality. Finally, several species of concern are large migratory pelagics (such as sharks and tuna) that are likely infrequent visitors to the cold waters of the Project Area.

Table 6.21 Summary of Habitat, Distribution, and Ecology of Species of Conservation Concern

Species	Habitat, Distribution and Ecology[1]
Striped wolffish*	• Spawns September and October • Pelagic larvae • Adults residents in Project Area • Abundant in Flemish Pass and continental slopes
Northern wolffish*	• Spawns September through November • Pelagic larvae • Adults resident in Project Area • Aggregated in Flemish Pass and northeast slopes
Spotted wolffish*	• Spawn June, July and August • Pelagic larvae • Adults resident in Project Area • Common on Flemish Cap, eastern Grand Banks and Newfoundland Shelf
White shark*	• Timing and location of spawning is unknown • Migratory pelagic species • May occasionally pass through the region
American eel*	• Spawn in the Sargasso Sea • Pelagic species • May pass through Project Area during migrations to or from spawning areas
Blue shark	• Circumglobal, temperate, migratory pelagic species • Prefers surface waters of 7-16ºC • Likely only occurs in the Project Area during warm water season • Undergoes a 9-12 month gestation period • Commercially important species
Basking shark	• Circumglobal, temperate, migratory pelagic species • Likely only occurs in the Project Area during warm water season • Mainly caught in waters ranging from 8-12ºC • Filter feeding planktivore • Oviviparous • Not commercially important
Black dogfish	• Small, deep water demersal shark • Numerically abundant in Canadian (1,000-1,300 m) and NAFO (600-1,460 m) Project Area waters • Young are reared in a brood chamber • Not commercially important
Atlantic cod	• Occurs on shelf and along shelf edge • Found within the Canadian EEZ and on the Flemish Cap • Broadcast spawner • Undergo inshore spawning migrations • Valuable commercial species harvested by several nations

Table 6.21 Summary of Habitat, Distribution, and Ecology of Species of Conservation Concern

Species	Habitat, Distribution and Ecology[1]
Cusk	• Slow swimming demersal fish • Temperate species that can be occasionally found further north on the slope edge • Were rare in Project Area Canadian RV surveys • Found in depths up to 1,000 m • Does not have any important socioeconomic use
Porbeagle	• Pelagic, littoral shark that is most common and continental shelves but can occur well offshore • Usually found in temperatures below 16ºC • Likely only occurs in the Project Area during warm water season • Mate in southern Newfoundland and give birth to live young • Not commercially important.
Shortfin mako	• A very fast, migratory shark • Circumglobal distribution in temperate and tropical waters • Typically found in waters above 17ºC and is usually associated with the Gulf Stream in Atlantic Canadian waters • Likely only occurs in the Project Area during warm water season • Can live to 45 years • Commercially important species
Roughhead grenadier	• Demersal species that is numerically dominant in Project Area along Slope from depths ranging from 500-2,000 m • Slow growing • Can be found in greater abundance in areas with soft corals • Commercially important
Roundnose grenadier	• Demersal species that is numerically dominant in Project Area along Slope from depths ranging from 500-1,450 m • Adults residents in Project Area • Mature fish found in deeper water • Can be found in greater abundance in areas with Gorgonian corals • Commercially important
American plaice	• Benthic flatfish that occurs in shallow (<250 m), cold water on the Grand Banks, Continental Shelf and the Flemish Cap • Adults are residents in Project Area • Broadcast spawner (spawning season is April in Project Area) • Commercially important
Atlantic halibut	• Largest flatfish in Project Area • A dominant Shelf/Slope Edge demersal species within the Canadian EEZ of the Project Area. • Not reported as numerically abundant off the Flemish Cap • Buoyant eggs • Commercially important

Table 6.21 Summary of Habitat, Distribution, and Ecology of Species of Conservation Concern

Species	Habitat, Distribution and Ecology[1]
Barndoor skate	• One of the largest species of skates in the Atlantic • Predominantly a more southern species, has been located as far east as the Flemish Cap • Found across depths up to 1,000 m • Deposits eggs in a capsule (skate purse) • Not commercially important
Smooth skate	• Captures in Canadian RV surveys of the Project Area were restricted to depths less than 500 m • Resident species but not numerically dominant in Canadian or NAFO waters in Project Area • Lays 40-100 large egg capsules per year • Not commercially important in the region
Spinytail skate	• One of the largest species of skates in the Atlantic • Found across all depth zones in the Canadian RV survey portions of the Project Area, but was not detected beyond ~1,700 m in deepwater long line surveys off the Flemish Cap • Common bycatch species in Greenland halibut fishery • Little is known about its life history • Sometimes used for human consumption
Thorny skate	• Adults are residents in Project Area and found in Canadian and NAFO areas at depths <1,200 m • In Canadian RV surveys of the Project Area, they are most abundant at depths <500 m • Occurs over a wide variety of bottom types and takes a variety of invertebrate and fish prey • Commercially important
Winter skate	• Rarely found in the Project Area • Most specimens are captured in <150 m of water but have been found as deep as 400 m • Occur over sandy or gravelly bottoms • Slow growing • Deposit 6-50 egg cases • Not commercially important
Atlantic salmon	• Anadromous species that spawns in freshwater rivers and can undertake oceanic feeding migrations • Adults return to natal spawning grounds after 1-3 years at sea • During ocean life history stage, they live a pelagic lifestyle • Populations from southern Newfoundland, Nova Scotia and the Gulf of St. Lawrence may pass through the Project Area on seaward migrations • May overwinter in the general vicinity of the Project Area, but most would be north of the Project Area. • Have recreational, cultural and commercial significance

Table 6.21 Summary of Habitat, Distribution, and Ecology of Species of Conservation Concern

Species	Habitat, Distribution and Ecology[1]
Atlantic bluefin tuna	• Large migratory pelagic species • Reside predominantly in temperate waters would occur in the Project Area only during warm water seasons • 99 percent of fishery captures are in Gulf of St. Lawrence and off Nova Scotia • Dive to depths up to 1,000 m
Bigeye tuna	• Migratory, pelagic oceanic species that is found in 13-29ºC water • Mostly found in depths shallower than 500 m but can dive deeper • Would occur in the Project Area only during warm water seasons and • Commercially important
Acadian redfish	• Distributed in shallower water than Deepwater redfish • Adults residents in Project Area • Numerically abundant in shallow Flemish Cap (<250 m) RV surveys • Not captured in Canadian Project Area surveys • Eggs develop in brood chamber, young are pelagic and important part of ichthyoplankton community • Commercially important
Deepwater redfish	• Found in upper slope waters (250-1,000 m) in the Project Area (Flemish Cap and Continental Shelf) • Year round residents of the Project Area • Eggs develop in brood chamber, young are pelagic and important part of ichthyoplankton community • Commercially important
Spiny dogfish	• More temperature species that rarely occurs in the Project Area[1] • Typically occupies shelf and shelf edge habitats[1] • Undertake seasonal inshore/offshore migrations[1] • Slow growing and long lived • Eggs incubated in a brood chamber • Not commercially important
Notes: * Formally protected under *SARA* or *NL ESA* [1]Information based on data presented in this Chapter, Amec (2014) or relevant COSEWIC and/or IUCN status reports.	

The presence and distributions of SARA listed demersal species and those of commercial importance are presented in Figures 6-41 to 6-45 (see also Figures 6-32 and 6-37). Species such as wolffish and grenadiers are found in greatest abundance in the slope areas, whereas Atlantic cod and thorny skate are most abundant on the slope edges of the Flemish Pass in Canadian waters and of the Flemish Cap in NAFO waters. In contrast, American plaice is mostly restricted to Shelf areas of the Grand Banks and the Flemish Cap.

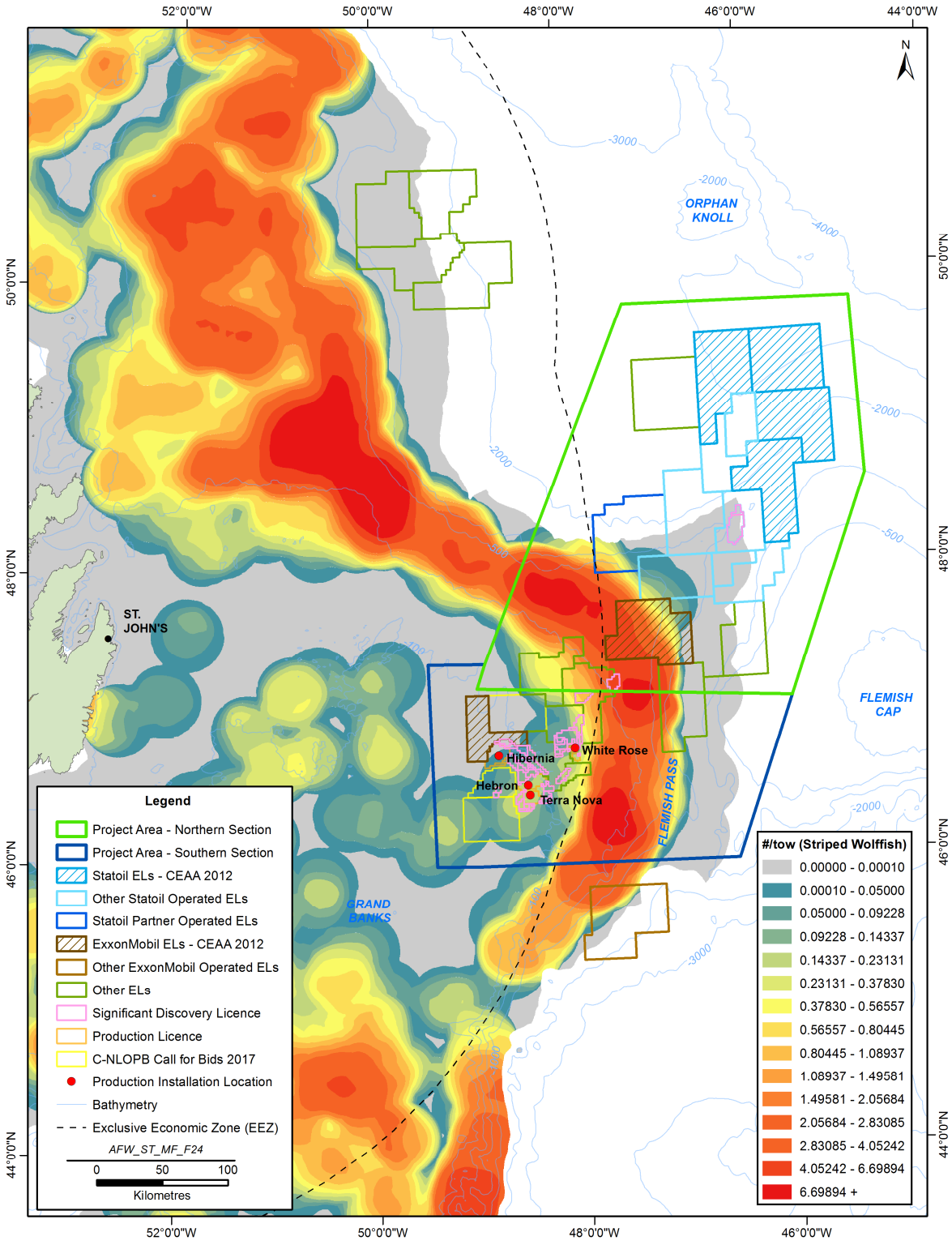


Figure 6-41 Striped Wolffish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data

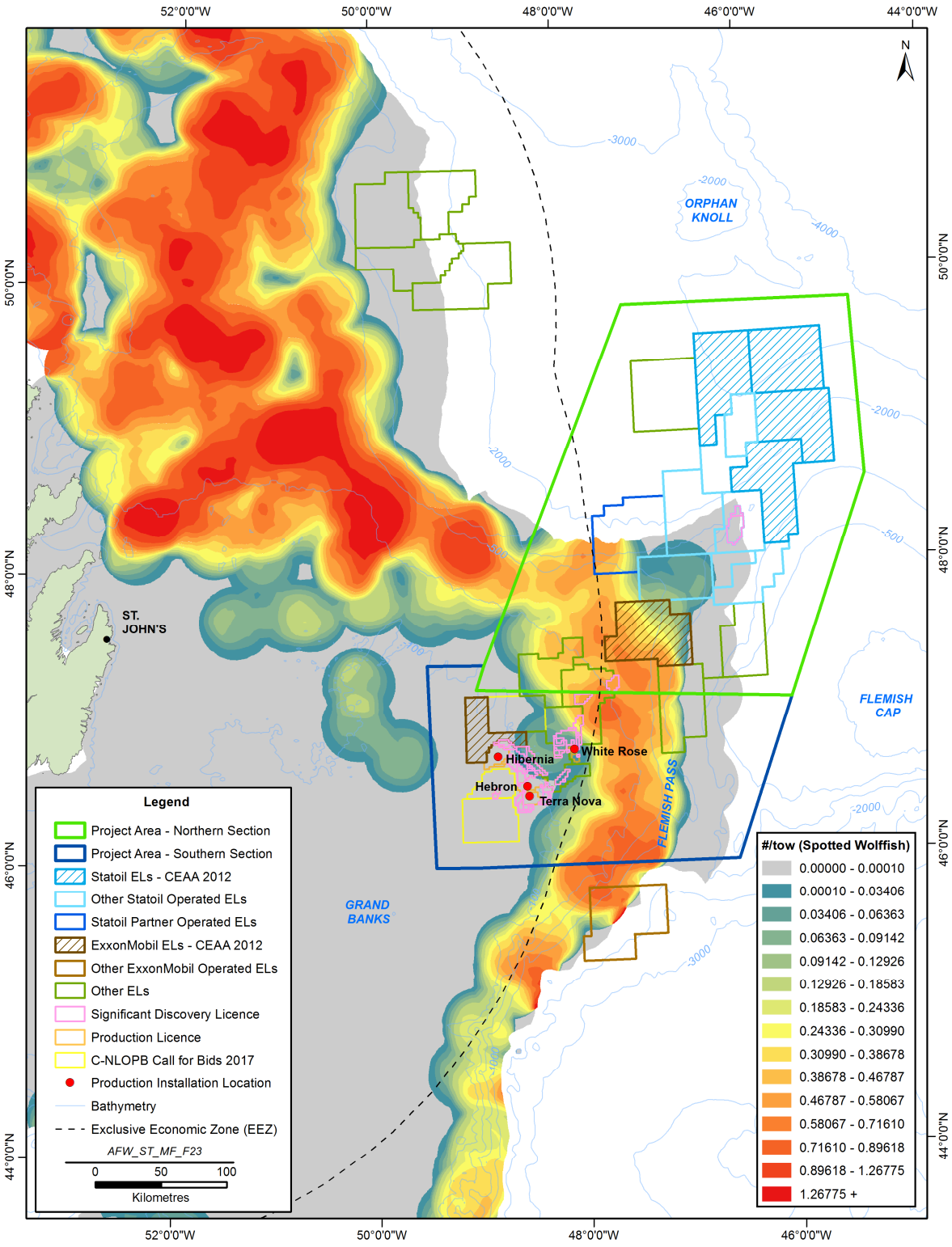


Figure 6-42 Spotted Wolffish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data

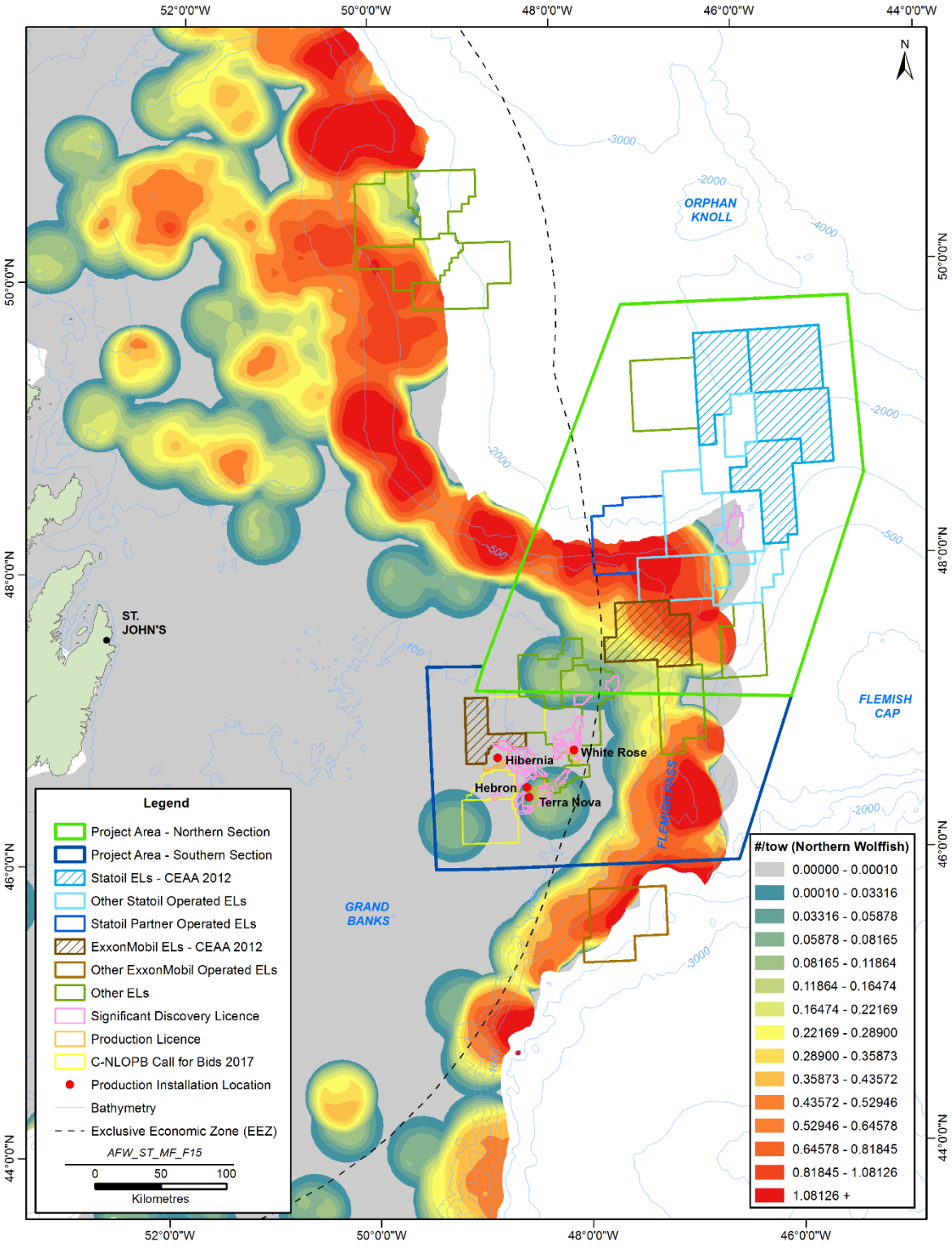


Figure 6-43 Northern Wolffish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data

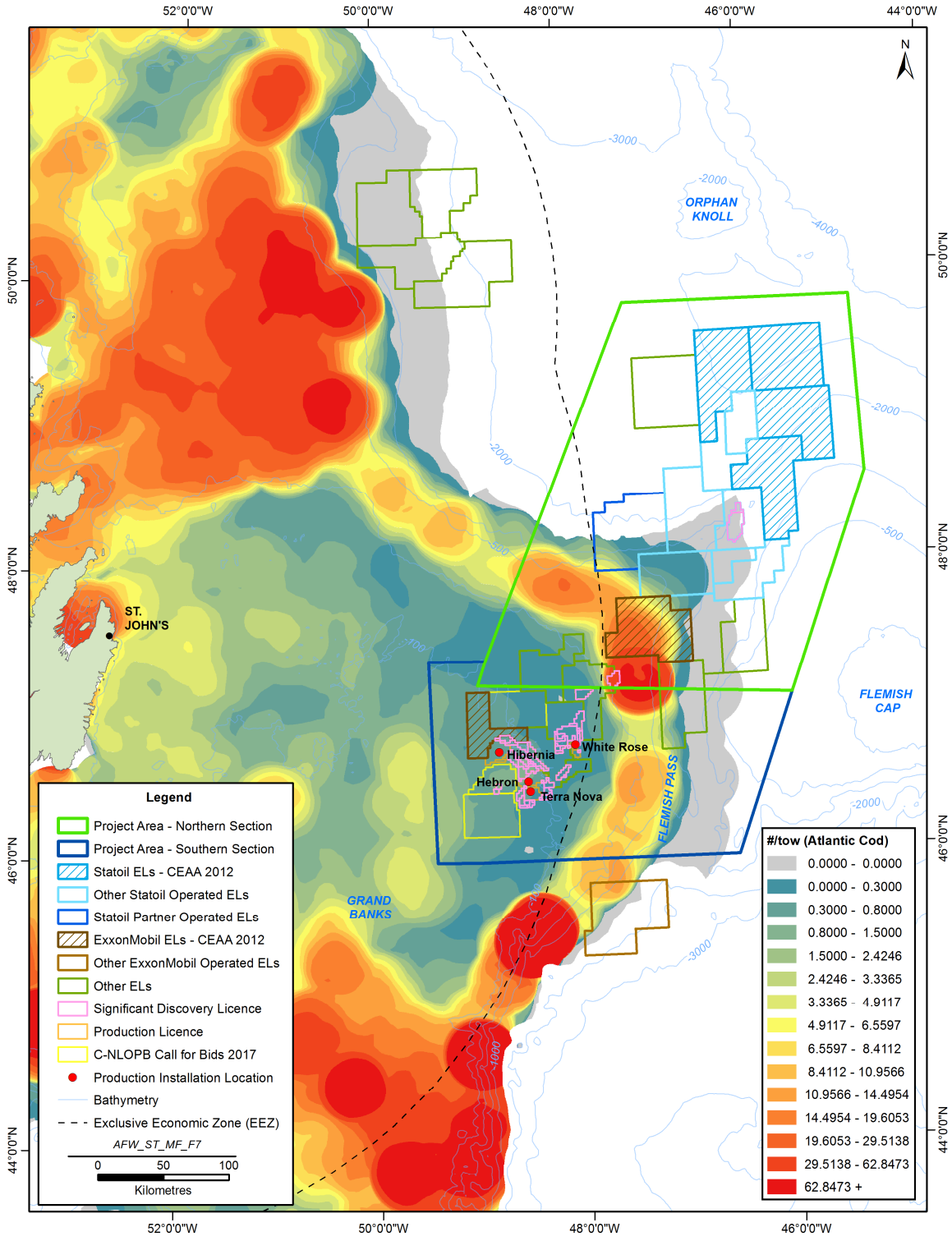


Figure 6-44 Atlantic Cod Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data

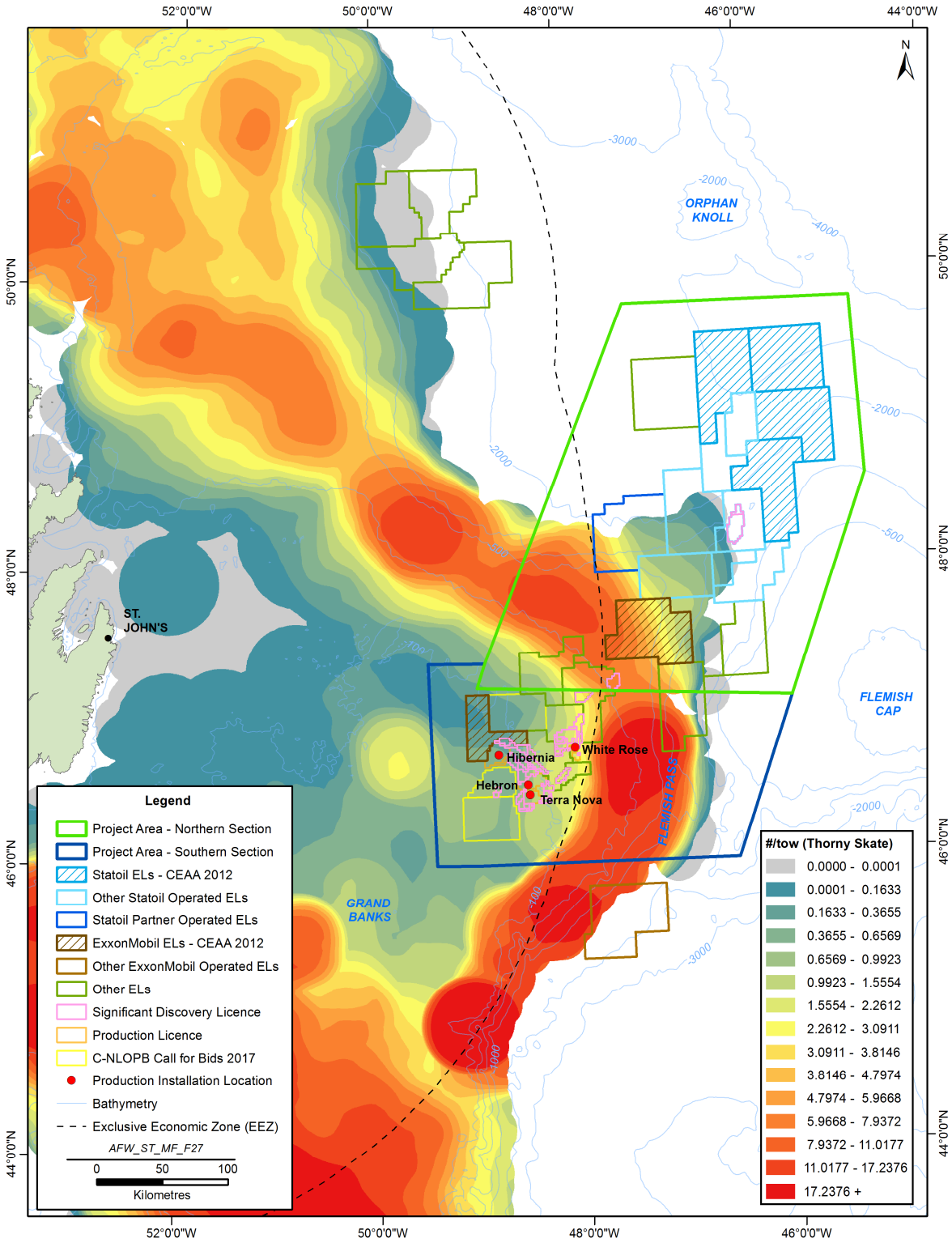


Figure 6-45 Thorny Skate Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data

6.1.9 Summary of Key Areas and Times

Plankton blooms occur in the spring and the fall with their exact timing largely dependent on seasonal and oceanographic conditions. The seasonal cycle affects temperature and controls light availability, which in turn triggers blooms of primary productivity. These increases in primary productivity trigger secondary productivity (i.e., zooplankton growth). The resulting spike in available prey sparks additional ecosystem activity that includes elevated feeding opportunities for resident species, lures migratory species from more southerly environments, and provides optimal conditions to spawning and subsequent larval survival. Not surprisingly, therefore, temporal periods of significance are often synchronized across several species in the spring / early summer period. During this time, the primary plankton bloom coincides with the spawning events of many invertebrate and fish species (Table 6.19).

However, there are exceptions to these generalizations. Life histories of some species allow them to spawn outside of this spring / early summer period. For example, slope species such as Greenland halibut and roughhead grenadier are winter spawners, whereas scallops and surf clams are late summer spawners. Some deep-water invertebrate species even exhibit aseasonal reproduction. Furthermore, large migratory pelagics often arrive after the plankton bloom dissipates and may remain in the northern extent of their range while temperatures remain warm. Other highly migratory species such as Atlantic salmon may overwinter within the region (Reddin 1985).

Ecosystem productivity and habitat heterogeneity are important characteristics and can be inferred by examining: 1) where greater numbers of animals exist (abundance, Figure 6-46); 2) where more species of animals co-exist (richness, Figure 6-47); and 3) areas that support a larger volume of biota (biomass, Figure 6-48). Areas in the marine environment with high values in one or more of these measures are likely to have greater ecosystem value.

In regions in and around the Project Area that have been surveyed (Figures 6-46 to 6-48), the slope area along the northeast edge of the Grand Banks has the highest abundance (Figure 6-46), richness (Figure 6-47), and biomass (Figure 6-48) relative to the shelf and slope areas covered by the Canadian RV survey. Species richness exists at regionally high levels at greater depths along the northeast edge of the Grand Banks, as well as along the slope region of the Flemish Cap and along the eastern edge of the Flemish Pass. The greatest densities of animals collected per trawl in these surveys was at the shelf edge, at the interface of the northeast slope of the Grand Banks and the northern section of the Grand Banks. These productive and diverse areas overlap with those known to contain abundant sponge and coral diversity, strong nutrient content, seawater mixing (e.g., Frontal Exclusion Zone; Amec 2014a) and typically strong primary production.

Deep slope habitats likely have less temporal variability as primary productivity blooms are restricted to upper layers and water temperatures are cold and more stable, thus limiting seasonal intrusions by temperate migratory species. At greater depths, species and habitats are poorly understood but are considered fragile because the species that occupy these areas have life history traits that limit their resilience to perturbations.

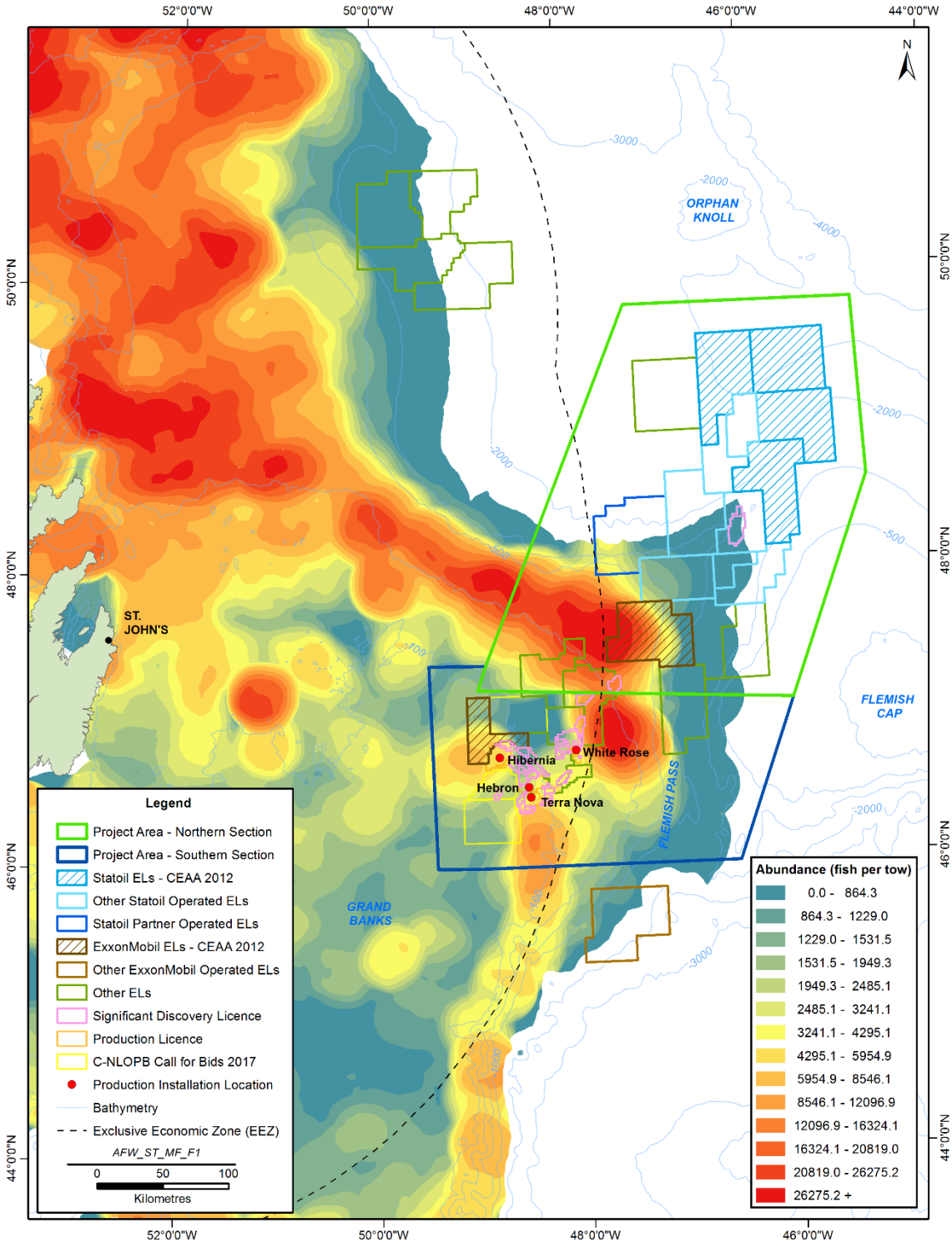


Figure 6-46 Overall Abundance of Organisms (Fish and Commercially Important Invertebrate Species) Inventoried from Canadian RV Trawl Survey Data (2008-2012)

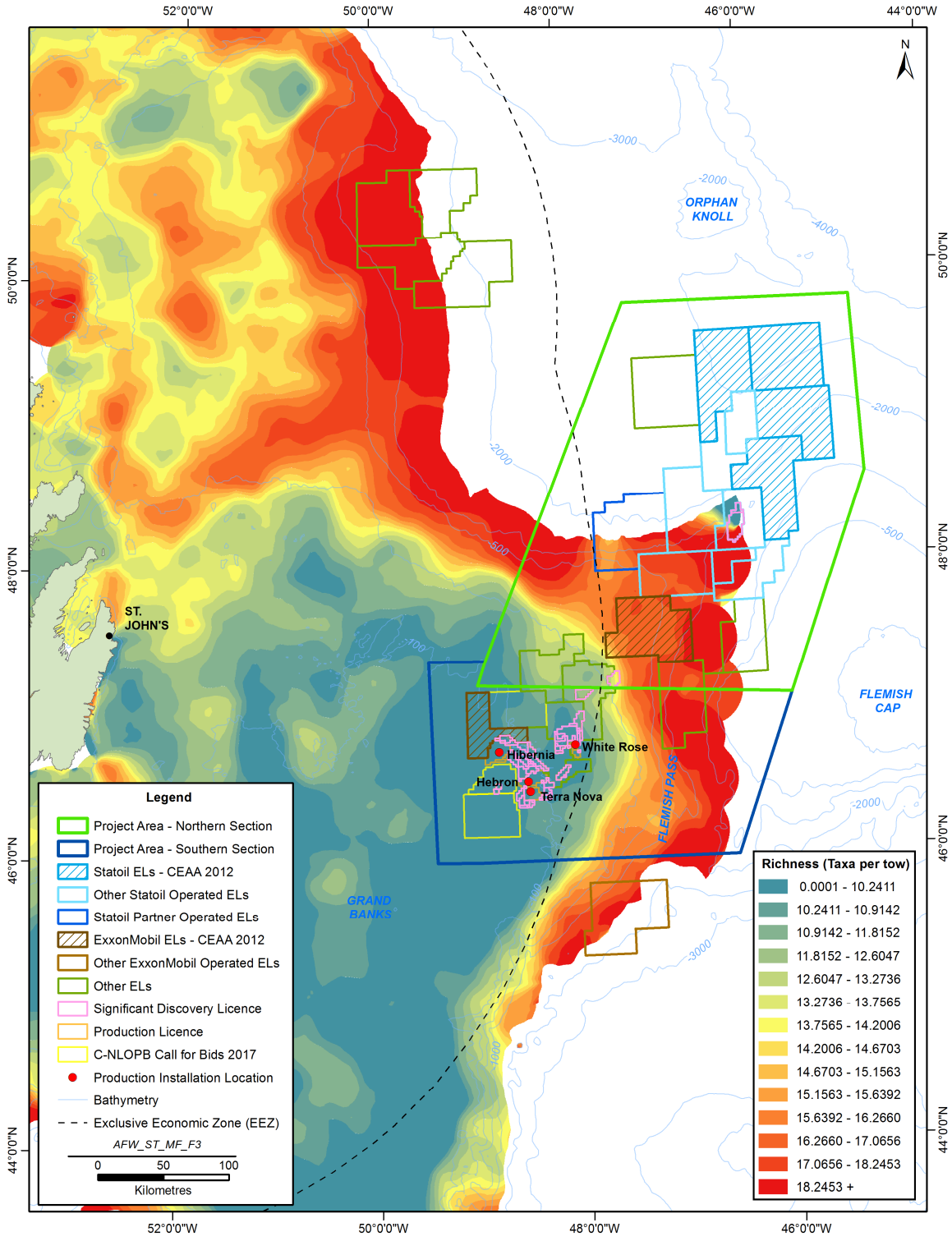


Figure 6-47 Total Species Richness (Fish and Commercially Important Invertebrate Species) Inventoried from Canadian RV Trawl Survey Data (2008-2012)

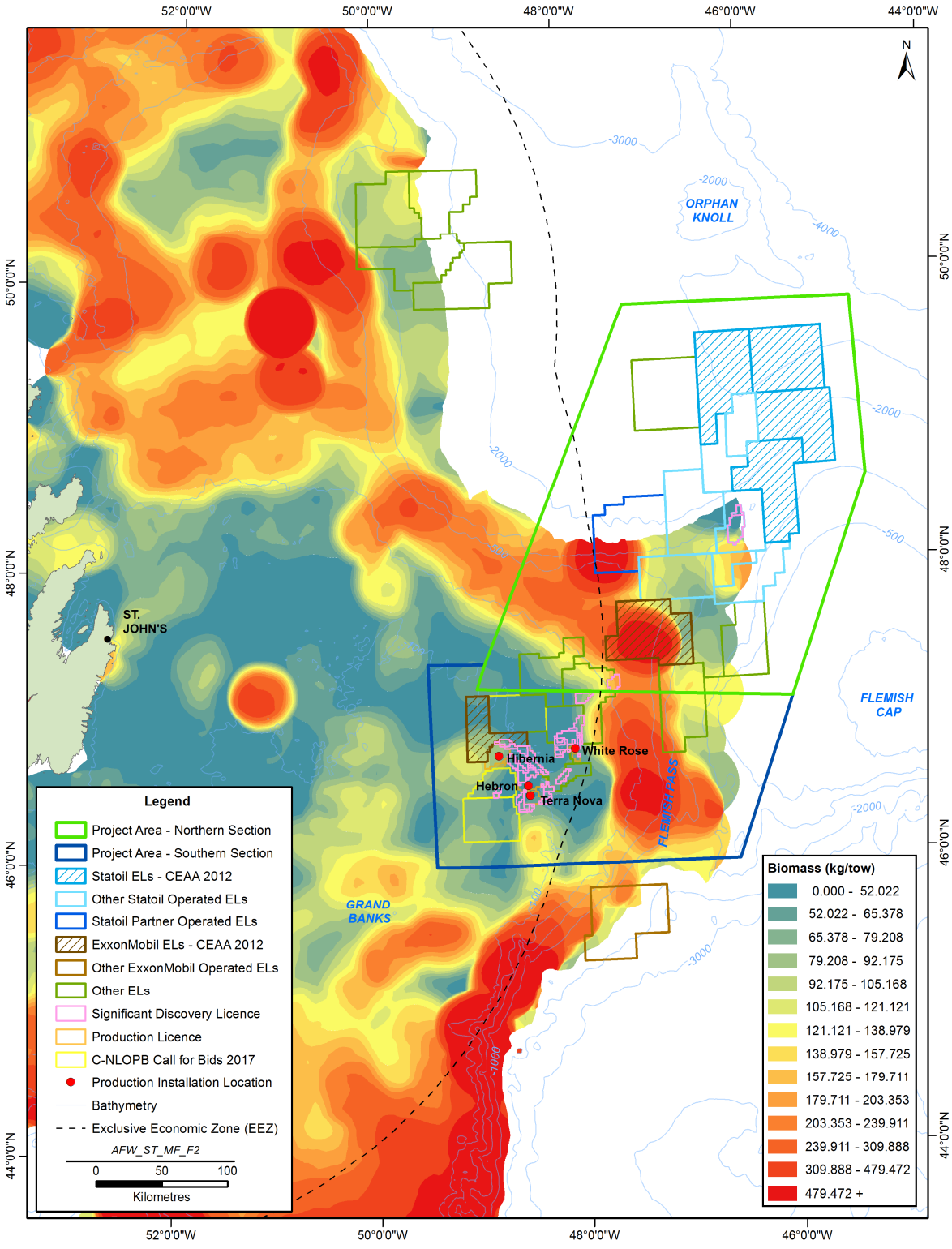


Figure 6-48 Total Biomass (Fish and Commercially Important Invertebrate Species) Inventoried from Canadian RV Trawl Survey Data (2008-2012)

Existing conservation designations by DFO and NAFO mirror the characterizations described above. For example, DFO has established the Northeast Shelf and Slope EBSA, which is an area of high species richness and supports aggregations of spotted wolffish and Greenland halibut in the spring. Similarly, NAFO has several fishing closure zones (fishery closure areas) on the north slope of the Flemish Pass and Sackville Spur that were established to protect habitat-forming species such corals (see Section 6.4 - Special Areas).

Based on the information and analysis related to marine fish and fish habitat in the preceding sections, Table 6.22 presents a summary of some key regional and seasonal considerations related to the various parts of the Project Area, including the various ELs upon which exploration drilling would occur as part of the Project.

Table 6.22 Summary of Some Key Regional and Seasonal Considerations Relevant to Marine Fish and Fish Habitat within the Project Area

Project Area Sub-Region	Key Regional and Seasonal Considerations
Project Area – Northern Section (Including ELs 1135, 1139, 1140, 1141, 1142 and surrounding areas)	• Slope areas contain relatively high densities of habitat forming sponges and corals. • VMEs Northern and Northwest Flemish Cap and Sackville Spur in this area. • Greenland halibut and “threatened” spotted wolffish aggregate in this area in the spring. • Seasonal phytoplankton blooms in the spring and fall coincide with presence in pelagic areas of early life history stages of various fish and invertebrate species. • Area of relatively high fish species richness. • Aggregation area for Atlantic cod, thorny skate and wolffish species.
Project Area – Southern Section (Including EL 1137 and surrounding areas)	• Slope areas contain habitat forming sponges and corals. • Seasonal phytoplankton blooms in the spring and fall coincide with presence in pelagic areas of early life history stages of various fish and invertebrate species. • Area of relatively high abundance and richness of fish and invertebrate species on slope areas.

6.1.10 Special Areas of Importance to Marine Fish

A number of areas of importance for marine fish and habitat have been protected through regulatory processes or identified as being special or sensitive by relevant agencies, and some special areas have received recognition or protection through one or more of such processes. Table 6.23 describes those special areas of importance to marine fish and fish habitat that overlap with the RSA. These include 2 Marine Protected Areas (MPAs), 3 Federal FCAs, 9 EBSAs, 3 Preliminary RMAs, 8 VMEs and 18 NAFO FCAs. These are described further in Sections 6.4.2 and 6.4.4.

Table 6.23 Special Areas and their Importance to Marine Fish and Fish Habitat

Special Areas	Name	Importance to Marine Fish and Fish Habitat
MPAs	Eastport-Duck Islands MPA	• A wide range of groundfish, pelagic fish, shellfish
	Eastport-Round Island MPA	

Table 6.23 Special Areas and their Importance to Marine Fish and Fish Habitat

Special Areas	Name	Importance to Marine Fish and Fish Habitat
Federal FCAs	Eastport Peninsula Lobster Management Area	• Species present include lobster, cod, capelin, herring, mackerel, crab, lumpfish, flounder, squid, sea urchin, whelk, scallops, clams, blue mussels, horse mussels, anemone, sea cucumbers, sea stars, jellyfish, polychaetes, wolffish and Atlantic salmon
	Funk Island Deep Box	• Northern shrimp habitat
	Hawke Box	• Snow crab habitat and area of cod aggregation
EBSAs	Northeast Shelf and Slope	• High aggregations of Greenland halibut and spotted wolffish. Concentrations of corals
	Virgin Rocks	• High aggregations of capelin and other spawning groundfish such as Atlantic cod, American plaice and yellowtail flounder
	Orphan Spur	• High concentrations of corals. Densities of sharks and species of conservation concern (e.g., northern, spotted and striped wolffish, skates, roundnose grenadier, American plaice, redfish)
	Lilly Canyon-Carson Canyon	• Concentration, reproduction and feeding area for Iceland scallops.
	Southeast Shoal and Tail of the Banks	• Highest benthic biomass in the Grand Banks; aggregation, feeding, breeding and/or nursery habitats for capelin, yellowtail flounder, American plaice, Atlantic cod/ 3NO cod and sand lance. Greatest concentration area of yellowtail flounder and single nursery area for the entire stock. Shallowest groundfish area. Reproduction area for, and densest concentration of, striped wolffish. Highest density of American plaice. Unique relict populations of blue mussel, wedge clam and capelin associated with beach habitats from the last glacial advance. The bivalve species are typically found in inshore areas. Capelin normally spawn on beaches and as this is the only known offshore spawning site, it could be genetically separate
	Smith Sound	• Atlantic Cod use the area for spawning and nursery grounds and as an overwintering refuge
	Fogo Shelf	• Abundance of beach and sub-tidal capelin spawning areas
	Labrador Slope	• High diversity of corals, sponges, rare or endangered species, core species and fish functional groups. Rare or endangered species: Atlantic, spotted and northern wolffish. Significant concentrations of roundnose grenadier, skates, northern shrimp, Greenland halibut, redfish, Atlantic cod and American plaice

Table 6.23 Special Areas and their Importance to Marine Fish and Fish Habitat

Special Areas	Name	Importance to Marine Fish and Fish Habitat
	Labrador Marginal Trough	• High densities of shrimp, snow crab, Greenland halibut, American plaice, witch flounder and capelin. Potential corridor for several fish species. Aggregations of planktivores, piscivores, and small and medium benthivores
Preliminary RMAs	Virgin Rocks	• Important spawning habitat for Atlantic cod, American plaice and yellowtail flounder. Congregation area for capelin
	South Grand Bank Area	• Relatively high coral species richness. High fish species richness. Significant groundfish biomass
	Northwestern Conception Bay	• Capelin spawn in high concentrations
VMEs	Northern Flemish Cap	• High density of sea pens, soft corals and black corals and, to a lesser extent, solitary stony corals and small gorgonians. Vulnerable fish species: northern wolffish and spiny dogfish
	Northeast Shelf and Slope (within Canadian EEZ)	• Abundance of gorgonian and antipatharian corals
	Southern Flemish Pass to Eastern Canyons	• Large gorgonians and high density of sponges. Vulnerable fish species: striped wolffish, redfish, spiny tailed skate, northern wolffish, some black dogfish, deep sea cat shark
	Beothuk Knoll	• Abundant gorgonian corals and high density of sponges. Vulnerable fish species: northern wolffish, spiny tailed skate, roundnose grenadier, deep sea cat shark, black dogfish
	Deep Water Coral Area	• An area where deep-water coral VMEs are considered likely
	Flemish Cap East	• Large gorgonians and high density of sponges. Vulnerable fish species: black dogfish and smooth skate
	South East Shoal and Adjacent Shelf Edge/Canyons	• Unique spawning grounds on South East Shoal, long-lived and relict bivalve populations in sandy shoal habitat. Vulnerable fish species: spawning capelin, northern wolffish, redfish, striped and spotted wolffish, roundnose grenadier and black dogfish
	Division 3O Coral Area Closure	• Existing closure based on coral concentrations. High bycatch of pennatulaceans and solitary scleractinian corals. Vulnerable fish species: white hake, redfish, black dogfish, smooth skate and deep-sea cat shark
NAFO FCAs	Sackville Spur (6)	• Closed to protect high coral and sponge concentrations • Dominant sponge species are demosponges of the order Astrophorida. Geodiids (mostly *Geodia*

Table 6.23 Special Areas and their Importance to Marine Fish and Fish Habitat

Special Areas	Name	Importance to Marine Fish and Fish Habitat
		barretti), *Stelletta normani* and *Stryphnus ponderosus* occur in the deeper water. These large-sized sponges, sometimes grow to more than 25 cm in diameter. The upper limit of the sponges is at about 1,300 m depth and extending down to about 1,800 m. These sponge grounds host a high diversity and abundance of associated megafaunal species
	Northern Flemish Cap (7), Northern Flemish Cap (8), Northern Flemish Cap (9), Northwest Flemish Cap (10), Northwest Flemish Cap (11), Northwest Flemish Cap (12)	• Closed to protect high coral and sponge concentrations • Sea pens are key biophysical components of soft-bottom VME indicator elements in the NAFO regulatory area. Aggregations of sea pens, known as “fields”, provide important structure in low-relief sand and mud habitats where there is little physical habitat complexity. Fields provide refuge for small planktonic and benthic invertebrates that may be preyed upon by fish. A system of sea pen VME indicator species has been identified extending around the edge of the Flemish Cap. Crinoids and cerianthids and black corals have been found associated with this sea pen system. Sponges, sea pens, cerianthids and crinoids are also found outside the FCA
	Flemish Pass/Eastern Canyon (2)	• Closed to protect extensive sponge grounds. • Area was expanded to protect large gorgonian corals in the Flemish Pass • Biological composition is similar to the Sackville Spur. These sponge grounds have been shown to house high species diversity compared with non-sponge ground habitat at similar depths. Some sponge, large gorgonians and seapen VMEs have also been identified outside the FCA
	Orphan Knoll	• Closed to protect seamounts • The Orphan Basin-Orphan Knoll region is biologically rich and complex. Corals, including stony corals, and sponges observed on the flanks of the seamount. Near-bottom anti-cyclonic circulation could have important implications for the benthic community
	Northeast Flemish Cap (5)	• Closed to protect high coral and sponge concentrations • Similar habitat to Northern and Northwest Flemish Cap • Encompasses a gradient of benthic communities, transitioning from coral dominated communities at ~2,450 m depth, corals intermixed with sponges around 2,000 m, sponge dominated grounds at 1,500 m, and a diverse community of corals,

Table 6.23 Special Areas and their Importance to Marine Fish and Fish Habitat

Special Areas	Name	Importance to Marine Fish and Fish Habitat
		sponges and other benthic taxa at approximately 1,300 m depth
	Eastern Flemish Cap (14)	• Closed due to significant concentrations of sea pens, a VME indicator species
	Beothuk Knoll (13)	• Closed to protect high coral and sponge concentrations
	Eastern Flemish Cap (4)	• Closed to protect high coral and sponge concentrations • See Northern, Northwest and Northeast Flemish Cap. High densities of the stalked crinoids *Gephyrocrinus grimaldii* together with several structure-forming sponges inside the FCA. A sponge and large gorgonian VME indicator element has been identified outside the FCA. Crinoids and cerianthids have also been found in this area
	Beothuk Knoll (3)	• Closed to protect high coral and sponge concentrations • Sponge and large gorgonian VMEs have been identified outside this FCA
	Tail of the Bank (1)	• Closed to protect high coral and sponge concentrations • Deep-sea sponge grounds are aggregations of large sponges that develop under certain geological, hydrological and biological conditions to form structural habitat. More recent studies to the south identified significant concentrations of erect bryozoans, large sea squirts (*Boltenia ovifera*) and small gorgonian VME indicator species, along with crinoids and cerianthids
	Newfoundland Seamounts	• Closed to protect seamounts • In general, seamounts tend to support endemic populations and unique faunal assemblages
	3O Coral Area Closure	• Closed to protect corals • Sea pen and small gorgonian VME indicator species have been identified near the FCA and species distribution models indicate a high probability of sea pens
	Fogo Seamounts (1)	• Closed as seamounts are VME indicator elements with high probability of containing VME indicator species
Sources: Templeman (2007); DFO (2007, 2013, 2014, 2016a; 2016b); WG-EAFM (2008); CPAWS (2009); EMPAAC (2013); AFW (2014); NAFO (2015, 2016b, 2016c); FAO (2016b)		

6.2 Marine and Migratory Birds

The coastline of eastern and southern Newfoundland and Labrador and the waters offshore provide important habitat for various species of marine-associated birds. The nutrient-rich Grand Banks and Flemish Cap regions are important feeding areas for dozens of marine bird species, and are of importance to planktivorous species including storm-petrels, shearwaters and dovekies due to the abundance of food in this area (Barrett et al. 2006; Fort et al. 2012, 2013). Offshore islands and mainland cliffs provide nesting grounds for tens of millions of seabirds representing some 20 species, including some of the largest seabird colonies in eastern North America south of the Hudson Strait (Lock et al. 1994). A number of special areas relevant to marine and migratory birds have also been identified in eastern Newfoundland, which have been designated as such because they provide important habitat for nationally and/or globally significant numbers of birds, and/or because they support avian species of conservation concern (Section 6.2.4).

Marine-associated birds in this area can be roughly divided into 1) seabirds, 2) waterfowl and divers, and 3) shorebirds. These groups are considered to be the most vulnerable to perturbation because they spend much of their life in the marine environment. Some landbird species may also be affected, particularly those associated with coastal habitats and those that migrate nocturnally over offshore waters (see Section 6.2.3).

6.2.1 Approach and Key Information Sources

The description of existing environmental conditions for marine and migratory birds is based on available information and datasets. Information on avifauna presence and abundance was obtained from the Canadian Wildlife Service (CWS) branch of Environment and Climate Change Canada. This source was also consulted for information on seabird colonies in eastern Newfoundland, as well as for recent data on seasonal and spatial trends in seabird abundance from the Eastern Canadian Seabirds at Sea (ECSAS) program. Records from the Atlantic Canada Shorebird Survey (ACSS) and the IBA of Canada programs were also accessed and used for the EIS. The existing information sources used are described and referenced throughout this chapter, and have been supplemented in certain instances with additional Operator-gathered environmental data collected during past exploration programs undertaken off Eastern Newfoundland. For example, bird sightings information collected during previous Statoil geophysical surveys and drilling campaigns were used to provide further information on species presence and to identify areas of importance to avifauna in and around the LSA and RSA.

Because birds are highly mobile, and as much of the available survey data is collected in an opportunistic (not systematic) manner (e.g., from vessels of opportunity), any assessment of marine and migratory bird presence is inherently regional in scope. As illustrated in the sections that follow, however, these existing and available information sources provide a good, regional understanding of these existing conditions within the Project Area, LSA and RSA, which is considered adequate and appropriate for EA purposes.

Section 6.1.4 of the EIS Guidelines outline the particular aspects of migratory birds and their habitats that are required to be described in the EIS, and in doing so, note for example that “the existing data must be supplemented by surveys, if required”. Given the regional and often dynamic nature of

avifauna presence and distributions across the Project Area, LSA and RSA, the value of undertaking such surveys over the course of EIS preparation is questionable. This issue was discussed during a meeting between the Operators and key federal and provincial regulatory agencies on March 1, 2017 at which time it was generally agreed that any such surveys would likely add little to the EIS effects analysis.

6.2.2 Seabirds

As key components and indicators of ecosystem health, seabirds are often considered to be of high intrinsic ecological importance. Further, they are of socioeconomic importance in Newfoundland and Labrador both in terms of tourism, and as a food source (murres, known locally as “turrs”, are hunted in the province). Seabirds are long-lived species with low fecundity, delayed recruitment and relatively low rates of population growth. A diverse assemblage of seabirds can be found in the marine waters off eastern Newfoundland at all times of year, including cormorants, gannets, phalaropes, gulls, terns, alcids (auks), jaegers and skuas, and tubenoses (fulmars, petrels and shearwaters), as summarized Table 6.24. Many of these taxa also nest along the coast of eastern Newfoundland. They are discussed in the following subsections, and detailed accounts of each (including general life history information) can be found in Section 4.2.2.1 of the Eastern Newfoundland SEA (Amec 2014a).

Table 6.24 Seabirds that are Known or Likely to Occur off Eastern Newfoundland

Type	Species
Phalacrocoracidae – Cormorants	Great Cormorant (*Phalacrocorax carbo*)
	Double-crested Cormorant (*Phalacrocorax auritus*)
Suliidae – Gannets	Northern Gannet (*Morus bassanus*)
Scolopacidae – Phalaropes	Red Phalarope (*Phalaropus fulicarius*)
	Red-necked Phalarope (*Phalaropus lobatus*)
Laridae – Gulls	Herring Gull (*Larus argentatus*)
	Iceland Gull (*Larus glaucoides*)
	Glaucous Gull (*Larus hyperboreus*)
	Great Black-backed Gull (*Larus marinus*)
	Ring-billed Gull (*Larus delawarensis*)
	Black-headed Gull (*Chroicocephalus ridibundus*)
	Sabine‘s Gull (*Xema sabini*)
	Ivory Gull (*Pagophila eburnea*)
	Black-legged Kittiwake (*Rissa tridactyla*)
Sternidae – Terns	Common Tern (*Sterna hirundo*)
	Arctic Tern (*Sterna paradisaea*)
	Caspian Tern (*Hydroprogne caspia*)
Alcidae – Alcids	Dovekie (*Alle alle*)
	Razorbill (*Alca torda*)

Table 6.24 Seabirds that are Known or Likely to Occur off Eastern Newfoundland

Type	Species
	Common Murre (*Uria aalge*)
	Thick-billed Murre (*Uria lomvia*)
	Atlantic Puffin (*Fratercula arctica*)
	Black Guillemot (*Cepphus grylle*)
Stercorariidae – Jaegers and Skuas	Pomarine Jaeger (*Stercorarius pomarinus*)
	Parasitic Jaeger (*Stercorarius parasiticus*)
	Long-tailed Jaeger (*Stercorarius longicaudus*)
	Great Skua (*Stercorarius skua*)
	South Polar Skua (*Stercorarius maccormicki*)
Procellariidae – Fulmars and Shearwaters	Northern Fulmar (*Fulmarus glacialis*)
	Great Shearwater (*Ardenna gravis*)
	Sooty Shearwater (*Ardenna grisea*)
	Manx Shearwater (*Puffinus puffinus*)
	Cory's Shearwater (*Calonectris borealis*)
Hydrobatidae – Storm-petrels	Leach's Storm-petrel (*Oceanodroma leucorhoa*)
	Wilson's Storm-petrel (*Oceanites oceanicus*)

Seasonal trends in abundance of seabirds off eastern Canada were examined in Fifield et al. (2009). The largest concentration of seabirds in the offshore waters of eastern Newfoundland was from March to August, while seabirds were least abundant in the area in the fall (September - October). Within the RSA, data are relatively sparse for the fall months due to lack of survey coverage, but seabird abundance was consistent throughout the rest of the year with an average of approximately 18 to 25 birds/km² (Fifield et al. 2009). The seasonal trends observed largely correspond with earlier Programme Intégré des Recherches sur les Oiseaux Pélagiques (PIROP) seabird survey data summarized in Lock et al. (1994). For these data sets, the geographical survey coverage was considerably greater in the spring and summer months than in the fall and winter, because the survey program relies heavily on the use of vessels of opportunity rather than dedicated survey vessels.

ECSAS data from 2006 to 2016 were obtained from CWS, and while these survey data cannot be used to calculate densities because they have not been corrected for detectability (unlike the data in Fifield et al. 2009), they provide valuable information on seasonal and spatial trends in abundance for the different seabird groups. Figures were developed for taxa that were commonly observed in the ECSAS surveys to illustrate these survey data for the spring (March to April), summer (May to August), fall (September to October) and winter (November to February) seasons (see specific species sections). The seasons as defined here are consistent with those used by Fifield et al. (2009) and correspond to seabirds' migratory (spring and fall), breeding (summer for northern hemisphere breeders; winter for southern hemisphere breeders) and non-breeding (winter for northern hemisphere breeders; summer for southern hemisphere breeders) seasons. Colony locations are illustrated in Figure 6-49, which is referred to throughout the following sections.

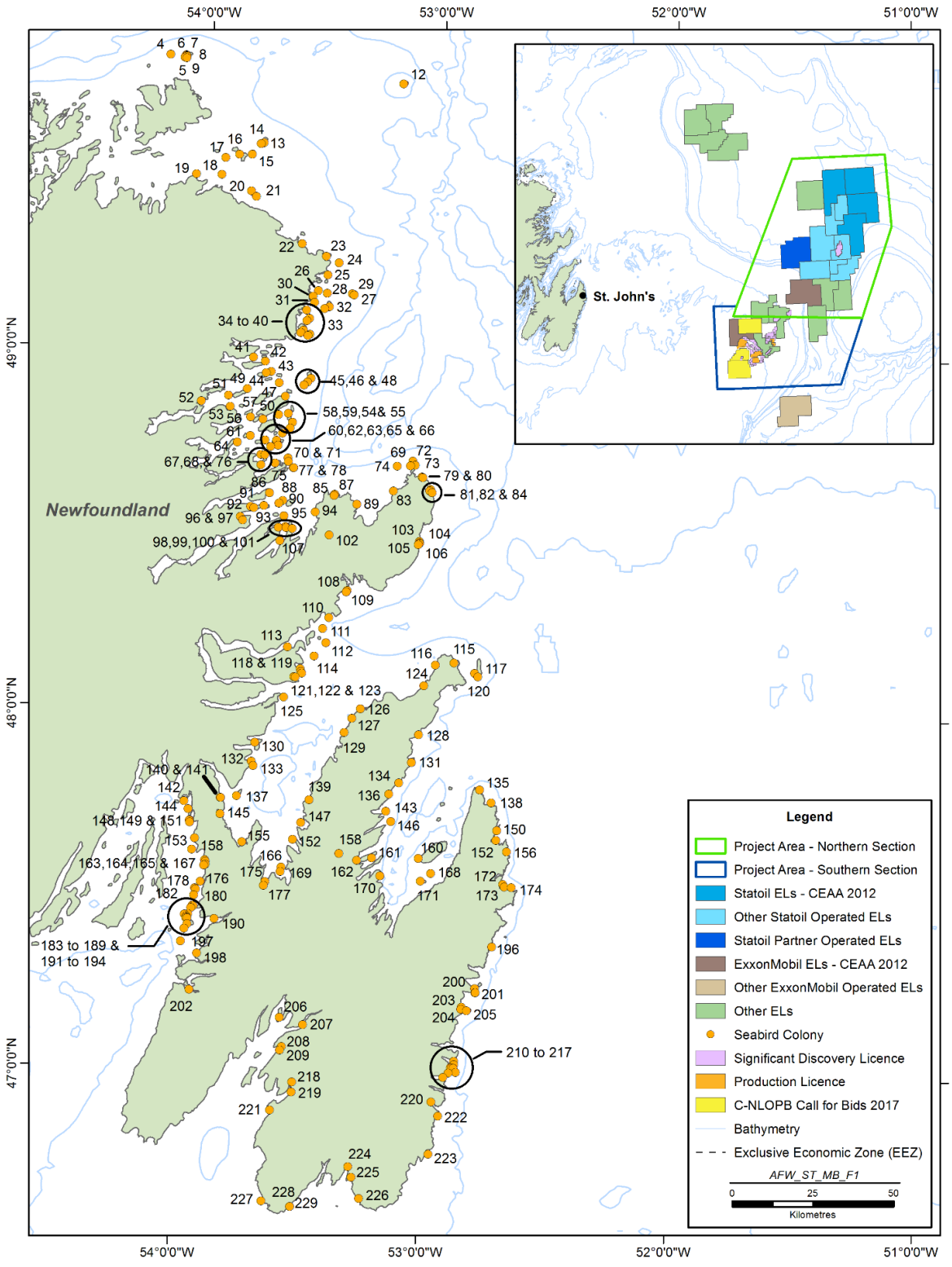


Figure 6-49 Seabird Colony Locations Eastern Newfoundland

6.2.2.1 Cormorants

Cormorants in Newfoundland are represented by two species, the double-crested cormorant and the great cormorant. both species nest in eastern newfoundland and often form mixed colonies (Hatch et al. 2000). Cormorants generally feed within a few kilometers of their colony or roost location and rarely venture far from the coast at any time of year, and so their abundance is low. Cormorants arrive at the breeding colony as early as late February, Double-crested cormorants leave the colony and migrate southward between late August and mid-October, while great cormorants are partial migrants with some individuals remaining within the breeding range year-round (Hatch et al. 2000; Dorr et al. 2015).

ECSAS sightings for cormorants off eastern Newfoundland are presented in Figure 6-50. Few of the cormorant sightings were far from shore and all were in the winter months and none within or near the Project Area. Two sightings were identified as great cormorants, and the rest were not identified to species level. CWS records identify eight cormorant colonies in eastern Newfoundland (Table 6.25), although species composition was not determined.

Table 6.25 Cormorant Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Penguin Island, South	21	60	Pairs	2005
Little Shag Rock	35	12	Pairs	2005
Big Shag Rock	36	50	Pairs	2005
Brown Store Islet	67	300	Individuals	2005
Gull Island, Cape Bonavista	69	50	Individuals	2005
Harbour Grace Islands	146	50	Individuals	2005
Green Island (CB)	199	50	Individuals	2005
Renews Island	222	50	Individuals	2005

Note:
Refer to Figure 6-49 for colony locations corresponding to each Colony #.
Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2016).

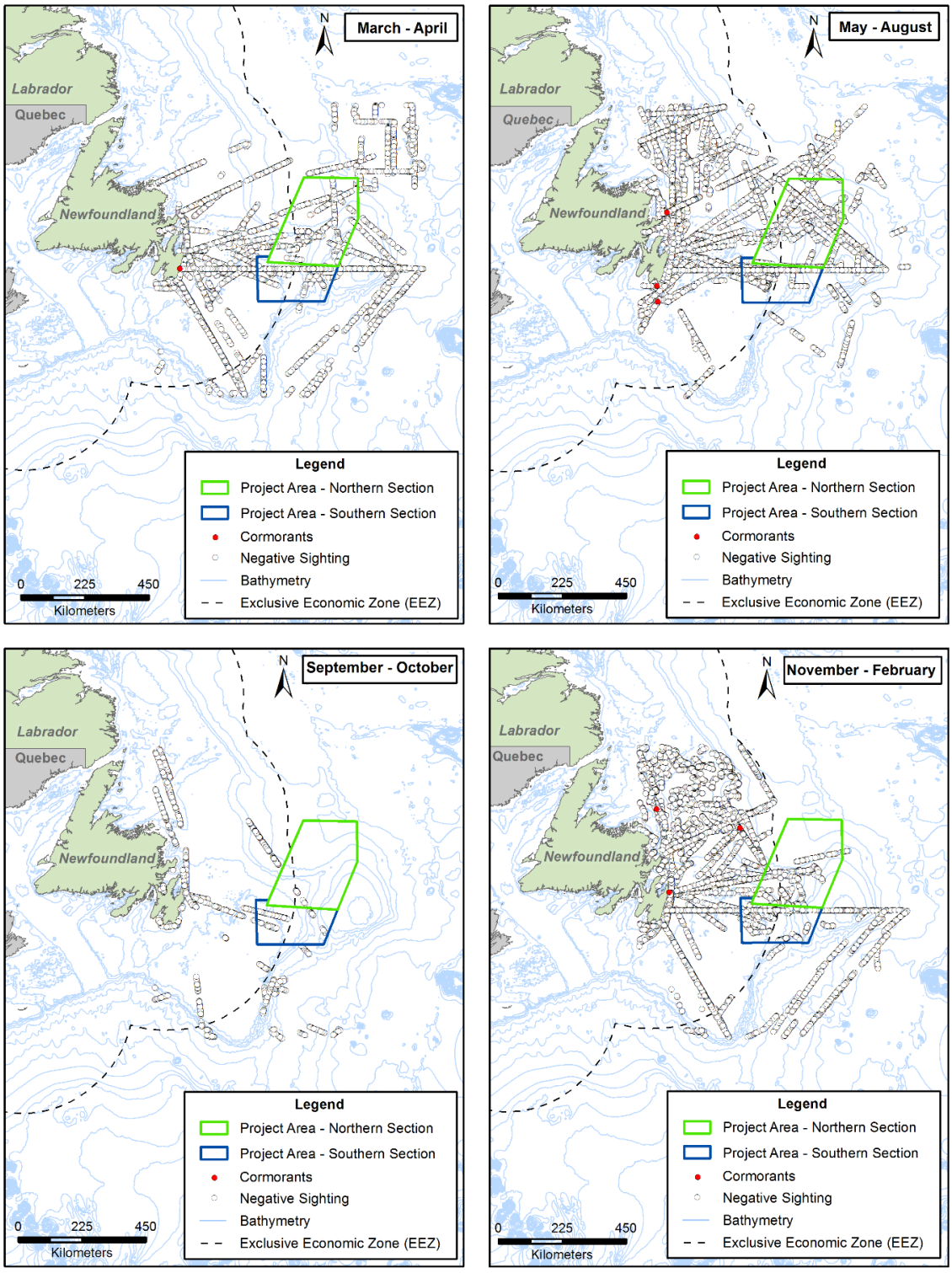


Figure 6-50 Seasonal Distribution of ECSAS Cormorant Observations in the Waters off Eastern Newfoundland (2001 – 2016)

6.2.2.2 Gannets

The northern gannet is a highly pelagic species, spending most of its time in continental shelf waters and coming ashore only to breed in large, dense, colonies. Adults arrive at the colony in mid-March, followed a few weeks later by subadults. Juveniles migrate southward in September; adults and older immatures may travel north from the colonies to feed along the Labrador Coast before southward migration. Gannets feed by plunge diving from a height of 10-40 m above the surface, descending to depths of 15 m. They may travel over 200 km from breeding colony to forage (Garthe et al. 2007), and flocks of up to a thousand gannets may congregate over shoals of fish (herring, mackerel and capelin), and invertebrates such as squid (Mowbray 2002).

Gannets are most likely to be present in the area from March to November, because the majority of the population overwinters in the Gulf of Maine and further south (Montevecchi et al. 2012; Mowbray 2002). However, they have been observed in the waters off Newfoundland at all times of year. ECSAS sightings for northern gannets are presented in Figure 6-51. CWS survey data for the two colonies of northern gannet in eastern Newfoundland are presented in Table 6.26.

Table 6.26 Northern Gannet Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Funk Island	12	10,156	Pairs	2013
Baccalieu Island	120	3,092	Pairs	2013

Note:
Refer to Figure 6-49 for colony locations corresponding to each Colony #.
Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2016).

6.2.2.3 Phalaropes

Phalaropes, represented in the RSA by the red phalarope and red-necked phalarope, spend most of the year offshore. They breed in Arctic tundra during the summer months and typically overwinter south of Canada, occurring most frequently in the area during migration. The red-necked phalarope has been assessed by COSEWIC as a species of Special Concern (see Section 6.2.4). Phalaropes congregate in areas which are associated with higher prey (zooplankton and small aquatic invertebrate) densities. They swim on the water surface in tight circles, churning prey upwards to within reach. Observations of their distribution at sea suggests that they are highly dependent on ocean fronts bordered by upwelling (Rubega et al. 2000; Tracy et al. 2002).

ECSAS sightings for phalaropes are presented in Figure 6-52. Phalarope sightings were infrequent in summer and fall and even rarer in winter, and no sightings were reported in the region during the spring surveys. Although most of the sightings were not identified to species level, of those that were identified most were red phalarope which is known to be the more pelagic of the two species (Tracy et al. 2002).

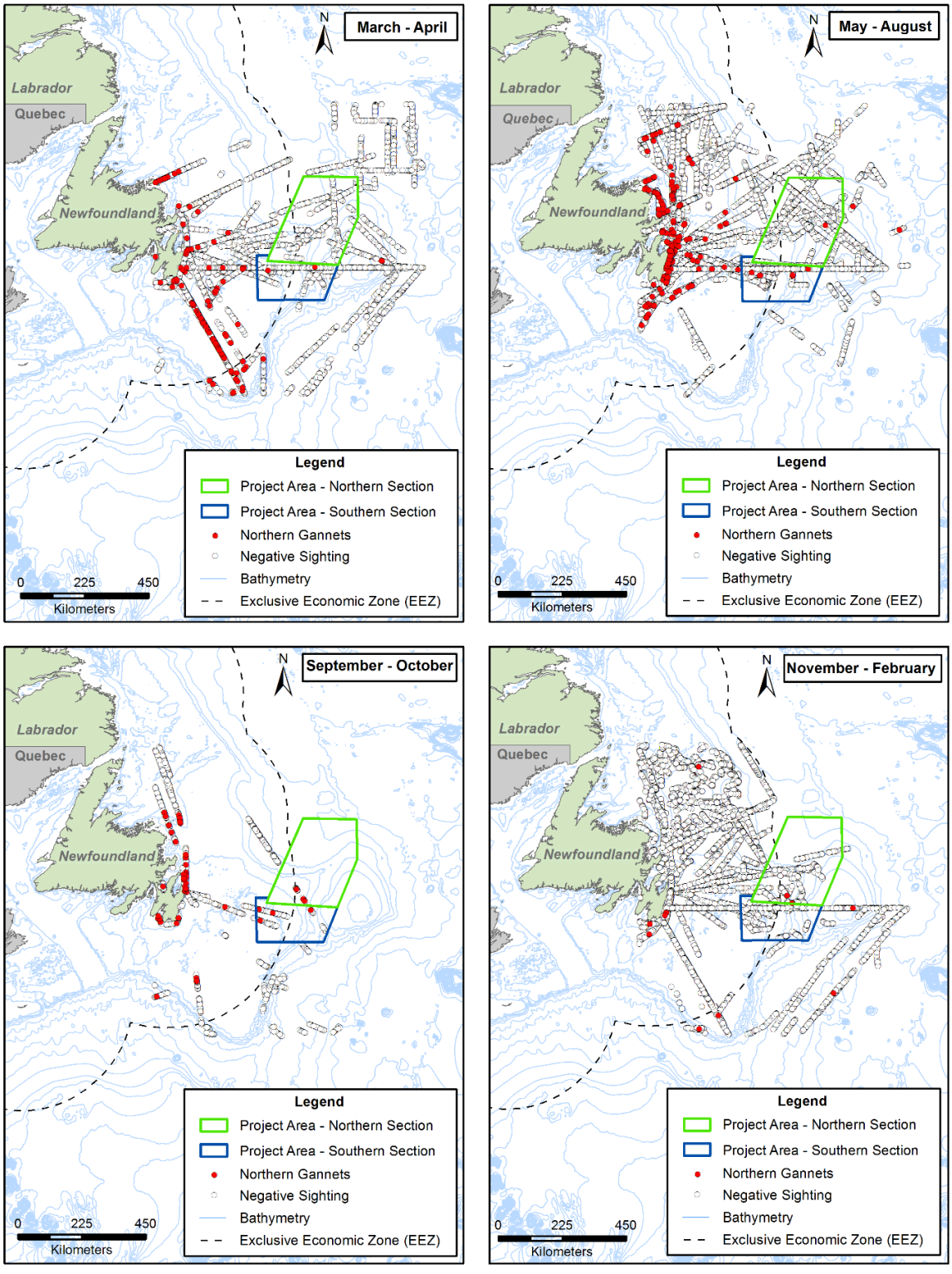


Figure 6-51 Seasonal Distribution of ECSAS Northern Gannet Observations in the Waters off Eastern Newfoundland (2001 – 2016)

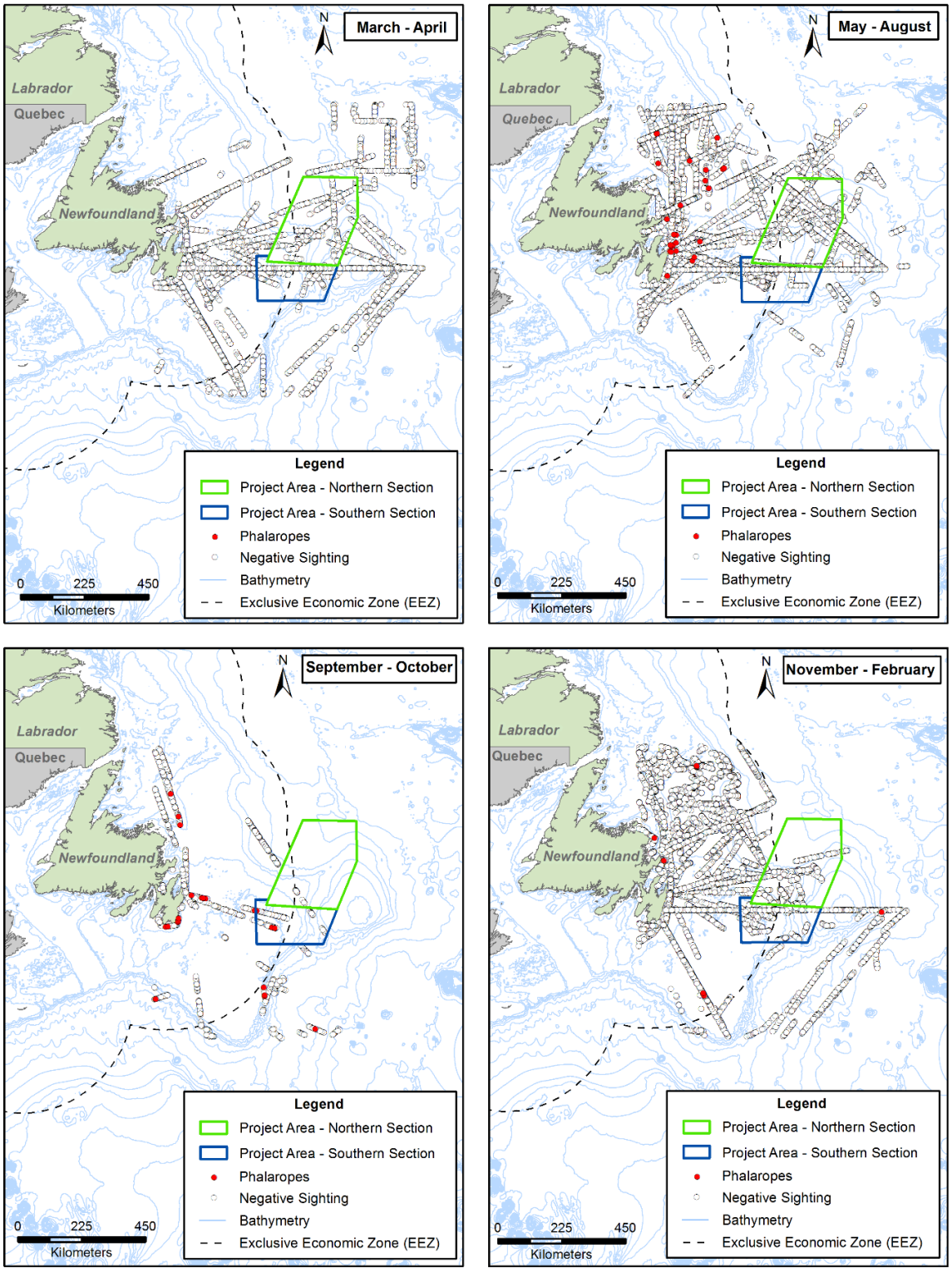


Figure 6-52 Seasonal Distribution of ECSAS Phalarope Observations in the Waters off Eastern Newfoundland (2001 – 2016)

6.2.2.4 Gulls

There are six species of gulls found commonly off the coast of eastern Newfoundland: herring, great black-backed and ring-billed gulls and black-legged kittiwakes occur in temperate areas year-round, while Iceland and glaucous gulls nest in the Arctic and are only found in the region outside the breeding season. Other species, including the Arctic-nesting Sabine's and ivory gulls as well as laughing, black-headed and lesser black-backed Gulls, occur infrequently in eastern Newfoundland. The ivory gull is listed as Endangered under both the provincial NL ESA and the federal SARA. Gulls breeding in the region have suffered population declines due to reduced food availability associated with fisheries collapse and closure of municipal dumps, although recent census data indicate that populations are showing some signs of recovery (Cotter et al. 2012).

Most gull species nest on the ground, although black-legged kittiwakes nest on cliffs. Outside of the breeding season, most gull species are associated with coastal areas, while Sabine's gull, ivory gull and black-legged kittiwake tend to be found further offshore. A recent tracking study of black-legged kittiwakes has shown that the Northwest Atlantic, and, in particular the shelf edge off Newfoundland, is an important wintering area for kittiwakes, with most of the Atlantic population overwintering in this region (Frederiksen et al. 2012). Gulls are surface feeders, preying on invertebrates (cephalopods and crustaceans), fish and offal, and larger species may also prey on eggs, young, and occasionally adults of other seabirds.

ECSAS sightings for black-legged kittiwakes and large gulls (all other gull species) are presented in Figures 6-53 and 6-54, respectively. Gulls and kittiwakes were both commonly observed in the area year-round. Most of the large gulls identified to species level were great black-backed gull, herring gull, and in the winter months, Iceland gull and glaucous gull. Kittiwakes and great black-backed gulls were among the most commonly reported species during bird surveys conducted for Statoil within and near the Flemish Pass in the summer and winter months (Statoil 2015a, 2015b). No endangered ivory gulls were identified in the ECSAS surveys within the RSA. However, they were reported on two occasions from bird surveys conducted during Statoil's drilling campaign at EL 1112 in the winter months (Statoil 2015a).

The Island of Newfoundland supports more than two-thirds of Atlantic Canada's breeding gull population, with black-legged kittiwakes accounting for almost half of this number (Cotter et al. 2012). CWS records of gull colonies in eastern Newfoundland are shown in Table 6.27, and the colony locations are shown on Figure 6-49. Herring Gull, great black-backed gull and black-legged kittiwake colonies are abundant and widespread along the coast, while ring-billed gull colonies are fewer in number.

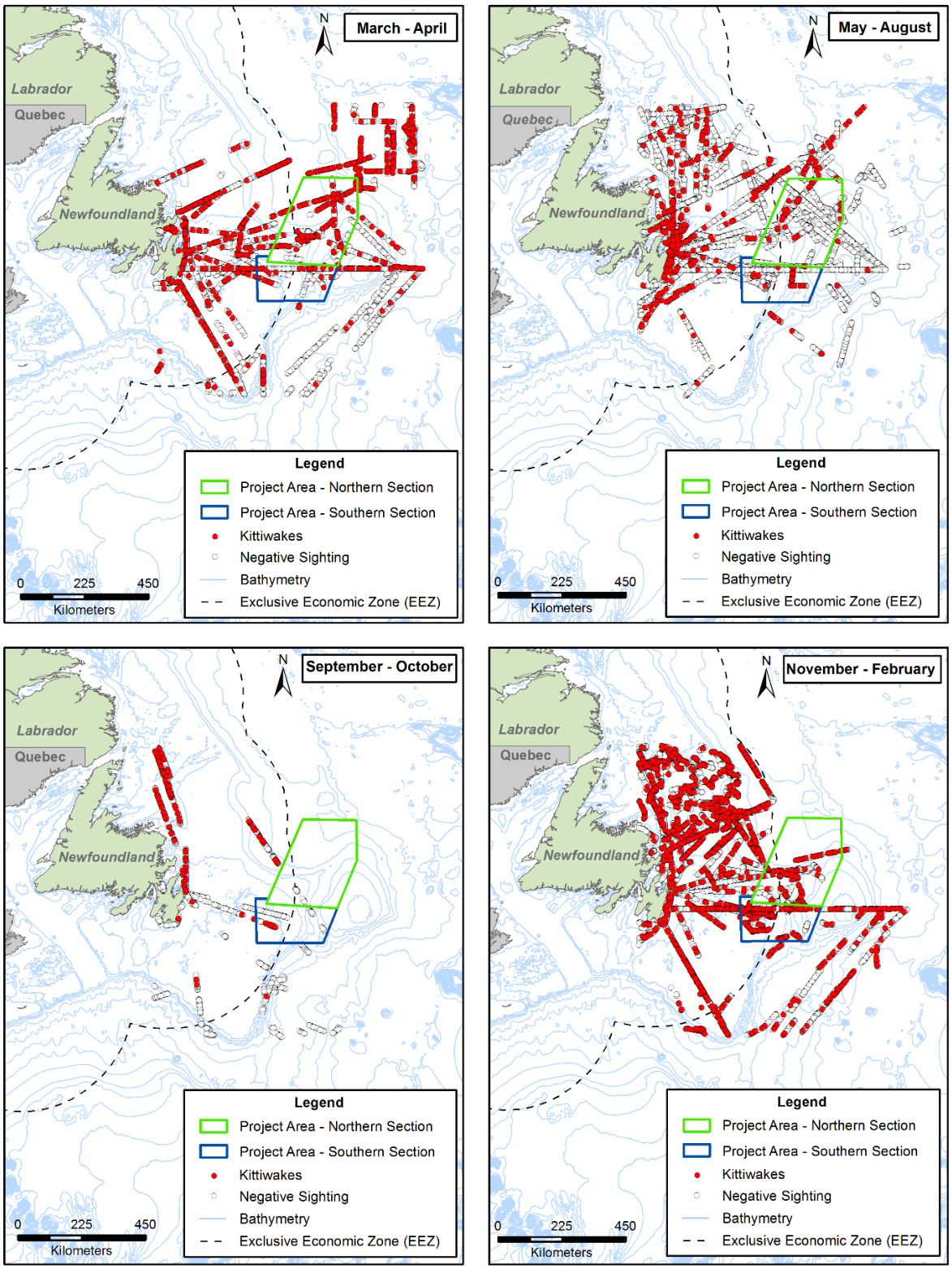


Figure 6-53 Seasonal Distribution of ECSAS Black-legged Kittiwake Observations in the Waters off Eastern Newfoundland (2001 – 2016)

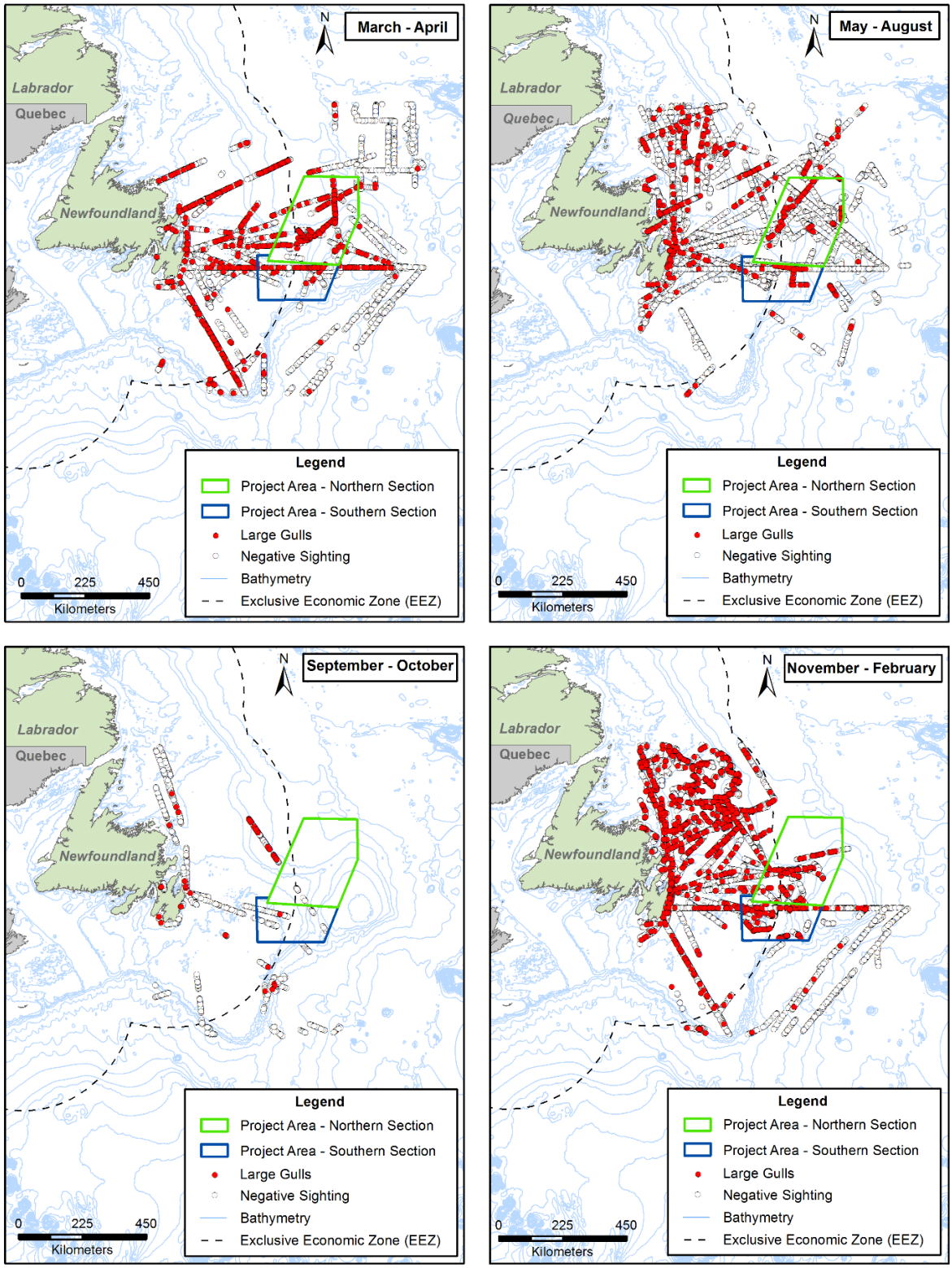


Figure 6-54 Seasonal Distribution of ECSAS Large Gull Observations in the Waters off Eastern Newfoundland (2001 – 2016)

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Black-legged Kittiwake	Funk Island	12	95	Pair	2012
	Gull Island, Cape Freels	24	300	Individual	2005
	Grassy Shag Rock, Offer Gooseberry	46	750	Individual	2005
	Double Shag Island	48	50	Individual	2005
	Gull Island, Cape Bonavista	69	1001	Individual	2005
	Stone Island	74	300	Individual	2005
	Little Denier Island	78	300	Individual	2005
	South of Spillars Point	79	750	Individual	2005
	North Bird Island	81	50	Individual	2005
	Black Head	83	300	Individual	2005
	Bird, South	84	50	Individual	2005
	Unnamed I. in from Ragged rocks	103	300	Individual	2005
	Ragged Islands, North	104	300	Individual	2005
	Ragged Islands, Middle	105	50	Individual	2005
	Green Island	108	50	Individual	2005
	Unnamed I. inside Green Island (off Salvage Head)	109	300	Individual	2005
	Maiden Island	110	208	Pair	2005
	Green Island, Trinity Bay	112	51	Pair	2005
	Cliff west of Red Head	115	50	Individual	2005
	Baccalieu Island	120	5,096	Pair	2012
	Copper Island, south of Verge Island	121	300	Individual	2005
	Green Islands, north of Long Island	125	50	Individual	2005
	Unnamed I. in St. Jones Harbour	130	750	Individual	2005
	Bradley's Cove	131	1001	Individual	2005
	Copper Island, Trinity Bay	133	300	Individual	2005
	Spout Cove	134	50	Individual	2005
	West Shag Islands, Bull Arm	140	43	Pair	2005
	East Shag Islands, Bull Arm	141	300	Individual	2005
	Goose Island, south	142	788	Pair	2005
	Carbonear Island	143	300	Individual	2005
	Unnamed I. in Rantem Harbour	145	300	Individual	2005
	Harbour Grace Islands	146	1001	Individual	2005
	Red Rocks	147	300	Individual	2005
	Church Cove	150	1333	Pair	2012

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	Torbay, Sculpin Point	152	218	Pair	2012
	Hopeall Island	153	50	Individual	2005
	Brigus Lookout cliff	170	300	Individual	2005
	Freshwater Bay	172	820	Pair	2006
	Deadmans Bay	173	2866	Pair	2006
	Blackhead	174	350	Individual	2005
	Miners Point	196	1001	Individual	2005
	Gull Island	200	3,052	Pair	2016
	Green Island	201	2,188	Pair	2007
	Great Island	205	6,547	Pair	2015
	Goose Island, Ferryland	211	50	Individual	2005
	Cape Ballard	223	50	Individual	2005
	The Drook/Mistaken Point	226	4,170	Pair	2009
	Cape Pine	228	575	Pair	2005
Herring Gull	Funk Island	12	150	Pair	2011
	Penguin Island, North	20	50	Individual	2005
	Penguin Island, South	21	300	Individual	2005
	Southern Cat Island	22	300	Individual	2005
	Middle Bill Island	23	300	Individual	2005
	Gull Island, Cape Freels	24	50	Individual	2005
	Cape Island	25	5	Individual	2005
	Cabot Island, North	27	50	Individual	2005
	Pouch Island	28	50	Individual	2005
	Butterfly Islets	33	50	Individual	2005
	Bennetts Low Island	34	50	Individual	2005
	Little Shag Rock	35	50	Individual	2005
	Big Shag Rock	36	300	Individual	2005
	Southwest Island	42	50	Individual	2005
	Small unnamed I. northeast of Deer Island	43	300	Individual	2005
	Double Shag Island	48	50	Individual	2005
	Small unnamed I. west of Lockers Flat Island	51	50	Individual	2005
	Great Black Island, unnamed I. north and west of Gulch Island	54	50	Individual	2005
	Black Island, St. Brendan's	58	50	Individual	2005

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	Puffin Island	59	50	Individual	2005
	Shag Rock, Varket Channel	60	50	Individual	2005
	Brown Store Islet	67	300	Individual	2005
	Gull Island, Cape Bonavista	69	50	Individual	2005
	Green Island, Cape Bonavista	73	750	Individual	2005
	Unnamed I. east of Sailors Island	75	300	Individual	2005
	Little Denier Island	78	50	Individual	2005
	North Bird Island	81	300	Individual	2005
	Elliston Point Island	82	300	Individual	2005
	Bird, South	84	300	Individual	2005
	North unnamed I. in Castle Cove	85	300	Individual	2005
	South unnamed I. in Castle Cove	87	300	Individual	2005
	South of Fish Point Gulch	89	50	Individual	2005
	Middle Long Island	90	50	Individual	2005
	Copper Island	91	50	Individual	2005
	Red Cliff Island	94	300	Individual	2005
	Mouse Island, Sweet Bay	98	50	Individual	2005
	Lakeman Island	101	50	Individual	2005
	Unnamed I. in from Ragged Rocks	103	50	Individual	2005
	Ragged Islands, North	104	50	Individual	2005
	Unnamed I. northeast of Wolf Island	107	50	Individual	2005
	Green Island	108	50	Individual	2005
	Unnamed I. inside Green Island (off Salvage Head)	109	300	Individual	2005
	Ragged Islands, west	111	300	Individual	2005
	Green Island, Trinity Bay	112	1,001	Individual	2005
	Duck Island (TB)	114	2	Individual	2005
	Verge Island	119	1,001	Individual	2005
	Baccalieu Island	120	46	Pair	2012
	Perlican Island	124	750	Individual	2005
	Green Islands, N of Long Island	125	50	Individual	2005
	Hants Head	126	50	Individual	2005
	Unnamed I. rock off of Kings Head	127	50	Individual	2005
	Sugar Loaf	129	50	Individual	2005
	Unnamed I. in St. Jones Harbour	130	50	Individual	2005

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	Copper Island, Trinity Bay	133	300	Individual	2005
	Pigeon Island	135	300	Individual	2005
	Stack in Shoe Cove	138	50	Individual	2005
	Goose Island, South	142	300	Individual	2005
	Carbonear Island	143	750	Individual	2005
	Duck Island, East	144	300	Individual	2005
	Harbour Grace Islands	146	1,001	Individual	2005
	Unnamed I. east of Grassy Island	148	50	Individual	2005
	Grassy Island	149	300	Individual	2005
	Woody Island, Southern Harbour	151	300	Individual	2005
	Hopeall Island	153	300	Individual	2005
	Salls Island	154	5	Individual	2005
	Unnamed I. off Bellevue Beach PP	155	300	Individual	2005
	Logy Bay	156	50	Individual	2005
	Stearin Island (off Corbin Head)	158	50	Individual	2007
	Little Harbour Island	159	300	Individual	2005
	The Bell	160	50	Individual	2005
	Fergus Island	161	750	Individual	2005
	Dildo Islands, north	166	1	Pair	2005
	Shag Roost	167	1	Pair	2005
	Little Bell Island	168	750	Individual	2005
	Kelly's Island	171	50	Individual	2005
	Freshwater Bay	172	3	Individual	2010
	Deadmans Bay	173	21	Individual	2010
	Fair Haven Island	176	50	Individual	2005
	Trinny Cove Islands, off Trinny Cove [1]	178	300	Individual	2005
	Trinny Cove Islands, off Trinny Cove [2]	180	50	Individual	2005
	Grassy Islands, Brine Islands, West	183	50	Individual	2006
	Unnamed I. west of Woody	185	50	Individual	2005
	North Green Island	187	300	Individual	2005
	Harbour Island	188	750	Individual	2005
	Graves Island	189	300	Individual	2005
	Harbour Island, Iona Islands	191	750	Individual	2005
	Unnamed I. off Graves Island	192	50	Individual	2005
	Hole in the Wall Island	194	50	Individual	2005

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	Fox Island	197	750	Individual	2005
	Green Island (CB)	199	5	Individual	2005
	Gull Island	200	1,881	Pair	2011
	Green Island	201	100	Pair	2011
	Ship Island	203	300	Individual	2005
	Pee Pee Island	204	300	Individual	2005
	Pee Pee Island	204	77	Pair	2012
	Great Island	205	1,640	Pair	2012
	Goose Island, Ferryland	211	300	Individual	2005
	Wrens Island	212	50	Individual	2005
	Costellos Island	213	50	Individual	2005
	Bois Island	214	300	Individual	2005
	Crow Island, near Ferryland Head	216	300	Individual	2005
	South Head	217	50	Individual	2005
	The Drook/Mistaken Point	226	12	Pair	2005
	Cape Pine Head	229	7	Pair	2005
Great Black-backed Gull	Funk Island	12	75	Direct count	2011
	Small Island	14	50	Individual	2006
	Coleman Island	15	50	Individual	2006
	Penguin Island, North	20	50	Individual	2005
	Penguin Island, South	21	50	Individual	2005
	Southern Cat Island	22	300	Individual	2005
	Middle Bill Island	23	5	Individual	2005
	Gull Island, Cape Freels	24	50	Individual	2005
	Cape Island	25	5	Individual	2005
	Honey Pot Island	26	5	Individual	2005
	Cabot Island, North	27	50	Individual	2005
	Pouch Island	28	300	Individual	2005
	Green Island, Wesleyville	31	50	Individual	2005
	Butterfly Islets	33	50	Individual	2005
	Big Shag Rock	36	50	Individual	2005
	Main Rock, Greenspond	38	50	Individual	2005
	Horse Island	39	5	Individual	2005
	Copper Island	40	50	Individual	2005

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	Small unnamed I. NE of Deer Island	43	5	Individual	2005
	Grassy Shag Rock, Offer Gooseberry	46	50	Individual	2005
	Deer Shag Islets	47	5	Individual	2005
	Flat Rock, Lockers Reach	49	50	Individual	2005
	Unnamed Is. inside Inner Gooseberry Islands, East	50	50	Individual	2005
	Small unnamed I. west of Lockers Flat Island	51	5	Individual	2005
	Small unnamed I. outside Great Content Cove	53	50	Individual	2005
	Unnamed I. north of Great Black Island and west of Gulch Island	54	5	Individual	2005
	Unnamed I. south of Lakeman Island	56	5	Individual	2005
	Black Island, St. Brendan's	58	50	Individual	2005
	Puffin Island	59	50	Individual	2005
	Shag Rock, Varket Channel	60	50	Individual	2005
	Lackington Rock	62	50	Individual	2005
	Unnamed I. northeast of Long Reach Island	64	5	Individual	2005
	Unnamed I. southwest of Ship Island	65	5	Individual	2005
	Brown Store Islet	67	50	Individual	2005
	Gull Island, Cape Bonavista	69	50	Individual	2005
	Green Island, Cape Bonavista	73	5	Individual	2005
	Unnamed I. east of Sailors Island	75	50	Individual	2005
	Little Denier Island	78	50	Individual	2005
	Bird, South	84	5	Individual	2005
	North unnamed I. in Castle Cove	85	50	Individual	2005
	Long Island, Middle	90	50	Individual	2005
	Copper Island	91	50	Individual	2005
	Red Cliff Island	94	50	Individual	2005
	Unnamed I. north of Chance Head	95	50	Individual	2005
	Southern Den	96	50	Individual	2005
	Mouse Island, Sweet Bay	98	50	Individual	2005
	Gull Island, Sweet Bay	100	5	Individual	2005
	Unnamed I. in from Ragged Rocks,	103	50	Individual	2005
	Ragged Islands, North	104	50	Individual	2005

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	Ragged Islands, South	106	50	Individual	2005
	Unnamed I. northeast of Wolf Island	107	50	Individual	2005
	Green Island	108	5	Individual	2005
	Unnamed I. inside Green Island (off Salvage Head)	109	50	Individual	2005
	Ragged Islands, West	111	300	Individual	2005
	Green Island, Trinity Bay	112	50	Individual	2005
	Duck Island	114	5	Individual	2005
	Red Head, cliff west of	115	50	Individual	2005
	Verge Island	119	50	Individual	2005
	Baccalieu Island	120	2	Boat estimate	2012
	Perlican Island	124	50	Individual	2005
	Green Islands, north of Long Island	125	300	Individual	2005
	Copper Island, Trinity Bay	133	5	Individual	2005
	Spout Cove	134	5	Individual	2005
	Goose Island, South	142	50	Individual	2005
	Duck Island, East	144	50	Individual	2005
	Unnamed I. east of Grassy Island	148	5	Individual	2005
	Woody Island, Southern Harbour	151	50	Individual	2005
	Hopeall Island	153	50	Individual	2005
	Salls Island	154	5	Individual	2005
	Unnamed I. off Bellevue Beach PP	155	300	Individual	2005
	Stearin Island (off Corbin Head)	158	50	Individual	2007
	Little Harbour Island	159	50	Individual	2005
	The Bell	160	50	Individual	2005
	Fergus Island	161	50	Individual	2005
	Little Bell Island	168	50	Individual	2005
	Freshwater Bay	172	6	Individual	2005
	Deadmans Bay	173	6	Individual	2005
	Fair Haven Island	176	5	Individual	2005
	Trinny Cove Islands, off Trinny Cove [1]	178	5	Individual	2005
	Trinny Cove Islands, off Trinny Cove [2]	180	5	Individual	2005
	Grassy Islands, Brine Islands, West	183	50	Individual	2006
	Unnamed I. west of Woody	185	50	Individual	2005
	East Green Island	186	300	Individual	2005

Table 6.27 Gull Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	North Green Island	187	300	Individual	2005
	Unnamed I. off Graves Island	192	50	Individual	2005
	Little Island (Iona Islands)	193	1	Pair	2005
	Hole in the Wall Island	194	50	Individual	2005
	Green Island (CB)	199	50	Individual	2005
	Gull Island	200	33	Ground count	2011
	Green Island	201	20	Estimate	2011
	Ship Island	203	50	Individual	2005
	Pee Pee Island	204	3	Ground count	2012
	Great Island	205	9	Ground count	2012
	Kerwan Point, Newbridge	207	2	Pair	2005
	Goose Island, Ferryland	211	50	Individual	2005
	Wrens Island	212	5	Individual	2005
	Bois Island	214	50	Individual	2005
	Crow Island, near Ferryland Head	216	50	Individual	2005
	Cape Pine Head	229	1	Pair	2005
Ring-billed Gull	Coleman Island	15	300	Individual	2006
	Pouch Island	28	50	Individual	2005
	Tinker Rocks	30	148	Pair	2005
	Bennetts Low Island	34	300	Individual	2005
	Unnamed I. in Willis Reach	55	300	Individual	2005
	Green Island, Cape Bonavista	73	6	Pair	2005
	Red Cliff Island	94	17	Pair	2005
	Mustard Bowl Island	99	50	Individual	2005
	Goose Island, South	142	304	Pair	2005
	Grassy Islands, Brine Islands, West	183	300	Individual	2006
	Crawley Island	190	992	Pair	2005
	The Neck at Isaac Heads	198	300	Individual	2005
	Kerwan Point (Newbridge)	207	2	Pair	2005
	ODonnells	209	321	Pair	2005
	Biscay Bay Pond	224	23	Pair	2005

Note:
Refer to Figure 6-49 for colony locations corresponding to each Colony number.
Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2016).

6.2.2.5 Terns

Three species of tern are found regularly in the waters off Newfoundland: common tern, Arctic tern and Caspian tern. The Caspian tern is less abundant than common and Arctic terns in Newfoundland, but is known to breed along the south and east coasts (Cuthbert and Wires 1999; Warkentin and Newton 2009). All three species are migratory, and found in the region only during the breeding season. Terns are typically found in coastal environments, seldom seen far from shore except for Arctic Terns, which tend to be highly pelagic during migration (Hatch 2002; Nisbet 2002; Cuthbert and Wires 1999). They feed at or near the water's surface, taking small fish and crustaceans.

They were infrequently observed in the spring and summer, and essentially absent in the fall and winter. While most tern sightings could not be identified to species level, both Common and Arctic Terns have been observed in the waters of eastern Newfoundland (ECSAS 2016). CWS records for tern colonies in eastern Newfoundland are provided in Table 6.28 (species composition of the colonies was not reported). ECSAS sightings for terns are presented in Figure 6-55.

Table 6.28 Tern Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Wadham Island, Offer	13	22	Pair	2006
Coleman Island	15	85	Pair	2006
Pigeon Island	16	28	Pair	2006
Duck Island, N (near Fogo)	17	20	Pair	2006
Muddy Shag Island	18	12	Pair	2006
Penguin Island, South	21	80	Pair	2005
Pouch Island	28	1	Pair	2005
Tinker Rocks	30	476	Pair	2005
Bennetts Low Island	34	10	Pair	2005
Unnamed I. in Greenspond Harbour	37	100	Pair	2005
Horse Island	39	8	Pair	2005
Unnamed I. southwest of Goodwithy Harbour	41	60	Pair	2005
Southwest Island	42	155	Pair	2005
Small unnamed I, north of Deer Island	44	70	Pair	2005
Deer Shag Islets	47	30	Pair	2005
Unnamed Is. inside Inner Gooseberry Islands, East	50	260	Pair	2005
Small unnamed I. west of Lockers Flat Island	51	105	Pair	2005
Unnamed I. off Hare Bay	52	45	Pair	2005
Unnamed I. in Willis Reach	55	25	Pair	2005
Unnamed I. rock southwest of Cottel Island	57	18	Pair	2005
Small unnamed I. 1km east of Hare Island	61	20	Pair	2005
Unnamed I. northeast of Morris Island	63	198	Pair	2005

Table 6.28 Tern Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Unnamed I. northeast of Long Reach Island	64	78	Pair	2005
Unnamed I. southeast of Shoe Island	66	13	Pair	2005
Shag Islands, Outer	70	200	Pair	2005
Green Island, Cape Bonavista	73	565	Pair	2005
Unnamed I. north of Baldric Head	76	65	Pair	2005
North unnamed I. in Castle Cove	85	2	Pair	2005
Swale Island Shag Rock	86	23	Pair	2005
Long Island	88	225	Pair	2005
Little Harbour Gull Rock	92	175	Pair	2005
Mermaid Rock	93	35	Pair	2005
Red Cliff Island	94	115	Pair	2005
Unnamed Is. in Lion's Den, Terra Nova NP	97	125	Pair	2005
Mustard Bowl Island	99	100	Pair	2005
Unnamed I. northeast of Wolf Island	107	50	Pair	2005
Maiden Island	110	3250	Pair	2005
Long Harbour, unnamed I. west of	113	15	Pair	2005
Sgeir Island	116	325	Pair	2005
Grassy Island North of Verge Island	118	9	Pair	2005
Copper Island, South of Verge Island	121	2	Pair	2005
Rocks northeast of East Random Head	122	10	Pair	2005
Unnamed I. in Random Head Harbour	123	15	Pair	2005
Gull Island, Conception Bay	128	105	Pair	2005
Harbour Rocks, Shoal Bay	132	49	Pair	2005
Spout Cove	134	15	Pair	2005
Unnamed I. in Salmon Cove	136	83	Pair	2005
Bull Island	137	38	Pair	2005
Unnamed I. off Islington	139	130	Pair	2005
Unnamed I. in Rantem Harbour	145	80	Pair	2005
Salls Island	154	3	Pair	2005
Spaniards Bay Spit	162	14	Pair	2005
Grassy Island, Little Pinchgut	164	4	Pair	2005
Rock southwest of Dildo Islands	169	1	Pair	2005
Upper Island, Chapel Arm	175	1	Pair	2005
Inside Chapel Arm	177	8	Pair	2005
Trinny Cove Islands, off Trinny Cove [2]	180	9	Pair	2005

Table 6.28 Tern Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Trinny Cove Islands, off Trinny Cove Head	182	51	Pair	2005
Phillips Island, southeast Placentia	202	10	Pair	2005
Point in Pinchgut Tickle	206	58	Pair	2005
Kerwan Point (Newbridge)	207	82	Pair	2005
Small unnamed I. in O'Donnells lagoon	208	111	Pair	2005
O'Donnells	209	41	Pair	2005
Stone Islands	210	25	Pair	2005
Hares Ears	215	18	Pair	2005
Riverhead	218	13	Pair	2005
Coote Pond	219	90	Pair	2005
Renews Harbour	220	125	Pair	2005
Point La Haye	221	2	Pair	2005
Biscay Bay Pond	224	1	Pair	2005
Unnamed I. in Portugal Cove Pond	225	10	Pair	2005

Note:
Refer to Figure 6-49 for colony locations corresponding to each Colony #.
Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2016)

6.2.2.6 Alcids

Six members of the alcid (auk) family occur in the Project Area and surrounding region: dovekie, razorbill, common murre, thick-billed murre, Atlantic puffin and black guillemot. The dovekie is a largely Arctic-nesting species, while the other five species breed in eastern Newfoundland. They arrive at their breeding colonies in May to early June, and typically depart from the colony by late August. During breeding, they are most abundant in the waters near the colonies. Alcids feed by pursuit diving, preying on small fish (capelin and sand lance) and invertebrates. Fish comprise a large proportion of the diet of the five larger alcid species while dovekies feed primarily on copepods, predominantly *Calanus* sp. (Fort et al. 2012). Among seabirds, murres and dovekies spend a large proportion of their time on the water relative to more aerial species (Weise and Ryan 2003; Wilhelm et al. 2007; Fifield et al. 2009) and congregate over relatively small, productive areas such as around the Grand Banks (Gaston et al. 2011; Hedd et al. 2011; Montevecchi et al. 2012). The core winter distribution of the world's dovekie population lies within the waters off eastern Newfoundland (Fort et al. 2013). Most of the eastern Canadian population of common murres and over a third of the region's thick-billed murres also congregate in this region in the winter months (McFarlane Tranquilla et al. 2013). Alcids are rendered flightless for several weeks each year during the fall moulting period (Gaston and Hipfner 2000; Ainley et al. 2002; Lavers et al. 2009; Montevecchi and Stenhouse 2002). Atlantic puffins tend to disperse widely and well offshore in the winter months (Fifield et al. 2009), while razorbills are believed to concentrate in the Bay of Fundy in winter (Huettman et al. 2006), and black guillemots tend to be associated with coastal environments year-round (Butler and Buckley 2002).

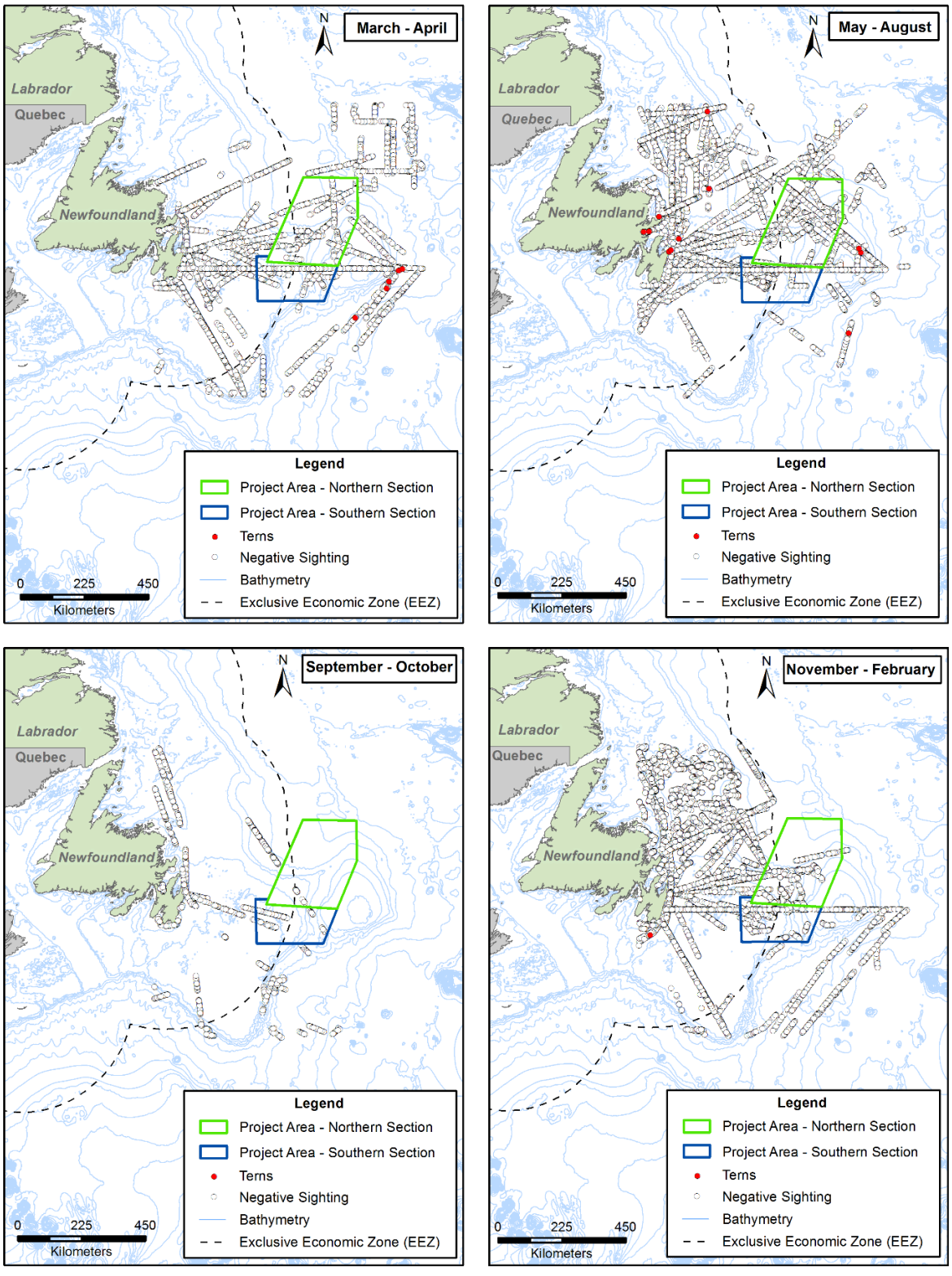


Figure 6-55 Seasonal Distribution of ECSAS Tern Observations in the Waters off Eastern Newfoundland (2001 – 2016)

ECSAS sightings for alcids are presented Figure 6-56 (dovekies), Figure 6-57 (murres) and Figure 6-58 (other alcids, including razorbills, black guillemots, and Atlantic puffins). All six species have been reported in ECSAS surveys year-round, although black guillemots are relatively infrequently observed. The eastern coast of Newfoundland supports numerous alcid colonies, the largest at Funk Island, Baccalieu Island, the Witless Bay Islands and Cape St. Mary's. CWS records for alcid colonies in eastern Newfoundland are provided in Table 6.29.

Table 6.29 Alcid Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Atlantic Puffin	Funk Island	12	2,000	Pair	1988
	Small Island	14	6,190	Pair	2001
	Coleman Island	15	950	Pair	1984
	Pigeon Island	16	20	Pair	1973
	Penguin Island, South	21	755	Pair	2013
	Unnamed I. east of Cape Bonavista	72	350	Pair	2011
	Little Denier	77	1,000	Pair	2011
	Spillars Point	80	250	Pair	1985
	North Bird Island	81	1,000	Pair	1987
	Elliston Point Island	82	400	Pair	1985
	Bird, South	84	1,000	Pair	1985
	Green Island, Trinity Bay	102	1,277	Pair	2005
	Duck Island, Trinity Bay	114	3,000	Pair	2005
	Baccalieu Island	120	75,000	Pair	2005
	Gull Island	200	118,401	Pair	2012
	Green Island	201	9,300	Pair	1979
	Pee Pee Island	204	1,850	Pair	2010
	Great Island	205	174,491	Pair	2011
	The Drook/Mistaken Point	226	79	Pair	2005
	Cape Pine Head	229	259	Pair	2005
Common Murre	Funk Island	12	472,259	Pair	2009
	Cabot Island, South	29	9,897	Pair	2009
	Baccalieu Island	120	1,441	Pair	2012
	Gull Island	200	11,640	Pair	2016
	Green Island	201	240,000	Pair	2007
	Great Island	205	1,037	Pair	2015
	The Drook/Mistaken Point	226	84	Pair	2009
	Western Head	227	27	Pair	1985
	Cape Pine Head	229	9	Pair	2005

Table 6.29 Alcid Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Thick-billed Murre	Funk Island	12	250	Pair	1980
	Baccalieu Island	120	73	Pair	2012
	Gull Island	200	1	Pair	2012
	Green Island	201	242	Pair	2004
Razorbill	Funk Island	12	200	Pair	1980
	Small Island	14	273	Pair	2001
	Coleman Island	15	10	Pair	1984
	Cabot Island, South	29	4	Pair	2011
	Puffin Island	117	50	Pair	2012
	Baccalieu Island	120	406	Pair	2012
	Gull Island	200	524	Pair	2016
	Green Island	201	170	Pair	1979
	Ship Island	203	12	Pair	2015
	Pee Pee Island	204	31	Pair	2015
	Great Island	205	201	Pair	2015
	The Drook/Mistaken Point	226	72	Pair	2009
	Western Head	227	7	Pair	1985
	Cape Pine Head	229	189	Pair	1985
Black Guillemot	Funk Island	12	1	Pair	1988
	Coleman Island	15	25	Pair	1984
	Offer Gooseberry Island	45	13	Pair	1945
	Brown Store Islet	67	2	Pair	1989
	Unnamed I. east of Brown Store Islet	68	3	Pair	1989
	Shag Islands	71	20	Pair	1974
	South of Spillars Point	79	25	Pair	1985
	Puffin Island	117	30	Pair	2012
	Baccalieu Island	120	113	Pair	2012
	Bull Island	137	8	Pair	1945
	Grassy Island	149	4	Pair	1974
	Tinker Islet	163	1	Pair	1974
	Unnamed I., Little Pinchgut,	165	10	Pair	1974
	Little Bell Island	168	125	Pair	1984
	Kelly's Island	171	100	Pair	1984
	Freshwater Bay	172	30	Individual	2006
	Deadmans Bay	173	10	Individual	2005

Table 6.29 Alcid Colony Locations in Eastern Newfoundland

Species	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
	Trinny Cove Islands, off Trinny Cove	178	36	Individual	2015
	Trinny Cove Islands, off Trinny Cove Head	182	2	Pair	1974
	Grassy Islands, Brine Islands, East	184	1	Pair	1974
	Gull Island	200	7	Pair	2016
	Ship Island	203	11	Individual	2015
	Pee Pee Island	204	1	Pair	2015
	Great Island	205	1	Pair	2015
	Bois Island	214	20	Pair	1984
	The Drook/Mistaken Point	226	17	Pair	2009
	Western Head	227	20	Pair	1985
	Cape Pine Head	228	5	Pair	2005

Note: Refer to Figure 6-49 for colony locations corresponding to each Colony #.
Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2016)

6.2.2.7 Jaegers and Skuas

Five species of jaegers and skuas regularly occur off eastern Newfoundland: pomarine jaeger, parasitic jaeger, long-tailed jaeger, great skua and south polar skua, none of which breed in Newfoundland. Pomarine, parasitic and long-tailed jaegers breed in high Arctic tundra, south polar skuas nest along the Antarctic coast, and great skuas on coastal moors and rocky islands in Europe. Non-breeders are found offshore year-round, while breeding adults attend the colonies in late-May to early-June until September. Outside of the breeding season, jaegers and skuas typically feed by stealing prey items from other seabirds (Wiley and Lee 1998, 1999, 2000). In the winter months, the waters off eastern Canada support a large proportion of the Icelandic population of great skuas (Magnusdottir et al. 2012).

ECSAS sightings for jaegers and skuas are presented in Figure 6-59, which illustrate that they are uncommonly observed year-round. While most sightings could not be identified to species level, all five species have been observed in the waters off eastern Newfoundland. Great skuas were much more numerous than south polar skuas, and pomarine jaegers were identified more often than parasitic or long-tailed jaegers.

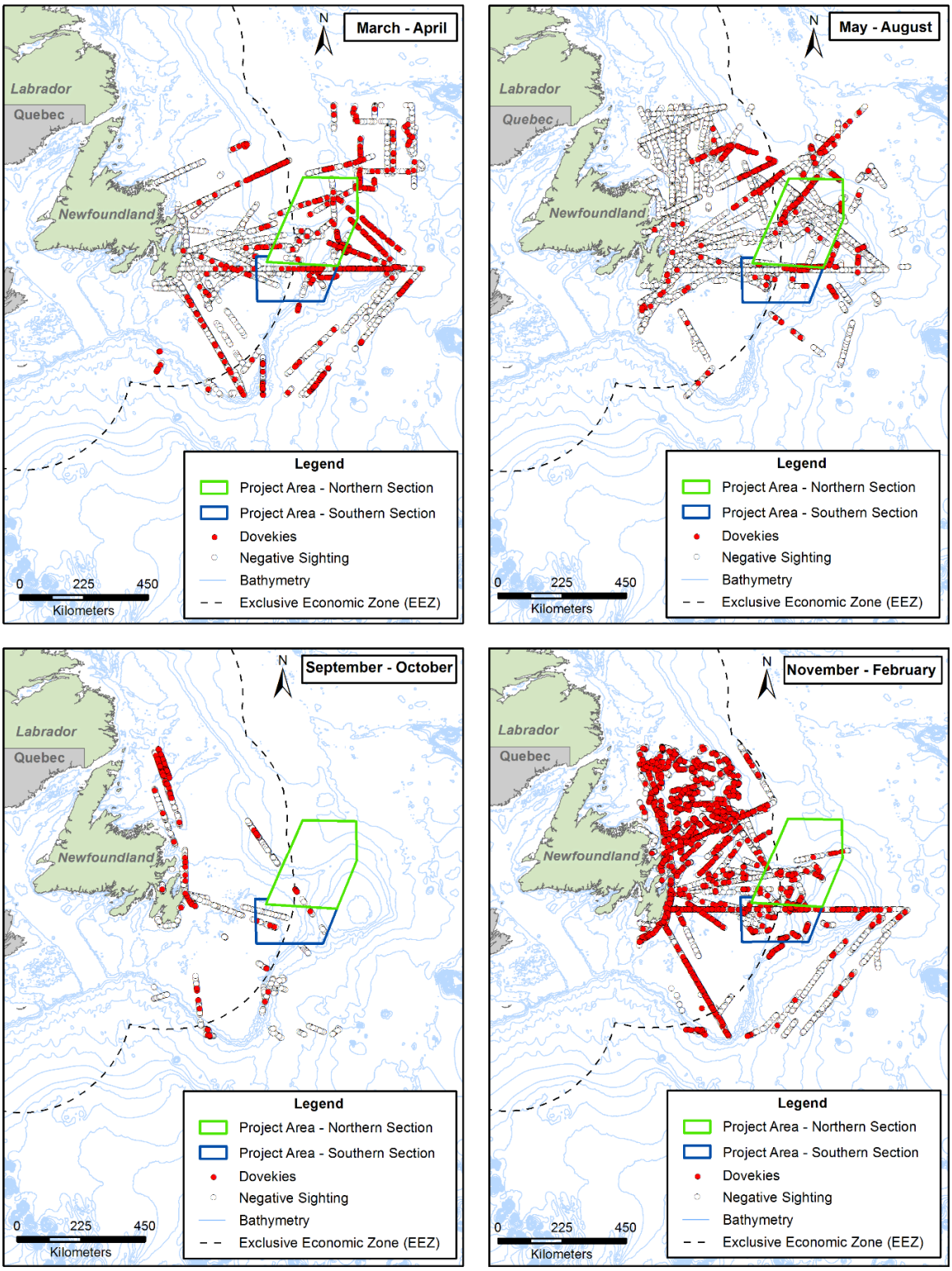


Figure 6-56 Seasonal Distribution of ECSAS Dovekie Observations in the Waters off Eastern Newfoundland (2001 – 2016)

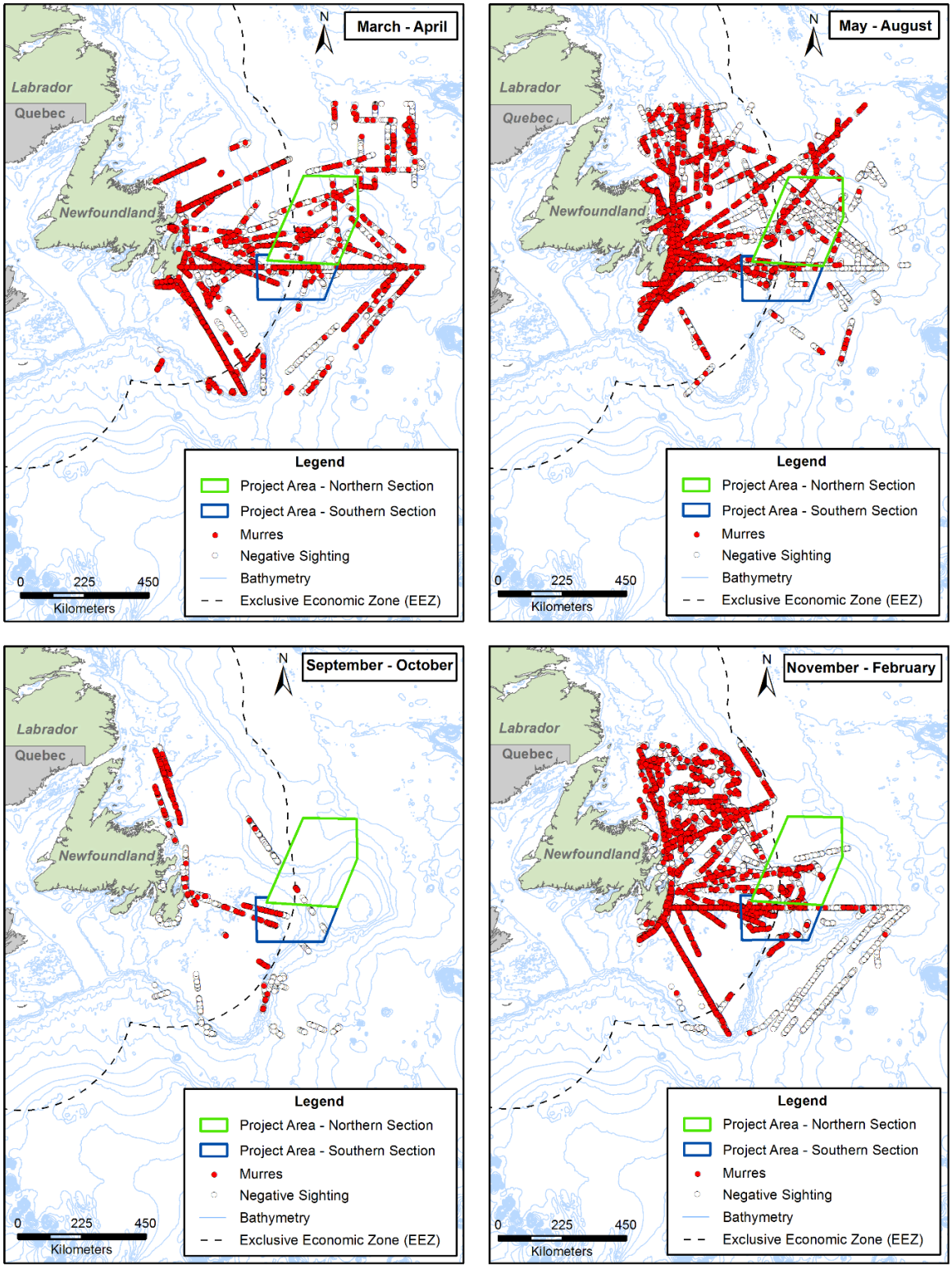


Figure 6-57 Seasonal Distribution of ECSAS Murre Observations in the Waters off Eastern Newfoundland (2001 – 2016)

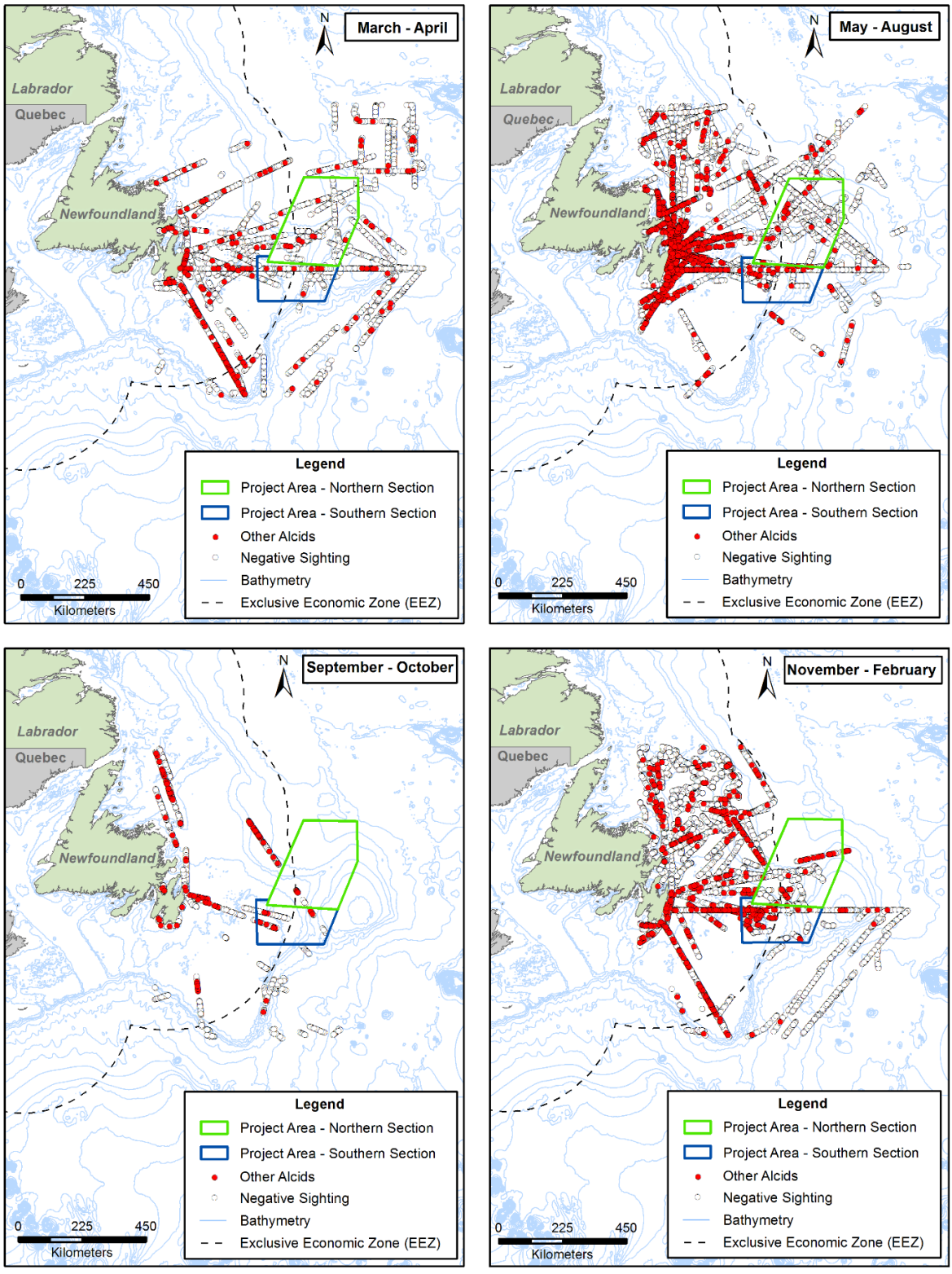


Figure 6-58 Seasonal Distribution of ECSAS Other Alcid Observations in the Waters off Eastern Newfoundland (2001 – 2016)

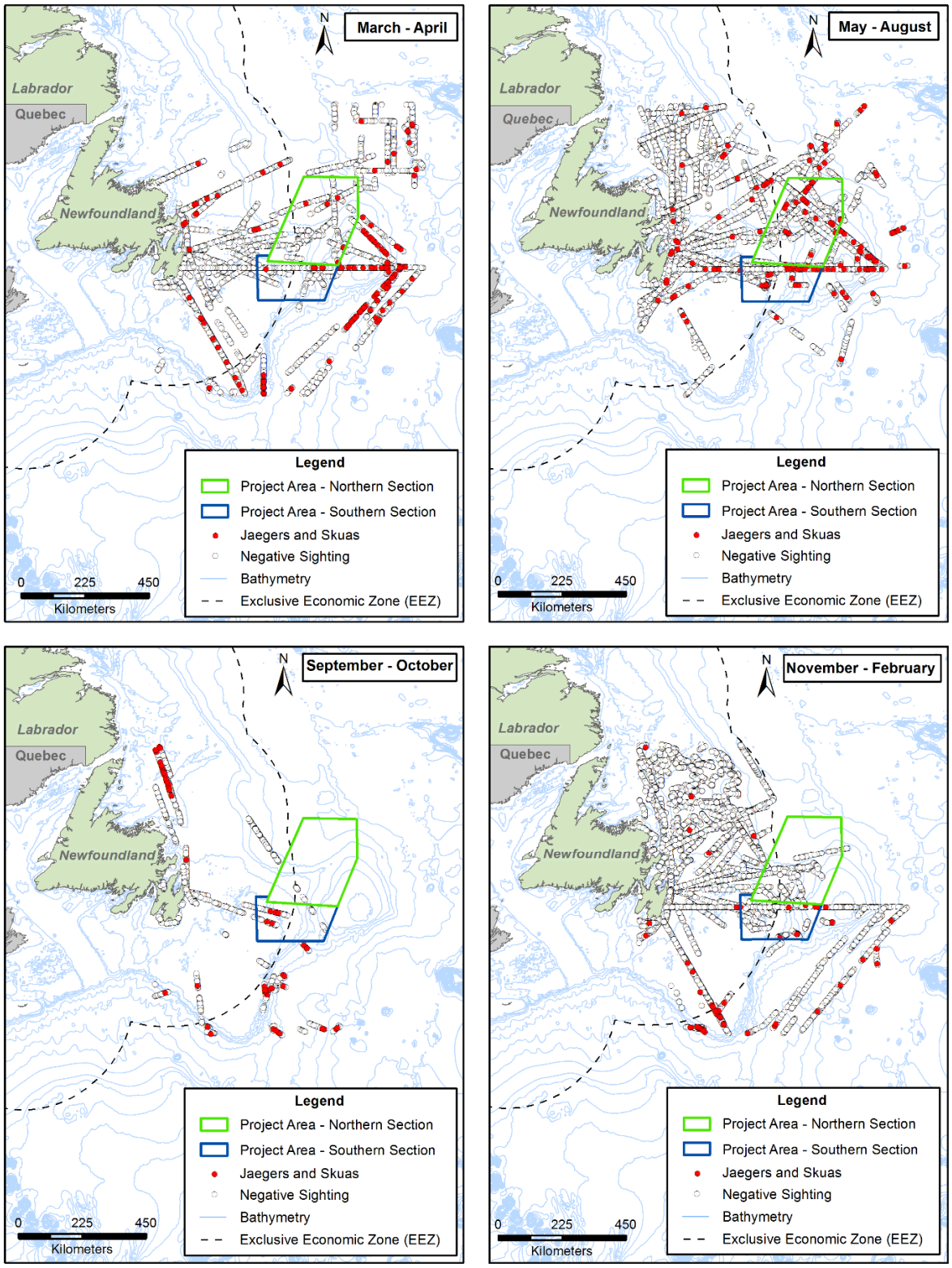


Figure 6-59 Seasonal Distribution of ECSAS Jaeger and Skua Observations in the Waters off Eastern Newfoundland (2001 – 2016)

6.2.2.8 Fulmars and Shearwaters

The northern fulmar and four species of shearwater (great, sooty, manx, and Cory's shearwater) occur regularly in the waters off eastern Newfoundland. Of these, only the northern fulmar and manx shearwater are known to nest in Newfoundland (Lee and Haney 1996; Mallory et al. 2012). Outside the breeding season, fulmars and shearwaters are found in offshore waters and spend most of their time in the air, at or near the water's surface. Shearwaters feed by pursuit plunging, while fulmars are typically surface feeders, taking fish, offal, and squid.

The northern fulmar is common year-round in the waters off eastern Newfoundland. Shearwaters are most common overall in offshore Newfoundland in the summer and fall months, particularly on the east and northeast Grand Banks (Fifield et al. 2009). Most of the world's population of great shearwaters is found in the northwest Atlantic in the summer months, outside of their austral breeding season (Brown 1986). In the summer months, northern fulmars and great shearwaters are among the most commonly observed species in seabird surveys conducted for Statoil (Statoil 2015b; Fugro EMU 2015).

ECSAS sightings for fulmars and shearwaters are presented in Figures 6-60 and 6-61, respectively. Of the shearwaters that could be identified by the surveyors, great shearwater was the most commonly identified species, followed by sooty, manx, and Cory's. CWS records for northern fulmar colonies in eastern Newfoundland are provided in Table 6.30. The manx shearwater is known to nest in one small colony, at Middle Lawn Island off the Burin Peninsula on the south coast of Newfoundland. This site is far removed from the Project Area, and is the only known regular nesting site in North America (Lee and Haney 1996).

Table 6.30 Norther Fulmar Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony size	Survey Unit	Year Surveyed
Funk Island	12	6	Pair	2012
Baccalieu Island	120	13	Pair	2003
Gull Island	200	12	Pair	2016
Green Island	201	1	Pair	1988
Ship Island	203	42	Pair	2015
Great Island	205	5	Pair	2015

Note:
Refer to Figure 6-49 for colony locations corresponding to each Colony #
Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2016)

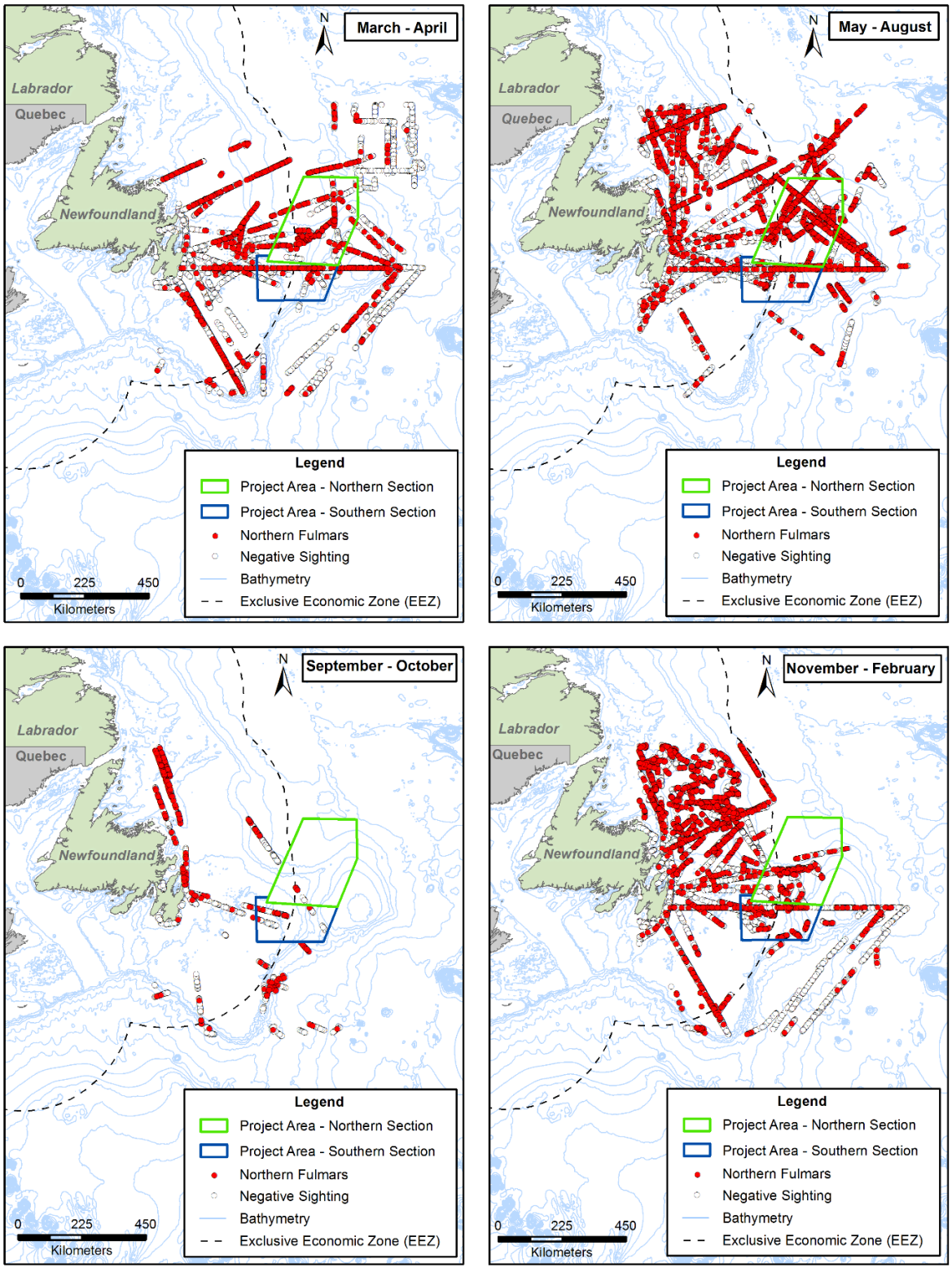


Figure 6-60 Seasonal Distribution of ECSAS Northern Fulmar Observations in the Waters off Eastern Newfoundland (2001 – 2016)

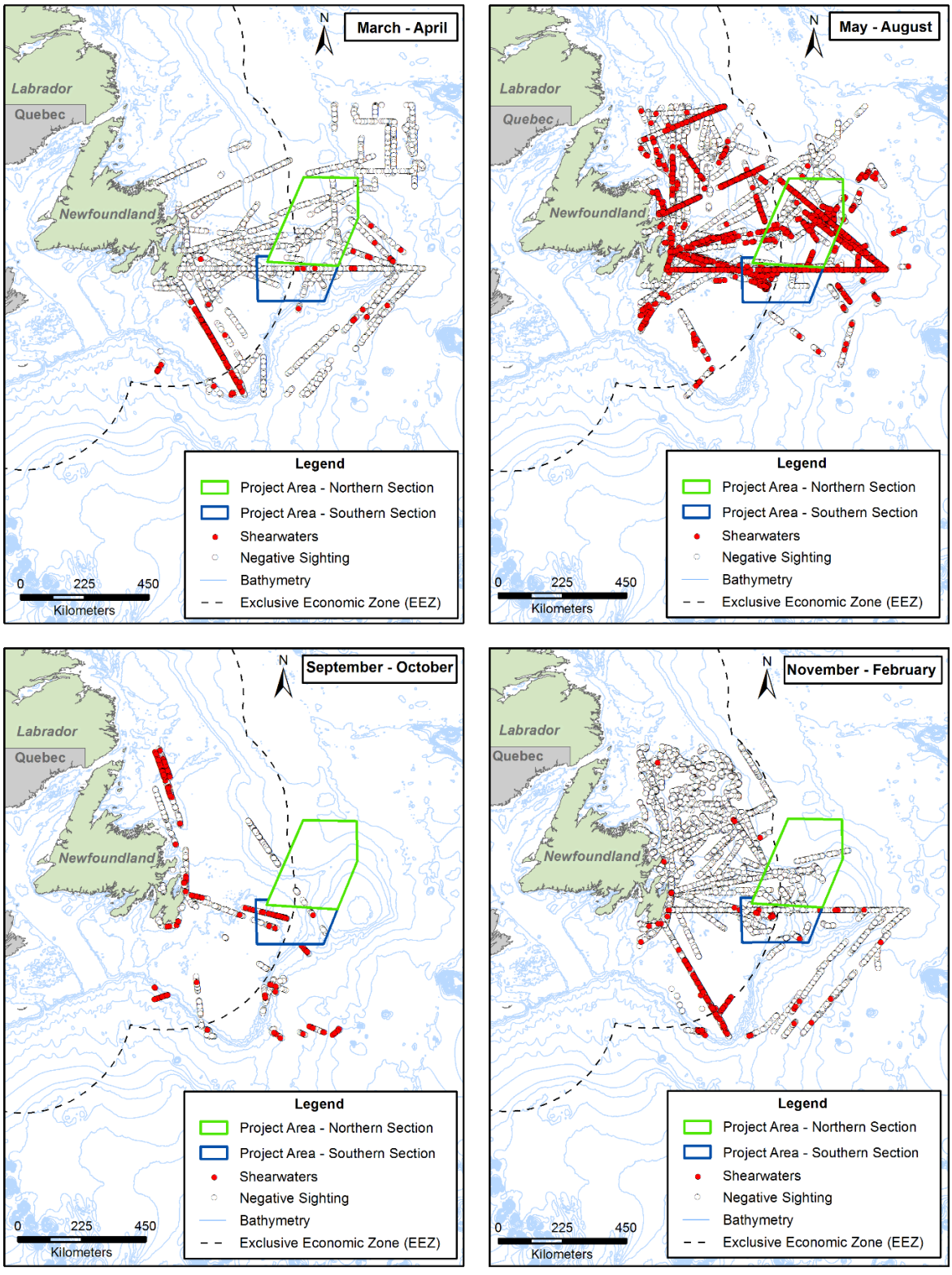


Figure 6-61 Seasonal Distribution of ECSAS Shearwater Observations in the Waters off Eastern Newfoundland (2001 – 2016)

6.2.2.9 Storm-petrels

Two species of storm-petrels are found in the waters off eastern Newfoundland, with the Leach's storm-petrel breeding in Newfoundland whereas Wilson's storm-petrel is an Antarctic breeder and uncommon visitor in the northwest Atlantic. Storm-petrels are found in offshore environments year-round, often following ships and fishing boats (Huntington et al. 1996). Leach's storm-petrel is the species most frequently found stranded on platforms and vessels off eastern Newfoundland; of 135 birds found between 2012 and 2015, 111 were Leach's storm-petrels, (e.g., Thomas et al. 2014; McTavish and Lang 2015, unpublished migratory bird salvage reports provided by Statoil). The majority of strandings (more than 80 percent) occurred in September and October, corresponding with the departure of fledglings from the breeding colonies (Davis et al. 2015). They are surface feeders, gleaning zooplankton and small crustaceans from the ocean's surface, and can travel more than 200 km from their colonies to feed during the breeding season (Huntington et al. 1996).

Leach's storm-petrels are the most numerous breeding seabird in Newfoundland. The largest colony in the world, Baccalieu Island, supports approximately one third of the species' population (Huntington et al. 1996; Barrett et al. 2006; CWS 2016). ECSAS sightings for storm-petrels within the RSA are presented in Figure 6-62. They are commonly observed in the summer months and regularly seen in the spring and fall, but are uncommon in winter. CWS records for Leach's Storm-petrel colonies in eastern Newfoundland are provided in Table 6.31.

Table 6.31 Leach's Storm-petrel Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
White Islands	1	400	Pair	1943
Rouge Island	2	1,000	Pair	1943
Isle Aux Canes	3	300	Pair	1986
Storehouse Islets	4	100	Pair	1984
Single Turr Cliff	5	1,523	Pair	2014
Double Turr Cliff	6	2,444	Pair	2014
Hennessey Island	7	9	Pair	2014
Bakeapple Island	8	2,317	Pair	2014
Little Bakeapple	9	113	Pair	2014
Wadhams Harbour Island	10	200	Pair	2012
Puffin Island (Little Fogo Islands)	11	396	Pair	2014
Small Island	14	1,038	Pair	2001
Coleman Island	15	5,000	Pair	1984
Ladle Island	19	20	Pair	1985
Penguin Island, North	20	200	Pair	1984
Penguin Island, South	21	7,800	Pair	1979
Cabot Island, North	27	100	Pair	1945
Flower Island	32	75	Pair	1945

Table 6.31 Leach's Storm-petrel Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Butterfly Islets	33	200	Pair	1967
Big Shag Rock	36	1,000	Pair	1980
Offer Gooseberry Island	45	100	Pair	1945
Shag Islands	71	1,700	Pair	1974
Green Island, Cape Bonavista	73	10	Pair	1945
Little Denier Island	78	1,300	Pair	1975
Bird, South	84	50	Pair	1985
Copper Island	91	10	Pair	1987
Green Island, Trinity Bay	112	1	Pair	2005
Baccalieu Island	120	2,022,000	Pair	2013
Wreck Island, Garia Bay	157	100	Pair	1944
Ramea Columbier Island	179	1,000	Pair	1989
Pass Island	181	100	Pair	1978
Penguin Islands	195	100	Pair	1978
Gull Island	200	179,743	Pair	2012
Green Island	201	20	Pair	1979
Great Island	205	134,139	Pair	2011

Note:
Refer to Figure 6-49 for colony locations corresponding to each Colony #.
Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2016)

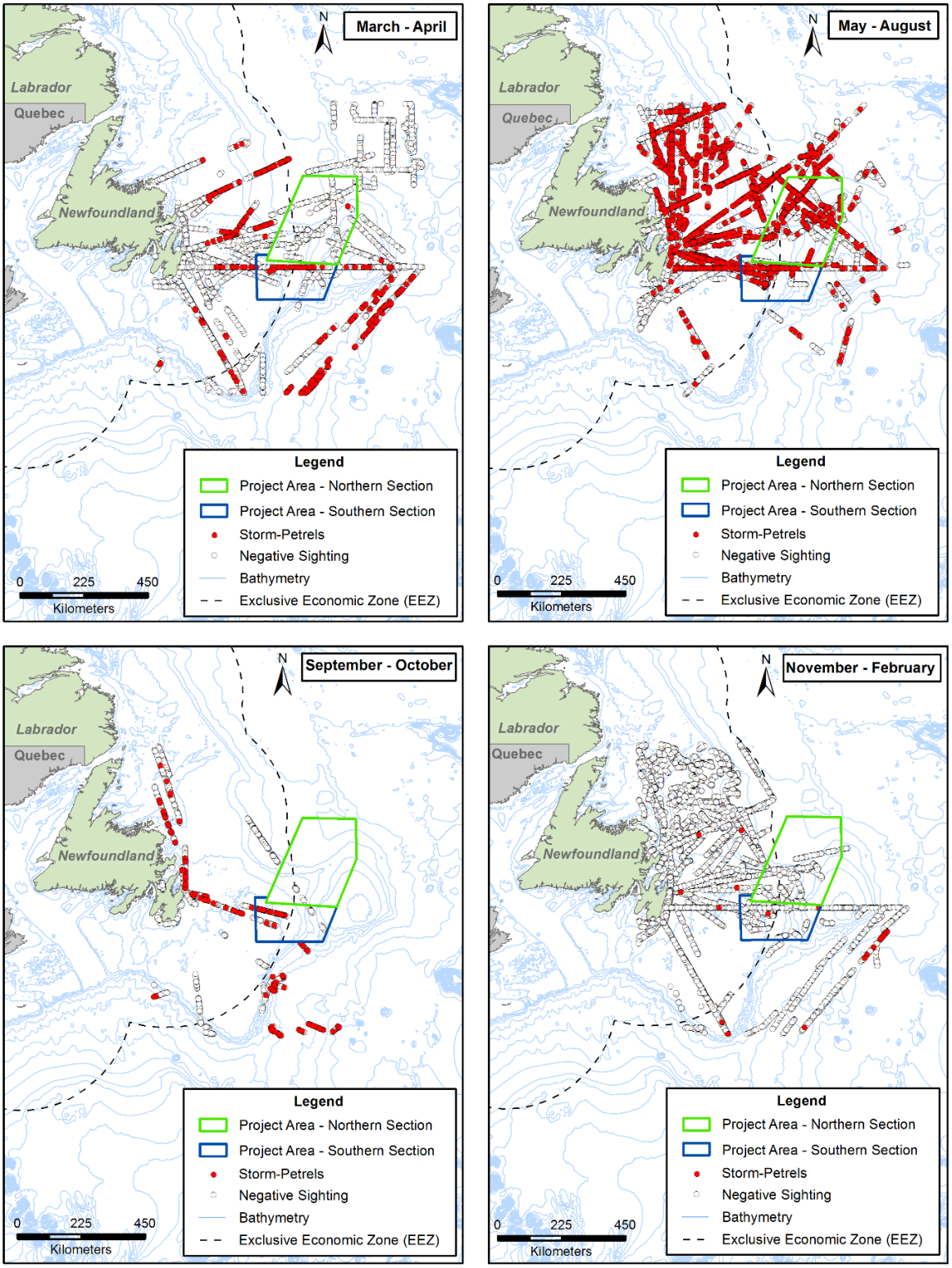


Figure 6-62 Seasonal Distribution of ECSAS Storm-petrel Observations in the Waters Off Eastern Newfoundland (2001 – 2016)

6.2.3 Other Marine-Associated Avifauna

Waterfowl occur in large numbers in marine habitats off eastern Newfoundland, especially during the winter months. However, they tend to prefer more coastal habitats and are unlikely to occur frequently in the offshore area. Because the Project Area is over 300 km offshore, it is unlikely that shorebirds will occur there with any regularity (other than phalaropes, which are taxonomically shorebirds but due to their pelagic habitat preferences are discussed along with the seabirds). Similarly, migrating landbirds are only expected to be found in the area on a transient basis.

6.2.3.1 Waterfowl and Divers

Waterfowl and divers (loons and grebes) spend much of their time on the water's surface. Although loons and grebes are not waterfowl, they are behaviourally and functionally similar, and have therefore been combined in this section. At sea, waterfowl and divers tend to prefer coastal areas, and are only occasionally seen in the offshore environment. The most abundant duck species in coastal Newfoundland waters occurring at all times of year is the common eider, which breeds in several small colonies along the coast (Locke et al. 1994). Close to 20 species of waterfowl and divers occur in the province during at least part of the year (Table 6.32), including two species of conservation concern, the Barrow's goldeneye and harlequin duck.

Table 6.32 Overview of Waterfowl that are Known or Likely to Occur off Eastern Newfoundland

Type	Species
Anserinae – Geese	Canada Goose (*Branta canadensis*)
Anatinae – Dabbling Ducks	Wood Duck (*Aix sponsa*)
	Gadwall (*Anas strepera*)
	Eurasian Wigeon (*Anas penelope*)
	American Wigeon (*Anas americana*)
	American Black Duck (*Anas rubripes*)
	Mallard (*Anas platyrhynchos*)
	Blue-winged Teal (*Anas discors*)
	Northern Shoveler (*Anas clypeata*)
	Northern Pintail (*Anas acuta*)
	Green-winged Teal (*Anas crecca*)
Aythyinae – Diving Ducks	Ring-necked Duck (*Aythya collaris*)
	Tufted Duck (*Aythya fuligula*)
	Greater Scaup (*Aythya marila*)
	Lesser Scaup (*Aythya affinis*)
Merginae – Sea Ducks	King Eider (*Somateria spectabilis*)
	Common Eider (*Somateria mollissima*)
	Harlequin Duck (Eastern pop.) (*Histrionicus histrionicus*)

Table 6.32 Overview of Waterfowl that are Known or Likely to Occur off Eastern Newfoundland

Type	Species
	Surf Scoter (*Melanitta perspicillata*)
	White-winged Scoter (*Melanitta fusca*)
	Black Scoter (*Melanitta americana*)
	Long-tailed Duck (*Clangula hyemalis*)
	Bufflehead (*Bucephala albeola*)
	Common Goldeneye (*Bucephala clangula*)
	Barrow's Goldeneye (Eastern pop.) (*Bucephala islandica*)
	Hooded Merganser (*Lophodytes cucullatus*)
	Common Merganser (*Mergus merganser*)
	Red-breasted Merganser (*Mergus serrator*)
Gaviidae – Loons	Red-throated Loon (*Gavia stellata*)
	Common Loon (*Gavia immer*)
Podicipedidae – Grebes	Pied-billed Grebe (*Podilymbus podiceps*)
	Red-necked Grebe (*Podiceps grisegena*)

Common eiders and other sea ducks such as white-winged scoters, surf scoters, black scoters, and long-tailed ducks occur in large flocks (“rafts”) off the coast from autumn to spring. Large wintering congregations occur at Witless Bay, between the Cape Freels coastline and nearby Wadham Islands, Grates Point, Cape St. Francis, Mistaken Point, Cape St. Mary’s, and Placentia Bay (Bird Studies Canada 2016). Small numbers of Barrow’s goldeneye have been reported wintering in eastern Newfoundland at Port Blandford and Newman Sound in Terra Nova National Park, as well as Traytown Bay, St. Mary’s Bay, and Spaniard’s Bay (Schmelzer 2006).

ECSAS sightings for waterfowl and divers within and near the RSA are presented in Figure 6-63. Waterfowl observations were scarce in the waters off eastern Newfoundland, but the most frequently observed species was common eider, followed by long-tailed duck; loons (common and red-throated), scoters (white-winged, surf and black) and a handful of other duck species were infrequently observed.

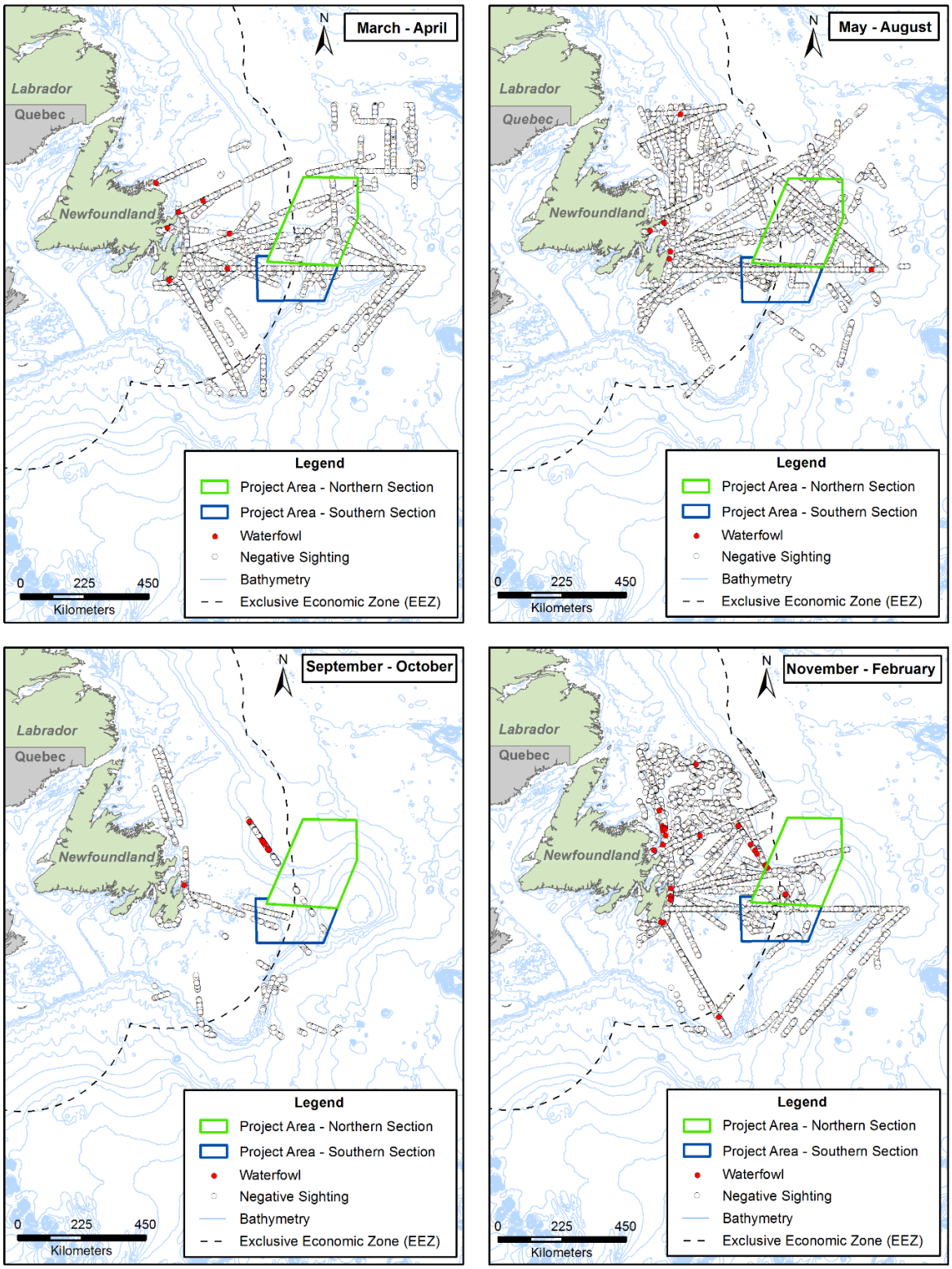


Figure 6-63 Seasonal Distribution of ECSAS Waterfowl Observations in the Waters off Eastern Newfoundland (2001 – 2016)

6.2.3.2 Shorebirds

Nearly 30 species of shorebirds occur in the province for at least part of the year (Table 6.33). Least sandpiper, spotted sandpiper, greater yellowlegs, piping plover, semipalmated plover and killdeer nest in Newfoundland, while others are present only during migration (Warkentin and Newton 2009). On the southern and eastern coasts of Newfoundland, shorebirds are most abundant during their fall migration, when many species move southward from their Arctic breeding grounds. Based on results from the Atlantic Canada Shorebird Survey, the eastern coast of the Avalon Peninsula has several important migration stopovers (e.g., Witless Bay, Renews, Long Beach, St. Shotts, Spaniard's Bay, Bellevue Beach); other major stopovers in southern and eastern Newfoundland include Big Barasway, Grand Bay West to Cheeseman Provincial Park, Codroy Valley Estuary, Cape Freels, and Cape Bonavista (Environment Canada 2009; Bird Studies Canada 2016). In the winter months, generally from November to April, purple sandpipers are present along rocky shorelines and offshore ledges and islands of southern and eastern Newfoundland, including at Cape Spear, Witless Bay, Ferryland, Cape St. Francis and Mistaken Point in eastern Newfoundland (Environment Canada 2009; Bird Studies Canada 2016). At Mistaken Point, far north of the rest of the species' usual wintering range, a small number of ruddy turnstones regularly overwinters (Bird Studies Canada 2016).

Table 6.33 Overview of Shorebirds that are Known or Likely to Occur off Eastern Newfoundland

Type	Species
Charadriidae – Plovers	Black-bellied Plover (*Pluvialis squatarola*)
	American Golden-Plover (*Pluvialis dominica*)
	Semipalmated Plover (*Charadrius semipalmatus*)
	Piping Plover (melodus ssp.) (*Charadrius melodus*)
	Killdeer (*Charadrius vociferus*)
Scolopacidae – Sandpipers	Spotted Sandpiper (*Actitis macularius*)
	Solitary Sandpiper (*Tringa solitaria*)
	Greater Yellowlegs (*Tringa melanoleuca*)
	Willet (*Tringa semipalmata*)
	Lesser Yellowlegs (*Tringa flavipes*)
	Whimbrel (*Numenius phaeopus*)
	Hudsonian Godwit (*Limosa haemastica*)
	Ruddy Turnstone (*Arenaria interpres*)
	Red Knot (rufa ssp.) (*Calidris canutus*)
	Sanderling (*Calidris alba*)
	Semipalmated Sandpiper (*Calidris pusilla*)
	Least Sandpiper (*Calidris minutilla*)
	White-rumped Sandpiper (*Calidris fuscicollis*)
	Baird's Sandpiper (*Calidris bairdii*)

Table 6.33 Overview of Shorebirds that are Known or Likely to Occur off Eastern Newfoundland

Type	Species
	Pectoral Sandpiper (*Calidris melanotos*)
	Purple Sandpiper (*Calidris maritima*)
	Dunlin (*Calidris alpina*)
	Stilt Sandpiper (*Calidris himantopus*)
	Buff-breasted Sandpiper (*Calidris subruficollis*)
	Short-billed Dowitcher (*Limnodromus griseus*)
	Wilson's Snipe (*Gallinago delicata*)
	American Woodcock (*Scolopax minor*)

Marine shoreline habitats such as sandy mudflats and coastal barrens are used by foraging shorebirds during migration, but they are not typically found offshore. Therefore, shorebirds are considered to be very infrequent visitors to the region, primarily in the fall months. Small groups of unidentified shorebirds were observed during nighttime surveys conducted at two offshore production platforms in October 2015 (McTavish and Lang 2015).

6.2.3.3 Landbirds

Many passerines, raptors and other landbirds breed in Newfoundland. Although most do not regularly occur in the marine environment, some species of landbirds are associated with coastal habitats including the bank swallow, Savannah sparrow and short-eared owl, which typically nest along the coast, as well as some raptor species that prey upon concentrations of shorebirds during migration. Further, many landbirds fly long distances over water during migration, and nocturnal migrants such as passerines are attracted to artificial light sources at sea, particularly in foggy conditions during the late summer to fall months (July to early November). Landbirds are considered to be very infrequent visitors. Species observed during surveys conducted from platforms and vessels, including stranding reports, include mourning dove, osprey, peregrine falcon, short-eared owl, common nighthawk, tree swallow, common redpoll, snow bunting, Lincoln's sparrow and three warbler species (Thomas et al. 2014; McTavish and Lang 2015; Statoil 2015a, 2015b; unpublished migratory bird salvage reports provided by Statoil). All of these landbird sightings were between July and November, during the fall migration period, with the exception of mourning doves, which were observed in February and May (Statoil 2015a, 2015b).

6.2.4 Species at Risk

Very few avian species listed under SARA as SAR or identified by COSEWIC as SOCC are likely to occur in the Project Area or larger surrounding region (Table 6.34). The Ivory Gull (SAR) is found almost exclusively in marine environments and is highly associated with pack ice, and therefore is more likely to be found in the Project Area – Southern Section where there is a higher potential for pack ice (refer to Section 5.7 for specific information on pack ice extents within the Project Area); although its breeding distribution (and critical habitat) is in the Arctic, it regularly occurs in small

numbers in the waters off eastern Newfoundland. Two waterfowl SAR, the Barrow's goldeneye and harlequin duck, both occur in the marine environment, particularly outside of the breeding season. Like other waterfowl species, they prefer coastal areas and so are considered unlikely this far offshore. Red-necked phalaropes, assessed by COSEWIC as a species of conservation concern, were seen in small numbers during ECSAS surveys in offshore waters from April to December. The other avian SARs listed in Table 6.34 are shorebirds and landbirds, and are unlikely to be found in the area except on a transient basis during fall migration (July to November).

Table 6.34 Avian Species at Risk and their Likelihood of Occurrence

Species	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
Barrow's Goldeneye (Eastern pop.)	Vulnerable	Special Concern (Schedule 1)	Special Concern	• Moults and winters in small numbers off the coast of Eastern Canada, often in groups with Common Goldeneye. Small numbers have been reported wintering at Port Blandford and Newman Sound in Terra Nova National Park, as well as Traytown Bay, St. Mary's Bay, and Spaniard's Bay (Schmelzer 2006) • Known to congregate in relatively small geographic areas in important shipping corridors, therefore considered to be vulnerable to being affected by accidental spills (Schmelzer 2006)	Unlikely to be present due to their preference for coastal habitats.
Harlequin Duck (Eastern pop.)	Vulnerable	Special Concern (Schedule 1)	Special Concern	• Breeds in fast-flowing streams, and congregate in moulting sites in the late summer to fall. Bay du Nord River in southeastern Newfoundland may support nesting Harlequins (Bird Studies Canada 2016) • Although they breed inland, Harlequin Ducks occur in the coastal marine environment	Unlikely to be present due to their preference for coastal habitats.

Table 6.34 Avian Species at Risk and their Likelihood of Occurrence

Species	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
				throughout the fall and winter months along rocky coastlines, subtidal ledges, and exposed headlands. Some non-breeding individuals may be found year-round at Cape St. Mary's, one of few known moulting sites in the province (Bird Studies Canada 2016; NLDEC 2016a)	
Ivory Gull	Endangered	Endangered (Schedule 1)	Endangered	• Breeds in the far north • Winters offshore, occurring in small numbers in the waters off eastern Newfoundland, where they are found most often among the pack ice • Rarely seen on the coast of the Northern Peninsula and ashore (Stenhouse 2004; NLDEC 2016a)	Potentially present. Ivory Gulls spend almost all of their time in the marine environment. They are typically found among pack ice. However, Ivory Gulls were reported on two occasions in bird surveys conducted at the Bay de Verde Well Site in the winter of 2014 - 2015 (Statoil 2015a).
Piping Plover (*Melodus* ssp.)	Endangered	Endangered (Schedule 1)	Endangered	• During the nesting season, Piping Plovers are found on sandy beaches along the coast • In Newfoundland, breeding population is	Unlikely to be present due to their preference for coastal habitats.

Table 6.34 Avian Species at Risk and their Likelihood of Occurrence

Species	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
				concentrated in the southwest and western portions of the Island (NLDEC 2016a); major breeding areas include Grand Bay West to Cheeseman Provincial Park and Big Barasway, and nesting has also been observed in Codroy Valley Estuary (Bird Studies Canada 2016). However, in 2013, breeding was reported at Deadman's Bay near the Cape Freels Coastline IBA in northeastern Newfoundland • Piping Plovers are unlikely to be affected by typical project activities, although accidental spills near breeding habitat could potentially be harmful	
Red Knot (*Rufa* ssp.)	Endangered	Endangered (Schedule 1)	Endangered	• Found on open sandy inlets, coastal mudflats, sand flats, salt marshes, sandy estuaries and areas with rotting kelp deposits during fall migration, from August 1st to October 30th (Garland and Thomas 2009; NLDEC 2016a) • Newfoundland is not considered to be a major stopover location; nonetheless, sightings have been reported around almost the entire coast of Newfoundland, mostly on the west coast (Baker et al. 2013) • In Atlantic Canada Shorebird Survey, they are considered regular or	Unlikely to be present due to their preference for coastal habitats.

Table 6.34 Avian Species at Risk and their Likelihood of Occurrence

Species	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
				occasional species during fall migration at Bellevue Beach, Cape Freels, and around the Codroy Valley Estuary, and they are rare visitors at a number of other survey sites (Environment Canada 2009)	
Buff-breasted Sandpiper	none	none	Special Concern	• Arctic breeders; during fall migration, considered to be a rare migrant in the province (COSEWIC 2012a) • Occasionally observed in Atlantic Canada Shorebird Surveys at St. Shott's Sod Farm near the southern shore of the Avalon Peninsula and at Cape Bonavista, and are reported as rare visitors at a number of other survey sites (Environment Canada 2009)	Unlikely to be present due to their preference for coastal habitats.
Red-necked Phalarope	none	none	Special Concern	• Phalaropes come onshore only to breed, and occur in the coastal marine environment the rest of the year • Surface feeders, often congregating in areas such as upwellings which are associated with higher prey densities • Reported as rare visitors at Cape Spear and Bonavista / Cape Bonavista Atlantic Canada Shorebird Survey sites (Environment Canada 2009)	Red-necked Phalaropes are seen in small numbers during ECSAS surveys, although they are scarce in the winter and spring (ECSAS 2016).

Table 6.34 Avian Species at Risk and their Likelihood of Occurrence

Species	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
Peregrine Falcon	Vulnerable	Special Concern Schedule 1	Special Concern	• Migrates along the coast of Newfoundland during the fall (particularly the west coast), preying on concentrations of migrating shorebirds • Peregrine Falcon sightings have been reported in the fall near Port-aux-Basques, St. Pierre et Miquelon, and on the Bonavista Peninsula, and at all times of year (but most frequently during the fall) on the Avalon Peninsula (White et al. 2002)	Unlikely to occur regularly; however, a vagrant was observed near an offshore production platform in October 2015 (McTavish and Lang 2015).
Common Nighthawk	Threatened	Threatened (Schedule 1)	Threatened	• Nests in open areas (e.g., coastal sand dunes and beaches, logged or burned areas of forests, woodland clearings, grassland habitat, farm fields, open forests, rock outcrops, and flat gravel rooftops); does not breed in insular Newfoundland (Brigham et al. 2011)	Unlikely to occur regularly in; however, a vagrant was observed offshore in November 2014 (Statoil 2015a).
Bank Swallow	none	none	Threatened	• Bank Swallows are colonial, often nesting in sandy banks created through coastal erosion; therefore, potentially in close proximity to the marine environment, but not Project Area, during the breeding season • Diurnal migrants (Garrison 1999) • Within the province, breeds primarily in southwestern Newfoundland (Warkentin and Newton 2009);	Unlikely to occur offshore. As diurnal migrants, they are less susceptible to disorientation from offshore artificial light sources.

Table 6.34 Avian Species at Risk and their Likelihood of Occurrence

Species	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
				however, sightings have also been reported in eastern Newfoundland (Garrison 1999)	
Gray-cheeked Thrush (*minimus* ssp.)	Threatened	none	Candidate Species (low priority)	• Nests in dense coniferous forest habitat throughout insular Newfoundland and overwinters in South America, migrating nocturnally (Lowther et al. 2001) • Most common on the Northern Peninsula and along the northeast coast, as well as the northern Avalon Peninsula (Endangered Species and Biodiversity Section 2010) • Has also been reported in Placentia Bay (Endangered Species and Biodiversity Section 2010) and breeds in Terra Nova National Park (Bird Studies Canada 2016) • An inland species, therefore unlikely to be affected by offshore activities at most times of year	During fall migration, like other nocturnal migrants, there is potential for Gray-cheeked Thrush to be attracted to or disoriented by artificial light sources in the offshore environment.
Olive-sided Flycatcher	Threatened	Threatened Schedule 1	Threatened	• Found in boreal forest habitat, open areas such as wetlands with tall trees and snags • Migrates to south and central America to overwinter (Altman and Sallabanks 2012) • Breeds throughout insular Newfoundland and Southern Labrador (COSEWIC 2007a), and in eastern Newfoundland it has been reported at	During fall migration, like other nocturnal migrants, there is potential for this species to be attracted to or disoriented by artificial light sources in the

Table 6.34 Avian Species at Risk and their Likelihood of Occurrence

Species	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
				several locations on the Avalon Peninsula as well as at Terra Nova National Park (Altman and Sallabanks 2012)	offshore environment
Bobolink	Vulnerable	none	Threatened	• Nests in agricultural and natural grasslands, and migrates to South America in the fall (Renfrew et al. 2015) • Breeding has been reported at Codroy Valley (Bird Studies Canada 2016), and there have been sightings on the Avalon Peninsula and Terra Nova National Park (Renfrew et al. 2015)	During fall migration, like other nocturnal migrants, there is potential for this species to be attracted to or disoriented by artificial light sources in the offshore environment
Short-eared Owl	Vulnerable	Special Concern Schedule 1	Special Concern	• Typically nests in coastal barrens and grasslands (Wiggins et al. 2006), and suitable habitat occurs in much of coastal Newfoundland • Sightings have been reported throughout the eastern portion of the Island from Wadham Islands to the Avalon and Burin Peninsulas, and near Port-aux-Basques and Codroy Valley in southwestern Newfoundland, mostly in the summer months (Schmelzer 2005; Wiggins et al. 2006)	Unlikely to occur regularly; however, a vagrant was observed near an offshore production platform in October 2015 (McTavish and Lang 2015).

Species that do not inhabit the offshore environment or only migrate over the ocean in the daytime include the red crossbill (*percna* subspecies), a non-migratory forest dweller (Environment Canada 2006). The rusty blackbird breeds throughout Newfoundland and may migrate over the offshore area, but as a diurnal (daytime) migrant (Avery 2013). Other diurnal migrant SAR or SOCC concern that may occur in Newfoundland include the chimney swift (Steeves et al. 2014) and barn swallow (Brown and Brown 1999).

6.2.5 Summary of Key Areas and Times

While seabirds occur off eastern Newfoundland throughout the year, the abundance and distribution of species varies considerably. Some taxa, notably large gulls and kittiwakes, many alcid species, fulmars and shearwaters, are abundant year-round. Others are absent or scarce in the winter months, such as the northern gannet, terns, cormorants and phalaropes. Ivory gulls and waterfowl (including harlequin duck and Barrow's goldeneye) are most likely to be present in the winter months, outside the breeding season. IBAs and breeding colonies are found in coastal areas and inland (refer to Section 6.4 for more information). At several hundred kilometres offshore, the Flemish Pass is outside of the reported foraging range of most species breeding at the major seabird colonies in coastal Newfoundland, although northern gannets and Leach's storm-petrels will travel hundreds of kilometres from their colonies over multi-day foraging trips (Garthe et al. 2007; Pollet et al. 2014a).

Figure 6-64 illustrates the seasonal presence of marine-associated bird species as described in the preceding sections, while nesting colony locations are shown on Figure 6-49. In the summer months, the greatest abundance of seabird species breeding in Newfoundland is concentrated around nesting colonies (Fifield et al. 2009). However, seabirds are relatively long-lived, and for many species, individuals do not breed until four or five years of age. Large numbers of these non-breeding birds may be found far offshore during the breeding season. Some Southern Hemisphere-breeding species spend their winter in the northwest Atlantic, including most of the world's great shearwaters (Brown 1986).

The fall months are an important time for Leach's storm-petrels and migrating landbirds (e.g., passerines, which tend to be nocturnal migrants). The Leach's storm-petrel is the species most frequently found stranded on platforms and vessels in and near the RSA, (e.g., Thomas et al. 2014; McTavish and Lang 2015, unpublished migratory bird salvage reports provided by Statoil), with the vast majority of strandings occurring in September and October, following the departure of fledglings from nearby breeding colonies (Davis et al. 2015).

During the winter months, tens of millions of dovekies travel several thousand kilometers from their breeding grounds to their core winter distribution within the highly productive waters off eastern Newfoundland (Fort et al. 2012, 2013). In the winter months, the waters off eastern Canada support a large proportion of the Icelandic population of great skuas (Magnusdottir et al. 2012). A recent tracking study of black-legged kittiwakes has shown that the northwest Atlantic, especially the shelf edge off Newfoundland, is an important wintering area for kittiwakes, with most of the Atlantic population overwintering in this region (Frederiksen et al. 2012). Most of eastern Canada's population of Common Murres and approximately a third of the region's Thick-billed Murres overwinter in the waters off eastern Newfoundland (McFarlane Tranquilla et al. 2013).

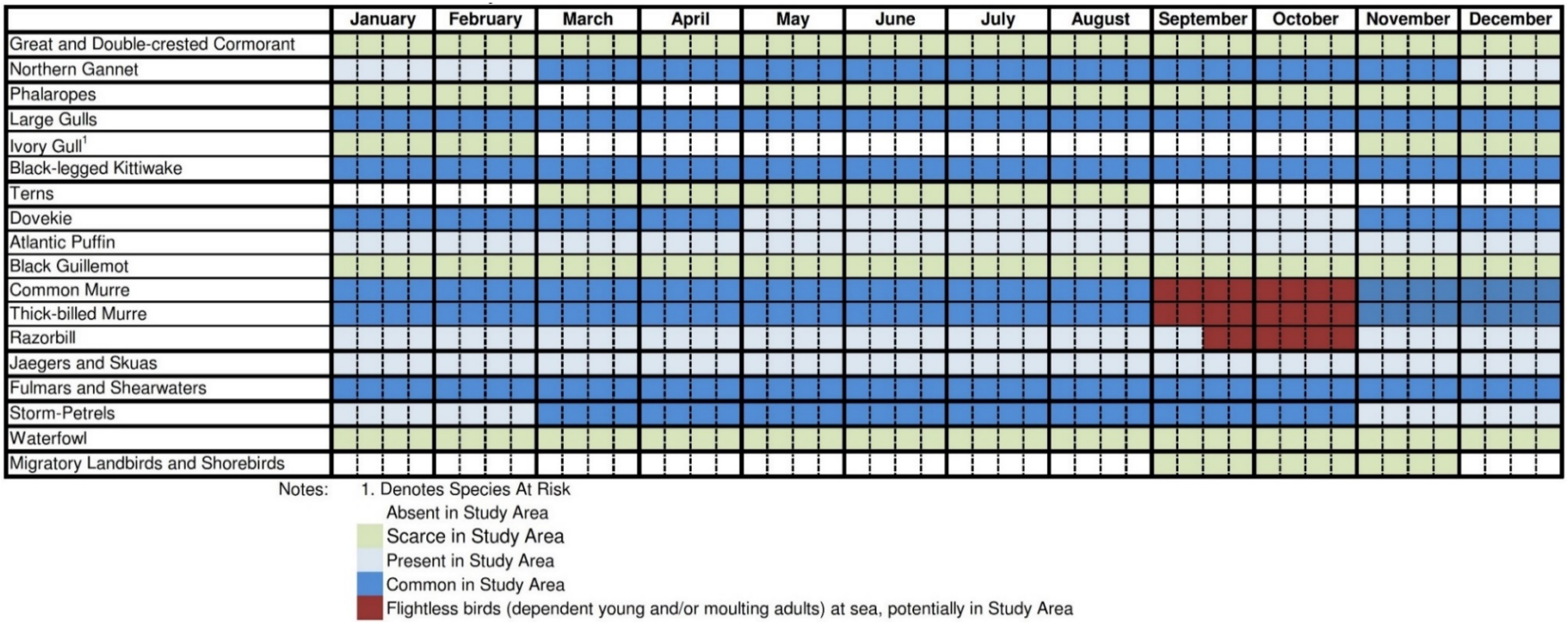


Figure 6-64 Summary of Seasonal Presence of Marine-associated Birds off Eastern Newfoundland

Areas of importance to the survival of bird species may be given the designation of IBA (Section 6.4.5). The IBA program is coordinated by BirdLife International, and administered in Canada by the Canadian Nature Federation and Bird Studies Canada. The criteria used to identify important habitat are internationally standardized, and are based on the presence of species at risk, species with restricted range, habitats holding representative species assemblages, or a congregation of a significant proportion of a species' population during one or more season. These criteria are used to identify sites of national and international importance. There are 21 IBA sites in eastern Newfoundland and 13 of these are located within the RSA. These are summarized in Table 6.35, and illustrated in Figure 6-65.

Table 6.35 Important Bird Areas in Eastern Newfoundland

IBA Name	Area (km^3)	Location	Importance to Marine and Migratory Birds
Funk Island (NF004)	135.18	An island off northeastern Newfoundland, situated approximately 60 km from shore.	Major concentration of nesting seabirds Globally significant Common Murre population Large numbers of Northern Gannets Provincially protected Seabird Ecological Reserve; as such, access to the island is restricted to scientific researchers. Overlaps with Fogo Shelf EBSA.
Wadham Islands and adjacent Marine Area (NF013)	159.23	Located near Fogo Island, approximately 40 km offshore, this IBA includes 7 main islands and several smaller rocks and shoals.	Globally significant number of wintering Common Eider (approximately 25,000 counted in a 1995 survey) Large numbers of nesting Atlantic Puffin, Leach's Storm-Petrel and Razorbill. Overlaps with Fogo Shelf EBSA.
Cape Freels Coastline and Cabot Island (NF025)	334.48	Located at the head of Bonavista Bay, this IBA includes several small islands and shoals.	Up to 25,000 wintering Common Eiders have been reported between the Cape Freels coastline and Wadham Islands Large numbers of nesting Common Murres, as well as some pairs of Razorbills Historic records of breeding Atlantic Puffins, although none were recorded in recent EC-CWS surveys.
Terra Nova National Park (NF017)	655.56	Situated on the inner reaches of Bonavista Bay. Much of the area is forested, but there are numerous lakes and wetlands, as well as a significant coastal component.	Numerous forest species nest here, including two subspecies with restricted ranges: the federally-listed Red Crossbill (*percna* ssp.) and Ovenbird (*furvoir* ssp.). Shorebirds, gulls and waterfowl can be seen on the flats at the outlet of Big Brook, as well as Newman Sound. At least six tern colonies (Common and Arctic Tern), totalling between 1000 and 1500 pairs. Also a federally designated Migratory Bird Sanctuary (MBS) and National Park.

Table 6.35 Important Bird Areas in Eastern Newfoundland

IBA Name	Area (km³)	Location	Importance to Marine and Migratory Birds
Grates Point (NF019)	66.55	The northern tip of the Bay de Verde Peninsula, which separates Trinity Bay from Conception Bay.	Large number of wintering Common Eiders (up to 12,000 individuals, but typically around 2,800) Other wintering species include Black-legged Kittiwake, Thick-billed Murre and Dovekie Atlantic Puffin and Northern Gannet are present in the summer months.
Baccalieu Island (NF003)	45.22	Located 5.5 km from the northern tip of the Avalon Peninsula.	Greatest seabird abundance and diversity in Eastern North America World's largest colony of Leach's Storm-petrels, including 70 percent of the North American population. Significant numbers of breeding Atlantic Puffin, Black-legged Kittiwake and Northern Gannet Smaller numbers of nesting Common Murre, Thick-billed Murre, Razorbill, Black Guillemot, Northern Fulmar, Herring Gull and Great Black-backed Gull Like Funk Island, a provincially designated Seabird Ecological Reserve
Cape St. Francis (NF021)	70.21	Located at the northern tip of the Avalon Peninsula.	Winter congregating area for Common Eiders; up to 5000 individuals recorded Purple Sandpipers regularly observed along the rocky shoreline in the winter
Quidi Vidi Lake (NF022)	7.0	Situated within St. John's city limits, and fed by the Virginia River and Rennies River.	Important daytime resting site for gulls from late fall to early spring, including significant numbers of Herring, Great Black-backed, Iceland, Glaucous and Common Black-headed Gulls. Locally rare Ring-billed Gull, Mew Gull and Lesser Black-backed Gull occasionally reported. Waterfowl including American Black Ducks, Mallards and Northern Pintails are common here in the winter, subsisting on food handouts from people.
Witless Bay Islands (NF002)	62.08	Composed of four small islands off the east coast of the Avalon Peninsula.	Provincially designated Seabird Ecological Reserve Globally significant numbers of breeding seabirds, including more than half of the eastern North American population of Atlantic Puffins and almost 10% of the global Leach's Storm-petrel population Large numbers of nesting Common Murres, Black-legged Kittiwakes and Herring Gulls Great Black-back Gulls, Northern Fulmars, Thick-billed Murres, Razorbills and Black Guillemots nest in smaller numbers During the fall migration, surrounding marine area is important to sea ducks including White-winged Scoter, Surf Scoter, Long-tailed Duck and Common Eider

Table 6.35 Important Bird Areas in Eastern Newfoundland

IBA Name	Area (km³)	Location	Importance to Marine and Migratory Birds
Mistaken Point (NF024)	102.77	Located near the southeastern corner of the Avalon Peninsula.	Important wintering area for up to 12,000 Common Eiders Continentally significant numbers of wintering Purple Sandpiper (> 1% of North American population) Small numbers of overwintering Ruddy Turnstone, far north of its usual wintering range Nesting Black-legged Kittiwake, Common Murre and Razorbill Designated as a Provincial Ecological Reserve and UNESCO World Heritage Site because of its rich fossil deposits
Cape St. Mary's (NF001)	329.39	Located at the entrance to Placentia Bay on the southwestern Avalon Peninsula.	Significant numbers of nesting Northern Gannet (> 2% of global population) Large numbers of Common Murre and Black-legged Kittiwake, and smaller numbers of nesting Thick-billed Murre, Razorbill, Great Cormorant and Double-crested Cormorant Herring Gull, Great Black-backed Gull and Black Guillemot historically reported nesting In the winter, large numbers of migrating sea ducks including scoters, Common Eider, Long-tailed Duck and the endangered Harlequin Duck Small numbers of Harlequin Duck during summer, moulting season in some years. Designated as a provincial Seabird Ecological Reserve. Overlaps with Placentia Bay EBSA.
Placentia Bay (NF028)	1398.05	Includes the eastern half of Placentia Bay in southeastern Newfoundland (between the Avalon and Burin peninsulas), and extends out 25 km from shore	Exceptional feeding area for seabirds during the summer capelin spawning season More than 100,000 shearwaters recorded in a single survey (mostly Greater and Sooty Shearwater, some Manx Shearwater) Large numbers of other species breeding at Cape St. Mary's feed here, including Northern Gannet, Black-legged Kittiwake, Atlantic Puffin, Thick-billed Murre and Common Murre Large numbers of feeding Pomarine and Parasitic Jaegers More than 1,000 wintering Common Eiders Overlaps with Placentia Bay EBSA.
Cape Pine and St. Shotts Barren (NF015)	57.4	Located on the southern tip of the Avalon Peninsula.	Large, possibly globally significant numbers of American Golden-Plover during their fall migration (August to mid-October) Dozens of Whimbrel during fall migration
Source: Important Bird Areas of Canada (Bird Studies Canada 2016); Atlantic Canada Colonial Waterbird database (CWS 2016)			

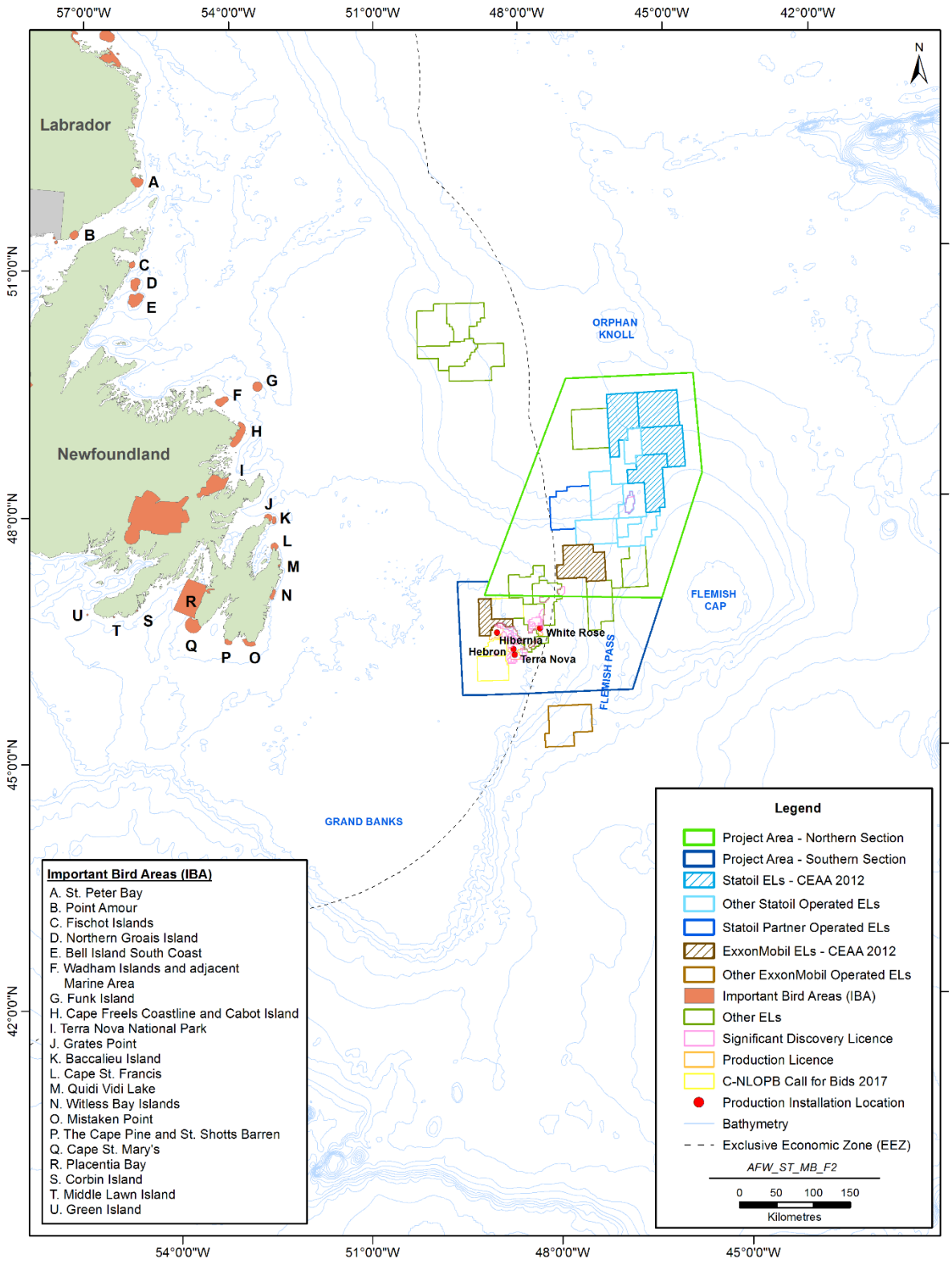


Figure 6-65 Important Bird Areas in Eastern Newfoundland

There are three MBSs in the eastern Newfoundland region: Terra Nova MBS, which is also an IBA, and the Shepherd Island MBS and Île aux Canes MBS, which are part of the Bell Island South Coast IBA (Table 6.35, Figure 6-65). Provincially, there are also numerous protected Wilderness and Ecological Reserves, including seven designated Seabird Ecological Reserves, five of which are located in eastern Newfoundland (NLDEC 2016b). Many of these sites, including Witless Bay, Lawn Bay (which includes Middle Lawn Island), Baccalieu Island, Cape St. Mary's and Funk Island, are also IBAs (see Table 6.35). The *Seabird Ecological Reserve Regulations*, NLR 66/97 prohibit or limit industrial development and certain activities that can cause disturbance to breeding seabirds, including hiking, boat traffic and low-flying aircraft near the colonies during the breeding season, and the use of ATVs at all times.

In addition to designated IBAs and MBSs, breeding sites for colonial species also constitute important areas and habitats for marine birds. Figure 6-49 shows the locations of known seabird colonies off eastern Newfoundland.

A number of EBSAs have also been identified. Among the criteria for selection and ranking of these areas was their importance to seabirds in terms of biodiversity, density, reproduction and survival. Table 6.36 provides a summary of key relevant characteristics of the four EBSAs that were identified as possessing important attributes pertaining to seabirds.

Table 6.36 EBSAs and Their Importance to Seabirds

EBSA	Importance to Seabirds
Southeast Shoal and Tail of the Banks	• An important offshore spawning area for key prey species (e.g., capelin and sandlance). This high concentration of forage species draws large and diverse aggregations of seabirds. • In terms of fitness consequences, this EBSA is an important seasonal foraging area for seabirds.
Placentia Bay Extension	• This EBSA supports important seabird breeding areas along the coast, as well as a high biomass of bird species typical of river and estuarine habitats. It is important for reproduction of many seabird species. • In terms of aggregation and fitness consequences, the EBSA is an important feeding area from spring to fall for many seabird species.
Southwest Shelf Edge and Slope	• This EBSA is critical to a wide variety of seabirds, providing the highest density of pelagic seabirds feeding within the PBGB LOMA.
Eastern Avalon Coast	• A diverse assemblage of seabirds feeds within this EBSA during the breeding season, from spring to fall.

6.3 Marine Mammals and Sea Turtles

Marine mammals and sea turtles are present at various times of the year off eastern Newfoundland, have the potential to interact with Project components and activities, and are considered to have ecological, economic, cultural, and recreational importance to government departments and agencies, Indigenous and stakeholder groups, and various other interested parties. This section

provides an overview of marine mammal and sea turtle species that are or may be present in the Project Area and/or the larger surrounding region, as defined below.

The description of the existing environment for Marine Mammals and Sea Turtles that is presented in this section covers an overall Study Area that includes the Project Area (see Section 2.3) as well as fully encompassing the LSAs (see Sections 4.3.1 and 10.1) and RSA (see Section 4.3.1) that have been defined and used in the environmental effects assessments for this VC.

6.3.1 Approach and Key Information

General life history and habitat information for marine mammals and sea turtles in the area has recently been described in the Eastern Newfoundland SEA (Amec 2014a), which has been drawn on extensively in this section. An overall summary of new information regarding these species that has been made available since the publication of the Eastern Newfoundland SEA is presented below. This summary is based on a literature review (e.g., COSEWIC assessment and status reports, Lawson and Gosselin 2009) and peer reviewed publications.

In addition to the literature review, marine mammal and sea turtle sightings data were retrieved from several sources to provide additional information on species presence. These sources include: Ocean Biogeographic Information System (OBIS), Fisheries and Oceans Canada (DFO) and Statoil. Data from OBIS covers opportunistic sightings reported over the period 1952 to 2008. Data from DFO Newfoundland Region (J. Lawson pers comm 2017) include all opportunistic marine mammal sightings between the years 1758 and 2015 (phocids were not recorded) and all sea turtle sightings between 1946 and 2015.

Data from OBIS and DFO entail a compilation of results from a number of survey programs, some of which are collected from opportunistic sightings as opposed to dedicated surveys that follow a systematic collection of data. These data, therefore, represent a consolidation of sightings from across programs, years and seasons, with sighting effort, methods and reporting being variable over the different programs and collection periods. Since effort has not been standardized spatially or temporally, a lack of sightings should not be interpreted to represent a definite lack of species presence nor should a seeming aggregation of sightings imply a necessary concentration of occurrence in an area. Since the sightings effort has not been quantified, these aggregated data also cannot be used to estimate species densities, abundances, or fine-scale habitat use for an area, nor do they give a representation of a typical day, week, month, or year of sightings or animal presence. Most sightings are reported from vessel-based platforms and the positive and/or negative reactions by animals to these vessels have not been factored into these data. Opportunistic sightings are reported by individuals with various degrees of experience and expertise in marine wildlife identification and these data have not been completely error-checked; as a result, the quality of some of the information is unknown. Despite these caveats, this information is of value in identifying overall species presence in the region or the potential for same.

Marine mammal records obtained from Statoil include observations of marine mammals, as reported in the following sources:

- Appendix C in LGL (2009): Summary of Marine Mammal Sightings
- Appendix C in LGL (2014): Summary of Marine Mammal Sightings

- Appendix A in Fugro (2015): Marine Mammal Observation Log
- Table 2 in PAL (2015): Marine Mammal Observations, Bay du Nord L-76 Site

Along with the reports listed above, Statoil provided additional data on marine mammal sightings for the years 2008-2015. These included sightings from exploratory drilling in the Bay de Verde field in 2014, the Cupids A-33 exploratory well in 2015, and some additional records from other Statoil surveys off eastern Newfoundland. Similar to OBIS and DFO data, these data represent a consolidation of marine mammal and sea turtle sightings from programs with different methods and different levels of spatial and temporal effort. As a result, a lack of sightings should not be interpreted as species absence, and concentrations of sightings should not be interpreted as predictable aggregations within a specific area. Species occurrence data presented in the distribution figures and sighting summary tables in the following sections are pooled from these three sources (OBIS, DFO, and Statoil), and across all years (i.e., the earliest record is 1758 and the latest is 2015). Figures and tables present individual sightings, not number of individuals observed – a sighting may involve one or a few hundred individuals observed at a given time (particularly in the case of smaller odontocetes such as dolphins).

In addition to the above data, sighting information collected in July and August 2007, as part of the Trans North Atlantic Sightings Survey (TNASS), which occurred partially in the waters surrounding Newfoundland and Labrador, was also considered within the species-specific descriptions. This large-scale survey was conducted in coordination with European countries and the US to estimate cetacean abundance in the North Atlantic (Lawson and Gosselin 2009). In Canadian waters, surveys for marine megafauna occurred from Cape Chidley in northern Labrador to the Scotian Shelf. During the surveys, there were 710 non-replicated sightings of 18 species, which totaled almost 4,000 individuals, the majority of which (3,691) were cetaceans. Abundance and distribution were also reported for leatherback sea turtle (Lawson and Gosselin 2009). While there is limited overlap between TNASS survey effort coverage and the Project Area (i.e., the eastern-most extent of TNASS aerial survey transects slightly overlap the southwestern-most extent of the Project Area – Northern Section as well as the western edge of the Project Area – Southern Section), the results of this extensive program provide information concerning overall species presence in the broader region.

6.3.2 Overview

Marine mammals and sea turtles that are found in the RSA include: an estimated 23 species of cetaceans (whales, dolphins, and porpoises), of which 7 are mysticetes (baleen whales), and 16 are odontocetes (toothed whales); 4 species of phocids (seals); and 4 species of sea turtles. Eleven of these species are designated at risk or otherwise have special conservation status (see Section 6.3.7). While some species of marine mammals remain in the waters off Newfoundland year-round, many marine mammals and sea turtles arrive in the late spring and early summer and remain until the fall. Tables 6.37 and 6.38 summarize the species of marine mammals and sea turtles (respectively) that may occur off eastern Newfoundland, including within the Project Area (Northern and Southern Sections). Potential for occurrence is a qualitative designation based on direct sighting information or known occurrence in the broader region. Conservation status and expected timing of presence are also summarized. General life history and habitat information for each species has recently been described and can be found in the Eastern Newfoundland SEA (Amec 2014a).

Table 6.37 Marine Mammals that May Occur in the Project Area and Surrounding Marine Environments

Common Name	Scientific Name	SARA Schedule 1 Status [1]	COSEWIC Designation [2,3]	Potential for Occurrence[4]	Potential Timing of Presence[5]	Sources
Mysticetes (Toothless or Baleen Whales)						
Blue whale (Atlantic population)	*Balaenoptera musculus*	Endangered	Endangered	Moderate	Year-round (highest concentrations from early spring through winter)	COSEWIC 2002; Lesage et al. 2016; NOAA 2010
Bowhead whale (Eastern Canada-West Greenland population)	*Balaena mysticetus*	Not Listed	Special Concern	Low	Unknown	COSEWIC 2009a; Ledwell et al. 2007; The Telegram 2014
Fin whale (Atlantic population)	*Balaenoptera physalus*	Special Concern	Special Concern	High	Year-round	COSEWIC 2005; DFO 2016a; NOAA 2015a
Humpback whale (Western North Atlantic population)	*Megaptera novaeangliae*	Not Listed (Special Concern on Schedule 3)	Not at Risk	High	Year-round (highest concentration from spring through winter)	Bettridge et al. 2015; Lawson and Gosselin 2009
Minke whale (North Atlantic subspecies)	*Balaenoptera acutorostrata*	Not Listed	Not at Risk	High	Year-round (highest concentration spring through fall)	NOAA 2016a; Risch et al. 2014
North Atlantic right whale	*Eubalaena glacialis*	Endangered	Endangered	Low	Unknown	COSEWIC 2013; NOAA 2016b
Sei whale (Atlantic population)	*Balaenoptera borealis*	Not Listed	Data Deficient	Moderate	Seasonal (summer)	COSEWIC 2003; NOAA 2016c
Odontocetes (Toothed Whales)						
Atlantic spotted dolphin	*Stenella frontalis*	Not Listed	Not Listed	Low	Unknown	NOAA 2014a
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Not Listed	Not at Risk	High	Year-round	NOAA 2016d

Table 6.37 Marine Mammals that May Occur in the Project Area and Surrounding Marine Environments

Common Name	Scientific Name	SARA Schedule 1 Status [1]	COSEWIC Designation [2,3]	Potential for Occurrence[4]	Potential Timing of Presence[5]	Sources
Beluga whale (St. Lawrence Estuary population)	*Delphinapterus leucas*	Endangered	Endangered	Low	Unknown	Amec 2014b; COSEWIC 2014
Common bottlenose dolphin	*Tursiops truncatus*	Not Listed	Not at Risk	Low	Seasonal (May to September)	NOAA 2016e
False killer whale	*Pseudorca crassidens*	Not Listed	Not Listed	Low	Unknown	NOAA 2015b
Harbour porpoise (Northwest Atlantic subspecies)	*Phocoena phocoena*	Not Listed (Threatened on Schedule 2)	Special Concern	Moderate	Year-round	COSEWIC 2006
Killer whale (Northwest Atlantic population)	*Orcinus orca*	Not Listed	Special Concern	Moderate	Year-round	COSEWIC 2009b; NOAA 2015c
Long-finned pilot whale	*Globicephala melas*	Not Listed	Not at Risk	High	Year-round	Fullard et al. 2000; NOAA 2016f
Northern bottlenose whale (1: Scotian Shelf population/ 2: Davis Strait-Baffin Bay-Labrador Sea population)	*Hyperoodon ampullatus*	1) Endangered 2) Not Listed	1) Endangered 2) Special Concern	Moderate	Year-round	COSEWIC 2011; DFO 2016b; CBC 2016
Risso's Dolphin	*Grampus griseus*	Not Listed	Not at Risk	Low	Year-round	NOAA 2016g
Short-beaked common dolphin	*Delphinus delphis*	Not Listed	Not at Risk	Moderate	Seasonal (summer through fall)	NOAA 2016h
Sowerby's beaked whale	*Mesoplodon bidens*	Special Concern	Special Concern	Low	Unknown	COSEWIC 2007b; DFO 2016c
Sperm whale	*Physeter macrocephalus*	Not Listed	Not at Risk	High	Year-round	NOAA 2015d

Table 6.37 Marine Mammals that May Occur in the Project Area and Surrounding Marine Environments

Common Name	Scientific Name	SARA Schedule 1 Status [1]	COSEWIC Designation [2,3]	Potential for Occurrence[4]	Potential Timing of Presence[5]	Sources
Spinner dolphin	*Stenella longirostris longirostris*	Not Listed	Not Listed	Low	Unknown	NOAA 2014b
Striped dolphin	*Stenella coeruleoalba*	Not Listed	Not at Risk	Low	Seasonal (summer)	NOAA 2014c
White-beaked dolphin	*Lagenorhynchus albirostris*	Not Listed	Not at Risk	High	Year-round	NOAA 2007a
Phocids (Seals)						
Grey Seal	*Halichoerus grypus*	Not Listed	Not at Risk	Low	Year-round	Lesage et al. 2001; NOAA 2016i
Harbour Seal (Atlantic subspecies)	*Phoca vitulina ssp. concolor*	Not Listed	Not at Risk	Low	Year-round	NOAA 2016j
Harp Seal	*Pagophilus groenlandicus*	Not Listed	Not at Risk	High	Year-round (highest concentrations in winter)	Amec 2014a; DFO 2012; NOAA 2014d
Hooded Seal	*Cystophora cristata*	Not Listed	Not at Risk	Moderate to High	Seasonal (highest concentrations in winter)	Anderson et al. 2009, 2013; NOAA 2007b

Notes:
1 SARA = Canadian *Species at Risk Act*
2 COSEWIC = Committee on the Status of Endangered Wildlife in Canada
3 None of these marine mammal or sea turtle species are currently listed under the NL ESA
4 This qualitative characterization is based on expert opinion and an analysis of understood habitat preferences across life-history stages, available distribution mapping, and sightings data for each species within or near the RSA. Further details concerning expected occurrence is provided for each species within each of the relevant subsections below. Given the wide-ranging nature of many marine mammal and sea turtle species it is possible that rare sightings of other species not listed here may occur.
5 See Section 6.3.8 for monthly breakdown of estimated presence.
Additional Sources: Husky Energy (2012), Amec (2014 a, 2014b), BP (2016)

Table 6.38 Sea Turtle Species that May Occur in the Project Area and Surrounding Marine Environments

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	Potential Occurrence [1]	Potential Timing of Presence [2]	Sources
Green sea turtle	*Chelonia mydas*	Not Listed	Not Listed	Low	Seasonal (summer and fall)	James et al. 2004; NOAA 2016k
Leatherback sea turtle (Atlantic population)	*Dermochelys coriacea*	Endangered	Endangered	Low to Moderate	Seasonal (spring through fall)	COSEWIC 2012b
Loggerhead sea turtle	*Caretta caretta*	Endangered	Endangered	Low	Seasonal (spring through fall)	Brazner and McMilan 2008; COSEWIC 2010d
Kemp's ridley sea turtle	*Lepidochelys kempii*	Not Listed	Not Listed	Low	Seasonal	NMFS et al. 2011

Notes:
[1] This qualitative characterization is based on expert opinion and an analysis of habitat preferences across life-history stages, available distribution mapping, and sightings data for each species within or near the RSA. Further details concerning expected occurrence is provided for each species within each of the relevant subsections below. Given the wide-ranging nature of many marine mammal and sea turtle species it is possible that rare sightings of other species.
[2] See Section 6.3.8 for monthly breakdown of predicted species presence.
Additional Sources: Husky Energy (2012), Amec (2014 a, 2014b), and BP (2016)

The information presented in this chapter considers species that are secure as well as those listed under SARA or identified by COSEWIC as SOCC. Listed marine mammals and sea turtles are defined as those species that are listed as endangered, threatened, or of special concern under Schedule 1 of SARA (and are therefore formally and legally protected) and/or which are otherwise designated by COSEWIC as SOCC. None of these species are currently listed under the NL ESA. Information on non-SAR species made available since the publication of the Eastern Newfoundland SEA is summarized, by species group, in the subsections below (i.e., non-SAR mysticetes in Section 6.3.3, non-SAR odontocetes in Section 6.3.4, non-SAR phocids in Section 6.3.5, and non-SAR sea turtles in Section 6.3.6). Marine mammal and sea turtle species that have been listed as SAR are described separately and in further detail in Section 6.3.7. Key areas and seasonal periods that have been identified as being of importance to marine mammals or sea turtles are summarized in Section 6.3.8.

6.3.3 Mysticetes (Baleen Whales)

Seven species of baleen whales have been identified as having the potential to occur in or near the Project Area, based on their known occurrence in the overall eastern Newfoundland offshore region (Table 6.37). While some species of baleen whales can be observed in the waters off Newfoundland year-round (blue, fin, humpback and minke whales), most individuals of all species arrive in the late spring and early summer and remain until fall. Several species migrate to lower latitudes in the winter months, returning to the productive waters off Newfoundland in the spring to feed (Amec 2014a). Baleen whales are opportunistic feeders, preying upon specific prey species (e.g., plankton and krill, and small schooling fish such as capelin). Since these prey species tend to be densely aggregated and have variations in their distribution and abundance, the presence of the cetaceans feeding on them is also temporally and spatially variable (Amec 2014a). Baleen whales may be solitary, found in small groups, or in large aggregations, typically around prey concentration areas. They are social animals, and use acoustic communication to maintain their social structures. Baleen whales communicate with low to moderate frequency vocalizations, with a generalized hearing range of 7 Hz to 35 kHz (Southall et al. 2007).

Key life history and habitat information for each of the species of baleen whales with the potential to occur here have recently been described and can be found in the Eastern Newfoundland SEA (Amec 2014a). Of the mysticetes that may occur in the area, four (blue, bowhead, fin, and North Atlantic right whale) are listed on Schedule 1 of SARA and/or are listed by COSEWIC – these species are addressed in Section 6.3.7. Section 6.3.3 presents species descriptions and the understood general distribution of non-SAR baleen whales found in the eastern Newfoundland offshore area, along with sighting records for these species in the Project Area (Northern and Southern Sections).

Figures 6-66 and 6-67 identify opportunistic sightings of non-SAR mysticetes recorded between 1952 (earliest record of a non-SAR mysticete) and 2015, as reported in the pooled OBIS, DFO and Statoil datasets (see Section 6.3.1). Figure 6-67 presents records where the observer did not identify the exact species. Table 6.39 summarizes the number of opportunistic sightings of non-SAR mysticetes reported to OBIS, DFO, or Statoil in the Project Area between 1952 and 2015. Fin and sei whales may be difficult to distinguish in the field. Because a number of records were reported as fin / sei, sightings for these species have been pooled in Table 6.39. These tallies are repeated in Section 6.3.7 since fin whales are a listed species (sei whales are non-SAR).

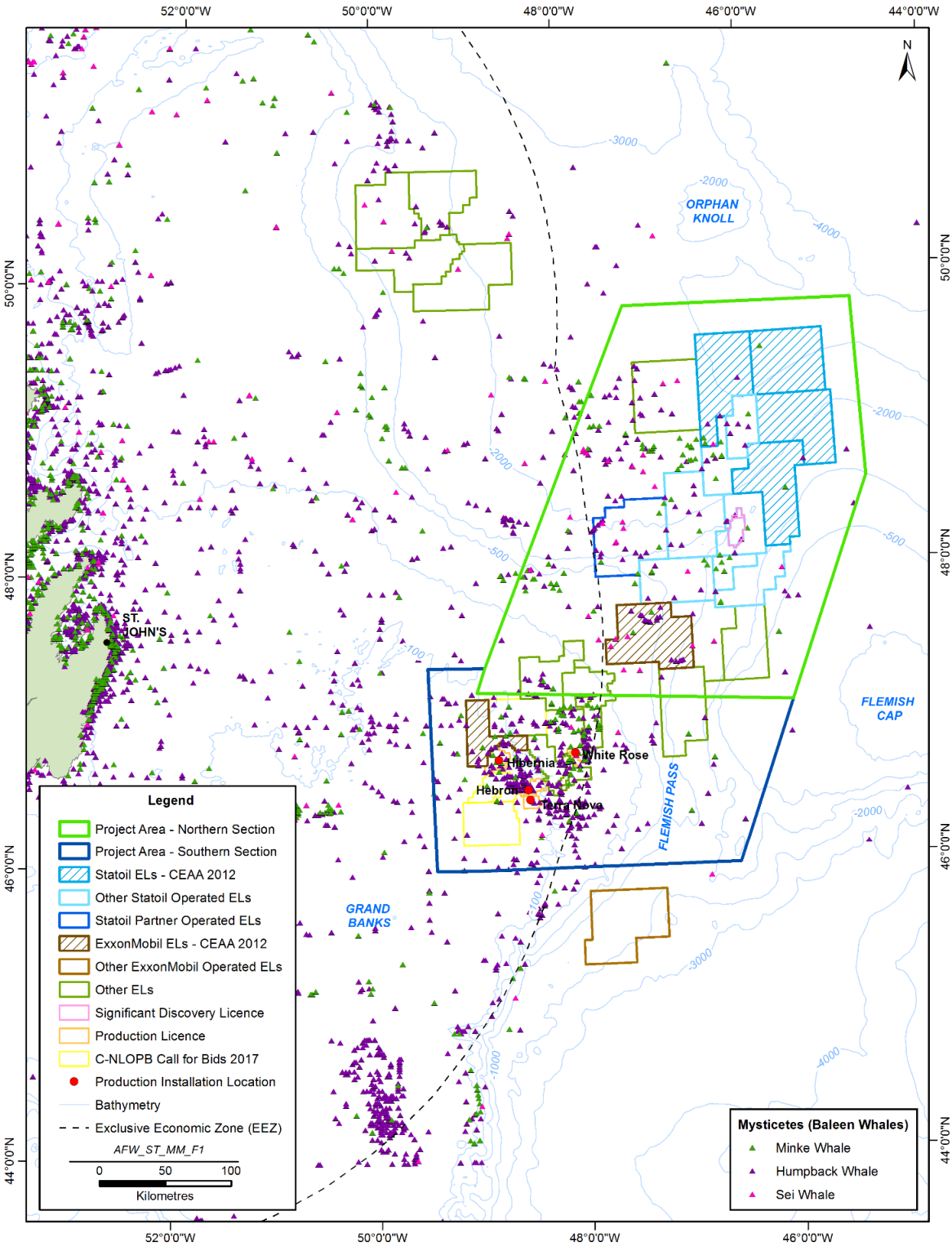


Figure 6-66 Opportunistic Sightings of non-SAR Mysticetes (1952 to 2015)

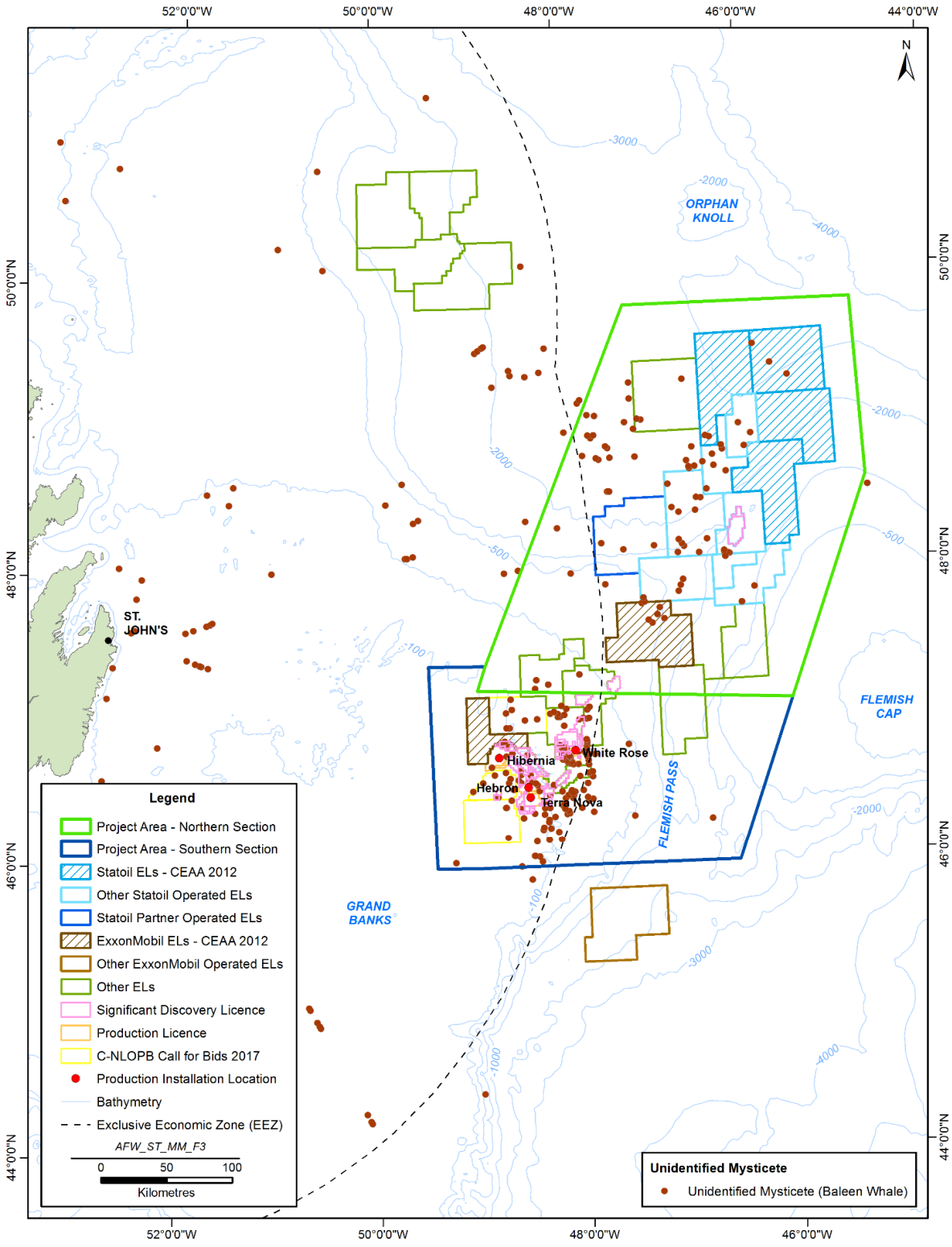


Figure 6-67 Opportunistic Sightings of Unidentified Mysticetes (1980 to 2015)

Table 6.39 Opportunistic Sightings of Non-SAR Mysticetes Reported in the Project Area

Common Name	Project Area – Northern Section	Project Area – Southern Section
Humpback whale	155	538
Minke whale	90	102
Fin and sei whale	134	147
Unidentified mysticete	95	228
Source: DFO, OBIS, Statoil (records span 1952 to 2015)		

6.3.3.1 Non-SAR Mysticete Species Descriptions and General Distributions

6.3.3.1.1 Humpback Whale

Humpback whales found in Newfoundland waters belong to a distinct population segment (or stock) that breeds in the West Indies (Bettridge et al. 2015). This stock consists of whales whose breeding range includes the Atlantic margin of the Antilles from Cuba to northern Venezuela. The feeding range of this group includes the Gulf of Maine, eastern Canada, and western Iceland (Bettridge et al. 2015). Population estimates from breeding grounds in the southern North Atlantic show strong increasing trends of population size. Sampling was conducted in the West Indies in 2004 and 2005 in order to obtain an updated abundance estimate for the West Indies population (Bettridge et al. 2015). This mark-recapture study resulted in an abundance estimate of 12,312 individuals (95 percent confidence interval (CI): 8,668-15,954). The most recent population estimate for the Newfoundland and Labrador area surveyed during the program, using survey data from 2007, resulted in an abundance estimate of 1,427 individuals (95 percent CI: 952-2,140) (Lawson and Gosselin 2009). Humpback whales were the most sighted whale species during the 2007 survey (Lawson and Gosselin 2009). Humpback whales were frequently recorded in the DFO, OBIS and Statoil marine mammal observation data in the Project Area (see Table 6.39). A map showing opportunistic humpback whale sightings from OBIS, DFO and Statoil, in the eastern Newfoundland offshore area, including the Project Area (Northern and Southern Sections) is provided in Figure 6- 68).

6.3.3.1.2 Minke Whale

Minke whales found in Newfoundland waters belong to the Canadian East Coast stock. This stock can be found from the Davis Strait to the Gulf of Mexico (NOAA 2016a). To date, the best recent abundance estimate for the Canadian East Coast stock is 20,741 individuals (coefficient of variation (CV)=0.30), derived from the 2007 TNASS survey (NOAA 2016a) which also estimated an abundance of 1,315 (95 percent CI: 855-2,046) individuals within Newfoundland and Labrador waters (Lawson and Gosselin 2009). Minke whales can occur year-round in the eastern Newfoundland offshore area, although they are most likely to occur spring through fall (Risch et al. 2014). There were a number of records of minke whales in the Northern and Southern Sections of the Project Area reported in the DFO, OBIS and Statoil marine mammal observation data (see Table 6.39) and numerous more reported in the coastal waters off eastern Newfoundland (Figure 6-69).

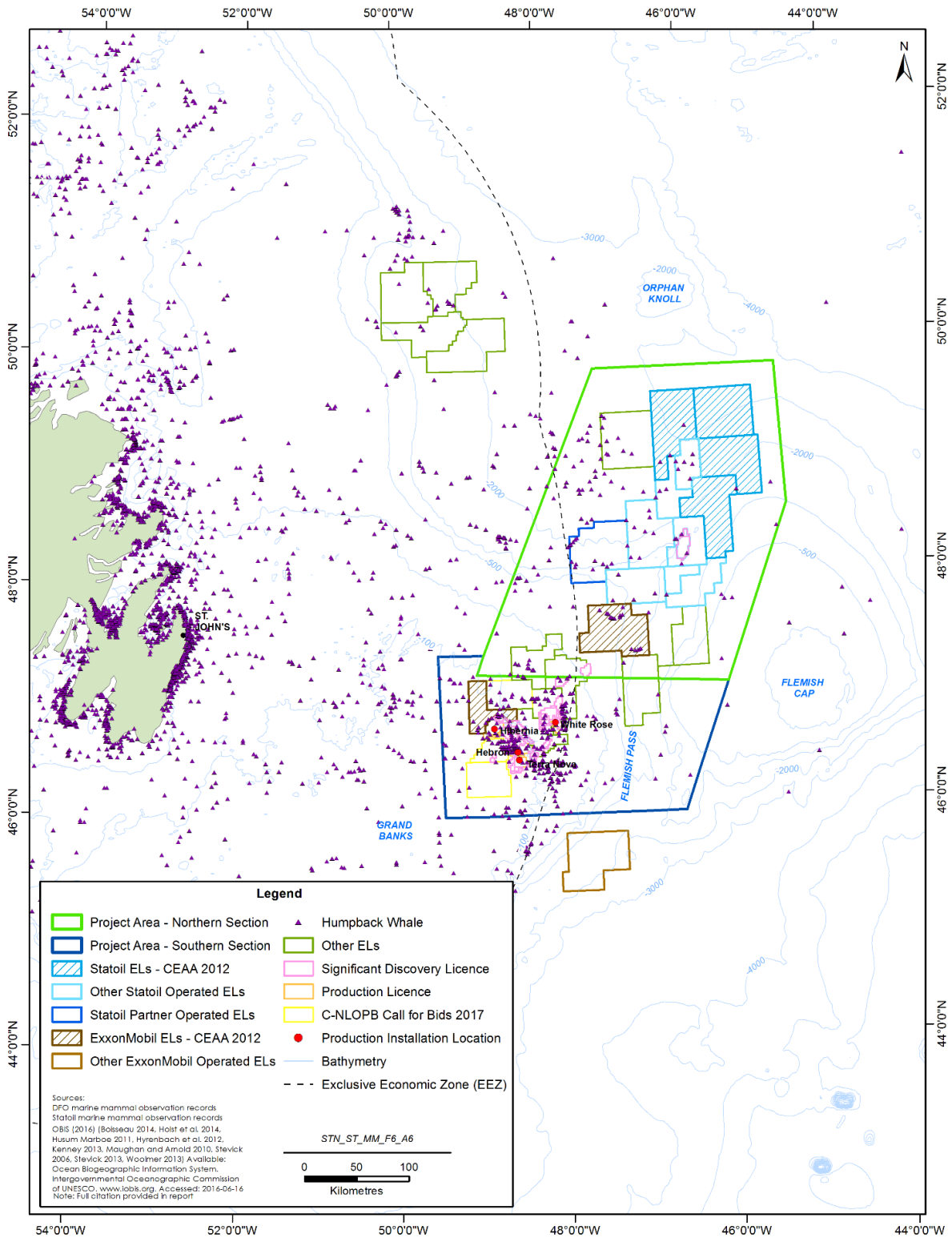


Figure 6-68 Humpback Whale Sightings in Eastern NL Offshore Area

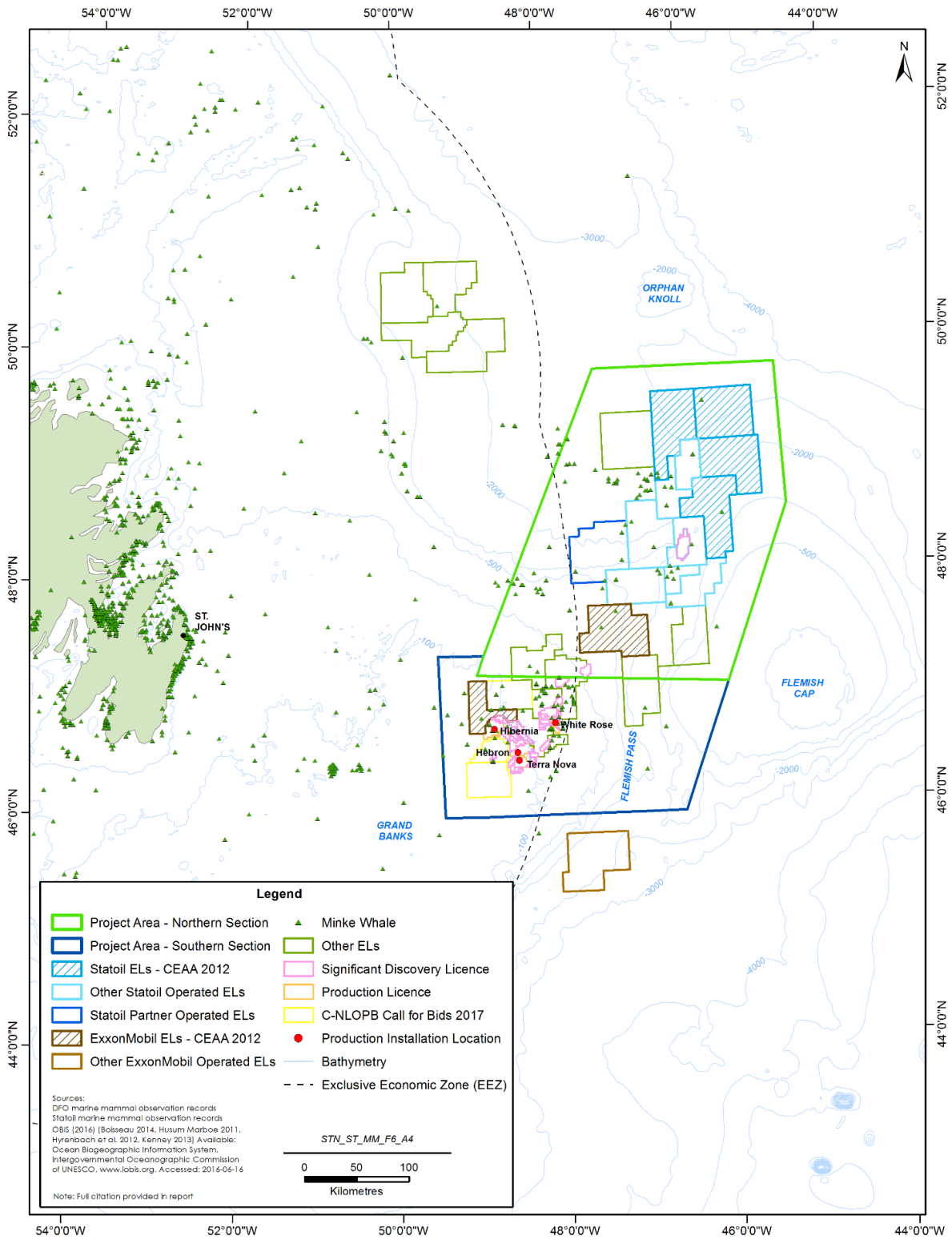


Figure 6-69 Minke Whale Sightings in Eastern NL Offshore Area

6.3.3.1.3 Sei Whale

Sei whales have historically been managed as stocks by the International Whaling Commission (IWC). Stock boundaries are typically based on political and commercial strategies, rather than on the biology of the species (COSEWIC 2003). In the Northwest Atlantic, it has been proposed that sei whales may be divided into two stocks – one off Nova Scotia and one off Labrador (COSEWIC 2003). The Nova Scotia stock range is from the shelf waters of the Northeastern United States to the waters south of Newfoundland, with an abundance estimate of 357 individuals (CV=0.52) (NOAA 2016c). The Labrador Sea stock has not been surveyed since the end of commercial whaling in the late 1970s (COSEWIC 2003). The degree to which the Newfoundland region is used by sei whales, and whether it is occupied by a unique stock, is unknown. Only one sei whale was observed in Newfoundland waters during the 2007 TNASS study (Lawson and Gosselin 2009). Sei whales are likely to be observed seasonally off eastern Newfoundland, with increased presence in summer (COSEWIC 2003).

A map showing opportunistic sightings expressly identified as sei whales in the eastern Newfoundland offshore area, including the Northern and Southern Sections of the Project Area is provided in Figure 6-70.

6.3.4 Odontocetes (Toothed Whales)

The odontocetes are comprised of the toothed whales, dolphins, and porpoises. There are 16 species of odontocetes that, based on direct sighting information or known occurrence, have the potential to occur in or near the Project Area. Several species of odontocetes have the potential to occur in the region seasonally, namely the common bottlenose dolphin, short-beaked common dolphin, and striped dolphin, while others have the potential to be found year-round.

Odontocetes primarily forage on small schooling fish species such as herring. Like baleen whales, odontocetes have complex social structures and rely heavily on acoustic communication. The hearing range of odontocetes is much higher than their baleen whale counterparts – odontocetes use frequencies primarily in the 200 Hz to 200 kHz range (Amec 2014a). Odontocetes are often further subdivided into two hearing classes – the mid frequency cetaceans (with generalized hearing ranges of 150 Hz to 160 kHz) and the high-frequency cetaceans (275 Hz to 160 kHz) (NMFS 2016). Of the species likely to be present, only the harbour porpoise is classified within the high frequency cetacean hearing group, and all other odontocetes likely to be present are classified as mid-frequency cetaceans. Many odontocetes also use echolocation to navigate and locate prey.

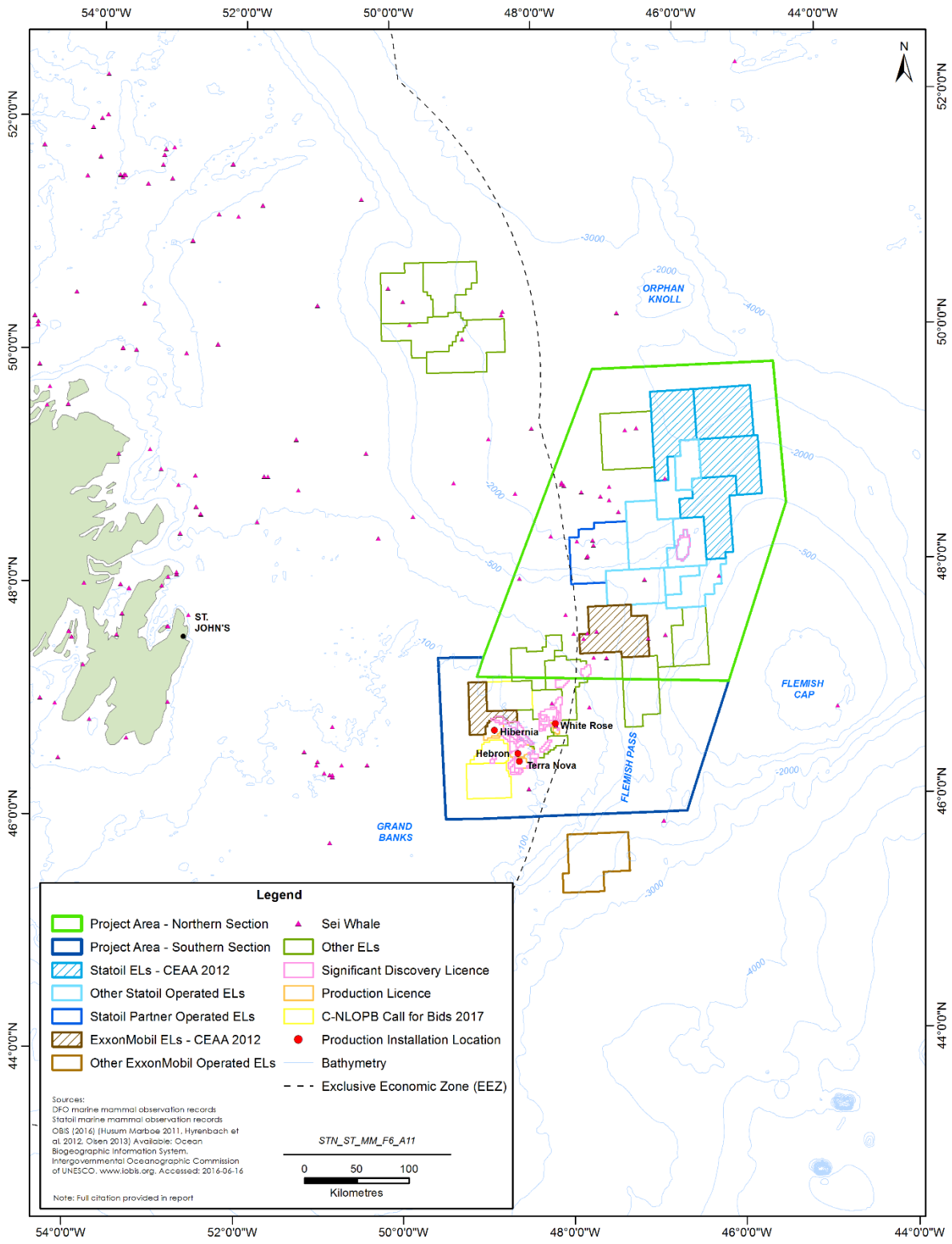


Figure 6-70 Sei Whale Sightings in Eastern NL Offshore Area

Key life history and habitat information for each of the species of toothed whales with the potential to occur in the area have recently been described and can be found in the Eastern Newfoundland SEA (Amec 2014a). Of these, five are protected under Schedule 1 of SARA and/or are listed by COSEWIC (beluga whale, harbour porpoise, killer whale, northern bottlenose whale, and Sowerby's beaked whale; Table 6.37) – these species are addressed in Section 6.3.7. Section 6.3.4 presents species summaries and the known general distribution of non-SAR toothed whales found in the eastern Newfoundland offshore area, along with sightings records for these species in the Project Area (Northern and Southern Sections). Table 6.40 summarizes the number of opportunistic sightings of non-SAR odontocetes reported to OBIS, DFO, or Statoil in the Northern or Southern Sections of the Project Area between 1958 and 2015. Figures 6-71 and 6-72 present opportunistic sightings of non-SAR odontocetes recorded between 1958 (earliest record of a non-SAR odontocete) and 2015, as reported in the pooled dataset of OBIS, DFO and Statoil records (see Section 6.3.1). Figure 6-72 presents records where the observer did not identify the exact species of odontocete.

Table 6.40 Opportunistic Sightings of Non-SAR Odontocetes Reported in the Project Area

Common Name	Project Area – Northern Section	Project Area – Southern Section
Atlantic spotted dolphin	0	0
Atlantic white-sided dolphin	95	105
Common bottlenose dolphin	10	7
False killer whale	0	0
Long-finned pilot whale	342	36
Risso's dolphin	0	0
Short-beaked common dolphin	11	6
Sperm whale	192	15
Spinner dolphin	0	0
Striped dolphin	4	0
White-beaked dolphin	22	76
Unidentified odontocete	256	186
Source: DFO, OBIS, Statoil (records span 1958 to 2015)		

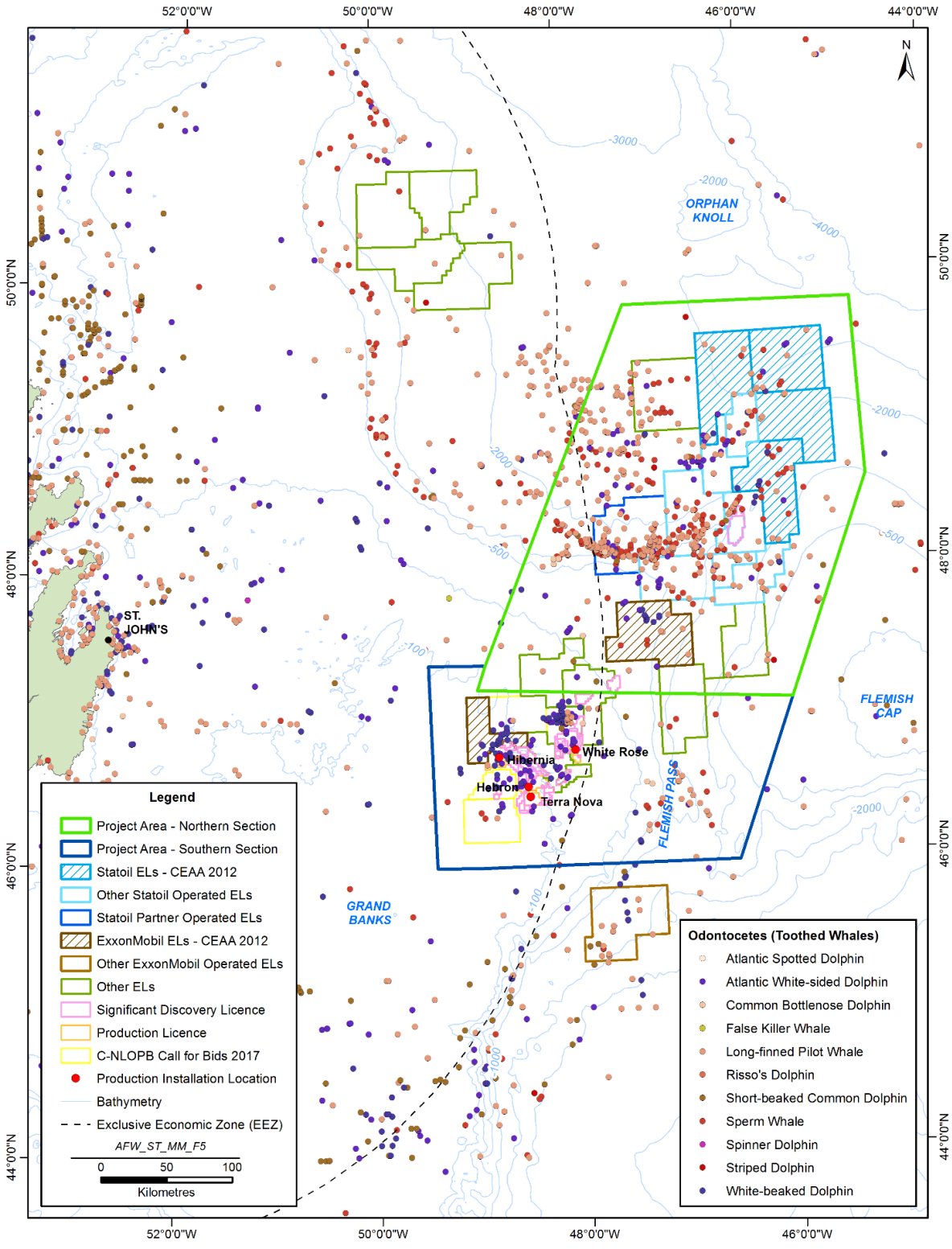


Figure 6-71 Opportunistic Sightings of non-SAR Odontocetes (1958 to 2015)

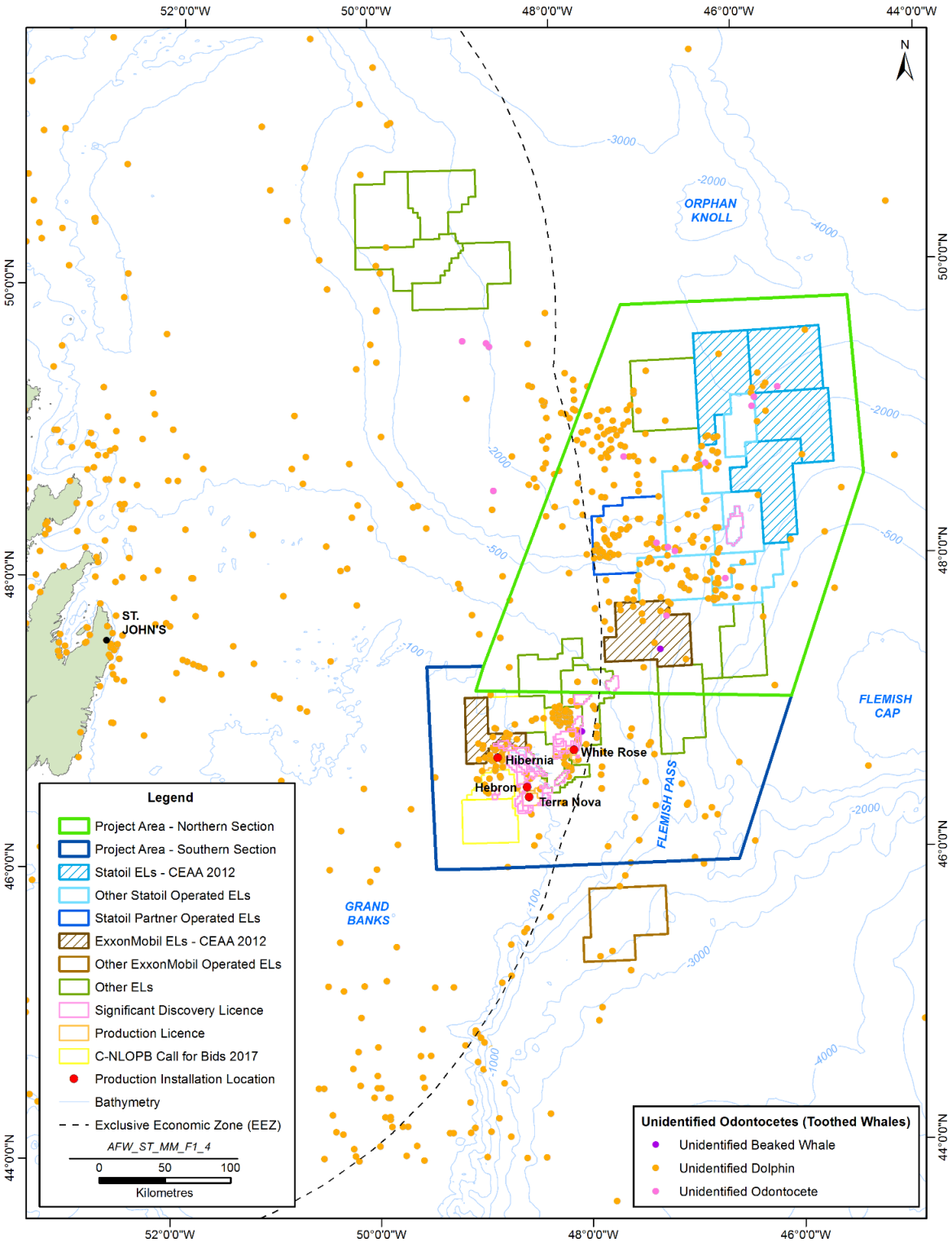


Figure 6-72 Opportunistic Sightings of Unidentified Odontocetes (1958 to 2015)

6.3.4.1 Non-SAR Odontocetes Species Descriptions and General Distributions

6.3.4.1.1 Atlantic Spotted Dolphin

Atlantic spotted dolphins are typically found in the tropical and warm temperate waters in the Northwest Atlantic. Generally, this species distribution ranges from southern New England to as far south as Venezuela (NOAA 2014a). Atlantic spotted dolphins regularly occur in continental shelf waters south of Cape Hatteras, North Carolina, and north of this region in continental shelf edge and continental slope waters (NOAA 2014a). Sightings have also occurred along the north wall of the Gulf Stream (NOAA 2014a). There are insufficient data to determine the population trends for this species, however, the best abundance estimate available for Atlantic spotted dolphins in the Northwest Atlantic is 44,715 (CV=0.43) (NOAA 2014a). Atlantic spotted dolphins are likely to be rare in the eastern Newfoundland offshore area. There are no sightings records for this species in the Project Area based on the DFO, OBIS and Statoil marine mammal observation records (see Table 6.40). The OBIS dataset has one sighting record for this species (Figure 6-73).

6.3.4.1.2 Atlantic White-sided Dolphin

In the western North Atlantic, Atlantic white-sided dolphin can be found inhabiting waters from central west Greenland to North Carolina and potentially as far east as the mid-Atlantic Ridge. Seasonal migration patterns of this species are poorly understood; however, they are considered abundant and likely to be found throughout the RSA (Amec 2014a). To date, the best available abundance estimate for the western North Atlantic stock is 48,819 (CV=0.61), derived from surveys completed in 2011 (NOAA 2016d). Another abundance estimate for the species in the Northern Labrador to Scotian Shelf area is 24,422 individuals (CV=0.49), based on surveys conducted in 2007 (NOAA 2016d). Lawson and Gosselin (2009) estimated a total of 1,507 Atlantic white-sided dolphins (95 percent CI: 968-2,347) in the waters off Newfoundland. Hundreds of Atlantic white-sided dolphin were recorded in the DFO, OBIS and Statoil marine mammal observation records in the Project Area and beyond (see Table 6.40 and Figure 6-74).

6.3.4.1.3 Common Bottlenose Dolphin

Common bottlenose dolphins are found primarily in coastal and continental shelf waters of tropic and temperate regions, are considered generalists in terms of habitat, and have highly diverse and adaptable behavioural and social systems (Leatherwood and Reeves 1990; Connor et al. 2000). The best available abundance estimate, based on surveys conducted in 2011, for the offshore stock of the species in the western North Atlantic is 77,532 individuals (CV=0.40) (NOAA 2016e). Common bottlenose dolphins were infrequently recorded in the DFO, OBIS and Statoil marine mammal observation records (see Table 6.40 and Figure 6-75).

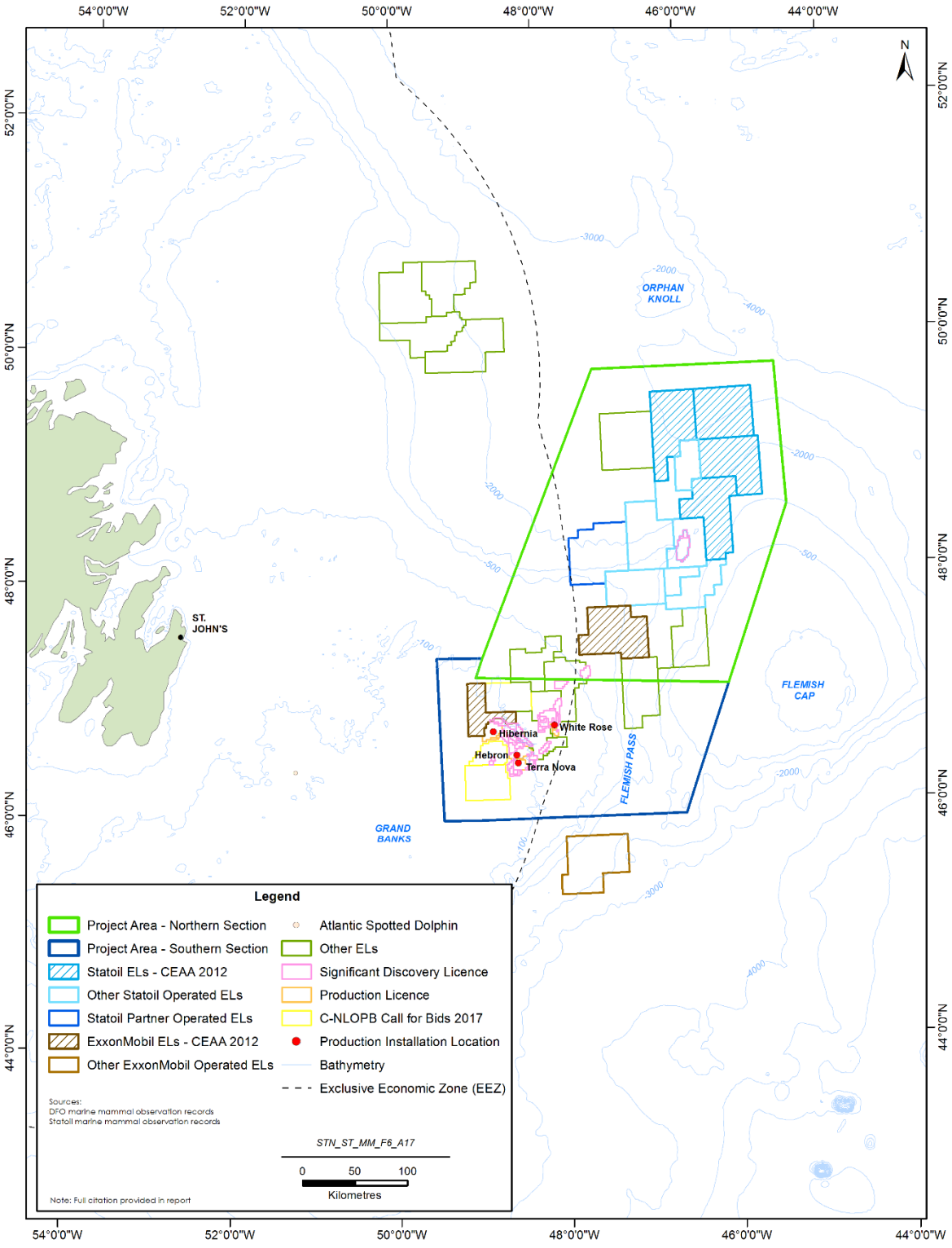


Figure 6-73 Atlantic Spotted Dolphin Sightings in Eastern NL Offshore Area

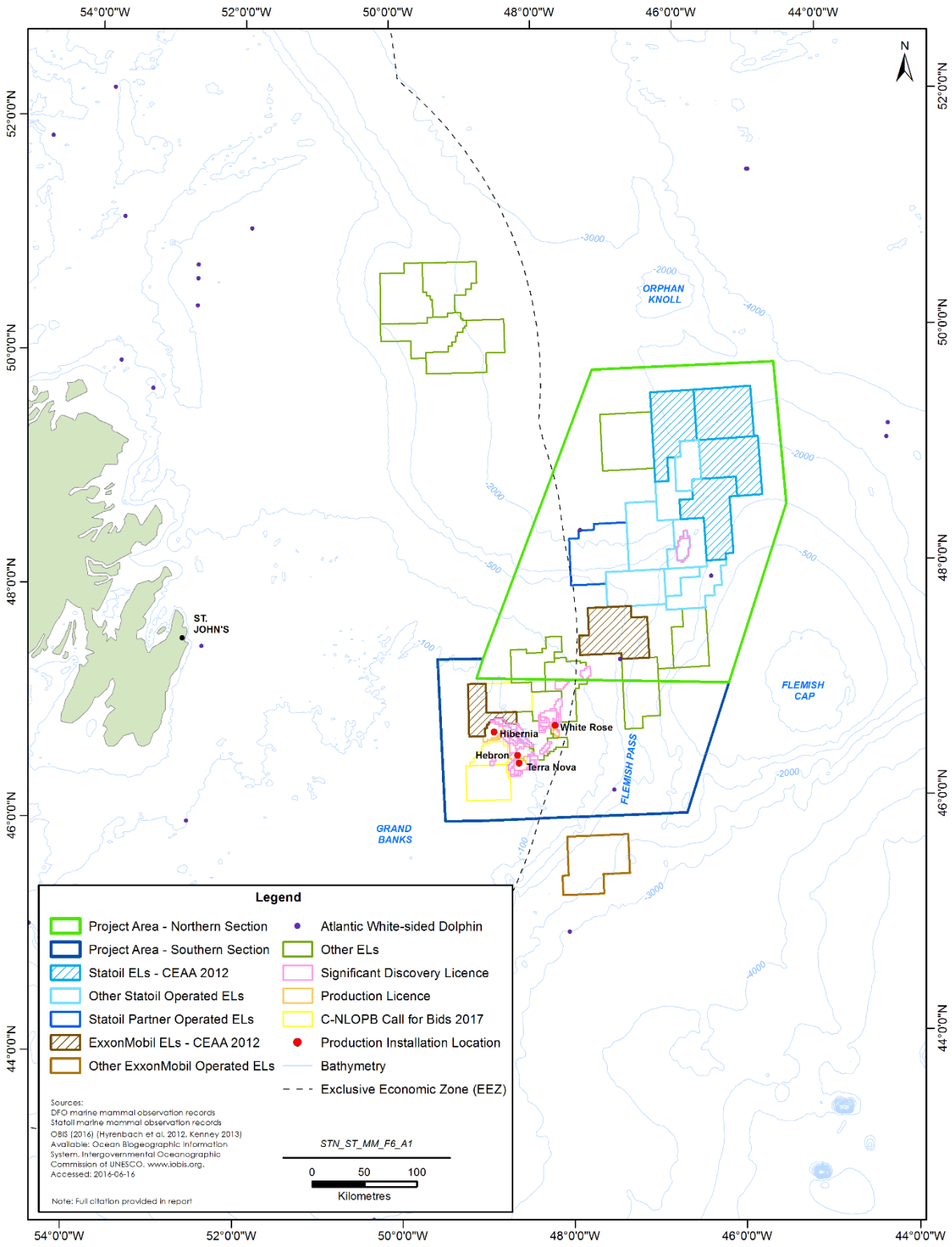


Figure 6-74 Atlantic White-sided Dolphin Sightings in Eastern NL Offshore Area

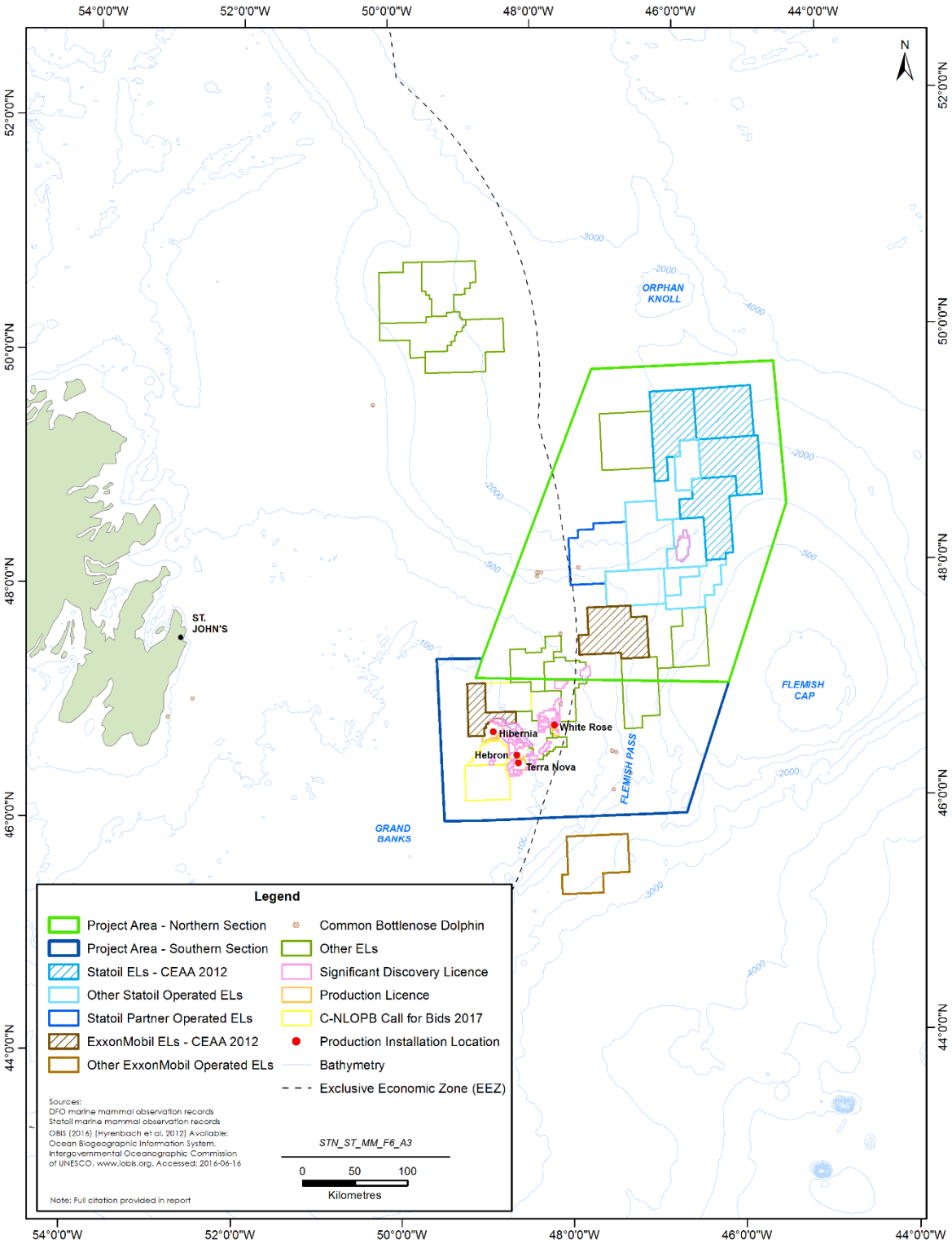


Figure 6-75 Common Bottlenose Dolphin Sightings in Eastern NL Offshore Area

6.3.4.1.4 False Killer Whale

False killer whales are distributed worldwide throughout warm temperate and tropical oceans (Jefferson et al. 2008 in NOAA 2015b). This species is generally found in offshore waters, but it has been observed in coastal waters (Baird et al. 20013 in NOAA 2015b). While records of false killer whales in the Northwest Atlantic are not common, the combination of sighting, stranding, and bycatch records indicate that this species routinely occurs in the region (NOAA 2015b).

There are insufficient data to determine population trends for the Northwest Atlantic stock of false killer whale and the best available abundance estimate for false killer whale in the Northwest Atlantic was determined to be 442 individuals (CV=1.06) (NOAA 2015b). This estimate is based on surveys from central Florida to the lower Bay of Fundy in summer 2011. Based on these surveys, the minimum population was estimated to be 212 individuals (NOAA 2015b). There were no records of false killer whales in the Project Area, based on the in the DFO, OBIS and Statoil marine mammal observation records (see Table 6.40); however, there was one sighting of this species in the region beyond the Project Area (Figure 6-76).

6.3.4.1.5 Long-Finned Pilot Whale

Long-finned pilot whales are distributed from North Carolina to North Africa and north to Iceland, Greenland and the Barents Sea (NOAA 2016f). Fullard et al. (2000) have proposed two stocks for this species that is associated with sea-surface temperature with one of the suggested stocks being a cold-water population west of the Labrador/North Atlantic current. To date, the best available abundance estimate for the western North Atlantic is 5,636 (CV=0.63), derived from surveys completed in 2011 (NOAA 2016f). This 2011 survey covered waters from central Virginia to the lower Bay of Fundy. Another less precise abundance estimate for the western North Atlantic long-finned pilot whale from Northern Labrador to the Scotian Shelf is 16,058 individuals (CV=0.79), based on surveys conducted in 2007 (NOAA 2016e). A total of 65 long-finned pilot whales were observed during the 2007 TNASS study off Newfoundland and an estimate of 6,134 individuals was calculated for the entire survey area (95 percent CI: 2,774-10,573) (Lawson and Gosselin 2009). Pilot whale whistles have been detected in the Flemish Pass between June and September (the extent of the recording period) (Appendix F). There were hundreds of long-finned pilot whale sightings in the eastern Newfoundland offshore area recorded in the DFO and Statoil marine mammal observation records, in the Project Area - Northern Section (see Table 6.40 and Figure 6-77).

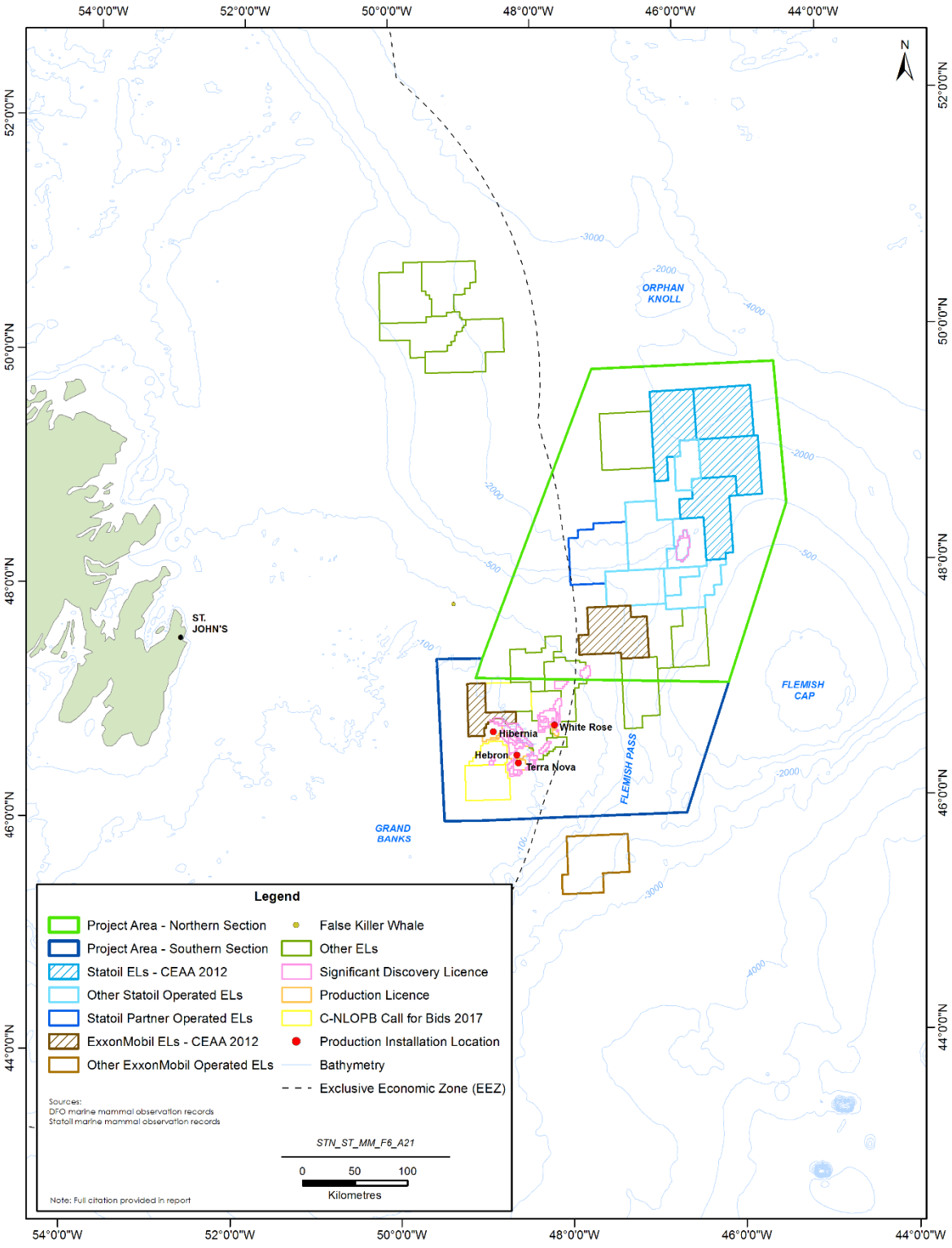


Figure 6-76 False Killer Whale Sightings in Eastern NL Offshore Area

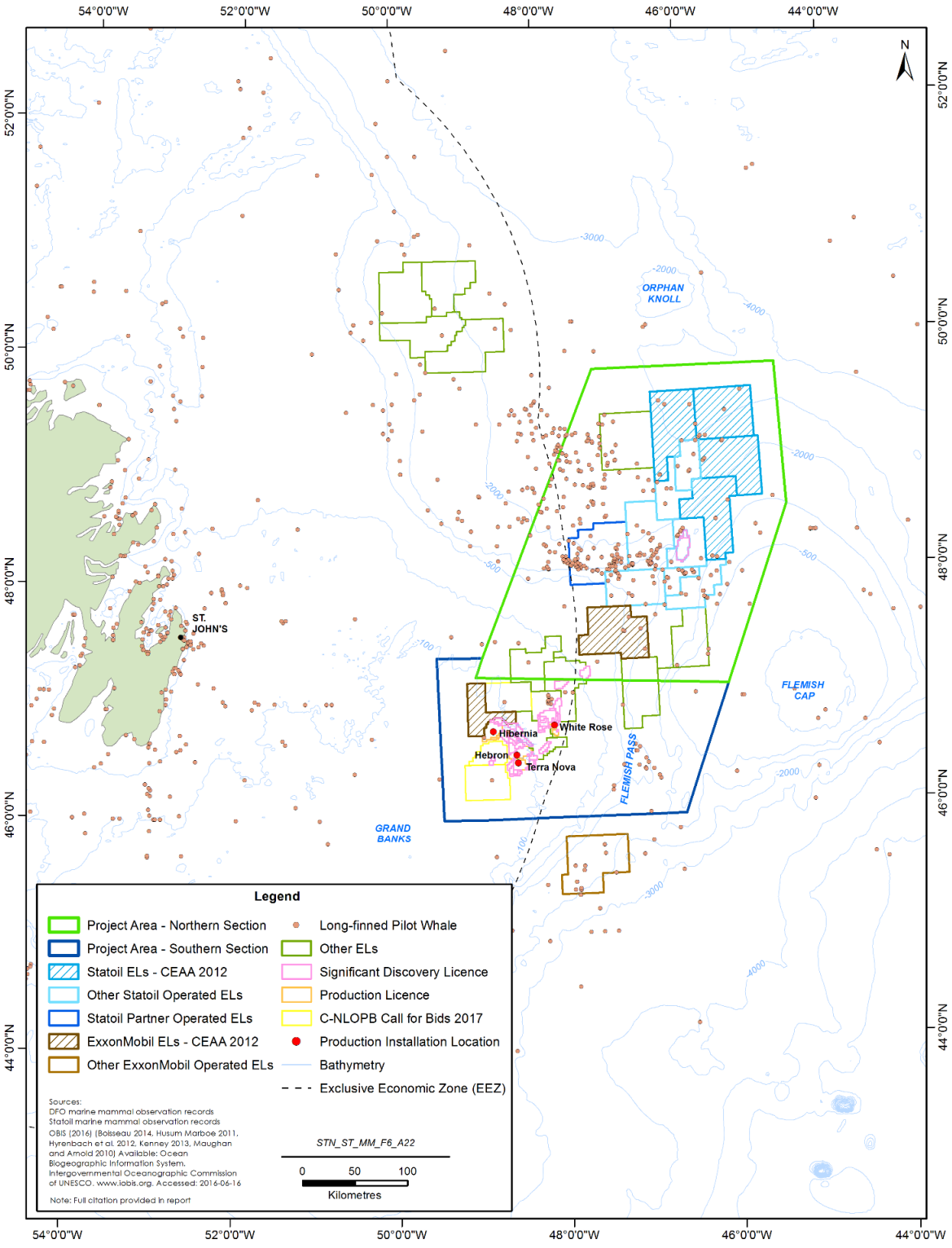


Figure 6-77 Long-finned Pilot Whale Sightings in Eastern NL Offshore Area

6.3.4.1.6 Risso's Dolphin

Risso's dolphin can be found globally in tropical and temperate waters and occurs in the Northwest Atlantic from Florida to eastern Newfoundland (NOAA 2016g). This species is found primarily in areas with surface water temperatures of 10°C-28°C (Reeves et al. 2002). It occupies a narrow niche, which is the steep upper continental slope where water depths usually exceed 300 m. There is no information on stock structure for individuals in the western North Atlantic. Currently, the best abundance estimate for Risso's dolphin is 15,197 individuals (CV=0.55), based on surveys conducted in 2011 (NOAA 2016f). There were no sightings of Risso's dolphin recorded in the Northern or Southern Sections of the Project Area based on DFO, OBIS and Statoil marine mammal observation records (see Table 6.40); however, there were a few sightings of Risso's dolphin in the OBIS records in the region beyond the Project Area (Figure 6-78).

6.3.4.1.7 Short-Beaked Common Dolphin

The short-beaked common dolphin can be found migrating onto the Scotian Shelf and continental shelf off Newfoundland during the summer and fall months when water temperatures exceed 11°C (NOAA 2016h). Currently, the best abundance estimate for the species off the U.S. or Canadian Atlantic coast is 173,486 individuals (CV=0.55), which was derived from the TNASS surveys that occurred from July to August 2007 (NOAA 2016h). Abundance estimates for the Newfoundland area based on the same surveys suggest a population of 576 individuals (95 percent CI: 314-1,056) (Lawson and Gosselin 2009). There were a few records of short-beaked common dolphin in the DFO, OBIS and Statoil marine mammal observation records for the Project Area and many more in the larger offshore area (see Table 6.40 and Figure 6-79).

6.3.4.1.8 Sperm Whale

There is only one recognized stock for the North Atlantic sperm whale that includes both the northwestern and northeastern Atlantic (NOAA 2015d). There is currently no reliable estimate for the total population of sperm whales in the western North Atlantic. Sightings are typically along the continental shelf edge and slope. The most recent abundance estimate for the western North Atlantic is 2,288 individuals (CV=0.28), based on surveys conducted in 2011 (NOAA 2015d). However, since this species has long dive times (i.e., 30 to 60 minutes), these numbers are potentially underestimates since they were not corrected for the fact that the time spent at the surface (i.e., available to visual observers) is low. Eleven sperm whales were sighted during the 2007 TNASS survey in the Newfoundland and Labrador survey area (Lawson and Gosselin 2009). Sperm whale clicks have been detected in the Flemish Pass consistently between May and early October (the extent of the recording period) (Appendix F). There were hundreds of sperm whale sightings recorded in the region in the DFO, OBIS and Statoil marine mammal observation records, in the Northern Section of the Project Area (see Table 6.40 and Figure 6-80).

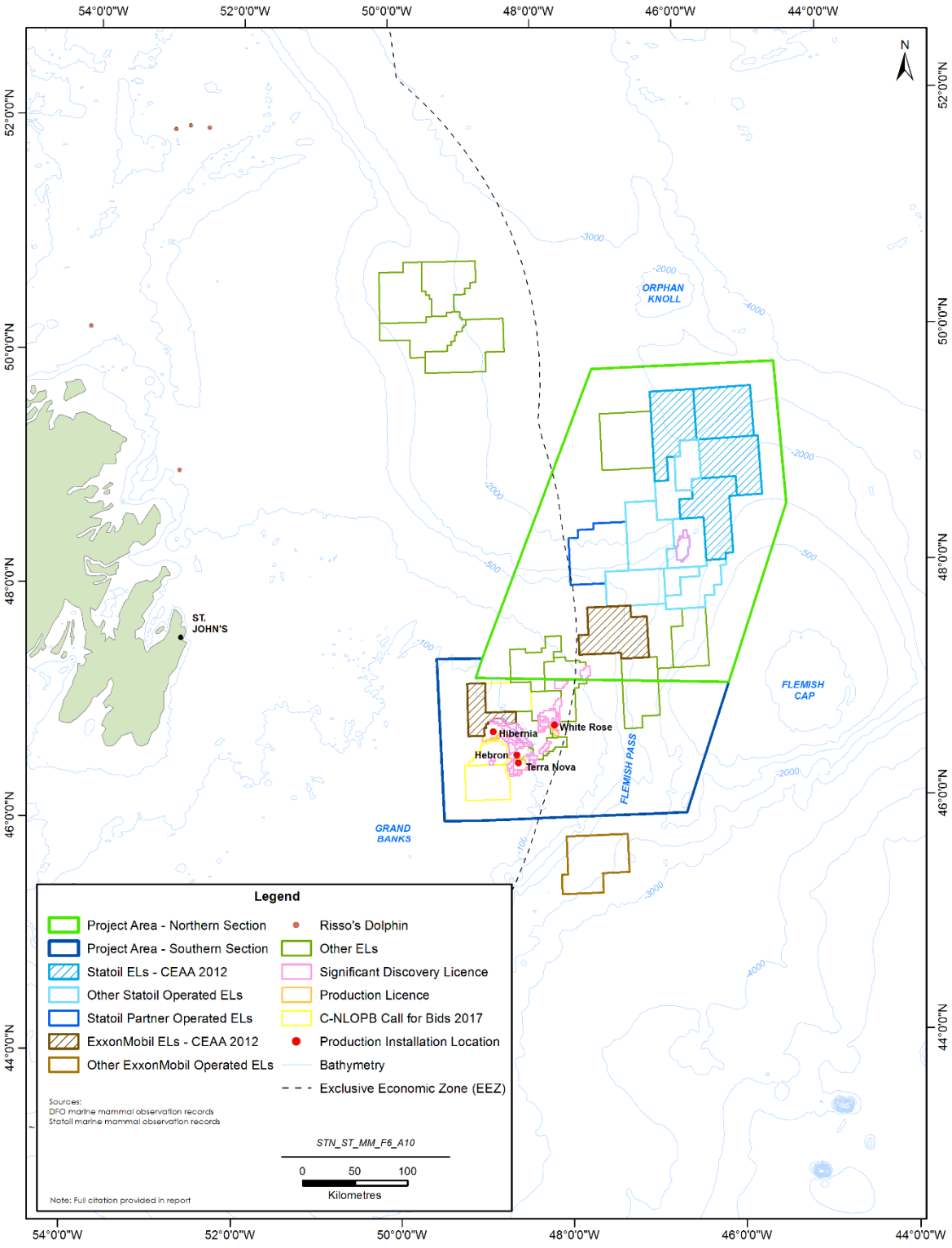


Figure 6-78 Risso's Dolphin Sightings in Eastern NL Offshore Area

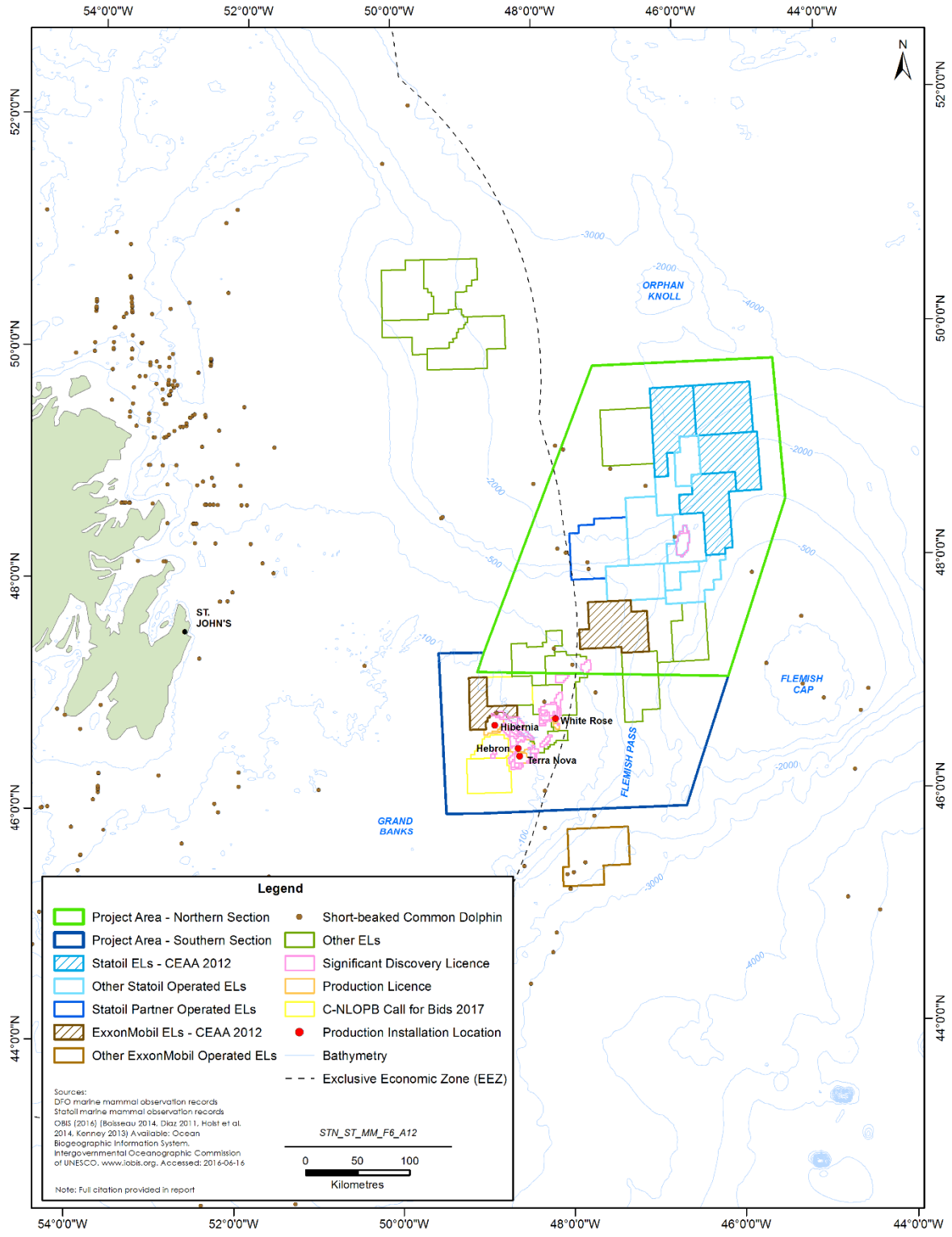


Figure 6-79 Short-beaked Common Dolphin Sightings in Eastern NL Offshore Area

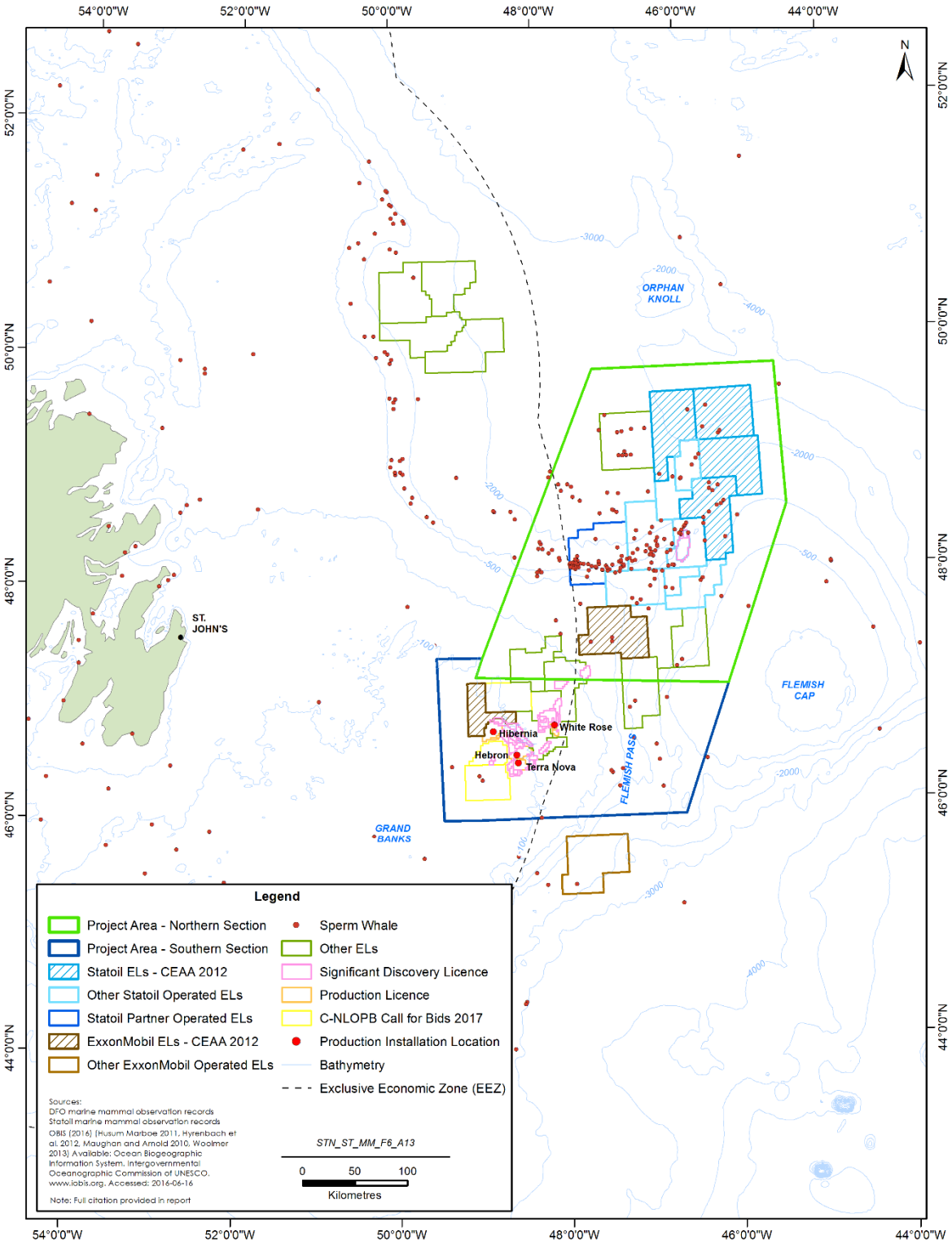


Figure 6-80 Sperm Whale Sightings in Eastern NL Offshore Area

6.3.4.1.9 Spinner Dolphin

Spinner dolphins are small dolphins that are found worldwide in oceanic and coastal tropical waters, but appear to be primarily an offshore, deep-water species (NOAA 2014b). In general, spinner dolphins occur in deep water along most of the east coast of the United States and south in the Gulf of Mexico and as far south as Venezuela (NOAA 2014b). In the waters off the northeast coast of the United States, almost all sightings have occurred in deeper oceanic waters (over 2,000 m) (NOAA 2014b). There is little information available on the stock structure of the spinner dolphin in the Northwest Atlantic, and its distribution in Atlantic Canada is poorly understood. There are no records of spinner dolphin sightings in the Project Area recorded in the DFO, OBIS and Statoil marine mammal observation records (Table 6.40) and only one sighting recorded in OBIS in the region beyond the Project Area (Figure 6-81).

6.3.4.1.10 Striped Dolphin

There is relatively little information on the stock structure of the striped dolphin in the Northwest Atlantic. This species is distributed worldwide in warm-temperate to tropical waters (NOAA 2014c). In general, striped dolphins appear to prefer continental slope waters offshore out to the Gulf Stream, and occur over the continental slope and rise in the mid-Atlantic region. Sightings of striped dolphins are uncommon in Canadian waters, especially in Newfoundland (NOAA 2014c). Abundance estimates for western North Atlantic striped dolphins suggest that there are currently 54,807 individuals (CV=0.3), based on surveys conducted in 2011. Few striped dolphins were observed in the 2007 TNASS surveys and as a result an abundance estimate was not calculated (Lawson and Gosselin 2009). There were few observations of striped dolphins in the DFO, OBIS and Statoil marine mammal observation records (see Table 6.40 and Figure 6-82).

6.3.4.1.11 White-beaked Dolphin

White-beaked dolphins can be found year-round from the southern New England states to southern Greenland and the Davis Straits (NOAA 2007a). They typically form social groups of 5 to 30 individuals. The best and only recent abundance estimate for western North Atlantic white-beaked dolphins is 2,003 individuals (CV=0.94), although this estimate is negatively biased because it is based on a 2006 surveys that covered only a portion of the species habitat (NOAA 2007a). The abundance of white-beaked dolphins estimated in Newfoundland waters from the TNASS survey in 2007 was 1,842 individuals (95 percent CI: 1,188-2,854) (Lawson and Gosselin 2009). Sightings of white-beaked dolphins were recorded in both the Northern and Southern Sections of the Project Area according to the DFO, OBIS and Statoil marine mammal observation records (see Table 6.40 and Figure 6-83).

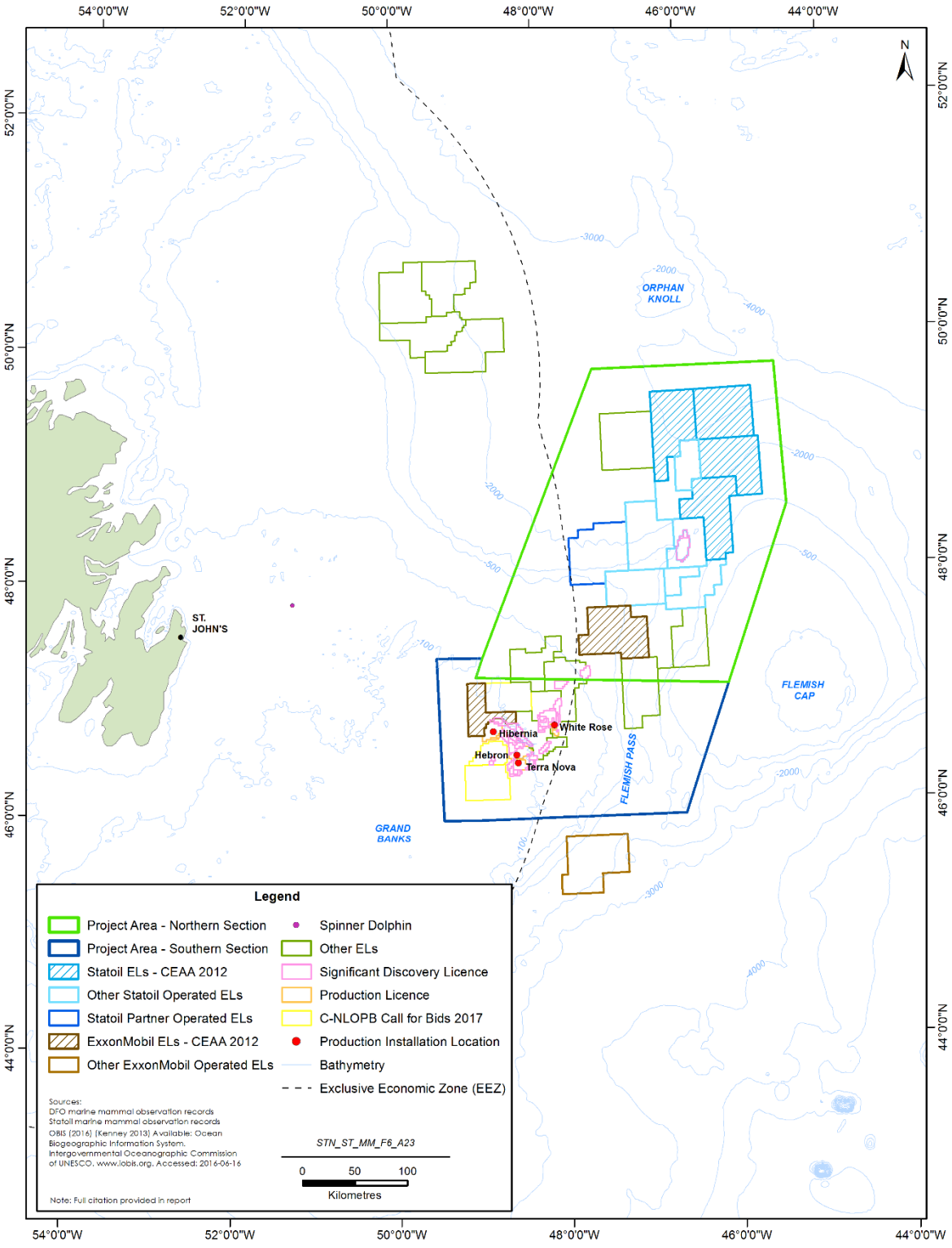


Figure 6-81 Spinner Dolphin Sightings in Eastern NL Offshore Area

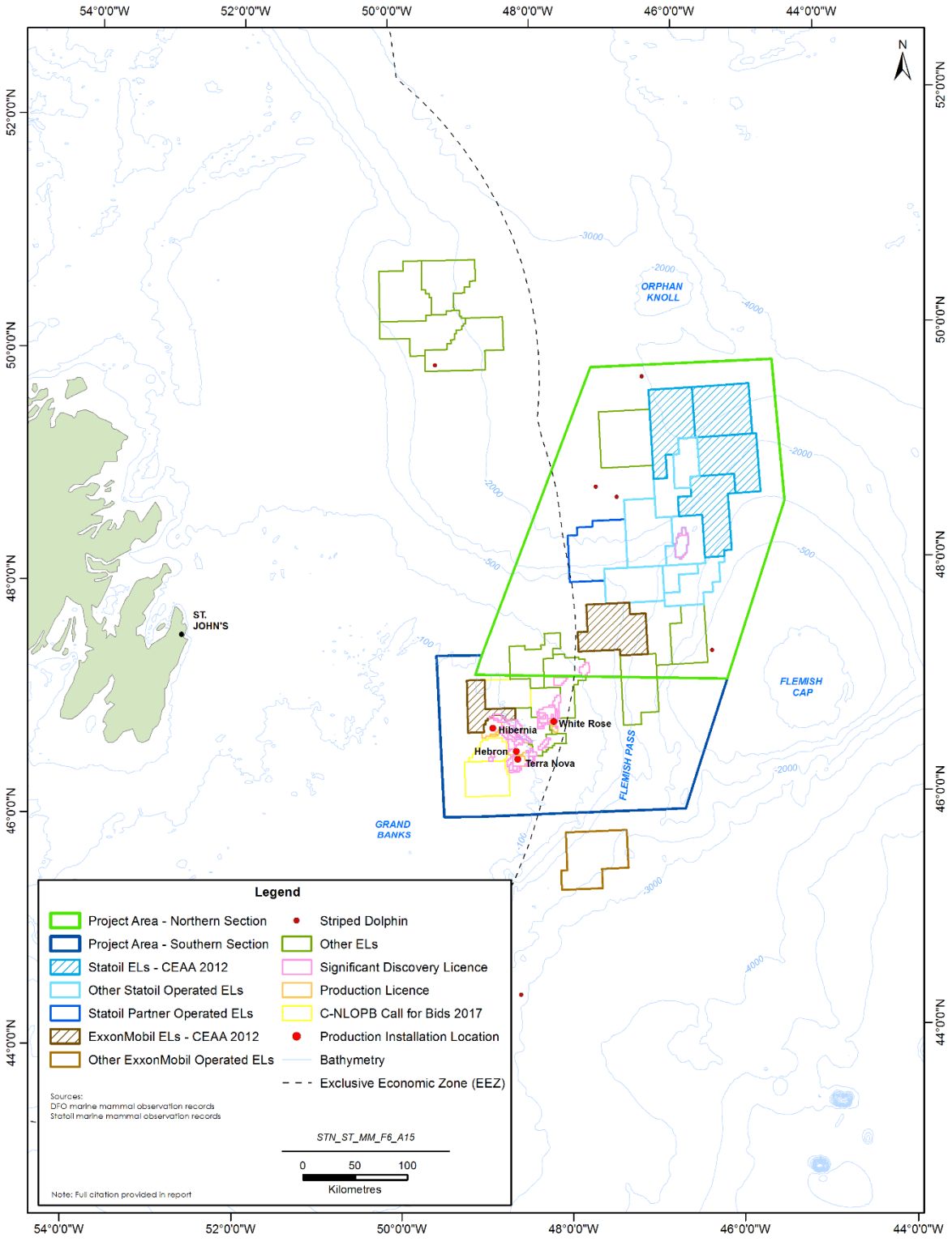


Figure 6-82 Striped Dolphin Sightings in Eastern NL Offshore Area

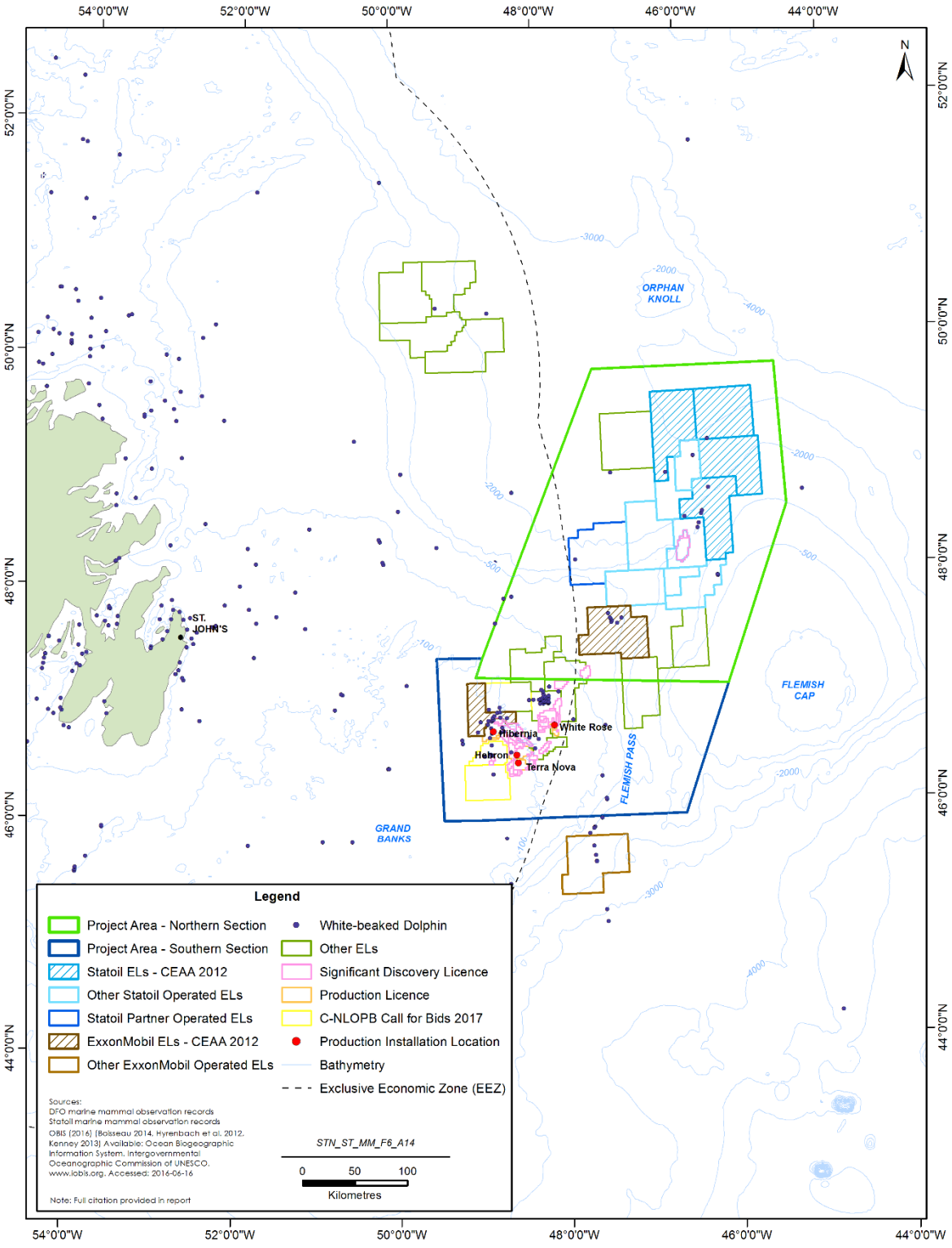


Figure 6-83 White-beaked Dolphin Sightings in Eastern NL Offshore Area

6.3.5 Phocids

Four species of seals have the potential to occur off eastern Newfoundland (Table 6.37). Several fish species (primarily cod, capelin, sand lance and halibut) and invertebrates (generally squid and shrimp) are consumed by seals, but diets can vary considerably across seasons, years, seal species, and geographic regions (Hammill and Stenson 2000).

Key life history and habitat information for each of the species with the potential to occur in the region have recently been described and can be found in the Eastern Newfoundland SEA (Amec 2014a). There are no pinniped species at risk expected to occur in the Project Area. Phocid sightings are not recorded in the DFO opportunistic sightings database and there are insufficient records to produce sighting tables or distribution figures. The following sections describe general distributions based primarily on published literature.

6.3.5.1 Phocid Species Descriptions and General Distributions

Information on seal species found in the eastern Newfoundland offshore area and their general distribution is provided in the following subsections. The regional distributions should be referred to for the potential occurrence of these species in the Project Area (Northern and Southern Sections).

6.3.5.1.1 Grey Seal

The grey seal can be found on both sides of the North Atlantic, and is subdivided into three populations, one of which occurs in eastern Canada (NOAA 2016i). The western North Atlantic stock (eastern Canada population) ranges from Labrador to New Jersey, but segregates into the following three breeding herds during their January breeding season: Sable Island, Gulf of St. Lawrence, and the Nova Scotia coastline. Although they disperse widely following the breeding season, grey seals are considered non-migratory (Lesage et al. 2001) and may occur year-round. There is currently no estimate for the total western North Atlantic population (NOAA 2016i). The abundance estimate for the three Canadian herds is 505,000 individuals (95 percent CI: 329,000-682,000) (DFO 2014a)).

6.3.5.1.2 Harbour Seal

In the western North Atlantic, harbour seal can be found in all nearshore waters from the eastern Canadian Arctic and Greenland to southern New England and New York (NOAA 2016j). Given their primarily coastal distribution, they are expected to occur only in low numbers in the more offshore waters of eastern Newfoundland. Five subspecies of harbour seal have been recognized with *Phoca vitulina concolor* occurring in the Northwest Atlantic (Hammill et al. 2010). Survey results from 2012 suggest an abundance estimate of 75,834 individuals for the western North Atlantic (CV=0.15) (NOAA 2016j).

6.3.5.1.3 Harp Seal

Harp seals are the most abundant pinniped in the northwest Atlantic and can be found throughout most of the North Atlantic and in the Arctic Ocean. The global harp seal population is divided into three separate stocks, identified by specific pupping locations (NOAA 2014d). The largest of these three stocks (the western North Atlantic stock) is located in eastern Canada and is divided into two breeding herds. The “Front herd” breeds off the coast of Newfoundland and Labrador, while the “Gulf herd” breeds in the Gulf of St. Lawrence (DFO 2012). Harp seals are highly migratory, and the western North Atlantic stock travels between summer feeding grounds in the Arctic to the aforementioned breeding, whelping, and moulting grounds off eastern Canada. While the major migratory pathways are primarily coastal (eastern coast of Labrador up into Davis Strait and Baffin Bay), harp seals disperse widely and are considered relatively common off eastern Newfoundland, particularly in the winter months, although smaller numbers may occur year-round (Amec 2014a). Abundance estimates for the western North Atlantic stock have been made using a variety of methods including both aerial and mark-recapture surveys (NOAA 2014d). The most recent estimate of the Northwest Atlantic harp seal population is 7,700,000 individuals (95 percent CI: 6,900,000-8,400,000) (DFO 2012).

6.3.5.1.4 Hooded Seal

Hooded seals can be found throughout most of the North Atlantic and Arctic Oceans in deep water (NOAA 2007b). The hooded seal population has been divided into three stocks: Northwest Atlantic, Greenland Sea, and White Sea. Hooded seals are a primarily pelagic species, that spends most of the year in the open ocean, except for brief periods when they reproduce and moult (Anderson et al. 2009). Hooded seals remain on the Newfoundland continental shelf during the winter and spring, from approximately December through March (Anderson et al. 2009, 2013), with areas of high use identified off the coast of Newfoundland and on the continental shelf and shelf break (Anderson et al. 2013). The population of hooded seals in the Northwest Atlantic in 2005 was estimated to be 592,100 individuals (standard error (SE)=94,800) (NOAA 2007b).

6.3.6 Sea Turtles

Sea turtle distribution in coastal waters is highly seasonal and location-dependent. Once they have left their hatching beach, hatchling (and later juvenile) turtles are typically absent from coastal waters for the first few years of life. Their location during this period is poorly understood. In deeper, epipelagic waters, sea turtle habitats are transitory as their distribution in the open sea typically matches the patchy, widely-scattered, and spatio-temporally dynamic distribution of the prey resources that they depend on. Recent research indicates that even hatchlings are not simply drifters, but they are capable of independent locomotion against fairly substantial currents.

Although sea turtles are likely uncommon transients in the Project Area, four species have the potential to occur there on occasion, based on known sightings or expected occurrence off eastern Newfoundland (Table 6.38). The leatherback sea turtle was recently split into two populations, Atlantic and Pacific, and the Atlantic population is listed as endangered under SARA and by COSEWIC (Species at Risk Public Registry 2017). Leatherback sea turtles are the most likely

species of sea turtle to occur off eastern Newfoundland. Both leatherback and loggerhead sea turtles are seen with some regularity off eastern Canada in summer and fall (Goff and Lien 1988; Witzell 1999; Ledwell and Huntington 2009). Loggerhead sea turtles are listed as Endangered under SARA and by COSEWIC (COSEWIC 2010d; Species at Risk Public Registry 2017). Less is known about the distributions of Kemp's ridley sea turtle and green sea turtle in eastern Canada, but these species are generally considered rare at these latitudes.

Key life history and habitat information for each of the species of sea turtles with the potential to occur in the RSA have recently been described and can be found in the Eastern Newfoundland SEA (Amec 2014a). A high-level overview of information on non-SAR sea turtles is summarized below. Information regarding the leatherback and loggerhead sea turtles is provided in the overview of listed species in Section 6.3.7. Figure 6-84 identifies opportunistic sightings of all sea turtle species recorded off eastern Newfoundland between 1938 (earliest record of a sea turtle) and 2015, as reported in the pooled dataset of OBIS, DFO and Statoil records (see Section 6.3.1).

6.3.6.1 Non-SAR Sea Turtles Species Descriptions and General Distributions

6.3.6.1.1 Green Sea Turtle

The green sea turtle is unique among sea turtles in that they are herbivorous and feed primarily on seagrasses and algae (NOAA 2016k). This species is generally found in tropical and subtropical waters, though juveniles are known to occur seasonally in temperate waters (James et al. 2004; NOAA 2016k). In the western Atlantic Ocean, they are found from the Gulf of Mexico to Massachusetts and their presence in the waters off the northeastern United States is seasonal and dependent on water temperature, as this species moves to southerly latitudes when water temperatures decline (James et al. 2004; NOAA 2016k). During the summer and fall, this species occurs as far north as New York, and their presence at higher latitudes is rare (James et al. 2004). The peak nesting periods for this species are between the months of June and September (NOAA 2016k), however no breeding or nesting is known to occur in Canadian waters.

Green sea turtles are uncommon in Atlantic Canada. There have been two sightings of green sea turtle in coastal areas in Nova Scotia: a juvenile green sea turtle was found in Chedabucto Bay in 1999, and a juvenile green-loggerhead sea turtle hybrid was found in St. Margaret's Bay in 2001 and these represented the most northerly confirmed records of green sea turtle in the Northwest Atlantic (James et al. 2004). The DFO observation records contain a few (seven) records of green sea turtles in the eastern Newfoundland offshore area (Figure 6-84).

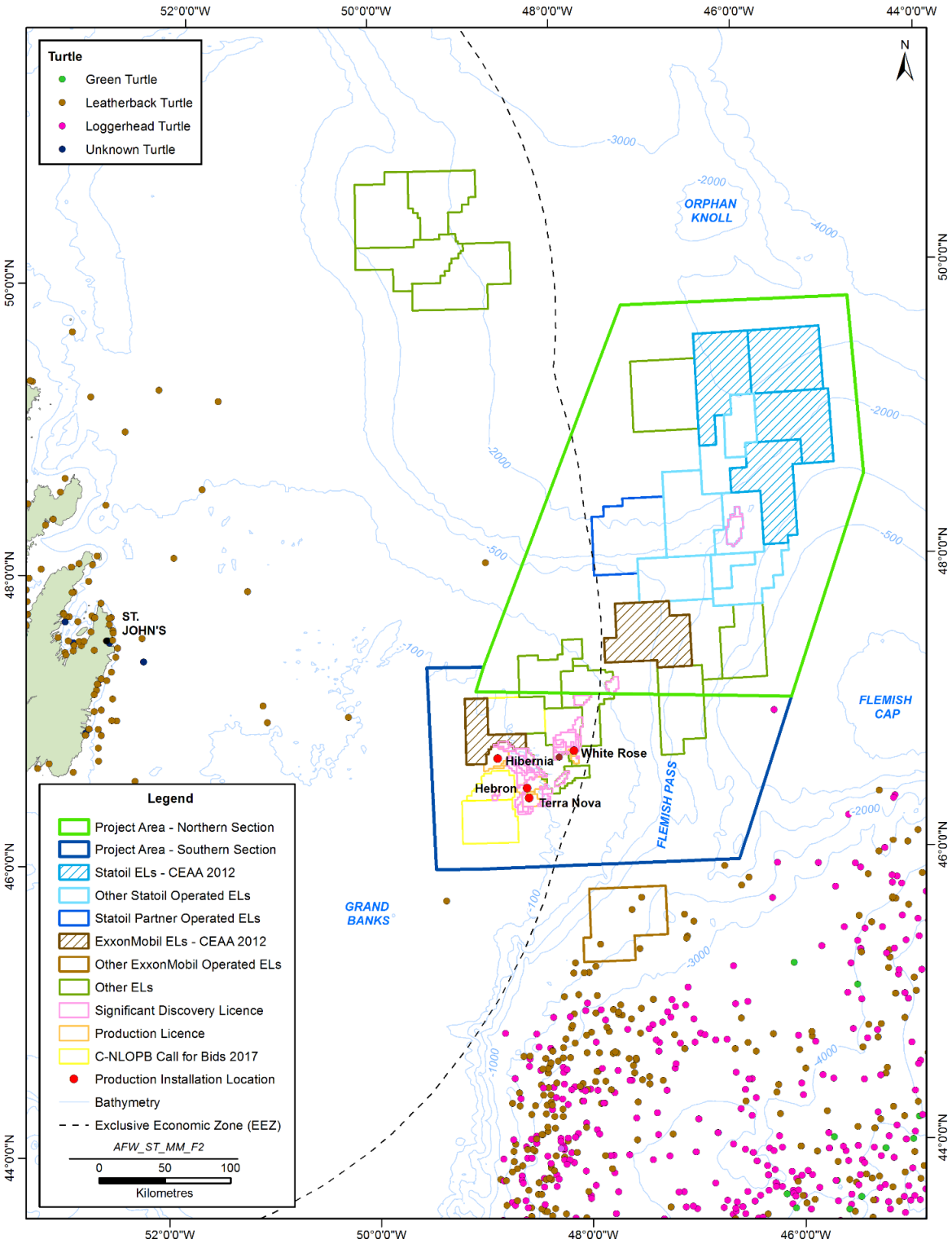


Figure 6-84 Opportunistic Sea Turtle Sightings (1938 to 2015)

6.3.6.1.2 Kemp's Ridley Sea Turtle

Kemp's ridley are the smallest and one of the most endangered species of sea turtle in the world. They are extremely rare in Atlantic Canada and are considered an accidental visitor to Canadian waters. This species is typically found in the more tropical water of the Gulf of Mexico, and breeding and nesting occurs almost exclusively on three beaches in Mexico (NMFS et al. 2011). While there have been very rare sightings of juvenile Kemp's ridley sea turtles in Atlantic Canada, this area is considered at the northern-most extreme of their range as colder water temperatures likely restrict their distribution. Furthermore, Kemp's ridley sea turtles rarely venture into waters deeper than 50 m (Byles and Plotkin 1994), as they tend to occupy neritic habitats, where they forage over sand or muddy substrates, feeding on crabs, fish, jellyfish, and mollusks.

There have been no sightings of Kemp's ridley sea turtle in the region based on available observation records from OBIS, DFO and Statoil.

6.3.7 Species at Risk

Marine mammal and sea turtles listed as species at risk are those species that are listed as endangered, threatened or of special concern under Schedule 1 of SARA (and are therefore formally and legally protected) and/or which are otherwise designated by COSEWIC as SOCC. There are currently no marine mammal or sea turtle species listed under the NL ESA. Nine marine mammal species and two sea turtle species at risk have been identified as having the potential to be present off eastern Newfoundland. These are: beluga whale, blue whale, bowhead whale, fin whale, North Atlantic right whale, harbour porpoise, killer whale, northern bottlenose whale, Sowerby's beaked whale, leatherback sea turtle and loggerhead sea turtle (Tables 6.37 and 6.38).

Figure 6-85 identifies opportunistic sightings of listed marine mammal species recorded in the region between 1758 (first record of a killer whale in the DFO dataset) and 2015, as reported in the pooled dataset of OBIS, DFO and Statoil records (see Section 6.3.1). Individual species maps are provided where available. Opportunistic sightings for all species of sea turtles (including listed species) were presented in Figure 6-84. Table 6.41 summarizes the number of opportunistic sightings of listed marine mammals and sea turtles reported to OBIS, DFO, or Statoil in either the Northern or Southern Sections of the Project Area between 1958 and 2015. Fin and sei whales may be difficult to distinguish in the field. Since a number of records were thus reported as fin/sei, sightings for these species have been pooled in Table 6.41, although only fin whale are a listed species (sei whale are not). Section 6.3.7.1.4 describes sightings identified expressly as fin whales.

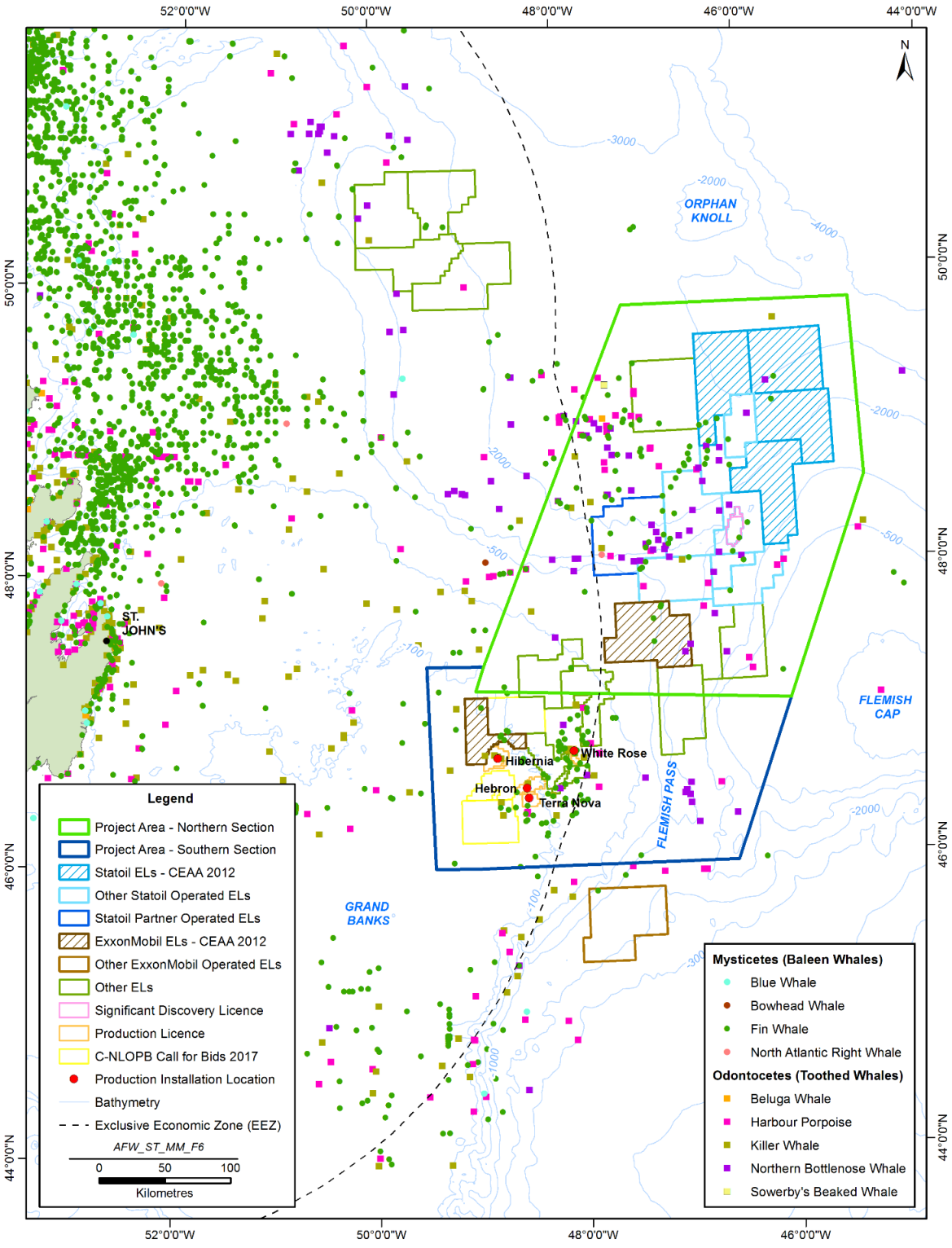


Figure 6-85 Opportunistic Sightings of Listed Marine Mammals (1867 to 2015)

Table 6.41 Opportunistic Sightings of Listed Marine Mammals and Sea Turtles Reported in the Project Area (1758 – 2015)

Common Name	Project Area – Northern Section	Project Area – Southern Section
Beluga whale	1	0
Blue whale	0	0
Bowhead whale	0	0
Fin and sei whale	134	147
Harbour porpoise	27	7
Killer whale	9	22
North Atlantic right whale	1	0
Northern bottlenose whale	53	12
Sowerby's beaked whale	1	0
Unidentified beaked whale	2	2
Loggerhead sea turtle	0	2
Leatherback sea turtle	0	1

Species-specific information including general distributions off eastern Newfoundland and within the Project Area (Northern and Southern Sections) is provided in the following sections.

6.3.7.1 Listed Species Descriptions and General Distributions

6.3.7.1.1 Beluga Whale

The St. Lawrence Estuary population of beluga whale is listed as endangered under SARA (Schedule 1) and endangered by COSEWIC. Belugas are generally found in seasonally ice-covered Arctic and sub-Arctic waters, and in Eastern Canada, their presence outside of the Gulf of St. Lawrence is rare (Amec 2014b). Spring is an important feeding period for this population and the timing and extent of seasonal movements are likely influenced by sea ice, food availability and predation risk (COSEWIC 2014). Generally, this population occurs in the Gulf of St. Lawrence Estuary during summer months and then migrates eastward into the northwestern Gulf of St. Lawrence during the fall and winter (COSEWIC 2014). As a result, their occurrence in the eastern Newfoundland offshore area is likely to be rare.

Habitat quality for beluga whales in the Gulf of St. Lawrence has declined in recent decades as a result of the large volume of vessel traffic, the chronic discharge of various chemical substances, fishing activities, changes in environmental conditions and recurrent toxic algal blooms (COSEWIC 2014). Despite these changes in habitat quality, belugas show strong site fidelity which makes them vulnerable to site-specific anthropogenic threats (COSEWIC 2014). As a result, the St. Lawrence Estuary population has experienced slow declines since the early 2000s, and it was estimated there were 889 individuals in 2012 (COSEWIC 2014). There was only one record of a beluga whale in the Project Area - Northern Section according to the DFO, OBIS, and Statoil opportunistic sighting records (Table 6.41). A few other opportunistic beluga whale sightings were recorded in the more coastal areas (Figure 6-86).

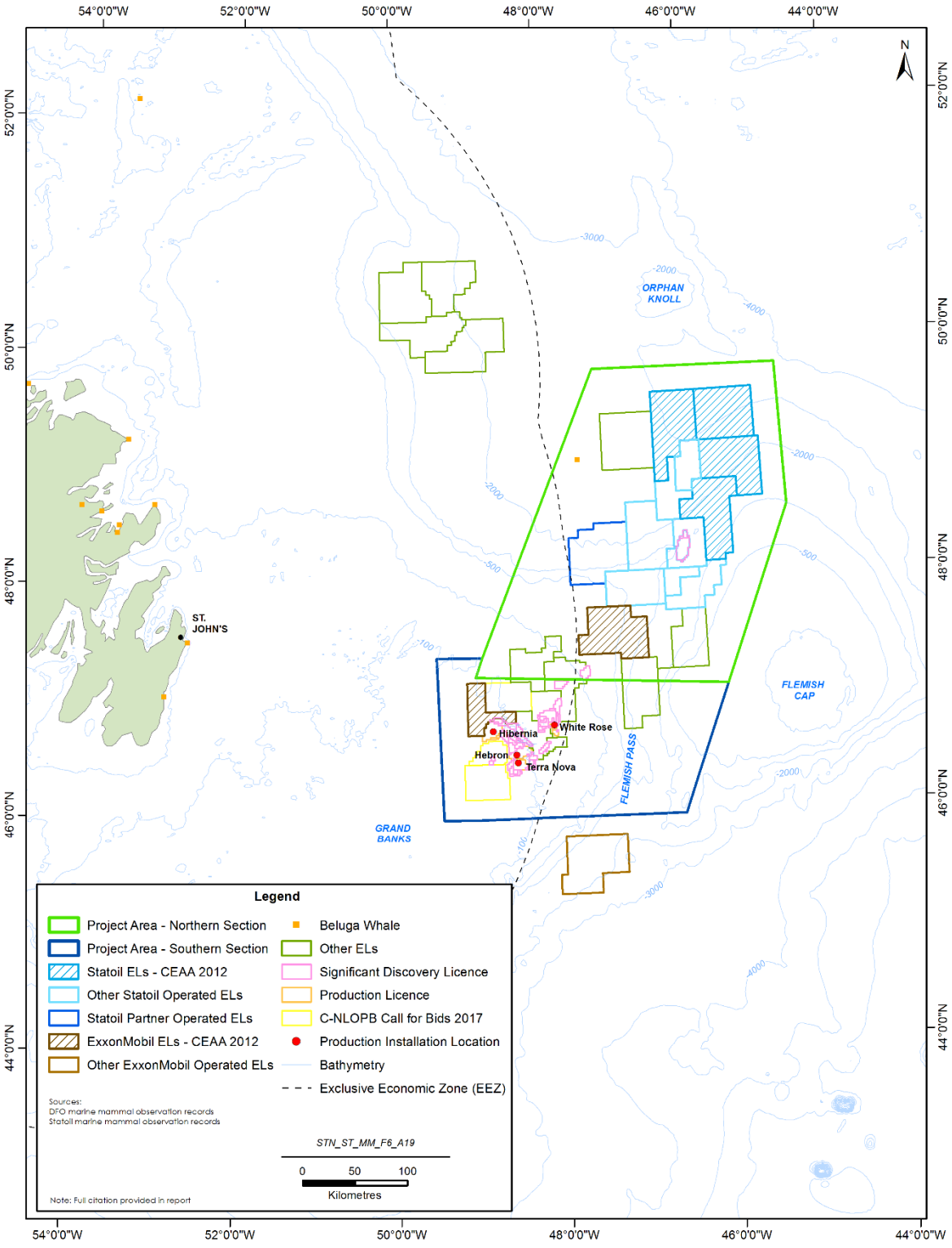


Figure 6-86 Beluga Whale Sightings in Eastern NL Offshore Area

6.3.7.1.2 Blue Whale

The blue whale is listed as endangered under SARA (Schedule 1) and by COSEWIC. The distribution of blue whales in the western North Atlantic extends from the Arctic to mid-latitude waters. This species is most frequently sighted in the waters off eastern Canada, with most sightings occurring in the Gulf of St. Lawrence (NOAA 2010). Blue whales were hunted off Newfoundland in the first half of the 20th century. Photo-identification in eastern Canadian waters indicates that blue whales from the St. Lawrence, Newfoundland, Nova Scotia, New England, and Greenland all belong to the same stock (NOAA 2010). The population size of the blue whale is unknown except for the Gulf of St. Lawrence area, where 440 blue whales have been individually photo-identified. Given that only a small proportion of the distribution range of the species has been sampled, and considering the low number of blue whales encountered and photographed, the current data based on photo-identification do not allow for an estimate of abundance for the Northwest Atlantic (NOAA 2010). However, COSEWIC (2002) has estimated the northwest Atlantic population to be in the low hundreds.

In the North Atlantic, seasonal movements and habitat use of blue whales are relatively poorly understood; this includes uncertainty regarding the location of breeding and wintering areas. To observe blue whale movements, Lesage et al. (2016) used satellite telemetry to track the seasonal movements of 24 blue whales in eastern Canada. These whales were tagged between August and November off the Gaspé Peninsula in the Gulf of St. Lawrence and at various sites throughout the St. Lawrence Estuary. Three of the tagged blue whales showed movement out of the nearshore waters, with two travelling into the waters around the New England seamounts and one blue whale in 2013 passing through offshore waters south of the Grand Banks (approximately 300 km to the southwest of the Project Area – Southern Section).

Blue whales are regularly sighted in the Gulf of St. Lawrence and St. Lawrence Estuary between the months of April and December (COSEWIC 2002). There have been a low number of sightings on the Grand Banks and eastern Newfoundland offshore area compared to the Gulf of St. Lawrence, where most of these sightings have occurred (COSEWIC 2002). A total of six blue whales were sighted during the TNASS survey off Newfoundland in 2007 (Lawson and Gosselin 2009). Blue whale vocalizations have been detected in the Flemish Pass in September (Appendix F).

Based on DFO, OBIS, and Statoil marine mammal observation records, there were limited blue whale sightings in the eastern Newfoundland offshore area, and none within the Project Area (Table 6.41 and Figure 6-87).

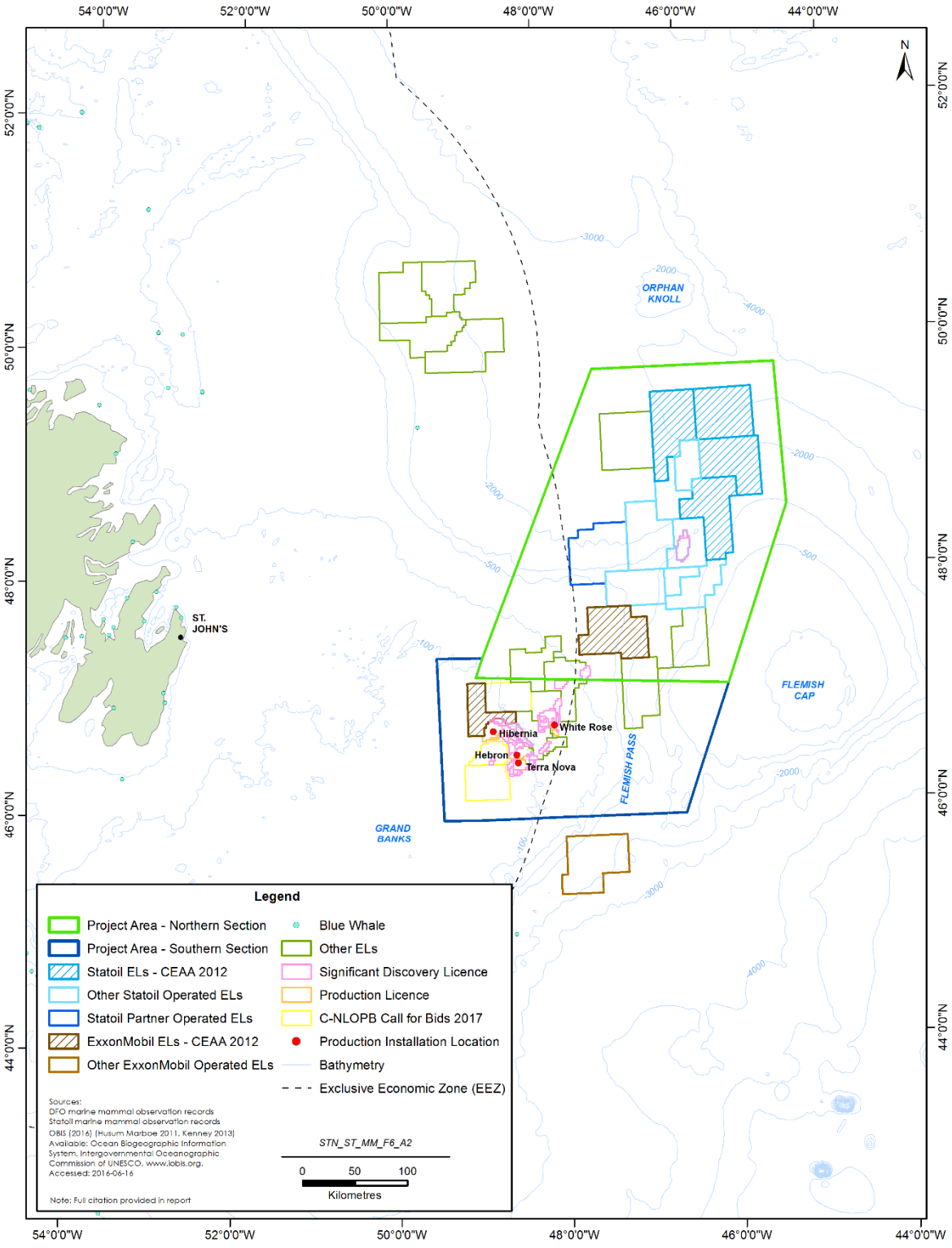


Figure 6-87 Blue Whale Sightings in Eastern NL Offshore Area

6.3.7.1.3 Bowhead Whale

The Eastern Canada-West Greenland Population of bowhead whale is listed as a species of special concern by COSEWIC and those bowhead whales that are occasionally found in Newfoundland and Labrador waters likely come from this population (COSEWIC 2009a). The bowhead whale has a nearly circumpolar distribution in the Northern Hemisphere and occurs in marine waters and conditions ranging from open water to areas with thick, unconsolidated pack ice (SEM 2008). Bowhead whales are most commonly found in the Arctic Ocean, and though the Newfoundland Labrador region was part of their historical range, hunting has depleted this population to the point where they are generally no longer found in the region (COSEWIC 2009a). The Eastern Canada-West Greenland population summers in the northwestern Hudson Bay, Foxe Basin, Lancaster Sound and western Baffin Bay, and winters in the Hudson and Davis Straits off western Greenland (COSEWIC 2009a). Bowhead whales have a fairly narrow feeding niche in northern latitudes and can be affected by human activities such as disturbance from shipping and offshore oil and gas development (COSEWIC 2009a). While the exact size of this population is not known, it has been roughly estimated to be in the thousands (COSEWIC 2009a).

Bowhead whales have been sighted in the waters off the coast of Newfoundland in Rattling Brook, Trinity Bay, and Witless Bay (Ledwell et al. 2007; The Telegram 2014). The sighting of a stranded whale in Witless Bay is the southernmost occurrence of a bowhead whale on record (Ledwell et al. 2007).

Bowhead whale sightings were rare in the eastern Newfoundland offshore area DFO, OBIS, and Statoil marine mammal records, with no sightings in the Project Area (Table 6.41 and Figure 6-88).

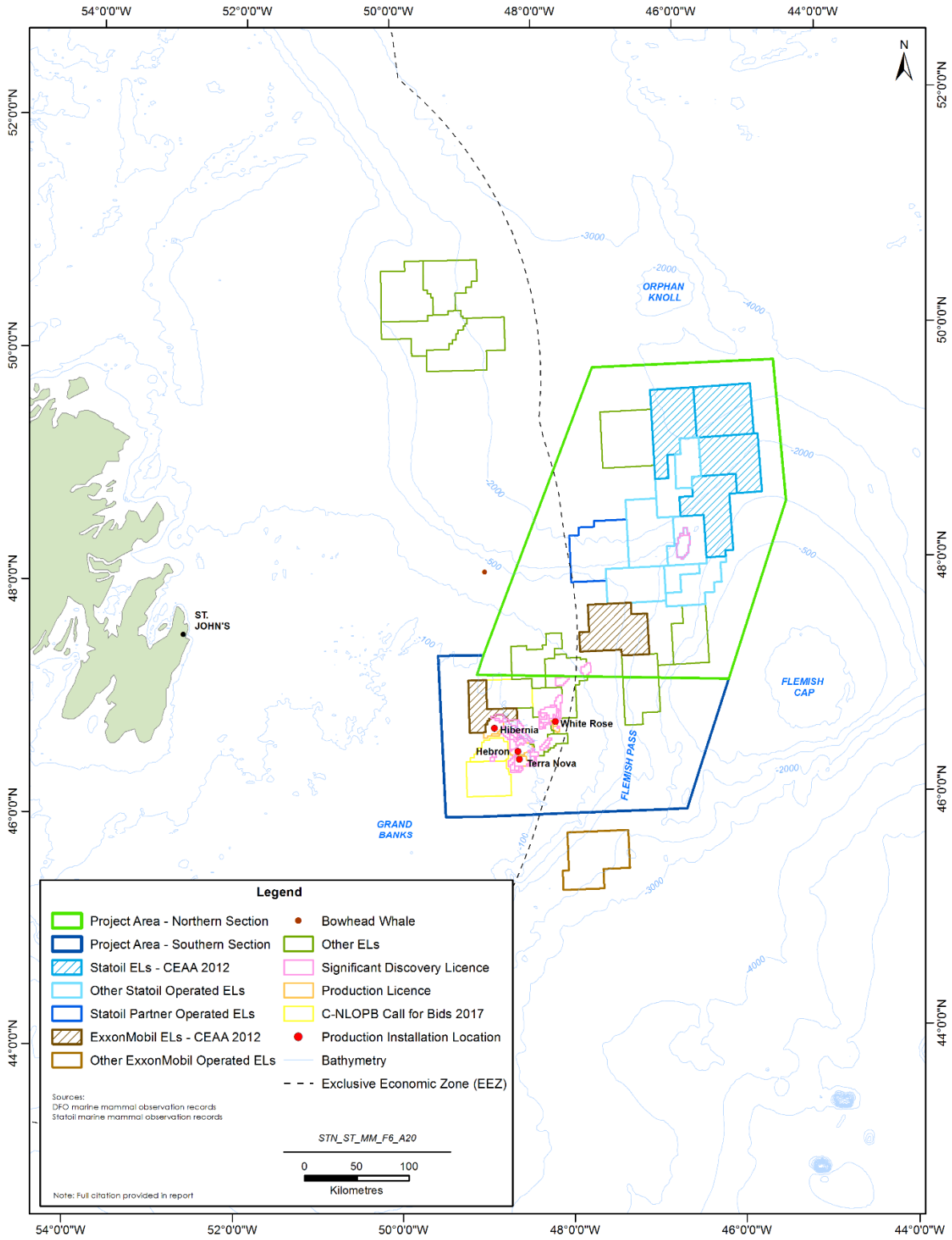


Figure 6-88 Bowhead Whale Sightings in Eastern NL Offshore Area

6.3.7.1.4 Fin Whale

The fin whale is listed as special concern by both SARA (Schedule 1) and COSEWIC. Fin whales make seasonal migrations between feeding grounds in high latitudes and calving and breeding grounds in lower latitudes (DFO 2016a). During summer months, concentrations of fin whales are known to occur in the Gulf of St. Lawrence, on the Scotian Shelf, and in the nearshore and offshore waters of Newfoundland and Labrador; though their wintering areas are not well known, there have been year-round observations of this species in the waters off of Nova Scotia and Newfoundland (COSEWIC 2005; DFO 2016a). Modelling efforts have suggested that fin whales in offshore Newfoundland prefer deep cold waters and their periodic abundance in the eastern Newfoundland offshore has been linked to seasonal aggregations of capelin (DFO 2016a). Fin whale vocalizations have also been recorded in the Project Area in June, August, and September (Appendix F) and every month from September through March (Appendix E). The key threats to fin whale are ship strikes and entanglement in fishing gear, though underwater noise may degrade their habitat and impair communication (COSEWIC 2005).

The scientific committee of the International Whaling Commission (IWC) classifies the fin whales off the eastern United States, Nova Scotia, and the southeastern coast of Newfoundland as a single stock (NOAA 2015a). An abundance estimate of 1,352 individuals (95 percent CI: 821-2,226) for the Canadian TNASS survey area was calculated in 2007 (Lawson and Gosselin 2009). The best abundance estimate available for the Western North Atlantic stock was 1,618 (CV=0.33), using surveys conducted in 2011 (NOAA 2015a).

A map showing opportunistic sightings expressly identified as fin whale in the eastern Newfoundland offshore area and the Project Area (Northern and Southern Sections) is provided in Figure 6-89.

6.3.7.1.5 Harbour Porpoise

The Northwest Atlantic population of harbour porpoise is listed as a species of special concern by COSEWIC. In the Northwest Atlantic, harbour porpoises occur from the Bay of Fundy north to Cape Aston, Baffin Island, but the extent of habitat in eastern Canada is not well known (COSEWIC 2006). Range-wide estimates for the abundance of harbour porpoise in eastern Canada do not exist (COSEWIC 2006), although an abundance estimate from the Lawson and Gosselin (2009) TNASS surveys, for Newfoundland waters, was 1,195 individuals (95 percent CI: 639-2,235).

Observations made from by-catches in groundfish gill nets indicate that this species can be found along the entire coast of Newfoundland, especially along the south and west coasts (COSEWIC 2006). Harbour porpoise are most commonly observed in coastal waters, but have also been caught in experimental drift nets across the entire Grand Banks, as well as the continental shelf as far north as Nain, Labrador (COSEWIC 2006). The major threat facing harbour porpoises is bycatch in fishing gear. There were 58 sightings of harbour porpoise during the 2007 TNASS survey conducted off Newfoundland (Lawson and Gosselin 2009). According to DFO, OBIS and Statoil marine mammal observation records, harbour porpoise have been observed off eastern Newfoundland, both within the Northern and Southern Sections of the Project Area (Table 6.41 and Figure 6-90).

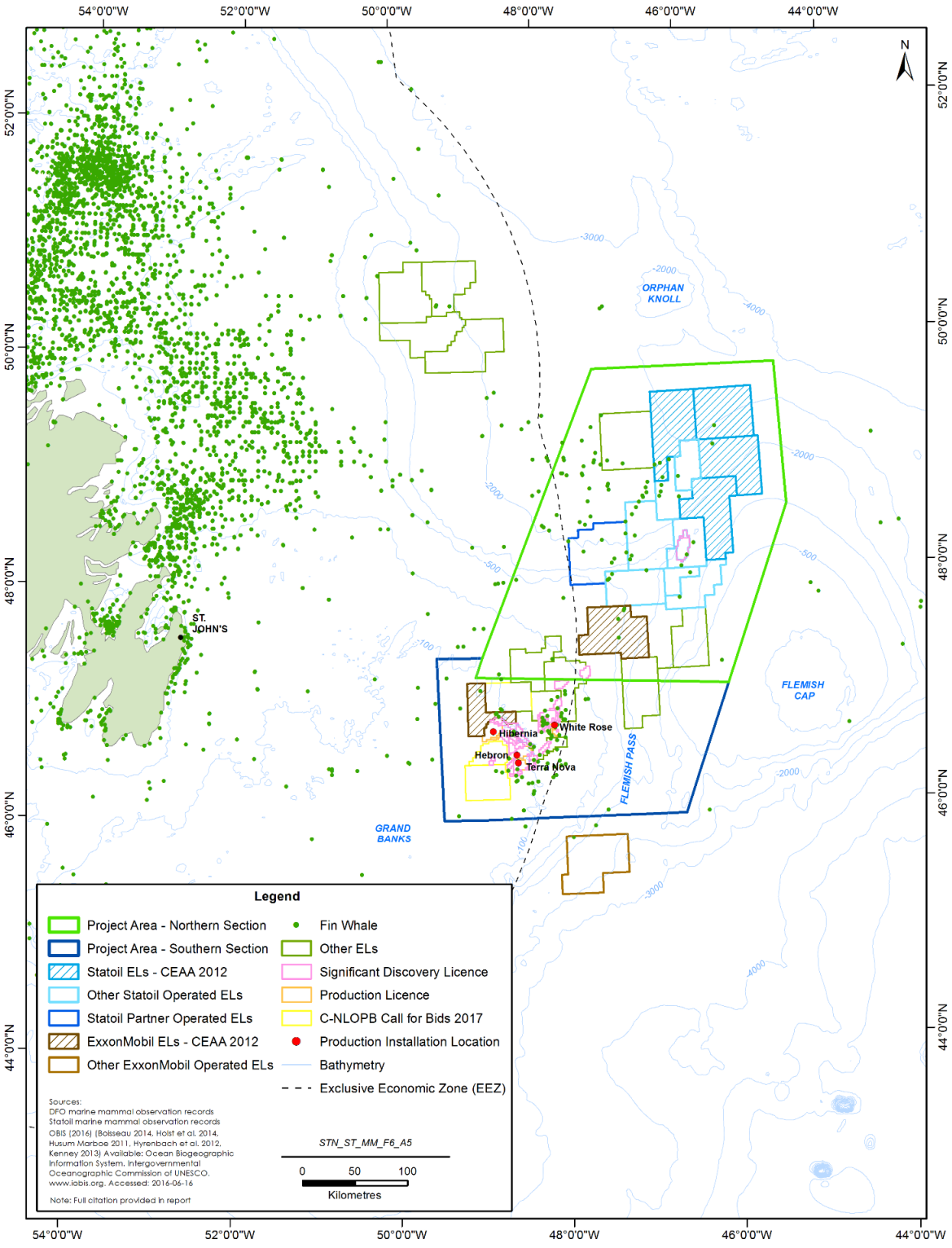


Figure 6-89 Fin Whale Sightings in Eastern NL Offshore Area

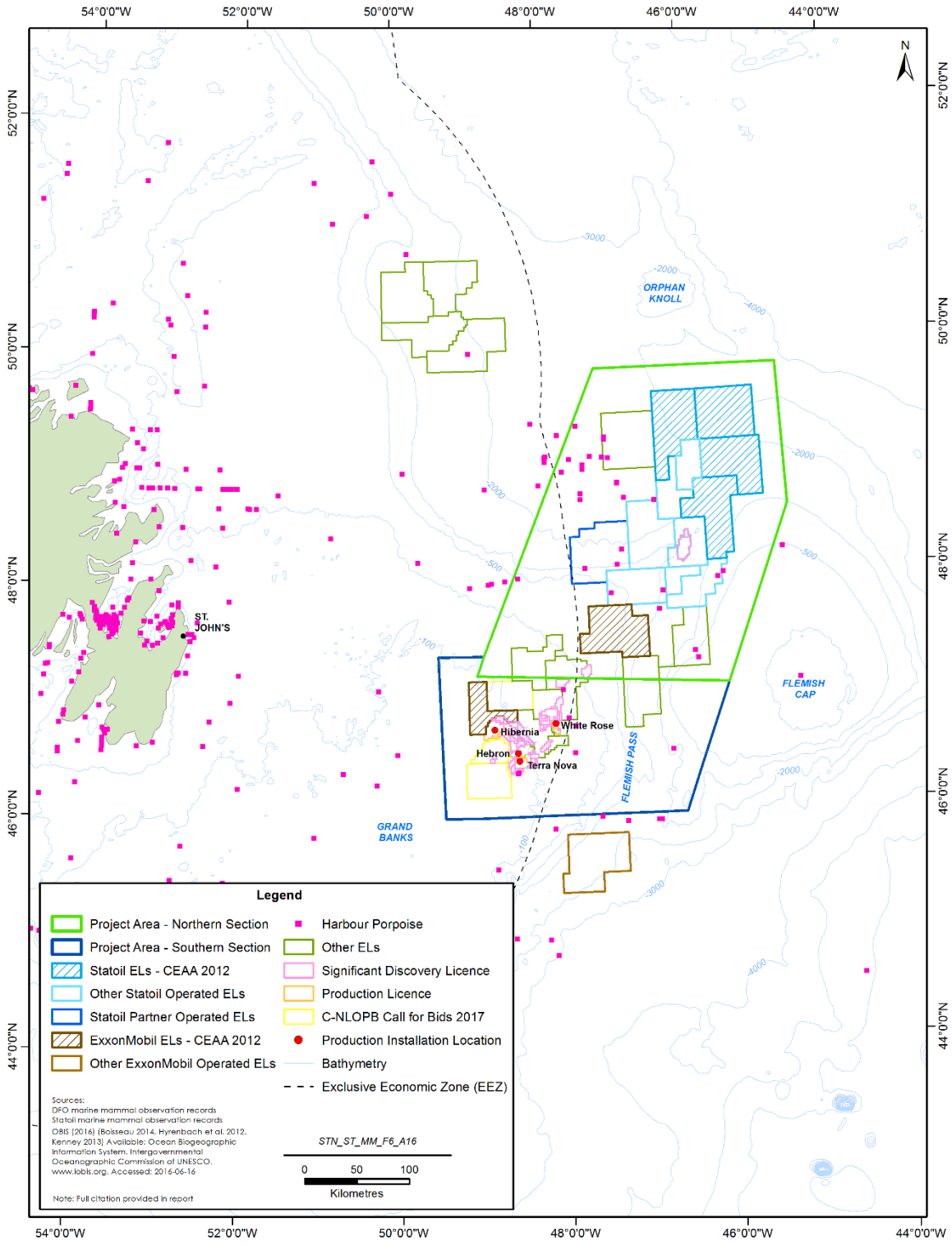


Figure 6-90 Harbour Porpoise Sightings in Eastern NL Offshore Area

6.3.7.1.6 Killer Whale

Killer whales (Northwest Atlantic population) are listed as a species of special concern by COSEWIC but are currently not listed by SARA. Killer whales are relatively uncommon in the waters of eastern Canada and the size of the Northwestern Atlantic/Eastern Arctic population is not known (COSEWIC 2009b, NOAA 2015c); however, sightings have been reported in the coastal waters of Newfoundland (COSEWIC 2009b). Based on observations of killer whales in Eastern Canada from 1758 to 2012, sightings are most common from June to September and have been more frequent over the last decade (NOAA 2015c).

The main threats facing killer whales are disturbance (both physical and acoustic), prey depletion, and contaminants, though the exact threats facing the Northwestern Atlantic/Eastern Arctic population are not well documented (COSEWIC 2009b). One killer whale was observed in the 2007 TNASS survey off Newfoundland (Lawson and Gosselin 2009).

While killer whales are believed to be relatively uncommon in the region, there were sightings recorded in the eastern Newfoundland offshore area in the DFO, OBIS and Statoil marine mammal observation records, including in the Project Area (Northern and Southern Sections; Table 6.41 and Figure 6-91).

6.3.7.1.7 North Atlantic Right Whale

North Atlantic right whales are listed as endangered by both SARA (Schedule 1) and COSEWIC. This species can be found in the northwest Atlantic from Florida to Newfoundland, and in the Gulf of St. Lawrence (COSEWIC 2013). North Atlantic right whales have wintering calving grounds located off the coast of Florida and Georgia. Whales that use the calving ground during the early winter migrate north in the late winter and spring to feed in Cape Cod Bay, the Great South Channel and Massachusetts Bay. Not all individuals occupy these areas during the winter and their whereabouts (especially adult males) is largely unknown (COSEWIC 2013). A possible breeding ground located in the middle of the Gulf of Maine has recently been discovered (COSEWIC 2013). During the summer and fall, right whales can be found congregating and feeding in the lower Bay of Fundy and in the Roseway Basin on the western Scotian Shelf. Smaller numbers have also been observed in other areas of the Scotian Shelf and the Gulf of St. Lawrence, and rarely, in the waters off Newfoundland. The main threats facing this species are ship strikes and entanglement in fishing gear; both of which have contributed to limited population recovery (COSEWIC 2013).

The western North Atlantic population size was estimated to be a minimum of 476 individuals in 2011, based on a census of individuals using photo-identification (NOAA 2016b). No North Atlantic right whales were observed in the waters off eastern and southern Newfoundland during the TNASS survey in 2007 (Lawson and Gosselin 2009). North Atlantic right whales were rarely reported in the DFO, OBIS and Statoil marine mammal observation records with only one sighting of this species in the Northern Section of the Project Area (Table 6.41 and Figure 6-92).

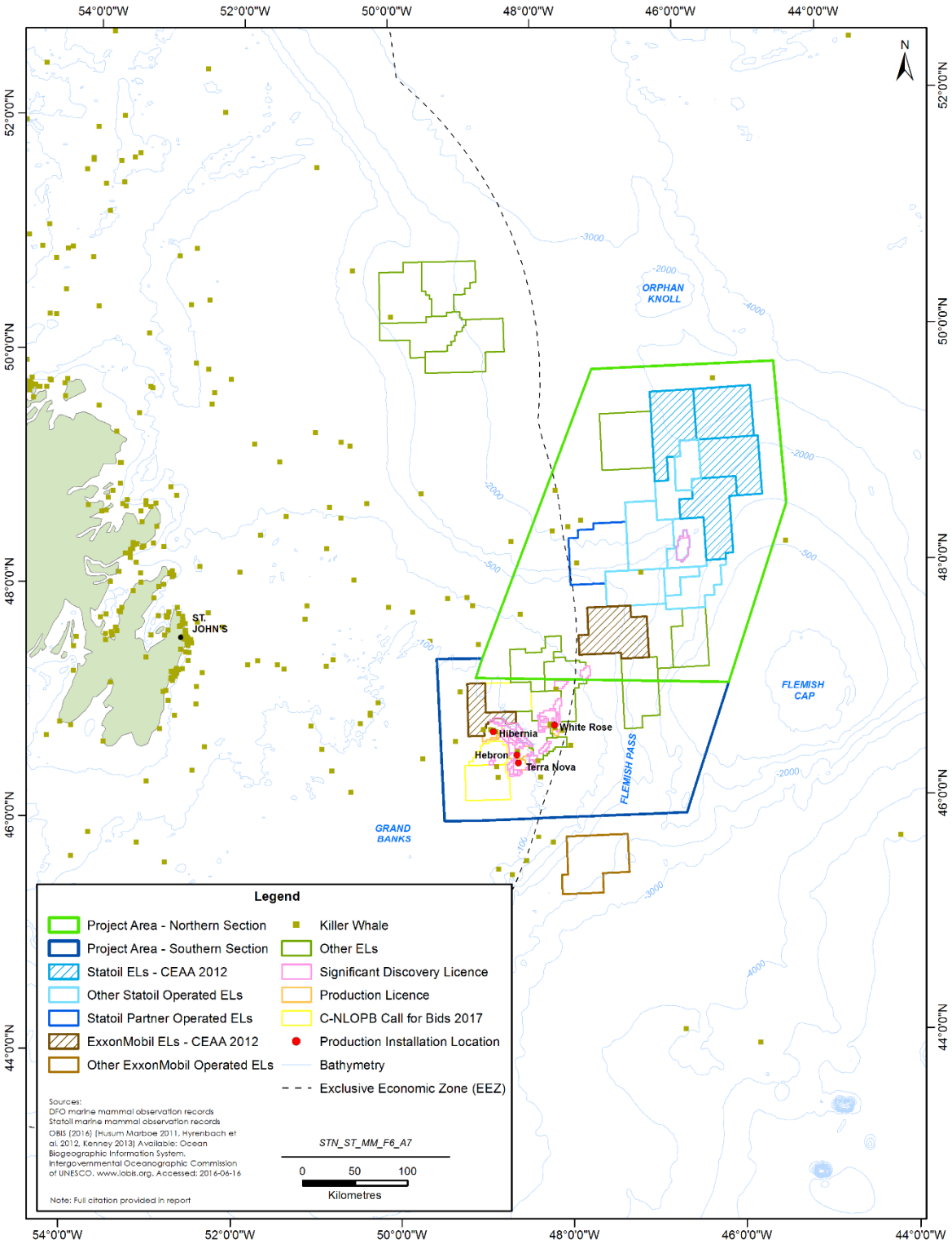


Figure 6-91 Killer Whale Sightings in Eastern NL Offshore Area

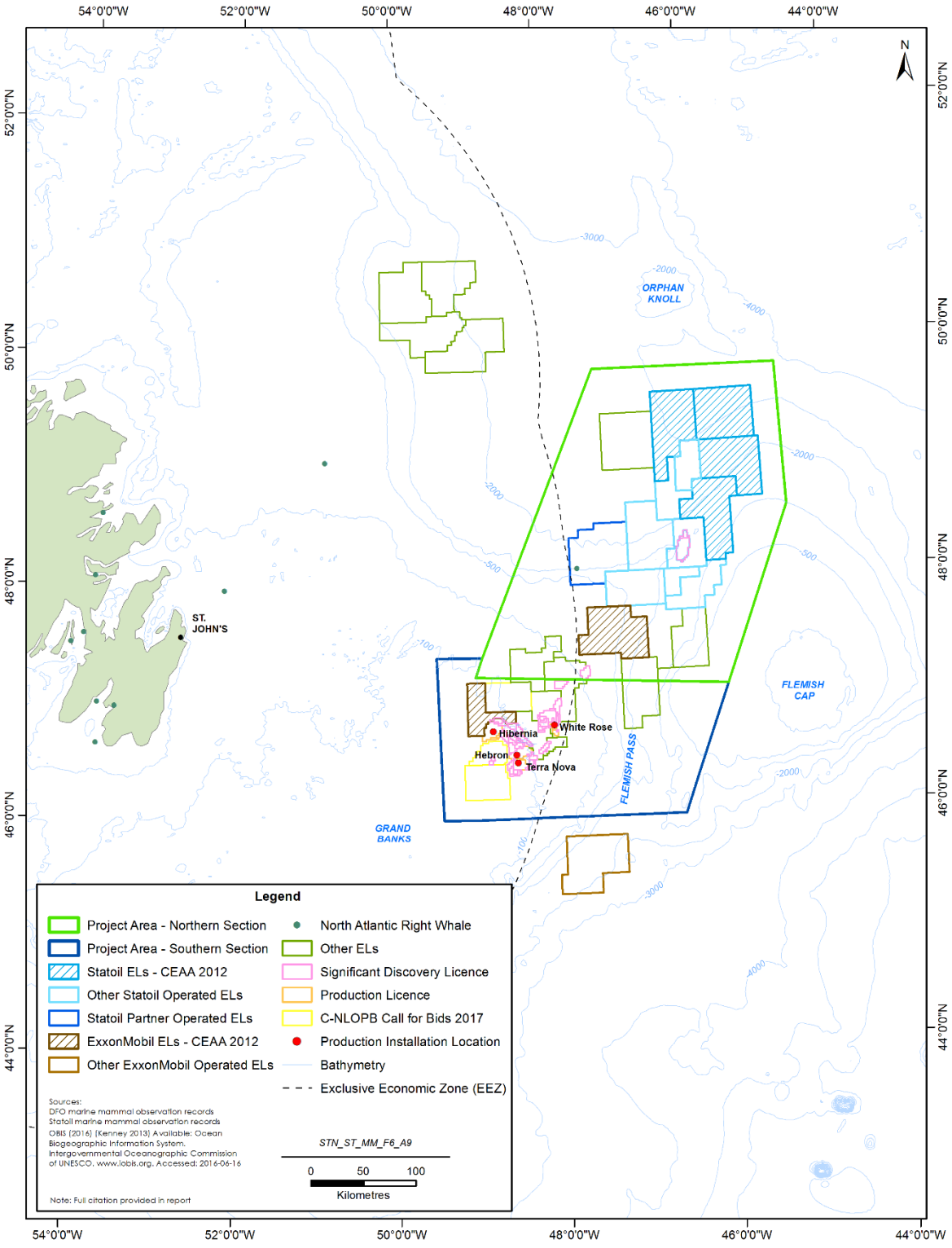


Figure 6-92 North Atlantic Right Whale Sightings in Eastern NL Offshore Area

6.3.7.1.8 Northern Bottlenose Whale

Northern bottlenose whales are found only in the North Atlantic. In Canada, northern bottlenose whales regularly occur in two locations: along the Scotian Shelf; and in the Davis Strait (DFO 2016b). The Scotian Shelf population is listed as endangered by both SARA (Schedule 1) and COSEWIC. The Davis Strait-Baffin Bay-Labrador Sea population is listed as special concern by COSEWIC but is not listed under SARA. Critical habitat for the Scotian Shelf population has been defined and includes the Gully, Shortland, and Haldimand submarine canyons, located at the edge of the eastern Scotian Shelf (DFO 2016b). Northern bottlenose whales are primarily found in offshore waters deeper than 500 m, often near the 1,000 m isobath (DFO 2016b). They are excellent divers; a tagged whale was recorded diving to 1,453 m, and they can remain underwater for up to two hours (DFO 2016b). The species mainly feeds on squid, which typically dwell at or near the bottom (DFO 2016b).

The Scotian Shelf population is estimated to be 164 individuals, but there are no estimates of the size of the Davis Strait-Baffin Bay-Labrador Sea population or for the total number of northern bottlenose whales in the Northwest Atlantic (COSEWIC 2011). During the 2007 TNASS survey, 42 northern bottlenose whales were observed in Newfoundland waters (Lawson and Gosselin 2009).

While the Scotian Shelf population does not appear to migrate, the movements of the Davis Strait-Baffin Bay population have not been studied (COSEWIC 2011). There is some evidence that northern bottlenose whales are also found on the edge of the Grand Banks near the Flemish Cap, although it is unclear whether these individuals are from the Scotian Shelf or Davis Strait-Baffin Bay-Labrador Sea populations, or if they are part of a previously unrecognized population unit (DFO 2016b). There have been recent sightings (2015 and 2016) in the Sackville Spur area of the Flemish Pass and, as reported in a recent news article, a survey team from Dalhousie University observed 50-200 individuals along the continental shelf near the Flemish Cap in the summer of 2016 (CBC 2016). Northern bottlenose whale clicks have been detected in the Flemish Pass between June and September (the extent of the recording period) (Appendix F).

The main threats facing northern bottlenose whales include entanglement in fishing gear, oil and gas activities, and acoustic disturbance (COSEWIC 2011; DFO 2016b). There are also concerns around the levels of contaminants in whale tissues, which may be related to oil and gas development activities, vessel strikes, and changes to food supply (COSEWIC 2011; DFO 2016b).

Northern bottlenose whales have been recorded in the DFO, OBIS and Statoil marine mammal observation records both in and beyond the Project Area (Table 6.41 and Figure 6-93).

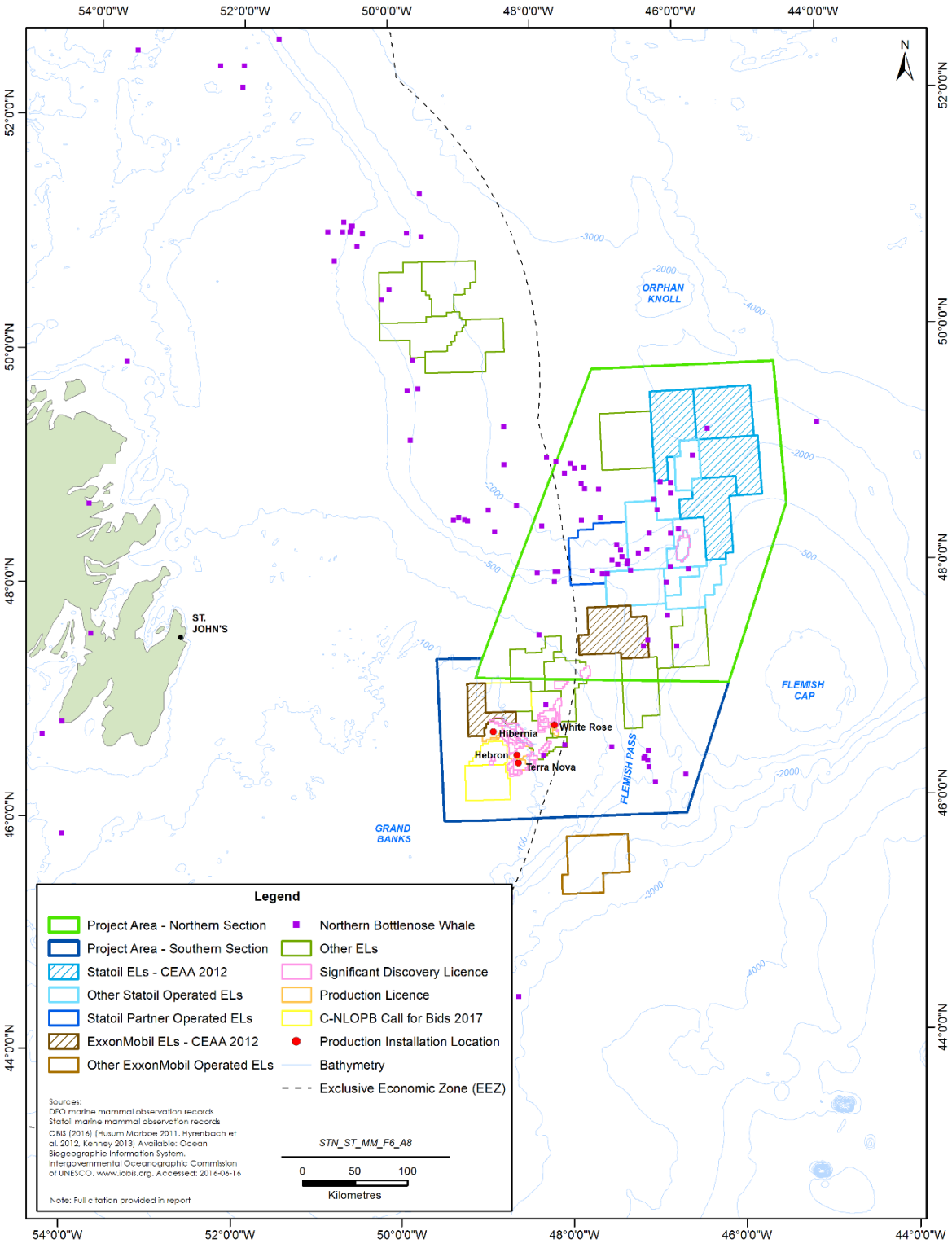


Figure 6-93 Northern Bottlenose Whale Sightings in Eastern NL Offshore Area

6.3.7.1.9 Sowerby's Beaked Whale

Sowerby's beaked whale is found exclusively in the North Atlantic. The species is listed as a species of special concern under SARA (Schedule 1) and COSEWIC. In the northwestern Atlantic, they are thought to occur as far north as the Davis Strait, although they are most frequently observed in the waters off Newfoundland, Nova Scotia, and the northeastern United States (DFO 2016c). Little is known of this species' habitat preferences and life history requirements. Sowerby's beaked whale is most often observed in deep water (>200 m) along the continental shelf edge and slope (COSEWIC 2007b; DFO 2016c). Submarine canyons appear to be of importance to this species and they demonstrate a strong affinity for canyon habitats along the Scotian shelf (DFO 2016c). Stomach content and isotope analyses indicate that the diet of Sowerby's beaked whale consists of squid and fish occurring in between 200 and 2,000 m depth (DFO 2016c). There is currently no population estimate for this species in Canada (DFO 2016c). There were no observations of Sowerby's beaked whale in the 2007 TNASS survey in Newfoundland waters (Lawson and Gosselin 2009). Threats to the species include acoustic disturbance, entanglement in fishing gear, vessel strikes, and exposure to contaminants (COSEWIC 2007b; DFO 2016c), Both impulsive (e.g., mid-frequency sonar, underwater explosions, and geophysical exploration) and continuous (e.g., vessel noise and drilling) noise sources are considered threats to Sowerby's beaked whale (DFO 2016c).

Sightings records for this species were rare in the DFO, OBIS and Statoil marine mammal dataset, with only one record in the Northern Section of the Project Area (Table 6.41; Figure 6-94). There were an additional four sightings in the Project Area of beaked whales that could not be identified to species (two in the Northern Section and two in the Southern Section; Figure 6-72).

6.3.7.1.10 Leatherback Sea Turtle

The Atlantic population of leatherback sea turtles is listed as endangered by both SARA (Schedule 1) and COSEWIC. Leatherback sea turtles are the largest species of sea turtle and the most likely to be observed in the eastern Newfoundland offshore area. They are a pelagic, migratory species that tend to inhabit temperate oceanic and coastal shelf waters, where they forage on jellyfish between April and December (COSEWIC 2012b). This species does not nest in Canada, but rather, nesting occurs on tropical and subtropical beaches during the spring (COSEWIC 2012b). In Atlantic Canada, leatherback sea turtles occur in both coastal and offshore waters, although most sightings are from the continental shelf (COSEWIC 2012b).

As of 2006, there were an estimated 34,000 - 94,000 adult leatherback sea turtles throughout the North Atlantic (TEWG 2007). While the size of the seasonal foraging population in Atlantic Canada is not known, sightings data suggest that the population in Canadian Atlantic waters numbers in the thousands (COSEWIC 2012b). The main threat facing leatherback sea turtles in Canadian waters is bycatch in fisheries, although globally, the species is threatened by ship strikes, marine debris and oil and gas exploration (COSEWIC 2012b).

Leatherback sea turtles were regularly recorded in the eastern Newfoundland offshore area in DFO, OBIS and Statoil observation records, although there was only one sighting of this species in the Project Area - Southern Section) (Table 6.41) and a few sightings in the region beyond the Project Area (Figure 6-84).

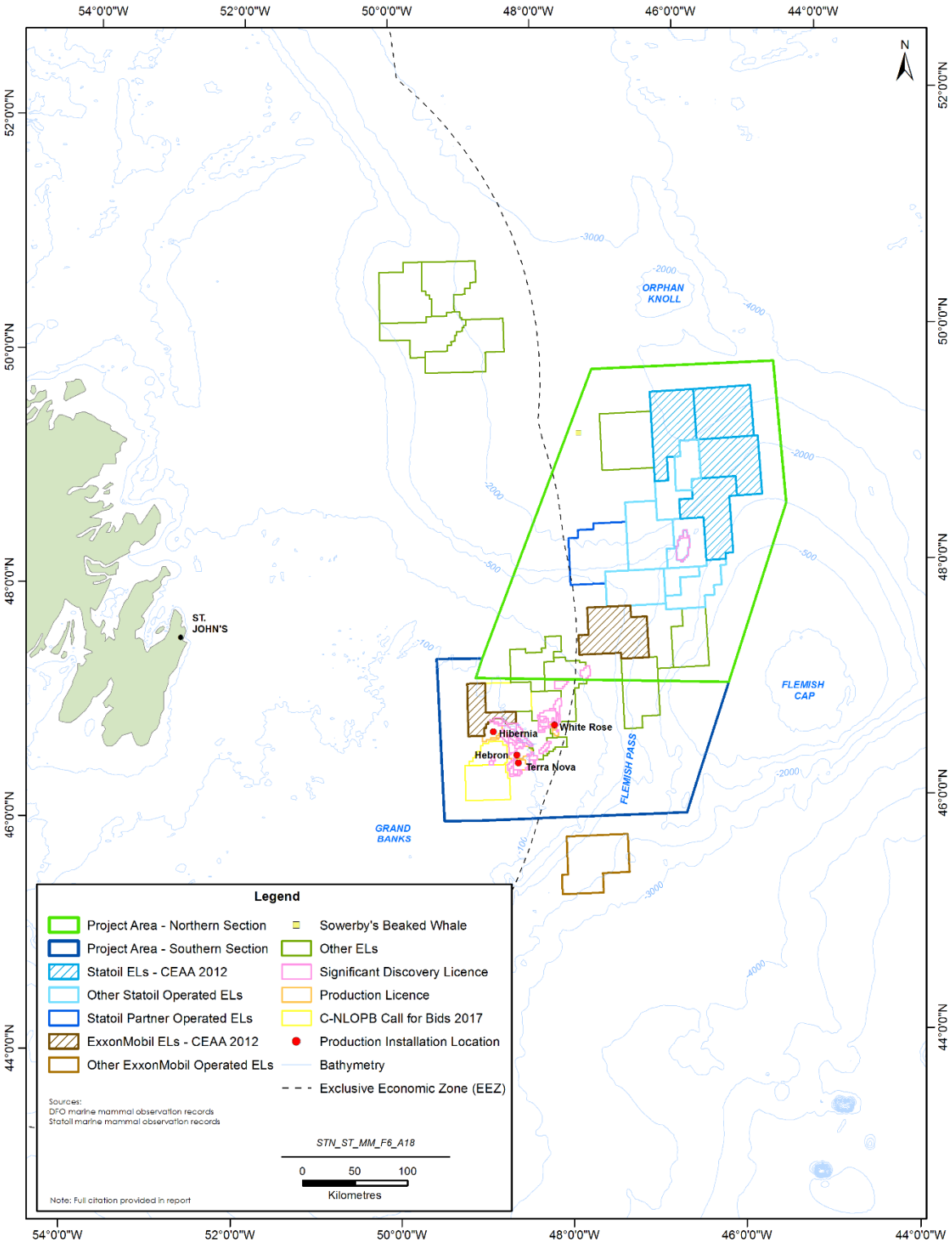


Figure 6-94 Sowerby's Beaked Whale Sightings in Eastern NL Offshore Area

6.3.7.1.11 Loggerhead Sea Turtle

Loggerhead sea turtles are designated as Endangered under SARA, and COSEWIC (Species at Risk Public Registry 2017). Loggerhead sea turtles do not nest in Canada but undertake a spring migration to Atlantic Canadian waters where they forage in the summer and fall, before returning south for the winter breeding season. Nesting sites in the northwest Atlantic are found from Virginia, down into the Caribbean, with the largest breeding colony in North America located in Florida (TEWG 2009). Loggerhead sea turtles in Atlantic Canada are generally associated with the warm waters (20°C-25°C) of the Gulf Stream and are concentrated in offshore areas along the Scotian Shelf, Georges Bank, and the Grand Banks from July through October (Brazner and McMilan 2008). These are likely individuals from the same nesting populations as those found in the northern limits of the United States' waters (COSEWIC 2010d). Incidental captures of loggerhead sea turtles (n=701) were reported by the Canadian Atlantic pelagic longline fleet between 1999 and 2006. Despite considerable observer coverage in the area, none of these sightings occurred northeast of the Grand Banks (Brazner and McMilan 2008), including in the RSA. It has been determined that this species has a strong presence in Canadian waters based on incidental bycatch records, but the size of the population is not known (COSEWIC 2010d).

Loggerhead sea turtles were rarely recorded in the eastern Newfoundland offshore area in DFO, OBIS and Statoil data. There were two sighting of this species in the Southern Section of the Project Area and none in the Northern Section (Table 6.41 and Figure 6-84).

6.3.8 Summary of Key Areas and Times

An overview of key areas and times for marine mammals and sea turtles off eastern Newfoundland was developed and presented in the Eastern Newfoundland SEA (Section 4.2.3.6; Amec 2014a). An overview of Special Areas, including Ecologically and Biologically Significant Areas (EBSAs) that have been identified as important to marine mammals and sea turtles, is presented in Section 6.4 of this EIS, and is summarized below in Table 6.42 along with a preliminary RMA. No critical habitat for marine mammals or sea turtles has been designated in or near the Project Area. The Northeast Shelf and Slope EBSA (see Section 6.4.2.1) overlaps with the Project Area – Northern Section and has been noted as having concentrations of cetaceans and pinnipeds (phocids). With respect to their relevance to marine mammals and sea turtles, most EBSAs and the RMA in the region (Table 6.42) serve as feeding aggregation areas, with some of the coastally located ones also providing migration corridors or breeding and whelping areas for seals.

Table 6.42 Proximity of Ecologically and Biologically Significant Areas off Eastern Newfoundland and their Relevance to Marine Mammals and Sea Turtles

Special Areas	Name	Relevance / Importance to Marine Mammals or Sea Turtles	Area
EBSAs	Northeast Shelf and Slope	Concentrations of cetaceans and pinnipeds.	13,885 km²
	Lilly Canyon-Carson Canyon	Aggregation and refuge / overwintering area for cetaceans and pinnipeds.	1,145 km²
	Eastern Avalon Coast	Cetaceans, leatherback sea turtles and seals feed in the area from spring to fall.	1,683 km²
	Southeast Shoal and Tail of the Banks	Highest benthic biomass in the Grand Banks; aggregation and feeding habitat for cetaceans.	30,935 km²
	Notre Dame Channel	Recognized for cetacean feeding and migration. Harp seals feed in the area during winter.	6,222 km²
	Fogo Shelf	Important cetacean feeding areas. Several areas of marine mammal presence.	9,403 km²
	Placentia Bay Extension	High level of biodiversity. Supports a high biomass of marine mammals. High aggregation of cetaceans and leatherback sea turtles in the spring and summer. Harbour seals use area year-round. Important feeding area from spring to fall for many cetaceans (especially humpback whales and porpoises). Important for reproduction of harbour seals. Possible migratory path for leatherback sea turtles.	7,693 km²
	Southwest Shelf Edge and Slope	Many marine mammals and leatherback sea turtles aggregate here in summer.	16,644 km²
	Labrador Marginal Trough	Potential corridor for several marine mammal species. Part of the highest probability of use for harp seal whelping and feeding. Aggregations of cetaceans in summer and fall.	16,952 km²
	St. Pierre Bank	Feeding areas for cetaceans.	5,482 km²
	Laurentian Channel and Slope	Used by cetaceans moving in and out of the Gulf of St. Lawrence.	17,140 km²
	Hamilton Inlet	Harp seals whelp on pack ice in the area. Fall and winter feeding area for ringed seals.	11,038 km²
	Southern Pack Ice	Seasonal pack ice is recognized for its importance to marine mammals.	N/A
Preliminary RMA	South Grand Bank Area	Feeding area for aggregations of cetaceans and leatherback turtles. Area overlaps with Southeast Shoal and Tail of the Banks EBSA.	18,201 km²
Sources: Templeman (2007); CPAWS (2009); DFO (2013, 2016a); AFW (2014)			

Baleen whale species expected to be most common off eastern Newfoundland include humpback whales, fin whales, and minke whales. Small toothed whale species are expected to occur in both coastal and offshore waters, while sperm whale sightings are more likely to be associated with the continental slope. Harbour seals are concentrated primarily in coastal areas, while the other three species of phocids are more widespread and can be found in deeper waters when not breeding or whelping on land or pack ice. Leatherback sea turtles are considered most likely to be observed over the continental slope areas off the Grand Banks and south of the Flemish Cap. The likelihood of loggerhead, green, and Kemp's ridley sea turtles occurring in the Project Area is considered low.

With respect to overall timing of presence, multiple species of baleen and toothed whales can be found in the waters off eastern Newfoundland year-round, while others are more typically observed during the summer and early fall, feeding and socializing in the highly productive waters of the Grand Banks, the Flemish Pass, and surrounding waters. In fall/winter, some of the species present migrate south to their breeding and wintering grounds, which are generally located in more tropical / sub-tropical latitudes. However, some species, and males that do not travel south to breed, have the potential to be found in the area year-round. Phocid species can be found here during the winter and early spring months, with grey, harp and harbour seals having the potential to be found year-round. Sea turtles are expected to be found in their highest numbers during the summer and fall. A summary of key timing for marine mammals and sea turtles offshore eastern Newfoundland is presented in Tables 6.43 and 6.44, respectively.

Table 6.43 Potential Marine Mammal Presence off Eastern Newfoundland

Common Name	January	February	March	April	May	June	July	August	September	October	November	December
Mysticetes (Baleen Whales)												
Blue whale												
Bowhead whale												
Fin whale												
Humpback whale												
Minke whale												
North Atlantic right whale												
Sei whale												
Odontocetes (Toothed Whales)												
Atlantic spotted dolphin												
Atlantic white-sided dolphin												
Beluga whale												
Common bottlenose dolphin												
False killer whale												
Harbour porpoise												
Killer whale												
Long-finned pilot whale												
Northern bottlenose whale												
Risso's Dolphin												

Table 6.43 Potential Marine Mammal Presence off Eastern Newfoundland

Common Name	January	February	March	April	May	June	July	August	September	October	November	December
Short-beaked common dolphin												
Sowerby's beaked whale												
Sperm whale												
Spinner dolphin												
Striped dolphin												
White-beaked dolphin												
Phocids (Seals)												
Grey Seal												
Harbour Seal												
Harp Seal												
Hooded Seal												

Notes:
Red-filled cells indicate month(s) when marine mammals are likely to occur at their highest density
Pink-filled cells indicate month(s) when marine mammals may be present
Blank cells indicate unlikely species occurrence
Gray-filled cells indicate month(s) when marine mammal occurrence is not known
Source: Modified from Husky Energy (2012), Amec (2014a), and BP (2016)

Table 6.44 Potential Sea Turtle Presence off Eastern Newfoundland

Common Name	January	February	March	April	May	June	July	August	September	October	November	December
Sea Turtles												
Green sea turtle												
Leatherback sea turtle					x	x	x	x	x			
Loggerhead sea turtle					x	x	x					
Kemp's ridley turtle												

Notes:
Red-filled cells indicate month(s) when sea turtles will occur at their highest density
Pink-filled cells indicate month(s) when sea turtles may be present
X indicates month(s) with sightings
Source: Modified from Husky Energy (2012), Amec (2014a), and BP (2016)

6.4 Special Areas

A number of marine and coastal areas in Newfoundland and Labrador have been designated as protected under provincial, federal and/or other legislation or agreements due to their ecological, historical or socio-cultural characteristics and importance. Other areas have been formally identified as being special or sensitive through relevant processes and initiatives. Previous sections of this chapter have presented a description of the existing physical and biological environmental setting, including marine fish and fish habitat, marine and migratory birds and marine mammals and sea turtles (including species at risk). This section identifies and describes any associated special areas within the Project Area and potential vessel and aircraft traffic routes, which in many cases have been identified because of their ecological characteristics, importance and value, as well as associated marine uses. In addition to focussing primarily on the northern and southern sections of the Project Area, it provides a general overview of identified special areas within the Eastern Newfoundland Offshore Area (including the Project Area and beyond), to provide overall context, and to illustrate the general proximity of the Project to these areas in the larger surrounding environment.

6.4.1 Approach and Key Information Sources

In describing special areas in eastern Newfoundland marine and coastal areas, a key source of information and the starting point for this current study was the Eastern Newfoundland SEA prepared for the C-NLOPB in 2014 (Amec 2014a). As part of this EIS, a literature review to obtain any new or updated information on these or subsequently designated special areas in eastern Newfoundland was also undertaken. Relevant data and information were obtained from federal and provincial regulatory bodies and other organizations that identify and/or administer such special areas in coastal and marine environments. A summary of these sources and relevant documents that provided key information and data on special areas in the marine environment off eastern Newfoundland is provided in Table 6.45.

Table 6.45 Some Key Information Sources Used to Describe Special Areas

Information Source	Relevant Studies and Documents
Amec 2014a	Eastern Newfoundland SEA, 2014
DFO	Identification of Ecologically and Biologically Significant Areas, 2005
DFO	Northern Shrimp (Shrimp Fishing Areas 0-7 and the Flemish Cap): Resource Management Operations, 2007
DFO	Identification of Additional Ecologically and Biologically Significant Areas (EBSAs) within the Newfoundland and Labrador Shelves Bioregion, 2013
DFO	Eastport Marine Protected Area (MPA) Case Study in Support of Ecosystems Goods and Services Valuation, 2014
DFO	Marine Protected Areas and Areas of Interest, 2016
DFO	Refinement of Information Relating to Ecologically and Biologically Significant Areas (EBSAs) identified in the Newfoundland and Labrador (NL) Bioregion, 2016

Table 6.45 Some Key Information Sources Used to Describe Special Areas

Information Source	Relevant Studies and Documents
Templeman, N.D. (DFO)	Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas, 2007
Parks Canada	National Marine Conservation Areas, 2017
Government of Canada	National Framework for Canada's Network of Marine Protected Areas, 2011
Environment and Climate Change Canada	Protected Areas, 2016
Department of Municipal Affairs and Environment	Wilderness and Ecological Reserves, 2016
FAO	VMEs Database, 2016
NAFO	NAFO Fishing Closures, 2015
NAFO	NAFO Strengthens its Protection Measures for Habitats and Species in the Northwest Atlantic, 2016
NAFO	Northwest Atlantic Fisheries Organization Conservation and Enforcement Measures 2016, 2016
NAFO	38th Annual Meeting – September 2016: Establishment of an Additional Area Closure to Protect VMEs in the NAFO Regulatory Area, 2016
NAFO	Northwest Atlantic Fisheries Organization Conservation and Enforcement Measures 2017, 2017
WG-EAFM	Report of the NAFO Joint Fisheries Commission-Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management. 26-30 May 2008. Dartmouth, Nova Scotia. NAFO SCS Doc. 08/10. Serial No. N5511, 2008
WG-EAFM	Report of the NAFO Joint Fisheries Commission-Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management. 10-12 August 2016. Halifax, Nova Scotia. NAFO FC-SC Doc. 16/03 Revised. Serial No. N6612, 2016
WWF	NAFO Supplement #2: VMEs, 2012
Fuller, S. and R. Myers (WWF)	The Southern Grand Bank: A Marine Protected Area for the World, 2004
IBA Canada	Important Bird Areas in Canada, 2016
Anuradha R., L.A. Outhouse and D. Gregory (CPAWS)	Special Marine Areas in Newfoundland & Labrador: Areas of Interest in our Marine Backyards, 2009
EMPAAC	Eastport Marine Protected Areas Management Plan, 2013
PB / GB LOMA	Placentia Bay/Grand Banks Large Ocean Management Area Integrated Management Plan (2012-2017), 2012

A general overview of the Project Area (Northern and Southern Sections), potential vessel and aircraft traffic routes, and a number of key types of special areas relevant to the Project Area off eastern Newfoundland is provided below in Figure 6-95 for general reference. More specific and detailed information and mapping for each type of special area is provided in the subsections that follow.

6.4.2 Canadian Designations and their Management

In Canada, various pieces of legislation and other processes are used to protect and conserve marine ecosystems. The following sections discuss Canada's management framework and specific measures used to identify and protect special sites in marine and coastal areas.

6.4.2.1 Bioregions and Large Ocean Management Areas

DFO (2002) outlines the federal government's approach to marine conservation through integrated resource management. Fisheries and Oceans Canada (DFO) has defined 13 Bioregions based on oceanographic and bathymetric similarities as important factors in defining marine habitats and as the ecological base for ocean management decisions (DFO 2002; Government of Canada 2011). Newfoundland and Labrador is included within two of these bioregions: 1) the Gulf of St Lawrence and 2) the Newfoundland and Labrador Shelves (Figure 6-96).

Within Canada's marine bioregions, DFO has identified five priority Large Ocean Management Areas (LOMAs) that exhibit important living and non-living marine resources, areas of high biological diversity and productivity combined with increasing development pressures and competition for ocean space and resources. Conservation strategies in these areas involve an integrated planning approach from all levels of government, Indigenous groups, industry organizations, environmental and community groups, and academia (DFO 2002).

Eastern and southern Newfoundland are included within the Placentia Bay/Grand Banks (PBGB-LOMA, which includes more than 500,000 km² of nearshore and offshore areas of the Grand Banks (Government of Canada 2011). The PBGB-LOMA Secretariat includes representatives of provincial and federal government departments and agencies, Indigenous groups and stakeholders such as coastal communities, which have regulatory or economic interests within the PBGB-LOMA. This group has prepared an integrated management plan that addresses ecological, social, cultural, and economic considerations with regard to resource use within the area (PBGB-LOMA Secretariat 2012). Portions of the Newfoundland and Labrador Shelves and the PBGB-LOMA overlap with the Project Area (Northern and Southern Sections), the potential vessel and aircraft traffic routes, and the surrounding region (Figure 6-96).

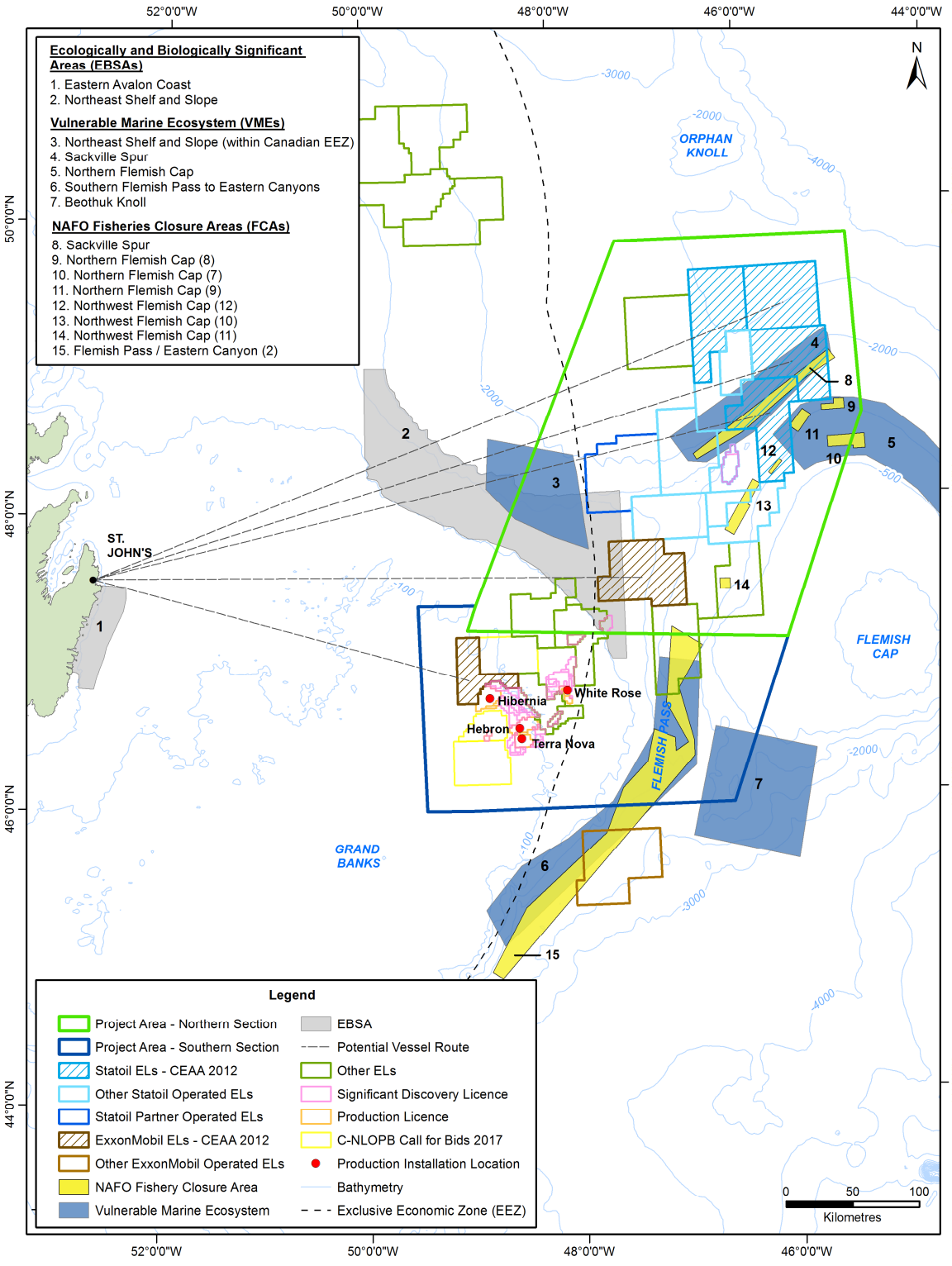


Figure 6-95 Initial Overview of the Project Area, Potential Vessel and Aircraft Traffic Routes and Some Key Special Areas off Eastern Newfoundland

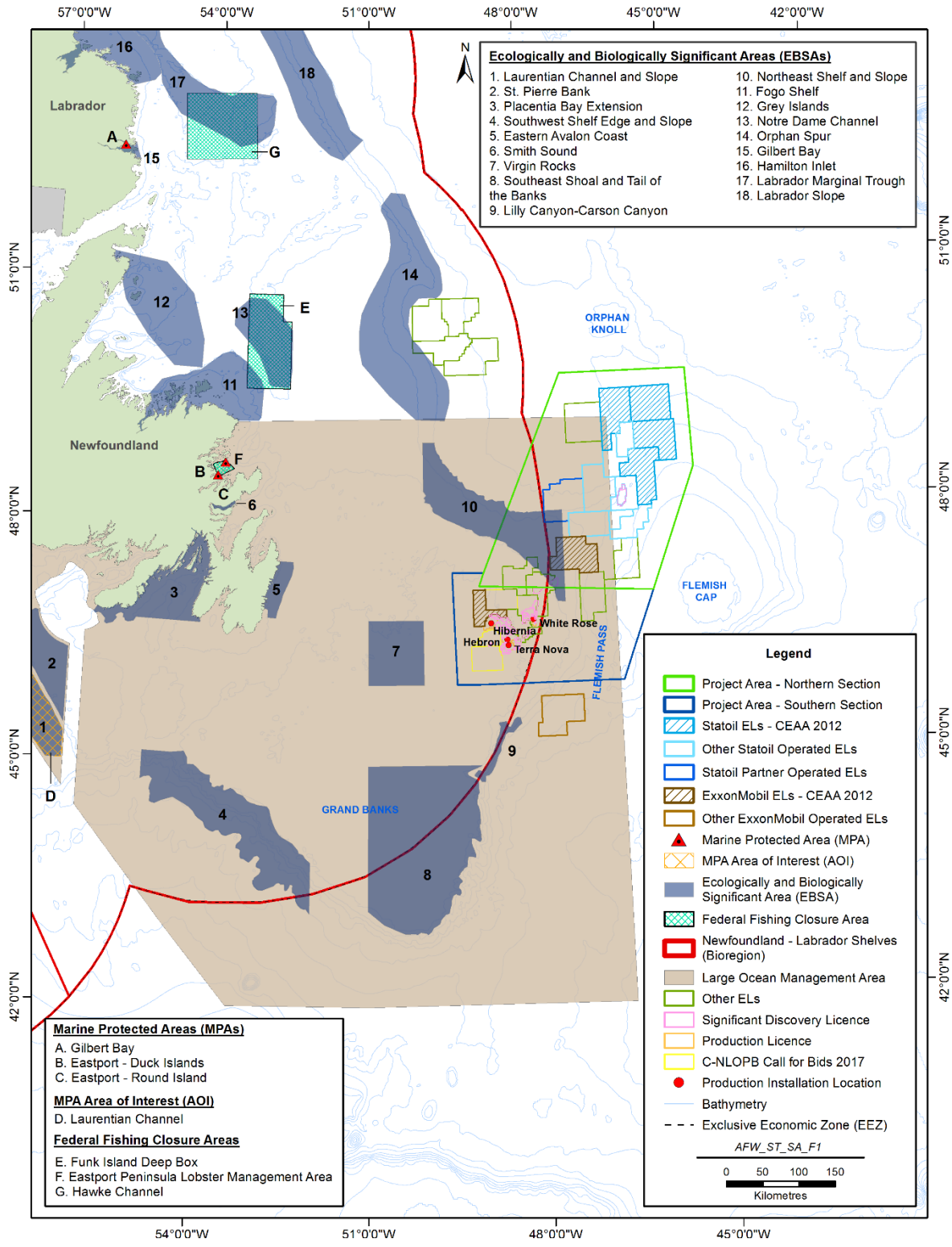


Figure 6-96 Canadian Marine Protected Areas, Federal Fisheries Closure Areas and Ecologically and Biologically Significant Areas

6.4.2.2 Marine Protected Areas and Areas of Interest

Through Canada's *Oceans Act,* DFO is mandated with establishing a network of Marine Protected Areas (MPAs) in Canada. An MPA designation provides protection for marine ecosystems and their resources in areas that are ecologically important, and which contain species and/or properties that require special consideration. The first step in MPA establishment is the identification of Areas of Interest (AOI), which then undergo detailed evaluation and public consultation before a decision is made concerning formal designation (DFO 2016e).

Several MPAs are located in coastal waters off Newfoundland (Bonavista Bay) and Labrador (Gilbert Bay) (Table 6.46; Figure 6-96). In June 2017, the Government of Canada announced a 30-day consultation period on the proposed Laurentian Channel Marine Protected Area Regulations for the Laurentian Channel AOI off the south coast of Newfoundland. Certain activities are prohibited within the Newfoundland and Labrador MPAs including: disturbing, damaging, destroying or removing living organisms or habitat; or depositing, discharging or dumping substances that may have the same result (DFO 2016e). Within the proposed Laurentian Channel Marine Protected Area, certain oil and gas activities (including exploration and production) would be allowed within specified areas and prohibited during sensitive foraging periods for leatherback sea turtles and mating periods for porbeagle sharks (DFO 2017).

Table 6.46 Marine Protected Areas in Newfoundland and Labrador

MPA	Rationale for Identification / Designation	Area
Eastport-Duck Islands MPA	Established in 2005 to limit fishing with an aim to provide a viable American lobster population and to protect other threatened or endangered species.	2.1 km² on 2 islands
Eastport-Round Island MPA		
Gilbert Bay MPA	Established in 2005 to conserve one of the few coastal concentrations of northern cod in the Newfoundland region and to indirectly protect other species and habitats.	60 km²
Laurentian Channel AOI	Designated as an AOI in 2010. Highest concentration of black dogfish and only pupping area in Canadian waters. Important spawning, nursing and feeding area for variety of species including porbeagle shark, and smooth skate. Critical migration route for marine mammals moving in and out of Gulf of St. Lawrence. Two SAR (i.e., northern wolffish and leatherback sea turtle) found in area. One of the highest concentrations of sea pens (soft feather-shaped corals) in the Newfoundland and Labrador Shelves Bioregion.	11,619 km²
Source: EMPAAC (2013); DFO (2016e, 2017)		

6.4.2.2.1 Project Area - Northern Section

The Eastport-Duck Islands MPA and Eastport-Round Island MPA are located in Bonavista Bay. Gilbert Bay MPA is located in Labrador (Figure 6-96). The MPAs are not within or near the Project Area (Northern Section). The Laurentian channel is also not within or near the Project Area.

6.4.2.2.2 Project Area - Southern Section

The Newfoundland and Labrador MPAs and AOI are located in coastal areas of Newfoundland and Labrador (Figure 6-96). These are also all distant from the Project Area - Southern Section.

6.4.2.2.3 Potential Vessel and Aircraft Traffic Routes

The potential vessel and aircraft traffic routes from the Project Area access the Port of St. John's (Figure 6-96). They do not intersect with coastal waters where the MPAs or AOI are located.

6.4.2.3 Fisheries Closure Areas within Canada's Exclusive Economic Zone

A number of areas off eastern Newfoundland and Labrador have been closed to certain types of fishing activities to help conserve productive fish and shellfish habitat for commercially fished species. Lobster fishing is limited in the Eastport Peninsula Lobster Management Area in Bonavista Bay through the *Fisheries Act*, in addition to the two portions of the area designated as MPAs under the *Oceans Act* (EMPACC 2013). An area of the Hawke Channel off Labrador is protected under the *Fisheries Act* as a no-trawl/no-gillnetting study area. An area of the Funk Island Deep off eastern Newfoundland is closed to gillnetting and small vessel bottom trawling under the *Fisheries Act* and voluntarily closed, by the fishing industry, to the large vessel shrimp fleet. The fishing industry and/or DFO are engaged in research and monitoring activities in these areas (DFO 2007). Two of the fisheries closure areas are located in coastal and nearshore areas of eastern Newfoundland (Table 6.47; Figure 6-96). Aside from the noted fishing restrictions, no other resource extraction activities are prohibited in these areas with the exception of within the MPAs, as noted previously.

Table 6.47 Federal Fisheries Closure Areas off Eastern Newfoundland

Closure Area	Rationale for Identification/Designation	Area
Eastport Peninsula Lobster Management Area	In 1995, Eastport Peninsula lobster fishers voluntarily limited lobster fishing in an area of Bonavista Bay to protect prime lobster habitat. In 1997, DFO provided protection through the *Fisheries Act* and designated two portions of the area as MPAs under the *Oceans Act*.	400 km²
Funk Island Deep Box	In 2002, DFO closed (through the *Fisheries Act*) an area of the Funk Island Deep to gillnetting to protect bottom habitat. DFO also closed the area to small vessel bottom trawling in 2005. The fishing industry has voluntarily closed the area to the large vessel shrimp fleet.	7,272 km²
Hawke Box	In 2002 at the request of local fishers, DFO closed a portion of the Hawke Channel to trawling and gillnetting (under the *Fisheries Act*) and expanded the area in 2003. The area remained open to seasonal snow crab pot fishing. Closure was a precautionary measure primarily to sustain the crab fishery and secondarily to conserve cod known to aggregate there.	8,610 km²
Source: DFO (2007, 2014b); EMPAAC (2013)		

6.4.2.3.1 Project Area - Northern Section

The Eastport Peninsula Lobster Management Area is found in a coastal area that surrounds the Eastport Peninsula between Terra Nova National Park and Alexander Bay. The Funk Island Deep Box is located off the northeast coast of Newfoundland, east of Fogo Island. Neither of these sites are within or near the Project Area - Northern Section (Figure 6-96).

6.4.2.3.2 Project Area - Southern Section

The federal fisheries closure areas off eastern Newfoundland are located in coastal and nearshore areas (Figure 6-96). As the Project Area - Southern Section is within offshore waters, these areas do not intersect.

6.4.2.3.3 Potential Vessel and Aircraft Traffic Routes

The potential vessel and aircraft traffic routes are anticipated to provide direct transport between offshore areas and St. John's (Figure 6-96). They do not cross either of these federal fisheries closure areas.

6.4.2.4 Ecologically and Biologically Significant Areas

DFO identifies Ecologically and Biologically Significant Areas (EBSAs) to provide a focus on marine areas with high ecological or biological activity (DFO 2005). Identification as an EBSA does not designate an area as protected, but rather provides information for processes that may eventually lead to protection or other management measures. Eleven EBSAs have been identified within the PBGB-LOMA through a ranking process using criteria of fitness consequence, aggregations, uniqueness, naturalness and resilience (Templeman 2007). In addition, 15 EBSAs have been identified in the Newfoundland and Labrador Shelves Bioregion outside of the PBGB-LOMA (DFO 2013). A number of EBSAs are located in marine and coastal areas of eastern Newfoundland (Table 6.48; Figure 6-96).

Table 6.48 Ecologically and Biologically Significant Areas off Eastern Newfoundland

EBSA	Rationale for Identification/Designation	Area
Northeast Shelf and Slope	High aggregations of Greenland halibut and spotted wolfish, which congregate in spring. Concentrations of cetaceans, pinnipeds and corals.	13,885 km²
Virgin Rocks	High aggregations of capelin and other spawning groundfish such as Atlantic cod, American plaice and yellowtail flounder. Seabird feeding areas. Unique geological features and habitat.	6,843 km²
Orphan Spur	High concentrations of corals. Densities of sharks and species of conservation concern (e.g., northern, spotted and striped wolffish, skates, roundnose grenadier, American plaice, redfish).	21,569 km²

Table 6.48 Ecologically and Biologically Significant Areas off Eastern Newfoundland

EBSA	Rationale for Identification/Designation	Area
Lilly Canyon-Carson Canyon	Concentration, reproduction and feeding area for Iceland scallop. Aggregation and refuge/overwintering for cetaceans and pinnipeds.	1,145 km²
Eastern Avalon Coast	Seabird feeding areas. Cetaceans, leatherback turtles and seals feed in the area from spring to fall.	1,683 km²
Southeast Shoal and Tail of the Banks	Highest benthic biomass in the Grand Banks; aggregation, feeding, breeding and/or nursery habitats for capelin, yellowtail, cetaceans, seabirds, American plaice and Atlantic cod. Reproduction of striped wolffish. Unique populations of species. Unique sandy habitat with important glacial history.	30,935 km²
Notre Dame Channel	Recognized for cetacean feeding and migration. Frequented by several species of seabirds. Harp seals feed in the area during winter.	6,222 km²
Smith Sound	Atlantic cod use the area for spawning and nursery grounds and as an overwintering refuge.	148 km²
Fogo Shelf	Funk Island, the largest common murre colony in the western North Atlantic and the only northern gannet breeding colony in the Newfoundland and Labrador Shelves Bioregion. Other bird species aggregations. Abundance of beach and sub-tidal capelin spawning areas. Important cetacean feeding areas. Several areas of marine mammals' presence.	9,403 km²
Placentia Bay Extension	High level of biodiversity. Supports important seabird breeding areas and a high biomass of birds and mammals. High aggregation of cetaceans and leatherback sea turtles in the spring and summer. Otters and harbour seals use area year-round. Important feeding area from spring to fall for many seabird species and cetaceans (especially humpbacks and porpoises). Important for reproduction of many seabird species, harbour seals and otters. Possible migratory path for leatherback turtles.	7,693 km²
Labrador Slope	High diversity of corals, sponges, rare or endangered species, core species and fish functional groups. Rare or endangered species: Atlantic, spotted and northern wolffish. Significant concentrations of roundnose grenadier, skates, northern shrimp, Greenland halibut, redfish, Atlantic cod and American plaice.	29,746 km²
Southwest Shelf Edge and Slope	Critical to a wide variety of seabirds, providing the highest density of pelagic seabird feeding within the PBGB-LOMA. Many marine mammals and leatherback sea turtles aggregate in summer.	16,644 km²
Grey Islands	Important for waterfowl and seabirds in coastal areas and on the shelf. Common eider and harlequin duck occur in high concentrations. Important breeding colonies for great black-backed gulls, herring gulls and terns. High diversity of seabird species aggregate along the inner shelf area.	11,301 km²

Table 6.48 Ecologically and Biologically Significant Areas off Eastern Newfoundland

EBSA	Rationale for Identification/Designation	Area
Labrador Marginal Trough	Core fish species and various marine mammals. High densities of shrimp, snow crab, Greenland halibut, American plaice, witch flounder and capelin. Potential corridor for several fish and mammal species. Part of the highest probability of use for harp seal whelping and feeding. Aggregations of plank piscivores, and small and medium benthivores. Aggregations of cetaceans in summer and fall. Important for seabirds including murres, black-backed kittiwake, great black-backed gull, herring gull, northern fulmar, Atlantic puffin, skuas, jaegers, Sooty Shearwater and the endangered Ivory Gull.	16,952 km²
St. Pierre Bank	Highest and only concentration of sea scallops on the Grand Banks. High concentration of spiny dogfish and northern most extent of the species. Feeding areas for cetaceans.	5,482 km²
Laurentian Channel and Slope	The sole pupping grounds of black dogfish off Canada. Important juvenile/nursery area for smooth skates. Used by cetaceans moving in and out of the Gulf of St. Lawrence.	17,140 km²
Gilbert Bay	Important habitat of genetically distinct Gilbert Bay Atlantic cod species. An MPA was established in 2005. Habitat of Arctic charr and Atlantic salmon. Capelin spawning area.	359 km²
Hamilton Inlet	Habitat of capelin, Atlantic salmon and seabirds. Capelin spawning areas. Harp seal whelp on pack ice in the area. Fall and winter feeding area for ringed seals. Important area for a number of species of seabirds, waterfowl, gulls, and fulmars including species of special concern: the harlequin duck.	11,038 km²
Southern Pack Ice	Seasonal pack ice recognized for its importance to marine mammals and seabirds.	N/A
Source: Templeman (2007); DFO (2013, 2016e); AMEC (2014a)		

DFO has recently undertaken a process to revaluate the PBGB-LOMA EBSAs to align with the process that was used to delineate the Newfoundland and Labrador Shelves Bioregion EBSAs. An atlas of the 26 EBSAs, which compiles all spatial data that will be considered in the development of an MPA network, will be available in 2017 (K. Clarke, pers comm 2017; M. Abbott, pers comm 2016; DFO 2016e).

6.4.2.4.1 Project Area -Northern Section

Various EBSAs are located in deep ocean areas off Newfoundland and Labrador (Figure 6-96). The Northeast Shelf and Slope EBSA is located partially within the Project Area - Northern Section.

6.4.2.4.2 Project Area -Southern Section

Various EBSAs are located in offshore areas of eastern Newfoundland (Figure 6-96). A small portion of the Northeast Shelf and Slope EBSA intersects with the Project Area - Southern Section.

6.4.2.4.3 Potential Vessel and Aircraft Traffic Routes

Potential vessel and aircraft traffic routes have been identified for the Project Area (Figure 6-96). Project vessel traffic could potentially cross the Northeast Shelf and Slope EBSA and the Eastern Avalon Coast EBSA.

6.4.2.5 National Marine Conservation Areas and Preliminary Representative Marine Areas

Parks Canada establishes National Marine Conservation Areas (NMCAs), under the *Canada National Marine Conservation Areas Act,* as general marine areas managed for ecologically sustainable use and with specific zones of protection. NMCAs include the seabed, the water column above it and may also encompass wetlands, estuaries, islands and other coastal lands. Conservation is the principal goal of NMCA designation, but traditional fishing activities are permitted (Parks Canada 2013). Prohibited activities include exploration for and extraction of hydrocarbons, minerals, aggregates and other inorganic matter (Government of Canada 2015). The Saguenay-St. Lawrence Marine Park is the only NMCA on the Atlantic coast, but the Governments of Canada and Quebec have undertaken a study on creating an NMCA in Îles-de-la-Madeleine, Quebec (Parks Canada 2017). No NMCAs have yet been established in Newfoundland and Labrador or elsewhere in Atlantic Canada.

Parks Canada's long-term goal is to establish at least one national marine conservation area in each of its 29 Marine Regions that encompass all of Canada's coastlines: Pacific Ocean, Arctic Ocean, Great Lakes and Atlantic Ocean. To achieve this, the agency has begun a process of identifying preliminary Representative Marine Areas (RMAs). Along with scientific study, formal establishment is subject to consultations with governments, stakeholders and the public. Atlantic Canada has 10 marine regions including those that encompass the coast of Newfoundland and Labrador, including the Labrador Shelf, the Newfoundland Shelf, the Grand Banks, the Laurentian Channel and the North Gulf Shelf (Parks Canada 2017).

Eastern Newfoundland is encompassed by the Grand Banks Marine Region (GBMR) and the Newfoundland Shelf Marine Region. No NMCAs have been established in either of these regions. Several organizations have recommended protection of special biophysical features that support marine life and productive fisheries in the area of the Grand Banks (Fuller and Myers 2004; CPAWS 2009). Parks Canada has identified preliminary RMAs within the GBMR and these areas may coincide with special areas, such as provincial ecological reserves and EBSAs, identified through other processes (Figure 6-97; Table 6.49).

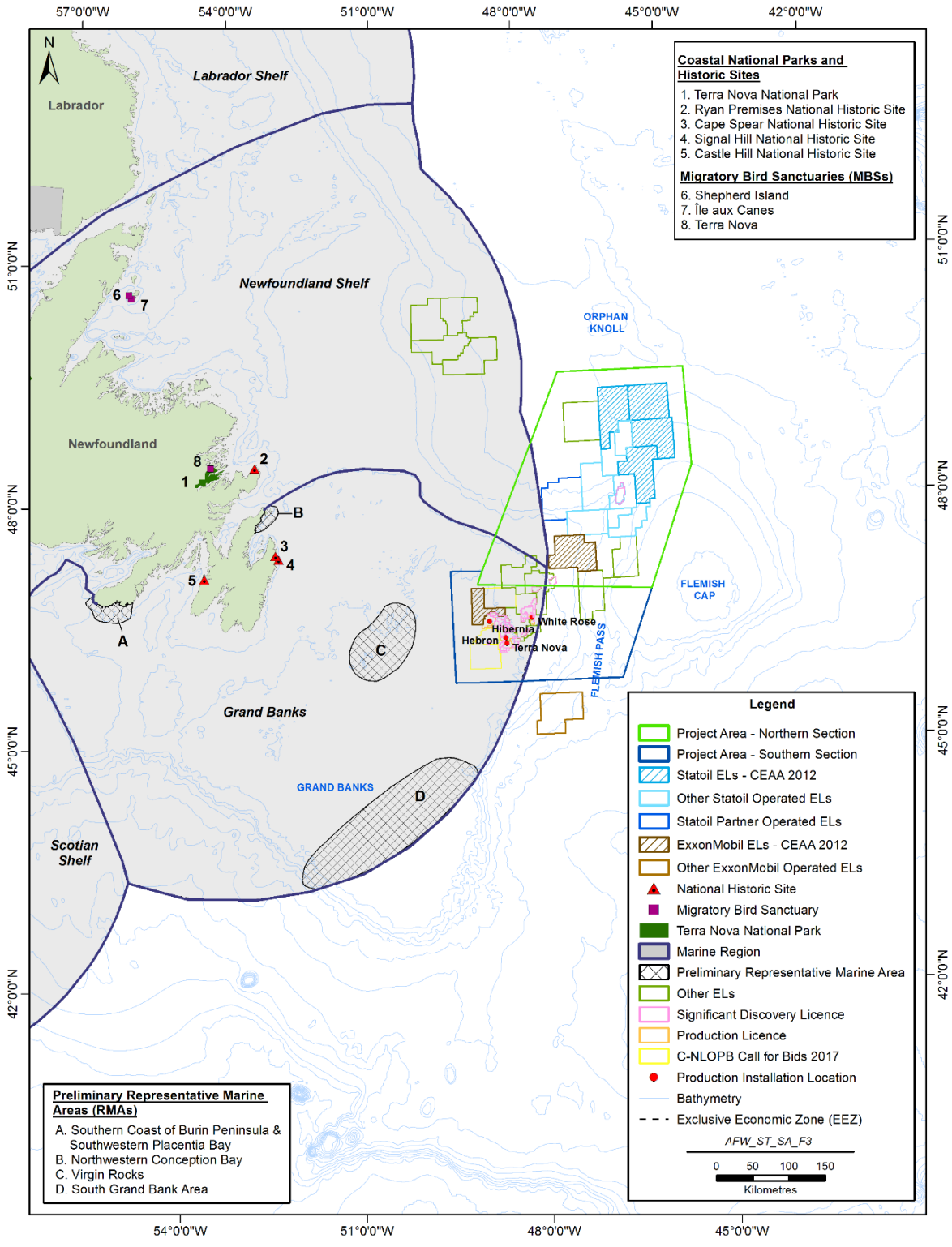


Figure 6-97 Federal Preliminary Representative Marine Areas, Migratory Bird Sanctuaries, National Parks and National Historic Sites

Table 6.49 Preliminary Representative Marine Areas off Eastern Newfoundland

Preliminary RMA	Rationale for Identification/Designation	Area
Virgin Rocks	Unique geological features and habitat within the PBGB-LOMA. Important spawning habitat for Atlantic cod, American plaice and yellowtail flounder. Congregation area for capelin. Congregation and feeding area for seabirds. Large winter colonies of common eiders. Area overlaps with Virgin Rocks EBSA.	6,740 km²
South Grand Bank Area	Relatively high coral species richness. High fish species richness. Significant groundfish biomass. Unique species biodiversity includes seabirds, Fea's petrel and other rare birds. Feeding area for aggregations of seabirds, cetaceans and leatherback turtles. Area overlaps with Southeast Shoal and Tail of the Banks EBSA.	18,201 km²
Northwestern Conception Bay	Capelin spawn in high concentrations. Greatest abundance and diversity of seabird species in eastern North America. Largest seabird island and greatest diversity of breeding seabirds in the province. Largest Leach's storm-petrel breeding colony in the world. One of six known breeding colonies of Northern Gannets in North America. One of four islands in eastern Canada where northern fulmars breed. Area overlaps with Baccalieu Island and Grates Point IBAs.	608 km²
Southern Coast of Burin Peninsula and Southeastern Placentia Bay	Globally significant concentrations of seabirds such as Leach's storm-petrel. Largest concentration of nesting Manx shearwaters in North America and the only North American location where the species nests regularly. Other seabirds and gulls nest in the area. Area overlaps with Placentia Bay Extension EBSA, Cape St. Mary's Ecological Reserve and Cape St. Mary's EBSA.	1,357 km²
Source: CPAWS (2009); AMEC (2014a)		

6.4.2.5.1 Project Area - Northern Section

The Virgin Rocks Preliminary RMA and the South Grand Bank Area Preliminary RMA are located in offshore Newfoundland (Figure 6-97). No preliminary RMAs are located within the Project Area - Northern Section.

6.4.2.5.2 Project Area - Southern Section

The Virgin Rocks Preliminary RMA and the South Grand Bank Preliminary Area RMA are located in offshore Newfoundland (Figure 6-97). Neither of these preliminary RMAs are located within the Project Area - Southern Section.

6.4.2.5.3 Potential Vessel and Aircraft Traffic Routes

The identified potential vessel and aircraft traffic routes will be used to service the Project Area (Northern and Southern Sections) (Figure 6-97). These routes will not likely cross the Preliminary RMAs.

6.4.2.6 National Wildlife Areas, Marine Wildlife Areas and Migratory Bird Sanctuaries

Through the *Canada Wildlife Act*, the Government of Canada has established 54 National Wildlife Areas (NWAs) on federally-owned lands for the purposes of wildlife conservation, research and interpretation. These areas, some of which are relatively undisturbed, protect approximately one million hectares of nationally significant plant and animal habitats, with nearly half of the total area protecting marine habitats. No NWAs are located in Newfoundland and Labrador; the nearest are in Cape Breton, Nova Scotia and the Northumberland Strait, New Brunswick (EC 2016).

In 1994, the *Canada Wildlife Act* was amended to allow for the identification of Marine National Wildlife Areas (MNWAs) beyond the 12 nautical mile territorial sea limit out to Canada's 200 nautical mile EEZ limit. No MNWAs have yet been designated in Canada, but candidate sites such as the Scott Islands off the coast of British Columbia are being evaluated (EC 2016).

Migratory Bird Sanctuaries (MBS) are designated under the *Canada Wildlife Act* to protect marine and migratory bird habitats used for feeding, breeding and as sanctuaries during spring and fall migration. Permitted activities are limited to low impact recreation and potentially other activities that are compatible with conservation (Government of Canada 2010). No MBS are located in Labrador. On the Island of Newfoundland, two MBS are located on the east coast of the Northern Peninsula and one in Terra Nova National Park (Table 6.50; Figure 6-97).

Table 6.50 Migratory Bird Sanctuaries in Newfoundland

MBS	Rationale for Identification/Designation	Area
Terra Nova	Designated in 1967 to protect an area adjacent to Terra Nova National Park. About 30 shorebird, waterfowl and seabird species. Important sanctuary during fall migration. Shorebirds frequent tidal flats during summer and early fall. Newman Sound is an important area for waterfowl species year-round.	12 km²
Shepherd Island	Designated in 1991 to protect one of the largest breeding sites (together with Île aux Canes) for common eider in insular Newfoundland.	0.18 km²
Île aux Canes	Designated in 1991 to protect nesting colonies of common eider. Together with Shepherd Island, one of the largest breeding sites for the common eider in insular Newfoundland.	1.62 km²
Source: EC (2016)		

6.4.2.6.1 Project Area - Northern Section

No NWAs or MNWAs are located off eastern Newfoundland. The Newfoundland MBSs are located off the Northern Peninsula and in Terra Nova National Park (Figure 6-97). None of these areas are within or near the Project Area - Northern Section.

6.4.2.6.2 Project Area - Southern Section

No NWAs or MNWAs are located off eastern Newfoundland. The MBSs are located in coastal areas (Figure 6-97). Neither are within or near the Project Area - Southern Section.

6.4.2.6.3 Potential Vessel and Aircraft Traffic Routes

No NWAs or MNWAs are located off eastern Newfoundland. The identified potential vessel and aircraft traffic routes will be used to service the Project Area (Figure 6-97). These vessel routes will not intersect with either of the MBSs.

6.4.2.7 National Parks and Historic Sites

Parks Canada establishes National Parks (under the *National Parks Act*) to protect representative examples of Canada's 39 National Parks Natural Regions. Two national parks have been established on the Island of Newfoundland: Gros Morne and Terra Nova. The Torngat Mountains National Park is located in northern Labrador and the Mealy Mountains National Park Reserve is in southeastern Labrador (Parks Canada 2009). Terra Nova National Park, along with various National Historic Sites (NHS), designated through the *Historic Sites and Monuments Act*, are located in coastal areas of eastern Newfoundland (Parks Canada 2016) (Table 6.51; Figure 6-97).

Table 6.51 Coastal National Parks and Historic Sites in Eastern Newfoundland

Park/National Historic Site	Rationale for Identification/Designation	Area
Cape Spear National Historic Site	Restored historical lighthouse and lighthouse keepers home on most eastern point of North America.	N/A
Signal Hill National Historic Site	Historic site of wireless communication and military defence of St. John's Harbour.	N/A
Ryan Premises National Historic Site	Restored merchant's premises, displaying artifacts focusing on traditional Newfoundland seafaring life.	N/A
Castle Hill National Historic Site	Restored site of 17th and 18th century French and English fortifications representing battles over Newfoundland fisheries resources.	N/A
Terra Nova National Park	Protects 400 km² of boreal forest and rocky coastlines as a representative example of Natural Region 35: Eastern Newfoundland Atlantic Region.	399 km²
Source: Amec (2014a); Parks Canada (2008, 2016)		

6.4.2.7.1 Project Area - Northern Section

Terra Nova National Park and the identified national historic sites are located in eastern Newfoundland, on the northeast coast and in Placentia Bay (Figure 6-97). None of these are within or near the Project Area - Northern Section.

6.4.2.7.2 Project Area - Southern Section

The National Park and national historic sites are located on land with coastal boundaries (Figure 6-97). None are located within or near the Project Area - Southern Section.

6.4.2.7.3 Potential Vessel and Aircraft Traffic Routes

The identified potential vessel and aircraft traffic routes will be used to convey goods and workers between St. John's Harbour and the offshore (Figure 6-97). These routes will be near Cape Spear and Signal Hill National Historic Sites, which are located on land in close proximity to St. John's.

6.4.3 Newfoundland and Labrador Designations and their Management

The Government of Newfoundland and Labrador, through the Department of Municipal Affairs and Environment, establishes and manages six types of Provincial Parks and Protected Areas, each of which is designed to fulfill conservation and/or cultural mandates. The Parks and Natural Areas Division is responsible for wilderness and ecological reserves and provincial parks, and the Wildlife Division manages wildlife reserves and a nature park. The Province has also undertaken scientific analysis and stakeholder consultation towards developing a draft Protected Areas Strategy to enhance its protected areas network, but to date has not released this plan (Department of Environment (DOEC) 2016a).

6.4.3.1 Provincial Wilderness and Ecological Reserves

Through the *Wilderness and Ecological Reserves Act*, the Provincial Government establishes and manages a series of Wilderness and Ecological Reserves, which are created to protect and conserve wildlife, wilderness and biodiversity. The *Seabird Ecological Reserve Regulations* and *Fossil Ecological Reserve Regulations* protect many of these areas and limit activities to learning, research and passive recreation (DOEC 2016b). In eastern Newfoundland, these special areas include five seabird ecological reserves and two fossil ecological reserves, which are located in marine and coastal areas (Table 6.52; Figure 6-98).

Table 6.52 Coastal Provincial Ecological Reserves in Eastern Newfoundland

Reserve	Rationale for Identification/Designation	Area
Witless Bay Seabird Ecological Reserve	Established as a wildlife reserve in 1964 and designated as an ecological reserve (under new legislation) in 1983. Large number of bird species. North America's largest puffin colony. Second largest Leach's storm-petrel colony in the world.	30.5 km² on four islands
Baccalieu Island Seabird Ecological Reserve	Established as a provisional ecological reserve in 1991, to protect breeding seabird habitat, and granted full status in 1995. Has more breeding seabirds than any other area of the province. Largest Leach's storm-petrel colony in the world. Second largest Atlantic puffin colony in North America.	22.9 km²
Mistaken Point Fossil Ecological Reserve	Established as a provisional ecological reserve in 1984 to protect fossils of the Earth's oldest complex life forms. Permanent designation in 1987. Reserve area expanded in 2009. Designated as a UNESCO World Heritage Site in 2016.	5.7 km²
Funk Island Seabird Ecological Reserve	Established as a wildlife reserve in 1964 to protect the largest colony of common murre in the Western North Atlantic. Designated as an ecological reserve (under new legislation) in 1983.	5.4 km²

Table 6.52 Coastal Provincial Ecological Reserves in Eastern Newfoundland

Reserve	Rationale for Identification/Designation	Area
Cape St. Mary's Seabird Ecological Reserve	Established as an ecological reserve in 1993 to protect major breeding seabird colonies. More than 65,000 birds in breeding season (April to October). Offshore waters are important wintering area for a number of duck species.	66.8 km²
Lawn Bay Seabird Ecological Reserve (Middle Lawn, Swale, and Colombier Islands)	Established as a provisional ecological reserve in 2009, to protect the habitat of thousands of nesting seabirds, and granted full status in 2015. Significant colony of Leach's storm-petrel. Middle Lawn Island is the only known colony of manx shearwater in North America.	3.8 km² on three islands
Fortune Head Fossil Ecological Reserve	Established as a provisional ecological reserve in 1990, to protect fossils representing the geological boundary between the Precambrian Era and the Cambrian Period, and granted full status in 1992.	2.4 km²
Sources: Amec (2014a); DOEC (2016a); UNESCO (2017)		

6.4.3.1.1 Project Area - Northern Section

Seven ecological reserves (i.e., Funk Island, Baccalieu Island, Witless Bay, Mistaken Point, Cape St. Mary's, Lawn Bay and Fortune Head) are located in coastal areas of eastern Newfoundland (Figure 6-98). None are located within or near the Project Area - Northern Section.

6.4.3.1.2 Project Area - Southern Section

Seven ecological reserves (named above) are located in coastal areas including the east coast of the Avalon Peninsula (Figure 6-98). However, none of these are located within or near the Project Area - Southern Section.

6.4.3.1.3 Potential Vessel and Aircraft Traffic Routes

The potential vessel and aircraft traffic routes enter and exit St. John's, which is the main supply centre for the offshore oil and gas industry (Figure 6-98). The closest provincial ecological reserve is Witless Bay Ecological Reserve (#14 on Figure 6-98) on the southern coast of the Avalon peninsula. This location does not intersect with vessel traffic routes to and from St. John's.

6.4.3.2 Provincial Parks and Protected Areas

Through the *Provincial Parks Act* and *Regulations*, the Government of Newfoundland and Labrador maintains a network of provincial parks and provincial park reserves to protect representative natural areas and scenic features and/or to provide recreational opportunities and amenities. Provincial parks and protected areas are intended for conservation, research and recreational use. Where harvesting activities are permitted, these are limited to fishing and hunting (DOEC 2016c). Existing provincial parks and protected areas that are located in coastal areas of eastern Newfoundland are listed and described in Table 6.53; Figure 6-98).

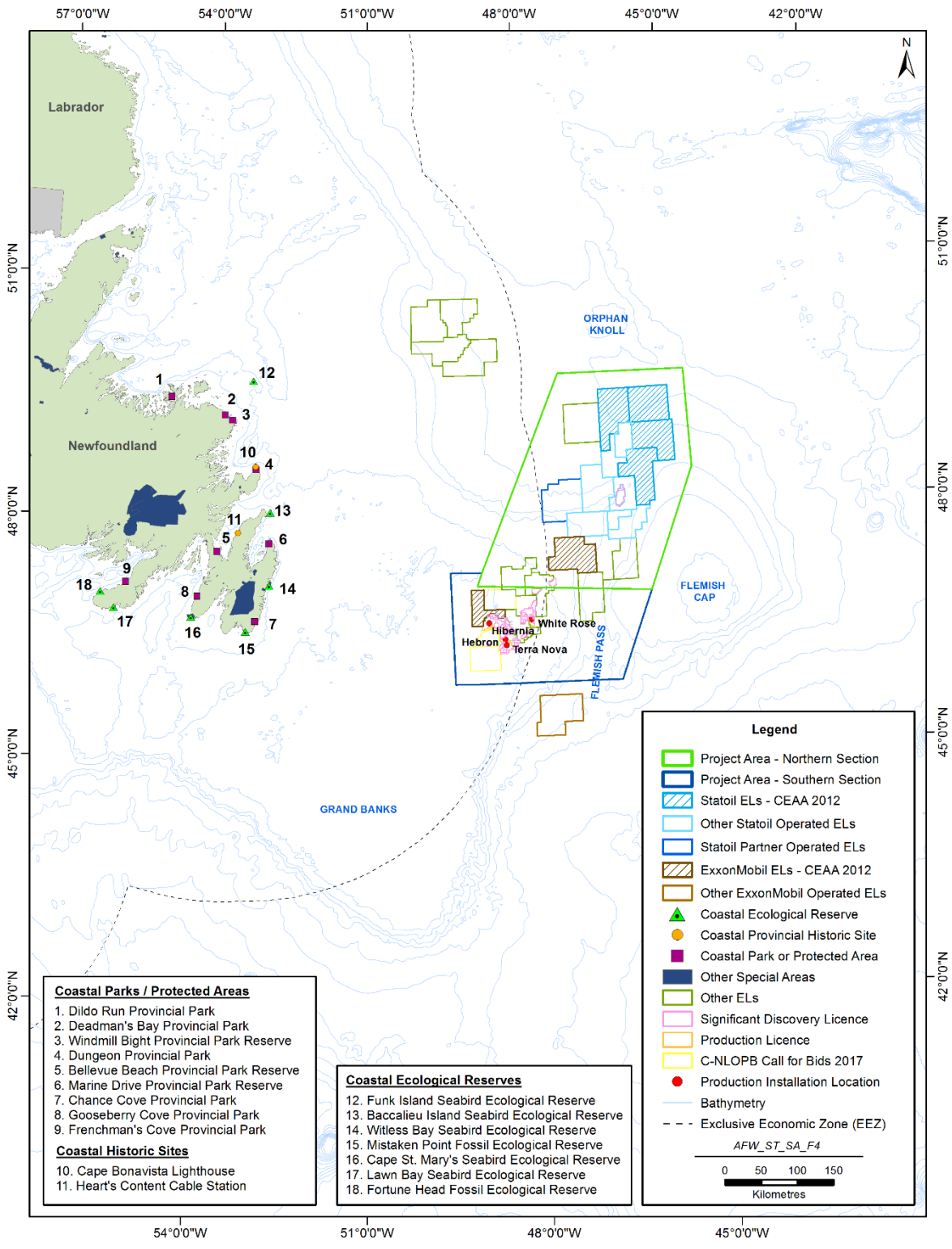


Figure 6-98 Provincial Protected and Special Areas

Table 6.53 Coastal Provincial Parks and Protected Areas in Eastern Newfoundland

Park/Protected Area	Rationale for Identification/Designation	Area
Marine Drive Provincial Park Reserve	Protects an area representative of the Northeastern Barrens Subregion. Park Type: Reserve.	6.17 km²
Chance Cove Provincial Park	Protects a large area including the coast where one can view whales, seabirds and seals. Natural or scenic attraction. Park Type: Day use.	20.68 km²
Dungeon Provincial Park	Protects a beach with a collapsed sea cave and natural archway carved by sea action. Natural or scenic attraction. Park Type: Day use.	0.02 km²
Bellevue Beach Provincial Park Reserve	Protects a sand and beach-rock bar, saltmarsh and barachois habitat used by migrating shorebirds. Park Type: Reserve.	1.16 km²
Gooseberry Cove Provincial Park	Protects a sandy beach with grassy back shore. Natural or scenic attraction. Park Type: Day use.	0.05 km²
Windmill Bight Provincial Park Reserve	Protects a plateau bog as an element of provincial Ecoregion 7. Park Type: Reserve.	2.86 km²
Deadman's Bay Provincial Park	Protects a sandy beach. Iceberg watching. Natural or scenic attraction. Park Type: Day use.	0.70 km²
Dildo Run Provincial Park	Protects a rocky coastline with rolling hills and valleys. Park Type: Camping.	3.28 km²
Frenchman's Cove Provincial Park	Protects an area adjacent to a large barachois, sand and mud flats, mixed forest and tidal lagoons. Diverse population of shore birds and waterfowl. Park Type: Camping.	0.51 km²
Source: DOEC (2016c)		

6.4.3.2.1 Project Area - Northern Section

Nine Provincial parks and protected areas (i.e., Dildo Run, Deadman's Bay, Windmill Bight, The Dungeon, Bellevue Beach, Marine Drive, Chance Cove, Gooseberry Cove and Frenchman's Cove) are located in coastal areas of eastern Newfoundland (Figure 6-98). None of these sites are within or near the Project Area - Northern Section.

6.4.3.2.2 Project Area - Southern Section

Nine Provincial parks and protected areas (named above) are located on the coast of the Avalon Peninsula (Figure 6-98). None of these are within or near the Project Area - Southern Section.

6.4.3.2.3 Potential Vessel and Aircraft Traffic Routes

The potential vessel and aircraft traffic routes will operate between St. John's and the offshore (Figure 6-98). As none of the provincial parks and protected areas are located at St. John's Harbour, these routes will not intersect with them.

6.4.3.3 Provincial Historic Sites

The Government of Newfoundland and Labrador designates Provincial Historic Sites, through the *Historic Resources Act*, because of their historical or architectural significance. These sites may be open to the public for interpretation purposes or are sometimes preserved and protected and therefore not available to visitors. Cultural and palaeontological resources related to historic sites are protected under the Act and may not be moved, damaged or altered. A number of these sites are found in coastal areas of eastern Newfoundland (Table 6.54; Figure 6-98).

Table 6.54 Coastal Provincial Historic Sites in Eastern Newfoundland

Historic Site	Rationale for Identification/Designation	Area
Heart's Content Cable Station	The first permanent telegraph cable between Europe and North America was connected at this site in 1866. Displays communications technology used until the 1960s.	n/a
Cape Bonavista Lighthouse	Historic lighthouse, built in 1843, includes traditional seal oil fueled catoptric light apparatus used in the 1800s. Also demonstrates the work of light keepers of the period.	n/a
Source: DBTCRD (2016)		

6.4.3.3.1 Project Area - Northern Section

The Heart's Content Cable Station and Cape Bonavista Lighthouse Historic Sites are located in Trinity Bay and Bonavista Bay respectively (Figure 6-98). Neither of these sites is located within or near the Project Area - Northern Section.

6.4.3.3.2 Project Area - Southern Section

The Heart's Content Cable Station and Cape Bonavista Lighthouse Historic Sites are located in Trinity Bay and Bonavista Bay respectively (Figure 6-98). Neither of these sites is located within or near the Project Area - Southern Section.

6.4.3.3.3 Potential Vessel and Aircraft Traffic Routes

The potential traffic routes will be used for transportation to and from St. John's and the Project Area (Figure 6-98). These routes will not intersect with any provincial historic sites.

6.4.4 International Designations and their Management

This section describes special areas that are either in areas of international jurisdiction or are considered to be of importance on an international scale. In coastal and marine areas of eastern Newfoundland, these areas include identified VMEs of which portions are protected through Canada's *Fisheries Act*. Also, various coastal and inland areas of eastern Newfoundland have been identified as globally, continentally or nationally significant bird habitats.

6.4.4.1 Vulnerable Marine Ecosystems

The Food and Agriculture Organization (FAO) of the United Nations (UN) is mandated by member countries to oversee the management and use of food resources, including marine fisheries. The FAO works with regional fishery bodies (RFBs) to sustainably manage seafood resources and habitats in marine areas beyond national jurisdictions. The Northwest Atlantic Fisheries Organization (NAFO) is the RFB responsible for fisheries beyond the EEZ off Canada's east coast. NAFO includes 12 member nations from North America, Europe, Asia, and the Caribbean that collaborate on fisheries management within the NAFO regulatory area (Figure 6-99). NAFO members are required to comply with binding international legal instruments, including the following:

- United Nations Convention on the Law of the Sea
- United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
- Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement)
- Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (Port State Measures Agreement)

In addition to legally binding instruments, NAFO members are signatory to various other agreements related to sustainable management of deep-sea fisheries (FAO 2016a; NAFO 2016a). The UN General Assembly adopted the VME concept in 2007 (through *UN General Assembly Resolution 61/105, paragraph 83*) as an approach to the regulation and management of deep-sea fisheries in areas that extend beyond national jurisdictions. In keeping with this Resolution, the FAO prepared International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (DSF Guidelines) to provide criteria for identifying and defining VMEs. These are defined based on the sensitivity of an ecosystem and the vulnerability of its constituent population, communities or habitats to the impacts of bottom fishing activities, which are defined as those where fishing gear is likely to contact seafloors during the normal course of fishing operations (FAO 2016b).

Identification of VMEs is based on the presence of indicator species such as corals, sponges and sea pens as well as indicator elements (topographical, hydrophysical, and geological features) such as seamounts, hydrothermal vents and sponge fields, which form physical and structural features of marine ecosystems. In addition, coral, sponge and sea pen communities act as nurseries, refuges and as spawning and breeding grounds for many species (WG-EAFM 2008; FAO 2016b). VMEs, which are general areas of known ecosystems, are illustrated in Figure 6-99.

The NAFO Joint Fisheries Commission-Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management (WG-EAFM) has identified VME candidate areas for corals, sponges and seamounts in NAFO Divisions 3LMNO (WWF 2012; FAO 2016b). Nine areas identified as containing VMEs are off eastern Newfoundland within and beyond Canada's EEZ (WG-EAFM 2008) with five of these located within or partially within the Project Area (Table 6.55; Figure 6-99). These VME areas are not protected, although portions of them may eventually receive protection through NAFO processes.

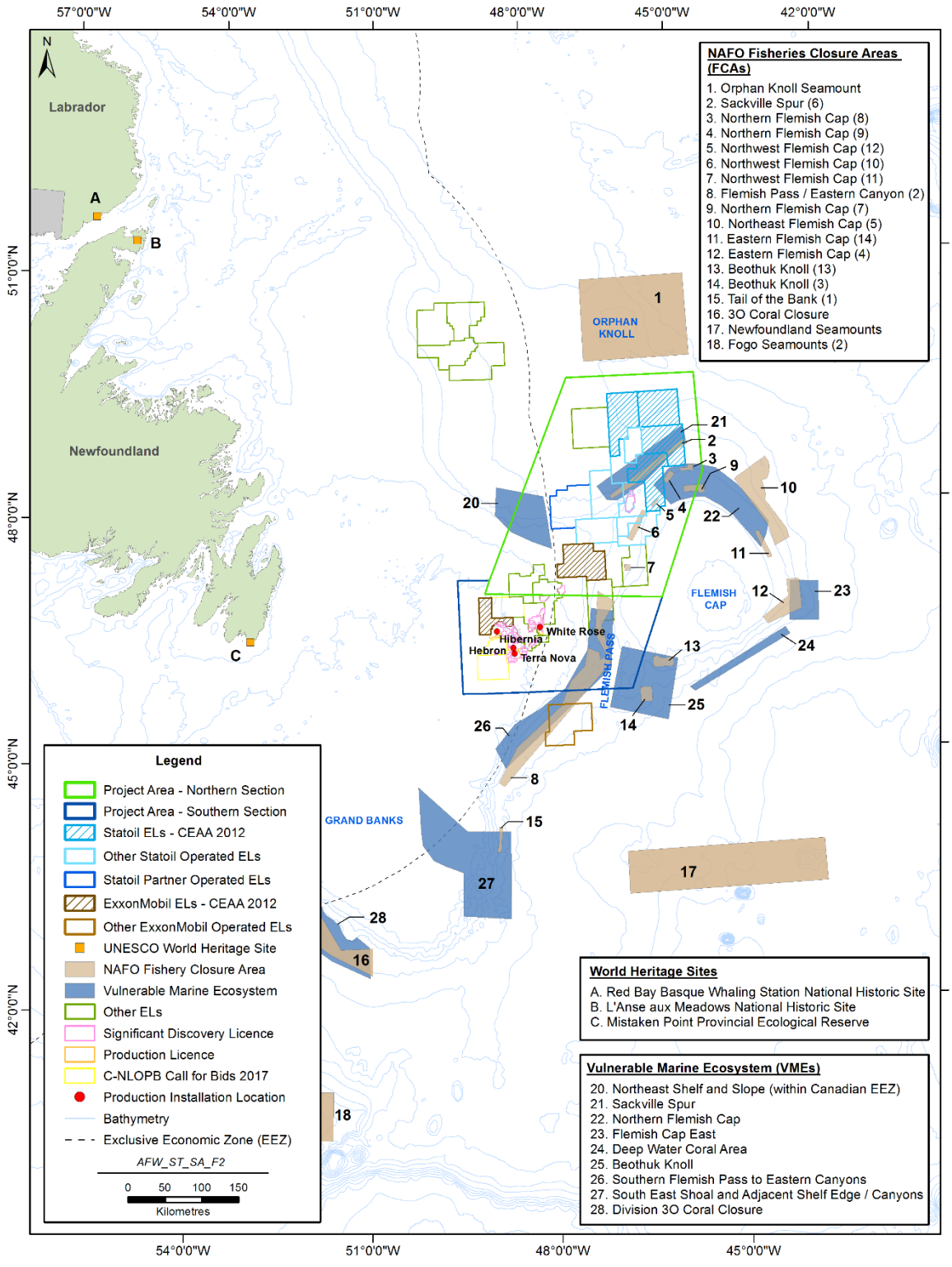


Figure 6-99 International Special Areas

Table 6.55 Vulnerable Marine Ecosystems off Eastern Newfoundland

VME	Rationale for Identification/Designation	Area
Sackville Spur	High density of sponges.	3,961 km²
Northern Flemish Cap	High density of sea pens, soft corals and black corals and, to a lesser extent, solitary stony corals and small gorgonians. Vulnerable fish species: northern wolffish and spiny dogfish.	6,650 km²
Northeast Shelf and Slope (within Canadian EEZ)	Abundance of gorgonian and black corals.	4,150 km²
Southern Flemish Pass to Eastern Canyons	Large gorgonians and high density of sponges. Vulnerable fish species: striped wolffish, redfish, spiny tailed skate, northern wolffish, some black dogfish, deep-sea cat shark.	7,928 km²
Beothuk Knoll	Abundant gorgonian corals and high density of sponges. Vulnerable fish species: northern wolffish, spiny tailed skate, roundnose grenadier, deep-sea cat shark, black dogfish.	6,685 km²
Deep Water Coral Area	An area where deep-water coral VMEs are considered likely.	1,502 km²
Flemish Cap East	Large gorgonians and high density of sponges. Vulnerable fish species: black dogfish and smooth skate.	2,098 km²
South East Shoal and Adjacent Shelf Edge/Canyons	Unique spawning grounds on South East Shoal, marine mammal feeding grounds, long-lived and relict bivalve populations in sandy shoal habitat. Vulnerable fish species: spawning capelin, northern wolffish, redfish, striped and spotted wolffish, roundnose grenadier, black dogfish.	11,930 km²
Division 3O Coral Area Closure	Existing closure based on coral concentrations, high density of sea pens and solitary stony corals. Vulnerable fish species: white hake, redfish, black dogfish, smooth skate and deep-sea cat shark.	16,877 km²
Source: WG-EAFM (2008)		

In addition to the areas described above, NAFO has identified seamounts and knolls (including the Orphan Knoll, Newfoundland Seamounts and Fogo Seamounts) as likely to host VME habitats, which include corals, sponges and a range of vulnerable fish species (e.g., alfonsino, orange roughy, silver roughy, wreckfish and cardinal fish) considered to be endemic to the area (WG-EAFM 2008).

6.4.4.1.1 Project Area - Northern Section

NAFO has identified nine VMEs within the Eastern Newfoundland Offshore Area (Figure 6-99). Three of these areas (Northern Flemish Cap, Sackville Spur and Northeast Shelf and Slope (within Canadian EEZ)) overlap with the Project Area - Northern Section.

6.4.4.1.2 Project Area - Southern Section

The VMEs in the offshore area have been identified to highlight abundant and or high density areas for various species (Figure 6-99). The Project Area - Southern Section overlaps with the Southern Flemish Pass to Eastern Canyons and Beothuk Knoll VMEs.

6.4.4.1.3 Potential Vessel and Aircraft Traffic Routes

The potential traffic routes connect to the supply and service base at St. John's (Figure 6-99). Identified potential traffic routes for exploration licences in the Project Area - Northern Section may intersect with Northern Flemish Cap, Sackville Spur and Northeast Shelf and Slope (within Canadian EEZ) VMEs.

6.4.4.2 NAFO Fisheries Closure Areas

Canada is signatory to international agreements such as United Nations Convention on the Law of the Sea and the Compliance Agreement. Within the EEZ, DFO manages Canada's NAFO commitments through the *Fisheries Act* by restricting one or more types of bottom contact fishing gear in portions of VME areas. Outside of Canadian jurisdiction, DFO is responsible for the fishing activities of the Canadian fleet within the NAFO regulatory area and other fishing vessels are administered by their respective country or flag state (FAO 2016).

Based on the recommendations of the WG-EAFM, NAFO has established various Fisheries Closure Areas (FCAs) within VMEs to help conserve ocean species, habitats and biodiversity from the effects of bottom fishing as well as for research purposes. NAFO reviews and updates FCAs on a regular basis and sometimes amends boundaries of existing areas or adds new closure areas.

NAFO has approved a WG-EAFRM recommendation to close an additional 239 km² within its regulatory area to protect substantial concentrations of sea pens in the Flemish Cap area (Table 6.56 and Figure 6-99). This area was recommended for closure as a precautionary measure and to study the relationship between sea pens and red fish productivity. This closure, in January 2017, has resulted in approximately 380,511 km² (15 percent) of the NAFO regulatory area being closed to bottom-contact fishing (NAFO 2016b; WG-EAFM 2016; NAFO 2017).

The NAFO FCAs were established to protect sensitive habitats for corals, sponges, sea pens and seamounts and other relevant areas and features (Table 6.56). Portions of NAFO coral, sponge and sea pen FCAs (current to 2017) are located within the Project Area (Figure 6-99). Other FCAs are within the marine environment of eastern Newfoundland.

Table 6.56 NAFO Fisheries Closure Areas off Eastern Newfoundland

Closure Area	Rationale for Identification/Designation	Closure Period	Area
Sackville Spur (6)	• Closed to protect high coral and sponge concentrations. • The Sackville Spur is an elongate sediment drift feature that extends from the Grand Banks across the northern limit of the Flemish Pass and along the northern slope of the Flemish Cap. Its southern flank gently slopes toward the 900 m isobath in the Flemish Pass, and steeper northern flank extends to the floor of the Orphan Basin at 2,500 m depth. • Dominant sponge species are demosponges of the order Astrophorida. Geodiids (mostly *Geodia barretti*), *Stelletta normani* and *Stryphnus ponderosus* occur in the deeper water. These large-sized sponges, sometimes grow to more than 25 cm in diameter. The upper limit of the sponges is at about 1,300 m depth and extending down to about 1,800 m. These sponge grounds host a high diversity and abundance of associated megafaunal species.	January 1, 2010 to December 31, 2020	992 km²
Northern Flemish Cap (7)	• Together identified as NAFO Coral Closures, these areas were closed to protect high coral and sponge concentrations. • The Flemish Cap is a plateau of approximately 200 km radius at the 500 m isobath, with depths of less than 150 m at its centre and separated from the Grand Banks by the approximately 1,200 m deep Flemish Pass. • Flemish Cap has a patch of sand at its centre, in the shallower water, but most of the Cap is covered with muddy sand and sandy mud. • Sea pens are key biophysical components of soft-bottom VME indicator elements in the NAFO regulatory area. Aggregations of sea pens, known as “fields”, provide important structure in low-relief sand and mud habitats where there is little physical habitat complexity. Fields provide refuge for small planktonic and benthic invertebrates that may be preyed upon by fish. A system of sea pen VME indicator species has been identified extending around the edge of the Flemish Cap. Crinoids and cerianthids and black corals have been found associated with this sea pen system. Sponges, sea pens, cerianthids and crinoids are also found outside the FCA.	January 1, 2010 to December 31, 2020	259 km²
Northern Flemish Cap (8)		January 1, 2010 to December 31, 2020	98 km²
Northern Flemish Cap (9)		January 1, 2010 to December 31, 2020	128 km²
Northwest Flemish Cap (10)		January 1, 2010 to December 31, 2020	317 km²
Northwest Flemish Cap (11)		January 1, 2010 to December 31, 2020	61 km²
Northwest Flemish Cap (12)		January 1. 2014 to December 31, 2020	35 km²

Table 6.56 NAFO Fisheries Closure Areas off Eastern Newfoundland

Closure Area	Rationale for Identification/Designation	Closure Period	Area
Flemish Pass/Eastern Canyon (2)	• Closed to protect extensive sponge grounds. • Area was expanded to protect large gorgonian corals in the Flemish Pass. • The Flemish Pass, approximately 1,200 m deep, separates the Flemish Cap from the Grand Banks. Includes canyons on the eastern slope of the Grand Banks, a portion of Flemish Pass in the south, and western slope of the Flemish Cap. Straddles the 2,000 m NAFO fishing footprint on the slopes except on Flemish Cap. • The Flemish Pass contains sandy muds with accumulations of pebbles and stones apparently deposited by icebergs floating along this course. The area has complex hydrography owing to the occurrence of two water masses. VME indicator elements include canyons and shelf-indenting canyons. • Biological composition is similar to the Sackville Spur. These sponge grounds have been shown to house high species diversity compared with non-sponge ground habitat at similar depths. Some sponge, large gorgonians and seapen VMEs have also been identified outside the FCA.	January 1, 2010 to December 31, 2020	5,418 km²
Orphan Knoll	• Closed to protect seamounts. • Orphan Knoll is a single peak, with depths of a minimum of 1,800 m. Mounds are found at depths of between 1,800 and 2,300 m. Einarsson Mound is 1,500 to 2,000 m wide and 300 m tall, and Nader Mound is between 400 and 800 m wide and 300 m tall, including the height of the base which is covered in sediment. • Physical properties indicate that mid-depth waters above Orphan Knoll are in a boundary region between outflow from the Labrador Sea (subpolar gyre) and northward flow of the North Atlantic Current (subtropical gyre). • A west-east gradient in nutrients is likely related to water mass differences between the Orphan Basin and the area east of the Orphan Knoll. • The Orphan Basin-Orphan Knoll region is biologically rich and complex, and strongly influenced by local processes and advection. Coral, including stony coral, and sponges observed on the flanks. Near-bottom anti-cyclonic circulation could have important implications for the benthic community.	January 1, 2007 until December 31, 2020	15,815 km²
Northeast Flemish Cap (5)	• Closed to protect high coral and sponge concentrations. • See Northern and Northwest Flemish Cap. The complexity of the bottom is increased along the southern slope of the Flemish Cap by numerous submarine	January 1, 2010 until December 31, 2020	2,892 km²

Table 6.56 NAFO Fisheries Closure Areas off Eastern Newfoundland

Closure Area	Rationale for Identification/Designation	Closure Period	Area
	canyons and steep cliffs. Steep flanks are the important VME indicator element in this area. The FCA straddles the NAFO fishing footprint. • This FCA encompasses a gradient of benthic communities, transitioning from coral dominated communities at approximately 2,450 m depth, corals intermixed with sponges around 2,000 m, sponge dominated grounds at 1,500 m, and a diverse community of corals, sponges and other benthic taxa at approximately 1,300 m depth.		
Eastern Flemish Cap (14)	• Closed due to significant concentrations of sea pens, a VME indicator species.	January 1, 2017 to December 31, 2018	239 km²
Beothuk Knoll (13)	• Closed to protect high coral and sponge concentrations. • Physical VME indicator elements include the Beothuk Knoll, steep flanks and canyons with heads greater than 400 m.	January 1, 2015 until December 31, 2020	340 km²
Eastern Flemish Cap (4)	• Closed to protect high coral and sponge concentrations. • See Northern, Northwest and Northeast Flemish Cap. High densities of the stalked crinoids *Gephyrocrinus grimaldii* together with several structure-forming sponges inside the FCA. A sponge and large gorgonian VME indicator element has been identified outside the FCA. Crinoids and cerianthids have also been found in this area.	January 1, 2010 until December 31, 2020	1,563 km²
Beothuk Knoll (3)	• Closed to protect high coral and sponge concentrations. • Beothuk Knoll is a discrete steep-sided plateau that forms an abrupt projection from the southwest edge of Flemish Cap. Adjacent sediment drifts consist of sands. Beothuk Knoll has an iceberg turbate with isolated deep-water scours. Knolls are recognized as VME indicator elements. • Sponge and large gorgonian VMEs have been identified outside this FCA.	January 1, 2010 to December 31, 2020	309 km²
Tail of the Bank (1)	• Closed to protect high coral and sponge concentrations. • The Tail of the Bank is a small FCA on the continental slope of the tail of the Grand Banks straddling the fishing footprint around 2,000 m in depth. • Deep-sea sponge grounds are aggregations of large sponges that develop under certain geological, hydrological and biological conditions to form structural habitat. More recent studies to the south of this FCA identified significant concentrations	January 1, 2010 to December 31, 2020	144 km²

Table 6.56 NAFO Fisheries Closure Areas off Eastern Newfoundland

Closure Area	Rationale for Identification/Designation	Closure Period	Area
	of erect bryozoans, large sea squirts (*Boltenia ovifera*) and small gorgonian VME indicator species, along with crinoids and cerianthids.		
Newfoundland Seamounts	• Closed to protect seamounts. • The Newfoundland Seamounts include six seamount peaks all with summits deeper than 2,400 m, with most of the area being deeper than 3,500 m. These seamounts were volcanically active in the late Cretaceous period. • Seamounts are uniquely complex habitats that rise into bathyal and epi-pelagic depths. In general, seamounts owing to their isolation tend to support endemic populations and unique faunal assemblages.	2007-01-01 until 2020-12-31	15,494 km²
3O Coral Area Closure	• Closed to protect corals. • The 3O FCA is located on the continental slope from 800 m and is the only FCA that straddles national and international waters. The area includes mostly soft bottoms with rocky outcrops. • Sea pen and small gorgonian VME indicator species have been identified near the FCA and species distribution models indicate a high probability of sea pens. • VME indicator elements are present: shelf-indenting canyons and canyons with heads of greater than 400 m in depth in the FCA have potential to have VME indicator species.	January 1, 2008 to December 31, 2020	13,995 km²
Fogo Seamounts (1)	• Two of the Fogo Seamounts, both below 4,000 m depth, were closed by NAFO as VME indicator elements, with high probability of containing VME indicator species. • Two seamounts located on oceanic crust southwest of the Grand Banks, which form a broad zone of basaltic volcanoes. Most of the Fogo seamounts are deeper than 2,000 m.	January 1, 2009 to December 31, 2020	4,522 km²
Fogo Seamounts (2)		January 1, 2009 to December 31, 2020	4,616 km²
Source: NAFO (2015, 2016c, 2016d); FAO (2016b, 2016c)			

6.4.4.2.1 Project Area - Northern Section

NAFO has imposed bottom contact fishing prohibitions in 21 FCAs within its jurisdiction outside the Canadian EEZ in offshore Newfoundland and Labrador (Figure 6-99). The Project Area - Northern Section overlaps with eight of these: Flemish Pass/Eastern Canyon (2), Sackville Spur (6), Northern Flemish Cap (7), Northern Flemish Cap (8), Northern Flemish Cap (9), Northwest Flemish Cap (10), Northwest Flemish Cap (11) and Northwest Flemish Cap (12).

6.4.4.2.2 Project Area - Southern Section

NAFO has imposed bottom contact fishing prohibitions in 21 FCAs within its jurisdiction outside the Canadian EEZ in offshore Newfoundland and Labrador (Figure 6-99) The Project Area - Southern Section overlaps with the Flemish Pass/Eastern Canyon (2) FCA.

6.4.4.2.3 Potential Vessel and Aircraft Traffic Routes

Potential traffic routes from ELs in the Project Area (Northern Section) may intersect with four FCAs: Sackville Spur (6); Northern Flemish Cap (8); Northern Flemish Cap (9); and Northwest Flemish Cap (12) (Figure 6-99).

6.4.5 Other Identified Marine Special Areas

Canada is signatory to various international conventions that identify important wildlife habitats, including those in coastal and marine areas. These areas may be protected in whole or in part through provincial and national legislation.

6.4.5.1 Important Bird Areas

BirdLife International's Important Bird Area (IBA) Program is a global effort to identify and protect the world's most critical bird habitats. BirdLife Canada has identified 597 Canadian IBAs as having worldwide, continental or national significance. Of these, 80 are located partially or wholly in NWAs or MBSs and all are included in science-based initiatives to identify, conserve and monitor a network of sites that provide essential habitat (IBA 2016; EC 2010).

A number of IBAs are located in coastal areas of eastern Newfoundland (Figure 6-100; Table 6.57). These areas may coincide with provincial (i.e., ecological reserves) or national (i.e., national parks or MBSs) special areas as identified previously in this section.

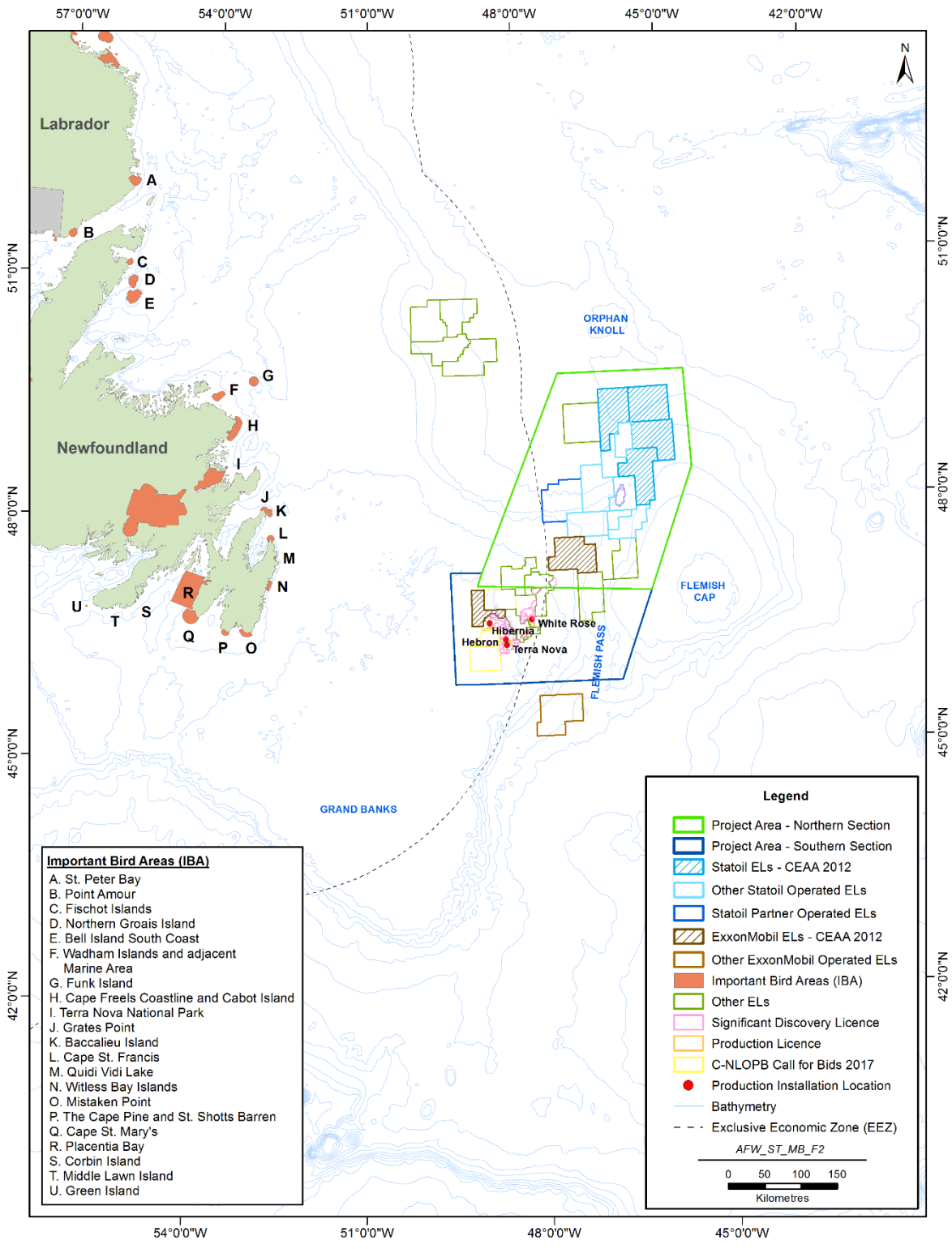


Figure 6-100 Important Bird Areas

Table 6.57 Important Bird Areas in Eastern Newfoundland

IBA Name	Area (km²)	Location	Importance to Marine and Migratory Birds
Funk Island (NF004)	135.18	An island off northeastern Newfoundland, situated approximately 60 km from shore.	Major concentration of nesting seabirds Globally significant common murre population Large numbers of northern gannets Provincially protected Seabird Ecological Reserve; as such, access to the island is restricted to scientific researchers. Overlaps with Fogo Shelf EBSA.
Wadham Islands and adjacent Marine Area (NF013)	159.23	Located near Fogo Island, approximately 40 km offshore, this IBA includes 7 main islands and several smaller rocks and shoals.	Globally significant number of wintering common eider (approximately 25,000 counted in a 1995 survey) Large numbers of nesting Atlantic puffin, Leach's storm-petrel and razorbill. Overlaps with Fogo Shelf EBSA.
Cape Freels Coastline and Cabot Island (NF025)	334.48	Located at the head of Bonavista Bay, this IBA includes several small islands and shoals.	Up to 25,000 wintering Common Eiders have been reported between the Cape Freels coastline and Wadham Islands Large numbers of nesting common murres, as well as some pairs of razorbills Historic records of breeding Atlantic puffins, although none were recorded in recent EC-CWS surveys.
Terra Nova National Park (NF017)	655.56	Situated on the inner reaches of Bonavista Bay. Much of the area is forested, but there are numerous lakes and wetlands, as well as a significant coastal component.	Numerous forest species nest here, including two subspecies with restricted ranges: the federally-listed red crossbill (*percna* ssp.) and ovenbird (*furvoir* ssp.). Shorebirds, gulls and waterfowl can be seen on the flats at the outlet of Big Brook, as well as Newman Sound. At least six tern colonies (common and Arctic tern), totalling between 1000 and 1500 pairs. Also a federally designated Migratory Bird Sanctuary (MBS) and National Park.
Grates Point (NF019)	66.55	The northern tip of the Bay de Verde Peninsula, which separates Trinity Bay from Conception Bay.	Large number of wintering common eiders (up to 12,000 individuals, but typically around 2,800) Other wintering species include black-legged kittiwake, thick-billed murre and dovekie Atlantic puffin and northern gannet are present in the summer months.
Cape St. Francis (NF021)	70.21	Located at the northern tip of the Avalon Peninsula.	Winter congregating area for common eiders; up to 5000 individuals recorded Purple sandpipers regularly observed along the rocky shoreline in the winter

Table 6.57 Important Bird Areas in Eastern Newfoundland

IBA Name	Area (km²)	Location	Importance to Marine and Migratory Birds
Baccalieu Island (NF003)	45.22	Located 5.5 km from the northern tip of the Avalon Peninsula.	Greatest seabird abundance and diversity in Eastern North America World's largest colony of Leach's storm-petrels, including 70 percent of the North American population. Significant numbers of breeding Atlantic puffin, black-legged kittiwake and northern gannet Smaller numbers of nesting common murre, thick-billed murre, razorbill, black guillemot, northern fulmar, herring gull and great black-backed gull Like Funk Island, a provincially designated Seabird Ecological Reserve
Quidi Vidi Lake (NF022)	7.0	Situated within St. John's city limits, and fed by the Virginia River and Rennies River.	Important daytime resting site for gulls from late fall to early spring, including significant numbers of herring, great black-backed, Iceland, glaucous and common black-headed gulls. Locally rare ring-billed gull, mew gull and lesser black-backed gull occasionally reported. Waterfowl including American black ducks, mallards and northern pintails are common here in the winter, subsisting on food handouts from people.
Witless Bay Islands (NF002)	62.08	Composed of four small islands off the east coast of the Avalon Peninsula.	Provincially designated Seabird Ecological Reserve Globally significant numbers of breeding seabirds, including more than half of the eastern North American population of Atlantic puffins and almost 10% of the global Leach's storm-petrel population Large numbers of nesting common murres, black-legged kittiwakes and herring gulls Great black-back gulls, northern fulmars, Thick-billed murres, razorbills and black guillemots nest in smaller numbers During the fall migration, surrounding marine area is important to sea ducks including white-winged scoter, surf scoter, long-tailed duck and common eider
Mistaken Point (NF024)	102.77	Located near the southeastern corner of the Avalon Peninsula.	Important wintering area for up to 12,000 common eiders Continentally significant numbers of wintering purple sandpiper (> 1% of North American population) Small numbers of overwintering ruddy turnstone, far north of its usual wintering range Nesting black-legged kittiwake, common murre and razorbill Designated as a Provincial Ecological Reserve and UNESCO World Heritage Site because of its rich fossil deposits

Table 6.57 Important Bird Areas in Eastern Newfoundland

IBA Name	Area (km²)	Location	Importance to Marine and Migratory Birds
Cape St. Mary's (NF001)	329.39	Located at the entrance to Placentia Bay on the southwestern Avalon Peninsula.	Significant numbers of nesting northern gannet (> 2% of global population) Large numbers of common murre and black-legged kittiwake, and smaller numbers of nesting thick-billed murre, razorbill, great cormorant and double-crested cormorant Herring gull, great black-backed gull and black guillemot historically reported nesting In the winter, large numbers of migrating sea ducks including scoters, common eider, long-tailed duck and the endangered harlequin duck Small numbers of harlequin duck during summer, moulting season in some years. Designated as a provincial Seabird Ecological Reserve. Overlaps with Placentia Bay EBSA.
Placentia Bay (NF028)	1398.05	Includes the eastern half of Placentia Bay in southeastern Newfoundland (between the Avalon and Burin peninsulas), and extends out 25 km from shore	Exceptional feeding area for seabirds during the summer capelin spawning season More than 100,000 shearwaters recorded in a single survey (mostly greater and sooty shearwater, some manx shearwater) Large numbers of other species breeding at Cape St. Mary's feed here, including northern gannet, black-legged kittiwake, Atlantic puffin, thick-billed murre and common murre Large numbers of feeding pomarine and parasitic jaegers More than 1,000 wintering Common Eiders Overlaps with Placentia Bay EBSA.
Cape Pine and St. Shotts Barren (NF015)	57.4	Located on the southern tip of the Avalon Peninsula.	Large, possibly globally significant numbers of American golden-plover during their fall migration (August to mid-October) Dozens of whimbrel during fall migration
Source: Bird Studies Canada (2016); CWS (2016)			

6.4.5.1.1 Project Area - Northern Section

The IBAs are located in coastal and inland areas (Figure 6-100). None are located within or near the Project Area - Northern Section.

6.4.5.1.2 Project Area - Southern Section

No IBAs are located in offshore areas (Figure 6-100). Thus, none are located within or near the Project Area - Southern Section.

6.4.5.1.3 Potential Vessel and Aircraft Traffic Routes

Various potential traffic routes have been identified for the Project, none of which intersect with an IBA.

6.4.5.2 UNESCO World Heritage Sites

The *Convention Concerning the Protection of the World Cultural and Natural Heritage* was adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1972. This international Convention identifies and encourages conservation of cultural and natural heritage sites considered to be of outstanding value to humanity. Newfoundland and Labrador has four UNESCO World Heritage Sites (WHSs), which are managed by the provincial or federal governments (Table 6.58).

Table 6.58 World Heritage Sites in Newfoundland and Labrador

WHS	Rationale for Identification/Designation	Area
Red Bay Basque Whaling Station National Historic Site	Earliest, most comprehensive and best preserved example of a pre-industrial whaling station. Established by Basque mariners in the 16th century, the site includes land-based remains of infrastructure (buried) and underwater wrecks of whaling ships.	3.13 km²
L'Anse aux Meadows National Historic Site	Excavated remains of an 11th century habitation are evidence of the only site established by Vikings in North America and the first European presence on the American continent.	80.56 km²
Gros Morne National Park	Rare visible example of process of continental drift; deep ocean crust and the earth's mantle are exposed. Also outstanding examples of glaciation (e.g., fjords, glacial valleys).	1,805 km²
Mistaken Point Provincial Ecological Reserve	The oldest known assemblages of large fossils are contained in a 17 km-long strip of rugged coastal cliffs. These marine fossils, dating to the Ediacaran Period (580-560 million years ago), illustrate the appearance of large, biologically complex organisms on earth.	1.46 km²
Source: UNESCO (2017)		

6.4.5.2.1 Project Area - Northern Section

The UNESCO WHSs are located in Labrador, on the Northern Peninsula and the southeast Avalon Peninsula (Figure 6-99). None of these sites are located within or near the Project Area - Northern Section.

6.4.5.2.2 Project Area - Southern Section

The WHSs are coastal and distant from the offshore area (Figure 6-99). Neither of the sites are within or near the Project Area - Southern Section.

6.4.5.2.3 Potential Vessel and Aircraft Traffic Routes

The potential traffic routes are between the offshore area and the Port of St. John's (Figure 6-99), and do not intersect with any of the WHSs.

6.4.5.3 Convention on Wetlands of International Importance

The 1998 Convention on Wetlands of International Importance (also referred to as the Ramsar Convention) established an objective of sustaining important wetland habitats throughout this network, which includes 169 countries. Canada has been a contracting party to the Ramsar Convention since 1981. To date, Canada has designated 37 Ramsar Sites of which 17 are also National Wildlife Areas or MBSs (EC 2010). The only Ramsar site identified in the province is the Grand Codroy Estuary in Western Newfoundland (Ramsar Convention 2001).

6.4.5.4 Western Hemisphere Shorebird Reserve Network

The Western Hemisphere Shorebird Reserve Network conservation strategy was established in 1986. North and South American scientists created the network to protect key habitats to sustain healthy populations of shorebirds. Of the seven identified Canadian sites, only one (i.e., Bay of Fundy) is in Atlantic Canada (Western Hemisphere Shorebird Reserve Network 2009).

6.4.5.5 The UNESCO World Biosphere Reserve Program

The UNESCO Man and Biosphere Program provides international recognition to special places nominated by their national governments, for applying interdisciplinary approaches to managing interactions between social and ecological systems, as World Biosphere Reserves. Globally, 669 biosphere reserves in 120 countries have received this designation. Canada has 18 biosphere reserves located in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia (UNESCO 2016).

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