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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 Environmental Impact Statement (EIS). It has also been prepared in accordance with the requirements and specifications of the EIS Guidelines (Appendix A).

The description that follows focusses on the biological Valued Components (VCs) that were identified as key areas of focus for the EIS, including Marine Fish and Fish Habitat, Marine and Migratory Birds, Marine Mammals and Sea Turtles, and Special Areas. Discussion of species at risk (SAR) 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 environmental assessment (EA).

Figure 6-1 illustrates the various geographical areas which are referenced throughout this Chapter in relationship to existing biological conditions. These areas include the Project Area, Core Bay du Nord (BdN) Development Area, vessel traffic route, the Local Study Area (LSA), which varies for each of the four biological VCs, and the Regional Study Area (RSA), which is the same for the four biological VCs. Although the primary focus of the description of existing conditions is on the Project Area and LSAs (see Chapters 9 to 12), the description also covers the larger RSA, 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.

A list of species, including scientific and common names, is provided in Appendix M.

6.1 Marine Fish and Fish Habitat

Marine ecosystems comprise biological and physical elements that interact to form complex and variable patterns across a seascape. The physical elements of fish habitats in shallower shelf areas and continental slopes to deep abyssal areas affect the presence, abundance and distribution of marine organisms, resulting in assemblages of species associated with particular habitats. Biological ecosystem elements span primary producers such as phytoplankton to consumers such as zooplankton, invertebrates and fish that have important roles in supporting regional biodiversity and marine productivity. This Chapter focuses on marine fish and fish habitat within the Project Area and surrounding area and includes consideration of relevant fish species (both secure and at risk), as well as plankton, algae, marine plants, benthos and relevant components of their habitats, such as water and sediment (see also Chapter 5).

The Project Area primarily includes the northern part of the Flemish Pass, and portions of the slope regions of the Grand Bank and Flemish Cap (Figure 6-2). Water depths within the Project Area range from 340 m to 1,200 m with habitats transitioning from relatively shallow slope areas (i.e., mesopelagic zone: 200 to 1,000 m) to deeper bathypelagic zone areas (1,000 m to over 2,000 m).

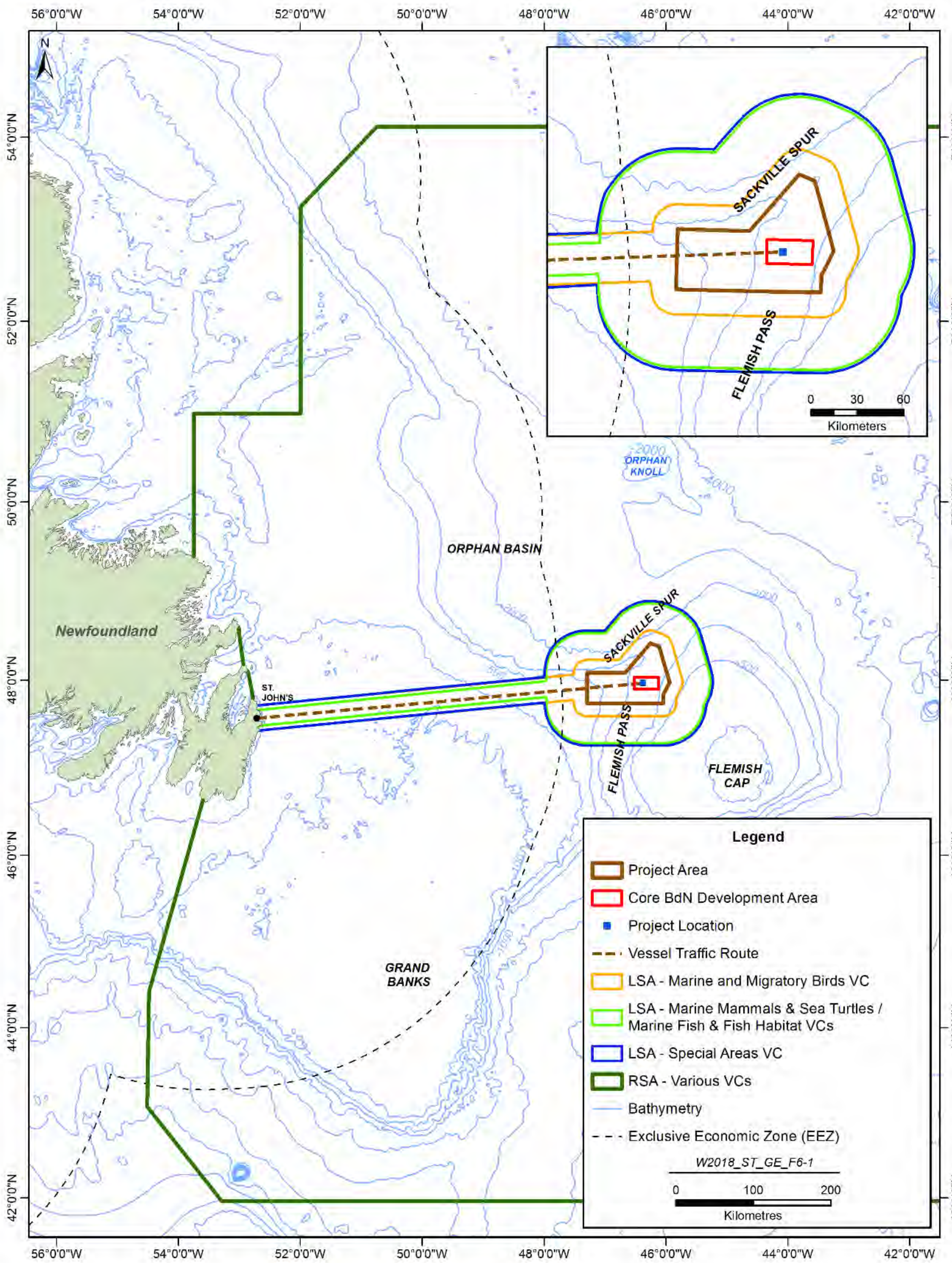

Figure 6-1 Study Areas Relevant to the Description of Existing Biological Conditions

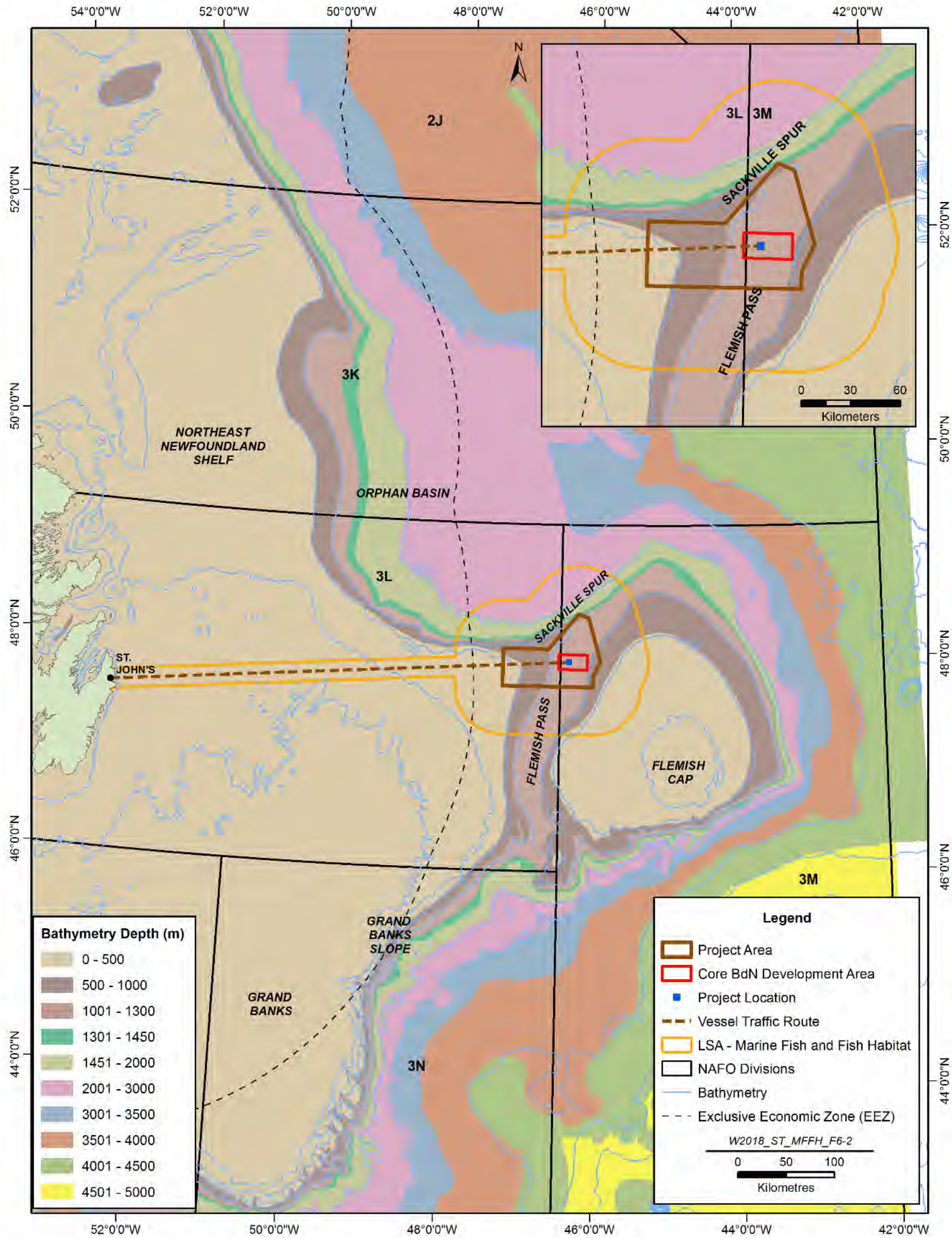

Figure 6-2 Primary Water Depth Zones of the Project Area and Surrounding Marine Environments

These habitats are used by fishes and invertebrates of commercial, cultural, and/or ecological value, and support regionally important areas of biodiversity and marine productivity. The abundance and distribution 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.

6.1.1 Approach and Key Information Sources

The Project Area and LSA falls within the geographic scope of the Eastern Newfoundland Strategic Environmental Assessment (SEA) (Amec 2014a), which provides a regional overview of the offshore marine ecosystem that includes the Grand Banks, Flemish Cap, and adjacent slope and deep-sea habitats. This section builds upon the fish and fish habitat information presented in the SEA by summarizing critical elements, augmenting the information with more detailed or more recent information available in the literature (Table 6.1) and providing additional analyses specific to the Project Area and LSA where available. It provides a holistic overview of fish and fish habitat, key species, and their trophic interactions. Summarized data are based on representative studies or data that are applicable to the Project Area. Each study or data source is based on a particular survey method (e.g., benthic grab, trawl, underwater images or video, longline) with inherent biases towards capturing particular species. Therefore, data metrics (e.g., total abundance, biomass, abundance per tow) are maintained in representation of data in figures and tables to reflect the survey type and original analyses. Although these studies are not directly comparable, they provide sufficient information for characterizing the presence species within the Project Area. Project Area specific data and analysis 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 Section 4.2 of the Eastern Newfoundland SEA (Amec 2014a).

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)
Fisheries and Oceans Canada (DFO) Research Vessel Trawl Surveys[1]	Data provided by DFO; Carter et al. (1979); Wareham (2009)
European Union Bottom Trawl Surveys	Casas and González-Troncoso, (2013, 2015); Vázquez et al. (2013); Kenchington et al. (2014); Mandado (2014); Altuna et al. (2013); Knudby et al. (2013); Nogueira et al. (2016, 2017); Murillo et al. (2016a; 2016b); Alpoim and González-Troncoso (2016)
Canadian Science Advisory Secretariat (CSAS) Reports and Stock Assessments	CSAS (2012, 2013, 2015, 2016)
NASA Satellite Imagery of chlorophyll *a*[1]	Open access data source: http://neo.sci.gsfc.nasa.gov/view.php?datasetId=MY1DMM_CHLORA
NEREIDA Initiative	Barrio Froján et al. (2012, 2016); Altuna et al. (2013); Beazley et al. (2013a, 2013b); Beazley and Kenchington (2015)
Deepwater Longline Survey	Murua and de Cardenas (2005)

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

Information Source	Relevant Studies and Documents
Committee on the Status of Endangered Wildlife in Canada (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/
Species at Risk Act (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, 2017); DFO (2017a)
Northwest Atlantic Fisheries Organization (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); DFO (2016a)
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-nautical mile (NM) Exclusive Economic Zone (EEZ) and sedentary species occurring on the extended continental shelf. In these areas, the federal *Fisheries Act* provides protection to commercial, recreational and Indigenous 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 Northest Atlantic Fisheries Organization (NAFO) (see Section 7.1 for a further discussion).

Within Canadian waters, the distribution and abundance of demersal fish and invertebrates are relatively well studied through annual standardized multi-species research vessel (RV) surveys conducted by 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, including parts of the Project Area. While data sets across the two jurisdictions are often not directly quantitatively comparable and do not necessarily provide comprehensive and comparable coverage in the 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 occurrence 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 reflect the habitat heterogeneity in and around the Project Area and pertain to most of the area known to be used for commercial fishing.

6.1.1.1 Canadian Research Vessel Multi-Species Surveys

Data for the monitoring and management of fish resources in Newfoundland and Labrador (NL) are derived from standardized scientifically-directed spring (NAFO Divisions 3LNOPs) and fall (NAFO Divisions 2J3KLNO) RV trawl surveys. Survey trawls from fisheries management area NAFO Division 3LM overlaps with the Project Area (NAFO Divisions 3LM, see Section 7.1.9). Canadian RV surveys extend to depths of approximately 1,450 m on the continental slope and provide insight into the distribution and abundance of commercially and/or ecologically important species. While the multi-species trawl data is an important source of information on fish and invertebrate species within the study areas, there are limitations of this data source including species selectivity associated with survey equipment (i.e., Campelen 1800 trawl with small mesh liner) and method (e.g., tow speed) (Walsh et al. 2019), and trawl depths (i.e., available trawls in Project Area from 340-1000 m). Although the multispecies surveys have been conducted for several decades, six years of recent available data (2011 to 2016) were synthesized in this summary as 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). As corals and sponges have not been consistently identified across survey years, a 15-year data set (2000 to 2015) was accessed and used in the EIS.

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 95 percent of the total cumulative catch inventory for the region).

NEREIDA (NAFO Potential Vulnerable Marine Ecosystems - Impacts of Deep-Sea Fisheries) is a Spanish-led international research project to which Canada has contributed surveys to identify vulnerable marine ecosystems around the Flemish Pass and Flemish Cap. Data from the NEREIDA survey were provided to Equinor Canada. In 2013, the HMS *Hudson* used two bottom camera set-ups, the 4K Cam and Deep Imager, to take photos of the seabed within the Flemish Pass. Though no species identification was provided with this data, photos from within the Project Area were analyzed for presence/absence of benthic species including corals, sponges, fish, and invertebrate species. Three survey transects were within the Project Area including one transect within the Core BdN Development Area using the Deep Imager. Overall, 274 pictures of sufficient quality for analysis were within the Project Area (998 m to 1,171 m deep), of which 153 pictures were within the Core BdN Development Area (1,074 m to 1,171 m deep). A summary of this information is provided in the Section 6.1.7.3.

6.1.1.2 International Research Vessel Surveys

In addition to Canadian RV surveys, other international research programs have conducted standardized surveys beyond the Canadian EEZ. The principal international program is the EU bottom trawl surveys that have been 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 to 2013 (based on some 1,699 trawls) by Nogueira et al. (2016, 2017). Randomly stratified trawl surveys have also been conducted in NAFO Division 3L in the Flemish Pass by Spain since 2003 (1,261 valid hauls from 2003-2017) (e.g., Román et al. 2018a, 2018b). Full surveys sampling in all strata have been conducted since 2006 with available information in published reports for specific groundfish species (e.g., Greenland halibut, Atlantic cod, American plaice, witch flounder, roughhead grenadier, black dogfish, thorny skate, redfish) (Román et al. 2018a, 2018b).These same data are used to describe the distributions of the important commercial species harvested from the Flemish Cap and slope from 2011 to 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. 2016a). Some data on coral (small and large gorgonians, sea pens) and sponge groups presence/absence in trawls that were not species-specific were available within the Project Area from 2002 to 2013 for re-analysis. The data from most of these surveys are not accessible; however, the resulting scientific papers are useful for comparison to Canadian surveys and for determining commonalities and characterizing the Flemish Cap and Flemish Pass slope components of the Project Area and surrounding marine environments.

6.1.1.3 Other Information Sources

The Atlantic Zone Monitoring Program (AZMP) is the largest monitoring program for the pelagic environment and conducts frequent collections (trawl surveys, fixed point stations, cross-shelf sections) at several sites in the Northwest Atlantic (Therriault et al. 1998; Pepin et al. 2013; 2017; 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; 2017; Johnson et al. 2014; DFO 2017a). Additional information sources such as satellite imagery provide broad scale overviews of primary productivity. These scientific studies that may be somewhat more limited in scope (e.g., Barrio Froján et al. 2012; Beazley et al. 2013a) also contribute to an overall understanding of the processes that shape the faunal communities in the region.

6.1.1.4 Indigenous Knowledge

Information gained during engagement with Indigenous groups are included as appropriate and include the results of the October workshops (Section 3.3 and Appendix G), the desktop Indigenous Knowledge Study (Appendix H), and the Mi'gmawe'l Tplu'Taqnn Inc (MTI) Indigenous Knowledge study associated with the Flemish Pass Exploration Drilling EIS (herein referred to as the Drilling EIS).

6.1.1.5 Equinor Canada Seabed Surveys

As outlined in the preceding sections, the description of existing environmental conditions for marine fish and fish habitat is based primarily on existing information and regional datasets with a variety of information sources being identified and used to describe the existing environment. These information sources provide a regional understanding of existing conditions within the Core BdN Development Area, Project Area and LSA, 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 of mitigation measures in the EIS (see Chapter 9). The information sources accessed and used are described and referenced throughout this Chapter and have been supplemented in certain instances with additional Equinor Canada-gathered environmental data.

2016 Exploration Wellsites Survey

In 2016, as part of its recent exploration drilling programs in the eastern NL Offshore Area, Equinor Canada completed seabottom video surveys at wellsites to provide additional information regarding the corals within 100 m of the wellsites (see Statoil 2017 for further details). In order to provide additional benthic information for representative habitats within the Project Area, a video transect from the Baccalieu F-89 seabed survey, in the Core BdN Development Area was analyzed in 10 second intervals. Videos were analyzed for animals (macrofauna), plants (macroflora), and substrate. 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 (e.g., Scott and Scott 1988; Daigle et al. 2006; Christian et al. 2010; Beazley and Kenchington 2015). Successful identification was dependent on the quality of the video and prominence of identifying characteristics. Flora was expressed as 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).

2018 Seabed Survey

In 2018, in order to support ongoing Project design and to provide benthic and fish habitat information for the Core BdN Development Area, Equinor Canada completed a seabed survey in representative locations (Figure 6-3). The areas chosen were based on the currently proposed subsea layout. Upon completion of final subsea layout design, the area occupied by the final layout design will be compared against the layout used in the 2018 survey. Based on the final design, if there are areas where subsea infrastructure will be installed on the seafloor that were not captured by the 2018 survey, the areas where no data were collected will be surveyed to collect coral, sponge and/or sea pens data. In addition, if DFO determines a Fisheries Act Authorization is required regarding the harmful alteration, disruption or destruction (HADD) of fish habitat resulting from Project activities, additional fish habitat data may be required in support of the authorization. The sea bottom was surveyed via remotely operated vehicle (ROV) and autonomous underwater vehicle (AUV). A summary of the data is provided in Sections 6.1.7.5, 6.1.7.6, and 6.1.8.4.

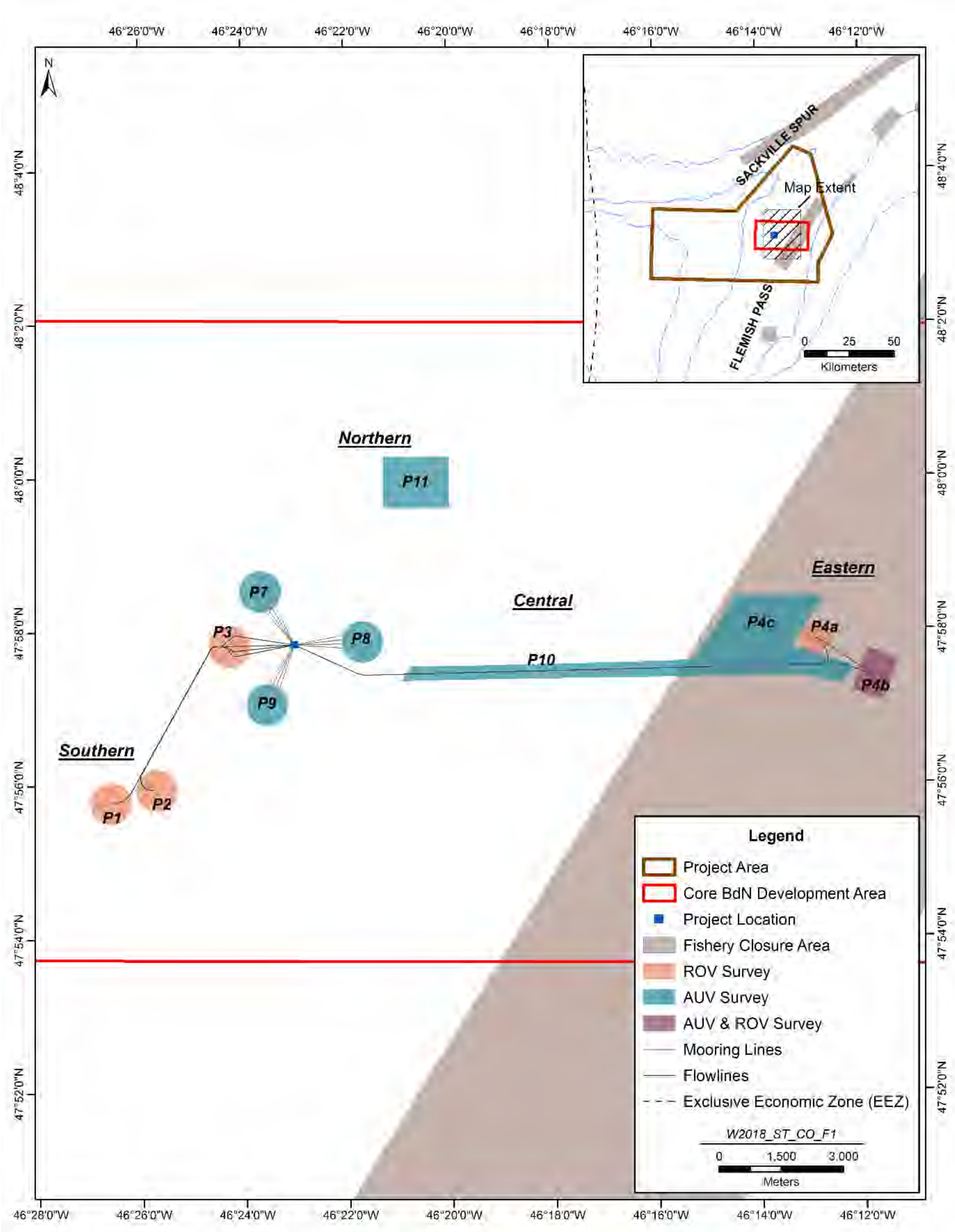

Figure 6-3 Equinor Canada 2018 Seabed Survey Areas in the Core BdN Development Area

The 2018 survey methodology was reviewed and accepted by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and DFO prior to commencement (see Section 3.2 and Appendix N). The survey design considered that design changes may be required in the field as appropriate. Due to technical difficulties and site constraints, survey methodology was adjusted during the field program to collect as much visual data possible with the resources available. Figure 6-31 illustrates areas where ROV and AUV data were collected. ROV video was collected approximately 1 m above the seabed at speeds of <1 km/hr along pre-determined transects within 500 m of proposed well template locations. The AUV captured seabed imagery directly below from approximately 4 m above the seabed within 500 m of proposed well template locations and along potential flowline infrastructure footprints. At least 56 percent of ROV video and 31 percent of AUV images were analyzed as representative data for the area. This information is presented below for the southern (sites P1 and P2), central (P3, P7, P8, P9, and P10) and the eastern site (P4a, P4b, and P4c).

The eastern sites are in a NAFO fisheries closure area (FCA) (see Section 0). Videos and image mosaics were analyzed for animals (macrofauna), plants (macroflora), and substrate as detailed for the 2016 exploration wellsites survey.

ROV videos were analyzed in 5-minute sections within a 200 m radius of planned subsea infrastructure, and the remaining sections were randomly subsampled from the ROV tracks. This methodology provided a total of 56 percent visual data reviewed. At site P4b, due to technical difficulties, ROV coverage was limited and approximately 75 min of video was recorded, all of which was analyzed. The AUV collects still pictures every 3 seconds as it transits, therefore for each picture there is spatial overlap with the preceding picture. Therefore, for data analysis and coverage of the area, every second photo was analyzed. This provided approximately 100 percent coverage, as the data collected from each AUV transect line is made of hundreds of individual photos.

6.1.2 Trophic Linkages and Community Change

Species within specific habitats interact both directly and indirectly with other species in the ecosystem (Gomes et al. 1992; Templeman 2010; Dawe et al. 2012; Amec 2014a). In and around the Project Area, primary production is generated by photosynthetic phytoplankton and transferred progressively through the food web 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 to the base of the food web. Widespread changes to the abundance of either predators or prey can therefore cascade to other levels of the food web. These linkages provide the mechanism through 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 daily, annually, or over a longer time scale. For example, recent studies and overviews have described regime shifts that have occurred in the Offshore NL 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, there was an increase in the abundance of their prey including pelagic fish (e.g., sand lance, herring) and invertebrates (e.g., shrimp, snow crab) (DeYoung et al; Koen-Alonso et al. 2010; Dawe et al. 2012). More recently, 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, migrations of many species 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 may be visited by large pelagic fish species (e.g., sharks, tunas) during the warm water season, while other species, 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 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, there are three general functional units:

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

The continental slopes and the Flemish Pass that act as transition zones between each of these functional units also represent important habitat types (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 Froján et al. 2012; Altuna et al. 2013). These conditions are thought to contribute to the elevated biodiversity found in these areas relative to the NL Shelf habitats (Altuna et al. 2013). Both the Flemish Cap and NL 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 NL 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 on the Tail of the Grand Banks. Instead, the primary factor that defines assemblages in the Project Area is water depth (Murua and de Cardenas 2005; Barrio Froján 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 6.4.3.2). Similarly, some species of fish are also known to specifically occupy complex habitats (Baker et al. 2012a). DFO considers cold-water coral and sponge grounds to be Significant Benthic Areas (SiBAs), while the United Nations Food and Agriculture Organization (FAO) considers these grounds to be VMEs (DFO 2017b). In particular, SiBAs play very important roles in biogeochemical cycles and nutrient recycling (DFO 2017b). The four SiBA types identified by DFO are based on the dominant coral and sponge taxa in Canadian waters and include sponges (phylum Porifera), and corals such as sea pens (order Pennatulacea), small gorgonians (order Alcyonacea), and large gorgonians (order Alcyonacea) (DFO 2017b).

The key species of a given marine assemblage is often based on dominance (numerical abundance or biomass), or on 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. In most cases, key species were based on either numerical dominance (based on the existing and available datasets) or their conservation status. Key fish species discussed in the EIS are those that comprise 95 percent of total abundance in Canadian RV surveys in the Project Area and EU RV surveys for the Flemish Cap (see Section 6.1.8.5).

6.1.4 Plants and Macroalgae

Macroalgae (i.e., kelps, seaweeds, coralline algae) and seagrasses serve to enhance productivity and provide habitat for marine organisms in coastal waters (Amec 2014a; Teagle et al. 2017). The habitat structures created by macroalgae also function in protection and nursery habitat for fishes (Teagle et al. 2017). Macroalgal species may be attached to hard substrates, to other macroalgae, or grow inside seaweed hosts (Mathieson and Dawes 2017). Macroalgal density and composition typically changes with depth, which is a proxy for environmental factors that influence macroalgae distribution, including substrate, nutrients, salinity, temperature, and light levels. For example, kelp species have been observed to decline in size and density with depth (Teagle et al. 2017). As sunlight is a key factor on the growth and survival of macroalgae and seagrass, plant and algal distribution is generally limited to photic zones of < 50 m (Amec 2014a; Mathieson and Dawes 2017). The depth beyond which various species will not grow is reported to be approximately 75 m for NL, depending on silt and turbidity levels (Mathieson and Dawe 2017). The Project Area ranges in depth from approximately 340 m to 1,200 m and is generally too deep to support macroalgae and seagrass colonization and growth. Therefore, there are no typical macroalgae or seagrass assemblages that are present in the Project Area. During the Equinor Canada 2018 Seabed Survey within the Project Area, no plants or algae were observed.

6.1.5 Plankton

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 invertebrate larvae in the vicinity of the Project Area, similar to those described in the Eastern Newfoundland SEA (Section 4.2.1.3 in Amec 2014a). Based on the nature of this environmental component and the existing information sources used, the discussion that follows is necessarily regional in scope although 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 µm and 2.0 µm in diameter including prokaryotes and eukaryotes), phytoplankton (microscopic algae), zooplankton (small animals) including invertebrate and vertebrate embryos and larvae, as well as viruses and phages (Legendre and Rassoulzadegan 1995; Suttle 2005). Plankton 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 m to 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).

6.1.5.1 Phytoplankton

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 outflow from the Labrador Sea is 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; Greenan et al. 2010). 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 (Greenan et al. 2010). Collectively, the primary production pattern of the North Atlantic is strongly related to light conditions, sea surface temperature, source waters, nutrient supply, as well as vertical water column stabilization mechanisms and grazing (Harrison et al. 2013; Melle et al. 2014). Arctic ice melt also influences primary production on the Labrador and Newfoundland Shelves as the stratified mixed layer established from ice melt and surface water warming creates the light conditions for initiating the spring phytoplankton bloom (Harrison et al. 2013). In addition to a longitudinal gradient in the seasonal cycle of primary production, there are differences 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 typically commence until May (Fuentes-Yaco et al. 2007, cited in Melle et al. 2014).

Satellite imagery of surface irradiance from chlorophyll *a (*Chl *a)* (a photosynthetic pigment used as a measure of photosynthetic activity) for the Project Area during the period December 2016 to November 2017 illustrates this seasonal pattern of Chl *a* abundance. 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, Chl *a* concentrations are homogeneously low (Figure 6-4). During spring (March to May), the largest annual concentrations of Chl *a* shift to more northern latitudes and includes most of the Project Area (Figure 6-4). 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 Chl *a* concentration 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. The contours of slope margins are highlighted by slightly elevated Chl *a* concentrations along the outer margin of the NL Shelf, Grand Banks and the northwest slope region of the Flemish Cap (Figure 6-4). Overall, Chl *a* concentrations are homogeneously 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 that benefit from the abundance of their phytoplankton food source. Zooplankton, in particular copepods, euphasiids and krill, are a key food source for larger invertebrates, 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 (Malick et al. 2015) and northern shrimp in the Northwest Atlantic (DFO 2017c).

The match-mismatch between the stock and the timing of the spring bloom has also been associated with poor stock condition for herring in the North Sea (Illing et al. 2016) and for 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 the distributions of temperate species *Calanus finmarchicus* and *C. helogolandicus* may increase (Sundby et al. 2016). It is uncertain how these distributional shifts may affect productivity of zooplankton.

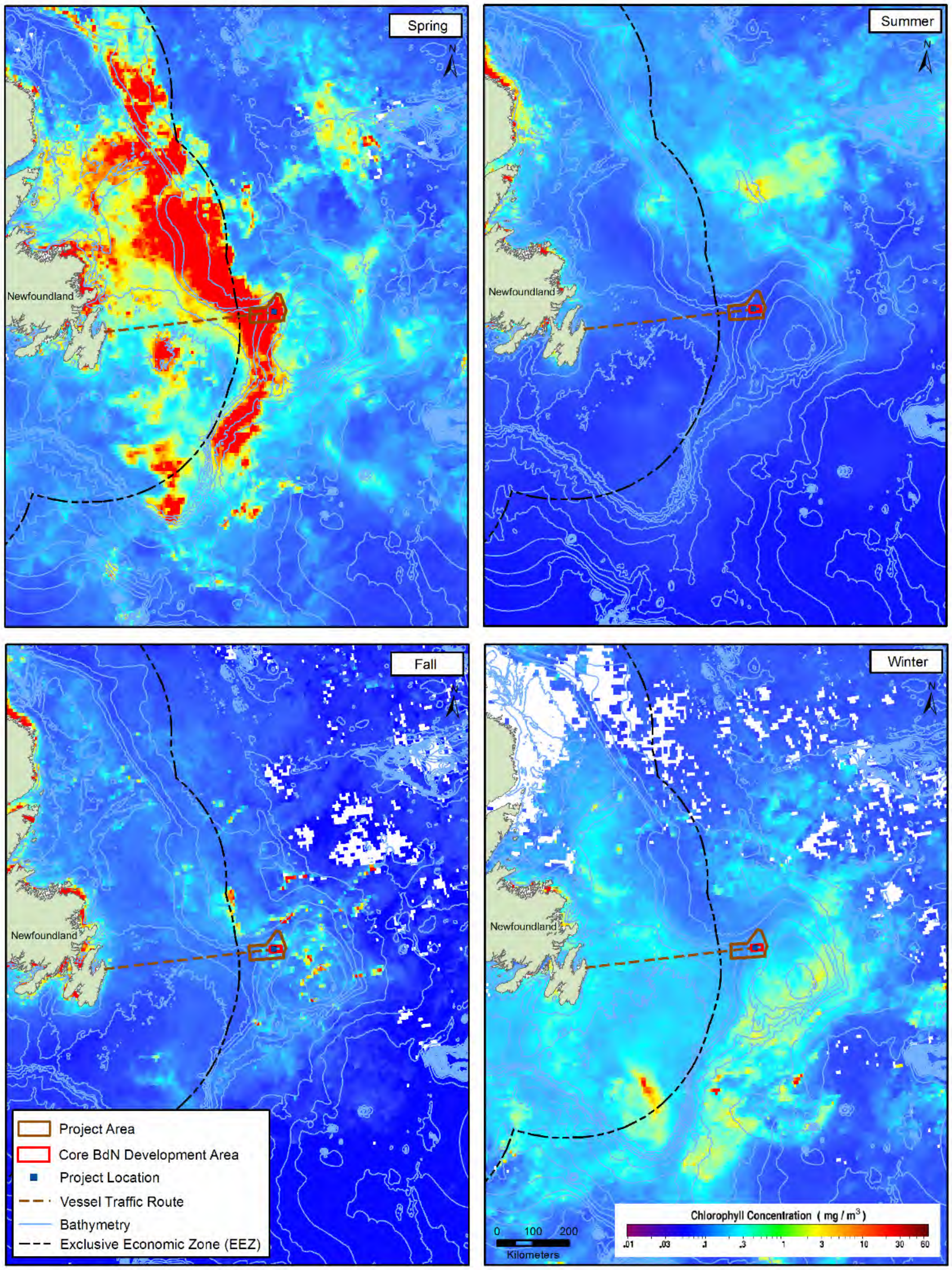

Figure 6-4 Distribution of Chlorophyll Irradiance Measured from NASA Satellite Imagery of the North Atlantic for Winter (December to February), Spring (March to May), Summer (June to August) and Fall (September to November) (2016 to 2017)

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).

6.1.5.2 Zooplankton

As with phytoplankton, oceanic gyres and circulation have effects on environmental characteristics such as temperature, nutrients, salinity, productivity, and prey availability that have effects on zooplankton dynamics (Johnson et al. 2014). In terms of biomass, the zooplankton community in the vicinity of the NL Shelf region is dominated by three large species of copepod. The largest and most abundant is a boreal species *Calanus finmarchicus,* an energy-rich keystone copepod species, 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 (Johns et al. 2001; Melle et al. 2014).

All three of these 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 m to 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 (Melle et al. 2014). Generally, large abundances of adult *C. finmarchicus* accumulate on the NL Shelf in January, peak between mid-March to May and then decline until late August. The abundance of adults then levels off from September until the end of October (Pepin et al. 2015). All three species migrate towards the surface to mature and reproduce in late winter or spring so that early larval stages can feed during the 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; Pepin et al. 2017). In recent years, the zooplankton community within the Atlantic zone has undergone a decrease in *C. finmarchicus* and an increase in the abundance of small and warm-water copepods and non-copepods (DFO 2017d). However, copepod abundances but not biomass were higher than normal on the NL Shelf in 2016, and cooler water temperatures in recent years has brought about higher abundances of *C. glacialis* and *C. hyperboreus* (DFO 2017d).

Inter-annual variation in the timing of the production cycle of C. *finmarchicus* on the Flemish Cap was also observed (Anderson 1994). This is thought to be mediated by warmer surface temperatures. Spawning of redfish occurred at the same time each year (Penney and Evans 1985; Anderson 1994). Similarly, Mullowney et al. (2016) proposed that reduced ice cover along the NL shelf has favoured the earlier onset of spring plankton blooms. This coupled with the later spawning of capelin observed during the last few years has contributed to reduced stock recruitment observed in the mid-1990s. In recent years, an increase in abundance of preferred and total zooplankton prey coinciding with the delayed capelin spawning is thought to be supporting increased capelin productivity (Mullowney et al. 2016).

6.1.5.3 Ichthyoplankton

Ichthyoplankton (fish larvae) distribution (redfish larvae in particular) tends to be affected by environmental variables such as temperature, salinity, and currents, therefore, they are more evenly distributed across pelagic habitats (Pepin and Anderson 1997). Different species of corals can also host eggs and/or larvae of redfish and other fish species (Baillon et al. 2012). Atlantic cod spawn during March to September off the coast of NL, and although developing pelagic cod eggs and larvae are able to survive the range of environmental conditions during that period, recruitment success varies (Bradbury et al. 2000). Based on their surveys of cod larval distribution across the northeastern NL Shelf and drift modelling of cod eggs and larvae, 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 observation 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).

Ichthyoplankton also depend on the availability of copepods as a critical food source during their pelagic developmental period. During 1979 to 1981, a multi-year plankton study was conducted on the Flemish Cap. It found that more than 90 percent of ichthyoplankton were redfish larvae (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 redfish larvae, as indicated by gut content analysis (Anderson 1994). As redfish larvae grow, the size of their preferred prey items also increases. Fish larvae sampled in early spring fed exclusively on copepod eggs and nauplii, whereas by mid-summer, contents of larval stomachs were comprised of a wider range of prey (Anderson 1994). The quality of the prey is important, 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 as being less beneficial for growth and survival (Anderson 1994).

Along the northeastern slope of the Grand Banks within a small portion of the Project Area, larval northern shrimp consume large amounts of phytoplankton, copepod eggs and nauplii larvae during several months of development in the upper 50 m of the water column (Stickney and Perkins 1981;

Pedersen and Storm 2002; Harvey and Morrier 2003; Fuentes-Yaco et al. 2007). As development proceeds, shrimp migrate towards the seabed. Adult shrimp are primarily found on the benthic habitat where they typically consume detritus (Hopkins et al. 1993; Ramseier et al. 2000; Fuentes-Yaco et al. 2007). On the other hand, at night, substantial numbers of adult males migrate towards the surface to feed diurnally on larger larval stages of copepods (copepodites) (Fuentes-Yaco et al. 2007). Every northern shrimp develops as a male, and after approximately three years, transitions to a female (i.e., protandric hermaphrodites) (Vázquez et al. 2014). Eggs are typically extruded in the summer and remain attached to the female until the following spring when the female migrates to shallow coastal waters to spawn. The hatched larvae float to the surface feeding on planktonic organisms (DFO 2017c).

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 and the individual 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 attributed to food limitation caused by rising sea temperatures that increase the metabolic demand for cold-blooded organisms such as shrimp. This effectively increases the amount of food required to adequately sustain growth (Koeller et al. 2007; Fuentes-Yaco et al. 2007). Fuentes-Yaco et al. (2007) also hypothesized that changes in food availability along the NL Shelf, in combination with other factors such as inter-regional variation in primary productivity, could be mediating temporal and spatial changes in individual shrimp sizes in the North Atlantic. DFO (2017c) attributes environmental conditions, predation and fishing as factors in the decline of northern shrimp in Shrimp Fishing Area (SFA) 6 which is located northwest of the Project Area. DFO has determined that the female spawning stock biomass in SFA 6 is in the “Critical Zone” and has suggested reductions in exploitation rates by shrimp harvesters in order to rebuild the stock (DFO 2017c).

6.1.6 Pelagic Macroinvertebrates

Pelagic macroinvertebrates are large enough to see without the aid of a microscope and include cephalopods (e.g., squid, octopus), shrimp, and cnidarians (e.g., jellyfish). These animals either live exclusively in the pelagic environment or move up into the pelagic zone from the benthic habitat to feed. In their review of trawl data collected from the Flemish Cap during 1977 to 2012, Vázquez et al. (2013) compiled the percentage of hauls with occurrence of each species or group of pelagic macroinvertebrates (no biomass, seasonal timing or locations were provided). As indicated by Vázquez et al. (2014), the benthic trawl surveys conducted during this period were not standardized as they were conducted as separate programs either by Canada or the EU. For example, depth of the surveys was limited to 730 m until 2003, after which the maximum depth of the surveying was increased to 1,460 m (Vázquez et al. 2013).

Although sampling was variable during this time period, the data provide an overview of the most prevalent pelagic species of macroinvertebrates on the Flemish Cap during Canadian and EU surveys (1977 to 2012) (Vázquez et al. (2013) (Table 6.2).

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 to 2012)

Phylum, Class (Order)	Common Name	Scientific Name	Species Observed Survey Years (34 Years)		Proportion of observed survey years (%)[1]	
			Years	%	Pre-2003, ≤730 m depth	Post-2003, ≤1,460 m depth
Mollusca, Cephalopoda	Squid	*Illex illecebrosus*	28	82	64	36
	Squid	*Histioteuthis reversa*	21	62	67	33
	Squid	*Semirossia* sp.	19	56	74	26
	Squid	*Histioteuthis* sp.	13	38	46	54
	Squid	*Histioteuthis bonnellii*	10	29	10	90
	Squid	*Gonatus fabricii*	10	29	10	90
	Squid	*Onychoteuthis banksii*	9	26	89	11
	Octopus	*Bathypolypus arcticus*	26	76	65	35
Arthropoda, Crustacea (Decapoda)	Shrimp	*Pandalus borealis*	27	79	63	37
	Shrimp	*Acanthephyra pelagica*	20	59	50	50
	Shrimp	*Pasiphaea tarda*	19	56	47	53
	Shrimp	*Eusergestes arcticus*	17	50	41	59
	Shrimp	*Sergia robusta*	17	50	41	59
	Shrimp	*Parapasiphae sulcatifrons*	15	44	33	67
	Shrimp	*Sabinea sarsii*	15	44	40	60
	Shrimp	*Sabinea hystrix*	15	44	33	67
	Shrimp	*Atlantopandalus propinqvus*	12	35	17	83
	Shrimp	*Pontophilus norvegicus*	12	35	17	83
	Shrimp	*Acanthephyra* sp.	11	32	36	64
	Shrimp	*Acanthephyra purpurea*	11	32	9	91
	Shrimp	*Spirontocaris liljeborgii*	10	29	60	40
	Shrimp	*Lebbeus polaris*	10	29	20	80
Arthropoda, Malacostraca (Mysida)	Mysid Shrimp	unidentified	9	26	0	100
Cnidaria, Scyphozoa	Jellyfish	unidentified	11	32	9	91

Source: Data compiled from Vázquez et al. (2013)
[1] Pre-2003 trawls included 24 survey years and post-2003 trawls included 10 survey years

Species such as the northern shortfin squid and northern shrimp were observed in 77 percent and 94 percent of 2003 survey trawls, respectively. In 2012, the percentage of trawls capturing these squid and shrimp species had declined to 17 percent and 59 percent, respectively (Vázquez et al. 2013). In 2011 to 2015, Canadian RV surveys indicated that aside from a localized aggregation on the northeastern edge of the Grand Banks, most of the northern shrimp observed were concentrated further north along the NL Shelf (i.e., Sackville Spur region) (Figure 6-5). Based on EU RV data collected during 2012 to 2015, Northern shrimp are most concentrated on the Flemish Cap slope area east of the Project Area (Figure 6-6).

In addition to the high proportion of small crustaceans (copepods and shrimp) that live in the pelagic environment, a variety of gelatinous animals can also be found. Pelagic tunicates, including salps, pyrosomes and doliolids, are gelatinous, free-floating, filter feeding animals found as either single individuals or assembled into colonies. Salps and doliolids are a food source for bluefin tuna (Dragovich 1970; Fromentin and Powers 2005), ocean 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) consume small planktonic organisms, the majority of jellyfish are carnivorous and consume zooplankton (including larval fish and invertebrates) and post-larval fish (Gibbons and Richardson 2009). Jellyfish serve as prey for Atlantic bluefin tuna (Fromentin and Powers 2005), leatherback turtles (Heaslip et al. 2012) and sunfish (Potter and Howell 2011).

A review of a 60-year time series of data from the Continuous Plankton Recorder Survey (2018) found that in shelf areas, peak jellyfish abundance in recent years has occurred later in the summer, reflecting changes in sea surface temperature and advective processes that cause aggregations of these species. 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 more recent years, the abundance of jellyfish has shown a pronounced, basin-scale, synchronous increase that cannot be explained by environmental variables such as zooplankton abundance, chlorophyll index, temperature changes or the North Atlantic Oscillation (Gibbons and Richardson 2009). In the vicinity of the Project Area, the highest abundances of jellyfish are along the shelf of the Grand Banks and Flemish Cap, with peak seasonal abundance observed from June to August (Gibbons and Richardson 2009).

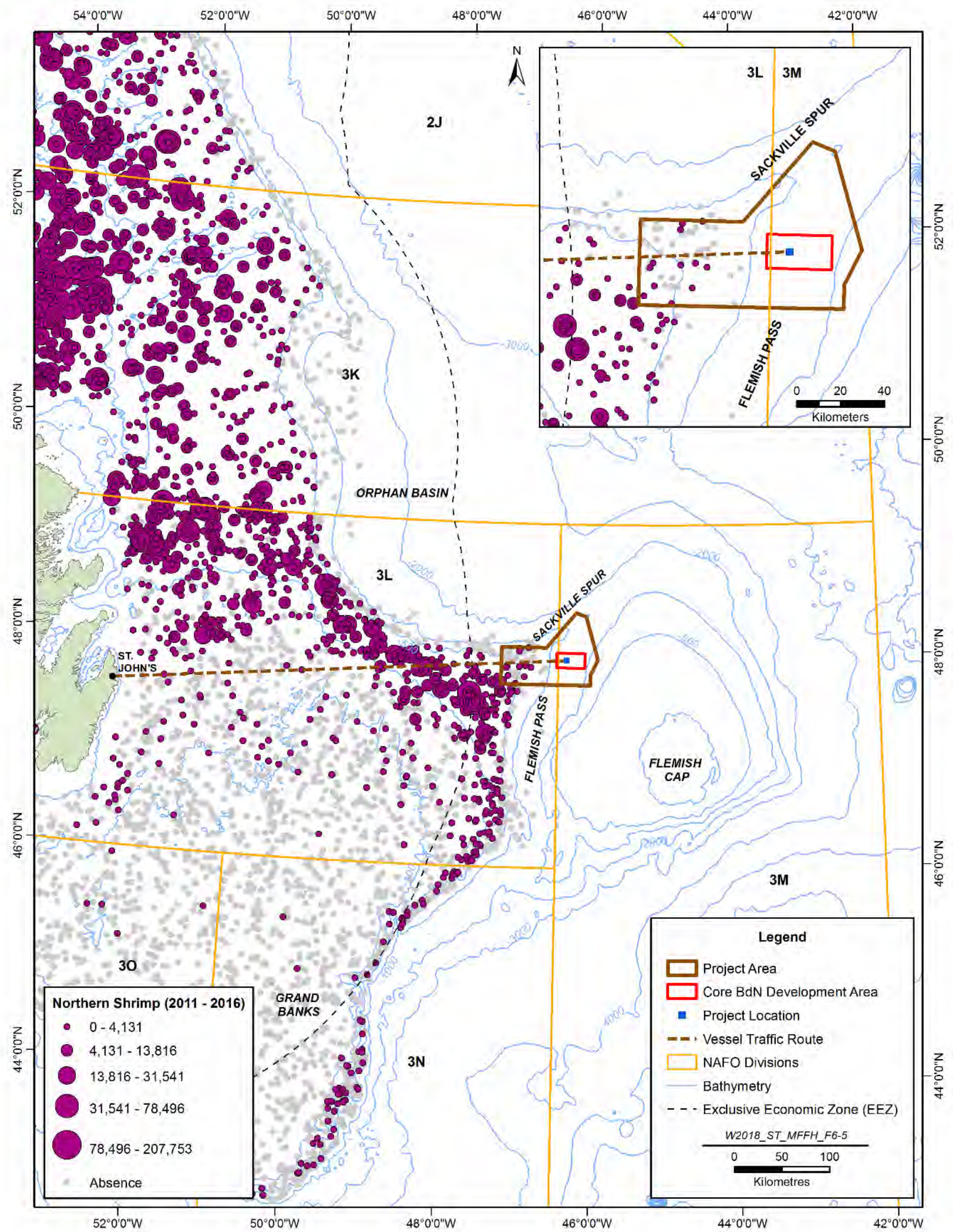

Figure 6-5 Northern Shrimp Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

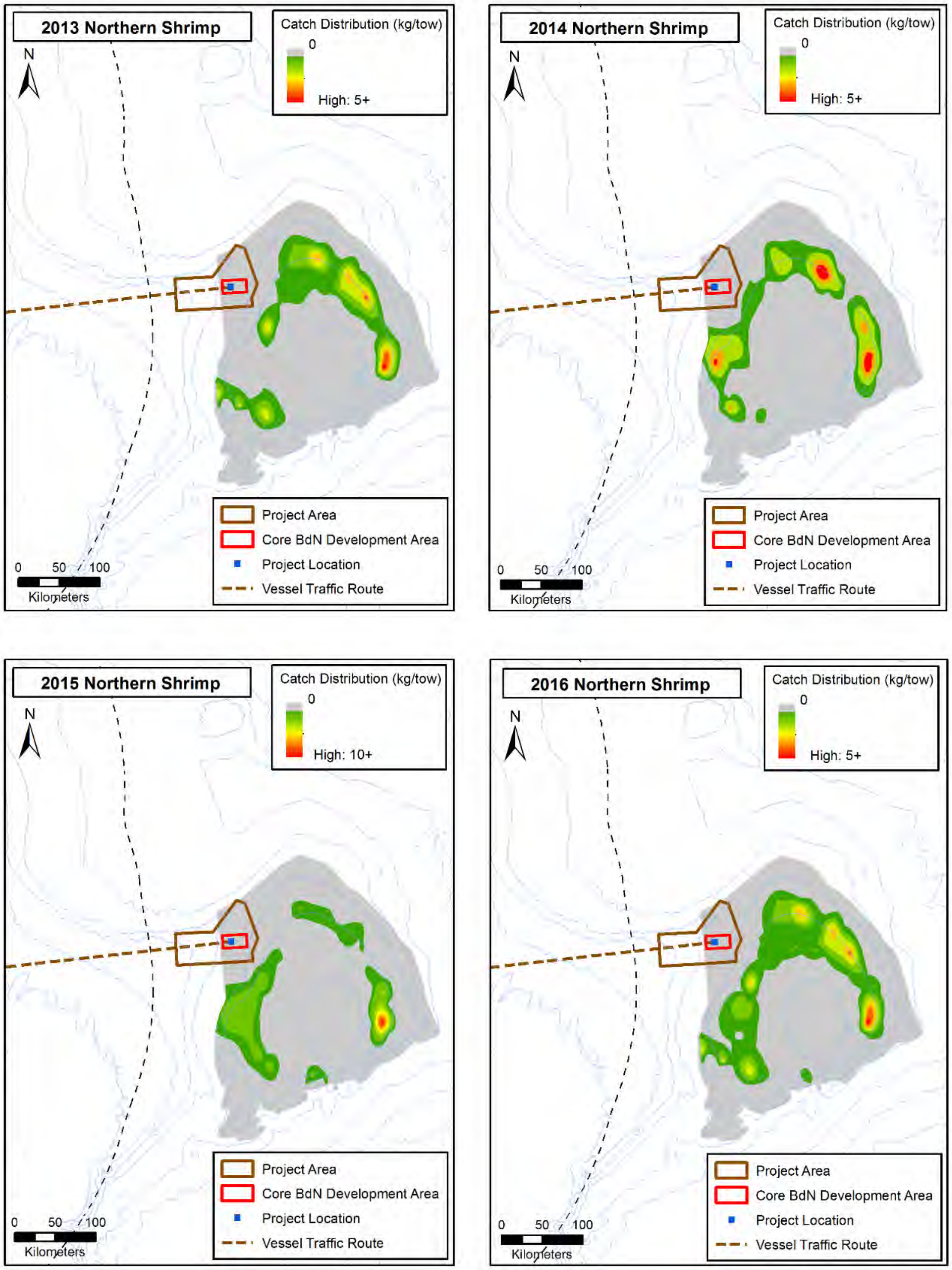

Figure 6-6 Northern Shrimp Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

Recently, Sweetman and Chapman (2015) reported jellyfish may function as an unexpected catalyst for the biological pump process in the pelagic environment. They reported that accumulation of carbon (C) and nitrogen (N) on the seafloor in a Norwegian fjord due to jellyfish abundance was either 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 the biological pump processes within the Project Area and surrounding region.

Pelagic cephalopods or squid are raptorial predators that consume smaller invertebrates when in juvenile stage, shifting to pelagic fishes and invertebrates as they grow. Cephalopods are also a food source for several species of pelagic vertebrates including fishes, seals, dolphins, and other toothed whales (Pauly and Trites 1998). Between 1999 and 2001, the contents of 1,022 porbeagle shark stomachs were analyzed and it was determined that cephalopods comprised 12 percent of the stomach contend by weight (Joyce et al. 2002). Results of a more recent survey conducted south of the Project Area indicated squid comprised more than 99 percent of porbeagle shark stomach contents (Bowman et al. 2000). Squid prey in the North Atlantic are primarily longfin (inshore) and Northern shortfin squids. They often comprise over 50 percent of stomach contents of the sharks, hake, red grouper, monkfish, and bluefish (Bowman et al. 2000).

6.1.7 Benthic Invertebrates

Marine benthic invertebrates include a diverse group of taxa that live either on the seafloor (epifauna, i.e., sea stars, crabs) or in surface layers of the sediment (infauna, i.e., polychaetes). These organisms 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 Froján et al. 2012; Beazley and Kenchington 2015; Murillo et al. 2016a).

Benthic species distributions are highly dependent on the environmental conditions associated with various depths, including temperature, salinity, current speed, maximum seasonal mixed layer depth, bottom shear, sea surface chlorophyll *a*, primary production, and dissolved inorganic nutrients (Nesis 1970; Windle et al. 2012; Knudby et al. 2013; Gale 2013; Gale et al. 2015; Beazley and Kenchington 2015; Buhl-Mortensen et al. 2015; Barrio Froján et al. 2016; Guijarro et al. 2016; Murillo et al. 2016a; Gullage et al. 2017).

In the Project Area, LSA and RSA, there are assemblages of species associated with depth zones. Benthic invertebrate distribution may also be affected by predator-prey relationships (Windle et al. 2012; Gale 2013), substrate type (Baker et al. 2012b; Gale et al. 2015) and associations with habitat engineering organisms (e.g., corals and sponges) (Baker et al. 2012b; Baillon et al. 2014a). Biological systems in the deep-sea operate at a notably slower pace than in shallow waters (Smith 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. 2016a, 2016b). Many benthic deep-sea invertebrate species are immobile and occur in stable environmental conditions and are therefore regarded as being sensitive to anthropogenic disturbance (Curtis et al. 2013; DeBlois et al. 2014; Barrio Froján et al. 2016; Clark et al. 2016; Cordes et al. 2016; Murillo et al. 2016a; DFO 2017b). In some habitats (e.g., hydrothermal vents), species can re-colonize rapidly after disturbance (Van

Dover 2014) but in most deep-sea ecosystems, recovery can be very slow (Williams et al. 2010, Schalcher et al. 2014; Clark et al. 2016; Van reusel et al. 2016).

Information on benthic community composition in the vicinity of the Project Area and in the RSA is sourced 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). These data are primarily focused on epifaunal communities that can be studied using trawls, ROV and camera surveys, and infaunal communities that are typically studied using grab samplers. The pooled data from various survey methods allow for an overall characterization and description of the region and the Project Area. Metrics of dominant species presented below are based on those typically used in surveys (abundance, biomass, survey presence). Coral and sponge presence is noted throughout this section as they are part of regional benthic invertebrate assemblages, however a focused description on Project Area and regional distributions is presented in Section 6.1.7.6.

6.1.7.1 Grand Banks Shelf

The Grand Banks shelf is adjacent to the west of the Project Area. Ongoing environmental effects monitoring (EEM) programs at the Terra Nova and White Rose developments on the shelf of the Grand Bank (< 150 m water depths) indicate that substrates at those locations are dominated by sand with lesser quantities of gravel and mud (Husky Energy 2013; Suncor Energy 2013). The relative abundance (percentage of total abundance) of polychaetes at these locations was over 70 percent, represented primarily by 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 observed infaunal species with relative abundances of < 10 percent included amphipods, bivalves, molluscs, barnacles, and isopods. Paine et al. (2014) conducted sampling of benthic macroinvertebrates for more than 10 years in the Terra Nova oil field, observing that Spionidae, Cirratulidae, and Syllidae were the three predominant polychaete families (accounting for 60 percent or more of invertebrates collected over the duration of the study). Bivalves were dominated by Tellinidae and Hiatellidae, and gastropods were primarily from the Leptidae family. Phoxocephalidae was the most common amphipod family, and Ophiuroidea was the most abundant class of echinoderms observed.

Dominant epifaunal species have been identified by a series of experimental trawling and underwater video sampling (Prena et al. 1999; Kenchington et al. 2001) on sandy areas of the northeast Grand Bank (approximately 150 km to 200 km southwest of the Project Area). Although not all data was reported (Table 6.2) video surveys conducted by Kenchington et al. (2001) indicated that species with the greatest abundance included polychaetes, amphipods, *Macoma* spp. clams, and sand dollars, whereas biomass was dominated by propeller clams, sand dollars, brittlestars, *Macoma* spp. clams, and pale sea urchins. Biomasses from other trawl surveys in the same area were dominated by sand dollars, brittle stars, pale sea urchin, snow crab, mollusc species, and soft corals (Prena et al. 1999). Video surveys by Schneider et al. (1987) identified brittlestars, sand dollars, Icelandic scallops and pale sea urchins as the dominant taxa. Soft corals, whelks and hermit crabs were also commonly caught.

The available data from Canadian RV surveys are generally focused towards commercial invertebrate species. Snow crab presence in and around the Project Area are mainly on the slope areas in its western and southwestern region (Figure 6-7). Snow crab have average depth distributions of 60 m to 400 m (Christian et al. 2010) and not predicted to occur within the Core BdN Development Area. Snow crab movements are associated with seasonal migrations and age-associated (ontogenetic) migrations. Age-associated movements are generally down-slope to deeper areas with warmer waters that support growth. Seasonal migrations are generally up-slope and are associated with mating and molting in shallow waters (Mullowney et al. 2018). Based on tagging and survey data of male and female snow crab on the Grand Banks, average age-associated movements range from 54 km to 72 km. Seasonal movements were estimated at 43 km to 46 km on the Grand Banks and at a scale of 25 km for an inshore bay. In general, mature snow crab make smaller seasonal vertical migrations compared to immature snow crab (Mullowney et al. 2018). The highest concentrations of snow crab regionally were found on the Grand Bank shelf (Figure 6-7). This species was detected at relatively low abundance (< 1 percent) in the Project Area compared to total trawl catches.

Orange footed sea cucumbers were not captured in Canadian RV trawl surveys in the Project Area. This species generally inhabits rocky areas and distributed from shallow water to more than 300 m depth (So 2009; Christian et al. 2010). While they have been observed at depths 1,300 m (So 2009), they are unlikely to be well distributed within the Project Area due to distribution of low complexity substrate (So 2009; So et al. 2010).

Shrimp species were also highly represented in the Canadian RV trawl surveys (approximately 87 percent total abundance) as discussed in previous sections (see Figure 6-5). 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[1]	Total Abundance (#/m²)	Contribution to Survey (%)
Shelf / Slope Edge 70 m to 100 m	Photograph Survey[2]	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[1]	Mean Abundance (#/0.5 m²)	Contribution to Survey (%)
Shelf / Slope Edge 120 m to146 m	Benthic grab[3]	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[1]**	**Mean Biomass (mg/0.5 m²)**	**Contribution to Survey (%)**
Shelf / Slope Edge 120 m to 146 m	Benthic grab[3]	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[1]**	**Mean Biomass (g/m²)**	**Contribution to Survey (%)**
Shelf / Slope Edge 120 m to 250 m	Trawl[4]	Sand dollar	*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 Zone	**Survey Type**	**Common Name**	**Scientific Name[1]**	**No. of Trawls present**	**Contribution to Survey (%)**
Shelf / Slope Edge 150 m to 250 m	Trawl[5]	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

[1] Taxonomic groups: O - Order, F - Family
Adapted from [2]Schneider et al. (1987); [3]Kenchington et al. (2001);[4]Prena et al. (1999); [5]Murillo et al. (2016a)
nr: not reported but identified in text as prevalent species. Number of trawls present is based on 176 trawls of the Flemish Cap and indicates presence among total number of trawls (Murillo et al. 2016a). Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.

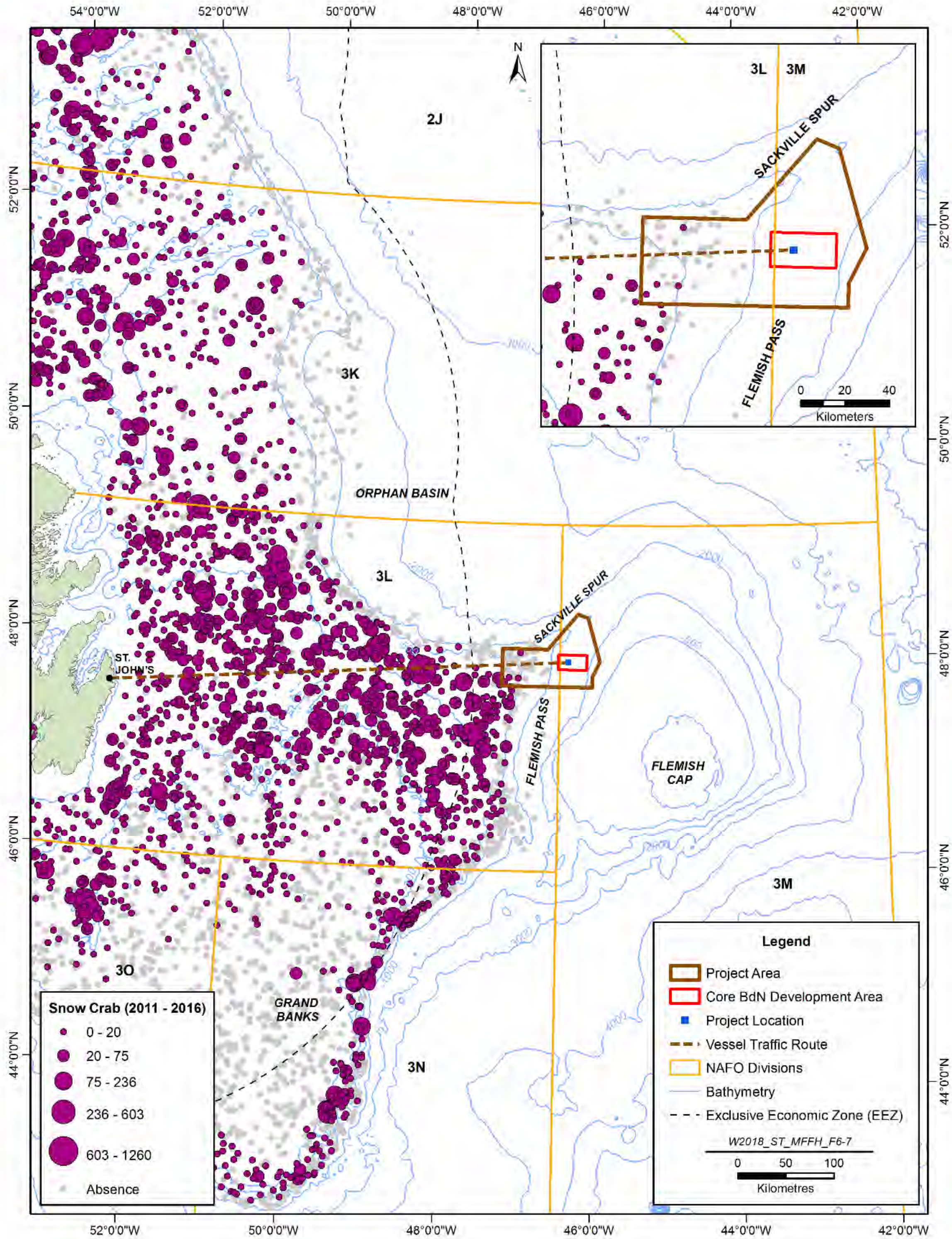

Figure 6-7 Snow Crab Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

6.1.7.2 Grand Bank Slope

Benthic species assemblages on the slopes of the Grand Banks are similar to those that occur on the slope of the Flemish Cap. The sponges *Tentorium semisuberites* and *Polymastia uberrima* are characteristic species along the slopes of the Grand Banks within and adjacent to the Project Area, occurring from the top of the slope to depths ranging from 650 m to 700 m. There are not characteristic benthic species on sandy and clay-silt substrates at water depths 620 m to1,400 m 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 at depths ranging from 700 m to 1,400 m (Table 6.4). Further discussion on sponge and coral distribution in the Project Area and adjacent areas is detailed in Section 6.1.7.6.

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 m to 700 m	Trawl	Sponge	Polymastia uberrima	21	11.9
		Sponge	Tentorium semisuberites	17	9.7
Shelf / Slope Edge 700 m to 1,400 m	Trawl	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
Adapted from Murillo et al. (2016a). Number of trawls present is based on 176 trawls of the Flemish Cap and indicates presence among total number of trawls (Murillo et al. 2016a). Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.					

6.1.7.3 Flemish Pass and Flemish Cap

The Project Area and Core BdN Development Area are within the northern section of the Flemish Pass and are adjacent to the Sackville Spur and Flemish Cap. Benthic community structure in the Flemish Pass and on the Flemish Cap, including Sackville Spur (< 2,000 m depth) has been analyzed using data from commercial bycatch logs, NAFO scientific trawling (Murillo et al. 2012, 2016; Vázquez et al. 2013), and NEREIDA research survey program camera stations and scientific trawling (Barrio Froján et al. 2012, 2016; Beazley et al. 2013a; Beazley and Kenchington 2015; Greenan et al. 2016). Murillo et al. (2016a) modelled the substrate based on sediment composition data from the area. The surficial sediment on the Flemish Cap is predominantly comprised of sand and silty-sand with patches of gravel. The surficial sediment types on the slopes of the Flemish Cap (200 m to 500 m) are predominantly silty-sand. In deeper areas (500 m to 2,000 m) of the Flemish Cap slope and Flemish Pass, the surficial sediment types are predominantly silty-clay or mud (Murillo et al. 2012; 2016a) (see also Section 5.1.2)

The highest diversity of species on the Flemish Cap was observed at water depths between 500 m to 1,000 m. Corals and sponges were the dominant taxa caught, followed by echinoderms, arthropods, and molluscs (Vázquez et al. 2013; Murillo et al. 2016a). Nesis (1970) also observed increasing biomass with increasing depth, down to 1,500 m. Comparisons of invertebrate species to environmental parameters allowed for identification of species groupings at varying depths. At relatively shallow depths (< 500 m) with colder, fresher waters, commonly occurring species included sponges, crustaceans, sea anemones and sea stars (Nesis 1970; Murillo et al. 2016a).

Along the slopes between 500 m and 900 m depth, benthic assemblages were characterized by a variety of coral species including black corals, cup corals, sea pens, soft corals and gorgonian corals (Table 6.5). The slope areas also had the highest average species richness of the area. Benthic assemblages along the silty-sand lower slope areas at 800 m to 1,200 m were characterized by echinoderms and sea pens (Murillo et al. 2016a). The natural communities along the northern edge of the Flemish Cap (620 m to 1,400 m) could not be properly characterized for occurrences of corals, sponges, and other deep-sea species because the area has been exposed to a high degree of commercial trawling.

The Sackville Spur is a high-density area for deep-sea (1,000 m to 1,700 m) sponge assemblages that are associated with high species richness and maximum bottom currents (Knudby et al. 2013; Barrio Froján et al. 2016; Beazley and Kenchington 2015; Murillo et al. 2016a). 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 Froján et al. (2016) 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, the greatest changes being observed at 1,600 m to1,700 m where there are 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[1]	No. of Trawls present	Contribution to Survey (%)
Shelf / Slope Edge < 200 m	Trawl[2]	Demosponge	Iphon piceum	74	42.0
		Crustacean	Sabinea sarsii	37	21.0
Shelf / Slope Edge 200 m to 340 m	Trawl[2]	Sea star	Ceramaster granularis	63	35.8
		Subarctic sea anemone	Hormathia digitata	39	22.2
Shelf / Slope Edge 300 m to 500 m	Trawl[2]	Sea star	Brisaster fragilis	28	15.9
		Sea star	Ctenodiscus crispatus	15	8.5

Table 6.5 Dominant Invertebrate Species Representative of the Flemish Cap

Depth Zone	Survey Type	Common Name	Scientific Name[1]	No. of Trawls present	Contribution to Survey (%)
Middle Slope 500 m to 900 m	Trawl[2]	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
Middle-Deep Slope 800 m to 1,200 m	Trawl[2]	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
		Sea star	Bathybiaster vexillifer	15	8.5
		Sea star	Zoroaster fulgens	11	6.3
Middle-Deep Slope 700 m to 1,400 m	Trawl[2]	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 m to 1,700 m	Video survey[3]	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

[1] Taxonomic group: P - Phylum, C - Class

Adapted from [2]Murillo et al. (2016a) and [3]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. 2016a).

Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.

Epifaunal communities of the Flemish Pass were described during the NEREIDA program (Beazley et al. 2013a, 2013b; Beazley and Kenchington 2015). Beazley and Kenchington (2015) identified 527 species from a depth range of 400m to 1,400 m. Sponges and cnidarians represented the highest number of taxa, followed by arthropods echinoderms, and molluscs (Table 6.6) (Beazley et al. 2013a; 2013b Beazley and Kenchington 2015).

Mean bottom current speed and mean bottom temperature are some of the most important environmental variables that influence the distribution of benthic assemblages (Barrio Froján et al. 2016). Murillo et al. (2011) characterized coral distributions for the Grand Banks areas beyond the Canadian EEZ and observed that soft corals, gorgonian corals, sea pens, and black corals were characteristic species in the Flemish Pass. For deep areas of the Flemish Pass and Flemish Cap slope, habitat complexity decreases with depth with the onset of higher prevalence of mud substrate. Within the Core BdN Development Area, as observed during the ROV and AUV survey, the shallower eastern area had predominantly mud substrate while the deeper southern and central areas had greater amounts of boulders, rubble, and cobble. Due the small scale of depths between the areas covered in the seabed analysis (1,080 m to 1,150m) this may be a localized effect and not representative of the Flemish Pass overall.

The presence of habitat-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, which in turn enhance species richness and diversity and increase overall biodiversity. Kenchington et al. (2013) noted the association of several demersal fish taxa with *Geodia*-dominated sponge grounds on the Grand Banks and Flemish Cap. Echinoderms, in particular suspension feeding brittle stars, are highly responsive to the presence of habitat-forming sponge grounds (Beazley et al. 2013a; Beazley and Kenchington 2015). In the Flemish Pass, Beazley et al. (2013a) observed a similar trend in benthic communities at the depth range 1,000-1,300 m where there is a distinct change in the density of sponges (Table 6.6).

Table 6.6 Dominant Invertebrate Species Representative of the Flemish Pass

Depth Zone	Survey Type	Common Name	Scientific Name[1]	Number of Units	Contribution to Survey (%)
Total Abundance					
Middle-Deep Slope 400 m to 1,400 m	Photograph survey[2]	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

Table 6.6 Dominant Invertebrate Species Representative of the Flemish Pass

Depth Zone	Survey Type	Common Name	Scientific Name[1]	Number of Units	Contribution to Survey (%)
Number of Taxa / Morphotypes					
Middle-Deep Slope 400 m to 1,400 m	Photograph survey[2]	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

[1] Taxonomic group: P - Phylum
Source: Adapted from [2]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.

Data collected as part of the NEREIDA program in 2015 include three sites within the Project Area and one in the Core BdN Development Area. In the Project Area overall, sea pens were the most commonly encountered group (37 percent of photos reviewed), of which *Pennatula* sp. and *Anthoptilum grandiflorum* were the most commonly encountered (Table 6.7). Other common species encountered were cerianthid anemones (Cnidaria, 30 percent of photos reviewed), the sea urchin *Phormosoma placenta* (Echinodermata, 21 percent of photos reviewed), and Nephtheid soft corals (Alcyoniina, 18 percent of photos reviewed). Sponges were observed in 9 percent of photos reviewed, and *Geodia* sp. was most commonly encountered. Other coral encountered (7 percent of photos reviewed) include the cup coral *Flabellum* sp. and an unknown branching coral.

Within the Core BdN Development Area, soft corals were the most commonly encountered groups (27 percent of photos reviewed), of which Nephtheid soft corals were the most common (Table 6.7). Echinoderms were the next most common (present in 23 percent of photos reviewed), and *Phormosoma placenta* was most commonly encountered, followed by sponges in 15 percent of photos (most common: *Geodia* sp.), and jellyfish and sea anemones in 10 percent of photos reviewed (most common: cerianthid anemones). An unknown branching coral was observed in 1 percent of photos reviewed. Photos taken in the Core BdN Development Area (using the Deep Imager) are further from the seafloor relative to the 4K camera system used elsewhere, less conspicuous species (i.e. brachiopods, brittle stars, small sponges) may be underestimated in the survey.

Table 6.7 Summary of Species Groups Observed in NEREIDA Photo Survey – Project Area and Core BdN Development Area

Common Name	Scientific Name[1]	Project Area (274 photos)[2,3]	Percentage of Photos where Species was Observed (%)	Core BdN (153 photos)[3]	Percentage of Photos where Species was Observed (%)
Sea pens	Pennatulacea (O)	102	37	12	8
Jellyfish / anemones	Cnidaria (P)	82	30	16	10
Echinoderms	Echinodermata (P)	57	21	35	23
Soft Corals	Alcyoniina (SO)	49	18	42	27
Shrimp	Decapoda (O)	30	11	7	5
Sponges	Porifera (P)	25	9	24	16
Other	-	19	7	3	2
Bivalves/Whelk/Squid	Mollusca (P)	16	6	7	5
Worms	Annelida (P)	8	3	0	0
Other Coral	Anthozoa (C)	7	3	2	2

[1] Taxonomic groups: O – Order, P – Phylum, SO – Suborder, C – Class.

[2] Photos within the Project Area include those from within the Core BdN.

[3] Numbers of photos given here are for useable photos, as several were either fully clouded by sediment or shot too high. Total photos for the Project Area and Core BdN Development Area are 399 and 252, respectively. Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.

6.1.7.4 Orphan Basin

The eastern Orphan Basin area, which is approximately 200 km to the north of the Project Area, is characterized by slope to abyssal habitats down to an approximate depth of 4,000 m. Carter et al. (1979) characterized sediments and benthos in parts of the Orphan Basin using a series of Van Veen sediment grabs and seabed photographs. The upper slope of the basin (300 m to 700 m) was dominated by gravel and sandy mud substrates, and polychaetes, bivalves, and echinoderms (echinoids and brittle stars) were the dominant fauna types (Table 6.8). Sponges, bryozoans and brachiopods were observed on cobble and boulders in the area. The middle slope (700 m to 2,000 m) was predominately mud, with benthic communities comprised mainly of cnidarians, polychaetes, echinoids, and brittle stars. Benthic infauna in this area were comprised mostly of mollusc species. The lower slope of the Orphan Basin (2,000 m to 2,500 m) was covered in a mixture of mud, sandy mud and gravels, with a relatively low diversity of polychaetes, ophiuroids and molluscs. The benthic communities in the deepest areas sampled (2,500 m to over 3,000 m) were similar to those observed on the lower slope of the Orphan Basin (Carter et al. 1979). A survey of drilling wellsites in the Orphan Basin was conducted by the international Scientific and Environmental ROV Partnership using Existing Industrial Technology (SERPENT) Project (d'Entremont et al. 2008) using ROV and baited stations. Preliminary data indicate the occurrence of sponges, cnidarians, crustaceans (*Lithodes* sp.) and ophiuroids in the area (Gates et al. 2008).

Table 6.8 Dominant Invertebrate Species within the Orphan Basin

Area	Survey Type	Common Name	Scientific Name[1]
Shallow Slope 300 m to 700 m	Photograph survey[2]	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 m to 2,000 m	Photograph survey[2]	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 2,000m to 2,500 m	Photograph Survey[2]	Polychaete	Polychaeta (C)
		Bivalve mollusc	Bivalvia (C)
		Brittlestar	Ophiuroidea (C)
		Sponges	Porifera (P)
		Brachiopod	Brachiopoda (P)
Deep Slope 2,500 m to more than 3,000 m	Photograph Survey[2]	Polychaete	Polychaeta (C)
		Bivalve mollusc	Bivalvia (C)
		Brittlestar	Ophiuroidea (C)

[1]Taxonomic group: P - Phylum, C - Class, O - Order
Adapted from [2]Carter et al. 1979. Abundance data not available

6.1.7.5 Equinor Canada Seabed Surveys

The following information summarizes the benthic and fish habitat data collected during the Equinor Canada seabed surveys and surveys associated with exploration drilling. As described in Section 6.1.1.5, this data was collected within the Core BdN Development Area (Figure 6-3) to support ongoing Project design and to provide more information regarding coral and sponge presence in the area. Further discussion on coral and sponge species observed during the Equinor Canada 2018 Seabed Survey are detailed in Section 6.1.7.6.

2016 Exploration Wellsites Surveys

Substrate at the Baccalieu F-89 wellsite was visible in 95 sections of the survey video (92 percent of the sections) and was comprised entirely of mud (100 percent). Seven macroinvertebrates were observed during re-analysis of the Baccalieu F-89 video (Table 6.9). Cnidarians were the most commonly observed organisms and were mainly comprised of sea pens. Sea pens accounted for 76 percent of species observed. Some of the observed organisms could not be identified to species including echinoderms, cnidarians, and crustaceans. Very little habitat complexity was observed along the transects. As expected, no macroflora were observed at this depth.

Table 6.9 Dominant Species Groups at the Baccalieu F-89 Wellsite in the Core BdN Development Area

Site	Survey Type	Common Name	Scientific Name[1]	Total Abundance	Sections Present[2] (%)	Contribution to Survey (%)
Baccalieu Wellsite 1,150 m	ROV Video Survey	Sea pen	Anthoptilum sp.	193	73	60
		Sea pen	Halipteris sp.	53	39	16
		Echinoderm species	Echinodermata (P)	50	31	16
		Cnidarian species	Cnidaria (P)	18	14	6
		Crustacean species	Crustacea (P)	8	13	2

[1]Taxonomic group: P - Phylum
[2]Percent of Sections Present is based on 103 surveyed sections for Baccalieu F-89 Wellsite
Contribution to survey: Reported percentage of total abundance.
Tentative identifications based on visual ROV survey.

2018 Seabed Survey

Based on visual data, substrate in the southern area of the Core BdN Development Area (survey stations P1 and P2) was approximately 93 percent mud, 5 percent boulders, <1 percent rubble, and <1 percent cobble. Substrate was similar in the central area (P3, P7, P8, P9, and P10), and was comprised of approximately 92 percent mud, 4 percent boulders, 2 percent rubble, and 1 percent cobble. Where rocks of any size were observed, soft corals or sponges were present in nearly 100 percent of cases. Species that require attachment sites (soft corals and sponges) were also observed regularly between rocks, indicating the likely presence of hard substrate below surface sediments. The eastern survey area included sites P4a P4b, and P4c that were predominantly covered in mud substrate. Bottom type in P4a based on subsampled ROV video was approximately 99 percent mud, <1 percent boulders and <1 percent rubble. Survey site P4b and P4c was almost 100 percent mud and <1 percent boulders based on reviewed ROV and AUV images. Substrate totals do not necessarily total 100% due to rounding.

Using multi-beam echosounder (MBES) data collected using the AUV, hard targets over 20 cm were identified within 1.5 km of each drill centre (Figure 6-8, Figure 6-9). The southern area (P1 and P2) had 3,005 hard targets together, with P2 having 177 more targets than P1 and the highest amount overall (Figure 6-8). The central area (P3) had 1,861 hard targets and the eastern area (P4a and P4b) had 1,474, with P4a having 612 more targets than P4b (Figure 6-9). As stated above, species from the soft coral functional groups or sponge functional groups were present on nearly all rocks observed during the ROV and AUV survey. Conservatively, it is assumed that all of these hard targets are likely to have soft corals and / or sponges present.

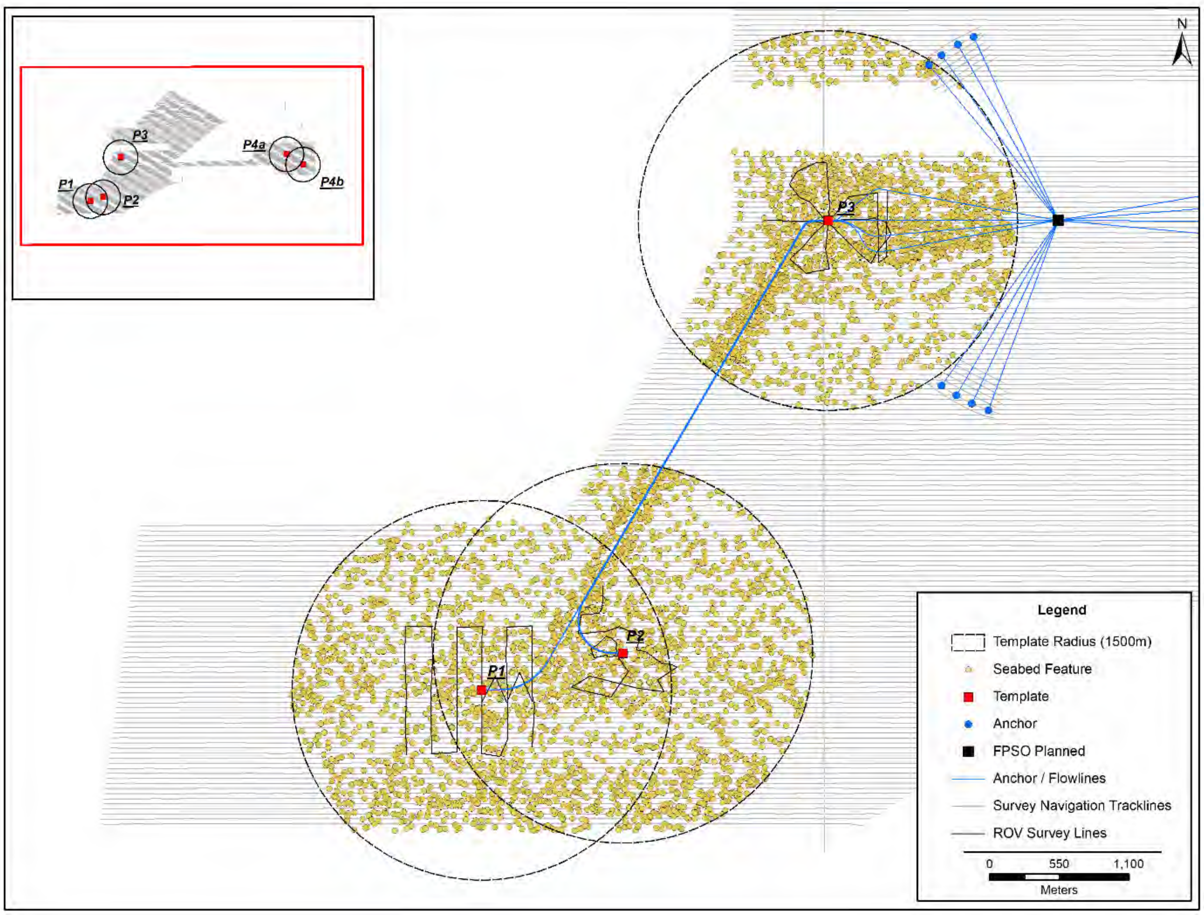

Figure 6-8 Multi-beam echosounder identified hard targets within 1.5 km of proposed drill centres in the southern and central Bay du Nord area.

Figure 6-9 Multi-beam echosounder identified hard targets within 1.5 km of proposed drill centres in the eastern Bay du Nord area.

Corals, sponges, and echinoderms were typically the most abundant and distributed macrofauna in southern and central areas (Table 6.10). Soft coral species (Family Nephtheidae) dominated the coral group and sponges observed were primarily comprised of the solid / massive functional group. Further details on coral and sponge species in the Project Area are presented in Section 6.1.7.6. Echinoderms observed were primarily sea urchins. In the southern area, these three species groups accounted for 61 to 83 percent of macrofauna observed and were well distributed across survey areas. Sponges were observed in 65.0 to 81.7 percent of survey sections and corals were observed in 67 to 90 percent of survey sections. Echinoderms were also distributed in 81 to 97 percent of survey sections. In the central area, corals, sponges, and echinoderms were the most common groups, with cnidarians becoming more prevalent toward to western site (P10). Sponges and corals were present in 94 to 100 and 67 to 100 percent of survey sections, respectively. Echinoderms were distributed in 94 to 100 percent of survey sections. Nephtheid soft corals were the predominant coral group, and solid / massive sponge functional group were the predominant sponges.

In the eastern area, corals, other cnidarian species (anemones and jellyfish), and corals were the most commonly observed macrofauna (Table 6.10). Corals and other cnidarians accounted for 71 to 90 percent of macrofaunal observed. Corals were observed in 86 to 100 percent of survey sections across ROV and AUV. Jellyfish and anemones were present in 81 to 100 percent of survey sections. Echinoderms had relatively lower distribution and were observed in 75 to 100 percent of survey sections and were mainly comprised of sea stars. Corals in this area were predominantly sea pens. The most common non-coral cnidarian group was anemones. Few soft corals and sponges were observed in the Eastern areas, likely due to the lack of hard substrate and rocks in the area.

Table 6.10 Species Observed in the Core BdN Development Area - 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Common Name	Scientific Name 1	Sections Present (%)	Contribution to Survey (%)
Southern Area	ROV	P1	Sponges	Porifera (P)	89.7	32.9
			Corals	Anthozoa (C)	89.7	24.6
			Echinoderms	Echinodermata (P)	89.7	18.6
			Jellyfish / anemones	Cnidaria (P)	86.8	16.8
			Other Invertebrate	-	97.1	5.2
			Bivalves / Whelk / Squid	Mollusca (P)	30.9	1.8
		P2	Other Invertebrate	-	83.1	31.7
			Corals	Anthozoa (C)	89.5	30.2
			Sponges	Porifera (P)	87.9	23.6
			Echinoderms	Echinodermata (P)	81.5	6.8
			Jellyfish / anemones	Cnidaria (P)	68.5	6.7
			Bivalves / Whelk / Squid	Mollusca (P)	41.1	1.1
Central Area	ROV	P3	Corals	Anthozoa (C)	94.4	44.6
			Echinoderms	Echinodermata (P)	97.2	22.7
			Sponges	Porifera (P)	66.7	15.4
			Jellyfish / anemones	Cnidaria (P)	94.4	10.7
			Other Invertebrate	-	84.3	6.1
			Bivalves / Whelk / Squid	Mollusca (P)	28.7	0.5

Table 6.10 Species Observed in the Core BdN Development Area - 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Common Name	Scientific Name 1	Sections Present (%)	Contribution to Survey (%)
Central Area	AUV	P7	Sponges	Porifera (P)	100	34.9
			Corals	Anthozoa (C)	93.8	34.1
			Echinoderms	Echinodermata (P)	100	25.6
			Jellyfish / anemones	Cnidaria (P)	75.0	3.1
			Other Invertebrate	-	37.5	2.1
			Bivalves / Whelk / Squid	Mollusca (P)	18.8	0.2
		P8	Corals	Anthozoa (C)	100	50.8
			Sponges	Porifera (P)	100	30.8
			Echinoderms	Echinodermata (P)	100	10.6
			Other Invertebrate	-	100	5.6
			Jellyfish / anemones	Cnidaria (P)	91.7	2.0
			Bivalves / Whelk / Squid	Mollusca (P)	33.3	0.2
		P9	Sponges	Porifera (P)	100	39.0
			Corals	Anthozoa (C)	100	34.9
			Echinoderms	Echinodermata (P)	94.1	18.7
			Jellyfish / anemones	Cnidaria (P)	100	4.5
		P9	Other Invertebrate	-	64.7	2.6
			Bivalves / Whelk / Squid	Mollusca (P)	17.6	0.1
		P10	Sponges	Porifera (P)	93.5	51.5
			Corals	Anthozoa (C)	100	21.8
			Jellyfish / anemones	Cnidaria (P)	100	13.7
			Echinoderms	Echinodermata (P)	100	10.3
			Other Invertebrate	-	93.5	2.1
			Bivalves / Whelk / Squid	Mollusca (P)	61.3	0.5

Table 6.10 Species Observed in the Core BdN Development Area - 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Common Name	Scientific Name 1	Sections Present (%)	Contribution to Survey (%)
Eastern Area	ROV	P4a	Corals	Anthozoa (C)	86.4	40.8
			Jellyfish / anemones	Cnidaria (P)	80.5	30.0
			Sponges	Porifera (P)	22.0	16.1
			Echinoderms	Echinodermata (P)	74.6	9.8
			Bivalves / Whelk / Squid	Mollusca (P)	48.3	2.1
			Other Invertebrate	-	21.2	1.2
		P4b	Corals	Anthozoa (C)	100	51.2
			Jellyfish / anemones	Cnidaria (P)	100	28.9
			Other Invertebrate	-	81.3	12.8
			Echinoderms	Echinodermata (P)	100	6.9
			Bivalves / Whelk / Squid	Mollusca (P)	12.5	0.2
			Sponges	Porifera (P)	6.3	0.1
	AUV	P4b	Corals	Anthozoa (C)	100	62.2
			Jellyfish / anemones	Cnidaria (P)	96.3	17.9
			Echinoderms	Echinodermata (P)	98.8	11.9
			Other Invertebrate	-	91.5	6.3
			Bivalves / Whelk / Squid	Mollusca (P)	47.6	1.6
			Sponges	Porifera (P)	6.1	0.1
		P4c	Jellyfish / anemones	Cnidaria (P)	100	47.7
			Corals	Anthozoa (C)	100	34.3
			Echinoderms	Echinodermata (P)	98.0	10.4
			Other Invertebrate	-	93.4	5.7
			Bivalves / Whelk / Squid	Mollusca (P)	42.8	1.1
			Sponges	Porifera (P)	21.7	0.8

[1]Taxonomic group: P – Phylum, C – Class
Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.
Other Invertebrates includes minor groups with low abundances (arthropods, annelids, brachiopods, and ctenophores)

6.1.7.6 Corals and Sponges

Habitat complexity in deep-sea environments is highly dependent on habitat-forming organisms, including corals, sea pens, and sponges (DFO 2015a, 2017d), which has direct and indirect influences on fish and invertebrate abundance and occurrence. The living habitat created by these long-lived and slow growing organisms are important refuges (Edinger et al. 2007; WG-EAFM 2008; Wareham 2009; Baker et al. 2012b; Baillon et al. 2014a), nursery areas (Baillon et al. 2012; Beazley et al. 2013a; DFO 2015a), and foraging areas (Baker et al. 2012b; DFO 2015a) 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 2015a). Habitat complexity within the Project Area decreases with depth (Murillo et al. 2016a). Therefore, patchy coral and sponge reef areas may provide “oases” in often barren deep-sea areas (Baker et al. 2012b).

Sponges are a major component of sessile benthic communities in temperate, polar and tropical habitats, and have a number of functional roles in marine ecosystems, including the filtration of large quantities of water and acting as a major link between benthic and pelagic environments (Bell 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 in the northwest Atlantic Ocean are designated as Ecologically and Biologically Significant Areas (EBSAs) or VMEs, with some closed to fishing activities (see Section 6.4.2.5).

Corals

More than 80 species of corals and sea pens have been observed in the vicinity of the Project Area (Table 6.11) along the shelf of the Flemish Cap, the Flemish Pass and northeast slope of the Grand Banks based on bottom trawling and seabed surveys (Wareham 2009; Murillo et al. 2011; Beazley et al. 2013a, Vázquez et al. 2013; Baillon et al. 2014a, 2014b; Beazley and Kenchington 2015; Miles 2018).

Dominant coral functional groups in the Project Area included the sea pens and soft corals (Table 6.12) based on Canadian and EU RV surveys and the Equinor Canada 2018 Seabed Survey. Canadian and EU RV surveys indicated that sea pens were mainly distributed on the slopes and bottom of the Flemish Pass whereas soft corals were mainly distributed in shallow shelf areas (Figure 6-10, Figure 6-11). However, the seabed surveys indicated that soft corals were common in the southern and central areas of the Core BdN Development Area and were associated with rocks of all sizes. Canadian RV surveys in this area capture large quantities of soft corals at these depths, so the numbers observed appear to be typical for the area. In Canadian RV surveys, *Duva florida* was the most commonly observed species in the Project Area and other Nephtheidae species, *Anthomastus* sp. and *Gersemia* sp. observed to a lesser extent (Table 6.13). Soft corals were not common in the eastern survey area of the Core BdN Development Area, likely due to lack of rocks and predominance of mud substrates.

Table 6.11 Corals Occurring within the Project Area and Adjacent Marine Environments

Order	Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	NE Grand Bank	Project Area	Reference
Antipatharia	Black-wire corals	Bathypathes spp.	-	●	●			1; 10
		Leiopathes sp.	-		●			2
		Stauropathes artica	480 to 970	●	●	●	●	1; 2; 5; 8; 9; 11
		Stauropathes magna	-		●			3
		Stichopathes sp.	243	●			●	2; 5; 8
Alcyonacea	Large gorgonians	Acanella arbuscula	480 to 1,442	●	●	●	●	1; 2; 5; 6; 9
		Acanella sp.	-				●	11
		Chrysogorgia sp.	-	●				10
		Isididae sp.	-	●				10
		Keratoisis ornata	-		●			1
		Keratoisis sp.	-	●	●			2; 3
		Keratoisis cf. siemensii	979 to 1,374	●				8
		Lepidisis sp.	-	●				10
		Paragorgia sp.	-	●				5; 10
		Paragorgia arborea	250 to 750		●	●	●	1; 2; 9
		Paragorgia johnsoni	1,079 to 1,351	●				2; 8
		Paramuricea sp.	-	●				2; 5
		Paramuricea spp.	335 to 1,351	●	●	●		1; 2; 3; 8; 10
		Paramuricea grandis	1,094 to 1,216	●				8
		Paramuricea placomus	494 to 646	●				8
		Parastenella atlantica	1351	●				2; 8
		Placogorgia sp.	404 to 423	●				2; 8
		Primnoa sp.	-	●				10
		Primnoa resedaeformis	527 to 619	●		●	●	2; 5; 8; 9

Table 6.11 Corals Occurring within the Project Area and Adjacent Marine Environments

Order	Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	NE Grand Bank	Project Area	Reference
		Swiftia sp.	984 to 1,332	●				2; 5; 8
	Small gorgonians	Acanthogorgia sp.	-	●	●			3; 5; 10
		Acanthogorgia armata	494 to 1,351		●		●	1; 8; 9
		Anthothela sp.	-	●				5
		Anthothela grandiflora	707 to 1,351	●	●			1; 2; 6; 8
		Chrysogorgia sp.	-	●				10
		Chrysogorgia cf. agassizii	-	●				10
		Corallium sp.	-	●				10
		Narella cf. laxa	-	●				10
		Parastenella sp.	-	●				10
		Radicipes sp.	-	●				5
		Radicipes gracilis	416 to 1,370	●	●			1; 2; 8
		Swiftia *sp.*	-	●				10
	Soft corals	Anthomastus grandiflorus	612	●	●			1; 8
		Anthomastus sp.	601 to 1,162	●	●	●	●	2; 5; 9; 11
		Anthomastus spp.	1,095 to 1,370	●	●			2; 8; 10
		Anthomastus cf. agaricus	634			●	●	9
		Anthothela grandiflora	707 to 1,351	●				2; 8
		Clavulariidae species	228 to 1,290	●				2; 8
		Drifa glomerata	47 to 1,370	●				8
		Drifa glomerata	620 to 985			●	●	9
		Drifa sp.	712 to 985			●	●	9

Table 6.11 Corals Occurring within the Project Area and Adjacent Marine Environments

Order	Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	NE Grand Bank	Project Area	Reference
		Duva florida	56 to 1,374	●	●	●	●	1; 2; 5; 7; 8; 9
		Gersemia sp.	383 to 632	●		●	●	5; 9
		Gersemia fruticosa	110	●				8
		Gersemia rubiformis	46 to 246		●	●		1; 2; 8
		Heteropolypus sp.	-	●				5
		Heteropolypus cf. insolitus	603 to 985		●	●	●	6; 9; 10; 11
		Heteropolypus sol	348 to 1,290	●				8
		Nephtheidae indet.	-	●	●	●	●	2; 11
		Pseudoanthomastus agaricus	624 to 1,351	●				8
		Telestula septentrionalis	494 to 1,332	●				2; 8
		Neptheidae sp.	383 to 833	●		●		9; 10; 11
Scleractinia	Solitary stony corals	Flabellum alabastrum	359 to 1,189	●	●	●	●	1; 2; 8; 9
		Flabellum angulare	-		●			6
		Flabellum sp.	-				●	11
		Desmophylllum dianthus	-	●	●			2; 10
Pennatulacea	Sea pens	Anthoptilum sp.	-	●	●		●	3; 5; 11
		Anthoptilum grandiflorum	200 to 1,370	●	●	●	●	1; 2; 4; 8; 9; 10; 11
		Distichoptilum gracile	727 to 1,020	●	●			2; 5; 8
		Funiculina quadrangularis	476 to 1,258	●	●	●	●	1; 2; 5; 8; 9
		Funiculina sp.					●	11
		Halipteris sp.	-		●		●	3; 6; 11
		Halipteris cf. christii	169 to 290	●				2; 5; 8

Table 6.11 Corals Occurring within the Project Area and Adjacent Marine Environments

Order	Group	Species	Depth Range (m)	Flemish Cap	Flemish Pass	NE Grand Bank	Project Area	Reference
		Halipteris finmarchica	320 to 1,370	●	●	●	●	1; 2; 4; 5; 8; 9; 10
		Kophobelemnon stelliferum	657 to 1,258	●				2; 5; 8
		Kophobelemnon sp.	-		●			3; 6
		Pennatula sp.	833 to 1,149	●	●		●	3; 5; 6; 9
		Pennatula aculeata	302 to 1,189	●	●	●		2; 5; 8
		Pennatula cf. aculeata	514 to 1000		●	●	●	9
		Pennatula grandis	324 to 1,246	●	●	●	●	1; 2; 5; 8; 9
		Pennatula phosphorea	-		●		●	1
		Pennatula cf. phosphorea	846 to 1,080		●	●		9
		Protoptilum sp.	-	●				2
		Protoptilum carpenter	973	●				8
		Umbellula sp.	-	●				5
		Umbellula encrinus	-	●				10
		Umbellula lindahli	402 to 1,370	●	●			1; 2; 8
		Unidentified Sea Pens	-	●	●		●	1; 9; 11
		Virgularia sp.	-	●				2
		Virgularia mirabilis	1,343	●			●	8; 11

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. (2016a); [9]DFO RV Data (2004 to 2015); [10]Miles (2018); [11]Equinor Canada Seabed Surveys (2016 to 2018).

Listed depth ranges are from Murillo et al. (2016a), Buhl-Mortensen et al. (2015), and DFO RV Data (2004 to 2015).

Table 6.12 Summary of Coral Groups from 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Functional Group	Scientific Name [1]	Sections Present (%)	Contribution to Coral (%)
Southern Area	ROV	P1	Soft coral	Alcyonacea (O)	89.7	74.8
			Sea pens	Pennatulacea (O)	86.8	24.5
			Branching coral	Alcyonacea (O)	11.8	0.7
		P2	Soft coral	Alcyonacea (O)	89.5	95.1
			Sea pens	Pennatulacea (O)	50.0	4.1
			Branching coral	Alcyonacea (O)	16.9	0.7
			Black coral	Antipatharia (O)	0.8	0.1
			Hard coral	Scleractinia (O)	1.6	0.1
Central Area	ROV	P3	Soft coral	Alcyonacea (O)	93.5	92.7
			Sea pens	Pennatulacea (O)	79.6	6.1
			Branching coral	Alcyonacea (O)	30.6	1.1
			Black coral	Antipatharia (O)	0.9	0.1
	AUV	P7	Soft coral	Alcyonacea (O)	93.4	92.6
			Sea pens	Pennatulacea (O)	62.5	5.9
			Branching coral	Alcyonacea (O)	31.3	1.1
			Hard coral	Scleractinia (O)	18.8	0.4
		P8	Soft coral	Alcyonacea (O)	100	99.3
			Sea pens	Pennatulacea (O)	33.3	0.4
			Branching coral	Alcyonacea (O)	25.0	0.3
		P9	Soft coral	Alcyonacea (O)	100	95.6
			Sea pens	Pennatulacea (O)	94.1	4.0
			Branching coral	Alcyonacea (O)	11.8	0.2
			Hard coral	Scleractinia (O)	5.9	0.1
		P10	Soft coral	Alcyonacea (O)	93.5	63.0
			Sea pens	Pennatulacea (O)	93.5	21.8
			Branching coral	Alcyonacea (O)	48.4	2.2
			Hard coral	Scleractinia (O)	12.9	0.3
			Black coral	Antipatharia (O)	3.2	0.1

Table 6.12 Summary of Coral Groups from 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Functional Group	Scientific Name [1]	Sections Present (%)	Contribution to Coral (%)
Eastern Area	ROV	P4a	Sea pens	Pennatulacea (O)	86.4	76.0
			Soft coral	Alcyonacea (O)	17.8	21.6
			Branching coral	Alcyonacea (O)	26.3	2.4
		P4b	Sea pens	Pennatulacea (O)	100	96.7
			Branching coral	Alcyonacea (O)	56.3	3.1
			Hard coral	Scleractinia (O)	6.3	0.2
	AUV	P4b	Sea pens	Pennatulacea (O)	100	96.4
			Branching coral	Alcyonacea (O)	58.5	3.5
			Hard coral	Scleractinia (O)	3.7	0.1
		P4c	Sea pens	Pennatulacea (O)	100	87.5
			Soft coral	Alcyonacea (O)	36.8	6.7
			Branching coral	Alcyonacea (O)	67.1	5.4
			Hard coral	Scleractinia (O)	6.6	0.3
			Black coral	Antipatharia (O)	2.6	0.1

[1]Taxonomic group: O – Order, SO – Superorder, F - Family
Contribution to survey: Reported percentage of total abundance, biomass, or presence in the survey.
Functional Groups are based on Kenchington et al. (2015)

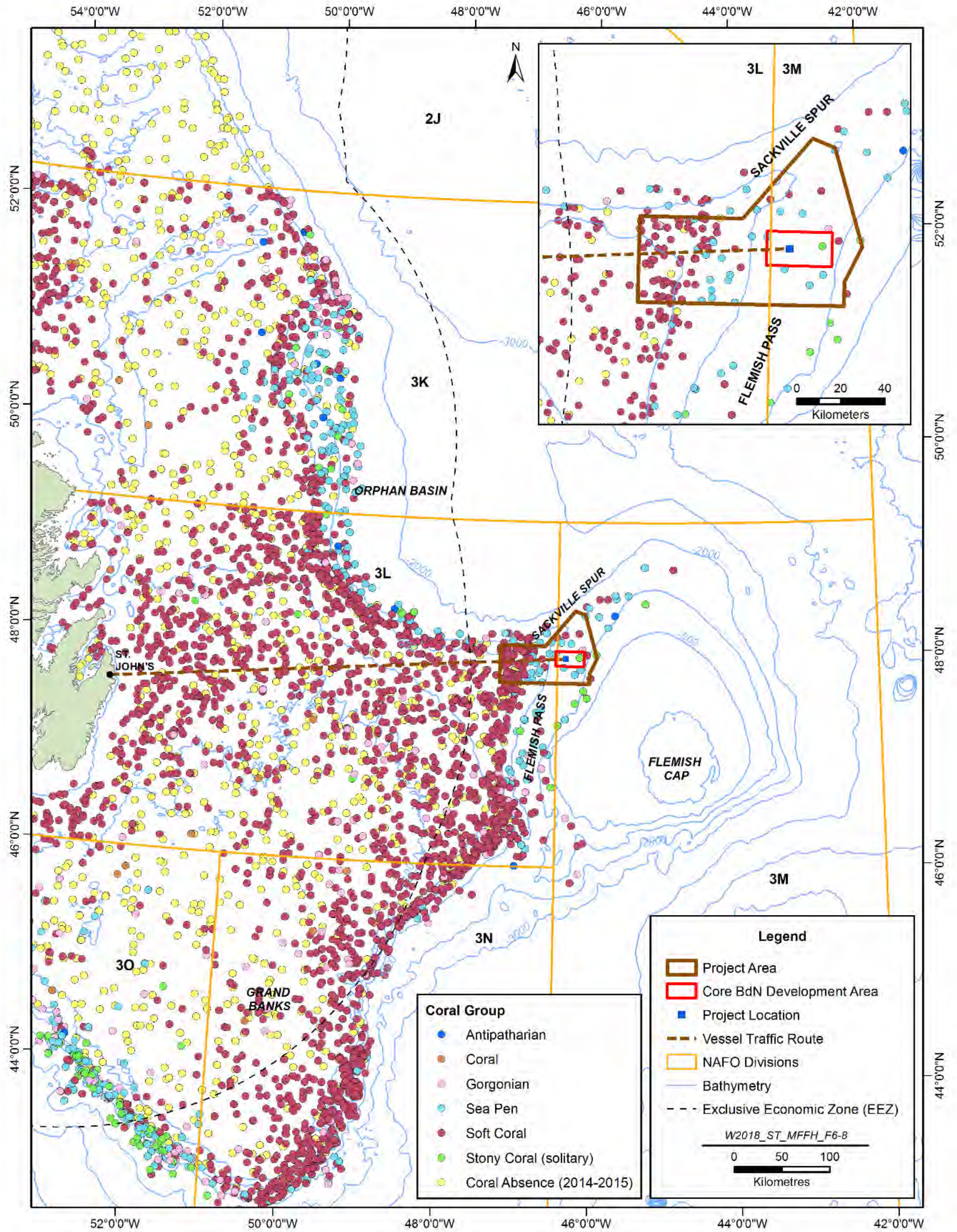

Figure 6-10 Summary of Regional Coral Distributions Compiled from Canadian RV Data (2004 to 2015)

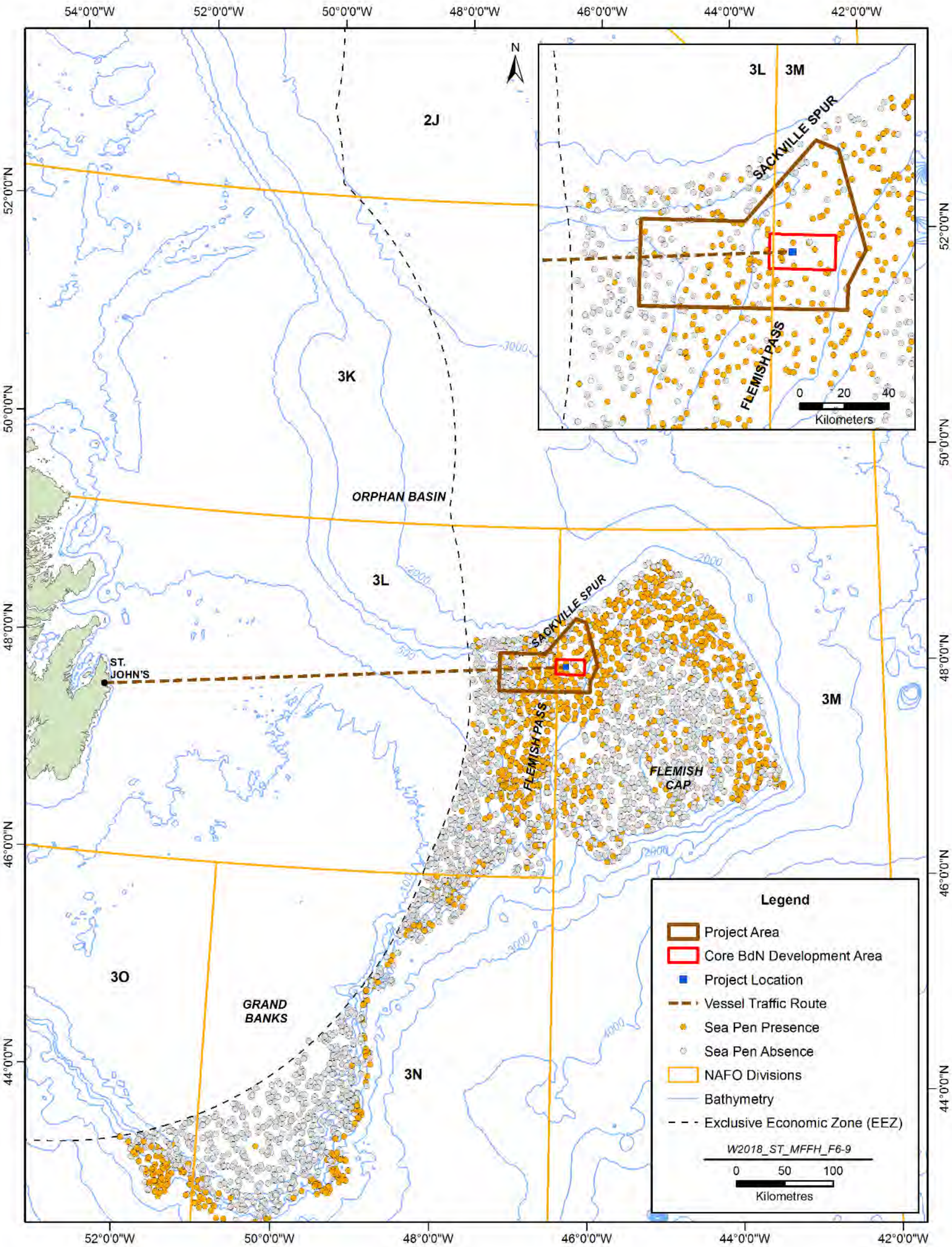

Figure 6-11 Summary of Sea Pen Coral Distributions in and Around the Project Area (Based on EU RV Data 2002 to 2013)

Table 6.13 Percentage of Trawls with Coral Catches based on Canadian RV Surveys (2004 to 2015) within the Project Area

Coral Species	Canadian RV Surveys (340 m to 1,178 m depth range)	
	No. of Trawls with Corals	Percentage of Trawls with Corals[1]
Black Wire Coral		
Stauropathes arctica	2	2.0
Gorgonian		
Acanella arbuscula	2	2.0
Acanthogorgia armata	1	1.0
Paragorgia arborea	2	2.0
Primnoa resedaeformis	1	1.0
Sea Pen		
Anthoptilum grandiflorum	22	21.8
Funiculinia quandrangularis	6	5.9
Halipteris finmarchica	7	6.9
Pennatula cf. *aculeata*	5	5.0
Pennatula cf. *phosphorea*	3	3.0
Pennatula grandis	8	7.9
Pennatula sp.	8	7.9
Sea pen species	7	6.9
Soft Coral		
Anthomastus sp.	10	9.9
Anthomastus cf. *agaricus*	1	1.0
Drifa cf. *glomerata*	2	2.0
Drifa sp.	2	2.0
Duva florida	79	78.2
Gersemia sp.	9	8.9
Nephtheidae species	13	12.9
Heteropolypus cf. *insolitus*	4	4.0
Solitary Stony Coral		
Flabellum alabastrum	6	5.9

[1] Based on total number of trawls, n = 101

Sea pens were common at all seabed survey sites but were the dominant coral group in eastern survey areas. In EU RV surveys, sea pens were present in 57 percent of trawls and were mainly distributed in bottom of the Flemish Pass and the deep slopes of the Grand Bank and Flemish Cap (Table 6.14). Murillo et al. (2011) indicated that most commonly observed sea pen species observed in the EU RV surveys included *Anthoptilum grandiflorum*, *Funiculina quadrangularis*, *Pennatula aculeata* and *Halipteris finmarchica*. Sea pens in the Core BdN Development Area did not form dense aggregations (sea pen fields) as have been observed in other areas of the Grand Banks. Baker et al. (2012b) observed up to 622 *Pennatula* sp. individuals per 10 m transect in the Desbarre Canyon (southern Grand Banks) whereas the highest density for the seabed survey was approximately 14 individuals per 10 m transect. A recent modelling study indicated that VME areas on the Flemish Cap are weakly connected by sea pen larval dispersal (Kenchington et al. 2018). Sea pens in the Flemish Pass are part of the recruitment source for other areas of the Flemish Cap (Kenchington et al. 2018).

Table 6.14 Corals Presence/Absence in the Project Area Based on EU RV Surveys (2002 to 2013)

Benthic Group	EU RV Surveys (500 m to 1000 m depth range)		
	No. of Trawls Group Present	No. of Trawls Group Absent	% of Trawls Group Present[1]
Small Gorgonians	11	228	4.6
Large Gorgonians	2	237	0.8
Sea Pens	137	102	57.3

[1] Based on total number of trawls, n = 239. The most commonly encountered species of each group were described by Kenchington et al. (2014).

Other coral functional groups, including branching corals, black corals, and hard corals, were not commonly observed in the Project Area in Canadian and EU RV surveys (Figure 6-10 to Figure 6-13). Canadian and EU RV surveys indicated that gorgonian and black-wire corals were in less than five percent of trawls in the Project Area (Table 6.14, Table 6.16). Bamboo corals (e.g., *Keratoisis* sp., *Acanella* sp.) are large gorgonian corals that have been documented in the Flemish Pass. *Acanella arbuscula* can form large coral fields in soft substrates (Beazley et al. 2013b; NAFO 2013, 2016a). *Keratoisis* sp. colonies that have been observed to reach more than 1 m height regionally (Baker et al. 2012b; Beazley et al. 2013b) and have been associated with various sponge species (Dinn and Leys 2018). Canadian RV surveys that indicate that stony cup corals were present in six percent of trawls mainly on the slopes in the Project Area

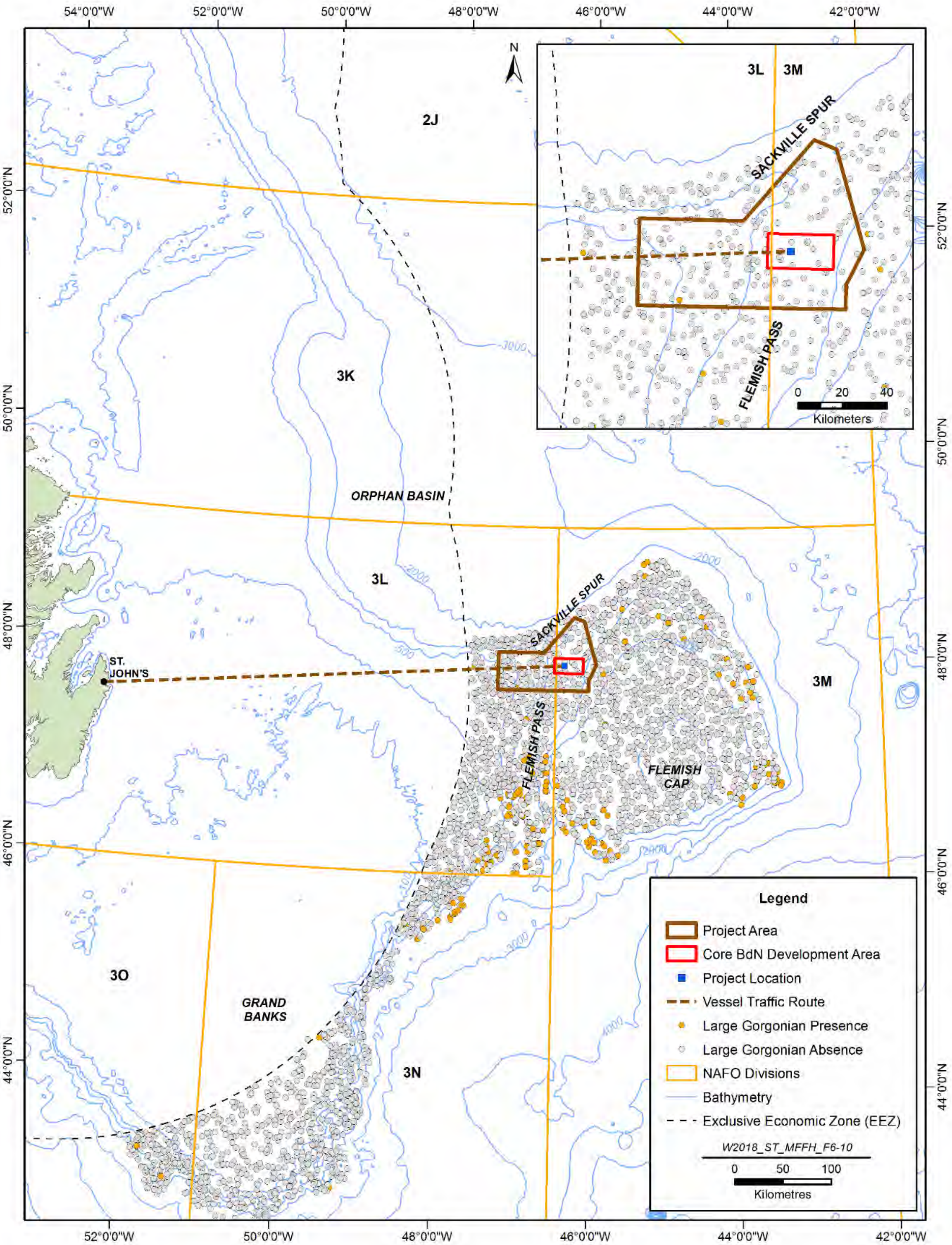

Figure 6-12 Summary of Large Gorgonian Coral Distributions in and Around the Project Area (Based on EU RV Data 2002 to 2013)

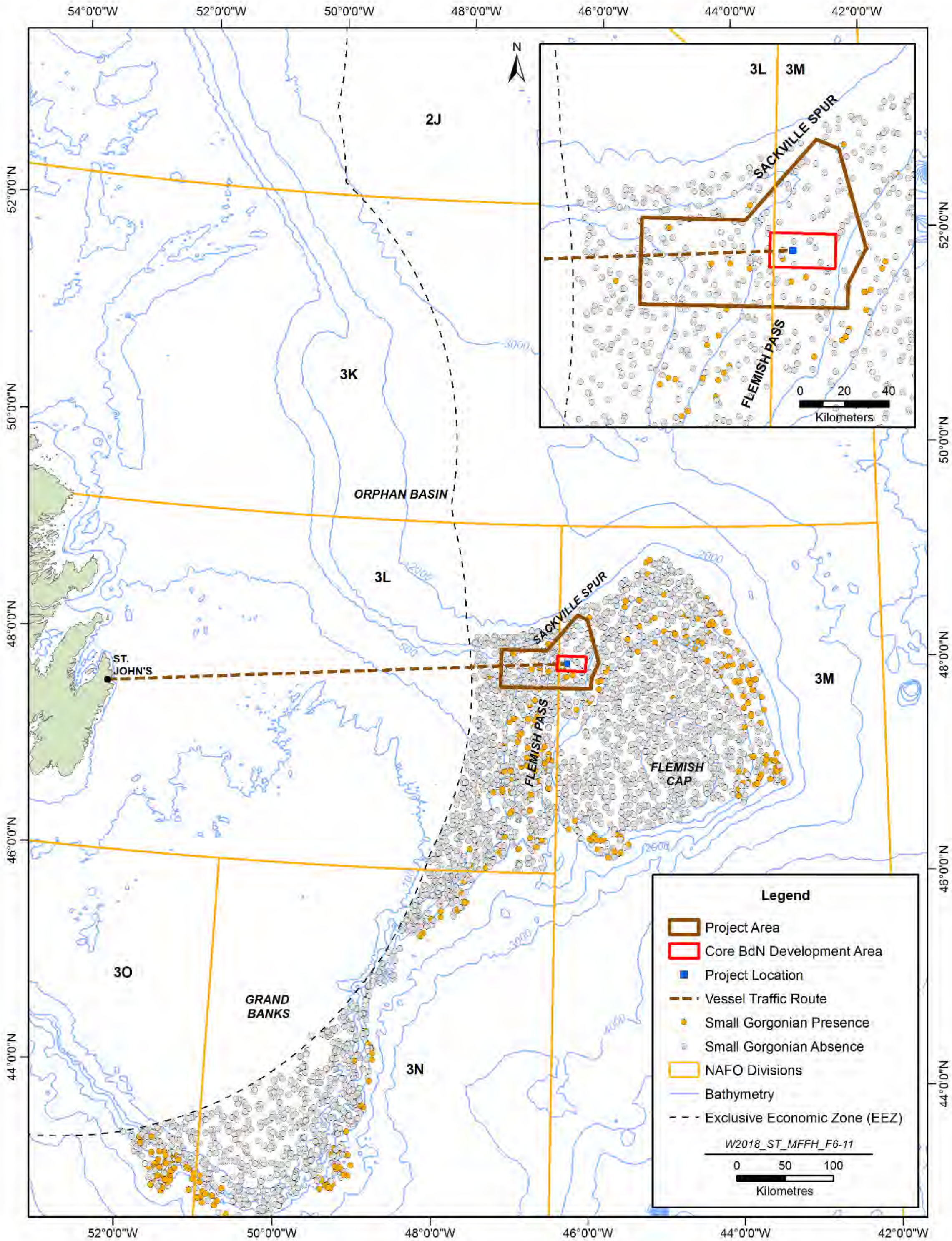

Figure 6-13 Summary of Small Gorgonian Coral Distributions in and Around the Project Area (Based on EU RV Data 2002 to 2013)

Table 6.15 Sponge Species Occurring within the Project Area and Adjacent Environments

Group	Scientific Name	Depth Range (m)	Flemish Cap	Flemish Pass	Project Area	Reference
Hexactinellida	*Aphrocallistes beatrix*	404	●			5
	Asconema foliata	138 to 1,374	●	●	●	4; 5; 7
	Asconema sp.	-	●			2
	Dictyaulus romani	1,079 to 1,332	●			5
	Euplectellidae indet.	-	●			4
	Rosselidae indet	-			●	6
Demospongiae	Demospongiae indet.	144 to 163	●	●	●	4; 5
	Desmacellida indet.	170 to 1,249	●			5
	Haliclona (*Gellius*) sp.	170 to 380	●			5
	Paratimea sp.	1,079 to 1,094	●			5
	Phakellia sp.	1,216	●			5
	Spongionella pulchella	494 to 538	●			5
	Tethya aurantium	138 to 341	●			5
Polymastiida	*Polymastia andrica*	306 to 1,295	●			5
	Polymastia corticata	1,079	●			5
	Polymastia thielei	527 to 528	●			5
	Polymastia uberrima	138 to 666	●			5
	Quasillina richardi	138 to 759	●			5
	Radiella hemisphaerica	141 to 494	●			5
	Polymastiidae indet.	-			●	7
Spirophorida	*Craniella* spp.	-	●	●		2
	Craniella cranium	138 to 1,374	●			4; 5
	Craniella polyura	159 to 478	●			5
Astrophorida	Ancorinidae indet.	-	●			4
	Stelletta normani	759 to 1,374	●			4; 5
	Stelletta tuberosa	1,079 to 1,332	●			5
	Stryphnus fortis	759 to 1,374	●			5
	Stryphnus ponderosus	-	●			4
	Geodia sp.	-			●	7
	Geodia barretti	979 to 1,374	●	●		3; 4; 5
	Geodia macandrewii	874 to 1,374	●			4; 5
	Geodia phlegraei	874 to 1,374	●			3; 4; 5
	Thenea muricata	567 to 1,374	●			4; 5

Table 6.15 Sponge Species Occurring within the Project Area and Adjacent Environments

Group	Scientific Name	Depth Range (m)	Flemish Cap	Flemish Pass	Project Area	Reference
Hadromerida	Hemiasterellidae indet.	-	●			4
	Weberella bursa	478 to 1,370	●			4; 5
	Weberella sp.	-	●			4
	Rhizaniella sp.	452 to 1,351	●	●		1; 4; 5
	Stylocordyla borealis	335 to 866		●	●	1; 5; 7
Poecilosclerida	*Asbestopluma* sp.	-	●			2
	Artemisina arcigera	154 to 620	●			5
	Chondrocladia sp.	404	●			2; 5
	Iophon piceum	138 to 1,351	●			4; 5
	Esperiopsis villosa	141 to 1,290	●			5
	Forcepia sp.	629 to 1,351	●			4; 5
	Hymedesmiidae sp.	-	●			2
	Crella sp.	119 to 1,249	●			4; 5
	Mycale lingua	119 to 1,351	●			4; 5
	Mycale loveni	148 to 777	●			5
	Myxilla sp.	1,216 to 1,332	●			4; 5
Halichondrida	Halichondrida indet.	-	●			4
	Hymeniacidon sp.	59 to 1,351	●			4; 5
	Axinella sp.	257 to 538	●			4; 5
	Axinella sp.	1,079 to 1,242	●		●	5; 7
Unidentified Sponge Species	Phylum Porifera	340 to 1382	●	●	●	6; 7

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. 2016a, 2016b; [6]Canadian RV data 2000 to 2015; [7]Equinor Canada Seabed Survey (2018).
Listed depth ranges are from Murillo et al. (2016a), Buhl-Mortensen et al. (2015), and Canadian RV Data (2000 to 2015).

Modelling analyses (Guijarro et al. 2016; Gullage et al. 2017) and seabed surveys (Miles 2018) indicate that depth and substrate and parameters such as bottom temperature, salinity and slope are main factors in determination of cold water coral presence in western North Atlantic waters. Gullage et al. (2017) demonstrated that the continental shelf break and canyons on the upper continental shelf (including the outer edges of the Flemish Cap) can provide ideal habitat for corals. The Flemish Cap, primarily adjacent to the Project Area, has the greatest coral richness among the areas assessed, likely due to the diversity of habitat types and depth gradients (Murillo et al. 2011, 2016a; Miles 2018). Within and adjacent to the Project Area, coral biomass is mainly distributed along the slopes of the Flemish Pass, the Flemish Cap, and the Grand Bank (Murillo et al. 2011). Coral data collected during Canadian and EU RV surveys and data from literature indicates with high concentrations on the slope of the Grand Banks / Flemish Pass in the Project Area. Coral biomass was highest at the depth range 600 m to 900 m along the slopes of the northern Flemish Cap, the Flemish Pass and the Northeast Grand Bank shelf, associated with warm, higher-salinity waters and silty sandy substrates (Murillo et al. 2011; Murillo et al. 2016a). 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 (e.g., temperature) to known coral distributions to assess environmental tolerances for cold-water corals and predict coral distributions (Davies et al. 2008; Tittensor et al. 2009; Guinotte and Davies 2014; Gullage et al. 2017). For example, Alyconiina, Antipatharia, Calcaxonia, and Scleraxonia corals occur in water temperatures ranging from 1.5°C to 8°C (Guinotte and Davies 2014). These studies have found that the most important factor determining habitat suitability is aragonite saturation (at least for hard corals) and oxygen concentrations (Tittenson et al. 2009). Vertical walls, boulders, rocky outcrops, small troughs, and ridges on the seabed also provide suitable habitats for many species of corals (Baker et al. 2012b).

Sponges

At least 32 species of sponges across six functional groups have been observed in the vicinity of the Project Area (Table 6.15, Table 6.16, Figure 6-14 and Figure 6-15), Murillo et al. 2012; Beazley et al. 2013a; Knudby et al. 2013; Beazley and Kenchington 2015). Of the identified sponge species, many have wide depth ranges (e.g.,100 m to 1,500 m), indicating that they can occupy slope and shelf areas in the region.

Table 6.16 Summary of Sponge Groups from 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Functional Group[1]	Sections Present (%)	Contribution to Sponges (%)
Southern Area	ROV	P1	Solid / Massive	89.7	89.3
			Other Sponge	23.5	7.8
			Leaf / Vase Shaped	8.8	1.4
			Round with Projections	19.1	1.3
			Thin-Walled, Complex	2.8	0.1
		P2	Solid / Massive	81.5	59.5
			Other Sponge	52.4	29.4
			Thin-Walled, Complex	5.6	7.0
			Leaf / Vase Shaped	3.8	3.8
			Round with Projections	6.5	0.3
Central Area	ROV	P3	Solid / Massive	96.3	81.5
			Other Sponge	55.6	15.9
			Leaf / Vase Shaped	28.7	1.4
			Thin-Walled, Complex	8.3	0.7
			Round with Projections	15.7	0.4
			Stalked	1.9	<0.1

Table 6.16 Summary of Sponge Groups from 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Functional Group[1]	Sections Present (%)	Contribution to Sponges (%)
Central Area	AUV	P7	Solid / Massive	100	90.7
			Other Sponge	75.0	3.4
			Round with Projections	56.3	2.4
			Leaf / Vase Shaped	56.3	2.1
			Thin-Walled, Complex	50.0	1.4
		P8	Solid / Massive	100	89.9
			Other Sponge	91.7	5.0
			Leaf / Vase Shaped	75.0	2.3
			Round with Projections	66.7	2.0
			Thin-Walled, Complex	41.7	0.7
		P9	Solid / Massive	100	88.3
			Other Sponge	82.4	8.9
			Round with Projections	41.2	1.4
			Thin-Walled, Complex	23.5	0.7
			Leaf / Vase Shaped	29.4	0.6
		P10	Solid / Massive	93.5	97.9
			Round with Projections	48.4	0.9
			Leaf / Vase Shaped	35.5	0.7
			Thin-Walled, Complex	29.0	0.3
			Other Sponge	19.4	0.3
Eastern Area	ROV	P4a	Other Sponge	16.1	70.2
			Thin-Walled, Complex	2.5	20.4
			Leaf / Vase Shaped	8.5	7.8
			Solid / Massive	6.8	1.5
		P4b	Round with Projections	6.3	100
	AUV	P4b	Solid / Massive	3.7	70.3
			Other Sponge	2.4	29.7
		P4c	Solid / Massive	9.9	38.9
			Other Sponge	7.2	27.7
			Round with Projections	5.9	15.2
			Leaf / Vase Shaped	5.3	11.6
			Thin-Walled, Complex	2.0	6.7

[1] Functional Groups are based on Kenchington et al. (2015)
Contribution to survey: Reported percentage of total abundance, biomass, or presence in the survey.

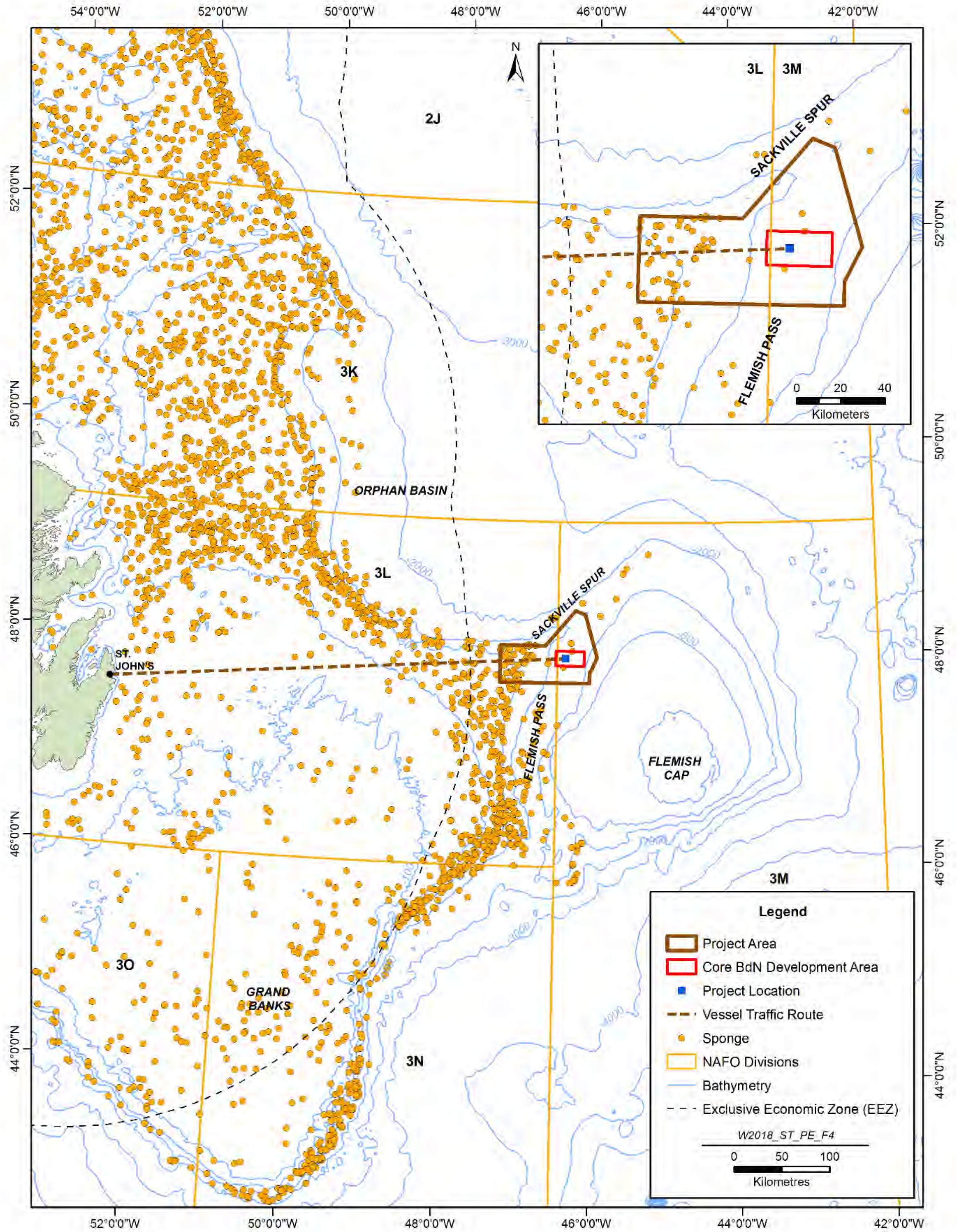

Figure 6-14 Summary of Regional Sponge Distributions Compiled from Canadian RV Data (2000 to 2015)

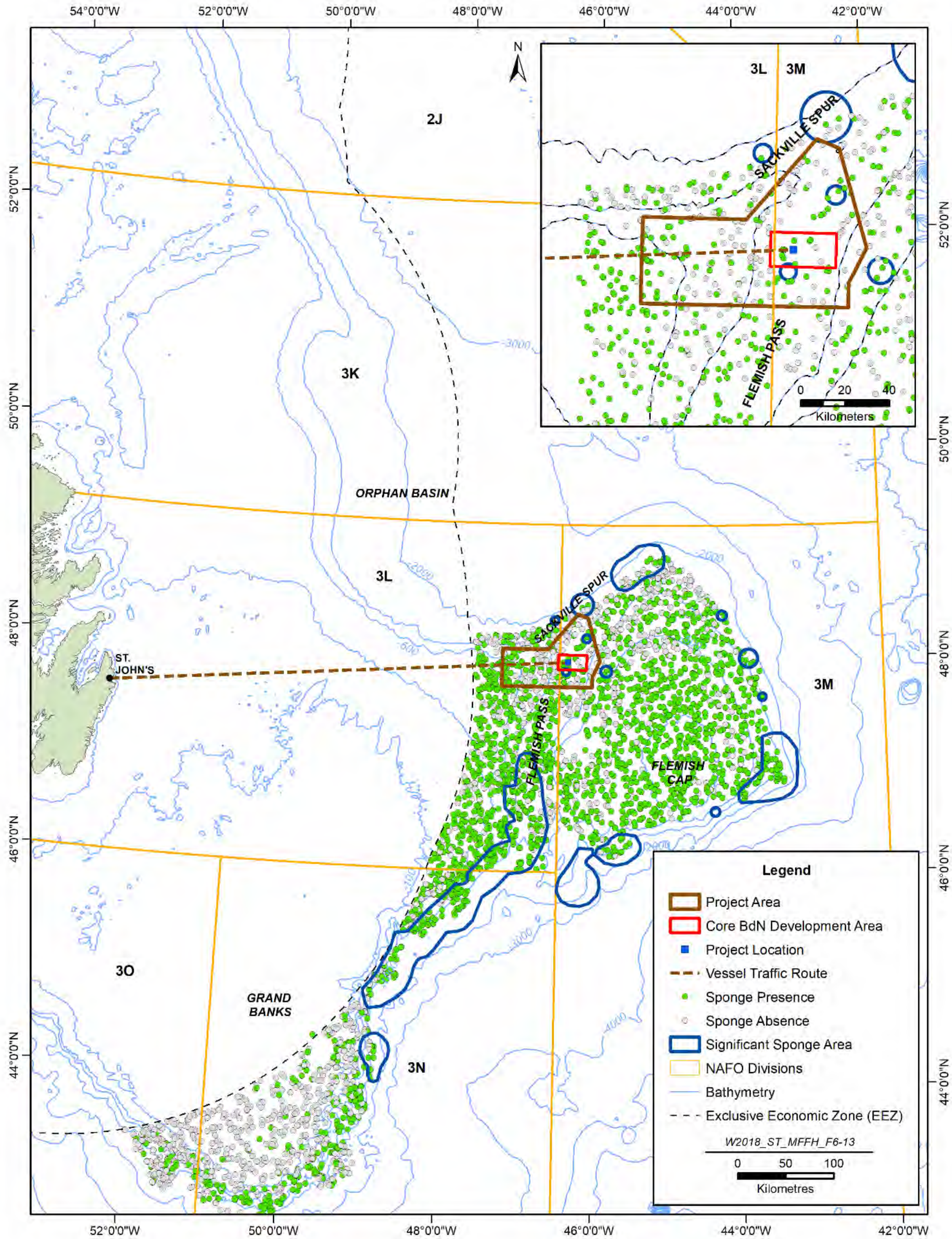

Figure 6-15 Summary of Regional Sponge Distributions Compiled from EU RV Data (2002 to 2013) with significant sponge catch data from WGESA (2017)

The Canadian and EU RV data indicate sponges are mainly distributed on the continental slopes with fewer observations in shallow shelf areas. The EU RV dataset also shows a relatively uniform distribution of sponges throughout the vicinity of the Project Area (Figure 6-15) in the Flemish Pass and on the slopes. Areas of significant sponge catch (≥75 kg per tow; NAFO 2017) are shown in Figure 6-15, with two areas shown inside the Project Area. This group was observed in 49 percent of trawls within the Project Area in EU RV surveys (Table 6.17). Sponge samples caught by trawls can disintegrate before reaching the sea surface due to their fragile nature and the damaging effects of trawls (Knudby et al. 2013). As a result, many samples collected in Canadian and European trawl surveys are not identified, raising the possibility that sponge species richness is somewhat different than reported. Sponges commonly encountered were from the Families Geodiidae and Ancorinidae (Kenchington et al. 2014).

Table 6.17 Sponge Presence / Absence in the Project Area based on EU RV Surveys (2005 to 2013)

Benthic Group	EU RV Surveys (500 m to 1,500 m depth range)		
	No. of Trawls Group Present	No. of Trawls Group Absent	% of Trawls Group Present[1]
Sponges	117	122	49.0

[1] Based on total number of trawls, n = 239.
The most commonly encountered species of each group were described by Kenchington et al. (2014).

Equinor Canada Seabed Surveys (2016 to 2018) indicated that the solid / massive sponge functional group was the most abundant sponge functional group in the Core BdN Development Area, occasionally forming dense aggregations (more than 0.75 individuals/m²) (Table 6.16). The solid / massive sponge functional group was primarily observed in the southern and central areas whereas sponge distribution was low in eastern areas (Table 6.16). Sponge grounds are known to occur within the Flemish Pass, typically with genera such as *Stryphnus* and *Stelletta*. However, though fewer in number, some key habitat-forming thin-walled, complex sponges were observed in the Project. This group existed at very low densities, with the exception of a dense aggregation of thin-walled, complex sponges observed growing on a fishing net found in P4a. These glass sponges are key habitat forming species and are occasionally associated with bamboo coral in other parts of the Flemish Pass (Beazley et al. 2013a), though no such associations were observed in this survey. Sponges were commonly encountered in the southern and central survey areas, and very rarely observed in the eastern survey areas.

Moderate sponge biomass (more than 3 kg/ha to 30 kg/ha) have been observed in the Core BdN Development Area and in the Project Area (Murillo et al. 2012). Sponge surveys by Murillo et al. (2012) indicated that the highest sponge biomass was located on the slope of the Grand Banks, the slope of the Flemish Cap, and in the Flemish Pass. Sponge biomass in the vicinity of the Project Area was highest on the northeast slope of the Grand Banks between 800 m to 1,450 m depths and on the southeastern slope of the Flemish Cap at 950 m to 1,400 m depths (Murillo et al. 2012). The Flemish Cap slopes and Sackville Spur from 1,000 m to 1,500 m are relatively high abundance and species diversity of invertebrate taxa. Within the Orphan Basin, north of the Project Area, sponges were observed at a 300 m to 700 m depth range and were not considered characteristic species of deeper areas of the survey (700 m to 3,000 m).

Distribution maps indicate regional sponge presence on the northeast NL Shelf (Guijarro et al. 2016). Areas of sponge concentration are present on the northeastern slope of the Grand Banks (Knudby et al. 2013; Guijarro et al. 2016). Similarly, Kenchington et al. (2016) provided distribution maps displaying the locations of significant coral and sponge concentrations on the Northeast NL Shelf and Slope. Using Canadian RV survey data and an updated kernel density estimation analysis, they modeled the distribution of sponges, small and large gorgonian corals, and sea pens throughout the Project Area and identified sponge and coral concentrations and SiBAs. Deep waters (500 m to 2,000 m) and food availability are considered the main environmental parameters that predict sponge abundance and biomass during distributional modelling for the Grand Banks (Knudby et al. 2013; Guijarro et al. 2016; Kenchington et al. 2016). For example, the large sponge grounds on the Sackville Spur FCA and VME (see Section 6.4.4.2), coincides with maximum bottom currents (Beazley and Kenchington 2015; Murillo et al. 2016b) that may transport food to the sessile, suspension-feeding sponges. Exposure to natural suspended and settled sediments has also been shown to have effects on sponge distribution through impacts on feeding, respiration, and larval settling (Bell et al. 2015). While adaptive mechanisms and associated costs are not well understood for all species, current evidence on tropical and deepwater species indicates that most sponges have some ability for tolerance of suspended and settled sediments (Bell et al. 2015). Some sponge species also have specific adaptations for thriving in these environments where fluctuating suspended or settled sediment levels are experienced (Bell et al. 2015).

6.1.7.7 Project Area Key Invertebrate Species Information and Distribution

Canadian RV Surveys have indicated that arthropods, cnidarians and sponges (porifera) and echinoderms are the main invertebrate species groups observed in the Project Area (Table 6.18). Arthropods, comprised mainly of shrimp species, were numerically dominant across depth zones. Cnidarians, comprised mainly of sea anemones and soft corals, dominated the biomass across depth zones. Sponges were not enumerated in the trawl surveys, likely due to the disintegration of specimens during sampling. However, as indicated by biomass measurements these were more prevalent in shallow parts of the Project Area. Further information on sponges and corals in the Project Area are detailed in Section 6.1.7.6 - Corals and Sponges . Echinoderms, comprised mainly of a variety of sea stars, echinoids, and brittle stars, were an important part of the slope edge depth zone assemblages.

Table 6.18 Abundance and Biomass of Invertebrate Species in the Project Area Based on Canadian RV Surveys (2011 to 2016)

Depth Zone	Survey Type	Scientific Name[1]	Mean Abundance (#/tow)	Biomass (kg)	Contribution to Total Abundance (%)	Contribution to Total Biomass (%)
Slope Edge 340 m to 600 m	Trawl	Arthropoda (P)	264	83	92	13
		Cnidaria (P)	11	477	3	75
		Echinodermata (P)	12	28	2	4
		Mollusca (P)	14	7	2	1
		Chordata (P)	22	1	<1	<1
		Brachiopoda (P)	13	<1	<1	<1
		Annelida (P)	10	<1	<1	<1
		Porifera (P)	nr	37	nr	6
Middle-Deep Slope 601 m to 1000 m	Trawl	Arthropoda (P)	77	22	78	8
		Cnidaria (P)	22	231	15	78
		Echinodermata (P)	6	20	3	7
		Mollusca (P)	8	4	3	1
		Brachiopoda (P)	20	<1	<1	<1
		Annelida (P)	8	<1	<1	<1
		Chordata (P)	10	<1	<1	<1
		Porifera (P)	nr	20	nr	7

[1]Taxonomic group: P – Phylum
nr: not reported. (Porifera collected were measured by weight, but not enumerated)
Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey.

There are more than 30 shrimp species found off NL (Squires 1990, Amec 2014a). In the Project Area, Northern shrimp species were numerically dominant in the Project Area based on Canadian RV surveys. However, the abundance in the Project Area is relatively low compared to captures on the Northeast NL Shelf (Figure 6-5). On the Grand Bank / Flemish Pass slope on the western side of the Project Area, *Eusergestes arcticus* and northern shrimp were the most commonly observed species and comprised 88 percent of the abundance alone between 341 m to 600 m. Along the middle-deep slopes of the *E. arcticus* and *Acanthephyra pelagica* were the most commonly observed species and comprised 89 percent of the abundance alone in that depth zone. Shrimp species consume zooplankton such as copepods, chaetognaths, and amphipods and are important prey species for many fish species (Squires 1990; Parsons et al. 1998; Amec 2014a).

Northern shrimp live for up to eight years, and function as a male for the early part of its life before changing into a female later in life (Amec 2014a). Survival and recruitment of larval stages is linked to the extent of phytoplankton blooms and sea surface temperatures (Amec 2014a) and population dynamics of Northern shrimp have been strongly correlated with predator biomass (Worm and Myers 2003).

As discussed in Section 6.1.6, Canadian RV surveys have indicated that aside from a localized aggregation on the northeastern edge of the Grand Banks, most of the Northern shrimp observed were concentrated further north along the NL Shelf (in the Sackville Spur region) (Figure 6-5). Based on EU RV data collected during 2012 to 2015, Northern shrimp are most concentrated on areas of Flemish Cap outside the Project Area (Figure 6-6).

6.1.7.8 Key Reproduction Times and Areas

The specifics of marine invertebrate reproduction vary widely across and within taxonomic groups and is often reflective of how environmental factors 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 the benthic invertebrate species that exhibit annual seasonal reproductive cycles, spawning coincides with the phytoplankton bloom (April to June) and/or the detrital deposition period (September to November). Reproductive cycles may also be triggered by environmental cues including photoperiods, temperatures (Sun et al. 2010), lunar cycles (Mercier and Hamel 2010; 2014), and 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), making the identification of spawning times difficult across all species. Deep-sea invertebrate reproduction is also challenging to research due to limitations in sampling methodology (Baillon et al. 2011) that could affect assessments of maturity, fecundity, sex ratios, spawning cycles and spawning strategies.

Recent studies have investigated the life history strategies of echinoderms, corals and sponges collected in the vicinity of the Project Area. For example, studies of the reproductive cycles of the deep-sea blood star *Henricia lisa* conducted by Mercier and Hamel (2008) 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 differences in water temperature stability at each depth. The more stable temperatures at 1,300 m may support a more continuous spawning cycle (Mercier and Hamel 2008). This species was observed to exhibit both brooding and broadcast spawning, possibly supporting recruitment to both the immediate area and other areas through passive dispersal. Studies of the sea urchin *Phormosoma placenta* collected at the Flemish Cap suggested synchronized spawning in November but this observation was not consistent for all trawl sets, further supporting localized differences in spawning times (Baillon et al. 2011).

The reproductive cycles of several coral species from the Grand Bank and Flemish Cap have also been studied. The soft coral *Drifa glomerata* has been observed to produced larvae year-round in the laboratory; however, larval release was seasonal. Larval release 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 characterized by spawning in April to June that seems to be 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 in the Project Area within the depth range 500 m to 1,400 m. The large gorgonian coral *Primnoa resdaeformis* is a broadcast spawner which showed variations in its reproductive cycle across months, depths and locations. It was suggested that differences in egg size across depths may be linked to differences in food availability, the highest being 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) spawn and release larvae during 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 (2010) 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 a depth range of 80 m to 200 m are also linked to food availability. Spetland et al. (2007) observed only sexual reproduction by this species in the northeast Atlantic, with spawning coinciding with spring and autumn phytoplankton blooms. Secondary spawning was only associated with one of the study areas, highlighting spatial differences in reproductive cycles within the same species.

Northern shrimp is a protandrous hermaphrodite where individuals function as males for the early part of their life and morph into females later in life (Amec 2014a). While present in the Project Area, overall abundances are low relative to the northeast NL Shelf. On the Flemish Cap, Northern shrimp are suggested to spawn in late July to August (Parsons et al. 1998) with egg hatching occurring in March to May.

Due to the low mobility of many benthic invertebrates and the need for spatial proximity between spawning individuals, primary areas for invertebrate spawning are generally areas with high densities of invertebrates. As already discussed, live and deceased corals and sponges add habitat complexity to areas that serve as settling substrates and nurseries for a variety of invertebrate and fish species. Within and near the Project Area, areas of high invertebrate densities have been identified using data associated with 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 6.4.2.5).

6.1.8 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 region and Project Area and identifies species groups by depth zones / habitats, within the larger RSA. 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) reported in Murua and de Cardenas (2005).

6.1.8.1 Grand Bank Shelf and Flemish Pass

Canadian RV surveys captured 53 fish species or species groups between 340 and 1,000 m in the Project Area (no data beyond 1,000 m water depth). Eight species comprised 95 percent of individuals captured with deepwater redfish, lanternfish, roundnose grenadier, and roughhead grenadier contributing to over 86 percent of the catch.

Dominant fish species for this area are reflective of the range of depths in the Project Area because they include shallow to deep slope species (Table 6.19). There are also higher abundances for shallow slope species (< 600 m) as evidenced by lower number of species required to account for 95 percent of total catch in comparison to the middle slope. Dominant species that were common across depth zones included lanternfishes, deepwater redfish, roughhead grenadier, common grenadier, and Greenland halibut.

Table 6.19 Numerically Dominant Fish Species by Depth Zone (Canadian RV Surveys, 2011 to 2016)

Depth Zone	Common Name	Scientific Name[1]	Mean Abundance (#/Tow)	Contribution (%)
Shallow Slope (340m to 600 m)	Lanternfishes	Myctophidae (F)	645	46
	Deepwater redfish	Sebastes mentella	261	40
	Roughhead grenadier	Macrourus berglax	19	3
	Common grenadier	Nezumia bairdii	33	2
	Longnose eel	Synaphobranchus kaupii	29	2
	Greenland halibut	Reinhardtius hippoglossoides	9	1
	Witch flounder	Glyptocephalus cynoglossus	8	1
Middle Slope (601m to 1000 m)	Lanternfishes	Myctophidae (F)	408	38
	Roundnose grenadier	Coryphaenoides rupestris	75	16
	Deepwater redfish	Sebastes mentella	67	15
	Roughhead grenadier	*Macrourus berglax*	34	9
	Blue hake	*Antimora rostrata*	69	6
	Longnose eel	*Synaphobranchus kaupii*	62	6
	Common grenadier	*Nezumia bairdii*	34	3
	Greenland halibut	*Reinhardtius hippoglossoides*	12	3

[1] Taxonomic Group: F – Family

The deep-water baited longline survey described in Murua and de Cardenas (2005) provides relevant and representative information for the Flemish Cap, Flemish Pass and Grand Bank slopes (Table 6.20). This survey extended from slope edge 800 m to 3,100 m of depth. In depth zones from 800 m to 1,500 m that cross the depths of the Project Area, the longline survey was dominated by Greenland halibut, blue hake, roughhead grenadier, black dogfish and skates.

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. These species declined in excess of 87 percent abundance over a 17-year period following the start of 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.

Table 6.20 Dominant Species by Depth Zone Found in Flemish Cap, Flemish Pass, and Grand Banks Slope Deepwater Longline Surveys

Depth Zone	Common Name	Scientific Name[1]	Contribution (%)[2]
Shallow-Middle Slope (< 800 m)	Greenland halibut	Reinhardtius hippoglossoides	87
	Skates	Rajidae (F)	12
	Other species	-	1
Middle Slope (800 m to 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 m to 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

Source: Murua and de Cardenas (2005)
Data is based on 64 longline hauls collected from 708 m to 3,028 m.
[1] Taxonomic Group: F – Family
[2] Contribution to survey: Reported percentage of survey study metric (e.g., total abundance in the survey).

Areas within the Project Area contained low to high abundances of *Geodia* sponges in the Flemish Pass as detailed in Section 6.1.7.6. Sponge grounds provide habitat complexity in deep-sea environments that have direct and indirect influences on fish and invertebrate abundance and occurrence (Beazley et al. 2013a, DFO 2015a). Areas of low (< 10 kg/km) and medium (10.01 kg/km to 249.99 kg/km) density were present along the bottom of the Flemish Pass and areas of high sponge densities (> 250 kg/km) were observed on the northern slope of the Flemish Cap. Fish species that form assemblages associated with sponge grounds include grenadiers (roughhead and roundnose), blue hake, longnose eel, Greenland shark, black dogfish and deep-sea catshark (Table 6.21) (Kenchington et al. 2013). Some species showed increased abundance or biomass with increased sponge density including deep-sea catshark, eelpouts, while spinytail skate, white skate and deepwater chimaera showed increased biomass only with increased sponge density (Kenchington et al. 2013). Deepwater redfish, American plaice, witch flounder, Vahl's eelpout and thorny skate were negatively associated with increased sponge density and may be due to their preference for soft-bottom habitats (Kenchington et al. 2013).

Table 6.21 Fish Species Associated with Sponge Ground Densities Based on Fish Abundance

Sponge Density	Common Name	Scientific Name[1]	Contribution (%)	Cumulative (%)
Low Sponge Catch (<10 kg/km)	Lanternfishes	Myctophidae (F)	15.1	15.1
	Blue hake	Antimora rostrata	14.81	29.91
	Roughhead grenadier	Macrourus berglax	12.38	42.29
	Longnose eel	Synaphobranchus kaupii	9.6	51.89
	Roundnose grenadier	Coryphaenoides rupestris	7.55	59.45
	Common grenadier	Nezumia bairdii	7.14	66.59
	Greenland halibut	Reinhardtius hippoglossoides	6.54	73.13
	Boa dragonfish	Stomias boa ferox	5.37	78.5
	Viperfish	Chauliodus sloani	2.66	81.16
	Threebeard rockling	Gaidropsarus spp.	2.57	83.73
	Barracudinas	Paralepididae	2.52	86.25
	Goitre blacksmelts	Bathylagus euryops	2.48	88.73
	Black dogfish	Centroscyllium fabricii	2.48	91.21
Medium Sponge Catch (10.01 kg/km to 249.99 kg/km)	Blue hake	Antimora rostrata	16.64	16.64
	Roughhead grenadier	Macrourus berglax	14.04	30.69
	Longnose eel	Synaphobranchus kaupii	11.84	42.52
	Lanternfishes	Myctophidae (F)	10.68	53.21
	Roundnose grenadier	Coryphaenoides rupestris	8.69	61.9

Table 6.21 Fish Species Associated with Sponge Ground Densities Based on Fish Abundance

Sponge Density	Common Name	Scientific Name[1]	Contribution (%)	Cumulative (%)
Medium Sponge Catch (10.01 kg/km to 249.99 kg/km)	Viperfish	Chauliodus sloani	5.49	67.39
	Common grenadier	Nezumia bairdii	4.37	71.75
	Greenland halibut	Reinhardtius hippoglossoides	4.33	76.08
	Boa dragonfish	Stomias boa ferox	3.97	80.05
	Threebeard rockling	Gaidropsarus spp.	2.97	83.02
	Black dogfish	Centroscyllium fabricii	2.75	85.76
	Eelpout	Lycodes spp.	1.8	87.56
	Shortnose snipe eel	Serrivomer beanii	1.74	89.31
	Beardfishes	Polymixiidae (F)	1.61	90.92
High Sponge Catch (>250 kg/km)	Roughhead grenadier	Macrourus berglax	28.46	28.46
	Blue hake	Antimora rostrata	16.3	44.76
	Roundnose grenadier	Coryphaenoides rupestris	10.88	55.64
	Longnose eel	Synaphobranchus kaupii	9.92	65.56
	Greenland halibut	Reinhardtius hippoglossoides	9.7	75.26
	Black dogfish	Centroscyllium fabricii	3.93	79.19
	Common grenadier	Nezumia bairdii	3.69	82.88
	Shortnose snipe eel	Serrivomer beanii	3.14	86.02
	Goitre blacksmelts	Bathylagus euryops	1.92	87.94
	Lanternfishes	Myctophidae (F)	1.67	89.61
	Deep-sea cat shark	Apristurus profundorum	1.66	91.27

[1] Taxonomic Group: F – Family
Source: Kenchington et al. (2013)

6.1.8.2 Flemish Cap

The Flemish Cap has been characterized through Canadian and EU RV surveys that sample within and outside the Project Area. While there are differences between the Canadian and EU RV survey gear types, associated information is sufficient for determination of species presence and distribution across depth zones. The Flemish Cap slopes within the Project Area and adjacent areas ranges from approximately 250m to 1,000 m in water depth. Migration for shallow demersal fish species such as Atlantic cod and American plaice, is hindered between the Flemish Cap and Grand Banks by the Flemish Pass, a deep channel that reaches depths > 1,400 m (Nogueira et al. 2017, 2018). However, there is migration by some deepwater species including Greenland halibut (Nogueira et al. 2018). There is also a quasi-permanent anticyclonic gyre that dominates the oceanography of the Flemish

Cap and leads to local retention of eggs and larvae (Pérez-Rodríguez et al. 2012, 2016). However, in years with weak currents on the Flemish Cap, there is current transport from the adjacent Grand Banks (Borovkov et al. 2006; Pérez-Rodríguez et al. 2012) indicating some connectivity between areas. The Flemish Cap is subject to international groundfish harvesting as either a targeted fishery or as by-catch for species including Atlantic cod, redfish, halibut, American plaice, and roughhead grenadier (Alpoim and González Troncoso 2016; Nogueira et al. 2017) (see Section 7.1.5).

Nogueira et al. (2017) identified 29 species from EU RV surveys on the Flemish Cap that comprised approximately 99 percent of total abundance (Table 6.22). The assemblages on the shallow slope (251 m to 600 m) and middle-deep slope (600 m to 1,460 m) were used to describe species on the Flemish Cap inside and around the Project Area.

Table 6.22 Numerically Dominant Fish Species on the Flemish Cap by Depth Zone (European Union RV Surveys, 2004-2013)

Depth Zone	Common Name	Scientific Name	Biomass %	Abundance %	Occurrence %
Shallow Slope (250 m to 600 m)	Acadian redfish	Sebastes fasciatus	38.6	46.3	99.3
	Deepwater redfish	Sebastes mentella	27.3	32.5	90.3
	Golden redfish	Sebastes norvegicus	23.0	17.9	80.1
	Atlantic cod	Gadus morhua	6.5	1.4	63.2
	Greenland halibut	Reinhardtius hippoglossoides	1.5	0.4	70.9
	Spotted wolffish	Anarhichas minor	0.7	0.1	60.1
	Thorny skate	Amblyraja radiata	0.5	0.1	65.6
Middle to Deep Slope (600 m to 1,460 m)	Greenland halibut	Reinhardtius hippoglossoides	35.2	20.6	95.5
	Roundnose grenadier	Coryphaenoides rupestris	14.0	19.0	99.3
	Longnose eel	Synaphobranchus kaupii	12.9	13.2	98.9
	Blue hake	Antimora rostrata	9.3	12.1	63.6
	Common grenadier	Nezumia bairdii	9.1	11.8	90.8
	Roughhead grenadier	Macrourus berglax	6.2	7.4	91.4
	Black dogfish	Centroscyllium fabricii	2.4	2.4	22.7
	Demon catshark	Apristurus sp.	2.3	0.4	94.9

Source: Nogueira et al. (2017).
Percent biomass, abundance and occurrence based on 1,699 bottom trawl hauls (30-minute passes at 3 knots) collected from 129 m to 1,460 m.

Redfish species (Acadian, deepwater, golden) were the most dominant fish species on the shallow slopes of the Flemish Cap (Nogueira et al. 2017) and is reflective of the retention of larvae by the anti-cyclonic gyre (Anderson 1984, Dalley and Anderson 1998; Pérez-Rodríguez et al. 2012). On the Flemish Cap, the greatest change in fish community structure occurs between the shallow slope and middle-deep slope, but less distinct changes also occur between the shelf and shallow slope

(Nogueira et al. 2017). The shallow slope assemblage is dominated by a few, highly abundant species, whereas deeper areas are dominated by several species with low abundance. For example, three redfish species comprise >95 percent of the abundance in the shallow slope assemblage whereas 87 percent of the abundance in the middle-deep slope is comprised of eight species. At the middle-deep slopes, the dominant species included Greenland halibut, roundnose grenadier, longnose eel, blue hake, common grenadier, and roughhead grenadier. This deep-water assemblage qualitatively resembles those found beyond 600 m depth on the Grand Bank slope in the Project Area with blue hake, Greenland halibut, grenadiers (roughhead, roundnose, common) and longnose eel common between the Canadian and EU RV survey. Greenland halibut occupies a wide depth range between 200 m to 2,000 m (Murua and de Cardenas 2005) and is the only assemblage species present from the shallow slopes to the middle-deep slopes (Nogueira et al. 2017).

6.1.8.3 Migratory and Transient Species

Pelagic species within the Project Area include resident pelagic species (such as capelin and lanternfish) and migratory warm-water pelagics (tunas, swordfish and several shark species). Resident species are able to carry out their life histories within the cold, northern waters and, in certain cases, are well-represented in the RV survey data. Capelin, for example, is a planktivorous fish that is largely restricted to the continental shelf, 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 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 webs.

Atlantic salmon and American eel also occupy areas of the continental shelf during the marine phase of their life history. 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). 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). In general, there are concentrations of both post-smolt and adult salmon in the Labrador Sea throughout the year where they feed and overwinter. 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 Banks area. Given the available data, there is likely low interaction with spring migration of adults within and near the Project Area for the insular Newfoundland populations, Gulf of St. Lawrence populations, and eastern-southern Nova Scotia and Outer Bay of Fundy Populations. Post-smolt and adult salmon from Labrador and Nunavik Populations generally feed and overwinter in the Labrador Sea therefore interaction of these populations with the Project Area would be considered negligible. Overwintering habitat for the iBoF is suggested to be off the Scotian shelf or the southern portion of the Gulf of Maine, therefore interaction with the Project Area is unlikely to occur.

Catadromous American eel adults migrate from freshwater environments to the Sargasso Sea off Bermuda to spawn from approximately February to April, with adults dying shortly after reproduction.

Adult eel migrations follow the shallow shelf areas before travelling directly to the Sargasso Sea in deeper waters. The resulting eggs transform into leptocephali larvae and migrate to coastal areas of North America through passive drifting and directional swimming (Rypina et al. 2014). The larvae metamorphose into the glass eel stage before reaching estuarine and freshwater coastal nursery habitats where they develop into juveniles that eventually migrate into freshwater lakes and rivers (Rypina et al. 2014). Further species details on Atlantic salmon and American eel are presented in Section 6.1.9.

In contrast, migratory pelagics (including swordfish, sharks, tunas) are typically large bodied predators that seasonally migrate from temperate areas into northern waters to feed. For example, swordfish are generally associated with thermal fronts, where there are large horizontal temperature gradients in the water column (Podestá et al. 1993, Dewar et al. 2011) that result in increased densities of swordfish prey items such as squid (Stillwell and Kohler 1985). The mixing of the cold Labrador Current and the North Atlantic Current creates these types of thermal fronts in some areas off eastern NL, including the NL Seamounts and Flemish Cap (Carr et al. 2001). During their northern migrations, sharks, tuna, and swordfish 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, which is principally exposed to the Labrador Current (see Section 5.4.2). While these species may not be specifically observed within the Project Area (OBIS 2019a, Ocearch 2019), nearby observations combined with the high mobility or migratory nature of these species suggests that they may travel through the Project Area. 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 provided in the Eastern Newfoundland SEA (Amec 2014a). Pelagic species of commercial, socioeconomic or Indigenous importance including capelin, mackerel, alewife, herring, and swordfish are further discussed in Section 6.1.8.5.

6.1.8.4 Equinor Canada Seabed Surveys

2016 Exploration Wellsites Survey

A small bodied fish (*Osteichthyes* sp. 1) was the most commonly observed species along and was present in 43 percent of survey sections (Table 6.23). All other species were observed in <10 percent of survey sections and included fish from the families Gadidae and Macrouridae and four other unidentified species (*Osteichthyes* sp. 2-5).

Table 6.23 Dominant Species Groups at the Baccalieu F-89 Wellsite in the Core BdN Development Area

Site	Survey Type	Common Name	Scientific Name[1]	Total Abundance	Sections Present (%)	Contribution to Survey (%)
Baccalieu Well Site 1,150 m	ROV Video Survey	Unidentified fish 1	Osteichthyes (SC)	71	43	70
		Unidentified fish 3	Osteichthyes (SC)	9	7	9
		Grenadier species	Macrouridae (F)	7	6	7
		Gadid species	Gadidae (F)	5	5	5
		Unidentified fish 5	Osteichthyes (SC)	4	4	4
		Unidentified fish 2	Osteichthyes (SC)	3	3	3
		Unidentified fish 4	Osteichthyes (SC)	2	2	2

[1] Taxonomic Group: SC – Superclass, F – Family

2018 Seabed Survey

Various fish species were also observed at the survey locations generally at low densities (Table 6.24, Table 6.25). Fish species were placed into functional groups, with small, medium, and large benthivores grouped together due to difficulty identifying certain fish groups to species (Ollerhead et al. 2017, Wells et al. 2019). Some of the observed organisms could not be identified to a functional group and are counted as 'unknown' (Table 6.24**Error! Reference source not found.**). Four wolffish observed at P2 (three northern and one spotted) and one observed at P4b (likely Atlantic) and grenadiers (likely roundnose, all sites) were the only species of conservation concern observed during the survey. Several skates were identified in this survey, potentially including the abyssal skate, thorny skate (SAR), or spinytail skate (SAR; see 6.1.9 for more details). Redfish were observed during ROV operations but not observed in the subsampled video review. Overall, benthivores were the most common functional group of fish, of which grenadiers and longnose eels were the most common species encountered (Table 6.24, Table 6.25). These species are common in Canadian and EU RV trawls, though other commonly encountered species in trawls such as lanterfishes, Greenland halibut, and blue hake were observed at low densities in these surveys. Similar species were seen in the Project Area during the NEREIDA survey.

Table 6.24 Fish Functional Groups Observed in the Core BdN Development Area during the 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Functional Group[1]	Sections Present (%)	Contribution to Fishes (%)
Southern Area	ROV	P1	Benthivores	77.9	66.6
			Unknown	51.5	33.4
		P2	Benthivores	65.3	68.8
			Unknown	31.5	16.8
			Piscivores	10.5	14.4

Table 6.24 Fish Functional Groups Observed in the Core BdN Development Area during the 2018 Equinor Canada Seabed Survey

Area	Survey Type	Station ID	Functional Group[1]	Sections Present (%)	Contribution to Fishes (%)
Central Area	ROV	P3	Benthivores	72.2	86.4
			Unknown	23.1	12.1
			Piscivores	0.9	0.9
			Planktivores	0.9	0.6
	AUV	P7	Benthivores	100	90.0
			Unknown	6.3	8.5
			Piscivores	6.3	1.5
		P8	Benthivores	100	92.3
			Unknown	16.7	5.4
			Piscivores	8.3	2.3
		P9	Benthivores	88.2	95.1
			Unknown	11.8	3.7
			Piscivores	5.9	1.2
		P10	Benthivores	93.5	79.8
			Unknown	41.9	16.7
			Piscivores	16.1	3.5
Eastern Area	ROV	P4a	Benthivores	54.2	73.1
			Unknown	27.1	24.9
			Piscivores	1.7	2.0
		P4b	Benthivores	75.0	70.2
			Unknown	37.5	29.8
	AUV	P4b	Benthivores	92.7	69.7
			Unknown	61.0	24.5
			Piscivores	22.0	5.8
		P4c	Benthivores	91.4	80.9
			Unknown	46.1	17.5
			Piscivores	4.6	1.4
			Planktivores	0.7	0.2

[1] Functional groups for fish based on Ollerhead et al. (2017) and Wells et al. (2019).
Contribution to fishes (%) is percent contribution of that species' abundance to the total abundance of fish.
Organisms were that unable to be identified to phylum were categorized as Unidentified Taxa.

Table 6.25 Fish Species Observed in the Core BdN Development Area - 2018 Equinor Canada Seabed Survey

Functional Group[1]	Species or Group	ROV					AUV					
		P1	P2	P3	P4a	P4b	P4b	P4c	P7	P8	P9	P10
Benthivores	Grenadiers	28	64	82	49	15	160	181	15	27	11	23
	Skates	4	7	6	3	3	5	6	-	-	1	1
	Wolf eels	27	31	32	5	-	-	120	19	9	18	34
	Blue hake	25	79	39	36	3	10	52	5	3	3	10
	Longnose eel	22	45	57	32	10	66	104	8	11	12	26
	Wolffishes	-	4	-	-	1	-	-	-	-	-	-
	Eelpouts	1	-	-	-	1	-	-	-	-	-	-
	Sculpins	-	-	-	-	-	1	-	-	-	-	-
Piscivores	Sharks	-	-	-	-	-	19	8	1	2	1	5
	Gadoid (NS)	-	4	3	-	-	-	2	-	-	-	-
	Greenland halibut	-	12	1	2	-	2	1	-	-	-	-
Planktivores	Lanternfishes	-	-	1	-	-	-	1	-	-	-	1
Unknown	Anguilliformes	-	-	5	5	3	3	2	1	2	1	15
	Other Fish	56	54	26	42	11	88	108	-	1	1	8

[1] Functional Groups are based on Ollerhead et al. (2017) and Wells et al. (2019).
Contribution to survey: Reported percentage of total abundance in the survey.
Unknown / Other Fish: Fish unable to be identified due to visibility. Functional group for unidentified Anguilliform is unknown

6.1.8.5 Project Area Key Species Information and Distributions

Further species information is presented below on the most abundant species comprising 95 percent of total abundance in Canadian RV surveys in and around the Project Area and EU RV surveys for the Flemish Cap (Table 6.26). Additional species-specific information is available in the Eastern Newfoundland SEA (Amec 2014a). Distribution maps are presented from the data available from these surveys where available.

Three species were dominant across both data sets, including deepwater redfish, blue hake, and roundnose grenadier. Seven species that dominated shelf slope and middle-deep slope for the Flemish Cap (Table 6.26) and were also abundant in Canadian RV surveys in the Project Area included deepwater redfish, common grenadier, roundnose grenadier, roughhead grenadier, Greenland halibut, blue hake, and longnose eel. Some of these species are also of commercial importance including Atlantic cod, redfish, grenadiers, Greenland halibut, and American plaice. Redfish, grenadiers, Atlantic cod, are also COSEWIC listed species as identified in Section 6.1.9; however, distribution and biological information for these species is described in this section. Alewife, capelin, herring, mackerel, and swordfish are also described below with regards to ecology and distribution as they are species of social, cultural and traditional importance for Indigenous groups as identified in Chapters 3, 7 and 14 of the EIS. While American eel and Atlantic salmon are of similar social, cultural and traditional importance, further details are provided for these species in Section 6.1.9 for SAR.

Table 6.26 Key Species within the Project Area Based on Canadian RV (2011 to 2016) and EU RV (2004 to 2013) Surveys

Common Name	Scientific Name	Total Abundance	Contribution to Survey (%)	Cumulative Contribution (%)
Canadian RV Survey within Project Area (2011 to 2016)				
Lanternfishes	Myctophidae (F)	10,835	44	44
Deepwater redfish	*Sebastes mentella*	8,255	33	77
Roughhead grenadier	*Macrourus berglax*	1,112	5	82
Roundnose grenadier	*Coryphaenoides rupestris*	1,084	4	86
Longnose eel	*Synaphobranchus kaupii*	716	3	89
Common grenadier	*Nezumia bairdii*	638	3	92
Blue hake	*Antimora rostrata*	498	2	94
Greenland halibut	*Reinhardtius hippoglossoides*	411	2	96
EU RV Survey on the Flemish Cap (2004 to 2013)[1]				
Acadian redfish	*Sebastes fasciatus*	1,781,944	39	39
Golden redfish	*Sebastes norvegicus*	1,345,832	29	68
Deepwater redfish	*Sebastes mentella*	1,043,142	23	91
Atlantic cod	*Gadus morhua*	144,426	3	94
Blue hake	*Antimora rostrata*	43,607	1	95
Roundnose grenadier	*Coryphaenoides rupestris*	39,584	<1	96

[1]Taxonomic group: F - Family
Source: [1]Nogueira et al. 2017
Contribution to survey: Reported percentage of total abundance in the survey.

Data collected as part of the NEREIDA program in 2015 include three sites within the Project Area and one in the Core BdN Development Area. Fish species were observed in 9.2 percent of photos within the Core BdN Development Area, and in 6.9 percent of photos within the Project Area (Table 6.27). The most commonly observed fish species was grenadiers, with low numbers of blue hake, longnose eels, and unidentified fishes observed.

Table 6.27 Summary of Fish Species Observed in NEREIDA Photo Survey – Project Area and Core BdN Development Area

Common Name	Scientific Name[1]	Core BdN (153 photos)[3]	Percentage of Photos where Species was Observed (%)	Project Area (274 photos)[2, 3]	Percentage of Photos where Species was Observed (%)
Unidentified Fish	-	3	2.0	4	1.5
Blue Hake	*Antimora rostrata*	2	1.3	2	<1
Grenadier	Macrouridae (F)	6	3.9	8	2.9
Common Wolf Eel	*Lycenchelys paxillus*	1	<1	1	<1
Longnose Eel	*Synaphobranchus kaupii*	2	1.3	3	1.1
Anguilliformes	Anguilliformes (O)	-	-	1	<1
Fish Total		14	9.2	19	6.9

[1] Taxonomic groups: F – Family, O – Order
[2] Photos within the Project Area include those from within the Core BdN.
[3] Numbers of photos given here are for useable photos, as several were either fully clouded by sediment or shot too high. Total photos for the Project Area and Core BdN Development Area were 399 and 252, respectively.
Contribution to survey: Reported percentage of total abundance or presence in the survey.

Atlantic Cod

Atlantic cod inhabit coastal and offshore regions from shallow waters to depths of approximately 460 m (Scott and Scott 1988) and are listed as Endangered under COSEWIC. This species comprised approximately 3 percent of the EU RV survey catch on the Flemish Cap. Atlantic cod was not an abundant species in available Canadian RV surveys within the Project Area. Atlantic cod is an iconic species that dominated the groundfish fishery for centuries and has long been associated commercially and culturally with NL (COSEWIC 2010b). However, poor environmental conditions and excessive fishing caused the collapse of the stock and resulted in significant and broad socioeconomic and ecological consequences (Worm and Myers 2003; Dawe et al. 2012; DFO 2018a). Cod are showing some signs of recovery after two decades of restricted fishing with variations among areas (Koen-Alonso et al. 2010; Nogueira et al. 2014). In recent stock assessments for NAFO Division 2J3KL Atlantic cod, the offshore biomass has largely increased over the past decade with the exception of southern areas of Division 3L (DFO 2018a). However, the spawning stock biomass still remains below the average spawning stock biomass during the 1980's (conservation limit reference point) (DFO 2018a). Atlantic cod catches by Spanish surveys in Division 3L are variable with increased catches from 2009-2011 and declines in 2013-2014 and again in 2017 (Román et al. 2018). Future recovery of the stock may also be affected by low levels and poor recruitment of capelin and simultaneous low levels of shrimp (DFO 2018a). Atlantic cod stocks in NAFO Division 3M on the Flemish Cap appear to be recovering with increases in spawning stock biomass since 2005 to highest levels in 2017 and 2018 (González-Troncoso et al. 2018).

Observations of slower growth and maturation in Atlantic cod from this area also suggests that the stock is in the recovery process (González-Troncoso et al. 2018). Threats to this species include overfishing, by-catch mortality, and a low productivity state of the ecosystem that may impact recovery (COSEWIC 2010b; DFO 2018a).

Atlantic cod have pelagic eggs that are prevalent in the water column from April to November (COSEWIC 2010b). Juvenile cod settle to the bottom for the first 1 to 4 years of life and prefer areas with habitat complexity that help reduce predation risk. Larval cod feed primarily on zooplankton and switch to larger prey including crustaceans (shrimp) as they grow. Adult Atlantic cod consume a variety of benthic and pelagic fish and invertebrates including capelin, sand lance, redfish, squid, crab, shrimp, whelks, and polychaetes (COSEWIC 2010b). Adult cod undergo extensive migrations as they travel from offshore to inshore areas in the spring to feed on capelin before returning in the fall (COSEWIC 2010b).

Adult cod occupy a diverse range of habitats and do not have depth or bottom substrate preferences, though are generally observed at < 500 m depths in offshore waters. Areas of high cod aggregation are present on the NL Shelf (Figure 6-16). While Atlantic cod are an important species on the Flemish Cap, their areas of aggregation are mainly restricted to shallow waters (<250 m) and are largely outside the Project Area (Figure 6-17; Nogueira et al. 2014, 2017). Currently no critical habitat has been established for Atlantic cod, however the Southeast Shoal and Tail of the Banks, Virgin Rocks, and Burgeo Banks EBSAs are considered important spawning areas for cod (Templeman 2007, DFO 2016). Spawning has also been observed on the Flemish Cap from late February to early April and peak spawning in March (Lilly 1987; ICES 2005). Atlantic cod on the Flemish Cap typically have a shorter and earlier spawning season relative to populations on the NL Shelf (ICES 2005).

Blue Hake

Blue hake are distributed worldwide and are present in all oceans except for the North Pacific (White et al. 2011). In the North Atlantic, blue hake are associated with mud bottoms on continental slopes and are distributed from 250 m to over 2,000 m depths (Figure 6-18) and are associated with waters between 1.5^{o}C to 4.5^{o}C (Nielsen et al. 2015).

This species feeds on euphausiids, chaetognaths, polychaetes copepods, and amphipods (Houston and Haedrich 1986; Parzanini et al. 2017) and is one of the most abundant fish species at bathyal depths (Kulka et al. 2003). They are an important part of deepwater assemblages with peak abundances between 1,300 m to 2,200 m depths (Kulka et al. 2003; Murua and de Cardenas 2005; White et al. 2011). Average size of individuals increases with depth (Kulka et al. 2003; Nielsen et al. 2015; Nogueira et al. 2017) and as blue hake age they move from coastal areas to deeper areas to spawn (Nielsen et al. 2015). Information on reproduction for this species is limited, with spawning estimated to occur from late autumn or winter in Icelandic waters (White et al. 2011). In Canadian waters, Kulka et al. (2003) found no evidence of eggs, larvae, and spawning fish, and few individuals with maturing gonads.

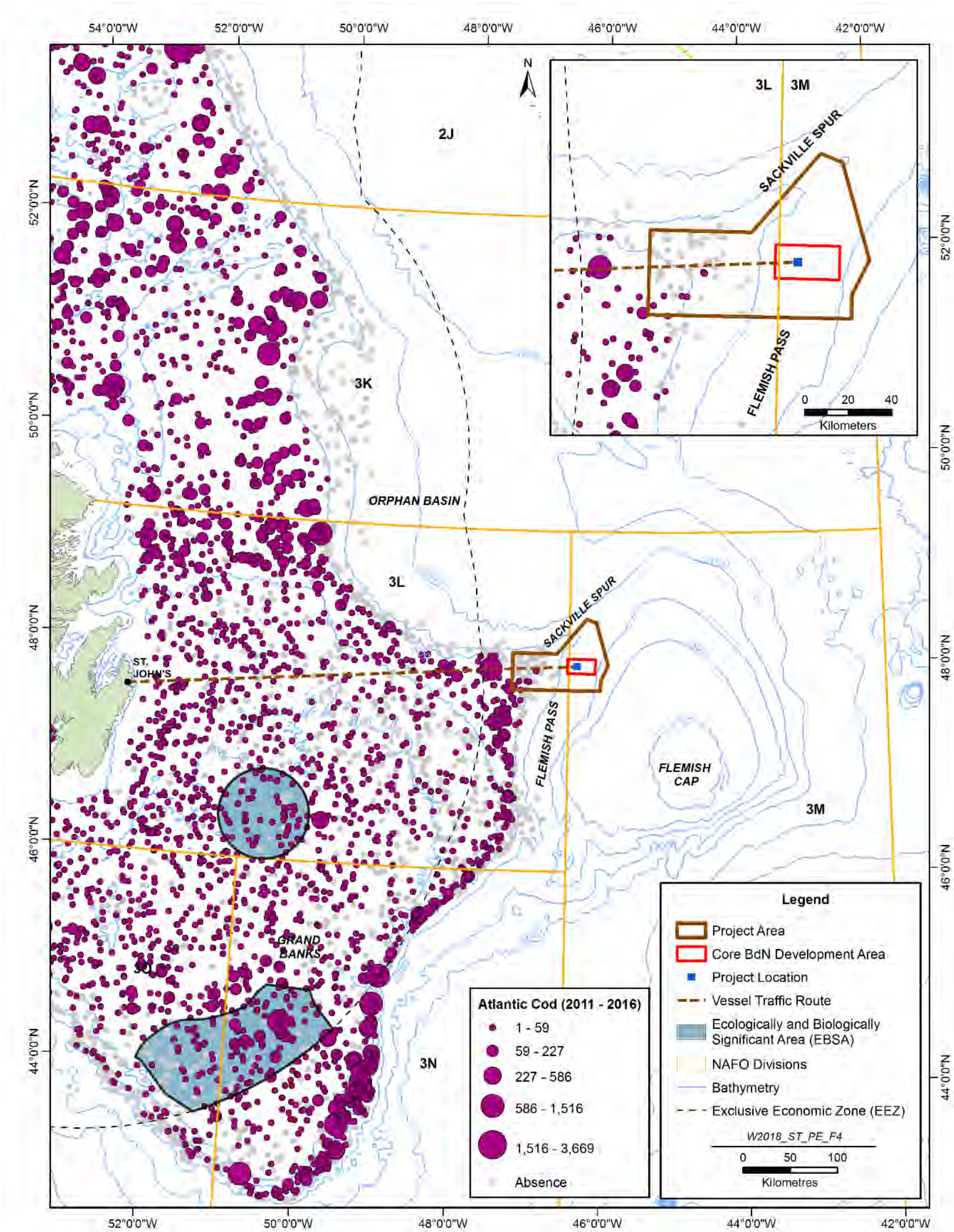

Figure 6-16 Atlantic Cod Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016) and associated EBSAs

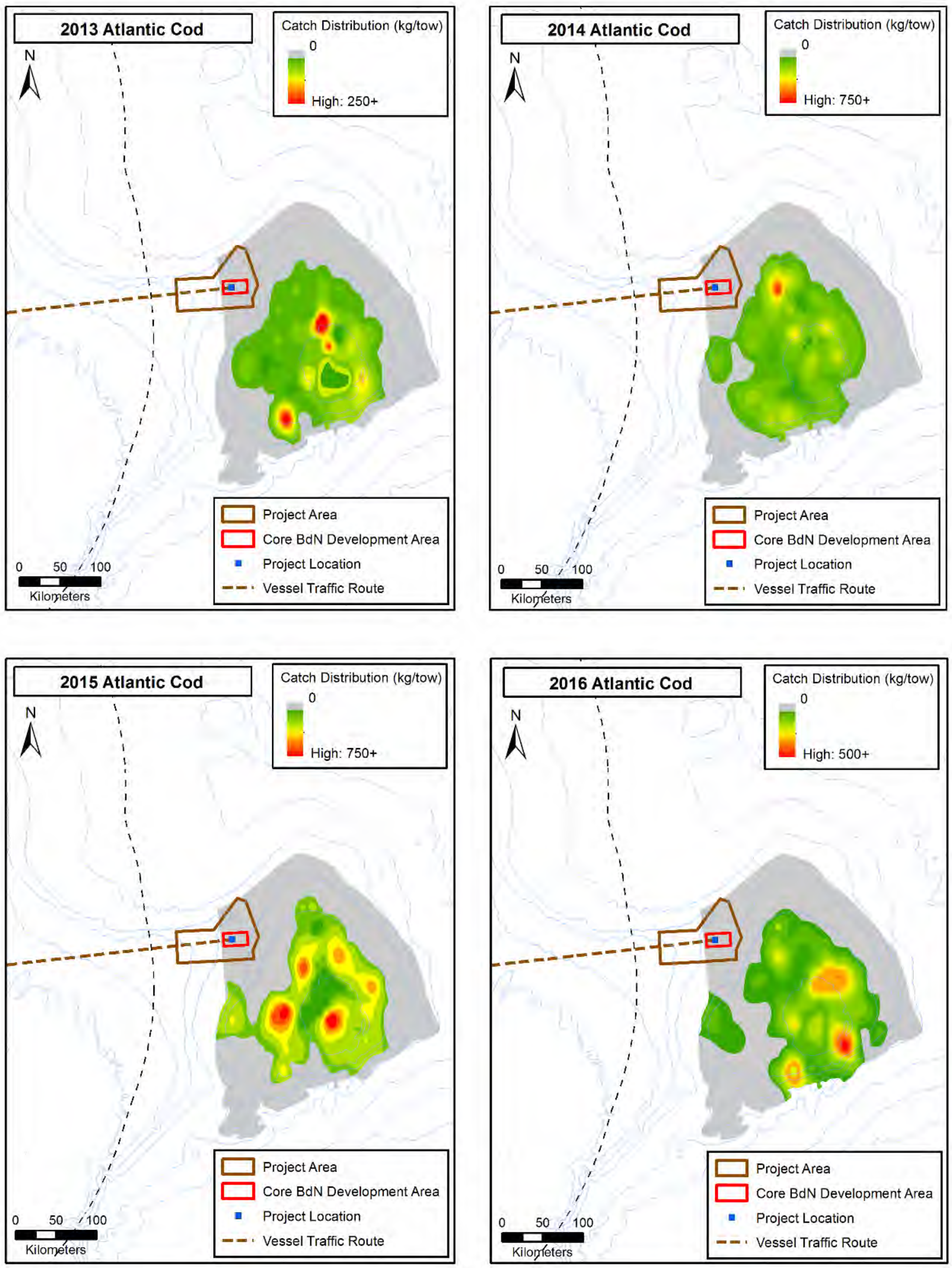

Figure 6-17 Atlantic Cod Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

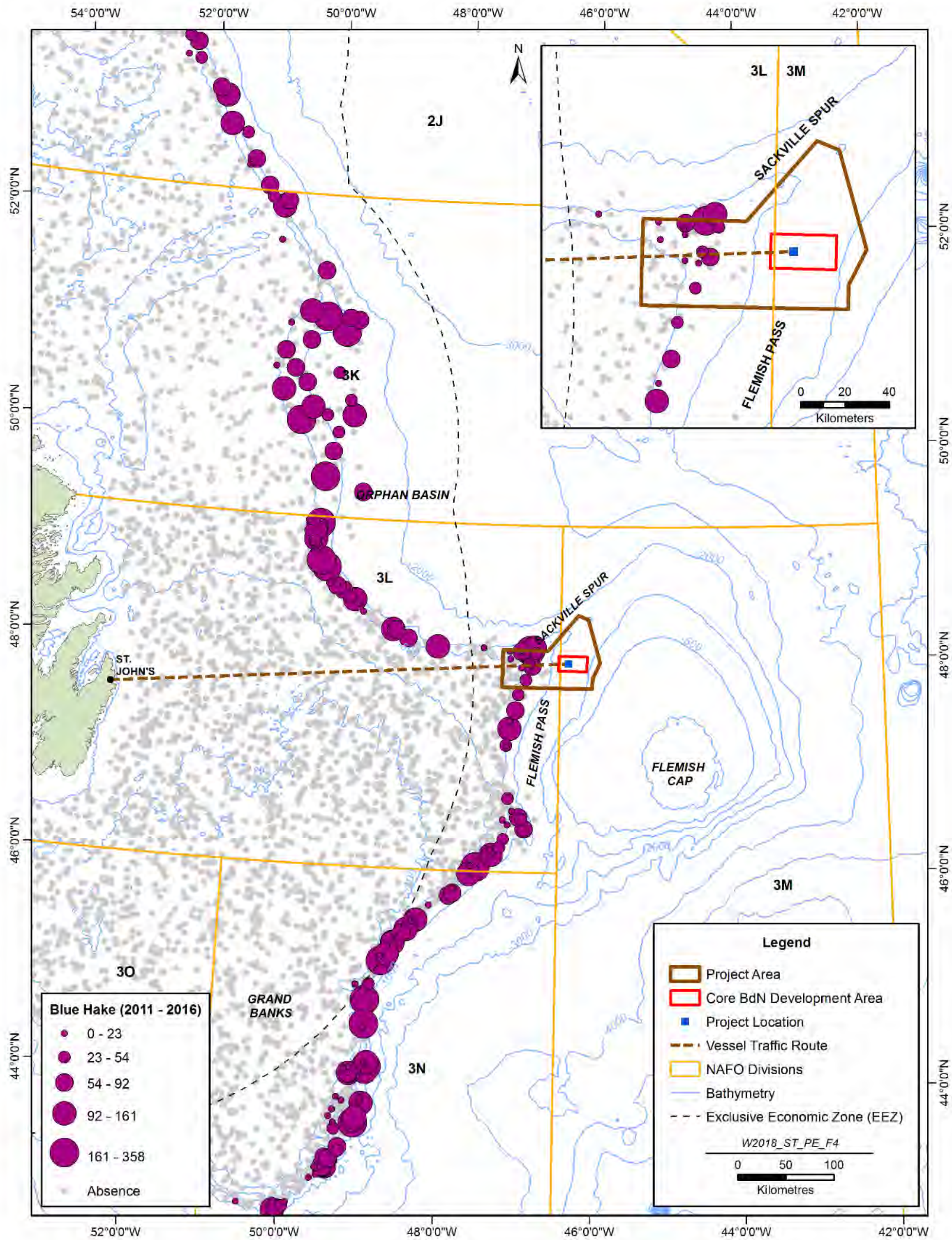

Figure 6-18 Blue Hake Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

Catches from Canadian RV surveys show high aggregations of blue hake on the northern and western slopes of the Flemish Cap and the northeastern slope of the NL Shelf (Figure 6-18). Areas of high aggregation for this species of > 110 individuals per tow is present in the Project Area and on the shelf slopes off NL. This species comprised three percent in the Canadian RV surveys and one percent of the EU RV survey catch on the Flemish Cap.

Greenland Halibut

Greenland halibut are a commercially important deepwater flatfish with a wide depth range of > 2,000 m and peak abundances from 1,300 m to 1,600 m (Murua and de Cardenas 2005). This species is fished commercially at depths >600 m on the Flemish Cap (Nogueira et al. 2017, 2018). It spends considerable time feeding pelagically on a variety of fish and invertebrates (Morgan et al. 2013), including commercially important Atlantic cod, capelin, redfish, shrimp and squid. It also inhabits progressively deeper waters as they age (Bowering and Chumakov 1989). Greenland halibut were identified as key species within the Project Area from the Canadian RV surveys (Table 6.27). Greenland halibut contributed approximately two percent of fish abundance in Canadian RV surveys and less than one percent of fish abundance in EU RV surveys (Nogueira et al. 2017; Table 6.26). However, distribution maps from Canadian RV and EU RV surveys indicated areas of aggregation along the slopes of the Grand Banks and Flemish Cap and within the Flemish Pass (Casas and Gonzáles Troncoso 2015; Alpoim and Gonzáles Troncoso 2016) (Figure 6-19 and Figure 6-20). Greenland halibut are also known to aggregate on the Northeast Shelf and Slope EBSA in the spring for foraging opportunities (Templeman 2007).

The high migratory capabilities of this species and continuous deepwater habitat supports intermixing and a genetically homogenous population in the North Atlantic (Vis et al. 1997). Morgan (2016) indicates that Greenland halibut populations in NAFO areas 2J3K have been increasing in abundance in recent years but populations in 3LNO have been declining. Greenland habitat from the Grand Banks also make large spawning migrations (>1,500 km) northward to the Davis Strait (Bowering 1984; Junquera and Zamarro 1994; Coad and Reist 2018). In the Flemish Pass area, adults may remain in the area for spawning, with spawning peaks from July to August and in December (Junquera and Zamarro 1994). Spawning occurs in deep waters of 600 m to more than 1,200 m where the eggs float and hatch. As the larvae develop and increase in size, the Greenland halibut rise towards surface waters where they are carried by surface currents to nursery areas (Sohn et al. 2010). Nursery Areas may include the Baffin Bank and the slopes around Disko Bay, Greenland, and they presumably return to Newfoundland water when grown (Coad and Reist 2018). Young remain pelagic until reaching 80 mm in length, at which point they metamorphose and settle on the bottom (Coad and Reist 2018).

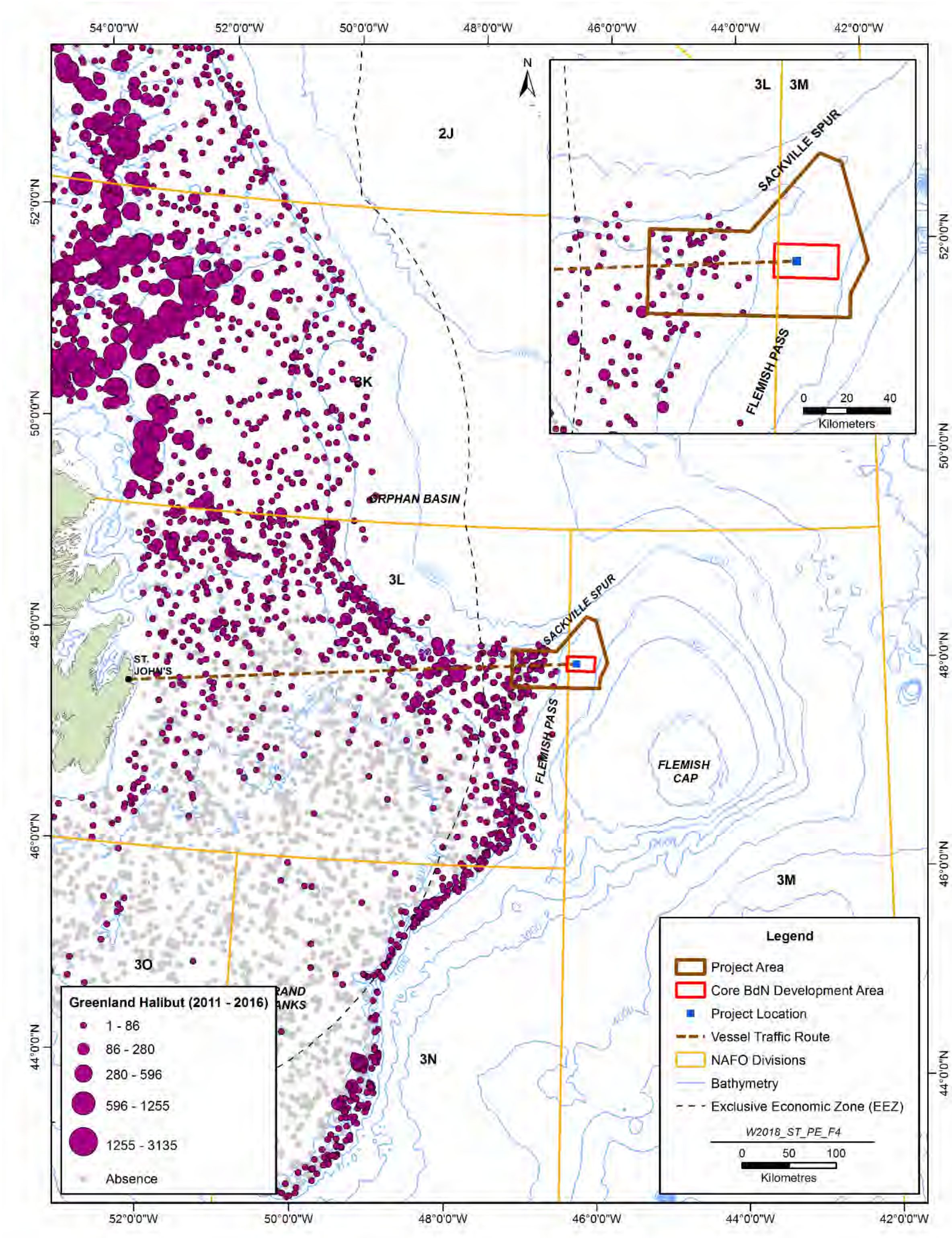

Figure 6-19 Greenland Halibut Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

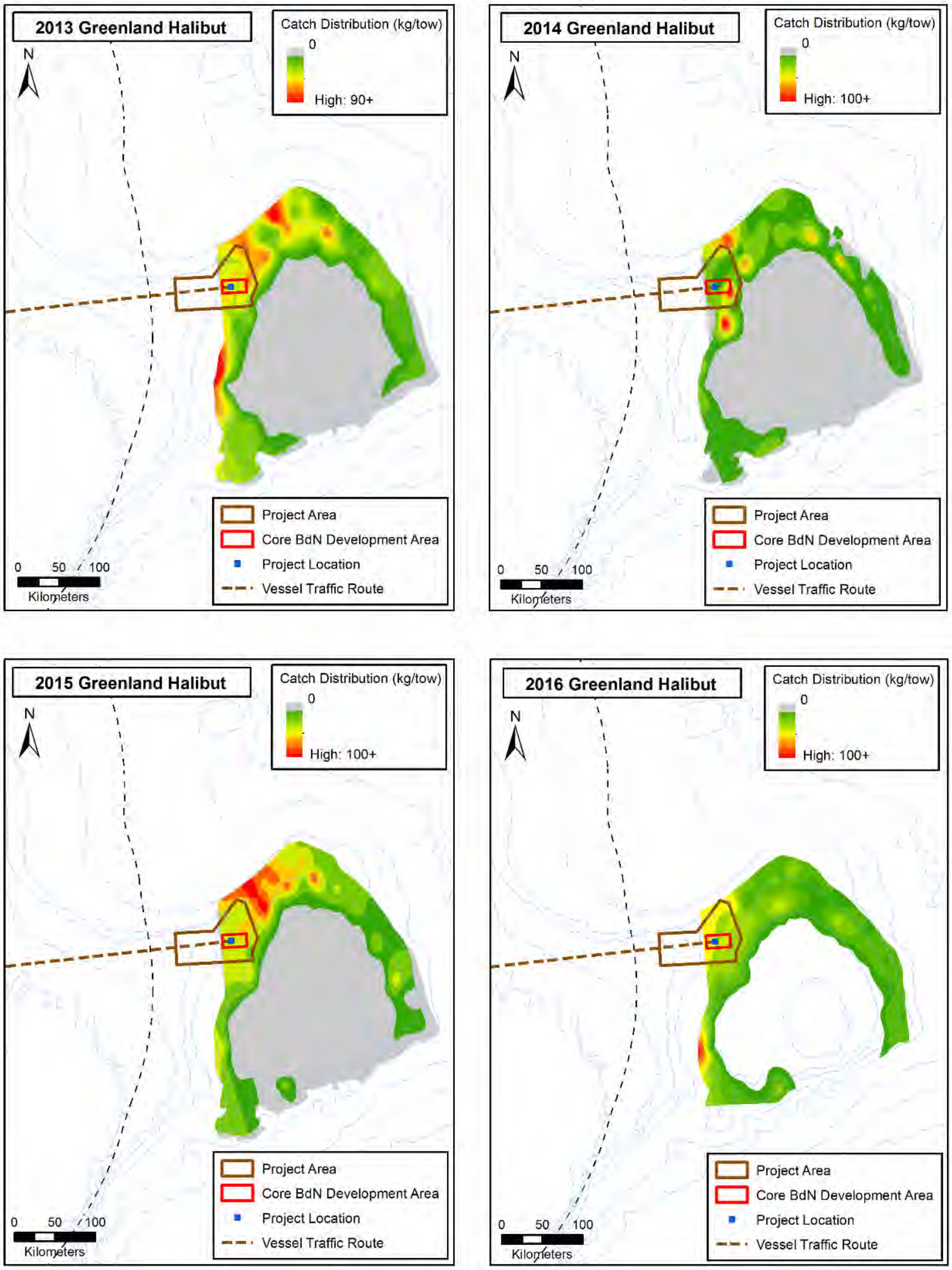

Figure 6-20 Greenland Halibut Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

Grenadiers (Common, Roundnose, Roughhead)

Combined abundances of common, roundnose and roughhead grenadiers comprised <16 percent and 2 percent of the total catch in the Canadian (Figure 6-21, Figure 6-22, and Figure 6-23) and EU RV surveys, respectively (Figure 6-24 and Table 6.26). Roundnose grenadiers are listed as Endangered by COSEWIC (COSEWIC 2008).

Grenadiers are slow-growing, deep-sea species that are important parts of the middle slope to deep slope assemblages (250 m to 1,300 m). Roughhead grenadiers have been captured from 200 m to 2,000 m depths and roundnose grenadier have been captured from 180-2,200 m, but both species are mainly observed at 400 m to 1,200 m depths (COSEWIC 2007a, 2008). Common grenadier have been captured from 400 m to 1400 m but are commonly observed at 500 m to 700 m depth (Snelgrove and Haedrich 1985; Jørgensen 1996). These three species have similar distributions with aggregations on the slopes of the Grand Banks and the Flemish Pass based on Canadian RV surveys. On the Flemish Cap, distributions available for roughhead grenadiers indicate that areas of concentration are on the deep slopes with relatively low to high abundances inside the Project Area (Casas and Gonzáles Troncoso 2015; Alpoim and González Troncoso 2016) (Figure 6-24). Distribution of roughhead grenadiers may be patchy on the Flemish Cap with a localized area of aggregation based on EU RV surveys. Canadian RV surveys indicate moderate to high abundances of roughhead grenadiers on the Grand Bank slopes in the Project Area.

Roundnose grenadiers spawn throughout the year and produce mesopelagic eggs and juveniles, whereas roughhead grenadiers spawn mainly between the winter to early spring and have pelagic larvae (COSEWIC 2007a; 2008). Common grenadiers are estimated to spawn in summer and autumn (Scott and Scott 1988). Roundnose grenadiers are thought to migrate into relatively deeper waters along the slope in winter and into shallower slope areas in the summer, but large-scale migrations are considered unlikely due to their poor swimming capability (COSEWIC 2008). The population structure of roughhead grenadiers is low, however it is uncertain whether this is due to connectivity through highly dispersed larvae or historical post-glacial expansion (Coscia et al. 2018). Critical habitat has not been established for the roundnose grenadier due to lack of information of habitat associations in relation to life history stages (DFO 2010). No critical habitat been established for roughhead grenadier, however spawning grounds for this species are suggested to lie on the southern and southeastern slopes of the Grand Banks (Scott and Scott 1988; COSEWIC 2007a).

The diet and feeding habits of grenadiers are dependent on size as young grenadiers feed on zooplankton and become more piscivorous with age (COSEWIC 2007a; 2008; Parzanini et al. 2017). For example, Parzanini et al. (2017) observed roundnose grenadiers to primarily consume planktonic crustaceans and chaetognaths consistent with the pelagic juvenile phase. Young roughhead grenadiers will also consume a variety of invertebrates including echinoderms, crustaceans and bivalves (COSEWIC 2007a; Parzanini et al. 2017). Adult grenadiers feed on shrimp, small fish including myctophids, and squid (COSEWIC 2007a; 2008).

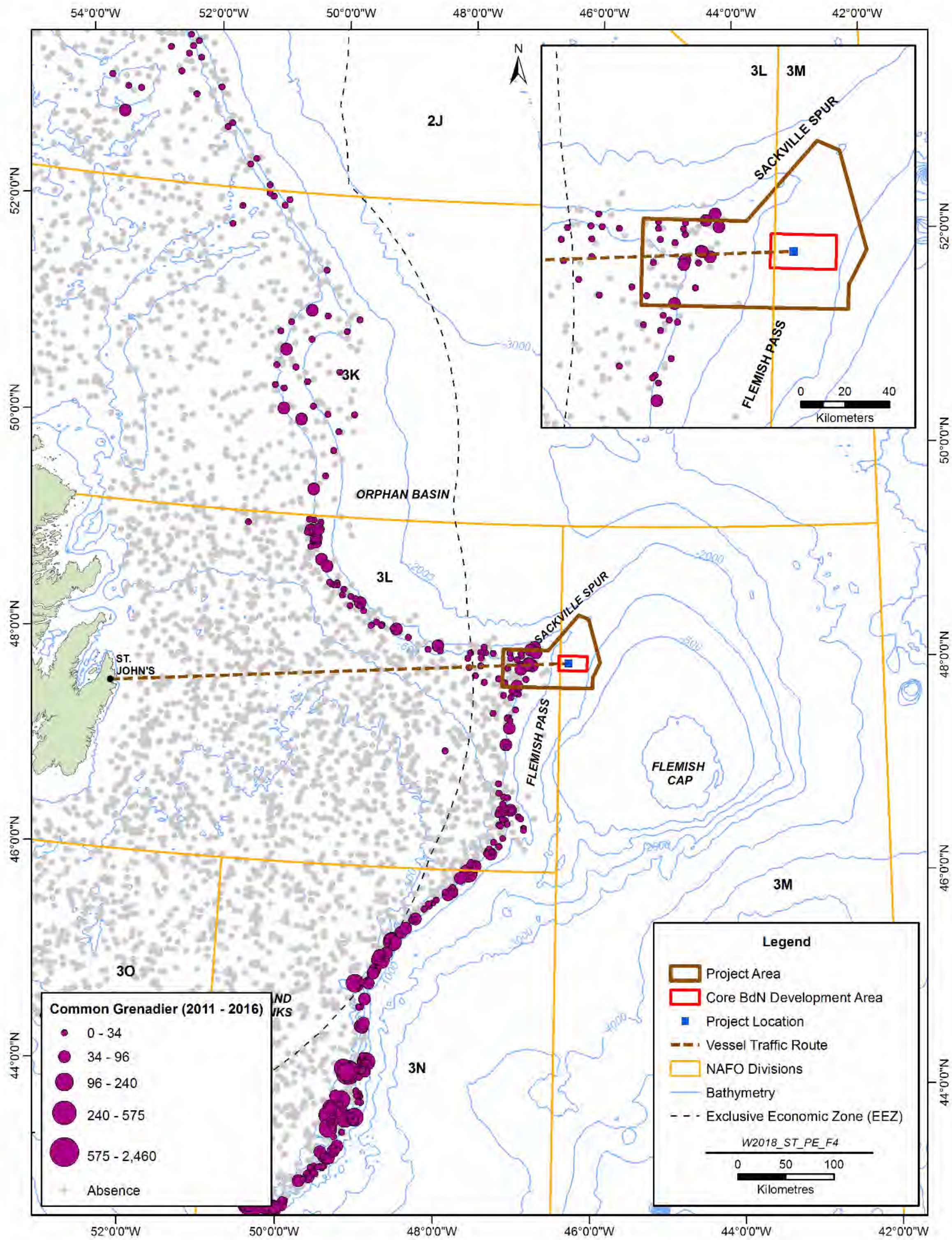

Figure 6-21 Common Grenadier Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

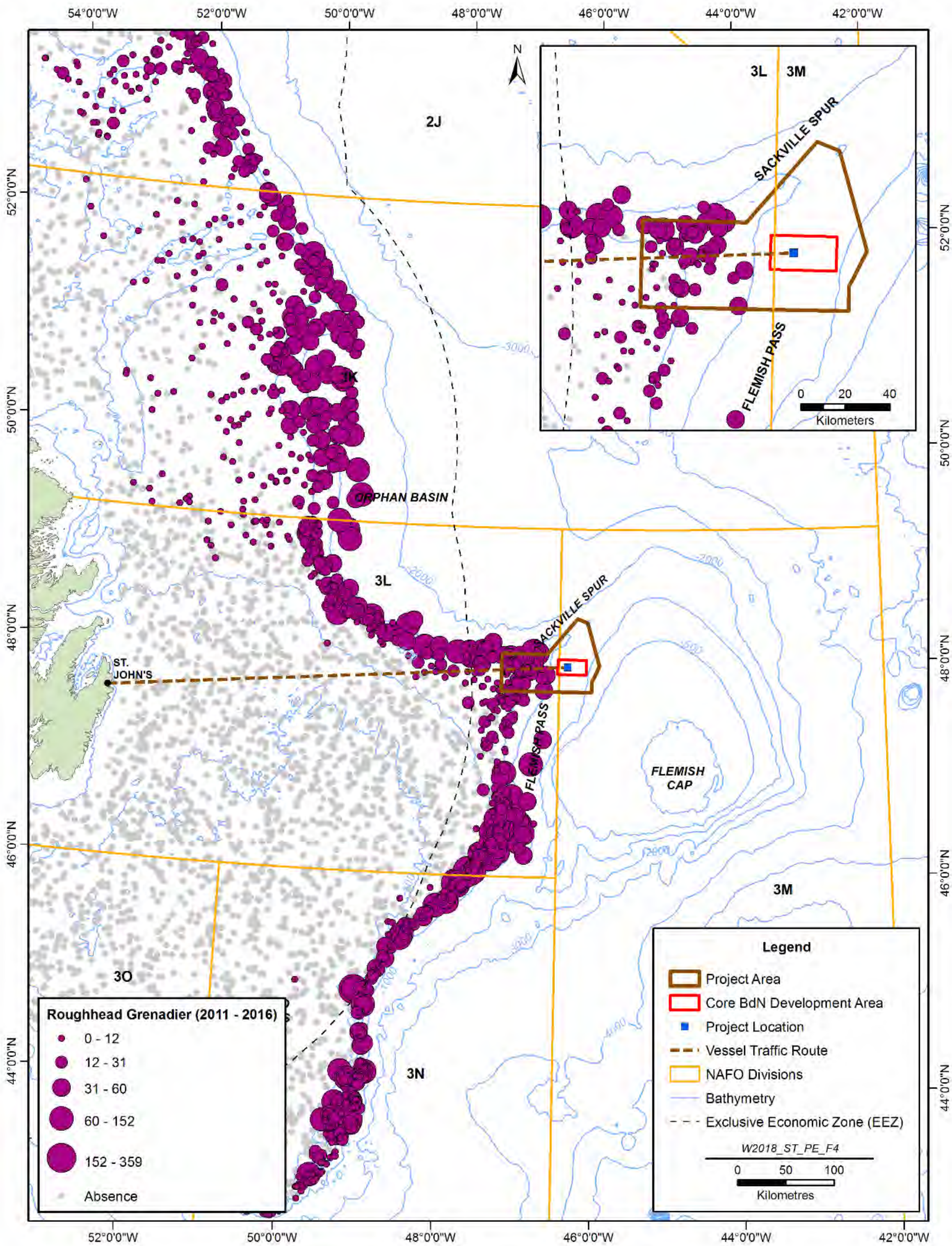

Figure 6-22 Roughhead Grenadier Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

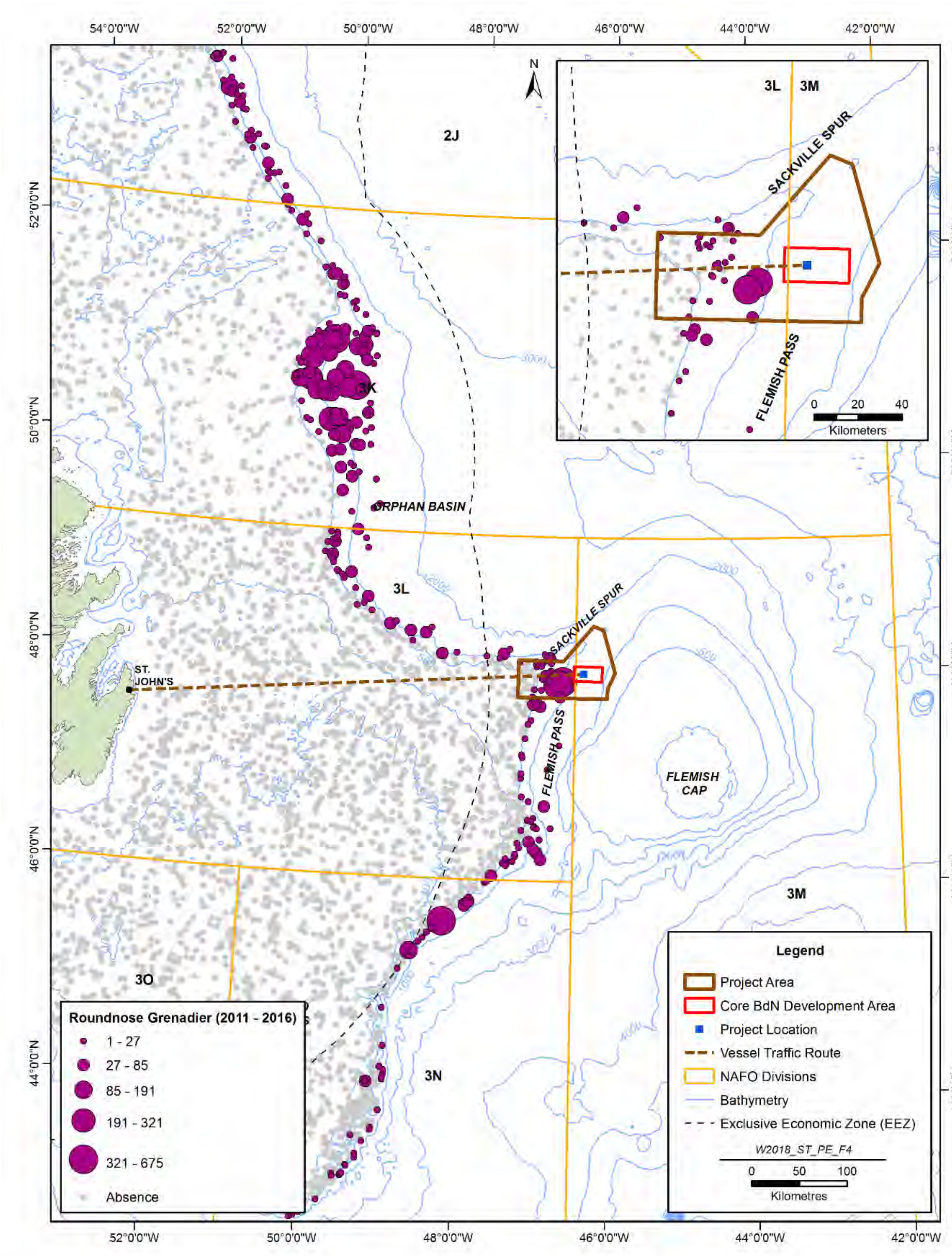

Figure 6-23 Roundnose Grenadier Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

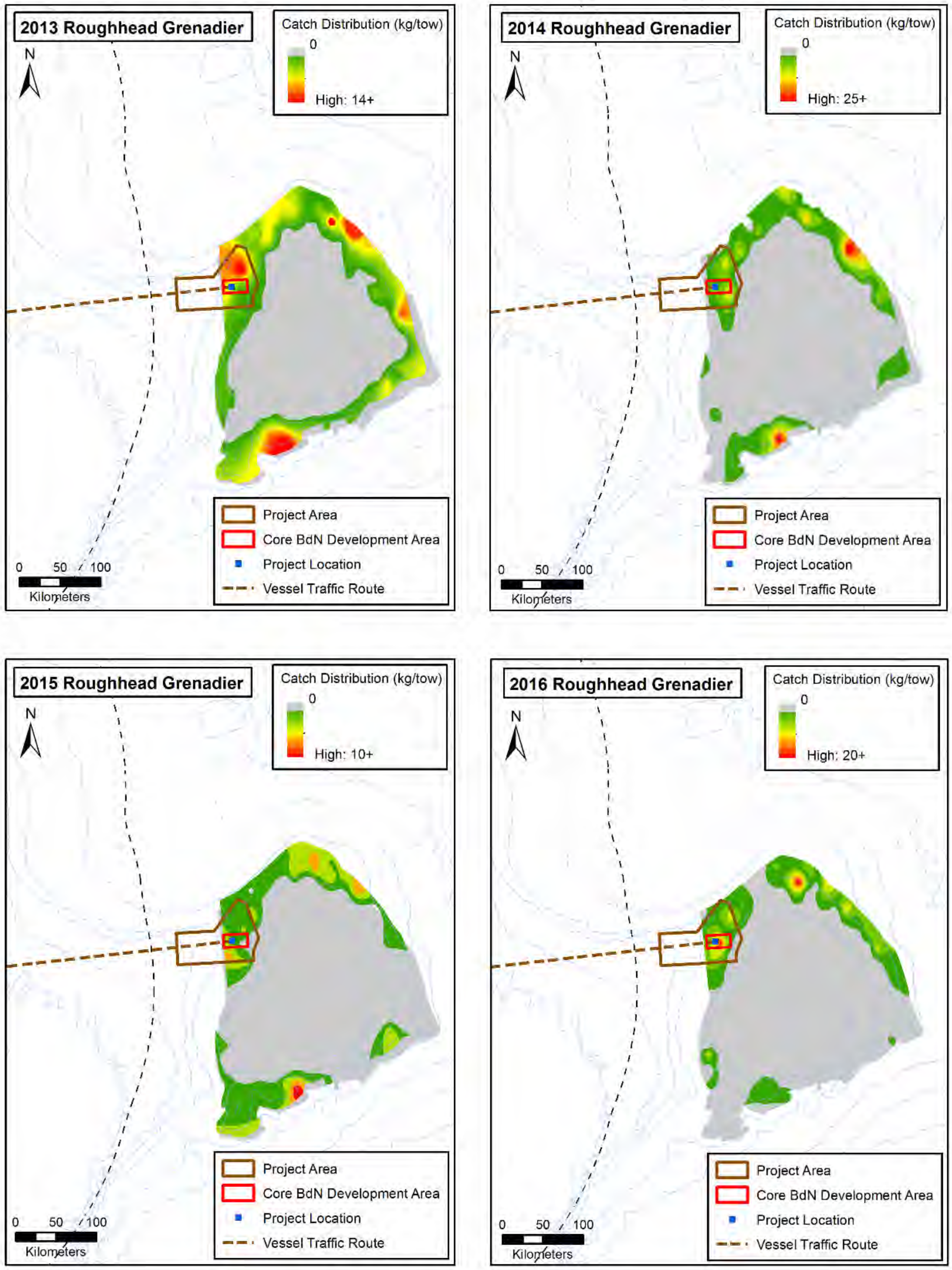

Figure 6-24 Roughhead Grenadier Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

Lanternfish

Lanternfish are a small, mesopelagic fish family that are widespread in deep waters and characterized by having light producing organs on their bodies (Scott and Scott 1988). Although this group is comprised of multiple species, the glacier lanternfish has been the predominant species (over 80 percent) in myctophids catches on the Grand Banks (McKelvie 1985; Halliday et al. 2015). This short-lived and small fish has a high growth rate and small size at maturity (Garcia-Seoane et al. 2014).

Lanternfish feed on copepods and lesser quantities of amphipods, ostracods, hyperiids and fish eggs (Kawaguchi and Mauchline 1982; Halliday et al. 2015). These fish serve an important ecological role in the systems they inhabit as prey for commercially valued species such as cod, hake, tunas, salmon and marine mammals (Scott and Scott 1988). This characterization is corroborated by Canadian RV trawl surveys, which show a near absence in shallow areas on the Grand Banks and the highest abundances at the deep-sea margins of the surveyed area particularly in the Flemish Pass (Figure 6-25). Batch spawning in glacier lanternfish in North Atlantic waters, derived from studies on the Flemish Cap, occurs from January to April (Garcia-Seoane et al. 2014). This species comprises 24 percent of overall fish abundance as reported in the Canadian RV survey but was not considered a key species in Flemish Cap surveys (Table 6.26).

Longnose Eel

The longnose eel is distributed in northern and southern parts of the Atlantic Ocean, in the Pacific Ocean and the Gulf of Mexico. This bottom-dwelling species is commonly observed on the Grand Banks with a depth range of 240 m to 3,650 m (Scott and Scott 1988, Baker et al. 2012a). This species is considered a deep-sea scavenger that also feed on euphausiids, amphipods, fish, cephalopods, mysid shrimp and molluscs (Houston and Haedrich 1986; Jamieson et al. 2011; Parzanini et al. 2017). This species is preyed on by roundnose grenadiers (DuBuit 1978). It is the eighth most abundant species caught on the Flemish Cap and is a key species in middle to deep slope assemblages at > 600 m depth (Figure 6-26). In the Canadian RV surveys, it is predominantly captured in deep regions of the Flemish Pass or western slopes of the Flemish Cap. This species contributed to less than one percent of overall fish abundance in both the Canadian and EU RV surveys. Little is known about reproductive characteristics of this species, however specimens in spawning condition have been captured during the summer months (Scott and Scott 1988).

Redfish (Acadian, Deepwater, Golden)

Three species of redfish have been captured within the Project Area during the Canadian and EU RV surveys, including Acadian, deepwater, and golden redfish. In the Canadian RV surveys, Acadian and deepwater redfish were the dominant redfish species captured and represented 44 percent of the total catch (Table 6.26; Figure 6-27). Redfish were primarily distributed on the shelf and slopes of the Grand Banks on the western side of the Project Area (Figure 6-27 and Figure 6-28). Redfish species were also well represented in the EU RV surveys, with the three species comprising over 90 percent of total catches on the Flemish Cap (Table 6.26). However, redfish in EU RV surveys were primarily distributed in shallower areas of the Flemish Cap with low occurrences in the Project Area (Figure 6-29 to Figure 6-31).

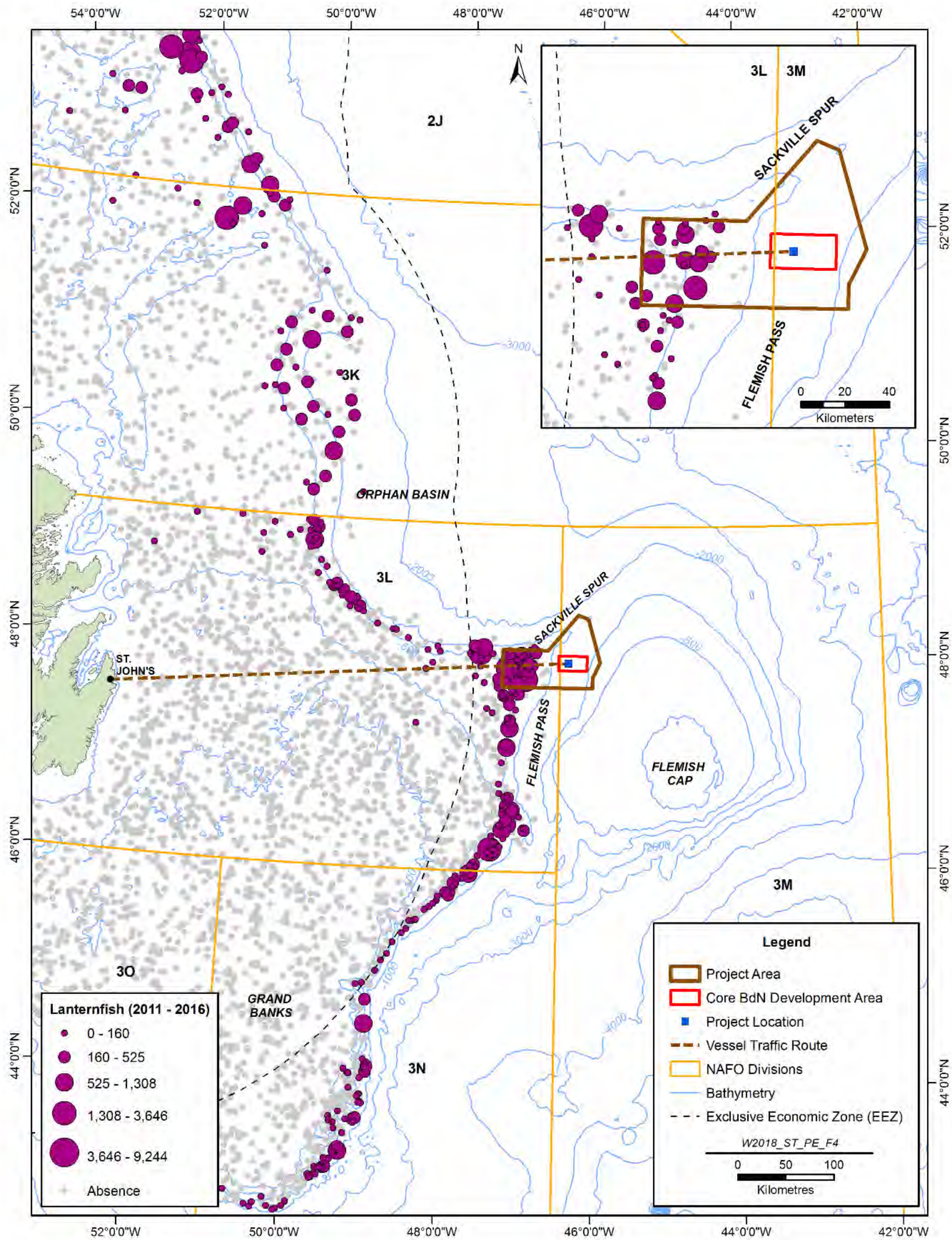

Figure 6-25 Lanternfish Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

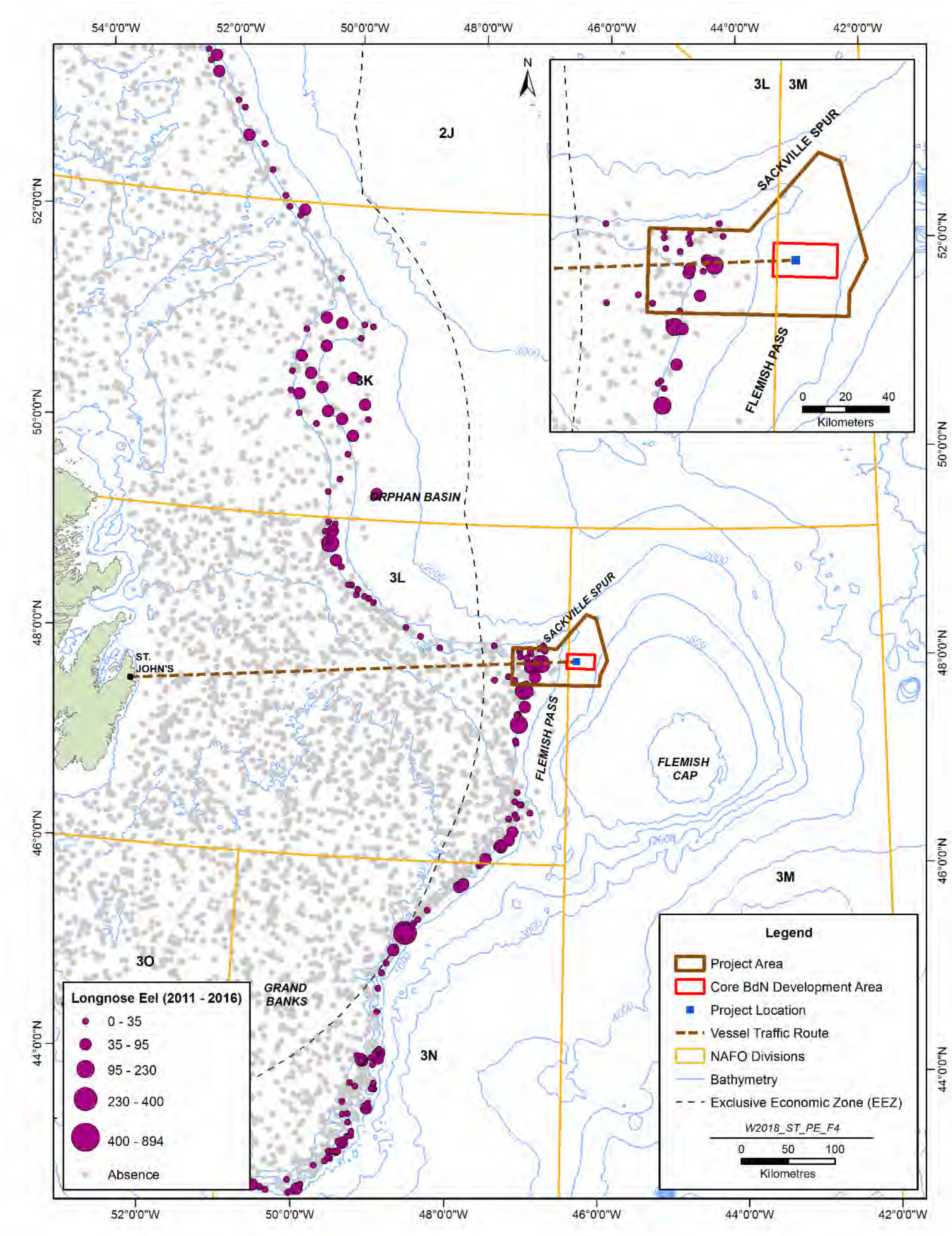

Figure 6-26 Longnose Eel Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

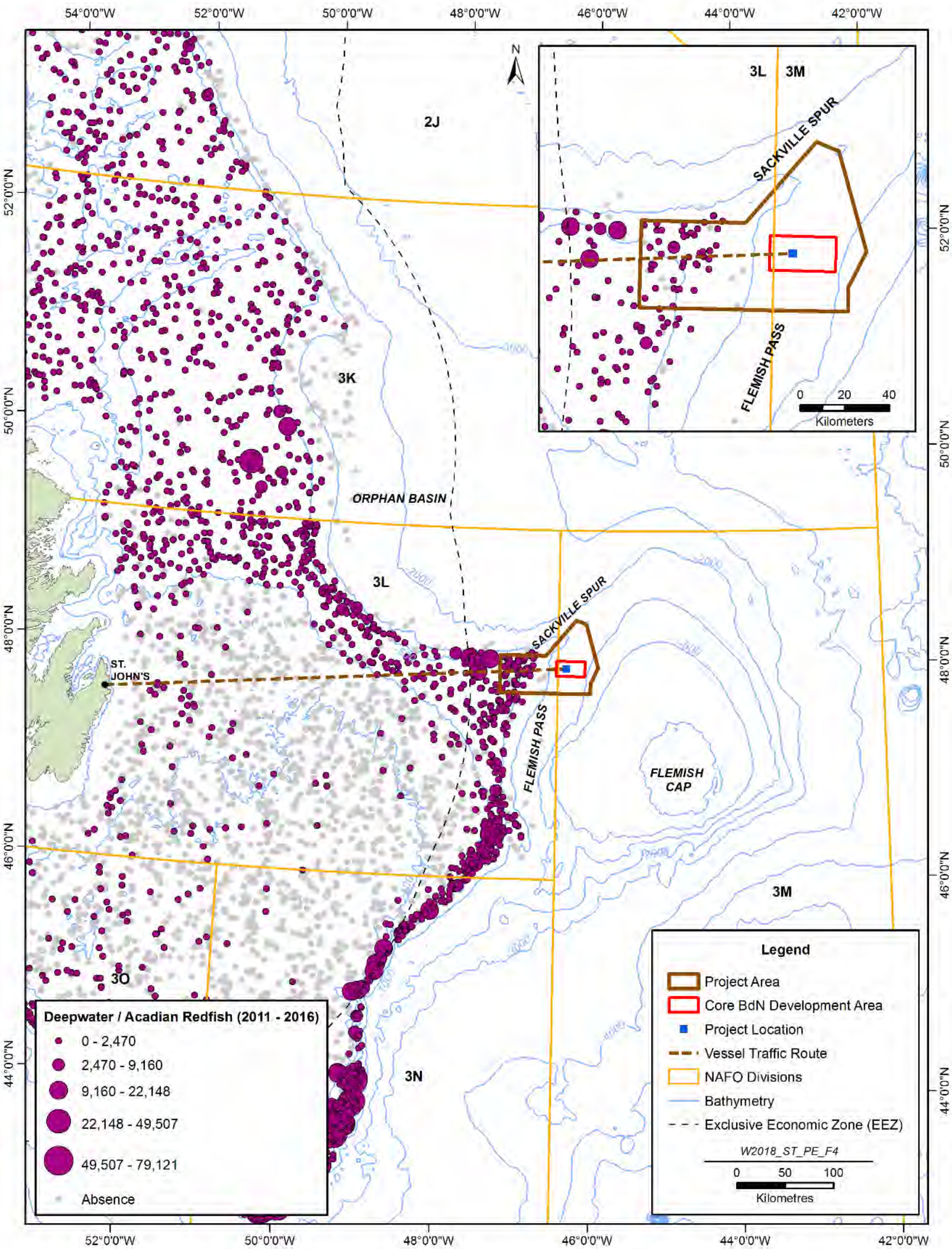

Figure 6-27 Deepwater and Acadian Redfish Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

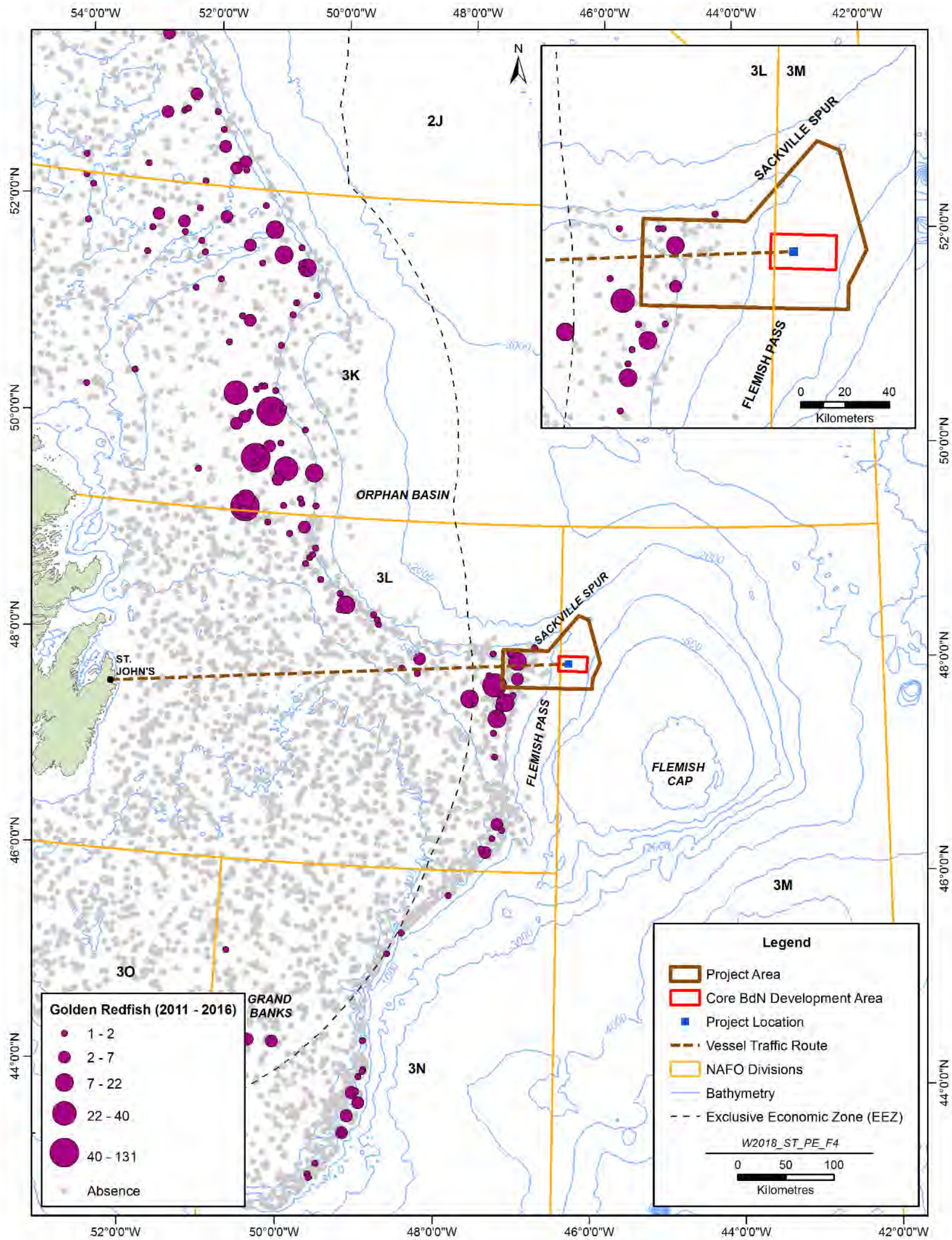

Figure 6-28 Golden Redfish Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

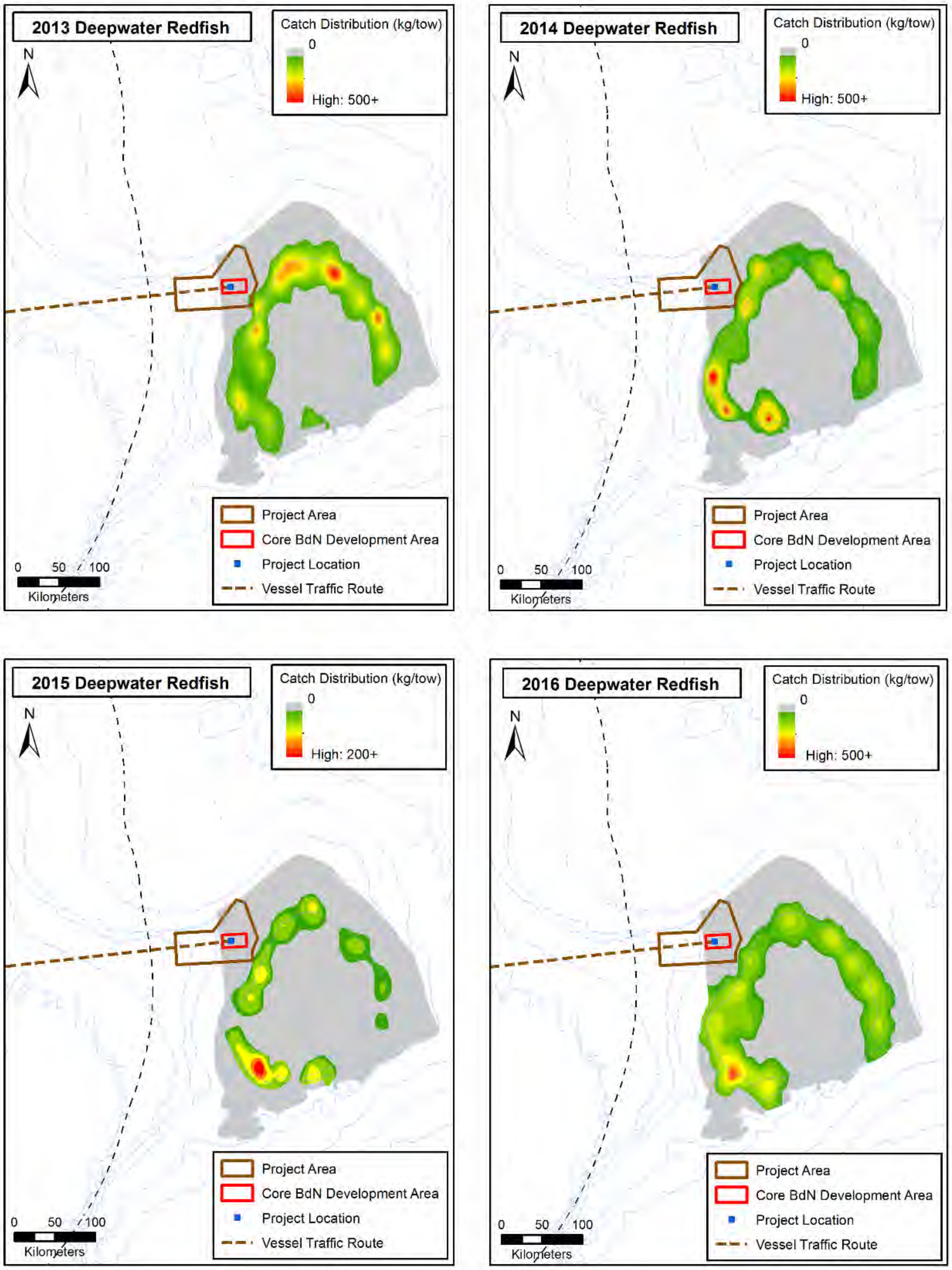

Figure 6-29 Deepwater Redfish Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

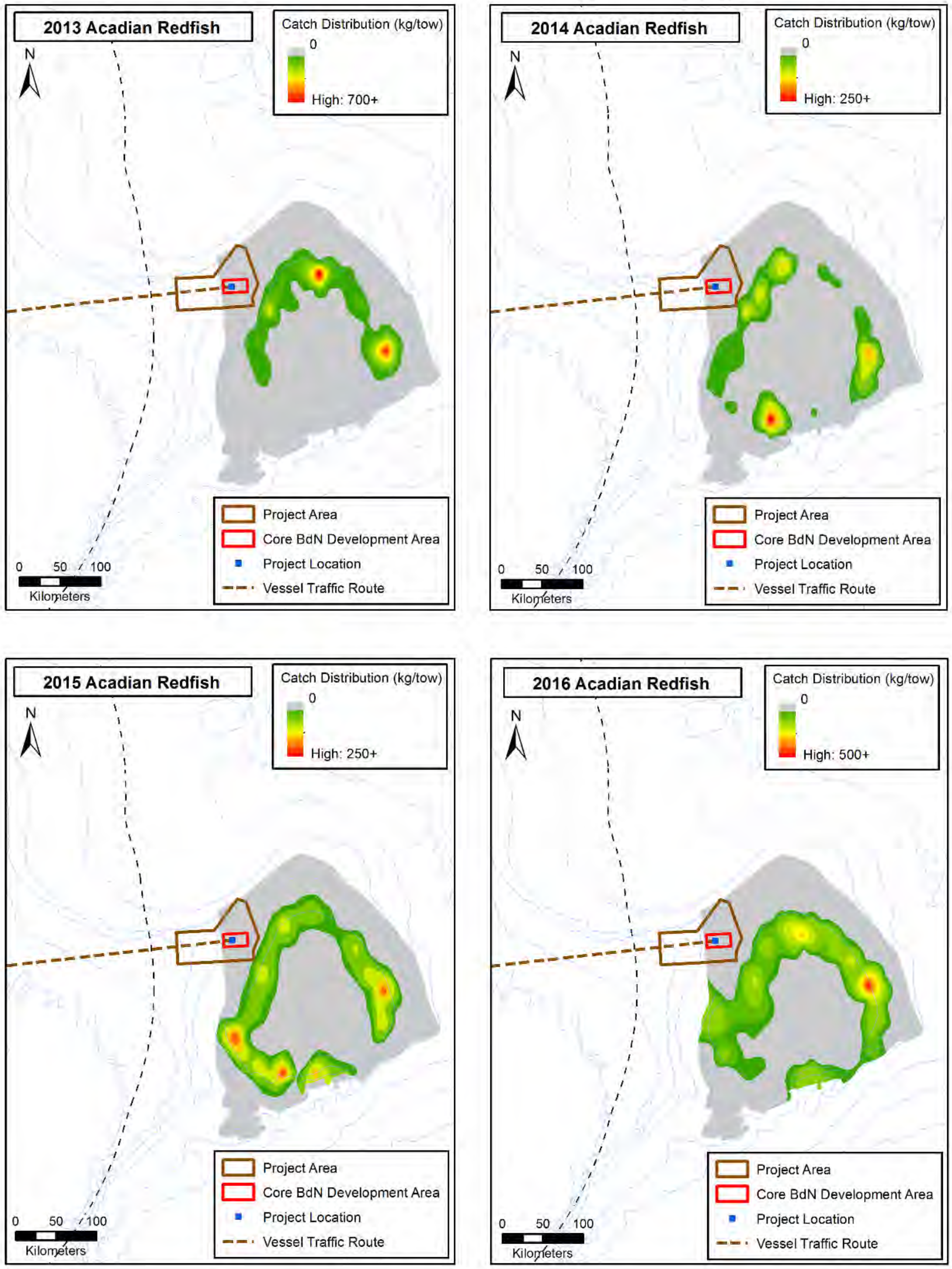

Figure 6-30 Acadian Redfish Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

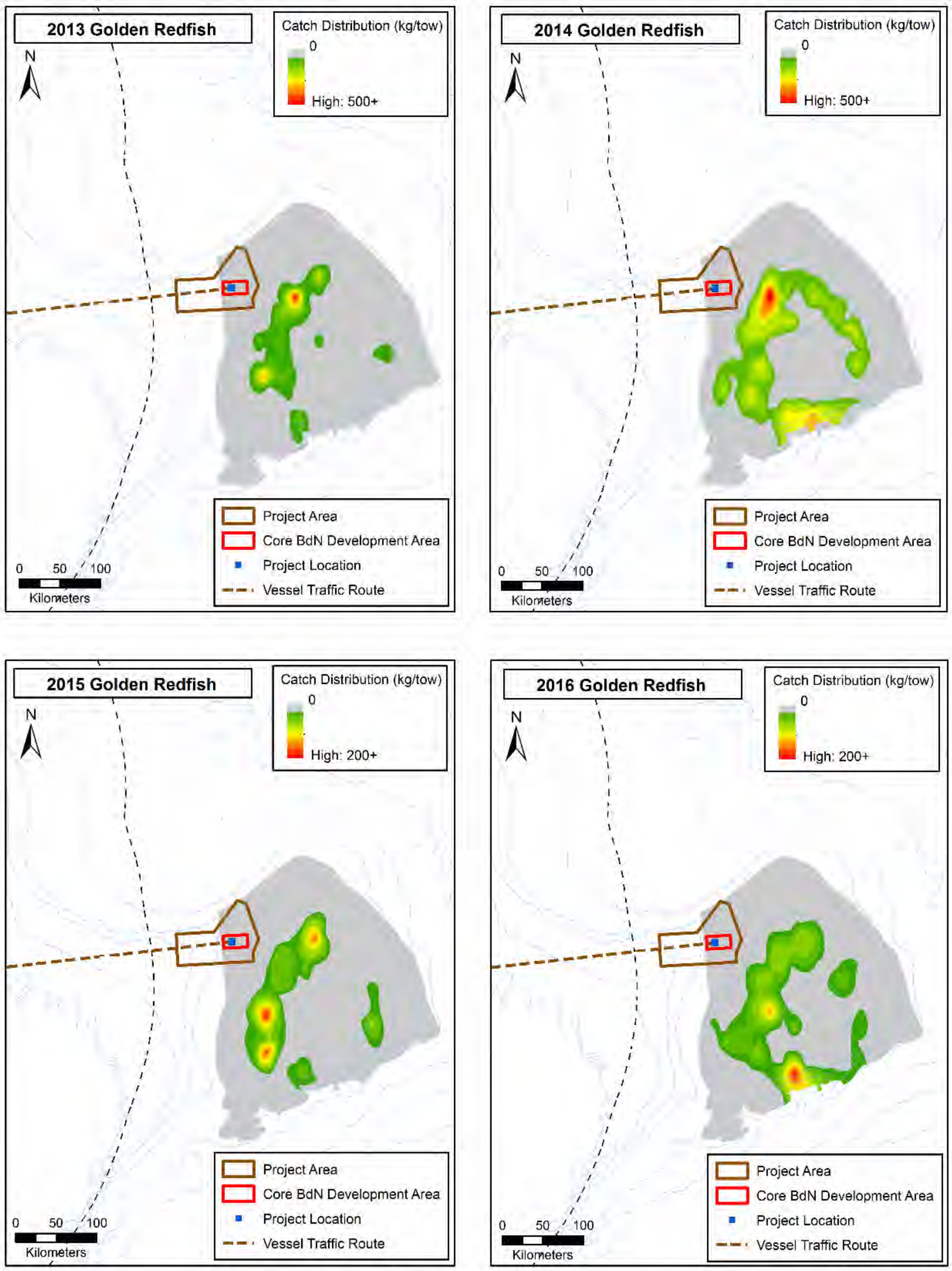

Figure 6-31 Golden Redfish Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

Habitats for adult redfish are generally bank slopes and deep channels in relatively cold waters (5ºC) (COSEWIC 2010c). Both Acadian and deepwater redfish have wide depth ranges of 138 m to 1,200 m (Nogueira et al. 2017) with relatively high abundances beyond shelf depths (> 250 m). Golden redfish has the lowest depth range (130 m to 631 m) of the three species and was another key species in shallow slope assemblages on the Flemish Cap (Nogueira et al. 2017) (Figure 6-31). Smaller adult redfish tend to occupy shallower waters and may migrate to deeper waters as they grow (COSEWIC 2010c). Areas of concentration were largely on the slopes of the Grand Banks and the Flemish Cap with infrequent captures in the Flemish Pass (Román et al 2018a). However, this may be due to lack of sampling effort from Canadian and EU RV surveys in the Flemish Pass rather than low abundances in the area. Redfish have historically been captured in the Flemish Pass as bycatch of the Greenland halibut fishery (Ávila de Melo et al 2018).

Redfish species are long-lived (40 to 75 years in age), commercially harvested species that are associated with the slopes of the NL Shelf, the Flemish Pass and Flemish Cap. Redfish engage in nocturnal vertical migrations to feed on zooplankton and fish (Scott and Scott 1988; Templeman 2010) but are not known to undertake the seasonal migrations exhibited by many shelf species. These fish are considered semi-pelagic due to their vertical migrations, although they prefer inhabiting shelf slope and deep channel areas (COSEWIC 2010c). Redfish species use internal fertilization with breeding occurring between September and December (COSEWIC 2010c). The larvae are released during the spring to early summer and are primarily found in surface waters, though they may be found in the upper 200 m of the water column. Redfish spawning has been recorded on the edges of the Flemish Cap with dispersal mainly to the Cap (Anderson 1984; Frank et al. 1996). The diet of larval redfish includes the eggs of fish and invertebrates and some zooplankton. As they reach juvenile and adult sizes, redfish feed mainly on copepods, euphausiids and fish (COSEWIC 2010c).

The redfish stocks in the western Atlantic are considered to be in poor condition and consequently Acadian and deepwater redfish are listed as Threatened by COSEWIC (2010c). Current threats to the Acadian and deepwater redfish include by-catch mortality, overfishing, predation by seals, and unfavourable environmental conditions for groundfish. To date, no critical habitats have been established for these species, however it has been suggested that habitats made up of anemones and coral beds may be linked to redfish survival (COSEWIC 2010c). The Southwest Shelf Edge and Slope is considered an important spawning area for redfish (Templeman 2007).

Other Species of Commercial, Socioeconomic, or Indigenous Importance

Alewife (Gasperau)

Alewife, also known as Gasperau, is an anadromous, densely schooling, pelagic fish native to the northwest Atlantic and its tributary fresh waters (Scott and Scott 1988). With the exception of "landlocked" populations, alewives spend the majority of their adult life at sea, only returning to freshwater to spawn in spring (Scott and Scott 1988; Kearley 2012). At sea, alewives occur at 50 to 150 m depth (Kearley 2012). Similar to herring, alewives tend to avoid light, migrating vertically daily in step with the diel movement of their food (Scott and Scott 1988).

In the northwest Atlantic marine environment, the alewife diet is majority northern krill and related zooplankton (Kearley 2012). As opportunistic feeders, alewife may also consume benthic insects, fish eggs and larval fish. A number of fish species prey on alewife, including striped bass, bluefish, salmonids and others; osprey, heron, gulls, eagles and other birds will target this species (Kearly 2012).

Alewife occur in freshwater and coastal marine waters from North Carolina to NL. It is most abundant in the coastal waters of New England and Nova Scotia, in large rivers throughout the Maritimes, as well as a large invasive freshwater population in the Great Lakes (Ocean Biogeographic Information System (OBIS)). This species is uncommon, but occasionally encountered, on the continental shelf off NL (OBIS). The National Oceanic and Atmospheric Administration (NOAA) lists alewife as a candidate species under the *Endangered Species Act*, due to habitat degradation and habitat loss. Alewives were not captured in Canadian RV surveys in the Project Area and were not a key species on the Flemish Cap.

American plaice

American plaice is a demersal flatfish that occupies sandy habitats and is widespread across continental shelf and slope habitats in the Northwest Atlantic (Scott and Scott 1988). This species contributes to less than one percent of abundance in Canadian RV surveys in the Project Area and on the Flemish Cap (Nogueira et al. 2017). Canadian RV survey data show them occupying habitats such as the Bonavista Corridor in high abundance, but also in shallow areas of the Grand Bank that are not used as frequently by other species (Figure 6-32). On the Flemish Cap, American plaice primarily occupy the relatively shallow areas (< 400 m) (Paz and Casas 1996; Alpoim and Gonzáles Troncoso 2016; Nogueira et al. 2017) (Figure 6-33). This demersal species feeds on a variety of invertebrates and fish (Scott and Scott 1988) and is a prey source for larger fish such as cod and sharks. The population is currently listed as Threatened by COSEWIC. Nogueira et al. (2016) indicated that there is some evidence for recovery of American plaice on the NL Shelf. This species does not undertake substantial migrations; however, adults may move to deeper waters to overwinter (COSEWIC 2009a). Spawning occurs in mid-March on the Flemish Cap and in April to May on the Grand Bank and Northeast NL Shelf. American plaice eggs float to the surface and are dispersed by the currents (Scott and Scott 1988; Frank et al. 1992). Settled juveniles generally inhabit shallow waters of 100 m to 200 m in areas of fine sediments where they can bury themselves (COSEWIC 2009a).

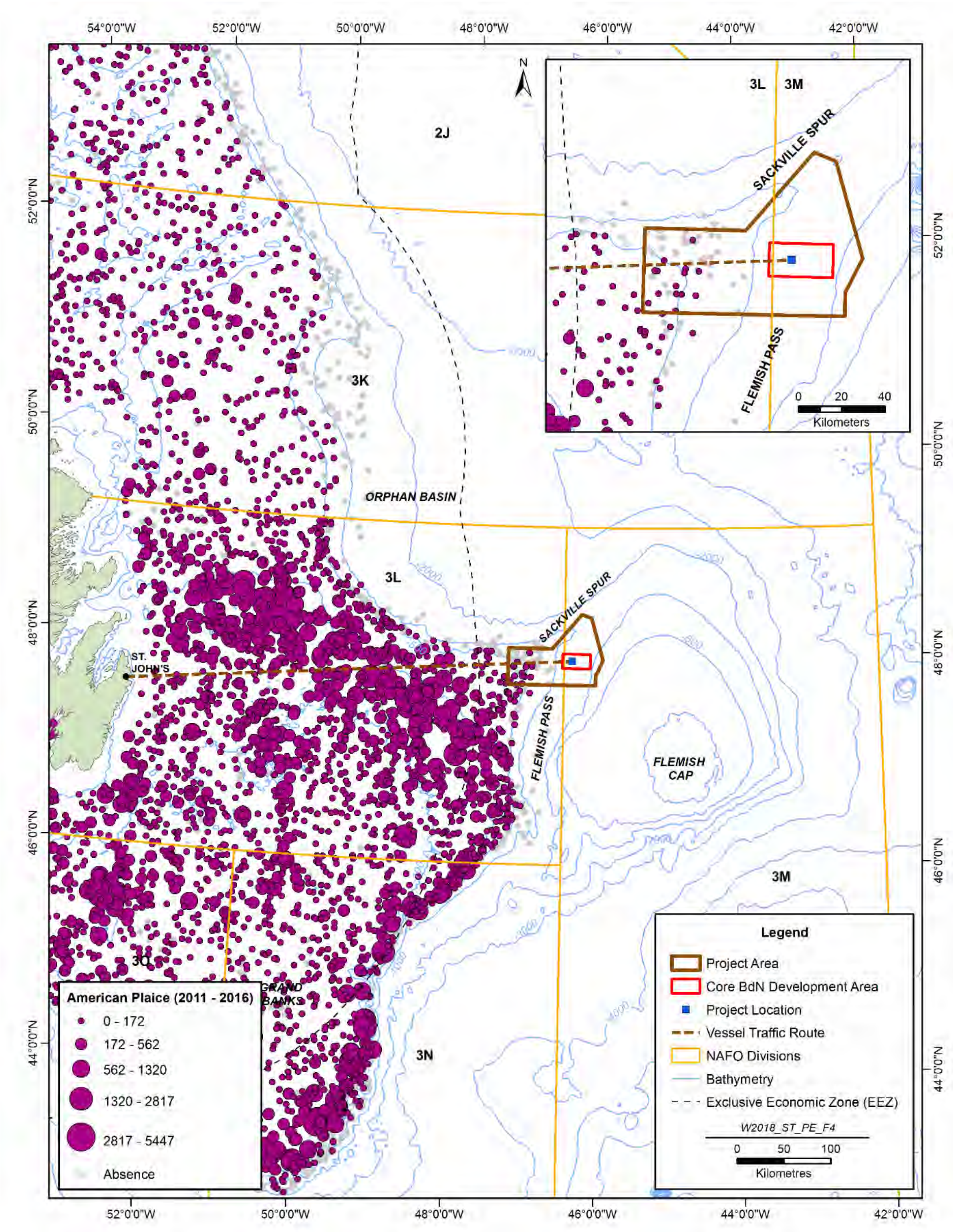

Figure 6-32 American plaice Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

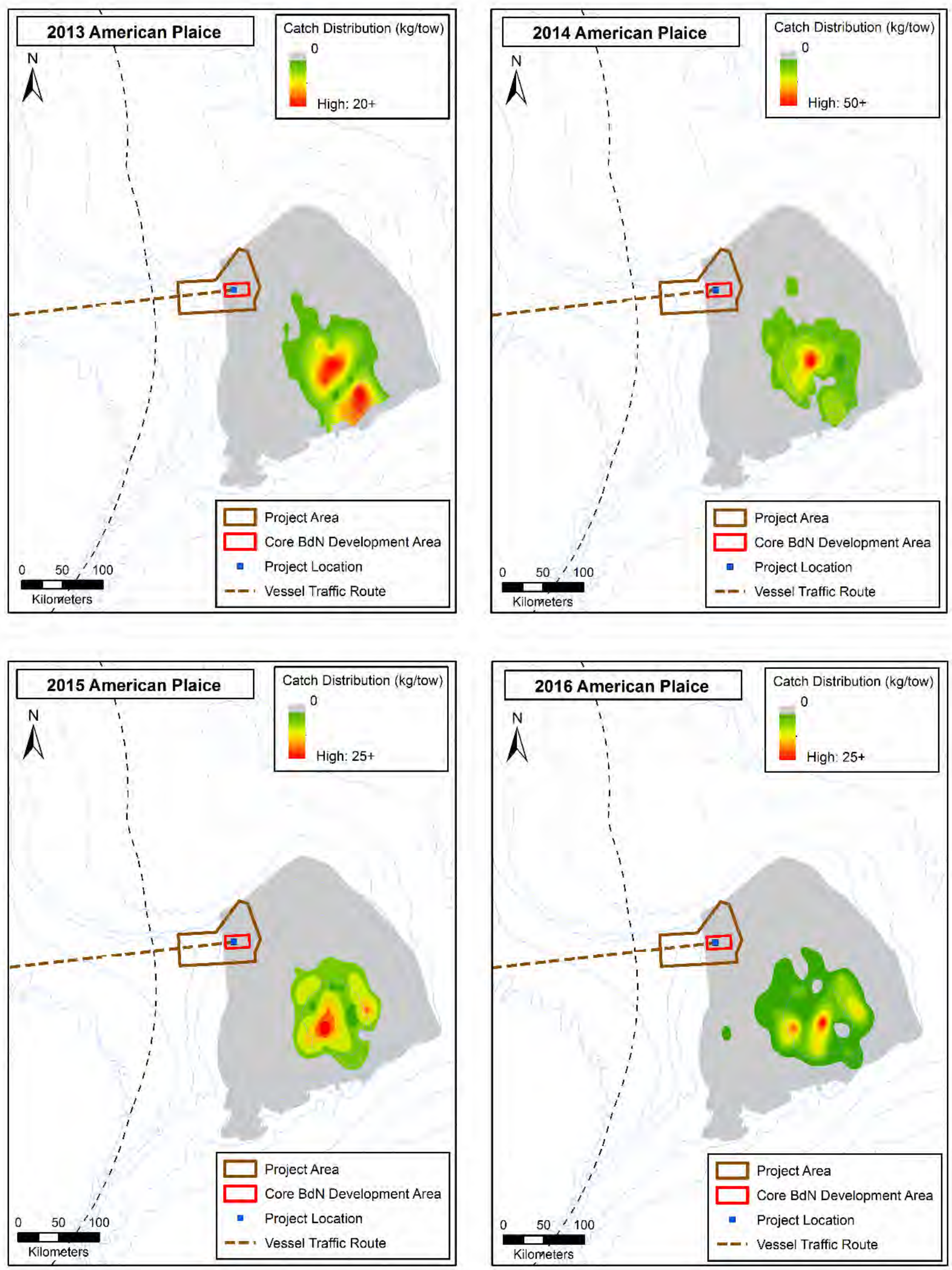

Figure 6-33 American plaice Distribution and Abundance as Compiled from EU RV Trawl Survey Data (2013 to 2016)

Capelin

Capelin are a schooling pelagic, planktivorous (e.g., copepods, amphipods, euphausiids) species that is typically associated with cold waters (Scott and Scott 1988; Trenkel et al. 2014; Maxner et al. 2016). Capelin are a temperature sensitive species and their distributions are known to respond quickly to changing environmental conditions. Capelin have great ecological importance as they are a primary prey species of predatory fish, marine mammals, and seabirds (Scott and Scott 1988; Gomes et al. 1992; Davoren and Montevecchi 2003; Rose 2005; Templeman 2010; Dawe et al. 2012; Maxner et al. 2016). In addition to serving as an important prey source, capelin is also a commercially harvested species. They undertake large spawning migrations from offshore waters to coastal spawning grounds in the spring (Maxner et al. 2016). A large variety of piscivores shadow their migrations to and from coastal waters each year. This species also undergoes diel vertical migrations, except during the inshore migration where they mainly occupy bottom waters (Maxner et al. 2016). In coastal NL waters, the demersal eggs adhere to sediment and are fertilized externally at beaches and deeper waters (15 to 40 m) from June to August (Trenkel et al. 2014; Penton et al. 2012; Maxner et al. 2016). Capelin are found at their highest concentrations along the shelf of the Grand Banks (Figure 6-34) with high concentrations of over 89,000 fish per tow in places. Although Canadian RV surveys are not well suited to sampling pelagic species such as capelin, they are appropriate for confirmation of presence or absence in an area. Within the multi-species survey area, capelin are primarily observed on the shelf of the Grand Banks (Figure 6-32). Capelin were not captured in Canadian RV surveys in the Project Area and were not a key species on the Flemish Cap (Frank et al. 1996).

Herring

Herring are a schooling, benthopelagic, planktivorous (e.g., copepods, amphipods, euphausiids) species that occurs in inshore and offshore waters from surface to 364 m (Trenkel et al. 2014; Coad and Reist 2018) (Figure 6-35). Herring adults and eggs are an important prey species of predatory fish, marine mammals, and seabirds (Scott and Scott 1988; Coad and Reist 2018). There is potential for increased predation pressure on herring as there has been a reduced availability of other important prey species including capelin and shrimp since 2014 (DFO 2018b). Most herring life stages undertake some degree of diel migration where they approach surface waters at night and descend in the water column during the day (Trenkel et al. 2014; Coad and Reist 2018). Some herring stocks in the northwest Atlantic undertake long distance (> 500 km) inter-annual migrations (Trenkel et al. 2014). Northern stocks generally avoid cold winter waters and move south for overwintering (Trenkel et al. 2014). Spawning occurs in Canadian waters from April to November, with spawning towards the latter range in offshore deep-water areas (Coad and Reist 2018). Spawning sites are generally in areas that support larval growth including areas of mixing where primary productivity is high (Coad and Reist 2018). Areas of high standing stock biomass include the North Sea and Georges Bank (Trenkel et al. 2014).

The NL region represents the northern geographic range for herring where ideal environmental conditions for this species are sporadic, leading to irregular occurrences of strong recruitment (DFO 2018b) (Figure 6-35). In the northwest Atlantic, herring are found at their highest concentrations along the Scotian Shelf and the Gulf of St. Lawrence. Distribution is lower on the Grand Banks shelf and slopes.

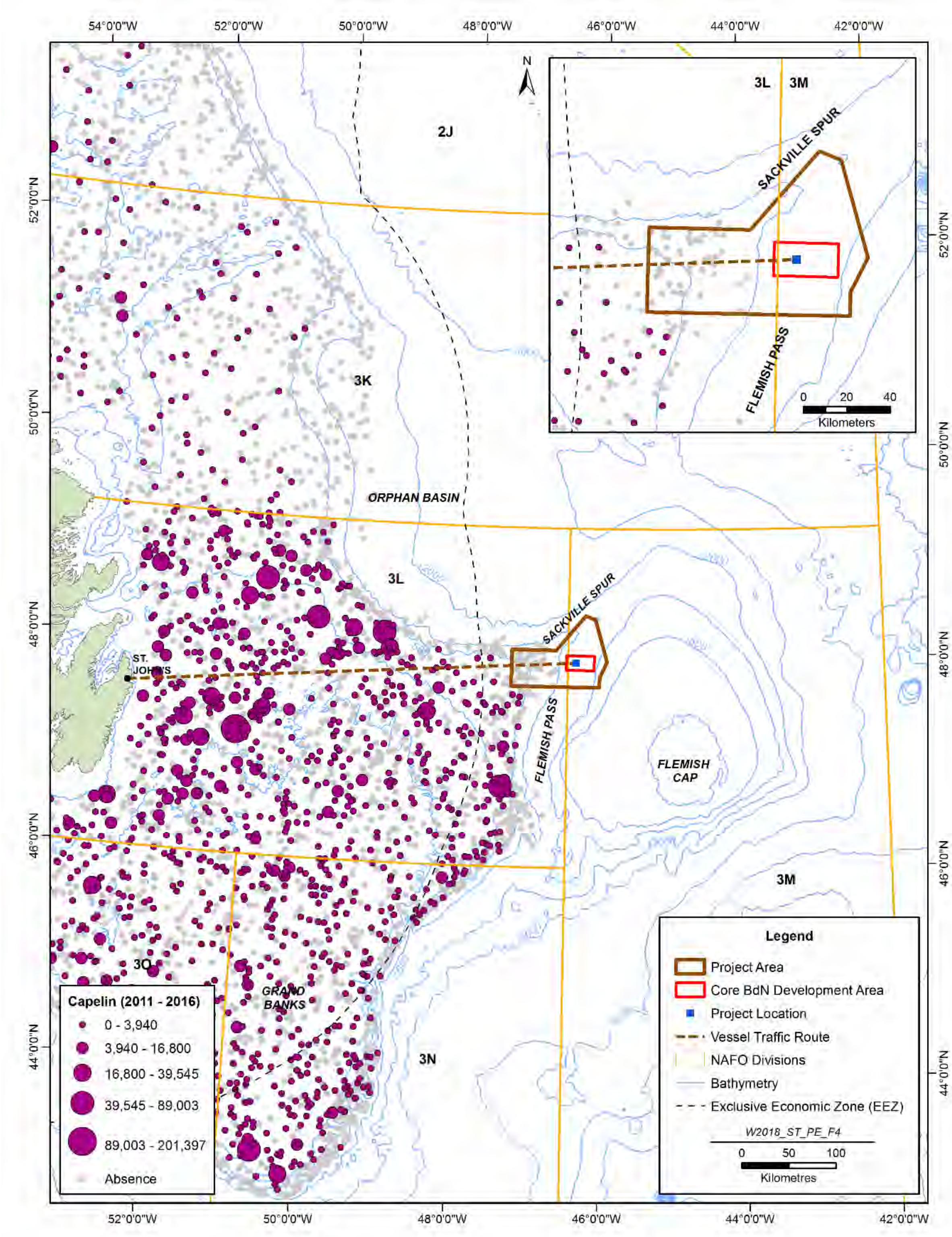

Figure 6-34 Capelin Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

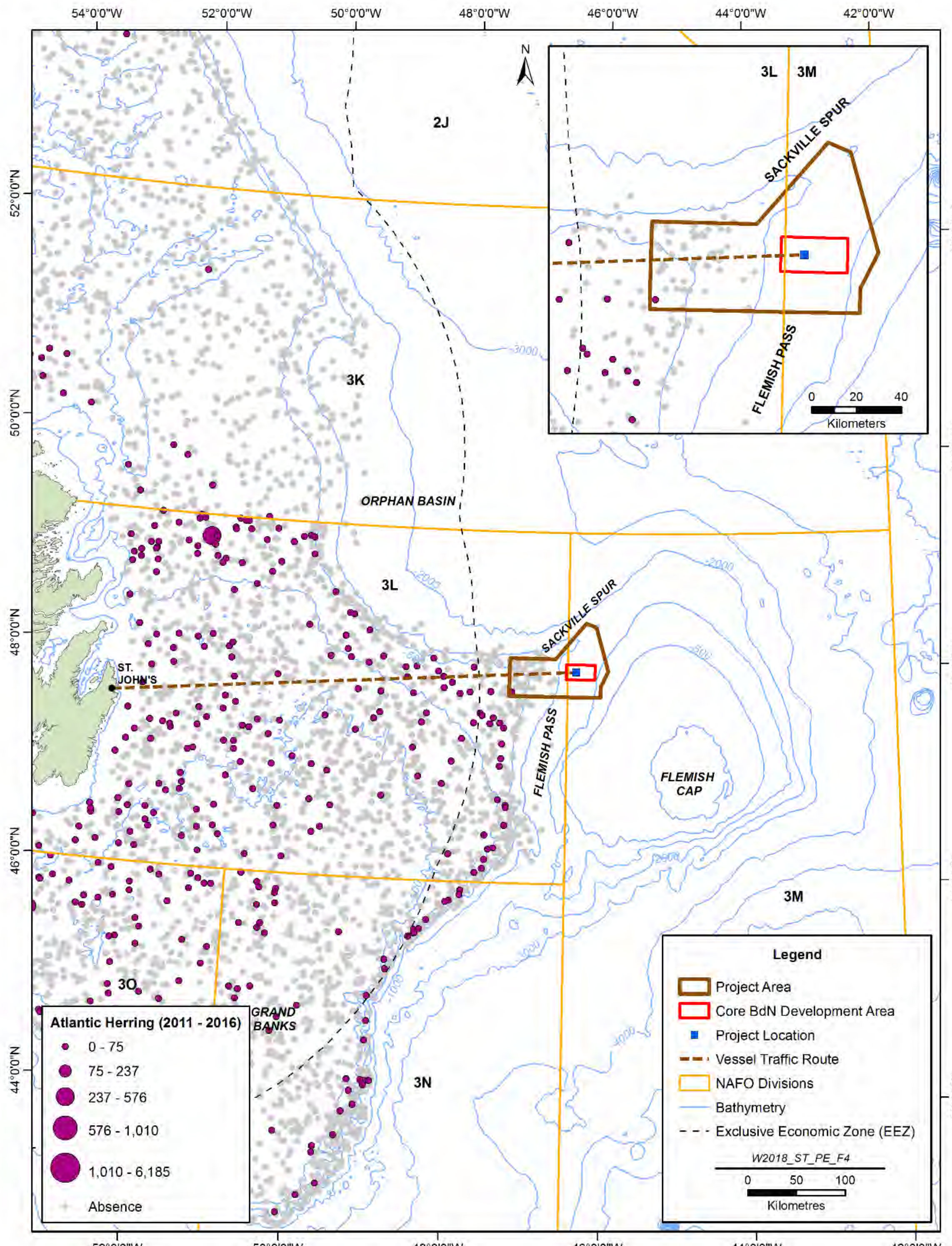

Figure 6-35 Herring Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

Mackerel

Atlantic mackerel are migratory, schooling, pelagic fish, found from near-surface to 200 m depth (Trenkel et al. 2014; Kearley 2012). They occur on both sides of the Atlantic; in the northwest Atlantic mackerel occur from Labrador to Cape Hatteras, North Carolina (Trenkel et al. 2014; Kearly 2012) and are seen in coastal and inshore waters off NL during summer and fall (Scott and Scott 1988). Northwest Atlantic mackerel undertake lengthy annual migrations between feeding and spawning grounds (Trenkel et al. 2014): both northern and southern components of the population overwinter along the continental shelf from Sable Island bank south to Chesapeake Bay, at depths of 70 to 200 m (Scott and Scott 1988; Kearley 2012). In early spring the northern stock moves toward the Gulf of St. Lawrence to spawn (Scott and Scott 1988; Kearly 2012); after spawning, adults move to feeding areas on the continental shelf offshore NL and Nova Scotia, returning to their overwintering areas in the fall (Scott and Scott 1988). The southern population moves toward the Gulf of Maine to spawn (Scott and Scott 1988). Unlike mackerel populations in northeastern Atlantic, there is no evidence of off-shelf feeding by northwestern Atlantic mackerel (Trenkel et al. 2014).

During spawning, eggs are released into the water column, at 10 m to 200 m depth, where they float freely until hatching. Larval mackerel undergo fast growth and extensive feeding on copepod nauplii, switching to a piscivorous diet at approximately 7 mm length (Trenkel et al. 2014). At juvenile and adult life stages, mackerel are opportunistic and adaptive feeders, capable of bother filter feeding and direct feeding (Trenkel et al. 2014; Kearley 2012). Feeding mostly at night, their varied diet includes shrimp and similar crustaceans, crab larvae, small squid, fish eggs, and small fish such as capelin, smelt, juvenile herring and mackerel. Mackerel are an important food source for a wide variety of predators including sea mammals, fish and seabirds (Trenkel et al. 2005; Trenkel et al. 2014). Mackerel tend to avoid cold water and occur most often at water temperatures above 6^{0}C (Trenkel et al. 2014). Mackerel may grow to 60 cm or longer and reach 20 years in age; they reach maturity at 2 or 3 years (Lockwood 1988, Trenkel et al. 2014). Recruitment in the northwest Atlantic is tied to the availability of the larval diet (Trenkel et al. 2014). A 2016 DFO stock assessment of the mackerel stock for the northwest Atlantic stated that spawning biomass had reached its historical low in 2012 but has increased since then (DFO 2017e). Commercial mackerel landings offshore NL reached a historical low in 2015 (DFO 2017e).

In the northwest Atlantic, mackerel are found at their highest concentrations along the Scotian Shelf and the Gulf of St. Lawrence (OBIS 2019b). Mackerel is unlikely to be distributed within the Project Area and therefore is not a key species for the purposes of environmental assessment. Mackerel were not captured in Canadian RV surveys in the Project Area and were not a key species on the Flemish Cap.

Swordfish

Swordfish are large, highly migratory, pelagic species that occupy Canadian waters for foraging from June to October (DFO 2015b) and return to southern spawning areas from December to June (Govoni et al. 2003; Arocha 2007; Neilson et al. 2009, 2014). The Gulf of Mexico and eastern continental shelf of the United States are suggested to be nursery areas for the pelagic larvae (Govoni et al. 2003; Arocha 2017). In Canadian waters, swordfish primarily feed on squid, Atlantic mackerel, Atlantic herring, and other fishes (Scott and Tibbo 1968; Stillwell and Kohler 1985).

The distribution assessment of swordfish in Canadian waters is primarily based on information from fisheries observations (longline and harpoon landings data) and tracking with pop-up satellite tags (Neilson et al. 2009, 2014; Andrushchenko et al. 2014). Distribution data from OBIS (OBIS 2018a) suggest that swordfish may pass through the Project Area (Figure 6-36).

Swordfish populations across the North Atlantic are separate with little evidence of movement between the western and eastern North Atlantic (Neilson et al. 2014). There are also separate northern and southern Atlantic stocks with an approximate boundary around 5^0N latitude. Swordfish associate with thermal fronts indicating they follow the warm Gulf Stream into Canadian waters similar to other large pelagic fishes (Podestá et al. 1993; Sedberry and Loefer 2001). Tagging studies indicate that the distribution of immature swordfish (<179 cm) is primarily along the eastern United States from Massachusetts to Florida. Mature swordfish (>179 cm) generally occupied higher latitudes including the eastern Coast of the United States, Atlantic Canada, the Grand Banks, and the Flemish Cap, with presence during spawning season in the Gulf of Mexico, Sargasso Sea, and Caribbean Sea (Govoni et al. 2003; Neilson et al. 2013, 2014, Luckhurst and Arocha 2016).

The Canadian longline fishery for swordfish generally matches the species distribution from the Georges Bank to the Flemish Cap, however effort is primarily along the Georges Bank, Scotian Shelf and southern Grand Banks (DFO 2011; Lauretta et al. 2014; Andrushchenko et al. 2014; Andrushchenko and Hanke 2015) (see Section 7.1.6.4). Swordfish also undergo diel vertical migrations where they occupy surface waters (<100 m) during the day and deeper waters (>400 m) at night (Lerner et al. 2013). Occasionally, swordfish bask in surface waters during the day; a behavior more common in colder waters (Dewar et al. 2011; Neilson et al. 2013).

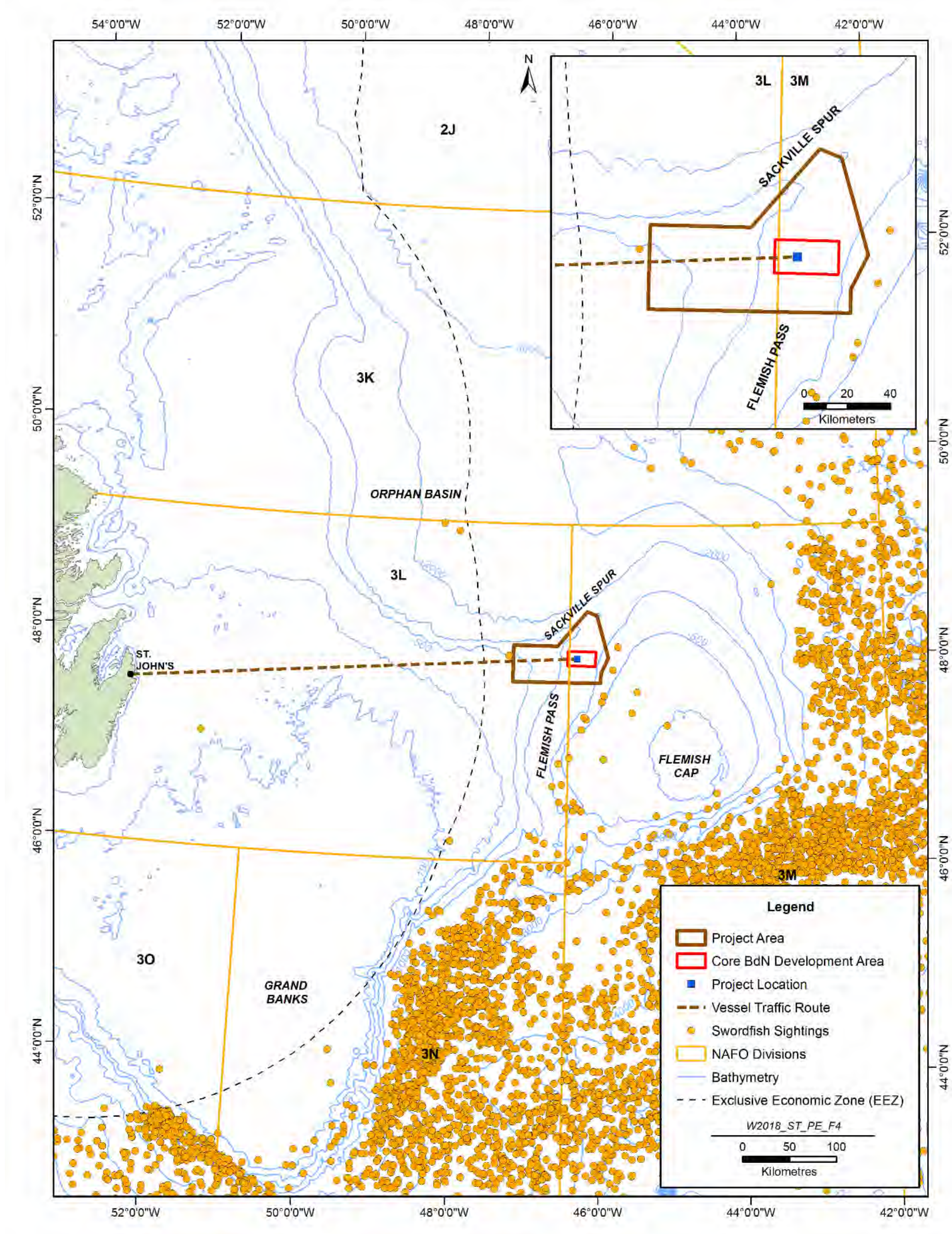

Figure 6-36 Swordfish Distribution as Compiled from Ocean Biogeographic Information System Data (1957 to 2005)

6.1.8.6 Key Reproduction Times and Areas

A variety of spawning strategies are pursued by fish regionally, including broadcast spawning (e.g., Atlantic cod, American plaice), ovoviviparous spawning (e.g., redfish) and depositing eggs in demersal cases (e.g., skates). Fish species may also undergo distant spawning migrations to freshwater rivers (e.g., Atlantic salmon), coastal beaches (e.g., capelin), or warm temperate or tropical waters (e.g., American eel, tunas, swordfish, and sharks). For poorly studied deep slope or abyssal species, many elements of their reproductive biology have yet to be documented.

Greenland halibut may potentially spawn in the Project Area as they are known to spawn in the Flemish Pass with spawning peaks from July to August and in December (Junquera and Zamarro 1994). Spawning occurs in deep waters of 600 m to more than1,200 m where the eggs float and hatch. Redfish species are known to spawn on the edges Flemish Cap including parts of the Project Area, with larvae eventually dispersing to the Cap (Anderson 1984). Spawning and reproduction, including identification of spawning areas, are not well understood in grenadier species. However, their low migratory capabilities (COSEWIC 2007a, 2008) suggests that spawning may occur within the Project Area.

A summary of spawning seasons and known spawning areas for key fish species is provided in Table 6.28. A large number of fish species are spring and early summer spawners, with overlap over March to April. This likely coincides with the spring phytoplankton bloom where there are higher food levels for planktonic larvae (DFO 2017d). For key fish species in the Project Area (Table 6.26), eggs and larvae are largely pelagic. Species that spawn throughout the year include roundnose grenadier.

Table 6.28 Spawning Periods and Locations of Some Key Fish Species

Common Name	Scientific Name	Eggs and/or Larvae	Spawning Time J	F	M	A	M	J	J	A	S	O	N	D	Known Spawning Locations
Acadian redfish	*Sebastes fasciatus*	P*				■	■								Flemish Cap, Southwest Shelf Edge and Slope of Grand Bank[2,3]
American plaice	*Hippoglossoides platessoides*	P				■	■								Grand Bank[1]
Atlantic cod	*Gadus morhua*	P		■	■	■	■	■	■	■	■	■	■		Southeast shoal and tail of the Banks, Virgin Rocks, Burgeo Banks, Flemish Cap
Blue hake	*Antimora rostrata*	P**	■	■								■	■	■	Not known to spawn in Canadian waters[5]. Eggs larvae not detected in Canadian Waters
Capelin	*Mallotus villosus*	D						■	■	■					Southeast shoal of Grand Bank[4] Coastal waters of NL[1]
Common grenadier	*Nezumia bairdii*	P							■	■	■	■			No particular spawning location[1]
Deepwater redfish	*Sebastes mentella*	P*				■	■								Flemish Cap, Southwest Shelf Edge and Slope of Grand Bank[2,3]
Glacier lanternfish	*Benthosema glaciale*	P	■	■	■	■									
Golden redfish	*Sebastes norvegicus*	P*				■	■								Flemish Cap, Southwest Shelf Edge and Slope of Grand Bank[2,4]
Greenland halibut	*Reinhardtius hippoglossoides*	P						■	■	■				■	Davis Strait, Flemish Pass[1]
Longnose eel	*Synaphobranchus kaupii*	P						■	■	■					
Roughhead grenadier	*Macrourus berglax*	P	■	■	■	■									Southern and Southeastern Grand Bank[1]
Roundnose grenadier	*Coryphaenoides rupestris*	P	■	■	■	■	■	■	■	■	■	■	■	■	
Swordfish	*Xiphias gladius*	P	■	■	■	■	■	■						■	Gulf of Mexico[1]

Note: Shading indicates spawning periods.
Eggs and/or larvae: pelagic (P), demersal (D)

*Redfish are ovoviviparous. **Assumed to be pelagic based on other gadid species.
Sources: [1] Scott and Scott (1988); [2] Templeman (2007); [3] COSEWIC (2010b); [4] COSEWIC (2010c); [5] Kulka et al. (2003).

6.1.9 Species at Risk

Several fish species identified as 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 federal and provincial legislation, including SARA and the NL *Endangered Species Act* (ESA), or those identified as of conservation concern by conservation bodies including the COSEWIC or the International Union for Conservation of Nature (IUCN) but not formally protected. 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
- *Vulnerable*: A species that has characteristics which make it sensitive to human activities or natural event

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, with the designations 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
- *Special Concern*: A species that may become threatened or endangered because of a combination of biological characteristics and identified threats

Further information on these conservation designations can be found in the Eastern Newfoundland SEA (Amec 2014a). In addition, although the information presented in this EIS 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 SAR in Canada.

There are 31 species with conservation designations (NL ESA, COSEWIC, SARA, IUCN) occurring in the western North Atlantic (Table 6.29) with 23 Canadian listed species (NL ESA, COSEWIC, SARA) that have potential to overlap with the RSA. Two species, blue shark and barndoor skate, have been listed as Not at Risk and are not included in the tally for Canadian listed species. Further species information is presented based on SAR designation, indigenous importance, range overlap with the Project Area, or a combination of these reasons. Only five species are listed under NL ESA or SARA legislation including the white shark (SARA: Endangered), northern (broadhead) wolffish (SARA*:* Threatened), spotted wolffish (SARA: Threatened) and striped (Atlantic) wolffish (SARA: Special Concern) and American eel (NL ESA: Vulnerable). Striped, northern and spotted wolffish also have ranges that overlap with the Project Area. American eel and Atlantic salmon were further described as they are species of social, cultural and traditional importance. Eleven other species have ranges distributions that may potentially overlap with the Project Area or adjacent areas including Atlantic cod, white hake, thorny skate, grenadier species, redfish species, shark species, and Atlantic bluefin tuna based on COSEWIC Assessment and Status reports. However, species range extents within the Project Area may not necessarily be areas of high utilization. These species are further described below in terms of their biology, ecology and distribution with some numerically dominant fish species of the area previously described in Section 6.1.8 Lumpfish, cusk, winter skate and spiny dogfish are unlikely to occur in the Project Area. The Project Area is not important habitat for these species and represents the edges of their respective ranges with the exception of the smooth skate. Smooth skates that would be present in the Project Area are from a population that are not listed by COSEWIC or SARA. Therefore, these species are not further discussed in the EIS. Additional biological information is described in the Eastern Newfoundland SEA (Amec 2014a). Although species-specific areas of relatively high aggregation have been identified in the Northwest Atlantic, proposed critical habitats have only been delineated for spotted and northern wolffish in the RSA. However, no proposed critical habitats overlap with the Project Area.

Table 6.29 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			NR	NT	Atlantic (COSEWIC); Global (IUCN)	D
Basking shark	Cetorhinus maximus			SC	V	Atlantic (COSEWIC); Global (IUCN)	NC
Common lumpfish	Cyclopterus lumpus			T		Atlantic (COSEWIC)	D
Atlantic cod	Gadus morhua			E	V	NL (COSEWIC); Global (IUCN)	NC
Cusk	Brosme brosme			E			NC
White hake	Urophycis tenuis			T		Atlantic and Northern Gulf of St. Lawrence (COSEWIC)	D
Haddock	Melanogrammus aeglefinus				V		

Table 6.29 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		
Porbeagle	Lamna nasus			E	V	Global (IUCN)	NC
Shortfin mako	Isurus oxyrinchus			E	V	Atlantic (COSEWIC); Global (IUCN)	D, NC
White shark	Carcharodon carcharias		E	E	V	Atlantic (COSEWIC/SARA); Global (IUCN)	NC
Roundnose grenadier	Coryphaenoides rupestris			E	CE	Global (IUCN)	D
American plaice	Hippoglossoides platessoides			T		NL (COSEWIC)	NC
Atlantic halibut	Hippoglossus hippoglossus			NR	E	Global (IUCN)	NS, D
Barndoor skate	Dipturus laevis			NR	E	Global (IUCN)	D
Little skate	Leucoraja erinacea				NT	Global (IUCN)	NC
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
Atlantic salmon[4]	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, Outer Bay of Fundy (COSEWIC); Global (IUCN)	D

Table 6.29 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		
Albacore tuna	Thunnus alalonga				NT	Global (IUCN)	NC
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); Global (IUCN)	NC
Deepwater redfish	Sebastes mentella			T	LC	Northern (COSEWIC); Global (IUCN)	NC
Spiny dogfish	Squalus acanthias			SC	V	Atlantic (COSEWIC); Global (IUCN)	NC

[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)
[4] Individual designations for populations are presented in Section 6.1.9.6 Atlantic Salmon.

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. Some species are also recreationally captured or of social, cultural and traditional importance for Indigenous groups including Atlantic salmon and American eel. 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.

The presence and distributions of SARA listed demersal species and those of commercial importance are presented in previous figures and detailed in the following section. 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.

6.1.9.1 Wolffish (Striped, Spotted, Northern)

Striped wolffish have a Special Concern designation and northern and spotted wolffish have Threatened designation under SARA. The three species are slow-growing and long-lived, characteristics that limit their recovery potential from stressors including by-catch mortality or habitat alteration. Populations of all three species have declined in Canadian waters since the 1980s due mainly to commercial fishing by-catch mortality; however, there has been a small upward trend since the mid 1990s (COSEWIC 2012a, 2012b, 2012c). Proposed measures to increase population levels and distributions as part of the Recovery Strategy and Management Plans include increasing research on each species, protecting habitat, monitoring, and mitigating human impacts (Kulka et al. 2007). Migrations of northern and spotted wolffish are limited based on tagging studies, however striped wolffish may undergo longer migrations as they move to inshore waters to spawn (Kulka et al. 2007). During the Equinor Canada 2018 Seabed Survey, a single spotted wolffish was observed in the Core BdN Development Area at survey location P2.

Critical habitat has been delineated for spotted and northern wolffish, primarily along the northeast shelf and slopes of the Grand Banks, however, there are no overlaps with the Project Area (Figure 6-37, Figure 6-38, Figure 6-39, DFO 2018c). The critical habitat extent was based on preferred sea bottom temperatures and depth for these species. While the entire area may not be critical habitat for the species, the functions and features necessary for the species survival and recover likely exist within the identified area based on available information (DFO 2018c). Potential critical habitat has not been established for striped wolffish as it is not a requirement of Special Concern SARA designation.

Striped and spotted wolffish lay egg clusters on the ocean bottom that are guarded by adults. Following hatching, the wolffish larvae become pelagic and are commonly found over continental slopes. The life history of northern wolffish is somewhat less known, but it may be similar in nature to the other two related species (Kulka et al. 2004). Striped and spotted wolffish primarily feed on invertebrates (68 to 85 percent) including echinoderms, crustaceans, and bivalves. Fish are consumed to a lesser extent (15 to 23 percent of diet) by these species (COSEWIC 2012a, 2012b). Northern wolffish that are associated with pelagic environments primarily feed on pelagic fish and invertebrates including jellyfish and gelatinous zooplankton (COSEWIC 2012c). Larval wolffish are thought to consume zooplankton including crustaceans, fish eggs and fish larvae (COSEWIC 2012c).

Habitat requirements and preferences differ considerably across these three species. Striped wolffish generally frequent depths of > 100 m with peak abundance around 250 m depths and below the thermocline (COSEWIC 2012a). Juveniles and adults of this species generally inhabit areas of rocky and sandy bottoms and require caves or boulders for spawning (COSEWIC 2012a, Novaczek et al. 2017). Spotted wolffish mainly frequent intermediate water depths (200 m to 750 m) with no apparent substrate type preferences (COSEWIC 2012b). Northern wolffish have a wide depth range (38 m to 1,504 m) but tend to occupy pelagic areas more than the other two wolffish species and are associated with sand and shell substrates (COSEWIC 2012c).

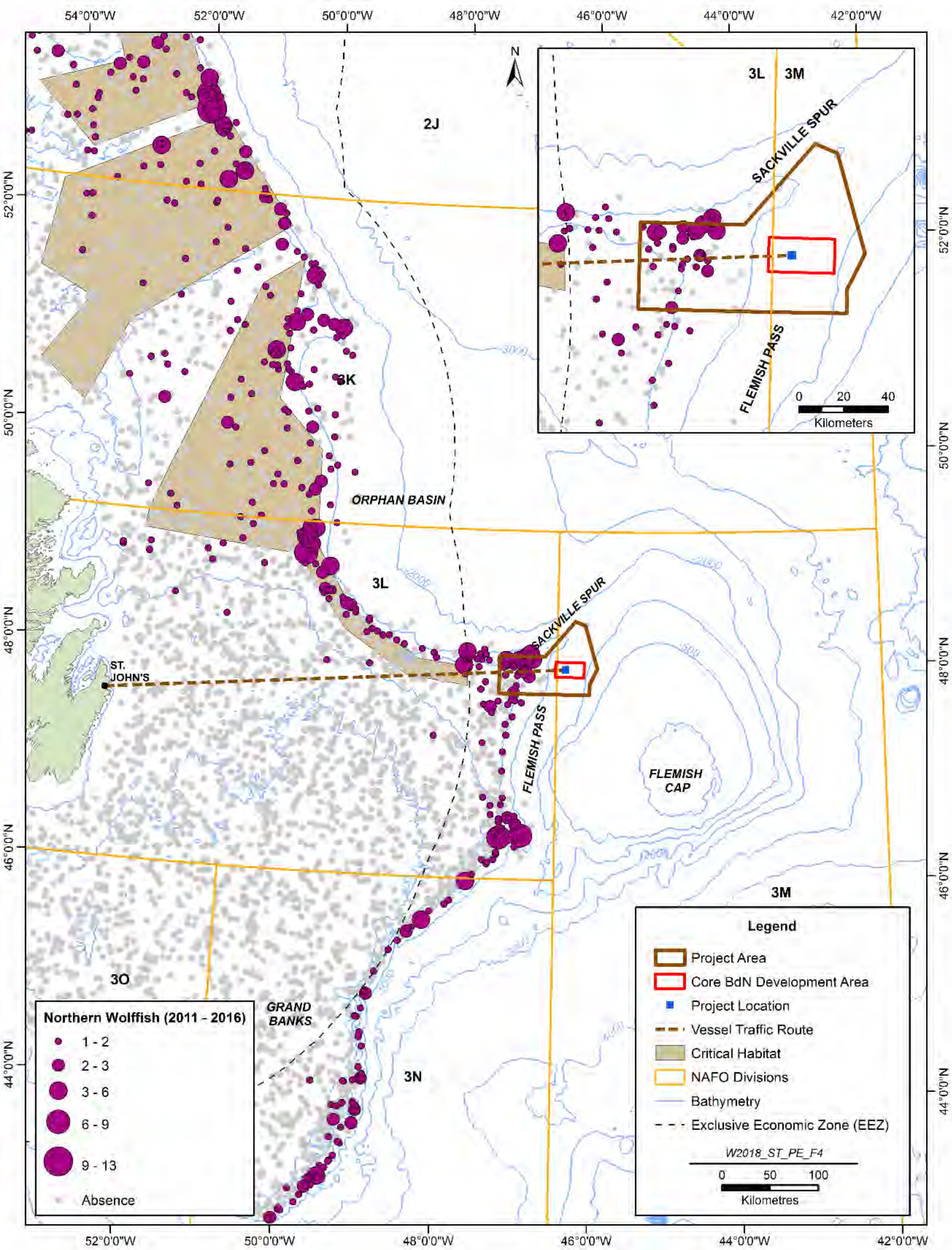

Figure 6-37 Northern Wolffish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

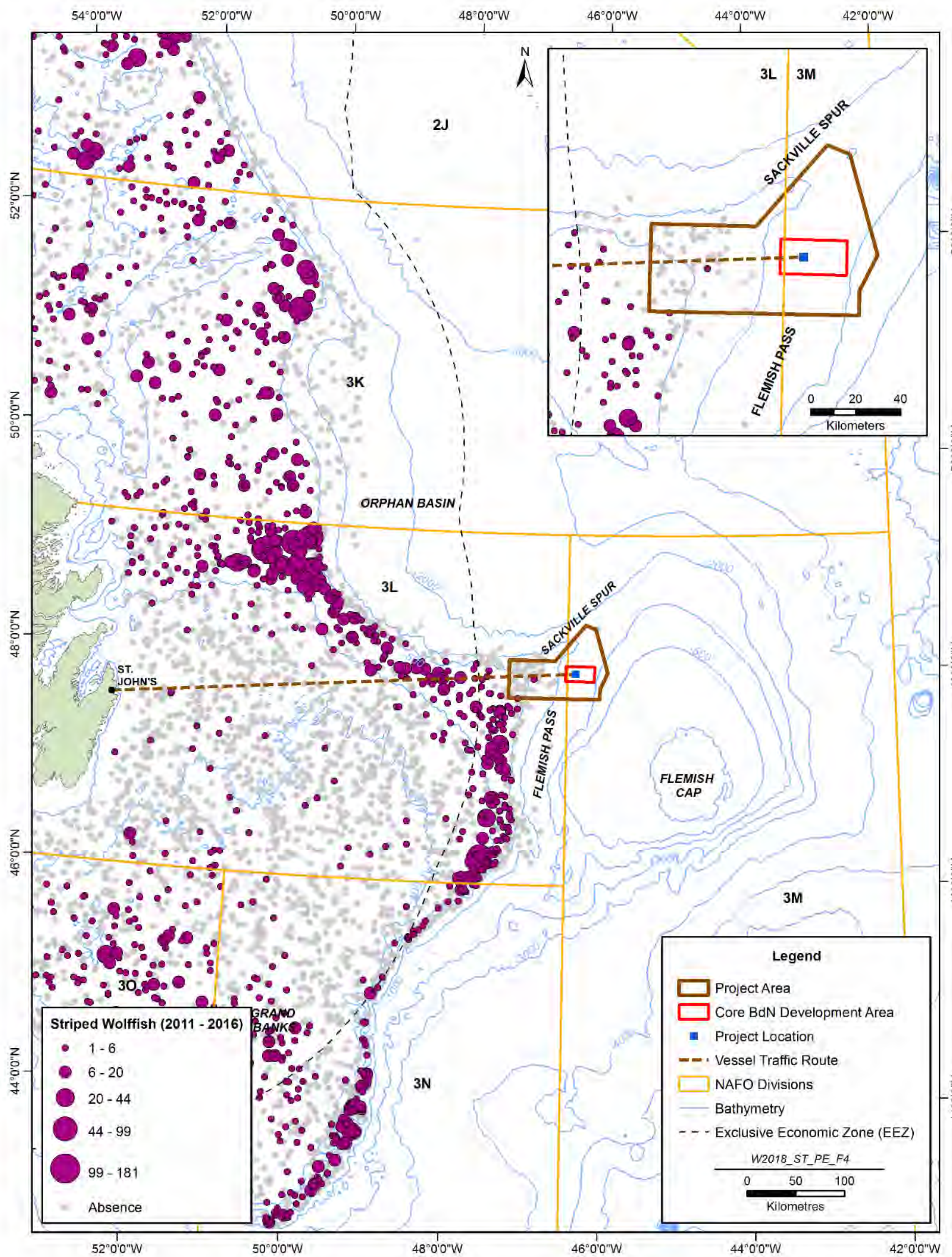

Figure 6-38 Striped Wolffish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

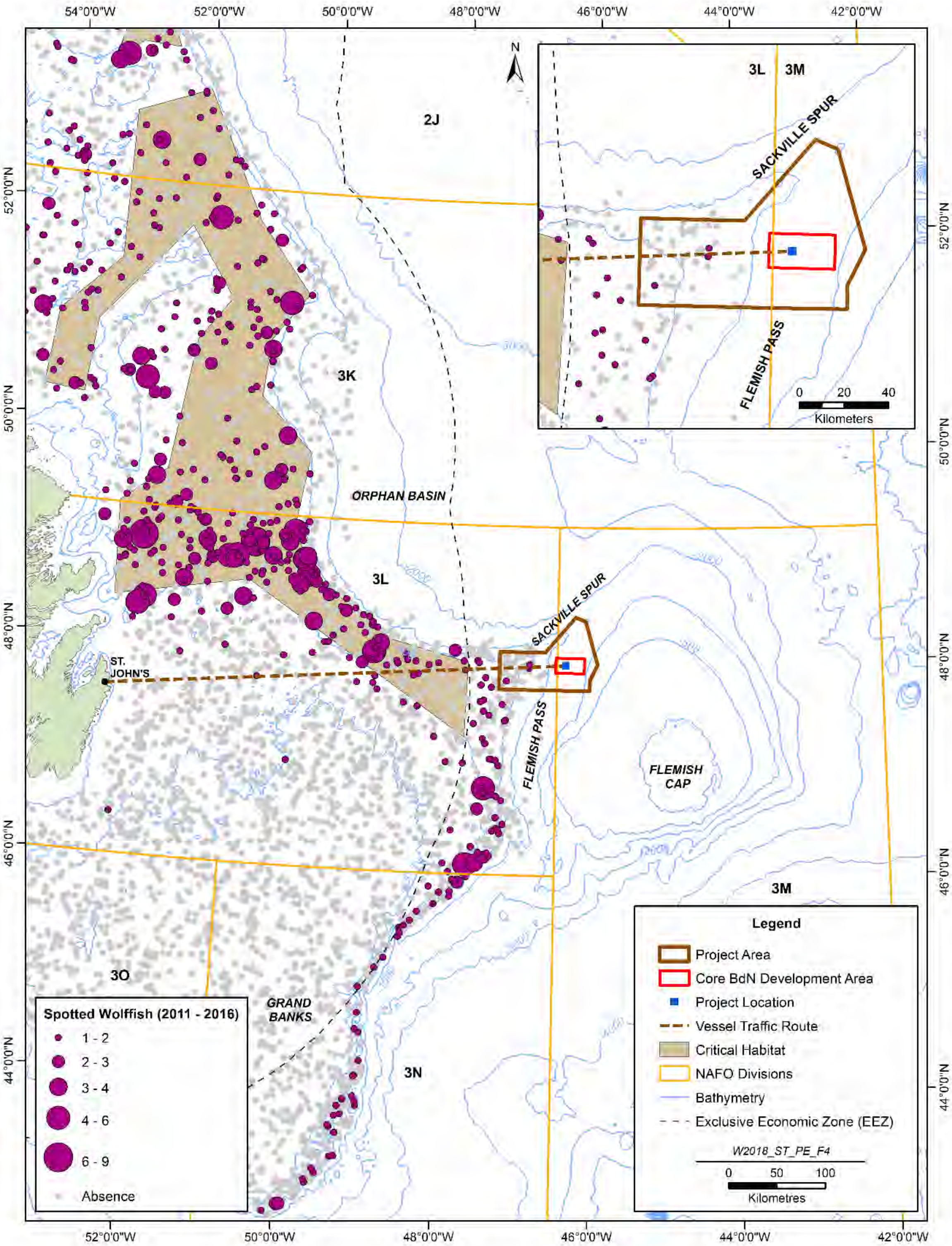

Figure 6-39 Spotted Wolffish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

The Canadian RV survey data support the scientific literature conclusions for wolffish distributions, including that the northern wolffish was typically distributed in deeper waters (Figure 6-37). Areas of aggregation for the northern wolffish included the northeast slope of the Grand Banks and slopes of the NL shelf in areas of 250 m to 600 m depth. Northern wolffish had the highest abundance of the three species in the Project Area, based on Canadian RV surveys. Areas of high abundance for all three species were associated with deep slope areas and the Flemish Pass. However, the striped wolffish (Figure 6-38) was more widespread, occurring in many areas of the continental shelf at lower abundance. Striped wolffish were mainly distributed between 600 m to 1,000 m based on Canadian RV data, however on the Flemish Cap they are associated with shelf areas (>250 m). Spotted wolffish were mainly associated with areas >600 m depth on both the Grand Banks and Flemish Cap slopes (Figure 6-39) (Nogueira et al. 2017).

6.1.9.2 American Eel

American eels are a catadromous species, meaning that they spawn in the marine environment and migrate to freshwater environments for rearing and growth. This species is listed as Vulnerable under the NL ESA and Threatened by COSEWIC. There has been a general decline in American eel abundance for over the past two or more eel generations (32 years) in Canada (Cairns et al. 2014). While there have been some increases to stocks in the Gulf of St. Lawrence, declines have been observed for the Lake Ontario, NL and Nova Scotia and Bay of Fundy areas (Cairns et al. 2014). Threats to eel populations include barriers to freshwater migration and habitat fragmentation, contaminants, parasites and shifting environmental conditions that may affect ocean migrations (COSEWIC 2012d). No critical habitat has been established for American eels (Wildlife Division 2010; COSEWIC 2012d), however it has been noted that freshwater riparian areas may be important habitat for developing eels (NL Wildlife Division 2010; COSEWIC 2012d). The Sargasso Sea, which lies approximately 2,000 km south of Canadian waters, is an area of importance for spawning and reproduction (COSEWIC 2012d), but it is quite distant from the Project Area.

American eel larvae feed on particulate matter and detritus, switching to primarily insect larvae as they occupy estuarine coastal habitats (COSEWIC 2012d). Adult eels in freshwater consume fishes, molluscs, crustaceans, insects, worms, and plants, however feeding activity declines during winters and ceases as eels prepare physiologically for their spawning migration to the Sargasso Sea (COSEWIC 2012d).

Spawning migrations for adult American eels in Canada occur in the fall and follow the continental shelf before travelling across open ocean to the Sargasso Sea (COSEWIC 2012d; Béguer-Pon et al. 2015). In tracking studies in Atlantic Canada, adult eels were observed to migrate in two phases. Eels first travel in shallow waters along the continental shelf and edge. Telemetry data indicates that adult eels undergo some exploratory behavior on their way to the Sargasso Sea, which is assumed to be for detection of cues or other migrants (Béguer-Pon et al. 2015).

In the second phase of migration, the eels travel in deep waters directly south towards the Sargasso Sea, which includes crossing the Gulf Stream (Béguer-Pon et al. 2015). After spawning from February to April, the larvae in the Sargasso Sea drift north with the Gulf Stream (Figure 6-40) (U.S Fish and Wildlife Service 2018), with some directional swimming (Rypina et al. 2014; Westerberg et al. 2017) and adults die shortly after reproduction (Cairns et al. 2014; Rypina et al. 2014). During this dispersal, the pelagic larvae are concentrated in the water column above 140 m at night and above 350 m during the day (McCleave and Kleckner 1982). The larvae metamorphose into the glass eel stage before reaching estuarine and freshwater coastal nursery habitats where they develop into juveniles that eventually migrate into freshwater lakes and rivers (Rypina et al. 2014). Variations in strength of the Gulf Stream and other ocean circulation patterns may influence success rates of larvae reaching coastal waters (Rypina et al. 2016; Westerberg et al. 2017). American eels are part of a large panmictic (well mixed) population with little genetic differentiation between eels from various locations (Côté et al. 2013).

6.1.9.3 White Shark

The white shark is listed as Endangered under SARA. White sharks are not regularly captured in Canadian waters, and their abundance is considered lower than in southern regions (COSEWIC 2006a). A directed fishery for this species is not conducted in Canadian waters, however by-catch mortality remains a threat to this species. To date, no critical habitat has been established for white shark (COSEWIC 2006a).

White sharks inhabit inshore and offshore waters and the intertidal zone to continental slopes and are distributed in sub-polar to tropical seas (COSEWIC 2006a). White sharks have been observed from NL and the Grand Banks to the Gulf of Mexico, but they are primarily distributed off the eastern coast of the United States (COSEWIC 2006a; Curtis et al. 2014). Their distribution ranges are seasonal, with sharks frequenting areas off the southeastern US in winter months and expansion to northern parts of their range in the spring to summer (Curtis et al. 2014). Ocearch (2019) has also tracked female white sharks from the continental shelf and slopes south of NL to the Flemish Cap (Figure 6-41) in the fall (Skomal et al. 2017). Male white sharks have also been tracked to the southern coast of NL and on the Grand Banks (Ocearch 2019).

There is a shift in habitat use with age, with younger white sharks inhabiting coastal shelf habitats and older individuals inhabiting pelagic waters with foraging excursions to mesopelagic depths (Skomal et al. 2017). Adult sharks have wide-ranging movements across the western North Atlantic and across seasons, except for summer where they occupy nearshore shelf habitats (Skomal et al. 2017). White shark diets are comprised of fish, other sharks, marine mammals, and squid (COSEWIC 2006a).

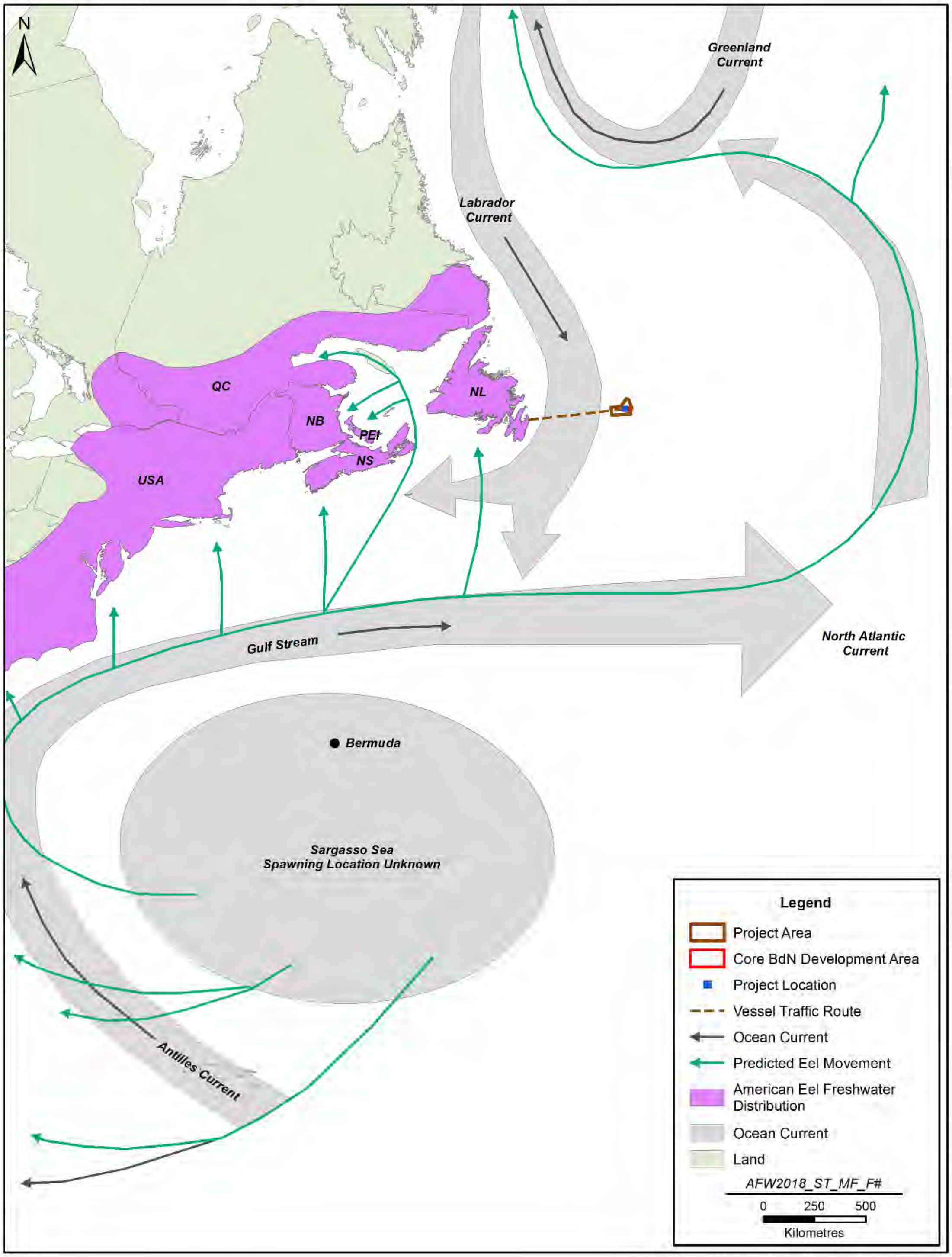

Figure 6-40 Predicted Larval Migratory Path of American Eel from the Sargasso Sea

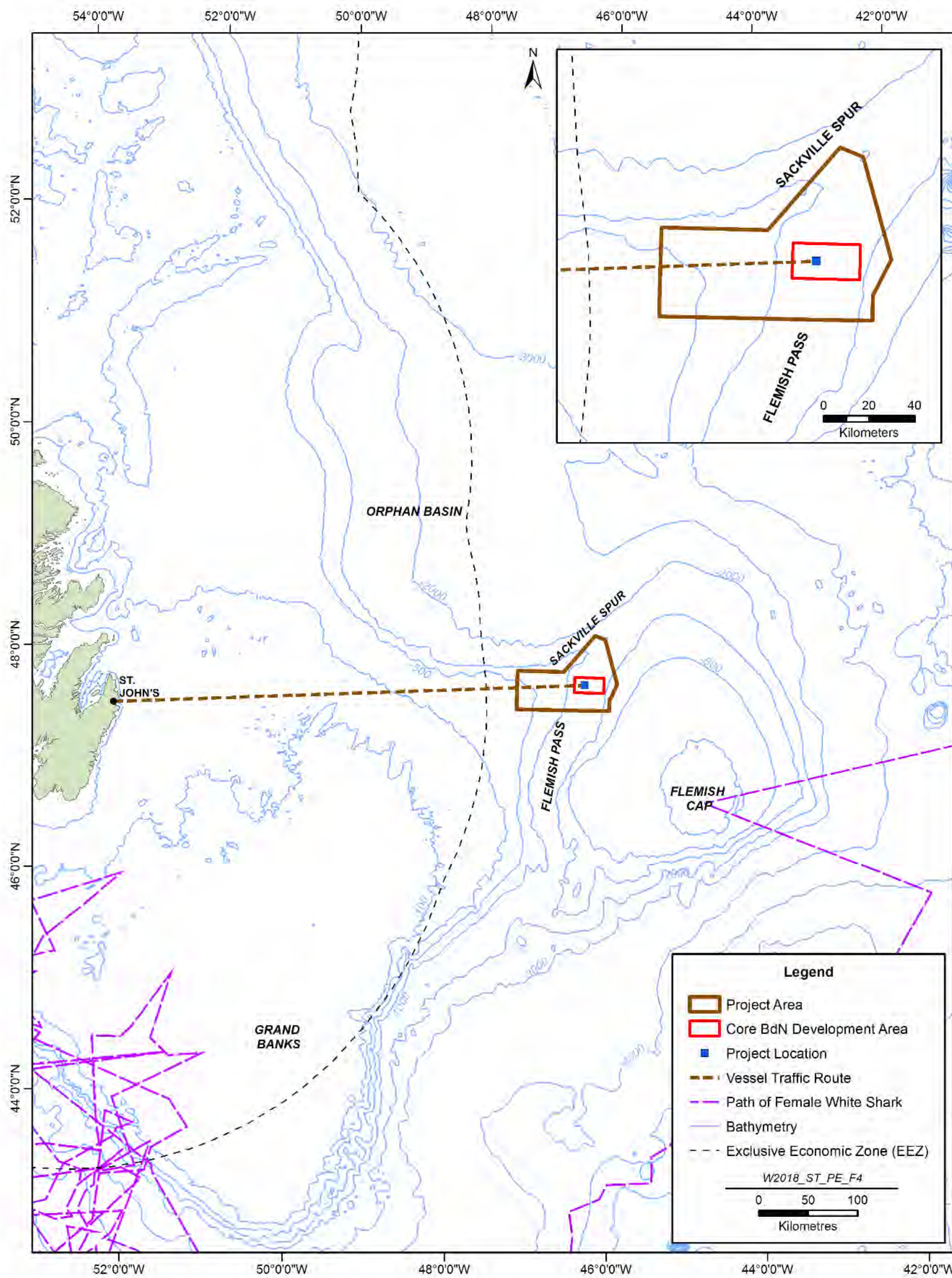

Figure 6-41 Tracked Movements of a Female White Shark in the North Atlantic

6.1.9.4 Other Sharks (Basking, Shortfin Mako, Porbeagle)

Under COSEWIC, basking shark are listed as Special Concern, shortfin mako sharks and porbeable are listed as Endangered. To date, no critical habitat has been established for these species (COSEWIC 2006b; 2009b).

Basking sharks occur in Canadian waters in summer months, indicating they may be associated with the seasonal shift of warm Gulf Stream toward the coast. Basking sharks occur throughout Atlantic continental shelf including the Bay of Fundy, Scotian Shelf and Grand Banks. Distribution data from the NL Observer Program from 1980 to 2004 indicate that the sharks are found on the Flemish Cap and the Northeast slope of the NL Shelf (COSEWIC 2009b). Basking sharks primarily feed on zooplankton (COSEWIC 2009b; Crowe et al. 2018). Large aggregations of these sharks have been associated with high sea surface temperatures of 13 ºC to 24ºC, chlorophyll *a* concentrations of 0.4 mg/m^3 to 2.6 mg/m^3, and high zooplankton levels (Crowe et al. 2018). These aggregations of sharks are believed to exploit the high food levels during the spring and fall phytoplankton blooms (Crowe et al. 2018). High fishing pressure through bycatch and vessel collisions are considered to be the main threats to this species (COSEWIC 2009b).

Shortfin makos sharks occur in Canadian waters in summer months and are typically associated with the warm waters in and around the Gulf Stream. This species has been captured from the continental shelf of Nova Scotia, the Grand Banks and the Gulf of St. Lawrence (COSEWIC 2006b). Shortfin mako presence is seasonal and they are found in Canadian waters from the later summer to fall. It is suggested that individuals observed in Canadian waters represent only a small proportion of the population (COSEWIC 2006b). Migration routes for shortfin mako are mainly in offshore areas outside the continental shelf including the NL Shelf and Flemish Cap (Vaudo et al. 2017). Shortfin mako sharks primarily consume pelagic fishes including tunas, mackerel, swordfish, and squid (COSEWIC 2006b). This species is threatened by fishing pressure (Sims et al. 2018).

In Canadian waters, the early, juvenile, and adult life stages of the porbeagle shark are abundant on or near the continental shelf (COSEWIC 2014a). They are rarely captured at the surface or at depths > 200 m in Canadian waters. No critical habitat has been established for this species, however there are mating grounds outside the Project Area on the Grand Banks off southern NL, the entrance to the Gulf of St Lawrence, and the Georges Bank. Porbeagle sharks mate in this area in the summer and early fall and migrate south in the winter to the pupping grounds in the Sargasso Sea (COSEWIC 2014a). Historical fisheries that overexploited the species and current by-catch mortality, combined with slow recovery, affect porbeagle populations. Porbeagles feed opportunistically on pelagic, epipelagic, and benthic species, though primarily on fishes and squid (COSEWIC 2014a).

6.1.9.5 Thorny Skate

Thorny skate are listed as being of Special Concern by COSEWIC. They are one of the most abundant skate species in the Canadian RV surveys and are concentrated and abundant on the Grand Banks (Figure 6-42) (COSEWIC 2012e). By-catch mortality in commercial fisheries is the main threat to this species and no critical habitat has been established.

This slow-growing species occupies depths of 18 m to 1,400 m and inhabits a broad range of substrates including sand, shell, gravel and mud (COSEWIC 2012e). Skates lay egg capsules on the seafloor year-round and all life stages occupy demersal habitats, and undergo limited seasonal migrations of approximately 100 km, with some skates migrating up to 440 km (COSEWIC 2012e). Areas of high aggregation include the NL Shelf and slopes and the southern Grand Banks. Thorny skate feed primarily on decapod crustaceans, euphasuiids, polychaetes, squid, and fishes including capelin and sand lance.

6.1.9.6 Atlantic Salmon

Atlantic salmon occupy freshwater, estuarine and marine environments. The main threats and limiting factors to Atlantic salmon include predation, climate change, fisheries, by-catch mortality, obstructions to spawning areas, and aquaculture. There have also been large declines in their marine survival, but the mechanism for mortality is poorly understood. It is suggested that declines in sea survival are occurring in parallel with wide spread changes in the North Atlantic ecosystem (COSEWIC 2010a); however, recent research suggests that phenomena such as water temperature increases due to climate change alone cannot explain the declines in salmon returns (Soto et al. 2018). To date, there has not been marine-based critical habitat established for this species, however freshwater habitat is considered a limitation to salmon production (COSEWIC 2010a).

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.

Both post-smolt and adult salmon tend to spend most of their time within the upper water layers, generally in the upper 5 m to 10 m (Reddin and Shearer 1987; Reddin and Friedland 1993; Hedger et al. 2017; Strøm et al. 2017), 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) (Windsor et al. 2012; Hedger et al. 2017; Strøm et al. 2017). Salmon tagged from Campbellton River in NL were frequently present at depths of more than five meters (Windsor et al. 2012).

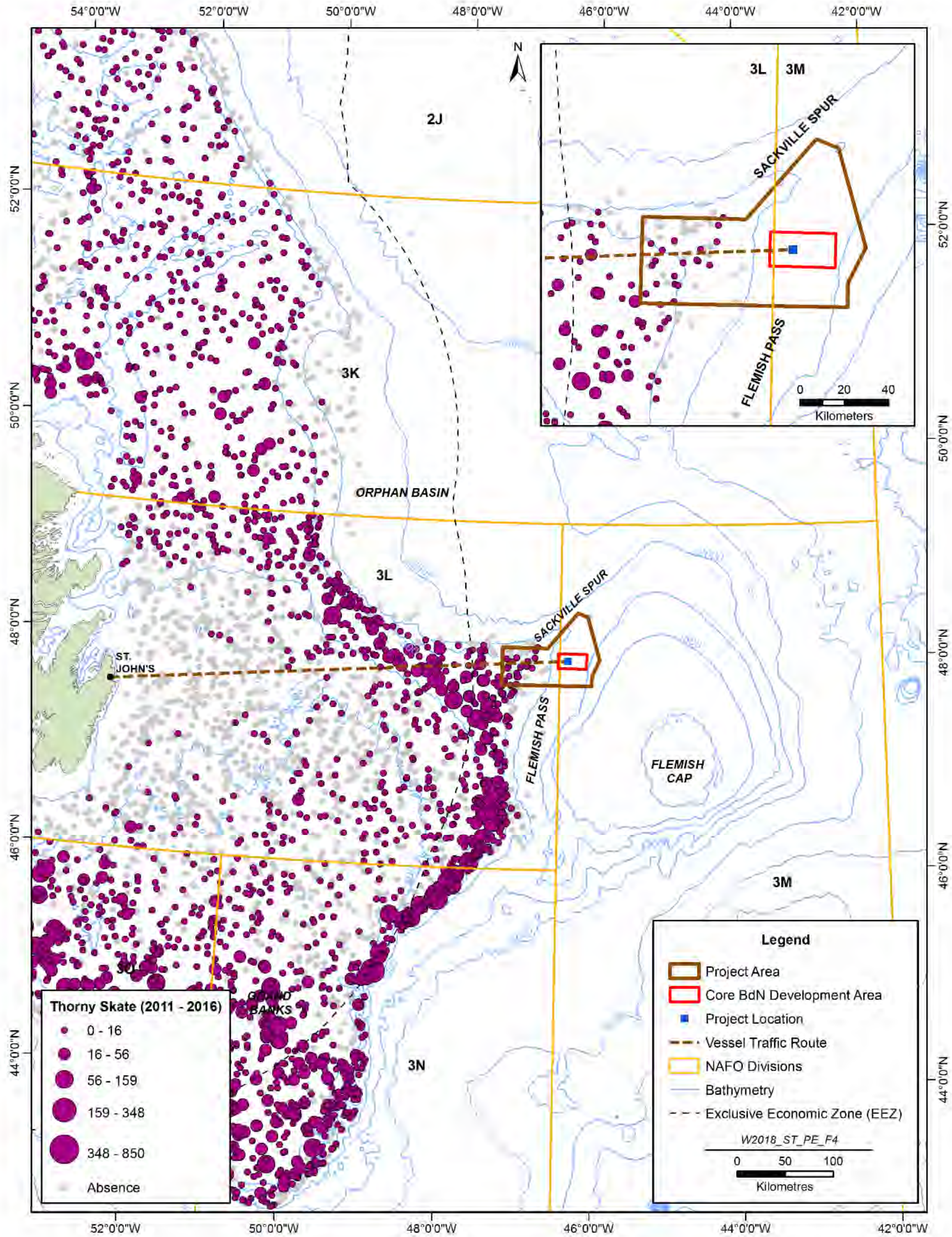

Figure 6-42 Thorny Skate Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

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 Friedland 1993; Reddin 2006). While there has been limited sampling directly in the Flemish Pass area, research trawl data near the Grand Banks 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 and beyond 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, Reddin 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. Salmon post-smolt and adults feed on various plankton, crustaceans, and larval fish (Lacroix and Knox 2005; Sheehan et al. 2012). Studies using stable isotope signatures of one sea winter (1SW) and multi-sea winter (MSW) salmon give indications of feeding areas in the marine environment (Soto et al. 2018). Salmon from the St. John River were correlated to feeding areas in the western North Atlantic (Irminger Sea near Iceland, southwest Greenland or NL), the southern North Sea, and northern Norwegian Sea areas (see Figure 4 from Soto et al. [2018]) based on comparisons of average SST and stable isotope values; however, they suggest the western North Atlantic region is the more likely feeding region for these fish (Soto et al. 2018). These potential feeding areas off the coast of Labrador and northern Newfoundland do not overlap with the Project Area.

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 6-43). 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).

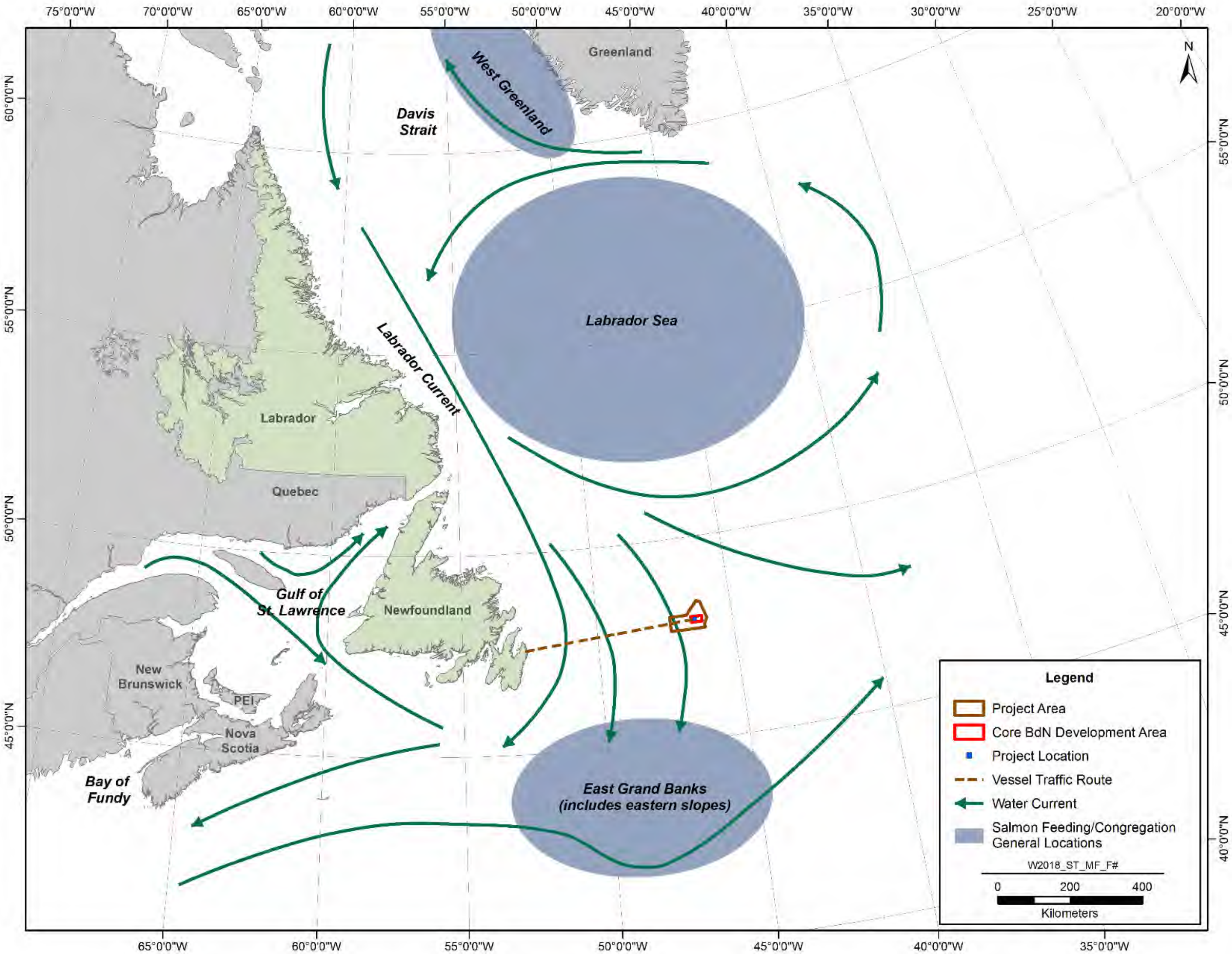

Figure 6-43 Atlantic Salmon: General Location of Currents and Summary Geographic Locations

Catch data in Reddin and Friedland (1993) indicate that post-smolt do not overwinter in the Grand Banks area during the period 23 December to 21 March. Reddin (2006) notes that post-smolt may overwinter off the Grand Banks but states that corroborative evidence from directed research or indirectly by commercial vessels fishing during the winter is lacking. Although Reddin (1985) suggested overwintering on the Grand Banks, subsequent research indicate that no overwintering has been confirmed by sampling. Reddin and Shearer (1987) note that "Seasonal oceanographic conditions suggest that Atlantic salmon do not overwinter in the Grand Bank area since the areas covered by warm water is small and variable". Reddin and Friedman (1993) and Reddin (2006) note that *[F]ew sets have been made for salmon during the winter months and these were all to the west of the Grand Bank of Newfoundland in 1985. The zero to low catch rates in the area of the Grand Bank suggest that salmon were located elsewhere at this time. These results suggest, since salmon were found in the Labrador Sea in the fall and then in the following spring, that adult salmon of North American origin probably overwinter there*. Sheehan et al. (2012) state that "*N]on-maturing one-sea-winter salmon are assumed to have overwintered in the Labrador Sea*.

In addition to the above research, data on adult salmon returning to the marine environment from the inner Bay of Fundy (iBoF) after spawning (termed kelts), provides further description of marine movements and habitat use of this life stage (Lacroix 2013). Habitat utilization distribution maps of tagged kelts indicate that both iBoF and outer Bay of Fundy (oBoF) kelts spend the majority of their time reconditioning through the oBoF and northern Gulf of Maine, around the southern tip of Nova Scotia on the western Scotian Shelf, and to some extent onto the eastern Scotian Shelf, the south coast of NL, and the southern edge of the Grand Bank (refer to Figure 13 in Lacroix 2013). This area on the edge of the Grand Bank is similar in location to the area of congregating salmon in the spring as they return to their home rivers and corroborates that this area may be an area of feeding prior to return migrations. No tags were shown migrating through the Project Area. Satellite data from pop-up tags includes sunrise and sunset times each day based on light thresholding and temperature and pressure records. The sunrise and sunset estimates are used to generate a light-based geolocation of the tag. The accuracy of light-based geolocations from pop-up tags is reported by the manufacturer (Microwave Telemetry Inc.) as $\pm 1^{\circ}$ for latitude and $\pm 0.5^{\circ}$ longitude (Lacroix 2013).

Adult salmon, primarily 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 at approximately 480 km east of the Strait of Belle Isle (western edge of Labrador Sea area, Figure 6-43) and slightly east of the 200 m depth contour along the eastern edge of the Grand Banks (East Grand Banks area Figure 6-43). Based on catch data provided in Reddin and Shearer (1987) (Figure 6-44), the area of congregation on the eastern edge of the Grand Banks would be located south of the Flemish Pass. Sampling near the Flemish Pass, Flemish Cap, and Grand Banks occurred during the Spring, Winter / Autumn, and summer time periods (Reddin and Shearer 1987); however, low catches (over 0.0 to 1.0 salmon per mile-hour of drift gillnet) of adult Atlantic Salmon were only indicated during Spring survey time periods.

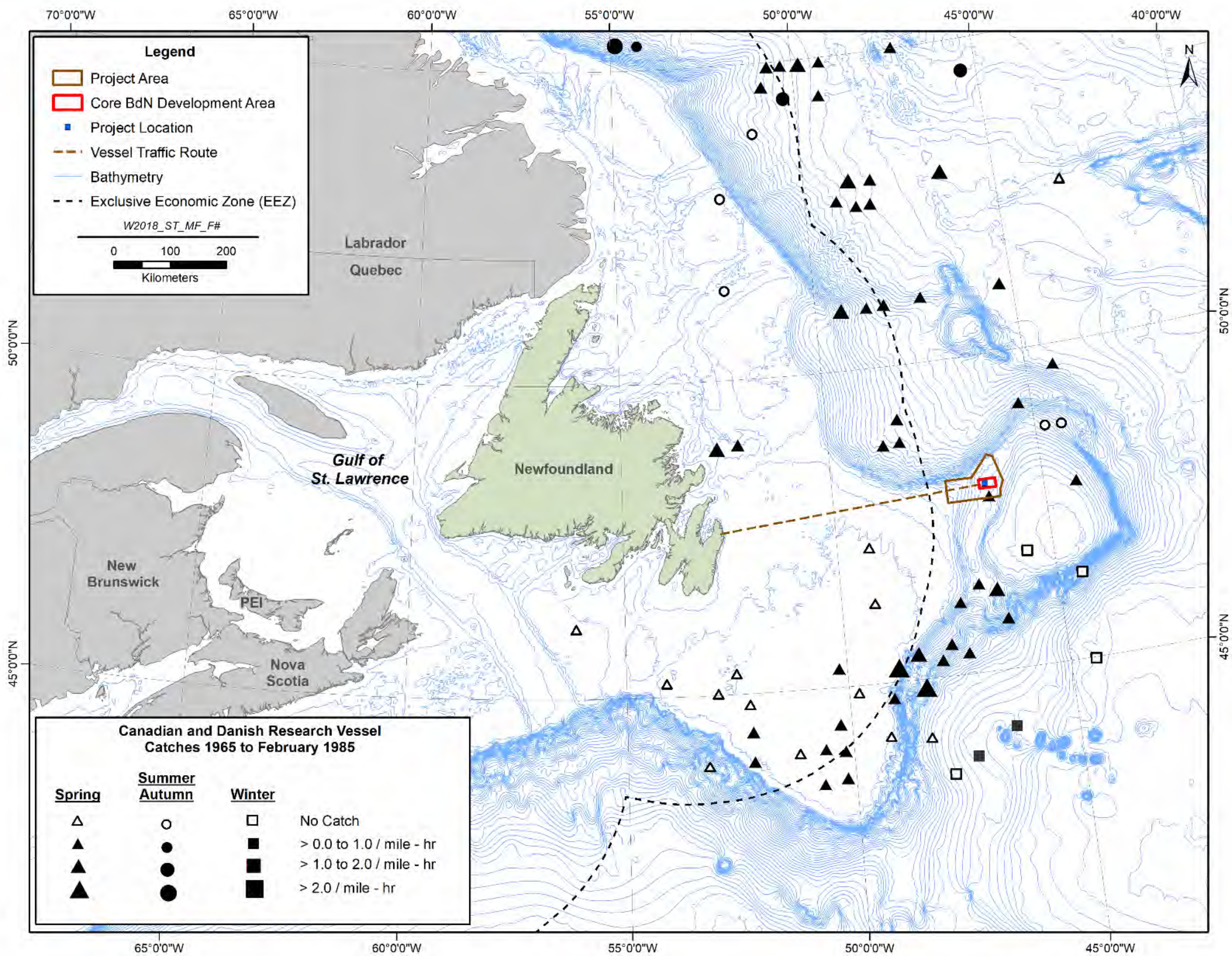

Figure 6-44 Atlantic Salmon Research Vessel Catches in the Northwest Atlantic Ocean (1965 to 1985)

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 NL smolt typically have river ages of three and four. Rivers to the south of NL 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 Banks (see Figure 6-45), indicate that salmon that congregate along the eastern Grand Banks are generally from more southern regions such as the Maritimes.

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 to 12°C SST in the Northwest Atlantic with an optimum between 4°C to 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).

Equinor Canada has deployed two moorings with Vemco acoustic receivers to assess potential movements of tagged Atlantic salmon in the Core BdN Development Area. This program builds upon the existing multi-year salmon tracking program by the Atlantic Salmon Federation (ASF) (ASF 2013). Equinor Canada also supplemented the ASF kelt tagging program (Fall 2018) by providing additional satellite tags and Vemco tags to the program.

The 2010 COSEWIC Assessment and Status Report on Atlantic salmon outlines a total of 16 Atlantic salmon populations (COSEWIC 2010a) (Table 6.30). Each of these populations has been delineated in terms of natal river destination within Designatable Units (DU) (Figure 6-46). The general criteria used by COSEWIC to recognize DUs, and therefore populations, is groups of individuals likely exhibiting unique adaptations that are a component of the species' biodiversity (COSEWIC 2010a). Summary information regarding the Atlantic salmon population within each DU and associated conservation status is provided primarily from COSEWIC (2010a) with updates since the COSEWIC assessment, where applicable (Table 6.30). Each group has its own migration routes and overwintering patterns in marine waters.

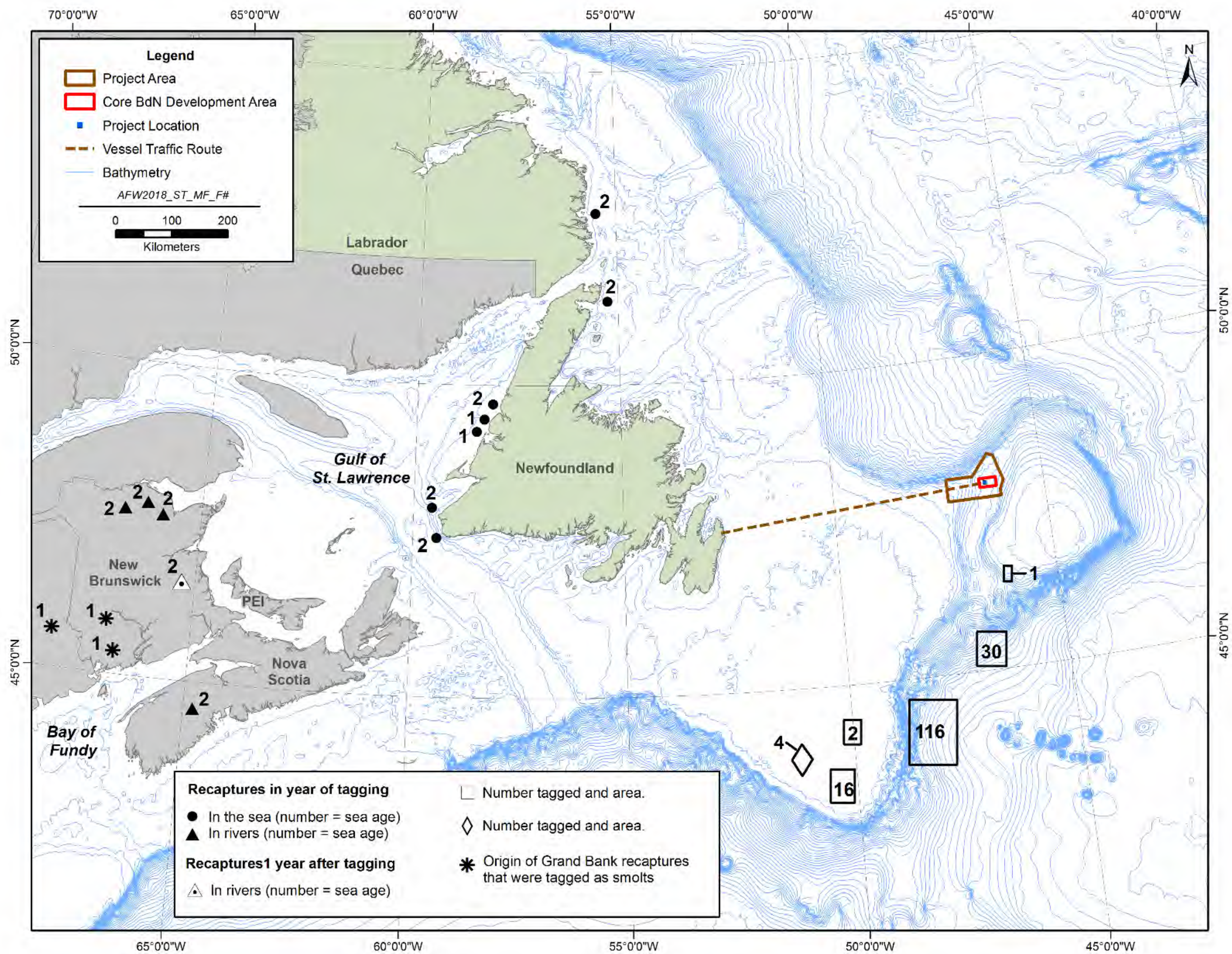

Figure 6-45 Numbers of Salmon Tagged on and East of the Grand Bank in May 1979 and 1980, and Subsequent Recaptures in the Coastal Fishery and in Rivers

Table 6.30 Atlantic Salmon Populations / Designatable Units and Their SARA and COSEWIC Status in the Western North Atlantic

Region	Population and Designatable Unit	SARA	COSEWIC
Nunavik and Labrador	Nunavik Population (DU1)	No Status	Data Deficient
	Labrador Population (DU2)	No Status	Not at Risk
Insular Newfoundland	Northeast Newfoundland Population (DU3)	No Status	Not at Risk
	South Newfoundland Population (DU4)	No Status	Threatened
	Southwest Newfoundland (Bay St. George Region) Population (DU5)	No Status	Not at Risk
	Northwest Newfoundland Population (DU6)	No Status	Not at Risk
Gulf of St. Lawrence	Quebec Eastern North Shore Population (DU7)	No Status	Special Concern
	Quebec Western North Shore (DU8)	No Status	Special Concern
	Anticosti Island (DU9)	No Status	Endangered
	Inner St. Lawrence (DU10)	No Status	Special Concern
	Lake Ontario Population (DU11)	No status	Extinct
	Gaspe-southern Gulf of St. Lawrence (DU12)	No Status	Special Concern
Eastern – Southern Nova Scotia and Outer Bay of Fundy	Eastern Cape Breton (DU13)	No Status	Endangered
	Nova Scotia Southern Upland (DU14)	No Status	Endangered
	Outer Bay of Fundy (DU16)	No Status	Endangered
Inner Bay of Fundy	Inner Bay of Fundy (DU15)	Endangered	Endangered

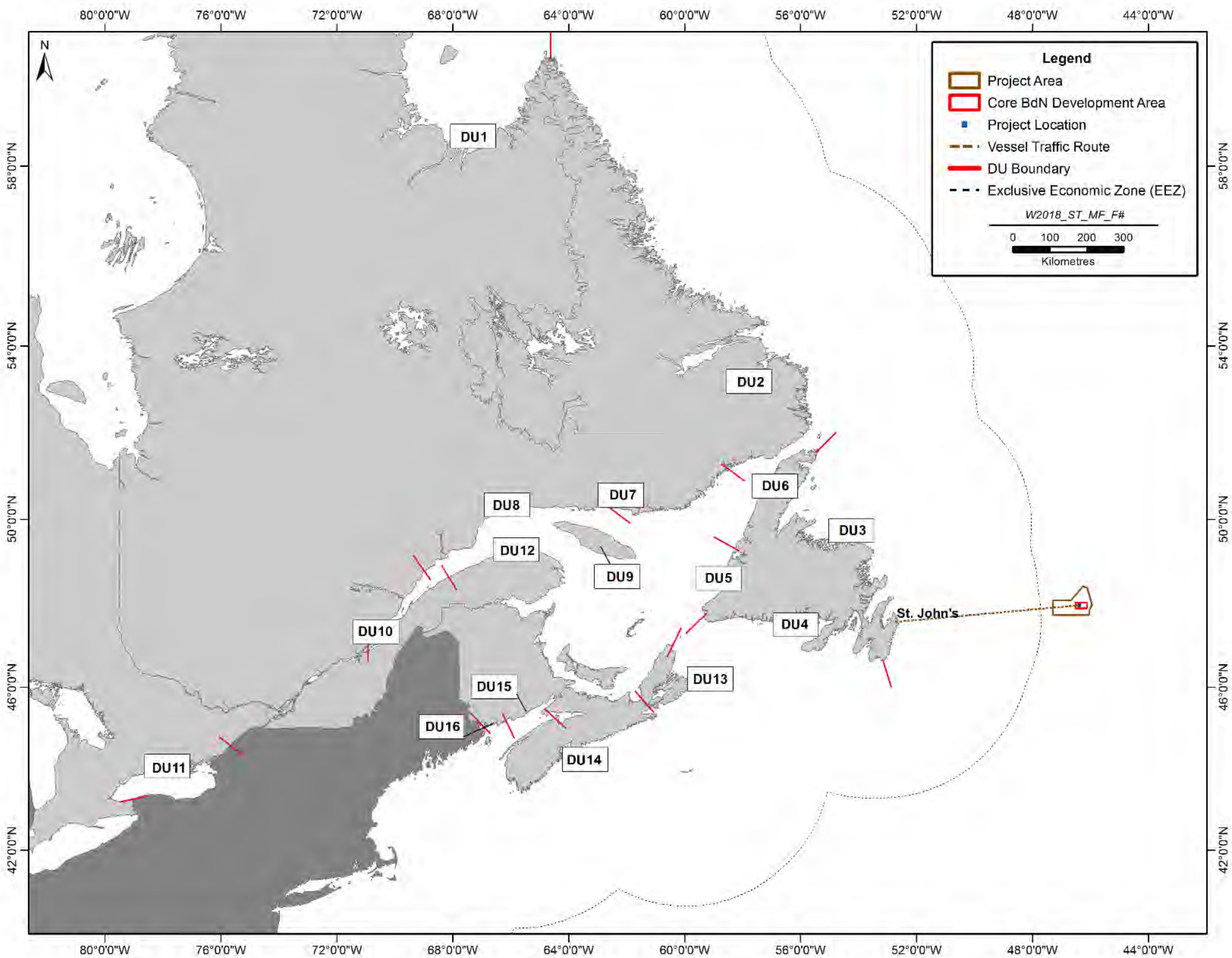

Figure 6-46 Designatable Units for Atlantic Salmon

Nunavik and Labrador Populations

Nunavik Population – Designatable Unit 1: The Nunavik population is within DU1 and is currently considered data deficient by COSEWIC (COSEWIC 2010a). Under SARA, this population is not listed. The DU extends from the tip of Labrador west along Ungava Bay to the western extent of the species range and represents the most northerly known population of Atlantic salmon in North America (COSEWIC 2010a). Genetic data suggest that the population is distinct from their nearest neighbour and there is little genetic evidence of straying between Ungava and other regions (COSEWIC 2010a).

Labrador Population – Designatable Unit 2: The Labrador population is within DU2 and is currently considered not at risk by COSEWIC (2010a) and is not listed under SARA (SAR Public Registry 2018). The DU extends from the northern tip of Labrador south along the coast of Labrador to the Napitipi River in Quebec. Given the large size of this geographic region there is substantial potential for smaller regional groupings within the DU, however the available information only supports a clear separation from other regions at the southern portion of the DU (COSEWIC 2010a). Genetic data suggest reasonable potential for gene flow and hence re-colonization throughout much of the southern portion of the unit. There is evidence from tagging studies, however, that salmon from the southern portion of this unit do not migrate north of Lake Melville.

Newfoundland Populations Including Southern Newfoundland

Northeast Newfoundland Population - Designatable Unit 3: The Northeast NL population is within DU3 and is currently considered not at risk by COSEWIC (COSEWIC 2010a) and is not listed under SARA (SAR Public Registry 2018). The DU extends from the northern tip of NL south and east along the northeast coast of the Island to the southeast tip of the Avalon Peninsula (COSEWIC 2010a). The salmon of the northeast coast of NL are unique in North America, in that they appear to have genetic profiles intermediate to European and North American salmon. Mean age of smoltification was intermediate between Labrador and the rest of NL (3 to 5 years versus 5 to 7 in Labrador and 2 to 4 in southern NL DUs). The proportion of grilse that were smaller one sea winter (1SW) females was relatively high as was the incidence of repeat spawners. The Exploits and Terra Nova Rivers were stocked extensively in the 1980s and 1990s after new habitat was made accessible with fishways.

South Newfoundland Population - Designatable Unit 4: The South NL population is within DU4 and is currently considered Threatened by COSEWIC (COSEWIC 2010a) and listed as no status under SARA (SAR Public Registry 2018). The DU extends from the southeast tip of the Avalon Peninsula (Mistaken Point) westward along the south coast of NL to Cape Ray. Unlike DU3, freshwater habitat in DU4 tends to have relatively low pH values (5.0 to 6.0). Genetic data suggest that populations along this coast have reduced gene flow among local rivers and between DU4 and other regions of the Island (COSEWIC 2010a). Salmon in DU4 experience substantially different ocean conditions than fish in DUs 2 and 3, entering an area influenced by the Gulf Stream compared to the Labrador Current (COSEWIC 2010a). Population trends for south coast rivers also appear to be distinct from the other DUs in NL.

Southwest Newfoundland (Bay St. George Region) Population – Designatable Unit 5: The Southwest NL population is within DU5 and is currently considered not at risk by COSEWIC (COSEWIC 2010a) and is not listed under SARA (SAR Public Registry 2018). The DU extends from Cape Ray northwards along the west coast of NL to approximately 40º 24'N, 58º 15' W. This DU is the only region in insular NL with large numbers of MSW salmon and minimal lacustrine habitat. Genetic comparisons of populations in this region with those in the rest of the Island suggest the populations here represent a distinct group, but that within the region gene flow appears to be higher than in DUs 3 and 4. DU5 also has the youngest mean smolt ages (3 years) on insular NL and the lowest proportion of female grilse (COSEWIC 2010a). DU5 is separated from mainland DUs by the Gulf of St. Lawrence and genetic data suggest low levels of gene flow between insular populations and the mainland (COSEWIC 2010a).

Northwest Newfoundland Population – Designatable Unit 6: The Northwest NL population is within DU6 and is currently considered not at risk by COSEWIC (COSEWIC 2010a) and is not listed under SARA (SAR Public Registry 2018). The DU extends from approximately 40° 24'N, 58° 15' W to the tip of the Great Northern Peninsula. Smolts from populations of DU6 most likely migrate northward through the Strait of Belle Isle (COSEWIC 2010a). Freshwater habitat in DU6 is significantly more alkaline than the rest of insular NL due to a large amount of limestone in the region's geology (COSEWIC 2010a). Genetic data for this DU are sparse.

Gulf of St. Lawrence Populations

Quebec Eastern North Shore Population – Designatable Unit 7: The Quebec Eastern North Shore population is within DU7 and is currently listed as Special Concern by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). The DU extends from the Napitipi River (not inclusive) westward along the north shore of the St. Lawrence to the Kegaska River (inclusive) in the west. DU7 is characterized by populations with high proportions of 1SW salmon and rivers with lower temperature regimes than DU8. The genetic data also suggest these populations have lower levels of gene flow within the DU than within other areas of the North Shore (COSEWIC 2010a).

Quebec Western North Shore Population – Designatable Unit 8: The Quebec Western North Shore population is within DU8 and is currently considered Special Concern by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). The DU extends eastward from the Natashquan River (inclusive) along the Quebec North Shore to the Escoumins River in the west (inclusive). The salmon of DU8 have the highest proportion of MSW salmon by a wide margin relative to the other populations in the North Shore DUs (COSEWIC 2010a) and stocking in this DU was substantial and has occurred in multiple rivers.

Anticosti Island Population – Designatable Unit 9: The Anticosti Island population is within DU9 and is currently considered Endangered by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). The DU encompasses Anticosti Island.

Inner St. Lawrence Population – Designatable Unit 10: The Inner St. Lawrence population is within DU10 and is currently considered Special Concern by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). The DU extends west along the northern shore of the St. Lawrence from the Escoumins River (not included) into the lower St. Lawrence River and returns eastward along the southern shore of the St. Lawrence to the Ouelle River (included). DU10 is characterized by a higher proportion of 1SW salmon than the Quebec Western North Shore (DU8) and a lower mean age at smoltification. Freshwater habitat is also the warmest along the Quebec North Shore (COSEWIC 2010a).

Lake Ontario Population – Designatable Unit 11: The Lake Ontario population is within DU11 and is currently considered extinct by COSEWIC (COSEWIC 2010a) and has no status under SARA (SAR Public Registry 2018). Approximately 67 tributaries of Lake Ontario were known to support runs of Atlantic salmon (COSEWIC 2010a). Scales obtained from two adult museum specimens indicate an exclusively freshwater growth history, suggesting that at least some salmon populations that originally inhabited Lake Ontario were freshwater resident and did not migrate to sea (COSEWIC 2010a). COSEWIC (2010a) suggests that Lake Ontario Atlantic salmon populations were likely reproductively isolated from other Atlantic salmon populations in North America.

Gaspe-southern Gulf of St. Lawrence Population – Designatable Unit 12: The Gaspe-southern Gulf of St. Lawrence population is within DU12 and is currently considered Special Concern by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). The DU extends from the Ouelle River (excluded) in the western Gaspe to the northern tip of Cape Breton. Genetic data are not available for Atlantic salmon on PEI; however, it is thought that salmon in small streams probably reflect the province's original populations, those in larger PEI streams are heavily influenced by stocking from eastern New Brunswick (COSEWIC 2010a). PEI has also provided salmon eggs for other rivers in the Maritimes and received substantial numbers of eggs and juveniles from mainland rivers; for most of this DU, stocking events have been common for at least the past 100 years (COSEWIC 2010a). For these reasons, PEI salmon are placed within DU12.

Eastern - Southern Nova Scotia and Outer Bay of Fundy Populations

Eastern Cape Breton Population – Designatable Unit 13: The Eastern Cape Breton population is within DU13 and is currently considered Endangered by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). The DU extends from the northern tip of Cape Breton Island to northeastern Nova Scotia (approximately 45º 21'N, 61º 28'W). The salmon in this DU appear to be genetically distinct from its southern neighbour, DU14 (Nova Scotia Southern Upland).

Nova Scotia Southern Upland Population – Designatable Unit 14: The Nova Scotia Southern Upland population is within DU14 and is currently considered Endangered by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). The DU extends from northeastern mainland Nova Scotia (approximately 45º 21'N, 61º 28'W) southward and into the Bay of Fundy to Cape Split. Many rivers in DU14 have freshwater habitat with relatively low pH. They also have lower proportions of MSW fish than their northern neighbours. Southerly populations in DU14 also have some of the youngest smolt ages reported in Canada (COSEWIC 2010a). This DU also has an extensive history of stocking, including recent efforts to slow the decline of a few of the severely depressed populations in the DU.

Outer Bay of Fundy Population – Designatable Unit 16: The Outer Bay of Fundy population is within DU16 and is currently considered Endangered by COSEWIC (COSEWIC 2010a) but has no status under SARA (SAR Public Registry 2018). This DU extends westward from just east of the Saint John

River estuary to the border with the United States (US). Within this DU, there is a higher proportion of MSW salmon migrating to the North Atlantic than DU15. While the DU terminates at the US border, from a biological perspective, the US populations may be included in the DU (COSEWIC 2010a).

Inner Bay of Fundy Population – Designatable Unit 15

The *Inner Bay of Fundy population* is within DU15 and is currently considered Endangered by both COSEWIC (COSEWIC 2010a) and under SARA (SAR Public Registry 2018). This DU extends from Cape Split around the Inner Bay of Fundy to a point just east of the Saint John River estuary. This DU has strong genetic differentiation from nearby DUs and appears to exhibit unique migratory behaviour (within the Bay of Fundy / Gulf of Maine (COSEWIC 2010a). Over 40 million salmon of differing ages have been stocked into rivers of this region since the turn of the 20th century. Early sources of stockings are unclear, but recent stocking has been done with Inner Bay of Fundy progeny (COSEWIC 2010a). Recent stocking events, intended to maximize exposure of salmon to wild environmental conditions are part of a captive-rearing program thought to have prevented, at least temporarily, the extinction of salmon in this DU (COSEWIC 2010a).

6.1.9.7 Atlantic Bluefin Tuna

Atlantic bluefin tuna are listed as Endangered under COSEWIC. Critical habitat has not been established for this species and there are no known spawning or rearing habitats for early life stages of bluefin tuna in Canadian waters. This pelagic species migrates to Canadian waters in summer in search of food and move southward in the fall. Satellite tagging data indicate that Atlantic bluefin tuna occupy Canadian shelf waters from May to October in temperatures mainly ranging from 14ºC to 18ºC (Galuardi et al. 2010). In Canadian waters Western Atlantic resident tuna are mainly distributed on the Scotian Shelf whereas trans-Atlantic tuna occupy habitat areas from the Grand Banks, Flemish Pass, Flemish Cap and areas off the continental shelf (Figure 6-47) (Walli et al. 2009; COSEWIC 2011a; OBIS 2018b). Historical and current commercial fisheries are the main threats to this species (COSEWIC 2011a). Juvenile and adult tuna feed opportunistically on pelagic and bottom fishes including capelin, saury, herring, mackerel and lanternfish (COSEWIC 2011a).

6.1.9.8 Roundnose Grenadier

Roundnose grenadiers are listed as Endangered by COSEWIC. Distribution, biology and ecology for this species are described in Section 0. Critical habitat has not been established for roundnose grenadier due to lack of information of habitat associations in relation to life history stages (DFO 2010).

6.1.9.9 Atlantic Cod

Atlantic cod are listed as Endangered by COSEWIC and details on distribution, biology and ecology for this species are described in Section 6.1.8.5. Currently no critical habitat has been established for Atlantic cod, however the Southeast Shoal and Tail of the Banks, Virgin Rocks and Burgeo Banks EBSAs (see Section 6.4.2.5) are considered important spawning areas for this species (Templeman 2007).

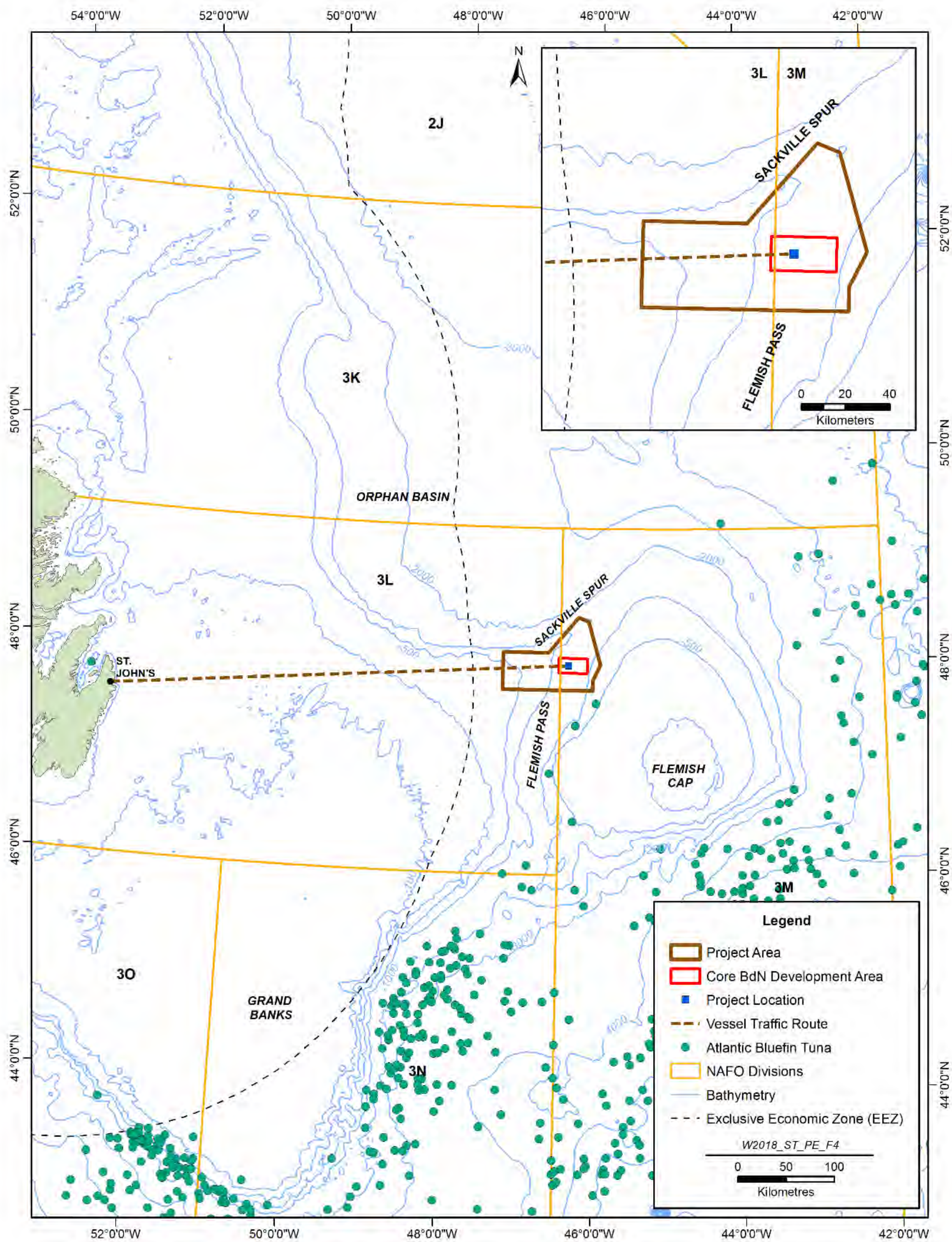

Figure 6-47 Atlantic Bluefin Tuna Distribution as Compiled from Ocean Biogeographic Information System Data (1867 to 2015)

6.1.9.10 White Hake

White hake are mainly distributed in the Gulf of St. Lawrence, Scotian Shelf, and Southern NL and are listed as Threatened under COSEWIC (COSEWIC 2013a; DFO 2016a). The population is divided into two DUs; the southern Gulf of St. Lawrence (DU1) and the Atlantic and northern Gulf of St. Lawrence (DU2) (COSEWIC 2013a). Since before the mid-1990s and over the past three generations, adult white hake abundance has declined 70 percent in DU2 (DFO 2016a). Fishing mortality through directed fishery and by-catch remains the greatest threat to white hake populations with habitats considered not likely to be a limiting factor to this species survival and recovery (COSEWIC 2013a; DFO 2016a). This species comprised approximately one percent of the total catch in Canadian RV surveys but was not a key species in EU RV surveys.

White hake are mainly distributed in areas of fine mud substrates at depths of 50 m to 360 m. This coincides with the Canadian RV surveys that indicate that white hake are associated with the shallow slope (250 m to 600 m) depth zone and have relatively low abundances in the region (Figure 6-48). White hake were not associated with assemblages on the Flemish Cap (Nogueira et al. 2017), and areas of aggregation are largely outside of the Project Area. No critical habitat has been established for this species; however white hake have been observed to aggregate for foraging opportunities in the spring in the Laurentian Channel and Southwest Shelf Edge and Slope EBSAs (Templeman 2007; COSEWIC 2013a; DFO 2016b, see Section 6.4.2.5).

This species does not undergo vertical migrations and abundance at depths is linked to fish size as larger adult fish are associated with deeper waters (COSEWIC 2013a). Spawning seasons are variable depending on population location with spawning occurring between June to September in the Southern Gulf of St. Lawrence. In offshore areas, spawning is estimated to occur in the spring and in the summer on the Scotian Shelf (COSEWIC 2013a). Eggs, larvae and pelagic juveniles may remain planktonic for two to three months depending on environmental conditions and distance to suitable settling areas (COSEWIC 2013a). Juvenile and adult hake primarily feed on crustaceans and fish and are prey species for other fish, seabirds, and seals (COSEWIC 2013a).

6.1.9.11 Redfish

Acadian and deepwater redfish are listed as Threatened by COSEWIC. Distribution, biology and ecology for these species are described in Section 6.1.8.5. To date, no critical habitats have been established for these species, however it has been suggested that habitats made up of anemones and coral beds may be linked to redfish survival (COSEWIC 2010c). The Southwest Shelf Edge and Slope is considered an important spawning area for redfish (Templeman 2007).

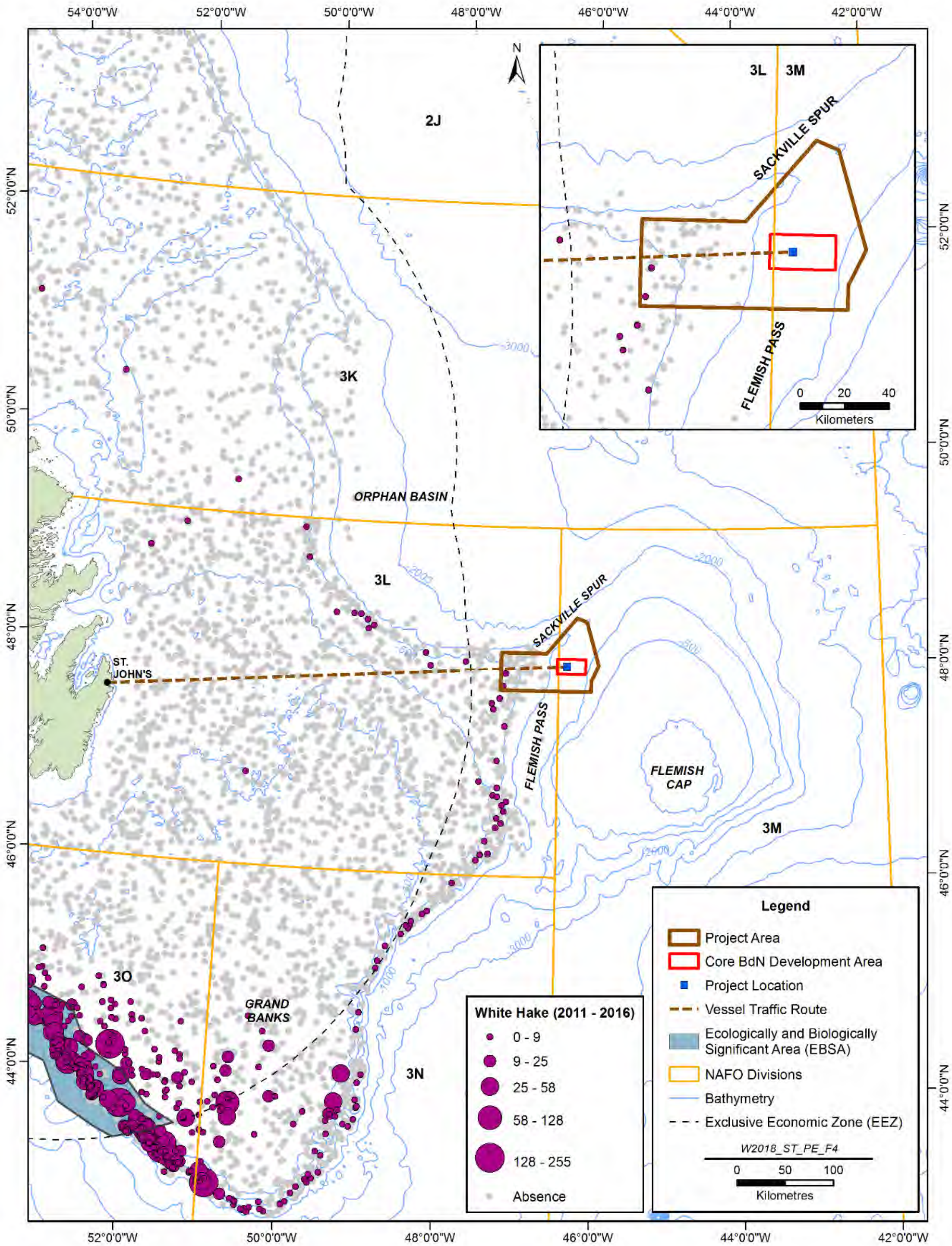

Figure 6-48 White Hake Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016) Summary of Key Areas and Times for Fish and Fish Habitat in the RSA

In regions in and around the Project Area that have been surveyed by Canadian RV programs (Figure 6-49 to Figure 6-51), the slope area along the northeast edge of the Grand Banks has the highest fish abundance (Figure 6-49), richness (Figure 6-50), and biomass (Figure 6-51) 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.

Findings from the Equinor Canada 2018 Seabed Survey indicate most coral and sponge species are widespread at typically low densities. These animals are generally concentrated in areas where hard substrate is available, and their distributions appear to be limited in areas that are primarily mud. Soft corals were the dominant coral species in the southern and central survey locations while the eastern survey locations were dominated by sea pen species. However, sea pens were widely distributed in mud habitats across all survey areas. Habitat-forming species, including glass sponges (Rosselidae species, and *Asconema* spp.), were seen at low densities across survey sites and bamboo coral (*Acanella* sp.) had a moderate distribution that was limited to eastern survey locations. In total twenty-three species of coral and twenty species of sponges were observed. Other benthic invertebrates observed included echinoderms and other members of the phylum cnidaria (jellyfish and anemones) that were widely distributed. Fish species observed include those of conservation concern (spotted wolffish and grenadiers) and others such as skates, longnose eels, blue hake, and juveniles of several species.

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.

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. Special areas of importance to marine fish and fish habitat that overlap with the RSA are further described in Section 6.4.

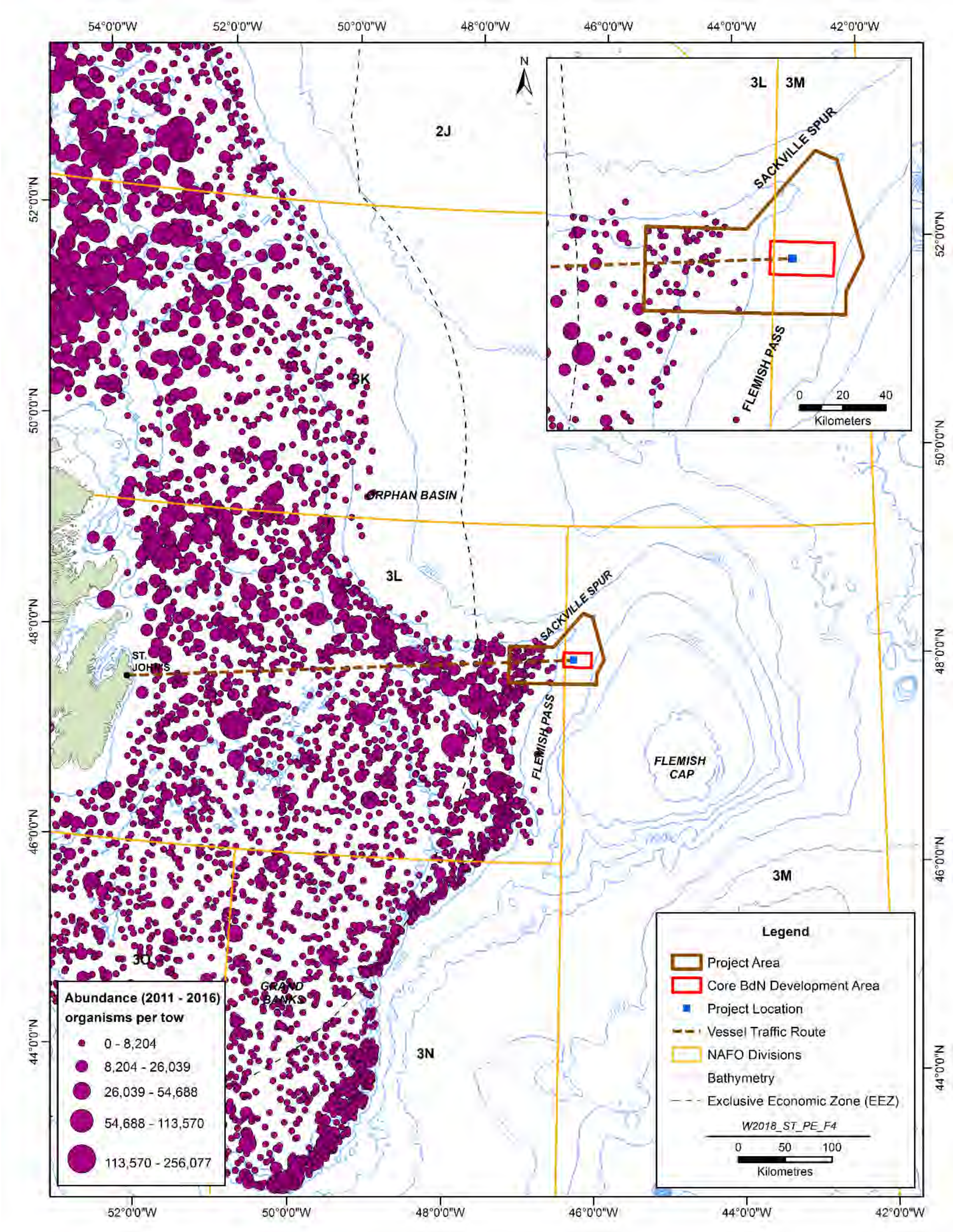

Figure 6-49 Overall Abundance of Organisms (Fish and Invertebrates) Inventoried from Canadian RV Trawl Survey Data (2011 to 2016)

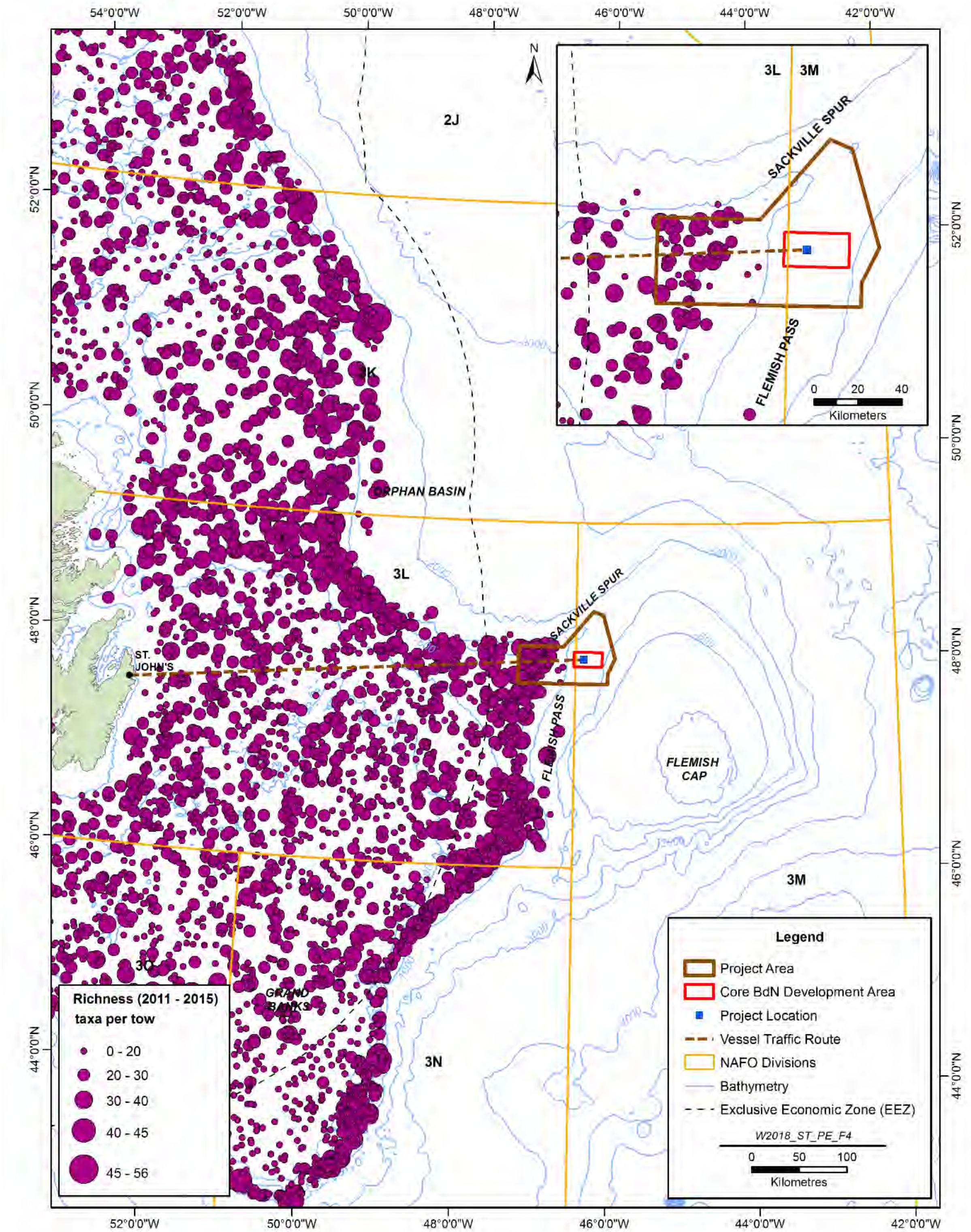

Figure 6-50 Overall Richness of Organisms (Fish and Invertebrates) Inventoried from Canadian RV Trawl Survey Data (2011 to 2016)

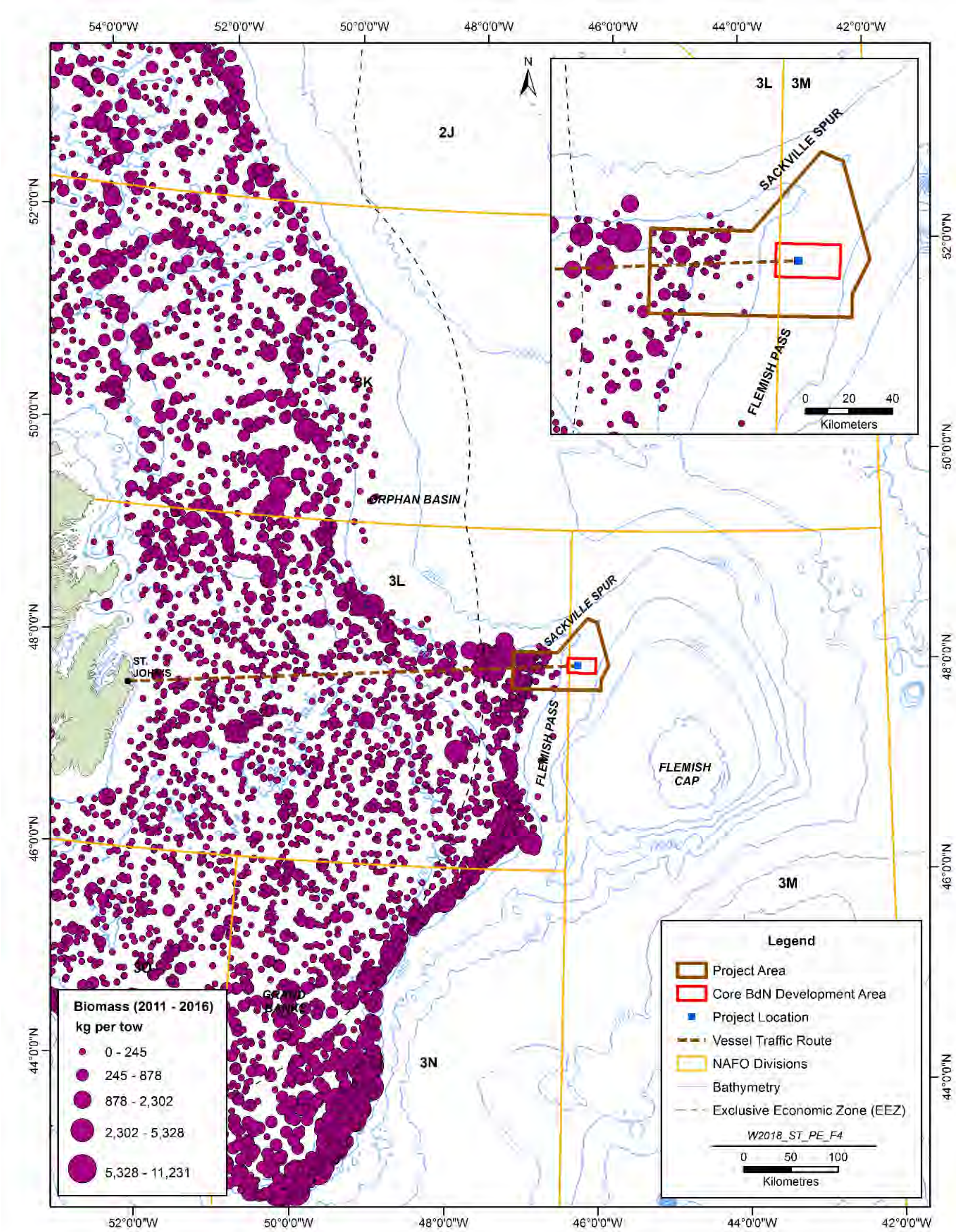

Figure 6-51 Total Biomass (Fish and Invertebrate Species) Inventoried from Canadian RV Trawl Survey Data (2011 to 2016)

6.1.10 Overview of Marine Fish and Fish Habitat

The existing biological environment for Marine Fish and Fish Habitat is described in Section 6.1 and key components and associated linkages are summarized below as context for the overall effects assessment. Table 6.31 and Table 6.32 provide a summary listing of this information. Information on marine fish and fish habitat within the Project Area was based on regional government datasets, Equinor underwater visual surveys, Indigenous knowledge, and scientific literature. The life history characteristics, details on movements and feeding are not completely understood for various deepsea fish and invertebrates within the Project Area. However, scientific literature from other regions or similar species have been used to provide additional information where data is limited. Overall, the information available on the existing environment is sufficient appropriate for assessing the effects of the Project.

Table 6.31 Summary of Key Fish Species in the Project Area

Depth Zone	Movements	Species	Feeding Group	Prey Species	Predators	References
Benthic		American plaice	Benthivore	invertebrates and fish	Larger piscivores such as cods and sharks	Scott and Scott 1988
Benthic	Seasonal migrations	Atlantic cod	Piscivore	sand lance, redfish, squid, crab, shrimp, whelks, and polychaetes		COSEWIC 2010b
Benthic		Blue hake	Benthivore	euphausiids, chaetognaths, polychaetes, copepods, and amphipods	Limited information	Houston and Haedrich 1986; Nielsen et al. 2015; Parzanini et al. 2017
Benthic		Common grenadier	Benthivore	euphausiids, amphipods, and polychaetes		
Benthic		Longnose eel	Benthivore	euphausiids, amphipods, fish, cephalopods, mysid shrimp and molluscs	Roundnose grenadiers	Houston and Haedrich 1986; Jamieson et al. 2011; Parzanini et al. 2017 DuBuit 1978

Table 6.31 Summary of Key Fish Species in the Project Area

Depth Zone	Movements	Species	Feeding Group	Prey Species	Predators	References
Benthic		Roughhead grenadier	Benthivore	echinoderms, crustaceans and bivalves, shrimp, small fish including myctophids, and squid	Larger piscivores such as cods	COSEWIC 200X, Parzanini et al. 2017
Benthic	Seasonal migrations	Roundnose grenadier	Benthivore	planktonic crustaceans and chaetognaths, shrimp, lanternfish, longnose eel, and squid		COSEWIC 200X, Parzanini et al. 2017 DuBuit 1978
Benthic		Spotted wolffish	Benthivore	Primarily invertebrates (echinoderms, crustaceans, and bivalves) and some fish.		COSEWIC 2012a, 2012b
Epipelagic	Diel vertical migration	Acadian redfish	Plank-piscivore	copepods, euphausiids and fish	Seals, and piscivorous fish (Greenland halibut, thorny skate, Atlantic cod, black dogfish, wolffish	COSEWIC 2010c
Epipelagic	Seasonal migrations, Diel vertical migration	Capelin	Planktivore	Plankton (e.g., copepods, amphipods, euphausiids))	Piscivorous fish, marine mammals, seabirds	Scott and Scott 1988; Trenkel et al. 2014; Maxner et al. 2016
Epipelagic	Seasonal migrations, Diel vertical migration	Swordfish	Piscivore	squid, Atlantic mackerel, Atlantic herring, and other fishes		Scott and Tibbo 1968; Stillwell and Kohler 1985; Lerner et al. 2013
Mesopelagic	Diel vertical migration	Deepwater redfish	Plank-piscivore	copepods, euphausiids and fish		COSEWIC 2010c

Table 6.31 Summary of Key Fish Species in the Project Area

Depth Zone	Movements	Species	Feeding Group	Prey Species	Predators	References
Mesopelagic	Diel vertical migration	Golden redfish	Plank-piscivore	copepods, euphausiids and fish		
Mesopelagic	Seasonal migrations	Greenland halibut	Piscivore	Pelagic fish and invertebrates including Atlantic cod, capelin, redfish, shrimp and squid		Morgan et al. 2013
Mesopelagic	Diel vertical migration	Lanternfish	Planktivore	amphipods, ostracods, hyperiids and fish eggs	Cod, hake, tunas, salmon, marine mammals	Kawaguchi and Mauchline 1982; Halliday et al. 2015). Scott and Scott 1988
Mesopelagic		Northern wolffish	Piscivore	pelagic fish and invertebrates including jellyfish and gelatinous zooplankton		COSEWIC 2012c

Table 6.32 Summary of Key Invertebrate Species in the Project Area

Depth Zone	Movements	Species Groups	Prey	Predators	References
Pelagic (epi, meso, bathy)	Diel vertical migrations	Squid	Small invertebrates, pelagic fish and invertebrates	Fish, seals, dolphins, toothed whales	Pauly and Trites 1998, Joyce et al. 2002
Pelagic (epi, meso, bathy)	Diel vertical migrations	Shrimp	Plankton	Planktivorous fish, baleen whales	Vázquez et al. 2013, Parsons et al. 1998
Pelagic (epi, meso, bathy)		Jellyfish, pelagic tunicates,	Plankton, POM, detritus	Planktivorous fish such as tuna and ocean sunfish, and sea turtles	Fromentin and Powers 2005, Dodge et al. 2011, Potter and Howell 2011
Pelagic (epi, meso, bathy)	Diel vertical migrations	Amphipods, Copepods	Plankton	Planktivorous fish, baleen whales	Bowman et al. 2000, Coyle et al. 2007, Bergstad et al. 2003, Fiksen and Carlotti 1997

Table 6.32 Summary of Key Invertebrate Species in the Project Area

Depth Zone	Movements	Species Groups	Prey	Predators	References
Benthic (epifauna)	Low mobility	Brittlestars, sea cucumbers	Detritus, copepods	Benthivorous fish and invertebrates	Pearson and Gage 1984, Templeman 1985, Hamel and Mercier 1998, Howell et al. 2003
Benthic (epifauna)	Low mobility	Sea urchin, sea star	Detritus, copepods	Benthivorous fish and invertebrates	Campos-Creasey 1995, Gale et al. 2013, Howell et al. 2003
Benthic (epifauna)	Seasonal migrations	Crab	Polychaetes, crustaceans, clams, small fish	Planktivorous fish (juveniles), benthivorous fish (small adults), other snow crab	Squires and Dawe 2003, Lovrich and Sainte-Marie 1997
Benthic (epifauna)	Sessile	Corals, Sponges, Sea anemones	POM, detritus	Limited information, evidence of predation by sea stars	Murillo et al. 2016a, Beazley and Kenchington 2015, Gale et al. 2013, Knudby et al. 2013
Benthic (infauna)	Low mobility	Polychaetes, bivalves, sand dollars	POM, detritus	Benthivorous fish and invertebrates	Bergstad et al. 2003, Ellers and Telford 1984

The Project Area incorporates areas of the Flemish Pass and slopes of the Grand Bank and Flemish Cap in water depths range from 340 m to 1,200 m. The Core BdN area lies directly in the northern part of the Flemish Pass. Fish habitat is characterized by a generally low complexity environment with survey areas dominated by fine substrates with intermittent occurrences of hard substrates. A variety of corals and sponges occur in the Project Area and may provide biogenic habitat to fishes and invertebrates. Based on the depths of area, seagrasses and macroalgae are not likely to occur in the Project Area.

Plankton, including phytoplankton and zooplankton occurs in the water column with seasonal increases in the spring and fall. The spring and fall blooms would be considered a sensitive time for various species as reproduction and presence of sensitive early life history stages coincide with these events. Calanus copepods are an important zooplankton prey species in the region with abundance dependent on their dynamics. Effects on early life history stages can have implications for connectivity between areas and recruitment to populations. Plankton also form the base of the food web and this productivity is transferred to deep waters through sinking biomass and waste. Pelagic macroinvertebrates in the area are derived from surveys on the Flemish Cap and include squid, shrimp, mysid shrimp, and jellyfish. These species are also prey species meso and epipelagic fish that occur in the area. Benthic invertebrates are characterized by echinoderms, crustaceans, and bivalves in the shelf areas, transitioning to sponges and corals on the middle to deep slopes (including the Core BdN Development Area). Benthic surveys in the Core BdN Area indicated occurrences of corals, sponges, echinoderms, and jellyfish/anemones with lesser occurrences of shrimp, bivalves, whelk, and squid. In the Equinor 2018 seabed surveys, sea pens and soft corals were the main functional groups observed and geodid sponges were the main sponge morphological groups observed. Feeding strategies for benthic invertebrates range from predators of other invertebrates to scavengers and suspension feeders (detritus, particulate organic matter).

A variety of fish species occur within the Project Area. Key species were identified based, conservation status (SARA schedule 1), and Indigenous social, cultural, commercial, and traditional importance, occurrence in Equinor seabed surveys and regional trawl data in the area. This included Atlantic cod, American plaice, blue hake, capelin, Greenland halibut, grenadiers (common, roughhead, roundnose), lanternfish, longnose eel, redfish (Acadian, deepwater, golden), swordfish, and wolffish (Atlantic, northern, spotted). Grenadiers and longnose eel were species commonly observed in the Equinor seabed surveys in the Core BdN Area. These species occupy various parts of the water column and may undergo seasonal migrations associated with foraging or reproduction (e.g., Atlantic cod, capelin, swordfish). Species may also undergo diel vertical migrations such as lanternfish and redfish, linking deep areas to upper areas of the water columns. These fish use various feeding strategies from consuming plankton, fish, benthic organisms, or a combination of these groups, linking these species to other organisms in the Project Area. Fish and invertebrates in the Project Area may also be preyed upon by marine mammals, sea turtles, and marine birds.

6.2 Marine and Migratory Birds

The coastline of eastern NL 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 (Barrett et al. 2006; Fort et al. 2012, 2013). Coastal 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 NL, 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 the RSA (Figure 6-1) can be roughly divided into 1) seabirds, 2) waterfowl (ducks, geese, and swans) and divers (defined for the purposes of this document as loons and grebes), 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 interact with the Project, particularly those associated with coastal habitats and those that migrate nocturnally over offshore waters (Section 6.2.3).

6.2.1 Approach and Key Information Sources

The description of existing environmental conditions for marine and migratory birds in the Project Area and larger RSA 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 (ECCC). This source was also consulted for information on seabird colonies in eastern NL, 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 Important Bird Areas (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 Equinor Canada-gathered environmental data collected during past exploration programs undertaken off eastern NL. For example, bird sightings information collected during Equinor Canada 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.

Because the distribution of marine and migratory birds is patchy and ephemeral, and because much of the available survey data were not collected in a systematic manner (e.g., from vessels of opportunity), the data do not provide a complete and specific representation of the fine-scale distribution and abundance. Therefore, analysis of avifauna abundance and distribution must be conducted on a regional basis. However, the available information sources provide a good regional understanding of the existing conditions within the Project Area LSA and RSA, which is considered adequate for EA purposes.

Section 7.1.4 of the EIS Guidelines (Appendix A) 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. In discussions in October 2018, it was agreed that such surveys would likely add little value to the EIS effects analysis.

6.2.2 Seabirds [1]

As key components and indicators of ecosystem health, seabirds are considered to be of high ecological importance. For certain species, they are of socioeconomic importance in NL 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 rates of population growth. A diverse assemblage of seabirds can be found in the marine waters off eastern NL at all times of year, including tubenoses (fulmars, storm-petrels and shearwaters), gannets, cormorants, phalaropes, jaegers and skuas, alcids (auks), gulls and terns as summarized in Table 6.33. Many of these taxa also nest along the coast of eastern NL. 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).

[1] Note to reviewer: Some species are not mapped. This is because they occur in very low densities, which is discussed in the text (see relevant subsections). Also, in the most recent ECSAS database some species are entirely absent from the RSA during one or more seasons.

Table 6.33 Seabirds that are Known or Likely to Occur off Eastern Newfoundland

Type	Common Name	Time of Occurrence [1]	Abundance [2]
Fulmarine Petrels	Northern Fulmar	Year-round	Common
Shearwaters	Great Shearwater	April–November	Common
	Sooty Shearwater	April–November	Common
	Manx Shearwater	April–October	Scarce
	Cory's Shearwater	July–September	Rare
Gadfly Petrels	Bermuda Petrel[3]	February–May	Rare
	Zino's Petrel[3]	April–October	Rare
	Desertas (Bugio) Petrel[3]	November–March	Rare
Storm-Petrels	Leach's Storm-Petrel[3]	April–November	Common
	Band-rumped Storm-Petrel	May–August	Rare
	Wilson's Storm-Petrel	June–September	Scarce
Gannets	Northern Gannet	March–November	Common (coastal)
Tropicbirds	White-tailed Tropicbird	October–November	Rare
Cormorants	Great Cormorant	Year-round	Common (coastal)
	Double-crested Cormorant	April–November	Common (coastal)
Phalaropes	Red Phalarope	May–October	Scarce
	Red-necked Phalarope[3]	May–September	Scarce
Jaegers and Skuas	Great Skua	Year-round	Scarce
	South Polar Skua	May–October	Scarce
	Pomarine Jaeger	April–October	Scarce
	Parasitic Jaeger	May–October	Scarce
	Long-tailed Jaeger	May–September	Scarce

Table 6.33 Seabirds that are Known or Likely to Occur off Eastern Newfoundland

Type	Common Name	Time of Occurrence [1]	Abundance [2]
Alcids	Dovekie	September–May	Common
	Common Murre	Year-round	Common
	Thick-billed Murre	Year-round	Common
	Razorbill	Year-round	Common (coastal)
	Atlantic Puffin	Year-round	Common
	Black Guillemot	Year-round	Common (coastal)
Gulls	Black-legged Kittiwake[3]	Year-round	Common
	Ivory Gull[3]	December–April	Rare
	Sabine‘s Gull	May–September	Rare
	Ross’s Gull[3]	October–March	Rare
	Black-headed Gull	Year-round	Scarce (coastal)
	Ring-billed Gull	March–November	Common (coastal)
	Herring Gull	Year-round	Common
	Iceland Gull	October–May	Common
	Lesser Black-backed Gull	Year-round	Scarce
	Glaucous Gull	October–May	Common
	Great Black-backed Gull	Year-round	Common
Terns	Caspian Tern	April–September	Scarce (coastal)
	Arctic Tern	May–September	Common
	Common Tern	May–September	Common (coastal)

[1] See Section 6.2 for a monthly breakdown of estimated presence.
[2] This 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 species, it is possible that rare sightings of other species not listed here may occur.
[3] See Section 6.2.4

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 NL was from March to August, while seabirds were least abundant in the area in the fall (September to 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/km^2 (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). Updated ECSAS data from 2006 to 2016 were recently made available by the CWS (at the on-line *Atlas of Seabirds at Sea in Eastern Canada*), which filled in information gaps in seabird distribution and relative abundance at sea (Bolduc et al. 2018). In this Atlas database, the marine bird densities are generated after dividing the survey data into three periods of the year to best describe potential changes in seabird distribution and abundance over the course of the year (Bolduc et al. 2018). These three periods are: 1) April–July, 2) August–November, and 3) December–March to represent: 1) spring migration and nesting periods of species whose young are mobile and leave the nest immediately after hatching, 2) adult moult, chick-rearing periods of species whose young are mobile and leave the nest immediately after hatching, and the second half of the nesting of species whose young are helpless and remain in the nest for a long period after hatching, and 3) fall migration and wintering. The density maps present seabird densities averaged over the months that comprise the time period presented.

Colony locations are illustrated in Figure 6-52, which is referred to throughout the following sections.

6.2.2.1 Fulmarine Petrels, Shearwaters, and Gadfly Petrels

The northern fulmar and four species of shearwater (great, sooty, Manx, and Cory's shearwater) occur regularly in the waters off eastern NL. Of these, only the northern fulmar and Manx shearwater are known to nest in NL (Lee and Haney 1996; Mallory et al. 2012). However, the numbers of northern fulmars and Manx shearwaters nesting in NL are very small. Fulmars and shearwaters are found in offshore waters and spend most of their time in the air, at or near the water's surface. However, tracking of sooty shearwaters shows that they spend most of their time on the water during their residence in the Northwest Atlantic, probably because they are undergoing their annual moult of flight feathers (Hedd et al. 2012). Shearwaters feed by pursuit plunging, while fulmars are typically surface feeders, taking fish, offal, and squid. In the summer months, northern fulmar and great shearwater are among the most commonly observed species in seabird surveys conducted during Equinor Canada exploration activities (Statoil 2015b).

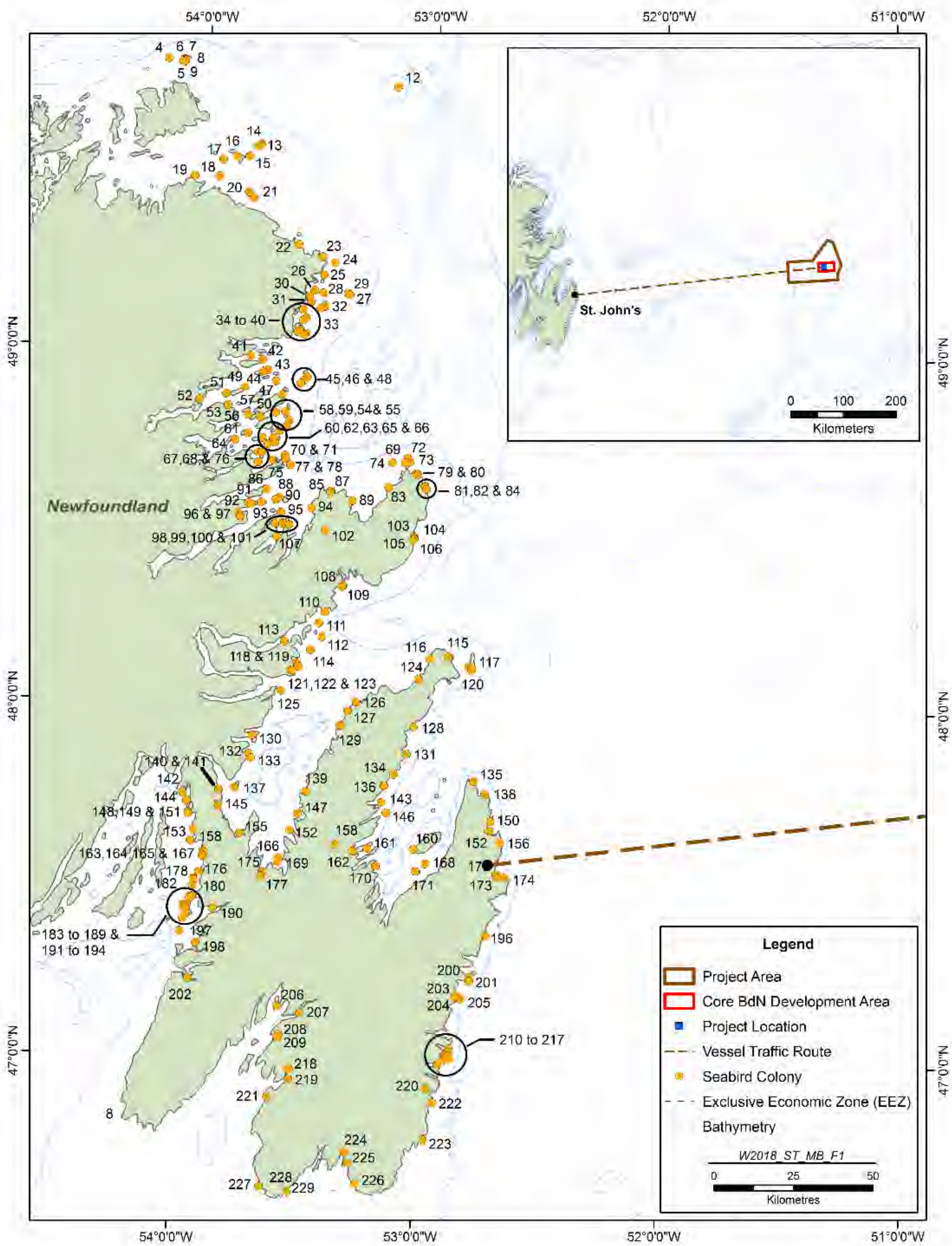

Figure 6-52 Seabird Colony Locations Eastern Newfoundland

Northern Fulmar

The northern fulmar is common year-round in the waters off eastern NL. Large numbers are present offshore in the RSA during summer due to the presence of moulting, sub-adult, non-breeding individuals from European colonies (Huettmann and Diamond 2000). During winter, large numbers from nesting colonies in the Canadian Arctic, Greenland, and Europe winter in the northwest Atlantic from the Labrador Sea to New England (Huettmann and Diamond 2000; Mallory et al. 2008). A small number of northern fulmars nest in NL (Table 6.34).

Table 6.34 Northern Fulmar Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony size	Survey Unit	Year Surveyed
Funk Island	12	40	Pair	2017
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
Cape St. Mary's	230	9	Pair	1998

Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2017).
[1] Refer to Figure 6-52 for colony locations corresponding to each Colony #.

The ECSAS 2006-2016 surveys showed this species was more common in the Project Area and adjacent continental shelf slope area than the other portions of the RSA throughout the year. Average density during the fall migration and wintering period (December–March), range from 3.8 to 20.8 birds/km² in the Project Area (Figure 6-53). Densities away from the shelf slope, in both the shallower waters of the Grand Banks and in deepest waters are generally low (i.e., 0 to 3.8 birds/km²). During the spring migration and early nesting period (April–July), average fulmar densities over most of the Project Area were relatively high (19.1 to 111.5 birds/km²), similar to other continental shelf slope areas and substantially greater than most continental shelf areas (Figure 6-53). However, densities within this period are not stable. Large numbers of birds are present in April and May and low numbers in July and August due to the departure of breeding-age birds for Arctic nesting colonies (Moulton et al. 2006; Holst and Mactavish 2014). This species is most numerous in the Project Area during the late nesting and chick-rearing period (August–November), with an average density of 48.0 to 399.4 birds/km² (Figure 6-53). In general, areas within the RSA near the north and east shelf slopes have higher average densities than the shallower and more southerly areas. However, many of these birds do not arrive in the RSA until September or October (Moulton et al. 2006; Holst and Mactavish 2014). During the Equinor Canada 2018 Seabed Survey in the Project Area, which was conducted from August 10 to October 8, the northern fulmar was observed almost daily. Concentrations of norther fulmar around the survey vessel in the Core BdN Development Area reached 300 to 959 individuals on seven dates between September 5 to 26.

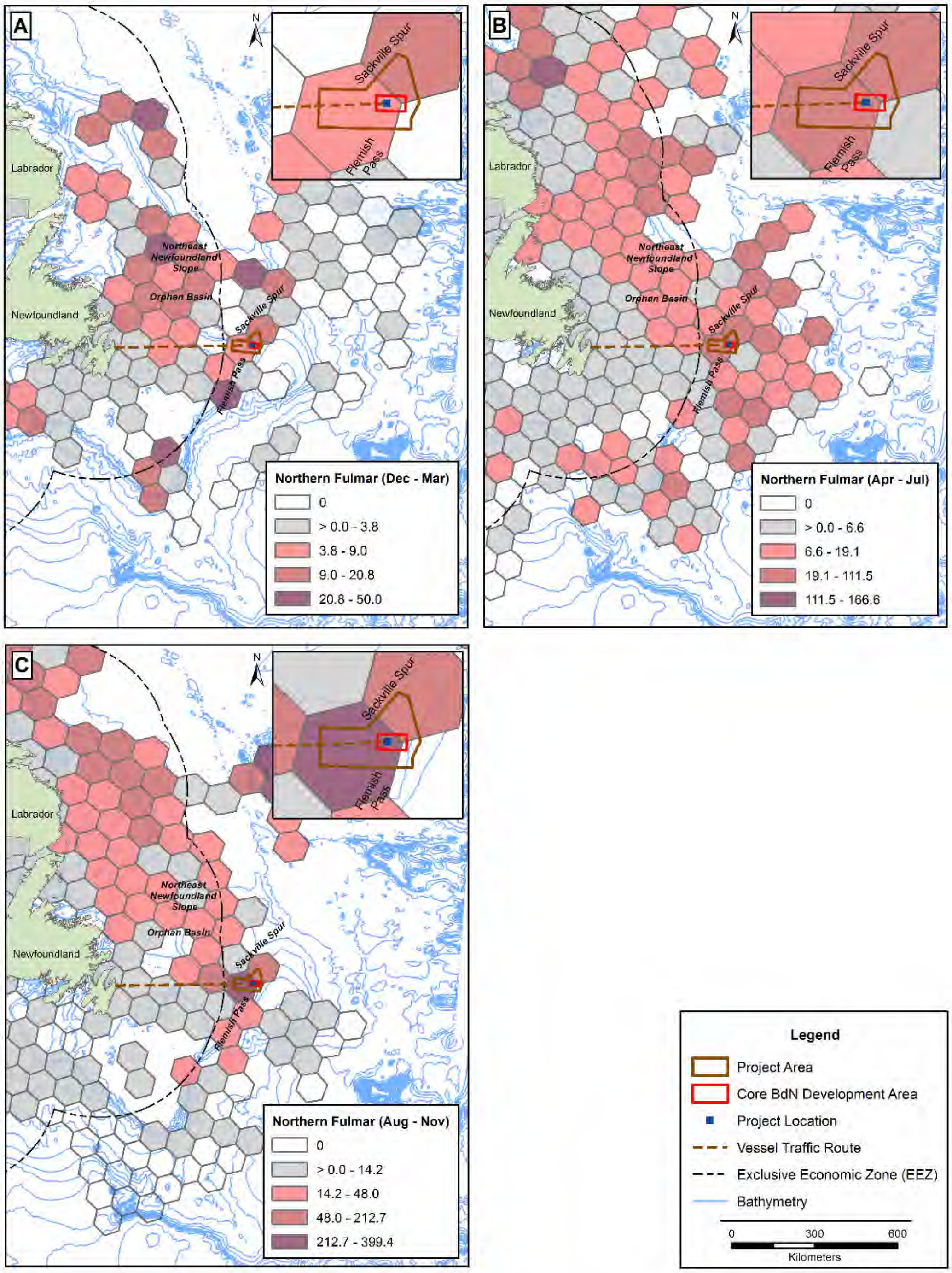

Figure 6-53 Northern Fulmar Observed Densities, a) Fall Migration and Wintering Period (December to March), b) Spring Migration and Early Nesting (April to July), and c) Late Nesting and Chick Rearing (August to November) (ECSAS Database, 2006 to 2016)

Shearwaters

Shearwaters are most numerous during the summer and fall months in offshore NL particularly on the east and northeast Grand Banks (Bolduc et al. 2018). Great shearwater is the most numerous of the four species of shearwater occurring regularly in NL waters. Great shearwater migrates north from breeding islands in the south Atlantic and arrives in the Northern Hemisphere in spring and peaks in number during summer and fall, before departing in late fall. A large percentage of the world population of great shearwater is thought to moult their flight feathers during the summer months while in NL waters (Brown 1986; Lock et al. 1994; Huettmann and Diamond 2000). Sooty shearwaters are usually outnumbered by great shearwaters but follow a similar pattern of migration and areas of concentration. Great and sooty shearwaters are the primary consumers of fish on the Grand Banks during summer (Hedd et al. 2012). Manx shearwater nests in small numbers on Middle Lawn Island, off the Burin Peninsula approximately 700 km southwest of the LSA but has been recorded in larger numbers prospecting for nest sites on other nearby islands (Roul 2010). Manx shearwater forages near the breeding colony during the nesting period (Onley and Scofield 2007). Overall, it is a scarce but widespread species in NL waters from late April–October occurring widely and generally in the same locations the commoner great and sooty shearwaters are found. Numbers are augmented by non-breeding subadults and individuals finished with nesting at European nesting colonies, the centre of the species' breeding range (Lee and Haney 1996). Non-breeding Cory's shearwaters from nesting colonies on Berlengas, Madeira, Desertas, Salvages, Azores, and Canary Islands (Onley and Scofield 2007) spend the summer off eastern Canada (Brown 1986). They are found in small numbers in Gulf Stream waters from the edge of the Scotian Shelf to edge of the southern Grand Banks (Brown 1986) and east of the Grand Banks (Bolduc et al. 2018). This species is expected to occur only in the southern most parts of the RSA and in very small numbers.

The ECSAS 2006–2016 surveys recorded a presence of great shearwater in eastern NL between mid-April and early December (Bolduc et al. 2018). During the spring migration and early nesting period (April–July), great shearwaters were recorded over the entire RSA in densities ranging from more than 0.0 to 12.3 birds/km². There was a distinctly higher concentration over the Sackville Spur, northern Flemish Pass, including the Project Area and Core BdN Development Area, and northern Flemish Cap and the edge of the NL Shelf with a density range of 12.3 to 38.3 birds/km² (Figure 6-54). Abundance peaks during the late nesting and chick-rearing period (August to November), with a geographic pattern of concentration similar to that of the preceding season: over the northeastern Grand Banks, Sackville Spur, northern Flemish Pass and the shelf slope of the southeastern Grand Banks with 11.0 to 59.5 birds/km² compared to over 0.0 to 3.0 birds/km² in the area to the north of the Labrador Shelf and Orphan Basin (Figure 6-54). During the fall migration and wintering period (December to March), ECSAS 2006 to 2016 surveys found this species is present in the RSA only on the southern Grand Banks and adjacent deeper waters, and only until early December. The less abundant sooty shearwater showed a similar distribution to the great shearwater including a distinct concentration of 0.3 to 6.2 birds/km² in the Flemish Pass, Sackville Spur and southern edge of the Orphan Basin during the August to November period. However, most sooty shearwaters are present from June to early September (Abgrall et al. 2008; Holst and Mactavish 2014).

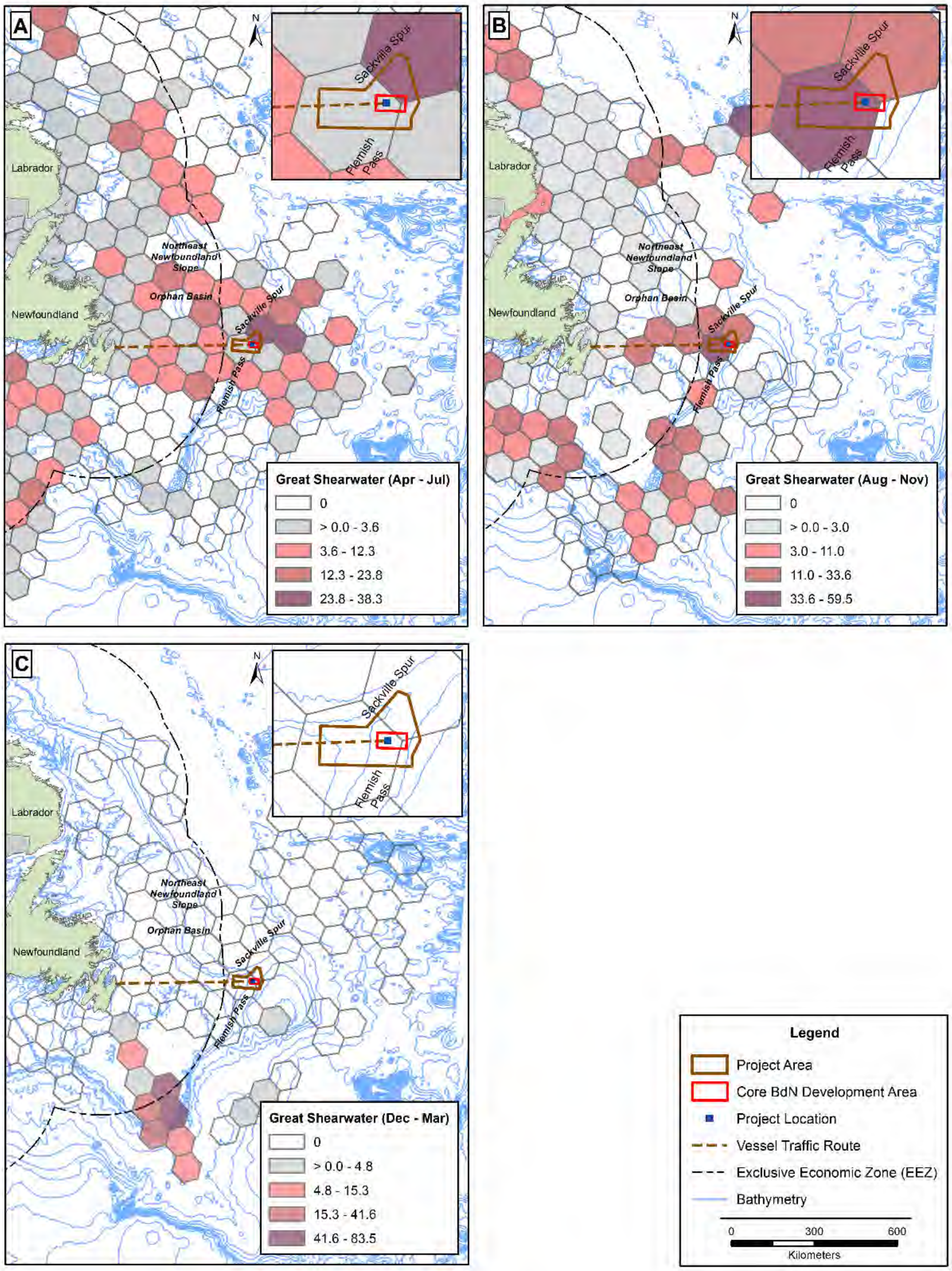

Figure 6-54 Great Shearwater Observed Densities, a) Spring Migration and Early Nesting (April to July), and b) Late Nesting and Chick Rearing (August to November) (ECSAS Database, 2006 to 2016)

During the Equinor Canada 2018 Seabed Survey, the great shearwater was observed almost daily. Concentrations of great shearwater around the survey vessel reached 200 to 850 individuals on 13 dates during September. Sooty shearwater was much less numerous than the great shearwater with only 32 individuals observed during this timeframe.

Gadfly Petrels

Three species of gadfly petrel occur in the RSA during fall and winter. These species are identified as globally threatened on the IUCN Red List of Threatened Species and are discussed in Section 6.2.4.

6.2.2.2 Storm-Petrels

Three species of storm-petrels are found in the waters off eastern NL (Onley and Scofield 2007; BirdLife International 2018). Leach’s storm-petrel is the common species breeding in NL. Wilson’s storm-petrel nests in sub-Antarctic and Antarctic regions and winters in the Northern Hemisphere up to 77°N in the north Atlantic (Onley and Scofield 2007). It is a scarce species in eastern NL waters. The band-rumped storm-petrel’s nearest nesting colonies are on Berlengas Island and the Azores Islands in the east Atlantic; it occurs in the RSA in the warm waters off the continental shelf in the non-breeding season (BirdLife International 2018).

Leach’s storm-petrel is the most numerous breeding seabird in NL. The largest colony in the world, Baccalieu Island, supports approximately one third of the species’ global population (see Sections 6.2.5.1, 6.4.3.1, and 6.4.6.1) (Huntington et al. 1996; CWS 2017). Accumulating evidence suggests the population of Newfoundland Leach’s storm-petrels is experiencing a considerable decline. Preliminary results from a 2013 survey of nesting Leach’s storm-petrels on Baccalieu Island provide an estimate of just under 2 million pairs, a decline of 40 percent from the previous survey in 1984 (ECCC-CWS, unpublished). The results of surveys of nesting Leach’s storm-petrels on Gull Island in the Witless Bay Ecological Reserve (see Sections 6.2.5.1, 6.4.3.1, and 6.4.5.1) indicated a decline from 352,000 breeding pairs in 2001 to 180,000 pairs in 2012, a decrease of 51 percent. (ECCC-CWS, unpublished). A 2015 population estimate update for Green Island, Fortune Bay (next to St. Pierre et Miquelon) was 48,000 pairs (ECCC-CWS, unpublished data), down from a previous estimate of 103,833 pairs (Russell 2008). The cause of the Leach’s storm-petrel population decline has not yet been determined. CWS records for Leach’s Storm-petrel colonies in eastern NL are provided in Table 6.35. This species is designated globally Vulnerable by the IUCN (see Section 6.2.4) (Birdlife International 2018). The natural variability in mortality and population size in Leach’s storm-petrel in the Northwest Atlantic (Leach’s storm-petrel) is poorly understood (Wilhelm et al. 2019). Predation at nesting colonies is believed to be the major cause of mortality (Stenhouse and Montevecchi 1999; Bicknell et al. 2009; Pollet et al. 2019; Pollet and Shutler 2019). High levels of mercury borne by these birds, and important shifts in demersal and pelagic food webs in the northwest Atlantic have also been identified as potentially important sources of mortality and potentially population decline (Bond and Diamond 2009; Head and Pepin 2010; Buren et al. 2014; Burgess et al. 2016 in Pollet et al. 2019; Pollet et al. 2016).

Table 6.35 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
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	1,977,692	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

Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2017).

[1] Refer to Figure 6-52 for colony locations corresponding to each Colony #.

Leach's storm-petrel is a surface forager, feeding on lower mesopelagic (700 m deep) crustaceans and small fish that migrate to the surface at night (Steele and Montevecchi 1994). Studies of the movements of Leach's storm-petrel using data loggers showed they travel up to 1,015 ± 238 km during foraging trips from nesting colonies in Nova Scotia and up to 2,100 km from colonies in NL to reach waters sufficiently deep for their prey (Pollet et al. 2014, Hedd et al. 2018). The core foraging areas of incubating individuals at Baccalieu Island and Gull Island, Witless Bay, include the Core BdN Development Area and the Project Area (Hedd et al. 2018).

The ECSAS 2006–2016 surveys recorded a presence of Leach's storm-petrel in eastern NL mainly between mid-April and late October with stragglers as late as early December (Bolduc et al. 2018). In the RSA, Leach's storm-petrel was most widespread and numerous in the spring migration and early nesting period (April–July) with the highest concentrations on the Labrador Shelf and Orphan Basin, in the range of 5.9 birds/km² to 25.9 birds/km². In the Sackville Spur and Flemish Pass area, surveys averaged > 0 birds/km² to 1.7 birds/km² over the course of this period (Figure 6-55). Densities were lower over the RSA in the late nesting and chick-rearing period (August to November), with densities ranging from 0 birds/km² to 1.4 birds/km². Higher densities of 1.4 birds/km² to 5.5 birds/km² were recorded on the Sackville Spur and Flemish Pass, including the Project Area, during this time period (Figure 6-55). During the fall migration and wintering period this species was recorded up to 3 December and only in Gulf Stream waters 800 km south of the Project Area. During the Equinor Canada 2018 Seabed Survey, only 40 Leach's storm-petrel were observed during the systematic seabird surveys, with a maximum of two per day observed.

Leach's storm-petrel is by far the most numerous species stranding on drilling and production installations and offshore supply vessels (OSVs) in the NL Offshore Area. Stranding data from Equinor Canada activities in the Project Area were collected on 1,755 days from 2008 to 2016 from exploration activities conducted during every month of the calendar year over this period. Of a total of 282 birds recovered, 252 were released alive. Leach's storm-petrels comprised 81 percent of the stranded birds. Because most survey days were from June through August most of these strandings occurred during those months. However, when stranding data from the NL Offshore area are examined, there is a trend showing a large peak in the average number of strandings per day in the last 20 days of September and the first 20 days of October (LGL 2017). During the Equinor Canada 2018 Seabed Survey, a total of 276 Leach's storm-petrels were found stranded on the survey vessel with 262 Leach's storm-petrels released alive and 14 found dead. However, in one night (Oct 5/6) 255 Leach's storm-petrels were stranded. The weather was foggy on 5 October but clear on 6 October. The increase in strandings in September and October coincides with the abandonment of the nesting colonies by fledglings and adults, the beginning of which is indicated by the earliest published fledging date (10 September) at the Great Island, Witless Bay, nesting colony (Pollet et al. 2019a). It is therefore likely that millions of storm-petrels cross the Atlantic during their migration south. Tracking studies confirm an increased presence of Leach's storm-petrels in the RSA as they cross the Atlantic in a southeast direction during migration to their wintering grounds (Pollet et al. 2014). Some individuals may remain in the vicinity of the RSA for the winter, as suggested by the presence of a tracked individual southeast of Newfoundland (Pollet et al. 2019b).

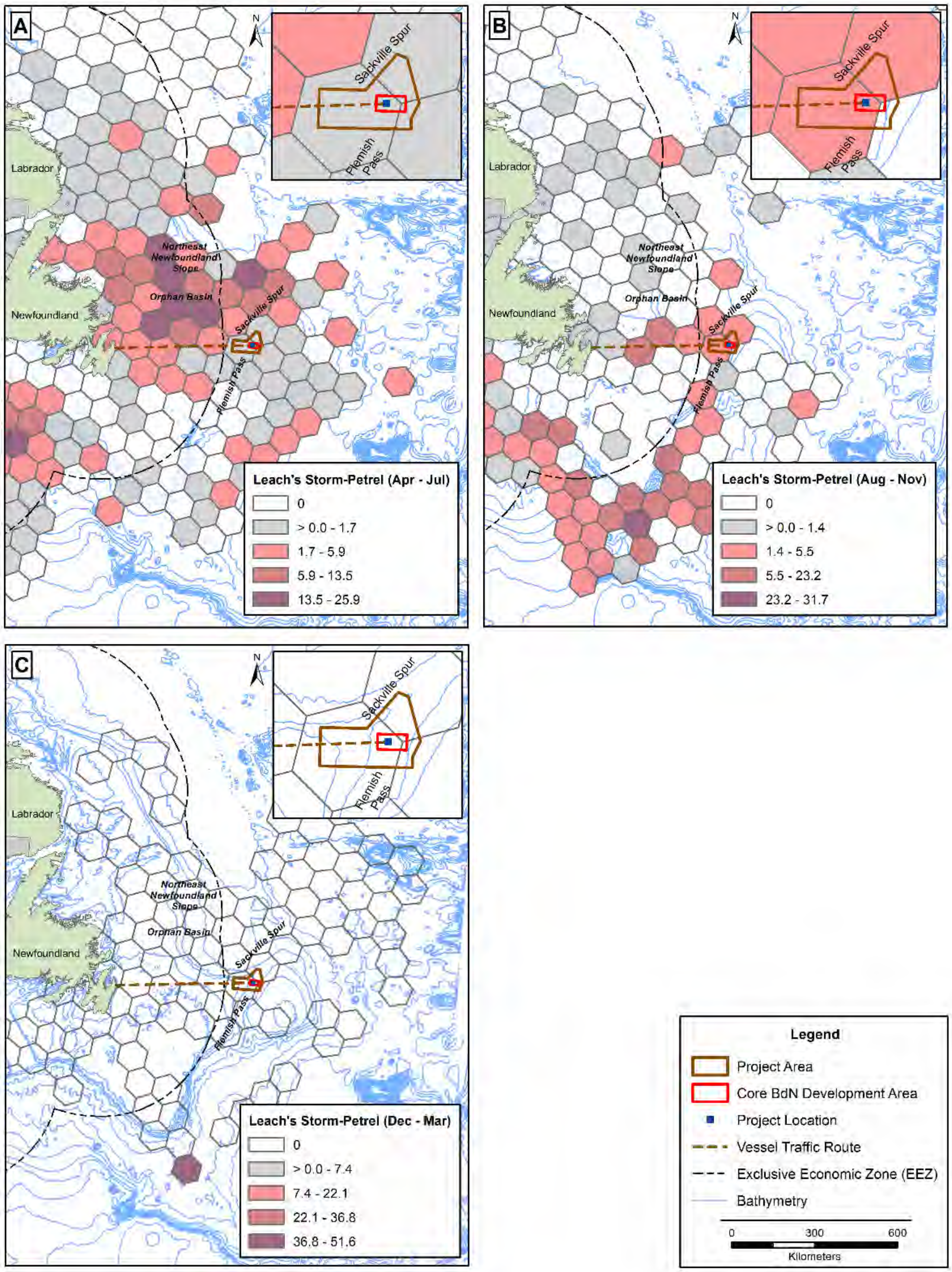

Figure 6-55 Leach's Storm-Petrel Observed Densities a) Spring Migration and Early Nesting (April to July), b) Late Nesting and Chick Rearing (August to November) (ECSAS Database, 2006 to 2016)

6.2.2.3 Gannets

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 (Garthe et al. 2007a; Fifield et al. 2014). Adults arrive at the colony in mid-March. 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 to 40 m above the surface, descending to depths of 15 m. They may travel over 200 km from the breeding colony to forage in coastal waters (Garthe et al. 2007b), 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 present in NL from March–November (Mowbray 2002; Montevecchi et al. 2012b). However, only small numbers venture off the continental shelf to the Project Area and primarily during the spring migration and early nesting period (April to July, ECSAS data, Bolduc et al. 2018). The majority of the population overwinters in the Gulf of Maine and farther south (Mowbray 2002; Montevecchi et al. 2012a).

CWS survey data for the two colonies of northern gannet in eastern NL are presented in Table 6.36. In addition, it should be noted that the largest northern gannet colony in NL is at Cape St. Mary’s located at the southeast corner of Placentia Bay approximately 50 km west of the RSA boundary. The 2013 survey of Cape St. Mary’s gannets showed there were 13,515 pairs (ECCC-CWS unpublished).

Table 6.36 Northern Gannet Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Funk Island	12	10,198	Pairs	2014
Baccalieu Island	120	3,241	Pairs	2014
Cape St. Mary`s	230	13,515	Pairs	2013

Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2017).
[1] Refer to Figure 6-52 for colony locations corresponding to each Colony #.

6.2.2.4 Tropicbirds

White-tailed tropicbird nests in tropical and sub-tropical waters. Some of those from the population nesting in Bermuda range north to the RSA during a portion of their non-breeding season (late October to mid-November) (Mejías et al. 2017). This distribution includes the Grand Banks, the southwest slope of Orphan Basin, and Labrador Sea. This species is designated Least Concern (does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened) by IUCN (BirdLife International 2018).

6.2.2.5 Cormorants

Cormorants in NL are represented by two species, the double-crested cormorant and the great cormorant. Both species nest in eastern NL 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 in the Project Area is low (Hatch et al. 2000; Dorr et al. 2015). 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. Small numbers remain in coastal NL in winter (Mactavish et al. 2016). Great cormorants are partial migrants, with some individuals remaining within the breeding range year-round (Hatch et al. 2000; Dorr et al. 2015).

ECSAS surveys recorded cormorants primarily in coastal areas no closer than 500 km from the Project Area and only during the late nesting and chick-rearing period (Bolduc et al. 2018). Two sightings were identified as great cormorants, and the rest were not identified to species level. CWS records identify eight cormorant colonies in eastern NL (Table 6.37), although species composition was not determined.

Table 6.37 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
Cape St. Mary’s	230	20	Individuals	2015

Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2017).
[1] Refer to Figure 6-52 for colony locations corresponding to each Colony #.

6.2.2.6 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 at sea south of Canada. Both species migrate through eastern NL waters but were not detected often on the ECSAS surveys. Very low densities were recorded in late May and in the late nesting and chick-rearing period (August to November) mostly near shore on the western side of the RSA (Bolduc et al. 2018). However, they have been recorded off-transect in small numbers from mid-May to early June and during August and September in the RSA in the deep waters off the continental shelf (e.g., Moulton et al. 2006). 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). During Equinor Canada's 2018 Seabed Survey, one red-necked phalarope was photographed in September in the BdN Core Development Area (Mactavish and Penney-Belbin 2018).

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. Their distribution at sea suggests that they are highly dependent on ocean fronts bordered by upwelling (Rubega et al. 2000; Tracy et al. 2002).

6.2.2.7 Skuas and Jaegers

Two species of skua and three species of jaeger regularly occur off eastern NL: great skua, south polar skua, pomarine jaeger, parasitic jaeger, and long-tailed jaeger, none of which breed in NL. South polar skuas nest in the south Atlantic, and great skuas on coastal moors and rocky islands in Iceland and Europe. Pomarine, parasitic, and long-tailed jaegers breed on Arctic tundra. Non-breeding skuas and jaegers are found offshore away from the breeding areas year-round. During the non-breeding season, skuas and jaegers typically feed by stealing prey items from other seabirds (Wiley and Lee 1998, 1999, 2000).

The two skua species occur in very low densities in offshore waters of NL mainly during the May–November period. Identifying skuas to species is difficult at sea. Skuas usually occur where other marine birds are numerous, particularly along shelf edges. Skuas occur in such low densities that they are infrequently recorded during systematic surveys during monitoring programs but are regularly recorded off-transect and between surveys (Moulton et al. 2006; Hauser et al. 2010; Jones and Lang 2013; Holst and Mactavish 2014). During the Equinor Canada 2018 Seabed Survey one south polar skua was seen during quantitative seabird surveys and 18 incidental sightings of individuals were seen on 14 days (Mactavish and Penney-Belbin 2018). The ECSAS surveys show a slightly higher density of sightings over the Flemish Cap 100 km southeast of the LSA and along the southeast edge of the Grand Banks 500 km southwest of the LSA (Figure 6-56). Transmitters placed on great skuas that nested in Iceland showed a large percentage of them overwinter in the southern Flemish Cap 160 km southeast of the LSA and southern Grand Banks area 500 km southwest of the LSA and farther south (Magnusdottir et al. 2012).

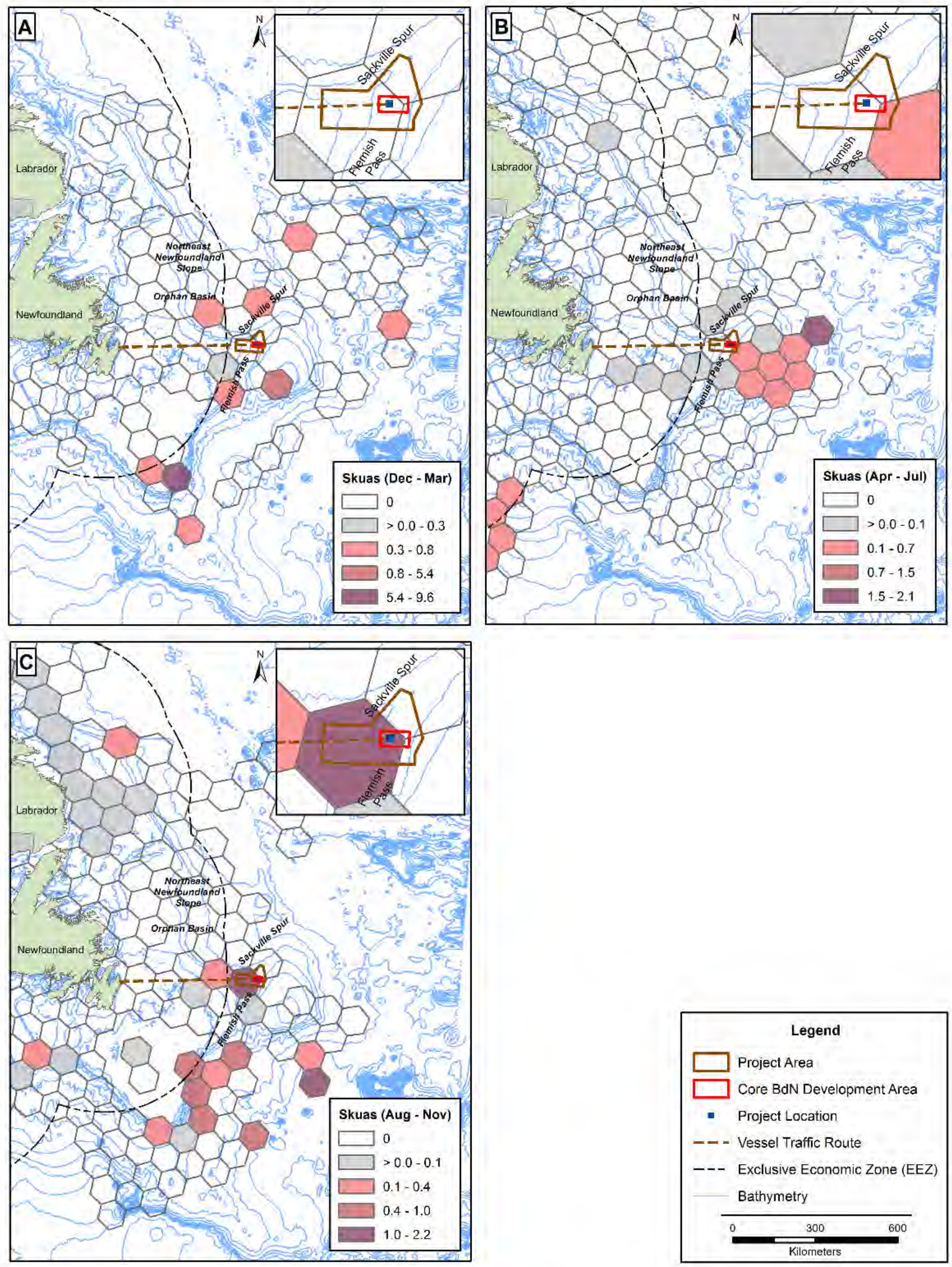

Figure 6-56 Skuas Observed Densities, a) Fall Migration and Wintering Period (December to March), b) Spring Migration and Early Nesting (April to July), and c) Late Nesting and Chick Rearing (August to November) (ECSAS Database, 2006 to 2016)

Pomarine and parasitic jaegers winter mainly south of 35°N, and long-tailed jaegers winter mainly south of the equator. Adults migrate through NL waters in spring, late summer and fall, while sub-adults migrate only part-way to the breeding grounds and are present in NL waters all summer. Because of the low densities of jaegers, they are infrequently recorded during systematic surveys (Bolduc et al. 2018). However, they are often sighted off-transect and between surveys (Moulton et al. 2006; Hauser et al. 2010; Jones and Lang 2013; Holst and Mactavish 2014). During the Equinor Canada 2018 Seabed Survey there were incidental sightings of 19 pomarine jaegers on 11 days, 16 long-tailed jaegers on nine days, and three parasitic jaegers on two days (Mactavish and Penney-Belbin 2018). During ECSAS surveys, pomarine jaeger was recorded more often than the other two species of jaeger. Peak periods of migration in eastern Canada were late April to late May and late August to mid-October (Bolduc et al. 2018). Parasitic jaeger was second most frequently recorded jaeger species, with peaks of migration from late April to late May and from mid-August to early November. Both pomarine and parasitic jaeger were widespread in distribution over eastern NL waters. Long-tailed jaeger was the least often recorded jaeger during the ECSAS surveys with most of the sightings in deep water beyond the shelf edge, particularly southeast of the Flemish Cap (Figure 6-57).

6.2.2.8 Alcids

Six members of the alcid (auk) family occur in the eastern NL and surrounding region: dovekie, razorbill, common murre, thick-billed murre, Atlantic puffin, and black guillemot. All except dovekie nest in large numbers in eastern NL. Dovekies nest mainly in Greenland. The six species occur commonly in the RSA for the whole year or a large portion of the year. Black guillemot and razorbill are coastal species, so are rarely found in the Project Area. Dovekie, common murre, thick-billed murre and Atlantic puffin are highly pelagic, living at sea outside the breeding season. Alcids 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* spp. (Fort et al. 2012). Among seabirds, alcids 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. 2012a). Alcids are rendered flightless for several weeks each year during the late summer moulting period (Gaston and Hipfner 2000; Ainley et al. 2002; Lavers et al. 2009; Montevecchi and Stenhouse 2002). The east coast of NL 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 NL are provided in Table 6.38.

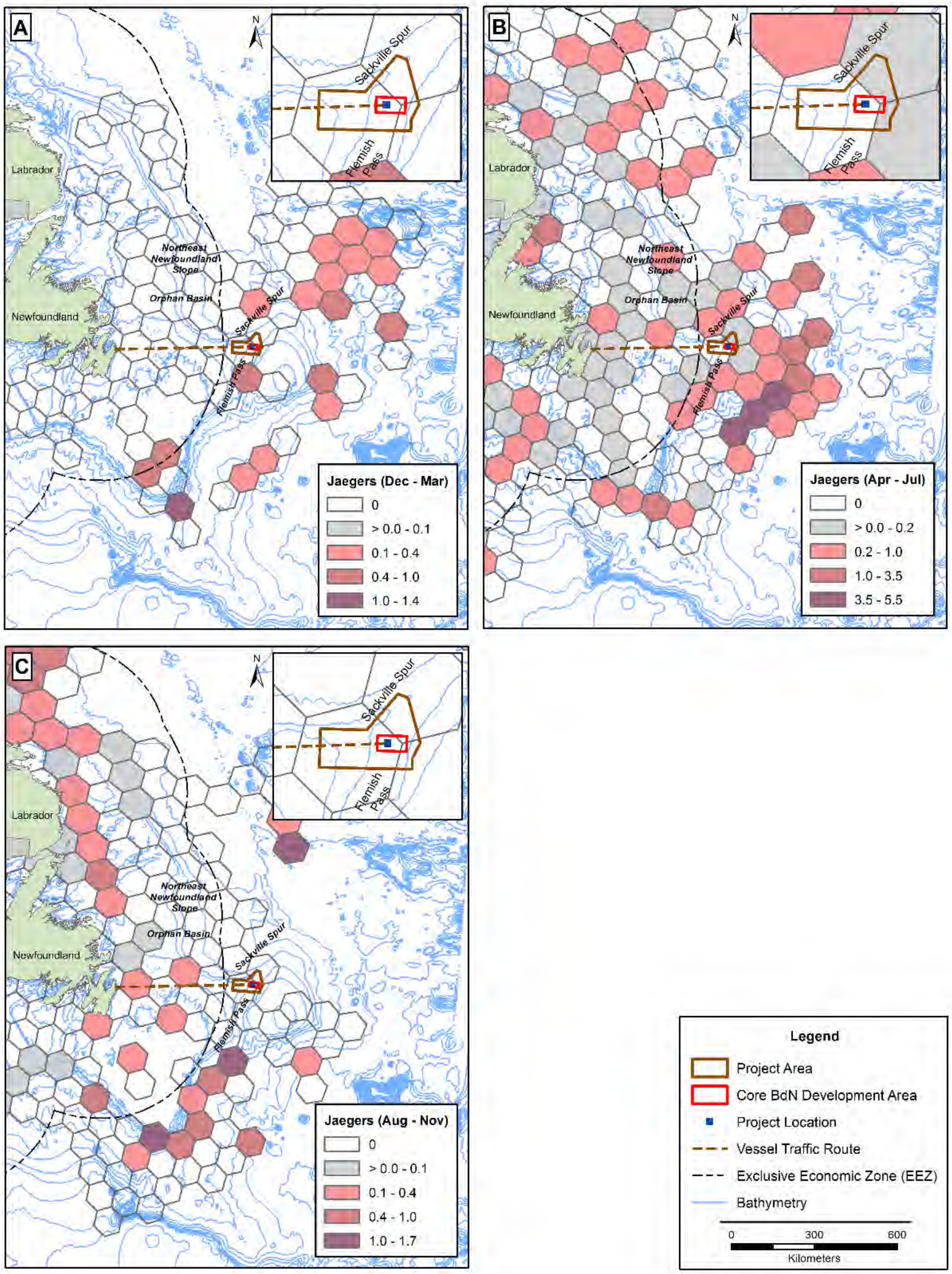

Figure 6-57 Jaegers Observed Densities, a) Fall Migration and Wintering Period (December to March), b) Spring Migration and Early Nesting (April to July), and c) Late Nesting and Chick Rearing (August to November) (ECSAS Database, 2006 to 2016)

Table 6.38 Alcid Colony Locations in Eastern Newfoundland

Common Name	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	Individual	2012
	Gull Island	200	11,795	Individual	2016
	Green Island	201	250,000	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
	Cape St. Mary’s	230	15,484	Pair	2007
Thick-billed Murre	Funk Island	12	250	Pair	1980
	Baccalieu Island	120	73	Individual	2012
	Gull Island	200	1	Pair	2012
	Green Island	201	242	Pair	2004
	Cape St. Mary’s	230	1,000	Pair	2012

Table 6.38 Alcid Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
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	2017
	Puffin Island	117	50	Pair	2012
	Baccalieu Island	120	406	Pair	2012
	Gull Island	200	159	Individual	2017
	Green Island	201	170	Pair	1979
	Ship Island	203	12	Individual	2015
	Pee Pee Island	204	31	Individual	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
	Cape St. Mary's	230	100	Pair	1979
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
	Trinny Cove Islands, off Trinny Cove	178	36	Individual	2015

Table 6.38 Alcid Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Black Guillemot	Trinny Cove Islands, off Trinny Cove Head	182	2	Pair	1974
	Grassy Islands, Brine Islands, East	184	1	Pair	1974
	Gull Island	200	6	Pair	2017
	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	Individual	2009
	Western Head	227	20	Pair	1985
	Cape Pine Head	228	5	Pair	2005

Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2017).
1 Refer to Figure 6-52 for colony locations corresponding to each Colony #.

Dovekie

Dovekies breed in the north Atlantic, primarily in Greenland and eastern Nova Zemlya, Jan Mayen, and Franz Josef Land in northern Russia. This species winters at sea south to 35°N. Dovekie is an abundant species, with a world population estimated at 30 million (Brown 1986). The core winter distribution of the world's dovekie population lies within the waters off eastern NL (Fort et al. 2013). Dovekies from large breeding colonies along northwestern and east Greenland migrate to wintering areas offshore NL, where they occur from early December through April (Fort et al. 2012, 2013). During the fall migration and wintering period (December to March) within the RSA, dovekie densities typically ranged from 3.0 to 32.6 birds/km² (Figure 6-58; Bolduc et al. 2018). However, lower densities were observed over the Sackville Spur and northern Flemish Pass, including the Core BdN Development Area and Project Area (>0.0 birds/km to 3.0 birds/km²). During the spring migration and early nesting period (April–July), there were average densities of more than 0.0 birds/km to 8.4 birds/km² over the Sackville Spur, including the Project Area, and southern Orphan Basin. Higher densities were recorded at the Flemish Cap (8.4 birds/km to 34.8 birds/km²). Very few of these dovekies were recorded during after April while adults were at Arctic nesting colonies (Bolduc et al. 2018). During the late nesting and chick-rearing period (August to November), relatively high densities (9.7 birds/km to 28.1 birds/km²) of dovekies were recorded on the Labrador Sea, whereas lower densities were recorded (> 0.0 birds/km to 9.7 birds/km²) on the Sackville Spur and Flemish Pass, including the Project Area (Figure 6-58). During this period most dovekies arrive from September to November (Bolduc et al. 2018).

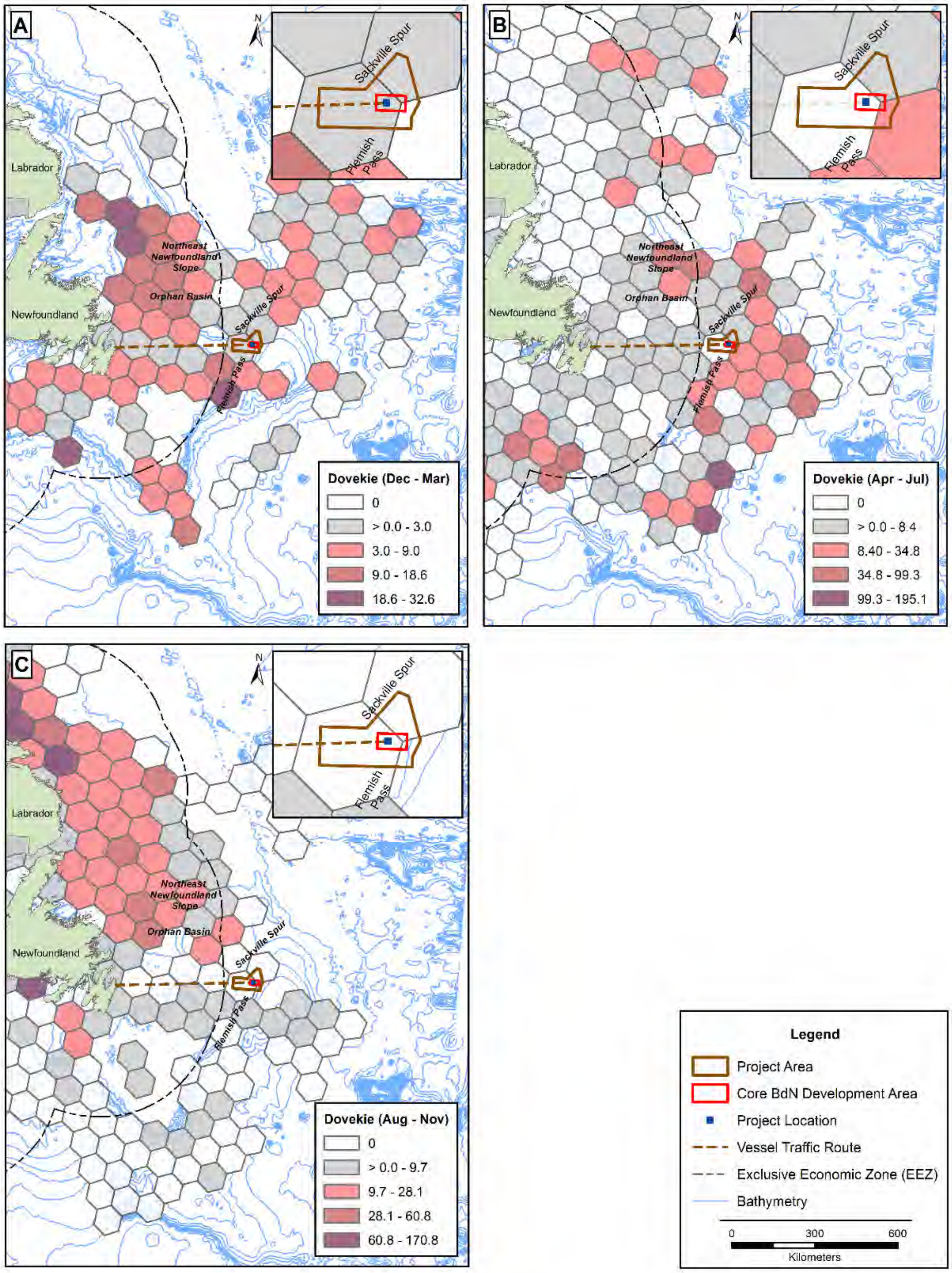

Figure 6-58 Dovekie Observed Densities, a) Fall Migration and Wintering Period (December to March), b) Spring Migration and Early Nesting (April to July), and c) Late Nesting and Chick Rearing (August–November) (ECSAS Database, 2006 to 2016)

Murres

Common murre is an abundant breeding species in eastern NL, with just over a half million pairs nesting. Most of these occur at two colonies, Funk Island (472,259 pairs) and the Witless Bay Islands (Great, Green, Gull, and Pee Pee Islands) (262,830 pairs) (EC-CWS unpublished data) (Table 6.38). They spend the winter from eastern NL south to Massachusetts, but the core wintering area is offshore NL (McFarlane Tranquilla et al. 2015).

Thick-billed murre is an uncommon breeder in eastern NL, with approximately 2,000 pairs (EC-CWS unpublished data); most nest much farther north in northern Labrador, Arctic Canada, northwest Greenland, Iceland, Svalbard, and Norway. Following breeding, most of these thick-billed murres, including those from Greenland, Iceland, and Europe, migrate south to winter in the RSA and the Labrador Sea (Frederiksen et al. 2016). However, the core of this wintering area is the Labrador Sea (McFarlane Tranquilla et al. 2015). Thick-billed murres shift latitudes throughout the nonbreeding season; whereas common murres move until October and then remain at that latitude until returning to nesting colonies in May (McFarlane Tranquilla et al. 2015). Female and flightless young swim to areas off Labrador starting in August while some males linger around Baffin Island and northwest Greenland breeding sites before migrating south to NL wintering areas (Frederiksen et al. 2016).

Because the two species of murres are difficult to differentiate at sea, they are generally combined in the ECSAS surveys (Bolduc et al. 2018). During the fall migration and wintering period (December–March) murre densities within the RSA ranged over the mid- and southern Grand Banks to the west and southwest of the Project Area, more than 0.0 birds/km to 3.7 birds/km² on the southern Orphan Basin to the northwest of the Project Area, and more than 0.0 birds/km to 11.3 birds/km² over the Sackville Spur and northern Flemish Pass, including the Project Area (Figure 6-59). During the spring migration and early nesting period (April to July), murre densities were 0.0 birds/km to 5.4 birds/km² over the northern RSA including Orphan Basin, Sackville Spur and Flemish Pass, including the Project Area, and 5.4 birds/km to 20.0 birds/km² over the mid- and southern Grand Banks to the west and southwest (Figure 6-59). During the late nesting and chick-rearing period (August to November), densities were lowest over the Sackville Spur, Flemish Pass, including the Project Area, and Flemish Cap (> 0.0 birds/km to 4.2 birds/km²) and highest over the northern Grand Banks to the west of the Project Area (4.2 birds/km to 14.8 birds/km²) (Figure 6-59). The ECSAS surveys show that common murres are less abundant in winter in the RSA and less widespread, occurring mostly on southern half of the Grand Banks to the southwest of the Project Area. Thick-billed murres are least numerous in the RSA, including the Project Area, from June–September, and most numerous from October to May (Bolduc et al. 2018).

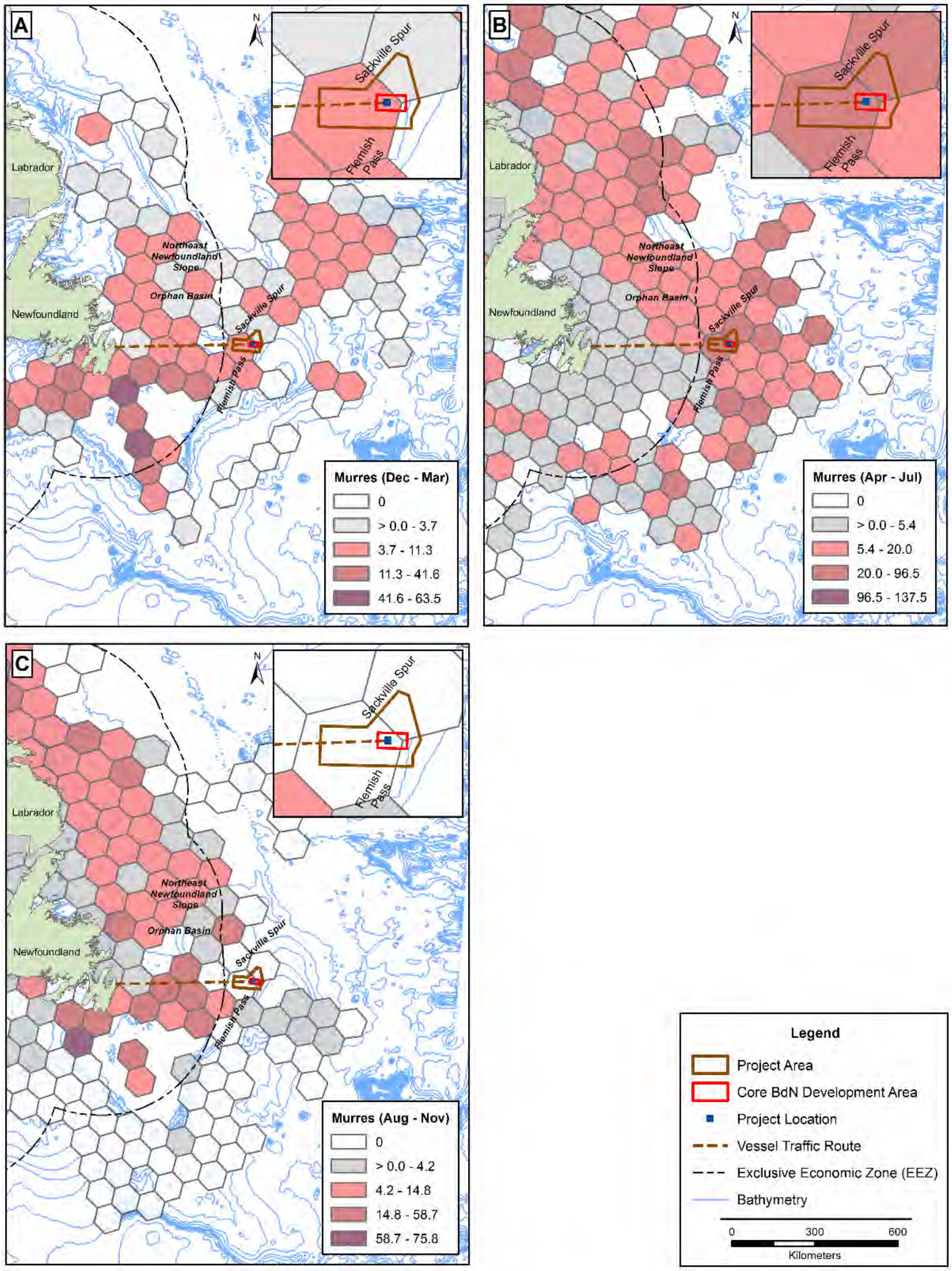

Figure 6-59 Murres Observed Densities, a) Fall Migration and Wintering Period (December to March), b) Spring Migration and Early Nesting Period (April to July), and c) Late Nesting and Chick Rearing Period (August to November) (ECSAS Database, 2006 to 2016)

Razorbill

Approximately 2,000 pairs of razorbills nest in eastern NL (Table 6.38). Razorbills tend to occur closer to shore than the murres and are rarely recorded more than 100 km from land. Most razorbills winter south of NL, especially in Bay of Fundy and southward (Huettman et al. 2005). It was recorded in very low numbers on the ECSAS surveys. It is expected to be a very rare occurrence in the Project Area.

Atlantic Puffin

There are more than 480,000 pairs of Atlantic puffins nesting in eastern NL (Table 6.38). During the breeding season (mid-May to late August) most puffins occur within 100 km of shore. In the non-breeding season, they move farther offshore. Atlantic puffins winter off southern NL and Nova Scotia. Atlantic puffins are not seen offshore in large numbers, so the core winter distribution is not known (Fifield et al. 2009). This species is designated globally Vulnerable on the IUCN Red List (Birdlife International 2018).

Based on the ECSAS survey data (Bolduc et al. 2018), during the fall migration and wintering period (December to March), puffins are found in the RSA only in low densities (>0.0 birds/km² to 1.1 birds/km²) and were not recorded in the Project Area. They were limited to the northern Grand Banks and southern Labrador Sea shelf areas and Orphan Basin (Figure 6-60). During the spring migration and early nesting season (April to July), the survey data shows high concentrations of puffins (7.5 birds/km² to 24.3 birds/km²) adjacent to the Avalon Peninsula and Bonavista Peninsula, where the breeding colonies are located. Therefore, during these times, offshore areas, including the Project Area, have low densities, ranging from 0 birds/km² to 1.6 birds/km² (Figure 6-60). Dispersal from the nesting colonies during the late nesting and chick-rearing period (August to November period) is shown by widespread densities of 0.3 birds/km² to 1.2 birds/km² over the northern half of the Grand Banks, densities of 0.0 birds/km² to 0.3 birds/km² over much of the rest of the RSA and Orphan Basin and Flemish Cap, but no sightings in the Project Area (Figure 6-60).

Black Guillemot

The black guillemot is a common seabird around the coastline of Atlantic Canada. It is a year-round species in NL waters. It is rare beyond 50 km from shore (Butler and Buckley 2002) and not likely to occur in the Project Area. Less colonial than the other alcids, surveying breeding populations is made difficult by their habit of nesting deep in the crevices of cliffs and under boulders.

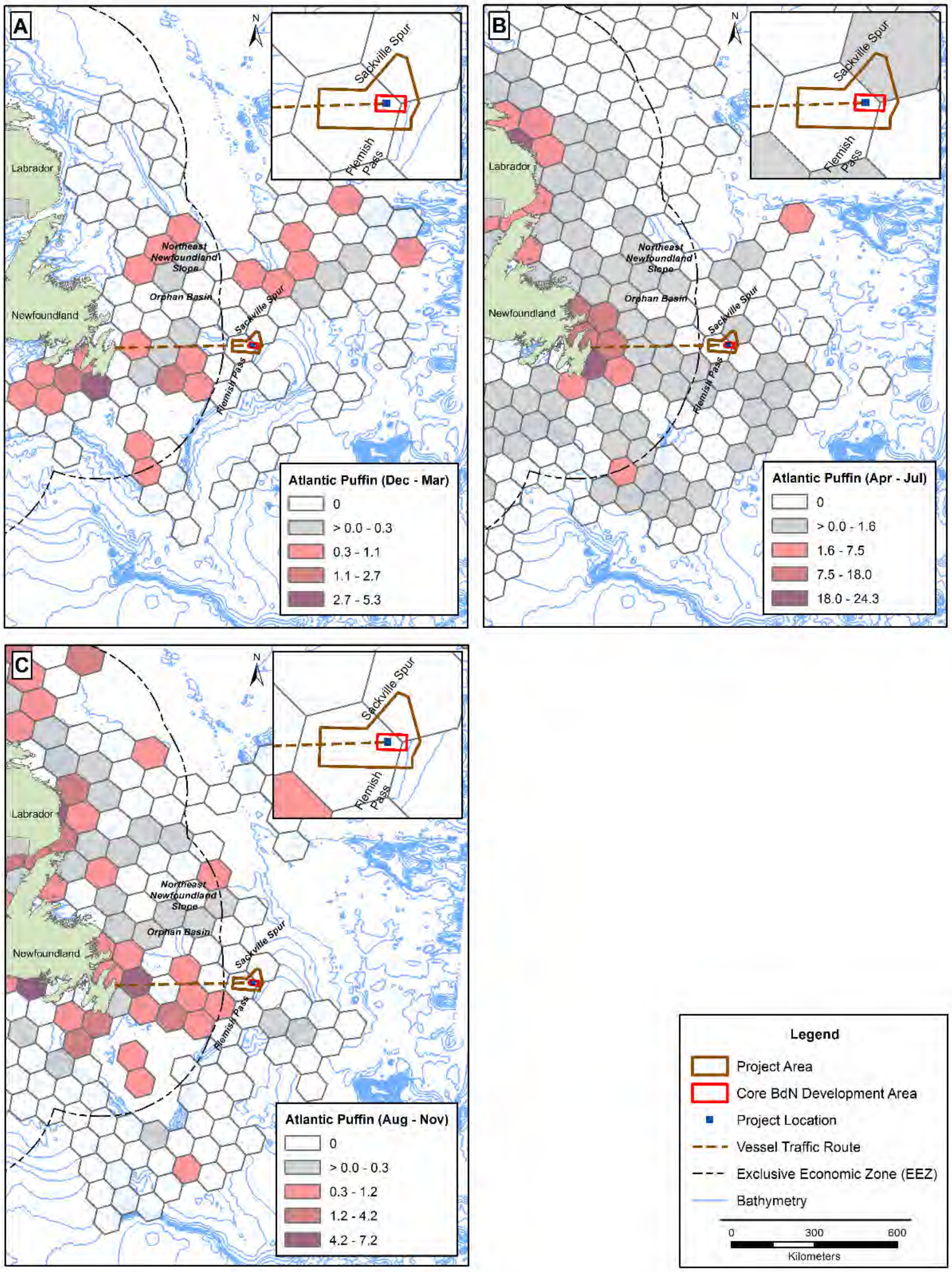

Figure 6-60 Atlantic Puffin Observed Densities, a) Fall Migration and Wintering Period (December to March), b) Spring Migration and Early Nesting (April to July), and c) Late Nesting and Chick Rearing (July to November) (ECSAS Database, 2006 to 2016)

6.2.2.9 Gulls

There are 10 species of gulls found regularly off the coast of eastern NL, six of which are present in high densities at some time of the year. These species can be broken into two groups of gulls: 1) pelagic, i.e., those that spend most of their lives at sea (black-legged kittiwake, ivory and Sabine's gull) and 2) coastal, i.e., those that spend most of their life near shore (ring-billed, herring, great black-backed, glaucous, Iceland, lesser black-backed and black-headed gulls). 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.

In addition to the regularly occurring species of gull, Ross's gull, a very rare species in the north Atlantic and listed as Threatened by COSEWIC and listed on SARA Schedule 1 as Threatened (COSEWIC 2007b) was recorded in the Orphan Basin and the western end of the Project Area through the use of geolocators placed on the birds at a nesting site in the high Arctic on two small islands in Queens Channel, Nunavut (Maftei et al. 2015). The 75 percent occupancy range of one of the three tagged birds included Orphan Basin and the western end of the Project Area. This indicates Ross's gull can occur in the RSA and potentially in or near the Project Area.

Pelagic Gulls

Black-legged kittiwake is an abundant species in the north Atlantic. It is a pelagic gull that goes to land only during the nesting season. Non-breeding sub-adults remain at sea for the first year of life. Black-legged kittiwake nests in large colonies in eastern NL with nearly 40,000 pairs nesting in the RSA (see Table 6.39). They are common year-round in the offshore. A tracking study of black-legged kittiwakes has shown that the northwest Atlantic, and in particular, the shelf edge off NL, is an important wintering area for kittiwakes, with most of the Atlantic population overwintering in this region (Frederiksen et al. 2012). This species is designated globally Vulnerable by the IUCN (Birdlife International 2018). ECSAS surveys show that from December–March, black-legged kittiwakes are widespread over the Labrador Sea, northern Grand Banks, Flemish Pass, Sackville Spur, and Orphan Basin with average densities ranging from 3.8 birds/km² to 35.2 birds/km² (Figure 6-61). As expected, during the nesting season, the highest densities, 2.3 birds/km² to 5.7 birds/km², occurred near shore around the Avalon and Bonavista Peninsula. Densities averaged from 0.7 birds/km² to 3.2 birds/km² (from April to August) over the Labrador Sea, Orphan Basin, Flemish Cap, Sackville Spur (Figure 6-61). During August to November, the kittiwakes have moved away from shoreline breeding sites and highest densities (2.7 birds/km² to 14.7 birds/km²) were recorded over the Labrador Sea shelf and shelf break, as well as Orphan Basin, Flemish Cap, and eastern Grand Banks (Figure 6-61). No kittiwakes were recorded over the Sackville Spur or northern Flemish Pass area during this time period. Kittiwakes were among the most commonly reported species during bird surveys conducted during Equinor Canada exploration activities within the Project Area in the summer and winter months (Statoil 2015a, 2015b).

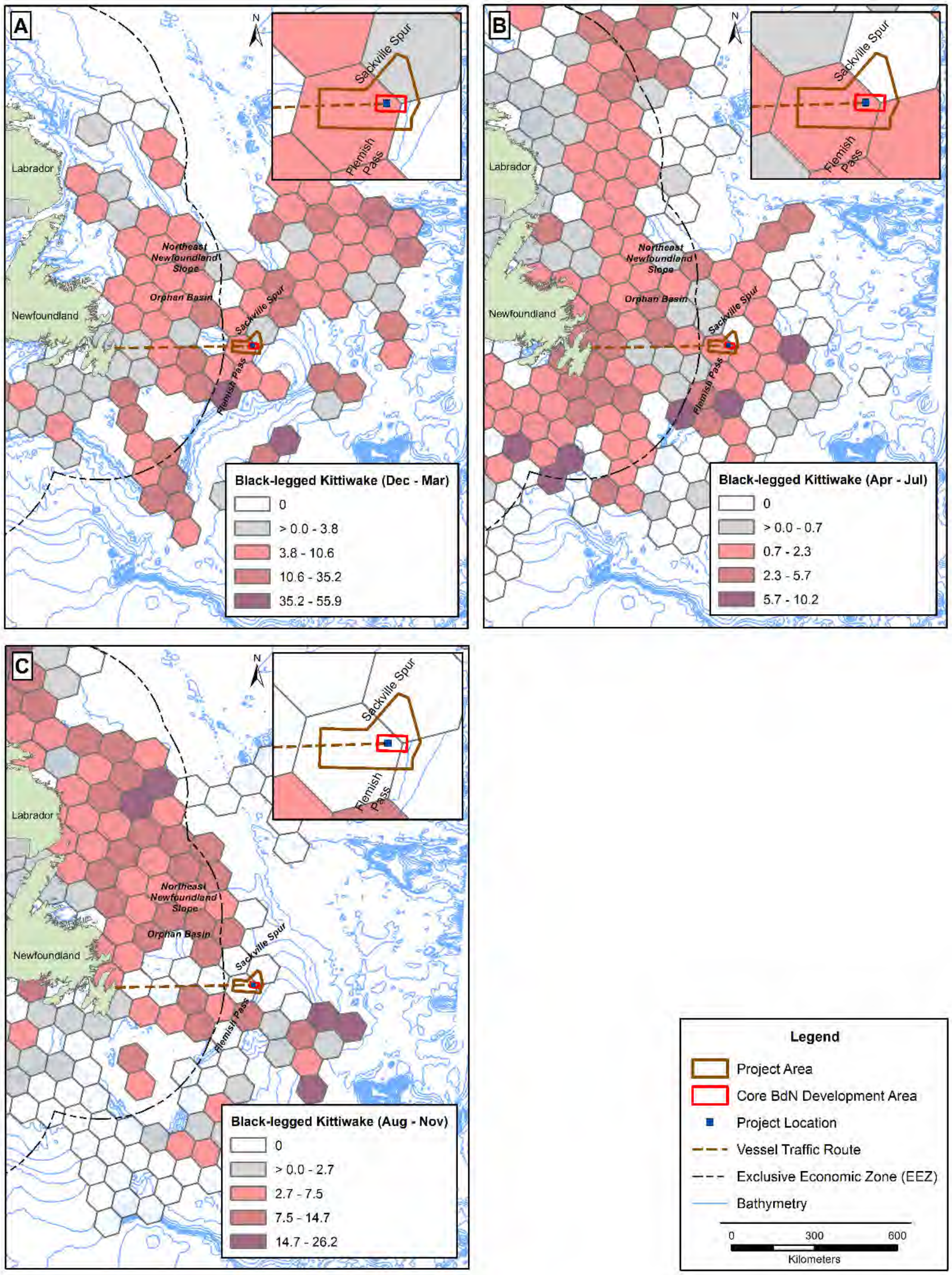

Figure 6-61 Black-legged Kittiwake Observed Densities, a) Fall Migration and Wintering Period (December to March), b) Spring Migration and Early Nesting (April to July), and c) Late Nesting and Chick Rearing (July to November) (ECSAS Database, 2006 to 2016)

Sabine's gull nests in the Arctic and winters in the south Atlantic. The species migrates through the offshore regions of NL (Davis et al. 2016) and has been recorded in small numbers from geophysical survey vessels in the RSA from late May to late September (Moulton et al. 2005, 2006; Abgrall et al. 2008; Mactavish et al. 2012, Jones and Lang 2013; Holst and Mactavish 2014). Ivory gull nests in the Arctic and winters on the pack ice, occurring annually in the RSA on the northeast NL Shelf when the pack ice reaches that area in late winter and early spring (Gilg et al. 2010; Spencer et al. 2016). Ivory gull is listed as Endangered under both the provincial NL ESA and the federal SARA (see Section 6.2.4). 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 an Equinor Canada drilling campaign in the winter months in the Project Area (Statoil 2015a).

Coastal Gulls

Ring-billed gull is a common nesting species in NL, present from April to November and absent in the winter. It is strictly a land-based gull, not venturing offshore except briefly to migrate to and from wintering areas on the east coast of the United States. However, it is occasionally sighted during geophysical surveys (Moulton et al. 2006; Abgrall et al. 2008).

Herring and great black-backed gulls are common, widespread species in eastern Canada. They nest, often in mixed colonies, at numerous locations around the province of NL both on the coast and inland (Table 6.39). They overwinter in NL south of the pack ice. Most great black-backed gulls move at least 50 km offshore following nesting (Good 1998). The Sackville Spur has been identified as an area with a high concentration of large gulls, particularly in late winter and early spring (Fifield et al. 2009). At drilling and production platforms on the northeast Grand Banks during 1999 to 2002, great black-backed gull is common from September–February and nearly absent from March to August (Baillie et al. 2005; Burke et al. 2012). During December to March, great black-backed gulls (1.8 birds/km^2 to 9.8 birds/km^2) and herring gulls (0.9 birds/km^2 to 17.2 birds/km^2) were observed in relatively high densities in the Sackville Spur and northern Flemish Pass, including the Project Area, area in contrast with much lower densities in the Labrador Sea, Orphan Basin and Grand Banks. 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 winter months (Statoil 2015a, 2015b).

Glaucous and Iceland gulls are northern species that include the Canadian Arctic within their breeding range. Both species move south during the winter. Both are common in the coastal waters of NL in the winter season. Small numbers are present in the offshore during the winter season (Bolduc et al. 2018). Small but growing numbers of lesser black-backed gulls from recently established colonies in southwest Greenland are also present in both coastal and offshore areas during migration and winter (Moulton et al. 2006; Abgrall et al. 2008; Hauser et al. 2010; Jones et al. 2012; Mactavish et al. 2012; Jones and Lang 2013; Holst and Mactavish 2014). Black-headed gull is another primarily European gull but has established a very small breeding population in NL. The only sustained breeding colony is 10–15 pairs nesting at Stephenville Crossing on the west coast of NL (Cotter et al. 2012). Small numbers occur around NL during migration periods and winter; this species is seen in the offshore zones on rare occasions (e.g., Hauser et al. 2010).

Table 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Black-legged Kittiwake	Funk Island	12	118	Pair	2017
	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	750	Individual	2015
	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	2015
	Black Head	83	300	Individual	2005
	Bird, South	84	50	Individual	2015
	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 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Black-legged Kittiwake	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	4,658	Pair	2017
	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
	Cape St. Mary's	230	10,000	Pair	10,000
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	250	Individual	2015
	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

Table 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Herring Gull	Black Island, St. Brendan's	58	50	Individual	2005
	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	70	Individual	2015
	Elliston Point Island	82	33	Individual	2015
	Bird, South	84	24	Individual	2015
	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

Table 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Herring Gull	Unnamed I. in St. Jones Harbour	130	50	Individual	2005
	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

Table 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Herring Gull	Hole in the Wall Island	194	50	Individual	2005
	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	175	Individual	2015
	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
	Cape St. Mary’s	230	39	Pair	2011
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	2015
	Butterfly Islets	33	23	Individual	2005
	Big Shag Rock	36	50	Individual	2005
	Main Rock, Greenspond	38	50	Individual	2005
	Horse Island	39	5	Individual	2005

Table 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Great Black-backed Gull	Copper Island	40	50	Individual	2005
	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	51	Individual	2015
	Green Island, Cape Bonavista	73	2	Individual	2015
	Unnamed I. east of Sailors Island	75	50	Individual	2005
	Little Denier Island	78	50	Individual	2005
	Bird, South	84	1	Individual	2015
	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

Table 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Great Black-backed Gull	Ragged Islands, North	104	50	Individual	2005
	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

Table 6.39 Gull Colony Locations in Eastern Newfoundland

Common Name	Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Great Black-backed Gull	East Green Island	186	300	Individual	2005
	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
	Cape St. Mary's	230	7	Pair	2011
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	350	Individual r	2015
	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
	O'Donnells	209	321	Pair	2005
	Biscay Bay Pond	224	23	Pair	2005

Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2017)
[1] Refer to Figure 6-52 for colony locations corresponding to each Colony number.

6.2.2.10 Terns

Three species of tern are found regularly in the waters off NL: common tern, Arctic tern, and Caspian tern. The Caspian tern is less abundant than common and Arctic terns in NL but is known to breed along the south and east coasts (Cuthbert and Wires 1999; Warkentin and Newton 2009). The 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 Tern, which tends to be highly pelagic during migration (Hatch 2002; Nisbet 2002; Cuthbert and Wires 1999). Common and Caspian terns are rarely seen offshore but have been photographed far offshore (Jones et al. 2012; Mactavish et al. 2012; Jones and Lang 2013). Terns feed at or near the water's surface, plunge diving to capture small fish and crustaceans (Cuthbert and Wires 1999; Hatch 2002; Nisbet 2002).

Arctic tern migrates across a very broad front, so densities offshore are very low. During ECSAS surveys they have been observed in the RSA primarily in coastal waters and in warm Gulf Stream waters and not in the Project Area both during the spring migration early nesting period (April to July) and during the late nesting season and chick-rearing period (August to November). They were not recorded in Project Area or the RSA during the fall migration and wintering period (December to March). While most tern sightings could not be identified to species level, both common and Arctic terns have been observed in the waters off eastern NL (Moulton et al. 2006; Hauser et al. 2010; Mactavish et al. 2012; Holst and Mactavish 2014; Bolduc et al. 2018). CWS records for tern colonies in eastern NL are provided in Table 6.40 (species composition of the colonies was not reported).

Table 6.40 Tern Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
Wadham Island, Offer	13	63	Individual	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

Table 6.40 Tern Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
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. 1 km east of Hare Island	61	20	Pair	2005
Unnamed I. northeast of Morris Island	63	198	Pair	2005
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

Table 6.40 Tern Colony Locations in Eastern Newfoundland

Colony Name	Colony #[1]	Colony Size	Survey Unit	Year Surveyed
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
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

Source: Data obtained from Atlantic Canada Colonial Waterbird Database (CWS 2017).
[1] Refer to Figure 6-52 for colony locations corresponding to each Colony #.

6.2.3 Other Marine-Associated Avifauna

Waterfowl occur in large numbers in marine habitats off eastern NL, especially during the winter months (Lock et al. 1994). However, they prefer coastal habitats and are unlikely to occur frequently in the Project Area. Some species of Arctic-nesting shorebirds (plovers and sandpipers) undertake trans-oceanic flights during fall migration from eastern North America to South America (Williams and Williams 1978; Richardson 1979), so some passage offshore through the RSA may be expected. Similarly, migrating landbirds are only expected to be found in the area on a transient basis.

6.2.3.1 Waterfowl and Divers

Waterfowl (ducks, geese and swans) and divers (defined here as 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, the members of these groups prefer coastal areas and are only occasionally seen in the offshore environment. ECSAS data recorded no ducks, geese or swans in the RSA (Bolduc et al. 2018).

The most abundant duck species in coastal NL waters is the common eider, which occurs mainly during late fall, winter and early spring. There are several small localized breeding colonies along the coast (Locke et al. 1994). A total of 32 species of waterfowl, loons, and grebes occur in the province during at least part of the year (Table 6.41), including two species of conservation concern: Barrow's goldeneye and harlequin duck. The long-tailed duck is designated Vulnerable on the IUCN Red List of globally threatened species (Birdlife International 2018).

Table 6.41 Overview of Waterfowl and Divers Occurring in Eastern Newfoundland

Group	Common Name	Time of Occurrence [1]	Abundance [2]
Geese	Canada Goose	Year-round	Common
Dabbling Ducks	Wood Duck	Year-round	Rare
	Gadwall	Year-round	Rare
	Eurasian Wigeon	September–May	Rare
	American Wigeon	Year-round	Scarce
	American Black Duck	Year-round	Common
	Mallard	Year-round	Scarce
	Blue-winged Teal	April–October	Rare
	Northern Shoveler	April–November	Rare
	Northern Pintail	Year-round	Common
	Green-winged Teal	Year-round	Common
Diving Ducks	Ring-necked Duck	March–December	Common
	Tufted Duck	September–May	Scarce
	Greater Scaup	Year-round	Common
	Lesser Scaup	September–May	Scarce
Sea Ducks	King Eider	October–May	Scarce
	Common Eider	Year-round	Common
	Harlequin Duck (Eastern pop.)[3]	Year-round	Scarce
	Surf Scoter	Year-round	Scarce
	White-winged Scoter	Year-round	Common
	Black Scoter	Year-round	Scarce
	Long-tailed Duck[3]	October–May	Common
	Bufflehead	October–May	Scarce
	Common Goldeneye	Year-round	Common
	Barrow's Goldeneye (Eastern pop.)[3]	October–April	Rare
	Hooded Merganser	Year-round	Rare
	Common Merganser	Year-round	Common
	Red-breasted Merganser	Year-round	Common

Table 6.41 Overview of Waterfowl and Divers Occurring in Eastern Newfoundland

Group	Common Name	Time of Occurrence [1]	Abundance [2]
Loons	Red-throated Loon	Year-round	Scarce
	Common	Year-round	Common
Grebes	Pied-billed Grebe	September–April	Rare
	Red-necked Grebe	October–May	Scarce

Source: Lock et al. (1994), Mactavish et al. (2016).
[1] See Section 6.2 for a monthly breakdown of estimated presence.
[2] This 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 species, it is possible that rare sightings of other species not listed here may occur.
[3] See Section 6.2.4.

Common eiders and other sea ducks such as white-winged scoters, surf scoters, black scoters, and long-tailed ducks occur in large flocks (“rafts”) along 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 2018). Concentrations along eastern NL increase in late winter as the winter sea ice forces those flocks along the north coast of the island to move southeastward. The largest concentration of the eastern population of harlequin duck wintering in Canada is found at Cape St. Mary’s (Bird Studies Canada 2018). Small numbers of Barrow’s goldeneye have been reported wintering in eastern NL 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).

The most recent ECSAS data (2006 to 2016) show no waterfowl or divers on-transect in the RSA, primarily because of the low amount of effort spent within 10 NM of the coastline. Individual ducks have been sighted occasionally from geophysical survey vessels well offshore during migration (Abgrall et al. 2008; Jones and Lang 2013; Holst and Mactavish 2014). The older ECSAS dataset summarized in the Drilling EIS (Statoil 2017), also showed that waterfowl observations were scarce in the waters off eastern NL and absent from the Project Area. The most frequently observed species was common eider, followed by long-tailed duck; loons (common and red-throated), scoters (white-winged, surf and black); a small number of other duck species were infrequently observed.

6.2.3.2 Shorebirds

A total of 26 species of plovers and sandpipers occur on and around insular NL as breeders, migrants in passage, or winter residents (Mactavish et al. 2016). The most likely species to occur in the RSA are listed in Table 6.42. Widespread nesting species in the province are spotted sandpiper, Wilson’s snipe, greater yellowlegs, and least sandpiper. Uncommon and local shorebirds nesting in the province are piping plover, semipalmated plover, killdeer, willet, and American woodcock. The other species are present in varying abundances only during migration (Warkentin and Newton 2009).

On the southern and eastern coasts of NL, shorebirds are most abundant during their fall migration, when many species move southward from their Arctic breeding grounds. Based on results from the

ACSS, the east 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 NL include Big Barasway, Grand Bay West to Cheeseman Provincial Park, Codroy Valley Estuary, Cape Freels, and Cape Bonavista (EC 2009; Bird Studies Canada 2018). In the winter months, generally from November–April, purple sandpipers are present along rocky shorelines and offshore ledges and islands of southern and eastern NL, including at Cape Spear, Witless Bay, Ferryland, Cape St. Francis and Mistaken Point in eastern NL (EC 2009; Bird Studies Canada 2018). A small number of ruddy turnstones regularly overwintered at Mistaken Point in the past (Bird Studies Canada 2018).

Table 6.42 Overview of Shorebirds Occurring in Eastern Newfoundland

Group	Common Name	Time of Occurrence [1]	Abundance [2]
Plovers	Black-bellied Plover	June–October	Common
	American Golden-Plover	August–October	Common
	Semipalmated Plover	May–October	Common
	Killdeer	May–October	Rare
Sandpipers	Spotted Sandpiper	May–September	Common
	Solitary Sandpiper	May; August–September	Rare
	Greater Yellowlegs	April–October	Common
	Willet	May–August	Rare
	Lesser Yellowlegs	July–October	Scarce
	Whimbrel	July–September	Common
	Hudsonian Godwit	August–October	Rare
	Ruddy Turnstone	July–November	Common
	Red Knot (*rufa* ssp.)[3]	July–October	Scarce
	Sanderling	May; July–December	Common
	Semipalmated Sandpiper	May; July–October	Common
	Least Sandpiper	May–September	Common
	White-rumped Sandpiper	July–November	Common
	Baird's Sandpiper	August–October	Rare
	Pectoral Sandpiper	August–October	Scarce
	Purple Sandpiper	October–May	Common
		August–November	Scarce
	Buff-breasted Sandpiper[3]	August–October	Rare
	Short-billed Dowitcher	May; July–September	Scarce
	Wilson's Snipe	April–November	Common

Source: Based on ACSS Data and Mactavish et al. (2016).
[1] See Section 6.2 for a monthly breakdown of estimated presence. [2] This 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 species, it is possible that rare sightings of other species not listed here may occur. [3] See Section 6.2.4.

Marine shoreline habitats such as sandy mudflats and coastal barrens are used by foraging shorebirds during migration. During fall migration, shorebird species such as American golden-plover, whimbrel, semipalmated sandpiper, white-rumped sandpiper, and red knot depart from staging sites in Atlantic Canada southward over the Atlantic Ocean to South America (Morrison 1984; Harrington et al. 1991; Baker et al. 2013). At least seven species of shorebirds, including red knot and buff-breasted sandpiper, have been sighted far offshore in small numbers from geophysical survey and oil industry supply vessels (Moulton et al. 2005; Abgrall et al. 2008; Hauser et al. 2010; Jones and Lang 2013; Holst and Mactavish 2014). However, most individuals undertaking this trans-oceanic migration appear to pass to the west of the Project Area (Baker et al. 2013; Lamarre et al. 2017) and at relatively high altitudes (Burger et al. 2011). Consequently, only small numbers may be expected near sea level in the Project Area during fall migration (primarily July to October).

6.2.3.3 Landbirds

Many species of land-based birds nest in NL. In spring and fall, the majority of species migrate between NL and wintering areas farther south. During migration, landbirds can be displaced from established migration routes by weather, inexperience or some other orientation error and may end up at sea off the east coast of NL. Ships and offshore installations at sea may offer a brief refuge for birds in need of a rest from flying but do not offer options for food. Typically, landbirds do not stay long on a vessel and move on. Other birds may be too exhausted to fly elsewhere and expire on board. Migratory landbird species in NL have the potential to end up on an offshore vessel in eastern NL waters.

Some 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; Statoil 2015a, 2015b; migratory bird salvage reports provided in Statoil 2017). 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 or IUCN as species of conservation concern (SOCC) are likely to occur in the Project Area or Regional Study Area (Table 6.43, Table 6.44).

Table 6.43 Avian Species at Risk and their Likelihood of Occurrence In, or Near the Project Area

Common Name	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 NL may support nesting harlequins (Bird Studies Canada 2018) • Although they breed inland, harlequin duck occurs in the coastal marine environment throughout the fall and winter months along rocky coastlines, subtidal ledges, and exposed headlands. The largest wintering concentration occurs at Cape St. Mary's with 636 present on a 2013 survey (EC 2013). 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 2018; DOEC 2016a)	Unlikely to be present due to their preference for coastal habitats; however, a female or immature harlequin duck was observed flying past a geophysical vessel on the southern Orphan Basin in September 2016 (Lang 2016)

Table 6.43 Avian Species at Risk and their Likelihood of Occurrence In, or Near the Project Area

Common Name	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
Ivory gull	Endangered	Endangered (Schedule 1)	Endangered	• Breeds in the far north • Winters offshore, occurring in small numbers on the northeast NL Shelf, where they are found with or near pack ice • Rarely seen on the coast of the Northern Peninsula and ashore (Stenhouse 2004; DOEC 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).
Ross's gull	None	Threatened (Schedule 1)	Threatened	• Known to nest in very small numbers at a few locations in Arctic Canada with most of the world population nesting in Arctic Russia (COSEWIC 2007b). • Geolocators placed on Ross's gulls at a nesting site in the high Arctic of Nunavut showed that some of them spent October–May in the Labrador Sea as far south as 50°N. One bird's track showed it within Orphan Basin and followed the shelf edge close to the Sackville Spur (Maftei et al. 2015).	Maftei et al. (2015) indicates Ross's gull can occur at least occasionally in the northern part of the RSA and very close to or in the Project Area.

Table 6.43 Avian Species at Risk and their Likelihood of Occurrence In, or Near the Project Area

Common Name	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
Piping Plover (*melodus* ssp.)	Endangered	Endangered (Schedule 1)	Endangered	• During the nesting season, piping plovers are found on sandy beaches along the coast • In NL, breeding population is concentrated in the southwest and western portions of the Island (DOEC 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 2018). However, in 2013, breeding was reported at Deadman's Bay near the Cape Freels Coastline IBA in northeastern NL • Piping plovers are unlikely to be affected by typical project activities, although accidental spills near breeding habitat could potentially be harmful	Unlikely to be present due to their preference for coastal habitats.
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 1 to October 30 (Garland and Thomas 2009; DOEC 2016a) • NL is not considered to be a major stopover location; nonetheless, sightings have been reported around almost the entire coast of NL, mostly on the west coast (Baker et al. 2013) • In Atlantic Canada Shorebird Survey, it is considered regular or occasional species during fall migration at Bellevue Beach, Cape Freels, and around the Codroy Valley Estuary, and it is a rare visitor at a number of other survey sites (EC 2009)	Unlikely to be present due to their preference for coastal habitats: however, a vagrant red knot rested on geophysical vessel working in Flemish Pass in September 2012 (Jones and Lang 2013).

Table 6.43 Avian Species at Risk and their Likelihood of Occurrence In, or Near the Project Area

Common Name	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
Buff-breasted sandpiper	none	none	Special Concern	• Arctic breeders; during fall migration, considered to be a rare migrant in the province (COSEWIC 2012f) • 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 (EC 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 (EC 2009)	Red-necked phalaropes are seen in small numbers during ECSAS surveys, although they are scarce in the winter and spring (Bolduc et al. 2018).
Peregrine Falcon	Vulnerable	Special Concern (Schedule 1)	Special Concern	• Migrates along the coast of NL 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 frequently; however, vagrants are regularly observed around offshore production platforms, and geophysical and supply vessels in (e.g., Moulton et al. 2006; Lang et al. 2008;).

Table 6.43 Avian Species at Risk and their Likelihood of Occurrence In, or Near the Project Area

Common Name	Provincial Status	Federal Status		Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
		SARA Listing	COSEWIC Assessment		
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 NL • 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 NL, 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

Table 6.44 Marine Bird Species Designated at Risk on the IUCN Red List but not Federally or Provincially

Common Name	IUCN Red List Status[1]	Habitat and Distribution in Newfoundland	Potential Presence in or Around Project Area
Long-tailed Duck	Vulnerable	Coastal waters	Low
Bermuda Petrel	Endangered	Grand Banks and waters to the south and east[2]	Low
Zino's Petrel	Endangered	Warm waters off the continental shelf[3]	Low
Desertas (Bugio) Petrel	Vulnerable	Warm waters off the continental shelf[3,4]	Low
Leach's Storm-Petrel	Vulnerable	Continental shelf and adjacent waters	High
Black-legged Kittiwake	Vulnerable	Continental shelf and adjacent waters	High
Atlantic Puffin	Vulnerable	Continental shelf	Low
[1] BirdLife International (2018), [2] Madeiros et al. (2014), [3] Ramos et al. 2016, [4] Ramirez et al. 2013.			

Ivory gull (SAR) is found almost exclusively in marine environments and is highly associated with pack ice. It nests in the high Arctic and winters on pack ice regularly as far south as northeast NL. It therefore is more likely to be found in the northern reaches of the RSA and Project Area where pack ice can occur (refer to Section 5.5 for specific information on pack ice extents within the Project Area) (Statoil 2015a). Ross's gull (SAR) was recently discovered in winter off northeastern NL and has potential to occur in the Project Area. Two waterfowl SAR, Barrow's goldeneye and harlequin duck, occur in coastal waters of the RSA, particularly outside of the breeding season. Like other waterfowl species, they are considered unlikely in the Project Area because they prefer coastal areas. However, a harlequin duck was seen in Orphan Basin from a geophysical survey vessel in September 2016 (Lang 2016). Red-necked phalaropes, assessed by COSEWIC as a SOCC were seen in small numbers during ECSAS surveys in the RSA, including the Project Area, from April to December. A red-necked phalarope tagged with a geolocator in Scotland migrated through the RSA, indicating that the RSA may be within the regular migration route for this species (Smith et al. 2014). Peregrine falcon and short-eared owl are landbird species but have been recorded on ships at sea off the east coast of NL during migration. The other avian SARs listed in Table 6.43 are shorebirds and landbirds and are unlikely to be found in the Project Area except as transients during fall migration (July to November).

The marine and migratory bird species, with proposed and finalized action plans and recovery strategies, that may interact with the Project are: ivory gull (EC 2014), piping plover (*melodus* subspecies) (EC 2012), red knot (*rufa* subspecies) (ECCC 2017), roseate tern (EC 2010a, 2015), common nighthawk (EC 2016a), and olive-sided flycatcher (EC 2016b).

SAR that do not inhabit the offshore environment or only fly over the ocean during migration are listed below (Table 6.45).

Table 6.45 Migratory Bird Species at Risk Unlikely to Occur Offshore

Common Name	Provincial Status[1]	SARA[2]	COSEWIC Assessment[2]
Common Nighthawk	Threatened	Threatened (Schedule 1)	Threatened
Chimney Swift	Threatened	Threatened (Schedule 1)	Threatened
Bank Swallow	none	None	Threatened
Barn Swallow	none	Threatened (Schedule 1)	Threatened
Olive-sided Flycatcher	Threatened	Threatened (Schedule 1)	Threatened
Gray-cheeked Thrush	Threatened	none	Candidate Species (low priority)
Bobolink	Vulnerable	none	Threatened
Rusty Blackbird	Vulnerable	Special Concern (Schedule 1)	Special Concern
Newfoundland Red Crossbill	Endangered	Threatened (Schedule 1)	Endangered

[1] www.flr.gov.nl.ca/wildlife/endangeredspecies/birds.html
[2] www.sararegistry.gc.ca/status/status_e.cfm

6.2.5 Important Bird Areas of Newfoundland

Areas of importance to the survival of bird species may be given the designation of IBA (Section 6.4.4) (IBA 2016). 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 SAR, 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 NL and 11 of these are located within the RSA. These are summarized in Table 6.46, with further information and associated mapping in Section 6.4 (Special Areas).

Table 6.46 Important Bird Areas in Eastern Newfoundland

IBA Name	Importance to Marine and Migratory Birds
Funk Island (NF004)	• 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.

Table 6.46 Important Bird Areas in Eastern Newfoundland

IBA Name	Importance to Marine and Migratory Birds
Wadham Islands and adjacent Marine Area (NF013)	• 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)	• 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 ECCC-CWS surveys.
Terra Nova National Park (NF017)	• Numerous forest species nest here, including two subspecies with restricted ranges: the federally-listed NL red crossbill (*percna* ssp.) and ovenbird (*furvoir* ssp.). • Shorebirds, gulls and waterfowl can be seen on the tidal flats at the outlet of Big Brook, as well as Newman Sound. • At least six tern colonies (common and Arctic tern), totaling between 1000 and 1500 pairs. Also a federally designated Migratory Bird Sanctuary (MBS) and National Park.
Grates Point (NF019)	• 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)	• 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)	• Winter congregation area for common eider; up to 5000 individuals recorded. • Purple sandpipers regularly observed along the rocky shoreline in the winter
Quidi Vidi Lake (NF022)	• Important daytime resting site for gulls from late fall to early spring, including significant numbers of herring, great black-backed, Iceland, glaucous, and black-headed gulls. • Locally rare mew gull and lesser black-backed gull occasionally reported. • Waterfowl including American black duck, mallard, and northern pintail are common here in the winter, subsisting on food handouts from people.
Mistaken Point (NF024)	• Important wintering area for up to 12,000 common eiders • Continentally significant numbers of wintering purple sandpiper (more than1 percent of North American population). • 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 6.46 Important Bird Areas in Eastern Newfoundland

IBA Name	Importance to Marine and Migratory Birds
Witless Bay Islands (NF002)	• Provincially designated Seabird Ecological Reserve. • Globally significant numbers of breeding seabirds, including more than half of the eastern North American population of Atlantic puffin and almost 10 percent of the global Leach's storm-petrel population. • Large numbers of nesting common murre, black-legged kittiwake and herring gull. • Great black-backed gull, northern fulmar, thick-billed murre, razorbill, and black guillemot 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.
Cape Pine and St. Shotts Barren (NF015)	• Large, possibly globally significant numbers of American golden-plover during their fall migration (August to mid-October). • Dozens of whimbrel during fall migration.

There are three Migratory Bird Sanctuaries (MBSs) in the eastern NL region: 1) Terra Nova MBS, which is also an IBA, 2) the Shepherd Island MBS, and 3) Île aux Canes MBS, which are part of the Bell Island South Coast IBA (Table 6.46). Provincially, there are also numerous protected Wilderness and Ecological Reserves, including seven designated Seabird Ecological Reserves, five of which are located in eastern NL (DOEC 2016b). Many of these sites, including Witless Bay, Lawn Bay (which includes Middle Lawn Island), Baccalieu Island, and Funk Island, are also IBAs (see Table 6.46). Helicopter flight paths and OSV traffic routes will avoid passing within 300 m of established migratory bird nesting colonies during the nesting period (May 1 to Aug 31; Sept 30 for northern gannet colonies) and will adhere with provincial *Seabird Ecological Reserve Regulations, 2015* and in consideration of federal guidelines in order to reduce disturbance to colonies (see Chapter 10).

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 6.47 provides a summary of key relevant characteristics of the four EBSAs that were identified as possessing important attributes pertaining to seabirds.

Table 6.47 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.
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 Large Ocean Management Area (LOMA).
Eastern Avalon Coast	• A diverse assemblage of seabirds feeds within this EBSA during the breeding season, from spring to fall.

Further information of these areas and associated mapping is provided in Section 6.4 (Special Areas).

6.2.6 Summary of Marine and Migratory Birds in the Project area

The coastline of eastern NL 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 (Barrett et al. 2006; Fort et al. 2012, 2013). Coastal 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). Marine-associated birds in the Project Area can be roughly divided into 1) seabirds (petrels and relatives, gannets, cormorants, phalaropes, skuas and jaegers, auks and relatives, gulls, and terns), 2) waterfowl (ducks, geese, and swans) and divers (loons and grebes), and 3) shorebirds (plovers and sandpipers). These groups are regarded as the most vulnerable to perturbation because they spend much of their life in the marine environment.

Among the fulmarine petrels, shearwaters and storm-petrels, northern fulmar forages in the Project Area year-round, primarily along the continental shelf slope, using foraging strategies such as dipping, surface-seizing, surface-plunging, pursuit-diving (to 3 m), and scavenging (Mallory et al. 2020). It feeds primarily on Atlantic cod, capelin, herring, sand lance, rockfishes, lanternfishes, various squid species, cuttlefish, octopus, amphipods, copepods, mysids, decapods, krill, isopods, cumaceans, polychaetes, sea butterflies, and cnidarians (Mallory et al. 2020). Great shearwater occupies the Grand Banks and shelf slope waters, including the Project Area, during summer, utilizing plunge-diving and pursuit-diving to 2 m depth, as well as surface-seizing (Ronconi et al. 2010). This species feeds on fish including capelin and mackerel, squid (especially northern shortfin squid), and crustaceans (Brooke 2004), This species and sooty shearwater are the primary avian fish consumers in the northwest Atlantic during the northern hemisphere summer (Barrett et al. 2006). Sooty shearwaters forage on the Grand Banks in large numbers, and in the Project Area in small numbers, during the summer, using pursuit-diving and plunge-diving to depths of 30-40 m, surface-seizing, and hydroplaning (low flight over the water while filtering surface layer) (Carboneras et al. 2020, Weimerskirch and Sagar 1996). This species feeds on schooling fish such as spawning capelin and herring, northern shortfin squid, and crustaceans such as krill (Brown et al. 1981, Brooke 2004, Ronconi et al. 2010). Northern fulmar and these two species of shearwaters are not regularly preyed upon at sea but may occasionally be taken by large fish, seals, or bald eagle (coastal only), and are subject to kleptoparasitism by skuas and jaegers. Most of the world's population of great shearwater spends the northern summer on the Grand Banks and its slopes, including the Project Area. Millions of Leach's storm-petrels nesting in Newfoundland commute to the continental shelf slope, including the Project Area from late-May to mid-November to feed at night on mesopelagic prey that undertake diel vertical migrations. This species forages while hovering low over the water and picking up prey from the surface, occasionally while pattering its feet on the surface (Pollet et al. 2019). It feeds mainly on vertically migrating lanternfish, mysids, and decapods, and, to a lesser extent, sand lance and amphipods (Steele and Montevecchi 1994; Hedd et al. 2006, 2009; Pollet et al. 2019). After the young Leach's storm-petrels fledge from their nests and the adults abandon the nesting colonies (peaking mid-September to mid-October), fledglings and adults may also pass through the oil fields on their way to the continental shelf slope, including the Project Area, to begin their migration. Great black-backed and herring gull are responsible for most predation of Leach's storm-petrels, primarily at the nesting colonies, but fish may take smaller numbers at sea (Pollet et al. 2019). Wilson's storm-petrel is in the Project Area during summer and has a foraging strategy similar to that of Leach's storm-petrel, also occasionally shallow-diving (Drucker et al. 2020). Its prey species are primarily planktonic crustaceans, especially krill, as well as small fish, squid, polychaetes, gastropods, and carrion (Drucker et al. 2020).

Northern gannet forages in coastal waters of the RSA during the breeding season, rarely occurring in the Project Area even during migration. Its foraging strategy consists of plunge-diving to depths of 3 m sometimes followed by pursuit-diving to 20 m to capture schooling fish and squid (Mowbray 2020). This species feeds primarily on mackerel, northern shortfin squid, capelin, and herring (Mowbray 2020). It also preys on Atlantic saury, post-smolt Atlantic salmon, sand lance, and flounders. Northern gannet is rarely preyed upon at sea but is occasionally taken by large fish species or seals. This species spends relatively little time on the surface, so it has a lower probability of encountering hydrocarbons than surface-diving species.

Double-crested cormorant is limited to coastal waters (<5 km from land) and does not normally occur in the Project Area. It uses pursuit-diving in water <10 m deep (Dorr et al. 2020). This species preys mainly on slow-moving or schooling species of fish. In marine waters bald eagle preys on cormorants. Great cormorant also forages in coastal waters of the RSA year-round and would occur in the Project Area only as an accidental vagrant. Its foraging strategy consists primarily of pursuit-diving in waters that are usually no more than 20 m in depth (Hatch et al. 2020a). It feeds primarily on benthic fish but also on pelagic schooling fish such as capelin and sand lance. Predation on great cormorant has not been studied in North America, but probably involves the same predator species as for double-crested cormorant. Since these species' foraging strategy consists surface-diving, it spends more time on the water than fulmars and related species.

Red-necked and red phalaropes migrate through the RSA and PA in spring and fall. They feed at ocean fronts by surface-seizing copepods, krill, other crustaceans, mollusks, polychaetes, gastropods, and fish eggs (Rubega et al. 2020, Tracy et al. 2020). They sometimes feed in association with marine mammals. Predation on phalaropes at sea is poorly known.

Great skua is present in the RSA well offshore, including the Project Area, from late summer and fall to early spring and south polar skua is present in summer and early fall. Their diet at this time of year is largely unstudied but probably includes fish such as sand lance caught via surface-plunging, kleptoparasitism on other seabird species, and scavenging (Furness et al. 2020a,b). They also prey on other seabird species such as black-legged kittiwake, Atlantic puffin, and Leach's storm-petrel. The skuas' relatives, the three jaeger species, migrate through the RSA and Project Area, during spring and fall. In marine waters they feed on fish captured by surface-seizing, dipping (in flight to peck at surface items), kleptoparasitism, scavenging, and, in pomarine jaeger, by surface-plunging and plunge-diving (Haven Wiley and Lee 2020a,b,c). However, pomarine jaeger is rarely observed feeding during migration. Long-tail jaeger also feeds on invertebrates. There are no known predators of skuas or jaegers at sea.

Alcids forage by surface-diving. Dovekie is present in very large numbers offshore, including the Project Area, in fall and winter, feeding to depths of 30 m on copepods, krill, amphipods, and young capelin (Montevecchi and Stenhouse 2020). Common murre is present in the RSA in very large numbers from spring to fall primarily close to the nesting colonies, but only in relatively small numbers in the Project Area from fall to early spring, whereas thick-billed murre is present in very large numbers, especially on the continental shelf slope (including the Project Area), primarily from fall to early spring. Common murre usually dives to 20-50 m but occasionally up to 180 m (Ainley et al. 2020). It feeds on capelin, Atlantic cod, rockfish, herring, sprat, sand lance, krill, large copepods, and squid. Thick-billed murre dives primarily to 7-31 m but occasionally as deep as 210 m (Gaston and Hipfner 2020). Off Newfoundland it feeds on capelin, arctic cod, squid, krill, and amphipods.

Black guillemot is in the RSA year-round in inshore waters, foraging in water < 35 m deep (Butler et al. 2020). It does not occur in the Project Area except as an accidental vagrant. It feeds primarily on bottom-dwelling prey including herring, cods, sand lance, sculpins, mysids, and amphipods, with smaller quantities of other invertebrate taxa. Atlantic puffin is abundant in coastal waters during the breeding season but is rare in the Project Area even during spring and fall migration. This species dives to depths of less than 70 m, feeding on capelin, sand lance, Arctic cod, polychaetes, pteropods, crustaceans, and northern shortfin squid (Lowther et al. 2020). Predators of alcids at sea include large gull species, skuas, peregrine falcon and bald eagle in coastal waters, and, in pack ice (including in the Project Area) gyrfalcon and snowy owl. Because alcids use their wings for underwater propulsion, their wing structure has evolved as a compromise between aerial and underwater flight. As a result, their wing area is small in relation to body mass and flight is energetically expensive. In contrast to most seabird species that search for food while in flight, alcids make foraging bouts (dives) from a resting position on the sea surface.

Large numbers of gulls are present in coastal waters of the RSA near breeding colonies in spring and summer and, in fall and winter, are also concentrated on the continental shelf slope, including the Project Area. Black-legged kittiwake is the only gull in regionally significant densities offshore, including the Project Area, in winter foraging by surface-plunging, surface-seizing, and surface-dipping (Hatch et al. 2020b). This species feeds primarily inshore on capelin during the breeding season, and offshore at other times of the year on sand lance, lanternfish, krill, amphipods, polychaetes, and squid. Great black-backed, herring, and ring-billed gulls are coastal, with the exception of some great black-backed gulls offshore, including the Project Area, during fall migration. Small numbers of large gulls may also be present in winter in the Project Area. These species feed by surface-seizing, surface-dipping, surface-diving, shallow plunge-diving, scavenging, and kleptoparasitism, foraging in pelagic, shallow subtidal, and intertidal zones (Good 2020, Nisbet et al. 2020a, Pollet et al. 2020). They are generalist predators and scavengers, feeding on capelin, Atlantic cod, Atlantic tomcod, alewife, mackerel, herring, Leach's storm-petrel, Atlantic puffin, seabird nestlings and eggs, northern shortfin squid, crabs, shrimps, lobster larvae, bivalves, whelks, fishery waste, sewage, and garbage. In fall migration large numbers of great black-backed gulls gather at platforms in Offshore NL to forage nocturnally on fish attracted to the surface by platform lighting (Montevecchi et al. 1999; LGL 2017). The primary predator of gulls in marine waters is bald eagle (coastal areas only).

Common and Arctic terns are present in the coastal of the RSA during the breeding season and the latter species is present offshore, including the Project Area, during spring and fall migration. They feed by plunge-diving, diving-to-surface, and surface-dipping to capture primarily small, schooling fish species such as herring, gadids, sand lance, capelin, as well as smaller quantities of amphipods and other crustaceans (Hatch et al. 2020c, Nisbet et al. 2020b). They dive to depths of < 1 m. Predators of these tern species at sea is unknown, but they are subject to kleptoparasitism by gulls, skuas, and jaegers. Terns rarely alight on water, so their only contact with water is through foraging.

Waterfowl and divers are present in coastal areas of the RSA primarily during migration and winter and occur in the Project Area only as accidental vagrants. The waterfowl species most important in the ecology of these coastal waters include common eider, long-tailed duck, scoters, common goldeneye, and red-breasted merganser. They feed by surface-diving, primarily to depths of 5 to 20 m. With the exception of mergansers, these species capture benthic mollusks, crustaceans, and gastropods, or on epibenthic amphipods, mysids, and isopods (Brown and Fredrickson 2020, Eadie et al. 2020, Goudie et al. 2020, Robertson and Savard 2020). Red-breasted merganser dives to depths of 2 to 9 m to capture small fish such as sand lance, and crustaceans (Craik and Titman 2020). Species of conservation concern harlequin duck forages in fall and winter in intertidal and subtidal waters on crabs and amphipods (Robertson and Goudie 2020). Predators of waterfowl at sea include bald eagle, peregrine falcon, and gyrfalcon. Divers (loons and grebes) occupy coastal waters of the RSA during fall and winter. They surface dive in subtidal water < 20 m deep to forage on fish including eel and herring, and crustaceans such as shrimp (Evers et al. 2020; Stout and Nuechterlein 2020). Predation on divers in marine waters is infrequent but may be due to bald eagle and sharks. Like alcids, waterfowl and divers spend most of their time on the sea surface, so have a greater chance of encountering hydrocarbons than more aerial species.

Shorebirds are present in the RSA along coastlines primarily during fall migration or, in purple sandpiper, during winter. They occur in the Project Area only as trans-oceanic migrants in passage (primarily in fall) and rarely, if ever, land on the sea surface. The coastal species forage primarily in the intertidal zone. Some species forage by surface-seizing whereas others feed by probing the substrate with their bills. Semipalmated plover, white-rumped sandpiper, and purple sandpiper feed on polychaetes, annelids, amphipods, isopods, decapods, bivalves, gastropods, copepods (Nol and Blanken 2020, Parmelee 2020, Payne and Pierce 2020). Their primarily predators are merlin, peregrine falcon, and gyrfalcon. These species forage on foot on shorelines, so they have the potential to encounter hydrocarbons that reach shorelines.

6.2.6.1 Summary of Key Areas and Times for Marine and Migratory Birds

While seabirds occur in the Project Area, the LSA, and the RSA, the abundance and distribution of species varies considerably (Table 6.48). Some taxa, notably kittiwake, some alcid species, and fulmar are abundant year-round (Lock et al. 1994; Fifield et al. 2009). Others are scarce or absent in the winter months, such as the shearwaters, storm-petrels, northern gannet, terns and phalaropes (Lock et al. 1994; Fifield et al. 2009. Dovekie, thick-billed murre, and ivory gull are most likely to be present in the winter months. 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 Project Area is outside of the reported foraging range of most species breeding at the major seabird colonies in coastal NL, except for Leach's storm-petrel (Lock et al. 1994; Garthe et al. 2007a,b; Pollet et al. 2014; Hedd et al. 2018).

Table 6.48 Summary of Marine and Migratory Birds Presence in the LSA and RSA

	January	February	March	April	May	June	July	August	September	October	November	December
Great and Double-crested Cormorant	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce
Northern Gannet	Present	Present	Common	Common	Common	Common	Common	Common	Common	Common	Common	Present
Phalaropes	Scarce	Scarce	Absent	Absent	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce
Large Gulls	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common
Ivory Gull [1]	Scarce	Scarce	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Scarce	Scarce
Black-legged Kittiwake	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common
Terns	Absent	Absent	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Absent	Absent	Absent	Absent
Dovekie	Common	Common	Common	Common	Present	Present	Present	Present	Present	Present	Common	Common
Atlantic Puffin	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present
Black Guillemot	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce
Common Murre	Common	Common	Common	Common	Common	Common	Common	Common	Flightless	Flightless	Common	Common
Thick-billed Murre	Common	Common	Common	Common	Common	Common	Common	Common	Flightless	Flightless	Common	Common
Razorbill	Present	Present	Present	Present	Present	Present	Present	Present	Present / Flightless	Flightless	Present	Present
Jaegers and Skuas	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present
Fulmars and Shearwaters	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common	Common
Storm-Petrels	Present	Present	Common	Common	Common	Common	Common	Common	Common	Common	Present	Present
Waterfowl	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce	Scarce
Migratory Landbirds and Shorebirds	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Scarce	Scarce	Scarce	Absent

Notes: [1] Denotes Species at Risk
- Absent in Project Area and RSA
- Scarce in Project Area and RSA
- Present in Project Area and RSA
- Common in Project Area and RSA
- Flightless birds (dependent young and/or moulting adults) at sea, potentially in Project Area and RSA

In the summer months, the greatest abundance of seabird species breeding in NL is concentrated around nesting colonies in the western RSA. 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, albeit spread over hundreds of square kilometres including the Project Area, during the breeding season. Sub-adult fulmars and 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-petrel and migrating landbirds (e.g., passerines, which tend to be nocturnal migrants). Leach's storm-petrel is the most common species of seabird stranding drilling and production installations and OSVs offshore in September and October, following the departure of fledglings from nearby breeding colonies (Huntington et al. 1996). The area between Flemish Cap and the mid-Atlantic Ridge, in the eastern half of the RSA, is an important staging area for migrating pelagic seabirds (Egevang et al. 2010; Boertmann 2011; Sittler et al. 2011; Frederiksen et al. 2012; Bennison and Jessopp 2015; van Bemmelen et al. 2017).

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 NL (Fort et al. 2012, 2013). A recent tracking study of black-legged kittiwakes has shown that the northwest Atlantic, especially the shelf edge off NL, 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 murre and approximately a third of the region's thick-billed murres overwinter in the waters off eastern NL (McFarlane Tranquilla et al. 2013).

6.3 Marine Mammals and Sea Turtles

Marine mammals and sea turtles are present at various times of the year in many areas off eastern NL. They 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. The focus of the description that follows is on the Project Area as it is within this area that operational Project-environmental interactions will primarily occur. Note that the Core BdN Development Area is located within the Project Area. Where relevant, based on the highly mobile nature of marine mammals and sea turtles as well as the regional nature of the sources of marine mammal and sea turtle baseline data used herein, the description of the existing biological environment generally also includes the larger RSA (see Section 4.1).

6.3.1 Approach and Key Information

General life history and habitat information for marine mammals and sea turtles has been recently described in the Eastern Newfoundland SEA (Section 4.2.3 of Amec 2014a) and project-specific geophysical and exploration drilling EAs off NL's east coast (e.g., Section 4.5 of LGL 2015, 2016; and Section 6.3 of Statoil 2017). An overview of marine mammals and sea turtles that occur in or near the Project Area, based primarily on the above cited documents, is provided below. Where relevant, updated information not previously included in the SEA and project-specific EAs is summarized, including a literature review of relevant government reports (e.g., COSEWIC assessment and status reports, Canadian Science Advisory Secretariat (CSAS) documents), available technical reports, and peer-reviewed publications. The Environmental Studies Research Fund (ESRF) draft report *Acoustic Monitoring Along Canada's East Coast: August 2015 to July 2017* provides insight into cetacean occurrence in the Project Area, particularly during the winter period when data are lacking (Delarue et al. 2018). This study involved the collection of marine mammal vocalization data by 20 acoustic recorders deployed at locations extending from northern Labrador to the southwestern Scotian Slope over a two-year period. The closest acoustic recorder to the Project Area (i.e., approximately 13 km to the northwest) was located at the Sackville Spur in approximately 1500 m of water. In addition to the ESRF-funded report, Equinor Canada commissioned JASCO Applied Science to analyze acoustic data collected in 2014 and 2015 for marine mammal vocalizations and to determine background sound levels in the Project Area (Maxner et al. 2018). This information, collected by an acoustic recorder (CM2) in the Project Area, along with data recorded by an ESRF acoustic recorder in adjacent areas (Station 19; northern entrance to Flemish Pass and Orphan Basin) was combined to provide a more comprehensive analysis of marine mammal occurrence in the Project Area and LSA. It is important to note that these acoustic studies provide information on species occurrence near the acoustic recorder but do not provide details on abundance. Species that are secure as well as those listed under SARA or identified by COSEWIC as species of conservation concern are considered.

In addition to the literature review, marine mammal and sea turtle sightings data were acquired from the following primary sources[2]:

- DFO cetacean and sea turtle database of sightings in NL waters, which has been compiled from various sources by DFO in St. John's (J. Lawson, pers. comm. 2018), and has been made available for the purposes of describing species sightings within the Project Area and larger RSA. These data have been opportunistically gathered and provide no information on survey effort. Therefore, while these data can be used to indicate what species occur in the Project Area and larger RSA and generally when they occur, they cannot be used to reliably predict species abundance, distribution, or fine-scale habitat use in the area. Data recorded from 1945 to 2015 (2015 being the most recent year for which such data are available) were used for mapping and generation of summary sightings tables in this section.

[2] Note that the OBIS, a global open-access database (http://www.iobis.org), including sightings for marine mammals and sea turtles, was not used as a primary data source because it contains sighting records including in the DFO cetacean and sea turtle database (J. Lawson, pers. comm. 2018). Additionally, like the above described DFO database, the OBIS data provide no information on survey effort and, therefore cannot be used to reliably predict species abundance, distribution, or fine-scale habitat use in the area. The OBIS database was used to map sea turtle sightings because it contains almost 2000 records of pelagic fisheries bycatch records. These bycatch records comprise the vast majority (99.7 percent) of sea turtle OBIS data in the RSA.

- Equinor Canada observational data and incidental sightings of marine mammals and sea turtles acquired during various geophysical surveys and drilling programs were compiled and mapped for 2008 to 015. Systematic records included LGL (2009, 2014), Fugro (2015), PAL (2015) along with incidental sightings from exploratory drilling in the Bay de Verde field in 2014, the Cupids A-33 exploratory well in 2015, and additional records from other Equinor Canada surveys off eastern NL (Equinor Canada, unpublished data). Note that these marine mammal sightings data were provided to the C-NLOPB. Marine mammal sightings were also recorded during Equinor Canada’s 2018 seabed survey program in the Project Area, which was conducted from August to October 2018 (Mactavish and Penney-Belbin 2018).
- The C-NLOPB database of marine mammal and sea turtle information was acquired. The information included monitoring reports and corresponding data collected during geophysical surveys offshore NL from 2004 to 2017. With the exception of 2016 and 2017, the sightings data have been previously incorporated into the DFO cetacean and sea turtle database described above (J. Lawson, pers. comm. 2018). Marine mammal data collected during two monitoring programs for Fugro (in 2017) and three monitoring programs for MKI (in 2016) conducted in and near the Project Area have been included in maps and summary sightings tables in this section.

Despite the caveats associated with using opportunistic sightings data, this information is of value in identifying overall species presence in the region from both a temporal and spatial perspective.

In addition to the above listed datasets, 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 NL, was also considered within the species-specific descriptions. This large-scale survey was carried out 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. Survey transects did not extend to the Project Area but did include portions of the RSA (i.e., Grand Banks). During the surveys, there were 710 non-replicated sightings of 18 species, which totaled almost 4,000 individuals, the majority (3,691) of which were cetaceans. Abundance and distribution were also reported for the leatherback sea turtle (Lawson and Gosselin 2009). The results of this extensive aerial survey program provide information on the overall species presence and relative abundance in the broader region.

6.3.2 Overview of Marine Mammals and Sea Turtles in the Project Area and RSA

Marine mammals and sea turtles that do or may occur in the Project Area and/or larger RSA include an estimated 23 species of cetaceans (whales, dolphins, and porpoises, of which seven are mysticetes or baleen whales and 16 are odontocetes or toothed whales); four species of phocids (seals); and four species of sea turtles. Eleven of these 31 species are designated at risk or otherwise have special conservation status (see Section 6.3.7). No critical habitat has been designated for marine mammals or sea turtles within the Project Area and RSA.

While some species of marine mammals remain in the waters off NL year-round, many marine mammals and sea turtles arrive in the late spring and early summer and remain until the fall. Table 6.49 and Table 6.50 summarize the species of marine mammals and sea turtles (respectively) that may occur off eastern NL, including within the Project Area and/or RSA. Potential for occurrence is 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 been described in the Eastern Newfoundland SEA (Amec 2014a).

Information on secure species is summarized by species groups in the sections below (Sections 6.3.3 to 6.3.6). Information on SAR is summarized by species groups in the 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 and RSA, based on their known occurrence in the overall eastern NL offshore region (Table 6.51). While some species of baleen whales can be observed in the waters off NL 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 NL in the spring to feed (Amec 2014a). Baleen whales are opportunistic feeders, preying on plankton, krill, and small schooling fish such as capelin. 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 in and near the Project Area have recently been described in the Eastern Newfoundland SEA (Amec 2014a). Of the mysticetes that may occur in the area, four (blue, fin, North Atlantic right, and bowhead whale) are listed on Schedule 1 of SARA and/or are listed by COSEWIC; these species are addressed in Section 6.3.7.

Sightings of baleen whales are shown in Figure 6-62 (i.e., a dot represents a sighting). Sighting numbers (as well as numbers of individuals), including month recorded, of baleen whales are summarized in Table 6.51. Note that a sighting is considered one or more marine mammals in a group. For all sighting maps, the RSA has been truncated in the east because there has been a low level of survey effort and no reported sightings in the DFO database.

Table 6.49 Marine Mammals that May Occur in the Project Area and Surrounding Marine Environment

Common Name	Scientific Name	SARA Schedule 1 Status [1]	COSEWIC Designation [2,3]	Potential for Occurrence in Project Area (RSA)[4]	Potential Timing of Presence [5]	Sources
Mysticetes (Baleen Whales)						
Blue Whale (Atlantic population)	*Balaenoptera musculus*	Endangered	Endangered	Low (Moderate)	Year-round (highest numbers from early spring through winter)	COSEWIC (2002); Waring et al. (2011); Lesage et al. (2016)
Fin Whale (Atlantic population)	*B. physalus*	Special Concern	Special Concern	High (High)	Year-round	COSEWIC (2005); DFO (2016[a]); Hayes et al. (2017)
Sei Whale (Atlantic population)	*B. borealis*	Not Listed	Data Deficient	Low (Moderate)	Seasonal (summer)	COSEWIC 2003; Hayes et al. 2017
Humpback Whale (Western North Atlantic population)	*Megaptera novaeangliae*	Not Listed (Special Concern on Schedule 3)	Not at Risk	High (High)	Year-round (highest concentration from spring through winter)	Bettridge et al. (2015); Lawson and Gosselin (2009)
Common Minke Whale (North Atlantic subspecies)	*B. acutorostrata*	Not Listed	Not at Risk	Moderate (High)	Year-round (highest concentration spring through fall)	Hayes et al. (2017); Risch et al. (2014)
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered	Endangered	Low (Low)	Summer	COSEWIC (2013); Hayes et al. (2017)
Bowhead Whale (Eastern Canada-West Greenland population)	*Balaena mysticetus*	Not Listed	Special Concern	Low (Low)[6]	Unknown	COSEWIC (2009a); Ledwell et al. (2007); The Telegram (2014)

Table 6.49 Marine Mammals that May Occur in the Project Area and Surrounding Marine Environment

Common Name	Scientific Name	SARA Schedule 1 Status [1]	COSEWIC Designation [2,3]	Potential for Occurrence in Project Area (RSA)[4]	Potential Timing of Presence [5]	Sources
Odontocetes (Toothed Whales) [7]						
Sperm whale	*Physeter macrocephalus*	Not Listed	Not at Risk; Mid-Priority Candidate	High (Moderate)	Year-round	Waring et al. (2015)
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	High (Moderate)	Year-round	COSEWIC (2011); DFO (2016b)
Sowerby's beaked whale	*Mesoplodon bidens*	Special Concern	Special Concern	Moderate (Moderate)	Unknown	COSEWIC (2007); DFO (2016c)
Killer whale (Northwest Atlantic/Eastern Arctic population)	*Orcinus orca*	Not Listed	Special Concern	Moderate (Moderate)	Year-round	COSEWIC (2009b); Waring et al. (2015)
False killer whale	*Pseudorca crassidens*	Not Listed	Not Listed	Low (Low)	Unknown	Waring et al. (2015)
Long-finned pilot whale	*Globicephala melas*	3) Not Listed	4) Not at Risk	High (High)	Year-round	Fullard et al. (2000); Hayes et al. (2017)
White-beaked Dolphin	*Lagenorhynchus albirostris*	Not Listed	Not at Risk	High (High)	Year-round	Waring et al. (2007)
Atlantic white-sided dolphin	*L. acutus*	Not Listed	Not at Risk	High (High)	Year-round	Hayes et al. (2017)
Common Dolphin (Short-beaked)	*Delphinus delphis*	Not Listed	Not at Risk	Moderate (Moderate)	Seasonal (summer through fall)	Hayes et al. (2017)
Risso's Dolphin	*Grampus griseus*	Not Listed	Not at Risk	Low (Low)	Year-round	Hayes et al. (2017)

Table 6.49 Marine Mammals that May Occur in the Project Area and Surrounding Marine Environment

Common Name	Scientific Name	SARA Schedule 1 Status [1]	COSEWIC Designation [2,3]	Potential for Occurrence in Project Area (RSA)[4]	Potential Timing of Presence [5]	Sources
Common bottlenose dolphin	*Tursiops truncatus*	Not Listed	Not at Risk	Low (Low)	Seasonal (May to September)	Hayes et al. (2017)
Atlantic spotted dolphin	*Stenella frontalis*	Not Listed	Not Listed	Low (Low)	Unknown	Waring et al. (2014)
Spinner dolphin	*S. longirostris longirostris*	Not Listed	Not Listed	Low (Low) [6]	Unknown	Waring et al. (2014)
Striped dolphin	*S. coeruleoalba*	Not Listed	Not at Risk	Low (Low)	Seasonal (summer)	Waring et al. (2014)
Harbour porpoise (Northwest Atlantic population)	*Phocoena phocoena*	Not Listed (Threatened on Schedule 2)	Special Concern	Moderate (Moderate)	Year-round	COSEWIC (2006)
Beluga whale (St. Lawrence Estuary population)	*Delphinapterus leucas*	Endangered	Endangered	Low (Low) [6]	Unknown	Amec (2014b); COSEWIC (2014)
Phocids (Seals)						
Harbour Seal (Atlantic and Eastern Arctic subspecies)	*Phoca vitulina concolor*	Not Listed	Not at Risk	Low (Low)	Year-round	Hayes et al. (2017)
Harp Seal	*Pagophilus groenlandicus*	Not Listed	Not Listed	Moderate (High)	Year-round (highest concentrations in winter)	Amec (2014a); DFO (2012a); Waring et al. (2014)
Hooded Seal	*Cystophora cristata*	Not Listed	Not at Risk; Mid-Priority Candidate	Moderate (High)	Seasonal (highest concentrations in winter)	Andersen et al. (2009, 2012, 2013, 2014); Waring et al. (2007)
Grey Seal	*Halichoerus grypus*	Not Listed	Not at Risk	Low (Low)	Year-round	Lesage and Hammill (2001); Hayes et al. (2017)

Table 6.49 Marine Mammals that May Occur in the Project Area and Surrounding Marine Environment

Common Name	Scientific Name	SARA Schedule 1 Status [1]	COSEWIC Designation [2,3]	Potential for Occurrence in Project Area (RSA)[4]	Potential Timing of Presence [5]	Sources

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 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 species, it is possible that rare sightings of other species not listed here may occur.

[5] See Section 6.3.8 for a monthly breakdown of estimated presence.

[6] These species are considered extra-limital to the RSA.

[7] Pygmy sperm whales (*Kogia breviceps*; not listed under SARA or COSEWIC) and Cuvier's beaked whale (*Ziphius cavirostris*; not listed under SARA or COSEWIC) may also occur in and near the Project Area based on the ESRF acoustic study (Delarue et al. 2018); however, there have been no confirmed visual detections in or near the Project Area.

Additional Sources: Husky Energy (2012), Amec (2014a, 2014b), BP (2016)

Table 6.50 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 in Project Area (RSA) [1]	Potential Timing of Presence [2]	Sources
Leatherback sea turtle (Atlantic population)	*Dermochelys coriacea*	Endangered	Endangered	Low (Low to Moderate)	Seasonal (spring through fall)	COSEWIC (2012)
Loggerhead sea turtle	*Caretta caretta*	Endangered	Endangered	Low (Low to Moderate)	Seasonal (spring through fall)	Brazner and McMilan (2008); COSEWIC (2010)
Green sea turtle	*Chelonia mydas*	Not Listed	Not Listed	Low (Low) [3]	Seasonal (summer and fall)	James et al. (2004); NOAA (2016)
Kemp's ridley sea turtle	*Lepidochelys kempii*	Not Listed	Not Listed	Low (Low) [3]	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 sea turtle species it is possible that rare sightings of other species not listed here may occur.

[2] See Section 6.3.8 for monthly breakdown of predicted species presence.

[3] These species are considered extra-limital to the RSA.

Additional Sources: Husky Energy (2012), Amec (2014a, b), and BP (2016)

Table 6.51 Baleen Whale Sightings in the Project Area and Regional Study Area

Common Name	Project Area			Regional Study Area		
	No. of Sightings	No. of Individuals	Months Sighted	No. of Sightings	No. of Individuals	Months Sighted
Species at Risk						
Blue Whale	0	0	–	28	36	Mar to Oct
North Atlantic Right Whale	0	0	–	3	5	Jun, Aug
Fin Whale	14	41	Jun-Jul, Sep	1724	2475	Mar to Dec
Bowhead Whale	0	0	–	1	1	May
Secure Species						
Sei Whale	1	1	Aug	116	220	Feb, May to Nov
Humpback Whale	11	24	May-Jun, Aug	3189	10653	Jan to Dec
Minke Whale	12	13	Jun-Jul, Sep	948	2209	Jan, Mar to Dec
Fin / Sei Whale	2	2	Jul-Aug	44	60	Apr to Sep
Unidentified Baleen Whale	16	18	Jun-Sep	430	565	May to Dec
Source: DFO sightings database (1945 to 2015), C-NLOPB records (2016, 2017), and Statoil / Equinor Canada monitoring data (LGL 2009, 2014, 2018; Fugro 2015; PAL 2015).						

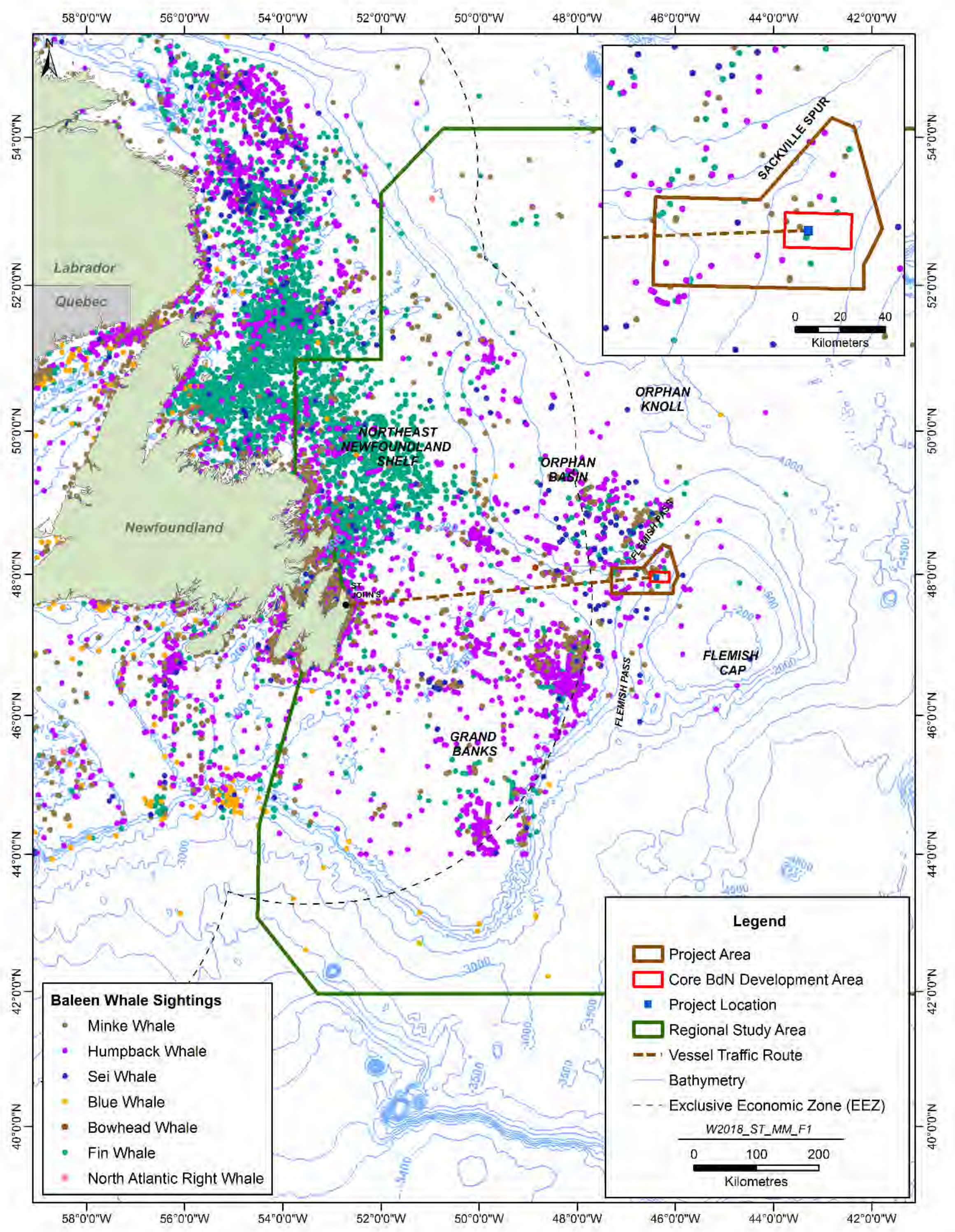

Figure 6-62 Baleen Whale Sightings in the Project Area and RSA

6.3.3.1 Humpback Whale

Humpback whales found in NL 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 to 15,954).

A population estimate for the NL area based on survey data from 2007 resulted in an abundance estimate of 1,427 individuals (95 percent CI: 952 to 2,140) (Lawson and Gosselin 2009). Lawson and Gosselin (2011) provided a corrected abundance estimate of 3,712. Humpback whales were the most frequently sighted whale species during the 2007 survey (Lawson and Gosselin 2009) and are the most frequently recorded baleen whale in the DFO database in the RSA (Table 6.51). There were similar numbers of humpback whales, fin whales, and minke whales reported in the Project Area (Table 6.51).

This species has been observed throughout the Grand Banks and in the deeper waters of the Project Area (Figure 6-62). During Equinor Canada's 2018 Seabed Survey, two humpback whale sightings (totalling three individuals) were observed in August in the Project Area (Mactavish and Penney-Belbin 2018). Humpback whale calls were regularly detected by the acoustic recorders deployed at the Sackville Spur and in adjacent slope waters. However, acoustic detections of humpbacks during summer near the Project Area were limited because of geophysical surveys which falsely triggered detector software used to identify humpback calls (Delarue et al. 2018).

6.3.3.2 Minke Whale

Minke whales found in NL waters belong to the Canadian East Coast stock, which occurs from Davis Strait to the Gulf of Mexico (Hayes et al. 2017). The current best abundance estimate for the Canadian East Coast stock is 2,591 (Hayes et al. 2017). Although the previously reported abundance estimate was much greater for this stock, that estimate was based on the 2007 TNASS, which is now considered too old to be reliable (Hayes et al. 2017). Nonetheless, the 2007 TNASS resulted in an abundance of 1,315 (95 percent CI: 855 to 2,046) individuals within NL waters (Lawson and Gosselin 2009). Lawson and Gosselin (2011) provided a corrected abundance estimate of 4,691 for NL.

Minke whales can occur year-round in the eastern NL offshore area, although they are most likely to occur spring through fall (Risch et al. 2014; Table 6.51). There have been 12 sightings of minke whales recorded in the Project Area (Table 6.51) and numerous more reported in the coastal waters off eastern NL (Figure 6-62). Based on a limited manual review of acoustic data (versus the use of automatic detection software, which was not effective at detecting minke whale pulse trains) collected during the ESRF acoustic study, minke whales were seemingly absent from slope waters, including the Project Area, and the Grand Banks but were detected in the shallower waters offshore Nova Scotia (Delarue et al. 2018).

6.3.3.3 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 the coast of Nova Scotia and one off the coast of Labrador (COSEWIC 2003). The Nova Scotia stock range is from the shelf waters of the northeastern US to the waters south of NL, with an abundance estimate of 357 individuals (coefficient of variation; CV=0.52) (Hayes et al. 2017). 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 offshore NL region is used by sei whales, and whether it is occupied by a unique stock, is unknown. Sei whales tagged in the Azores during 2008 and 2009 travelled through the waters off eastern NL, including north of the Flemish Pass, to the Labrador Sea, where they spent extended periods of time on the northern shelf, presumably to feed (Prieto et al. 2010, 2014). Only one sei whale was observed in NL waters during the 2007 TNASS study (Lawson and Gosselin 2009). Sei whales are likely to be observed seasonally off eastern NL, with increased presence in summer (COSEWIC 2003). There has been one confirmed sighting of a sei whale and two sightings identified as either sei or fin whales in the Project Area (Figure 6-62; Table 6.51). Based on a limited manual analysis of acoustic data (versus the use of automatic detection software) from shelf and slope waters, Delarue et al. (2018) surmised that sei whales prefer slope waters like those in the Project Area.

6.3.4 Odontocetes (Toothed Whales)

There are 16 species of odontocetes (large toothed whales; dolphins and porpoises) that have the potential to occur in or near the Project Area. Several species of odontocetes occur in the region seasonally, namely the common bottlenose dolphin, short-beaked common dolphin, and striped dolphin, while others have the potential to occur year-round.

Odontocetes forage primarily on small schooling fish 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. There are two functional hearing groups – 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 that are known to occur in the Project Area, only the harbour porpoise is classified within the high-frequency cetacean hearing group. Many odontocetes use echolocation to navigate and locate prey.

Key life history and habitat information for toothed whale species known or expected to occur in the Project Area have been described in the Eastern Newfoundland SEA (Amec 2014a). Of these odontocetes known or expected to occur in the Project Area, five are listed under Schedule 1 of SARA and/or are listed by COSEWIC (northern bottlenose whale, Sowerby's beaked whale, killer whale, beluga whale, and harbour porpoise; Table 6.52). These species are described in Section

6.3.7. Sighting numbers, including month recorded, of toothed whales summarized in Table 6.52. Sightings of odontocetes are shown in Figure 6-63 (large toothed whales) and Figure 6-64 (dolphins and harbour porpoise).

Table 6.52 Toothed Whale Sightings in the Project Area and Regional Study Area

Common Name	Project Area			Regional Study Area		
	No. of Sightings	No. of Individuals	Months Sighted	No. of Sightings	No. of Individuals	Months Sighted
Species at Risk						
Northern Bottlenose Whale	7	18	May-Aug	109	346	Mar-Nov
Sowerby's Beaked Whale	0	0	–	1	4	Sep
Killer Whale	1	4	Jun	229	1273	Jan, Mar-Dec
Beluga Whale	0	0	–	7	7	May-Jul
Harbour Porpoise	3	5	May-Jun, Aug	204	968	Feb-Nov
Secure Species						
Sperm Whale	26	41	Jan-Nov	334	785	Jan-Dec
False Killer Whale	0	0	–	1	2	Jun
Long-finned Pilot Whale	43	830	Feb, Jun-Nov	792	14629	Jan-Dec
White-beaked Dolphin	2	12	Aug	259	2048	Feb-Mar, May-Nov
Atlantic White-sided Dolphin	11	114	Jul-Sep	451	8276	Jan-Dec
Common Dolphin (short-beaked)	2	20	Sep-Oct	278	3976	Jan, Mar, Jun-Dec
Risso's Dolphin	0	0	–	1	3	Sep
Common Bottlenose Dolphin	0	0	–	12	32	Apr-Jun, Aug-Sep
Atlantic Spotted Dolphin	0	0	–	2	13	Jul
Striped Dolphin	0	0	–	7	320	Aug-Sep
Unidentified Dolphin	56	964	Apr, Jun-Nov	781	11951	Jan-Dec
Unidentified Beaked Whale	0	0	–	4	5	Jun, Aug-Sep
Unidentified Toothed Whale	1	1	N/A	17	44	Jun-Sep
Source: DFO sightings database (1945 to 2015), C-NLOPB records (2016, 2017) and Equinor monitoring data (LGL 2009, 2014, 2018; Fugro 2015; PAL 2015). Note: there was one sighting of a Cuvier's beaked whale reported in July 2015 seen over 600 km from the Project Area but within the RSA.						

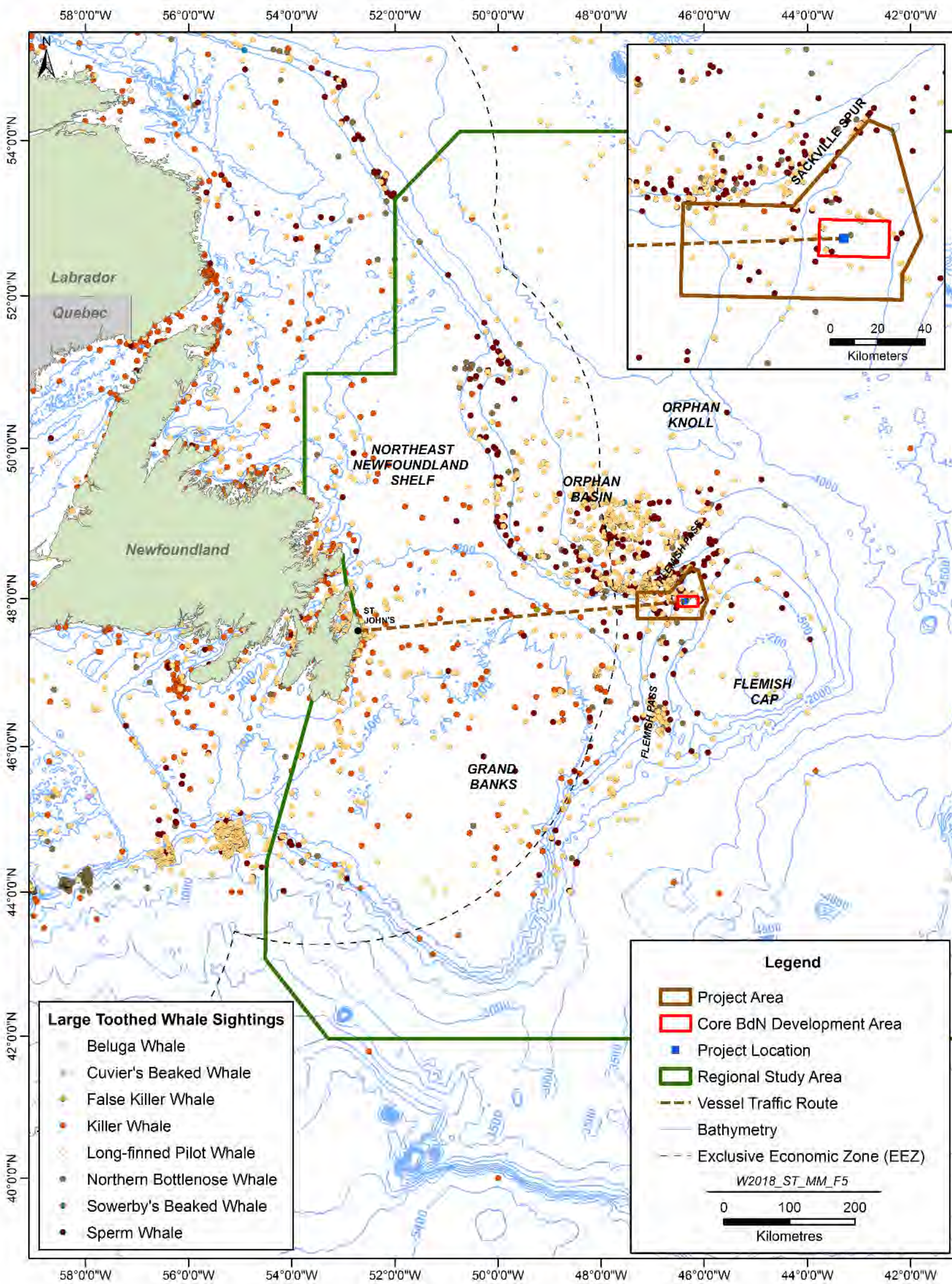

Figure 6-63 Large Toothed Whale Sightings in the Project Area and RSA

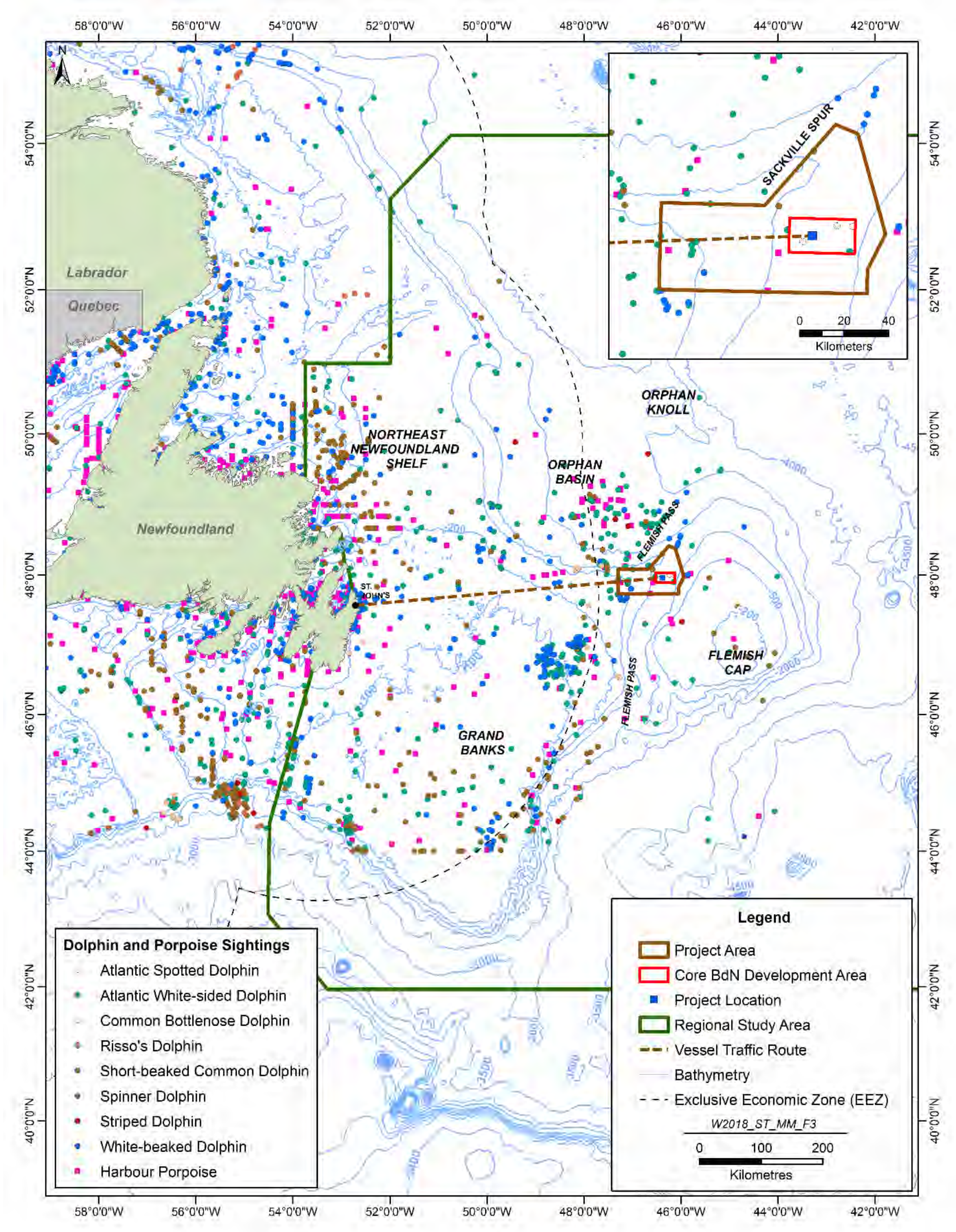

Figure 6-64 Dolphin and Harbour Porpoise Sightings in the Project Area and RSA

6.3.4.1 Sperm Whale

There is only one recognized stock for the North Atlantic sperm whale that includes both the northwestern and northeastern Atlantic (Waring et al. 2015). 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 (Figure 6-63). The most recent abundance estimate for the western North Atlantic is 2,288 individuals (CV=0.28), based on surveys conducted in 2011 (Waring et al. 2015; Hayes et al. 2017). However, since this species has long dive times (i.e., 30 to 60 minutes), these numbers are potentially under-estimated 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 in the NL survey area (Lawson and Gosselin 2009). There have been 26 sperm whale sightings (totaling 41 individuals) recorded in the Project Area (Table 6.52). Sperm whale clicks have been detected in the Project Area (an acoustic recorder, i.e., CM2, was located just south of the Sackville Spur in approximately 1,200 m water depth) consistently between May and early October (the extent of the recording period) (Maxner et al. 2018). Similarly, during the ESRF acoustic study, sperm whale clicks were frequently recorded at the northern (i.e., the "Sackville Spur" recording site located approximately 13 km northwest of the Project Area) and southern 'entrance' to Flemish Pass. Of the 20 acoustic recorders deployed offshore NL and Nova Scotia during the ESRF study, those at either end of the Flemish Pass had the highest click detection rates—suggesting that the Flemish Pass and adjacent waters (including the Project Area) may be an important area for this species year-round (Delarue et al. 2018).

6.3.4.2 False Killer Whale

False killer whales are distributed worldwide throughout warm, temperate, and tropical oceans (Jefferson et al. 2015). This species is generally found in offshore waters, but it has also been observed in coastal waters (Baird et al. 2013). 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 (Waring et al. 2015).

There are insufficient data to determine population trends for the Northwest Atlantic/Eastern Arctic population 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) (Waring et al. 2015; Hayes et al. 2017). 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 (Waring et al. 2015). The false killer whale is expected to be rare in the Project Area. There were no records of false killer whales in the Project Area; however, there was one sighting of this species in the RSA (Table 6.52). This species was not detected during the ESRF acoustic study (Delarue et al. 2018).

6.3.4.3 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 (Hayes et al. 2017). 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 (Hayes et al. 2017). This 2011 survey covered waters from central Virginia to the lower Bay of Fundy. A total of 65 long-finned pilot whales were observed during the 2007 TNASS study off NL 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). Generally, this species is considered to prefer slope versus shelf waters.

There were hundreds of long-finned pilot whale sightings in the Offshore NL Area recorded in the DFO, C-NLOPB, and Equinor Canada marine mammal observation records, including those within the Project Area (Table 6.52 and Figure 6-63). Pilot whale whistles have been detected in the Project Area between June and September (the extent of the recording period) (Maxner et al. 2018). Similarly, during the ESRF acoustic study, pilot whales were acoustically detected at the Sackville Spur recording site (i.e., 13 km from the Project Area) throughout the year but with fewer detections during winter (Delarue et al. 2018).

6.3.4.4 White-beaked Dolphin

White-beaked dolphins can be found year-round from southern New England to southern Greenland and the Davis Straits (Waring et al. 2007). 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). This estimate is negatively biased because it is based on a 2006 survey that covered only a portion of the species habitat (Waring et al. 2007; Hayes et al. 2017). The abundance of white-beaked dolphins estimated in NL waters from the TNASS in 2007 was 1,842 individuals (95 percent CI: 1,188 to 2,854) (Lawson and Gosselin 2009). Lawson and Gosselin (2011) provided a corrected abundance estimate from the TNASS of 15,625. Only two sightings of white-beaked dolphins have been recorded in the Project Area (Table 6.52); these sightings were recorded in August during Equinor Canada's 2018 Seabed Survey (Mactavish and Penney-Belbin 2018).

6.3.4.5 Atlantic White-sided Dolphin

In the western North Atlantic, Atlantic white-sided dolphins 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 Project Area and 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 (Hayes et al. 2017). Lawson and Gosselin (2009) estimated a total of 1,507 Atlantic white-sided dolphins (95 percent CI: 968 to 2,347) in the waters off NL and later provided a corrected abundance estimate of 3,384 (Lawson and Gosselin 2011). Eleven sightings of Atlantic white-sided dolphins (totaling 114 individuals) were recorded in the Project Area (Table 6.52 and Figure 6-64).

6.3.4.6 Short-beaked Common Dolphin

The short-beaked common dolphin can be found migrating onto the Scotian Shelf and continental shelf off NL during the summer and fall months when water temperatures exceed 11°C (Hayes et al. 2017). Currently, the best abundance estimate for the Western North Atlantic stock is 70,184 individuals (CV=0.28), which was derived from the TNASS that occurred from July to August 2007 (Hayes et al. 2017). The abundance estimates for the NL area based on the 2007 TNASS suggests a population of 576 individuals (95 percent CI: 314 to 1,056) (Lawson and Gosselin 2009). There were two sighting records of short-beaked common dolphins for the Project Area and many more in the larger RSA (Table 6.52 and Figure 6-64).

6.3.4.7 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 NL (Hayes et al. 2017). It is found primarily in areas with surface water temperatures of 10°C to 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 18,250 individuals (CV=0.46), based on surveys conducted in 2011 (Hayes et al. 2017). Risso's dolphin is known to occur off NL (Jefferson et al. 2014). However, there were no sightings of Risso's dolphin recorded in the Project Area and only one in the RSA (Table 6.52).

6.3.4.8 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) (Hayes et al. 2017). Common bottlenose dolphins were infrequently recorded in the RSA but not in the Project Area (Table 6.52 and Figure 6-64).

6.3.4.9 Atlantic Spotted Dolphin

Atlantic spotted dolphins are typically found in tropical and warm temperate waters of the Northwest Atlantic. Generally, this species distribution ranges from southern New England to as far south as Venezuela (Waring et al. 2014). 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 (Waring et al. 2014). Sightings have also occurred along the north wall of the Gulf Stream (Waring et al. 2014). 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) (Waring et al. 2014; Hayes et al. 2017). Atlantic spotted dolphins are likely to be rare in the eastern NL offshore area; there are no sightings records for this species in the Project Area (see Table 6.52).

6.3.4.10 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 (Waring et al. 2014). In general, spinner dolphins occur in deep water along most of the east coast of the US and south in the Gulf of Mexico and as far south as Venezuela (Waring et al. 2014). In the waters off the northeast coast of the US, almost all sightings have occurred in deeper oceanic waters (over 2,000 m) (Waring et al. 2014). There is little information available on the stock structure of the spinner dolphin in the Northwest Atlantic and the population size is unknown (Waring et al. 2014); its distribution in Atlantic Canada is poorly understood. Spinner dolphins are likely to be rare in the Project Area. There are no records of spinner dolphin sightings in the Project Area and RSA based on the DFO database (Table 6.52).

6.3.4.11 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 (Waring et al. 2014). 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 NL (Waring et al. 2014). Abundance estimates for western North Atlantic suggest that there are 54,807 individuals (CV=0.3), based on surveys conducted in 2011 (Waring et al. 2014; Hayes et al. 2017). Few striped dolphins were observed in the 2007 TNASS and as a result an abundance estimate was not calculated (Lawson and Gosselin 2009). Striped dolphins are likely to be rare in the Project Area (Table 6.52 and Figure 6-64).

6.3.5 Phocids

Four species of seals are known to regularly occur off eastern NL (Table 6.49). 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 seal species known to occur in the region have been described in the Eastern Newfoundland SEA (Amec 2014a). There are no pinniped SAR that are known or expected to occur in the Project Area. Seals are not recorded in the DFO database, and there are insufficient records to produce sighting tables or distribution figures.

6.3.5.1 Harbour Seal

In the western North Atlantic, the harbour seal can be found in nearshore waters from the eastern Canadian Arctic and Greenland to southern New England and New York (Hayes et al. 2017). Given their primarily coastal distribution, they are expected to occur only in low numbers in the more offshore waters of eastern NL. 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) (Hayes et al. 2017). Harbour seals do occur in small numbers at haul-out sites on the Avalon and Burin peninsulas (Templeman 2007; B. Mactavish, pers. comm., 2018).

6.3.5.2 Harp Seal

Harp seals are the most abundant pinniped in the northwest Atlantic and can be found throughout most of the North Atlantic, including the Project Area, and in the Arctic Ocean. The global harp seal population is divided into three separate stocks, identified by specific pupping locations (Waring et al. 2014). 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” whelps and breeds off the coast of NL, while the “Gulf herd” whelps and breeds in the Gulf of St. Lawrence (DFO 2012a). The location of the Front herd varies from year to year depending on sea ice conditions and has historically occurred from Groswater Bay, Labrador to offshore Fogo and Cape Bonavista (Stenson and Hammill 2014); some years it occurs within the northwest portion of the RSA). Harp seals are highly migratory, and the western North Atlantic stock travels between summer feeding grounds in the Arctic to the breeding, whelping, and moulting grounds off eastern Canada (i.e., off northern Newfoundland and southern Labrador as well as in the Gulf of St. Lawrence). 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 NL, particularly in the winter months, although smaller numbers may occur year-round (Amec 2014a). The most recent estimate of the Northwest Atlantic harp seal population is 7.4 million individuals (95 percent CI: 6,475,800 to 8,273,600) (Hammill et al. 2015). During the ESRF acoustic study, harp seal vocalizations were recorded in the Sackville Spur but most acoustic detections occurred farther north and during February and March (Delarue et al. 2018).

6.3.5.3 Hooded Seal

Hooded seals can be found throughout most of the North Atlantic and Arctic Oceans in deep water (Waring et al. 2007). The hooded seal population has been divided into three stocks: Northwest Atlantic, Greenland Sea, and White Sea. The population of hooded seals in the Northwest Atlantic in 2005 was most recently estimated to be 593,500 individuals (Hammill and Stenson 2006). Hooded seals are a primarily pelagic species, which spends most of the year in the open ocean, except for brief periods when they reproduce and moult (Andersen et al. 2009). Hooded seals occur on the NL continental shelf primarily during winter and spring, from approximately December through March (Andersen et al. 2009, 2012, 2013, 2014). They breed and whelp at several locations including the Front off northern Newfoundland and southern Labrador before migrating north to moult (Sergeant 1976). Andersen et al. (2012) suggested that hooded seals prefer areas with topographic and oceanographic conditions off the coast of NL that produce good feeding conditions. During autumn/winter, males showed greater search effort for prey in areas with complex seabed relief, including areas in the Flemish Cap and adjacent waters of the Project Area; whereas females spent more effort along the Labrador Shelf. Juveniles occurred off the east coast of NL between the Grand Banks and the Flemish Cap during spring.

6.3.5.4 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 (Hayes et al. 2017). 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: 1) Sable Island, 2) Gulf of St. Lawrence, and 3) 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 in the region year-round. There is currently no estimate for the total western North Atlantic population (Hayes et al. 2017). The 2016 abundance estimate for Canadian waters is 424,300 individuals (95 percent CI: 263,600 to 578,300), and the population is expected to continue to increase at 4.4 percent per year (Hammill et al. 2017). Grey seals are unlikely to occur in the Project Area but may occur in small numbers in the RSA. During the ESRF acoustic study, grey seal vocalizations were only detected at recorders offshore Nova Scotia and in nearshore waters off the west coast of NL (Delarue et al. 2018).

6.3.6 Sea Turtles

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 NL (Table 6.50). 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 (SAR Public Registry 2017). Loggerhead sea turtles are listed as Endangered under SARA and by COSEWIC (COSEWIC 2010d; SAR Public Registry 2017). Leatherback sea turtles are the most likely species of sea turtle to occur off eastern NL. However, 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). Less is known about the distributions of Kemp's ridley sea turtle and green sea turtle in eastern Canada, but these species are considered rare at these latitudes.

Key life history and habitat information for sea turtle species that may occur in the RSA was described in the Eastern Newfoundland SEA (Amec 2014a). An overview of information on green and Kemp's ridley sea turtles is summarized below whereas leatherback and loggerhead sea turtles are overviewed in Section 6.3.7. Figure 6-65 shows opportunistic sightings of sea turtle species recorded off eastern NL between 1938 (earliest record of a sea turtle) and 2015, as reported in the combined dataset of OBIS, DFO, and Equinor Canada records (see Section 6.3.1).

6.3.6.1 Green Sea Turtle

The green sea turtle is unique among sea turtles in that it is herbivorous and feeds primarily on seagrasses and algae (NOAA 2016). 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 2016). In the western Atlantic Ocean, they are found from the Gulf of Mexico to Massachusetts, and their presence in the waters off the northeastern US is seasonal and dependent on water temperature, as this species moves to southerly latitudes when water temperatures decline (James et al. 2004; NOAA 2016). During the summer and fall, this species occurs as far north as New York; its 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 2016); no breeding or nesting is known to occur in Canadian waters.

Green sea turtles are uncommon in Atlantic Canada. James et al. (2004) reported two sightings of green sea turtles in coastal areas in Nova Scotia: a juvenile green sea turtle was found in Chedabucto Bay in 1999, and a juvenile green-loggerhead hybrid was found in St. Margaret's Bay in 2001. Observation records contain several sightings of green sea turtles in the eastern NL offshore area, including near the Flemish Cap (Figure 6-65).

6.3.6.2 Kemp's Ridley Sea Turtle

Kemp's ridley is 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 DFO, C-NLOPB, Equinor Canada, and OBIS.

6.3.7 Species at Risk

Marine mammal and sea turtles listed as SAR 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 species of conservation concern. Other than the polar bear (which is listed as Vulnerable and is not considered in this EIS), there are currently no other marine mammal or sea turtle species listed under the NL ESA.

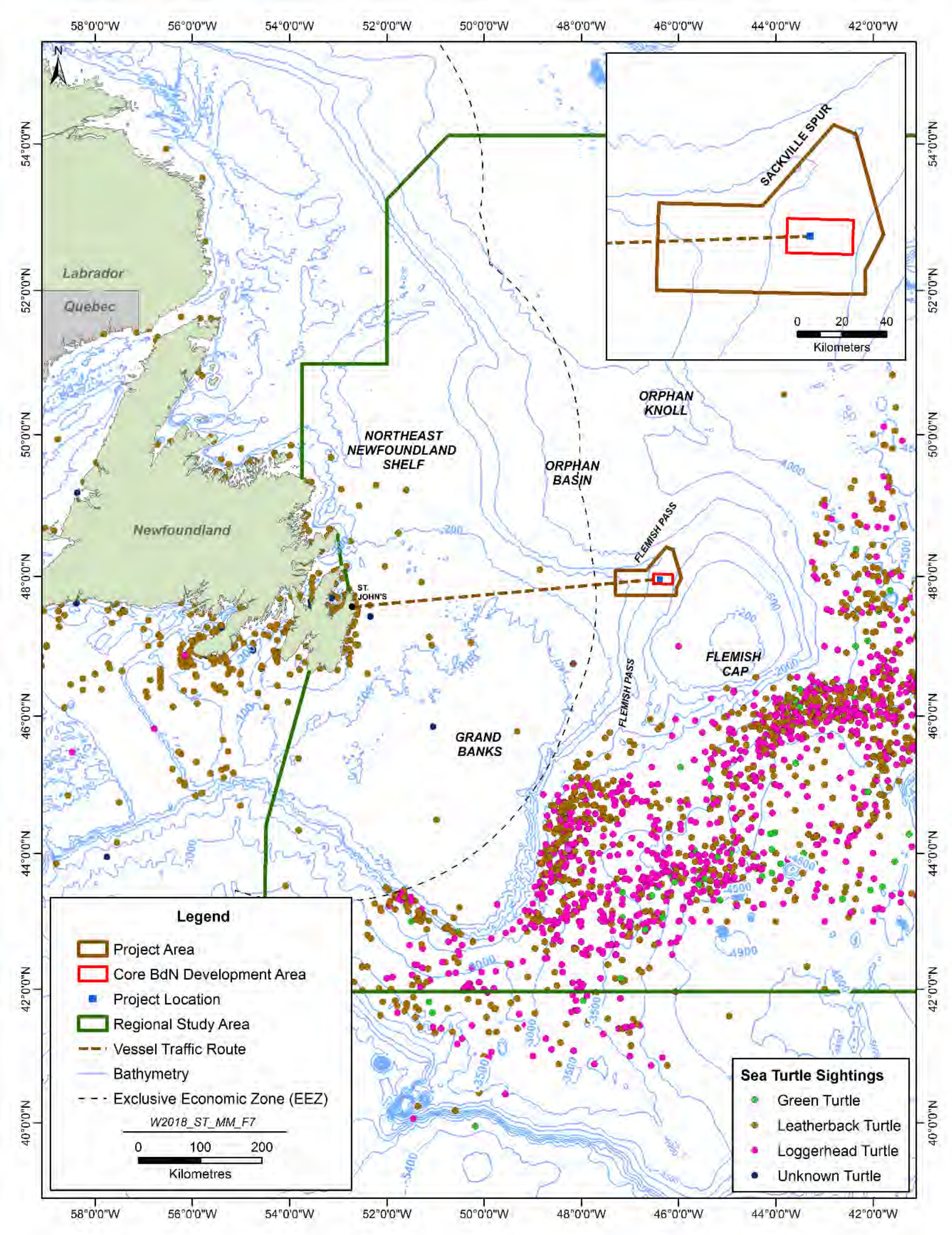

Figure 6-65 Sea Turtle Sightings in the Project Area and RSA

Nine marine mammal species and two sea turtle SAR have been identified as having the potential to be present off eastern NL: blue whale, North Atlantic right whale, bowhead whale, fin whale, northern bottlenose whale, Sowerby's beaked whale, killer whale, beluga whale, harbour porpoise, leatherback sea turtle, and loggerhead sea turtle (Table 6.49, Table 6.50).

Summaries of these species are provided below, and sightings are presented in Figure 6-66 to Figure 6-68.

6.3.7.1 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 (Waring et al. 2011). Blue whales were hunted off NL in the first half of the 20th century. Photo-identification in eastern Canadian waters indicates that blue whales from the St. Lawrence, NL, Nova Scotia, New England, and Greenland belong to the same stock (Waring et al. 2011). 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 (Waring et al. 2011). However, COSEWIC (2002) estimated the northwest Atlantic population to be in the low hundreds; this estimate was reconfirmed (i.e., < 250 mature individuals) in 2012 (COSEWIC 2012g). No critical habitat has been identified for this species (see Recovery Strategy; i.e., Beauchamp et al. 2009). As recently reaffirmed in a proposed Action Plan prepared by DFO (2018c), the main threats to the recovery of the Northwest Atlantic Blue Whale population were determined by experts to be anthropogenic sound, which causes a degraded underwater acoustic environment and can alter behaviour, and the lack of prey availability which could result from ecosystem changes caused, in particular, by climate change. Contaminants, vessel collisions, disturbances caused by whale watching activities, entanglements in fishing gear, epizootics, toxic algal blooms and toxic spills are also threats for this species.

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. 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 (southwest of the Project Area).

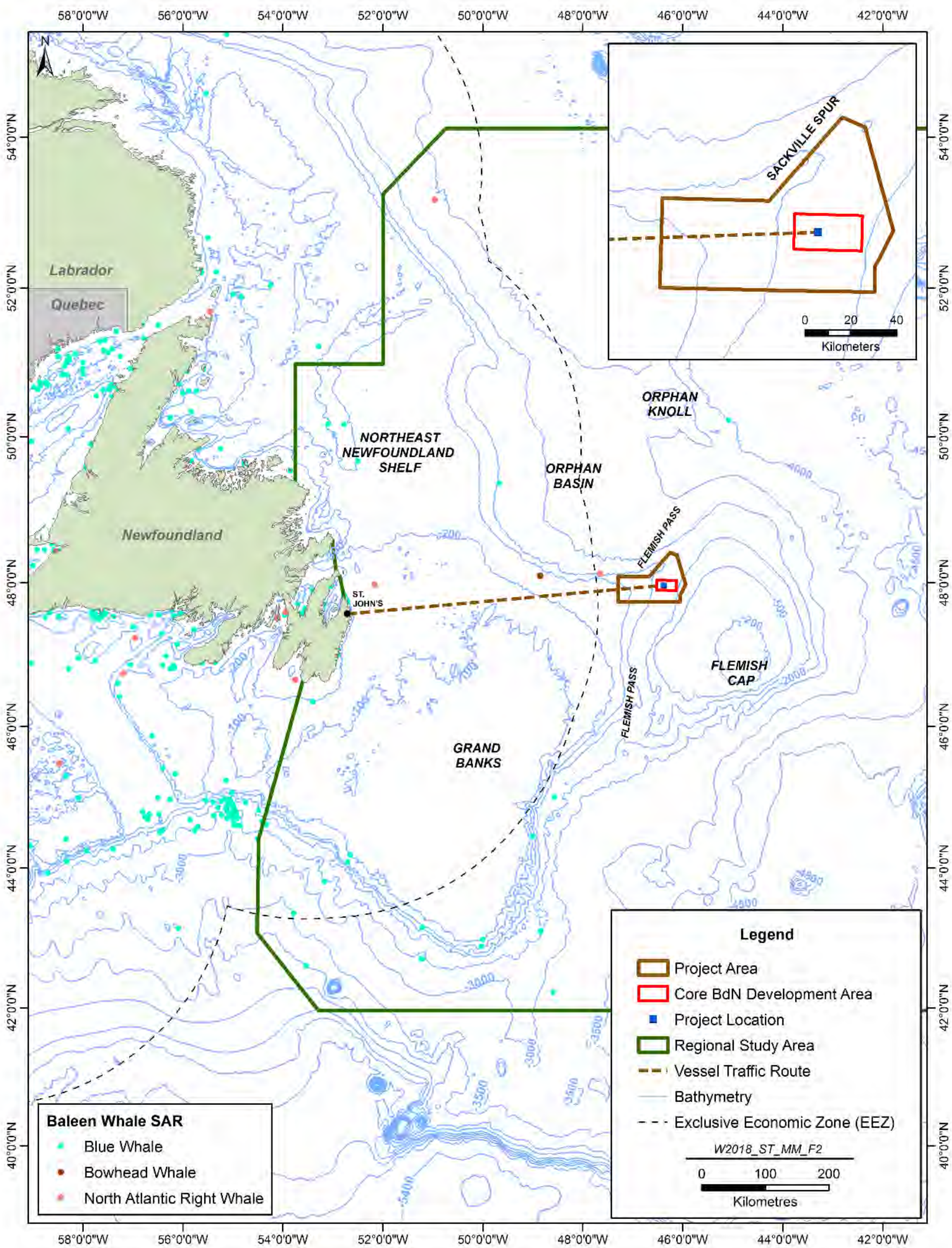

Figure 6-66 Blue Whale, North Atlantic Right Whale and Bowhead Whale Sightings in the Project Area and RSA

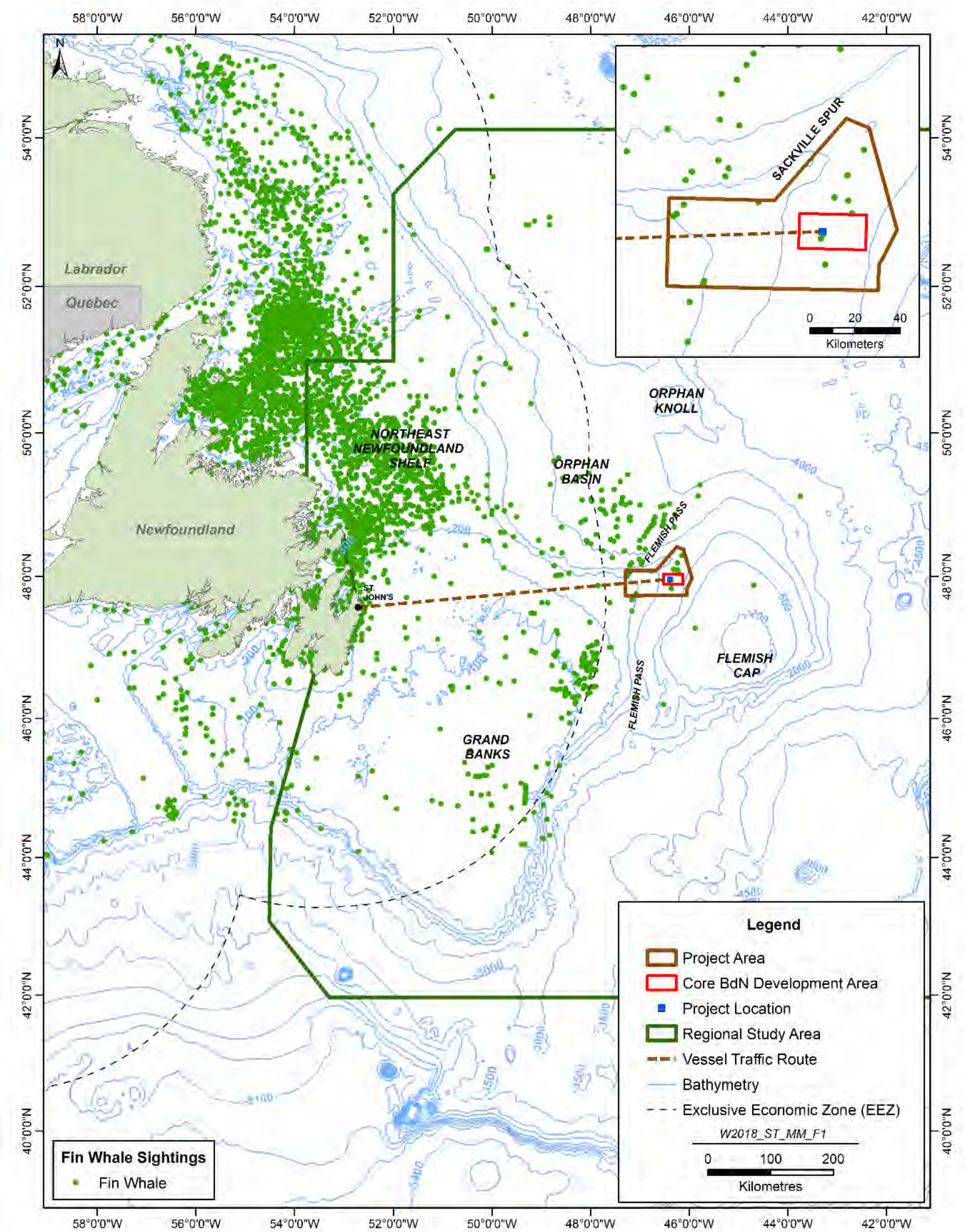

Figure 6-67 Fin Whale Sightings in the Project Area and RSA

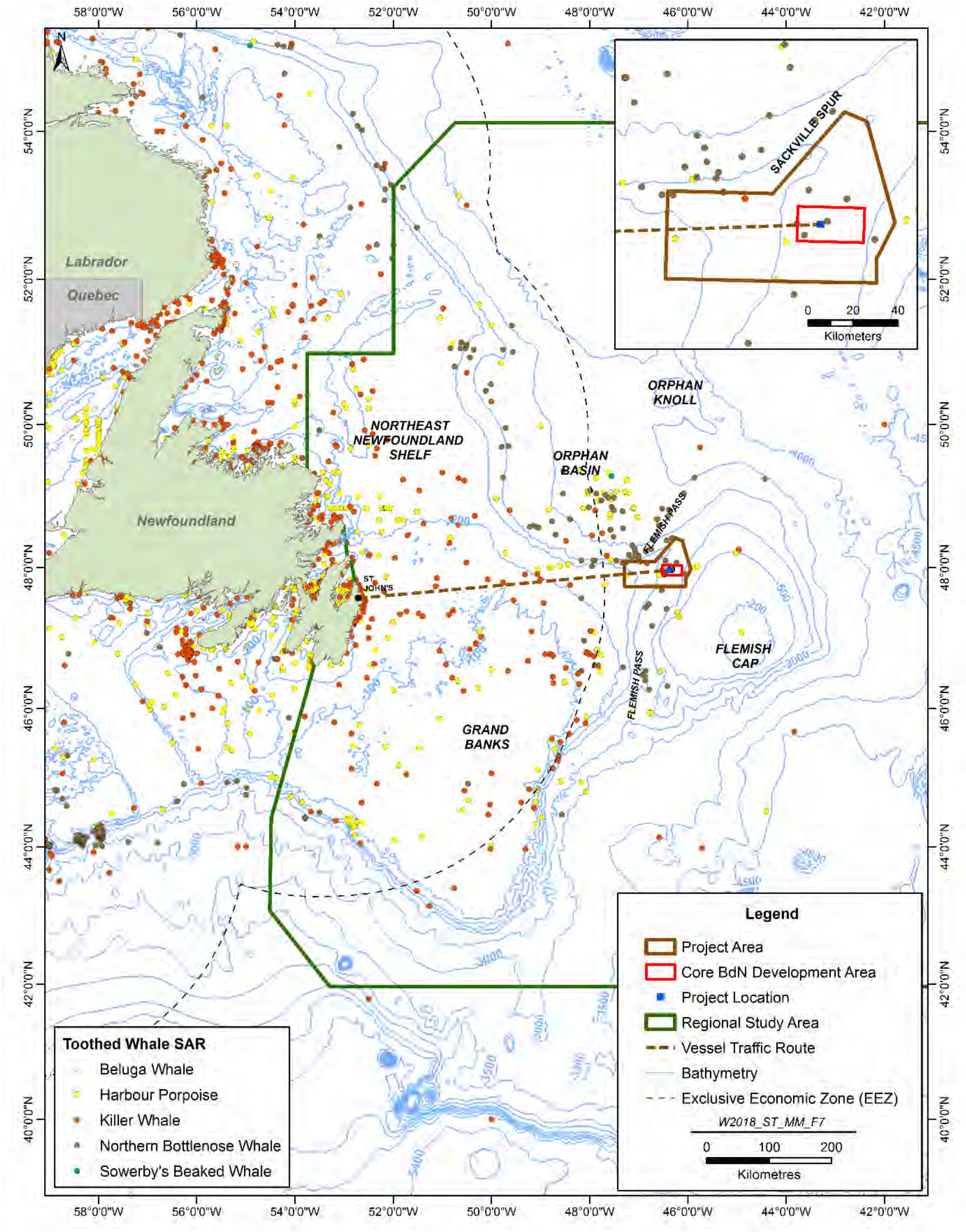

Figure 6-68 Toothed Whale Species at Risk in the Project Area and RSA

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 Offshore NL Area compared to the Gulf of St. Lawrence, where most of these sightings have occurred (COSEWIC 2002; Gomez et al. 2017). A total of six blue whales were sighted during the TNASS off NL in 2007 (Lawson and Gosselin 2009). Blue whale vocalizations have been detected in the Project Area in late summer and early fall (Maxner et al. 2018). Habitat suitability modeling showed that the Project Area is a low priority area (Gomez et al. 2017). Based on marine mammal observation records, there were limited blue whale sightings in the eastern NL offshore area, and none within the Project Area (Table 6.51 and Figure 6-66). Data from the ESRF acoustic study, which provided year-round coverage at sites throughout the NL offshore, including an acoustic recorder near the Sackville Spur (i.e., approximately 13 km northwest of the Project Area) demonstrated that blue whale calls were generally detected from August to January. Offshore NL, blue whales were recorded near the Sackville Spur (in the fall) but less frequently than at sites on the slope of southern Grand Banks and near the Laurentian Channel (Delarue et al. 2018). The authors of this study caution that blue whale vocalizations in spring and summer are likely underestimated because of the inability to automatically detect downsweep vocalizations, which predominantly occur in spring and summer.

6.3.7.2 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 NL and in the Gulf of St. Lawrence (COSEWIC 2013b). 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 2013b). A possible breeding ground located in the middle of the Gulf of Maine has recently been discovered (COSEWIC 2013b). 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 NL. The main threats facing this species are ship strikes and entanglement in fishing gear (COSEWIC 2013b; DFO 2014a; Brillant et al. 2017); both have contributed to limited population recovery (COSEWIC 2013b). Other threats as identified in the Recovery Strategy (DFO 2014a) and proposed Action Plan (DFO 2016c) for this species include exposure to contaminants, acoustic disturbances, vessel presence disturbances, and changes in prey availability and quality.

The western North Atlantic population is thought to have a minimum of 440 individuals (Hayes et al. 2017), but perhaps as many as 736 individuals (Pettis et al. 2017). The best estimate is 451 individuals (Pettis et al. 2017), but the population size has been declining since 2010 (Pace et al. 2017). It is likely that only approximately 100 reproductive females remain in the population (Baumgartner et al. 2017; Pennisi 2017). Decreasing calving rates (down 40 percent since 2010) and increasing rates of human-caused mortality are of great concern (Kraus et al. 2016). Some researchers suggest the right whale population can recover as long as prey availability is favourable and mortality rates are low (Meyer-Gutbrod and Greene 2017). However, in 2017, only five calves were reportedly born and there were three times as many mortalities (Pettis et al. 2017). From 6 June to 15 September 2017, 12 dead North Atlantic right whales were reported in the Gulf of St. Lawrence; nine were observed floating in the southern Gulf of St. Lawrence and four came ashore in western NL (Daoust et al. 2017). Necropsies on seven of the whales determined that the cause of death was blunt trauma in four instances and drowning as a result of entanglement in two instances; the cause of death could not be determined for the seventh whale due to advanced decomposition. An additional five entanglements were reported between 5 July and 28 August 2017; of these entanglements, two were disentangled, one shed the gear on its own and the remaining two entangled whales could not be disentangled; their fate remains unknown (Daoust et al. 2017).

North Atlantic right whales were not observed in the waters off eastern and southern NL during the TNASS in 2007 (Lawson and Gosselin 2009). North Atlantic right whales were rarely reported in the marine mammal observation records with no sightings of this species in the Project Area (Table 6.51 and Figure 6-66). Similarly, during the ESRF acoustic study and the acoustic monitoring program undertaken by Equinor Canada (Maxner et al. 2018), right whales were not detected on acoustic recorders located at the Sackville Spur and adjacent areas. The closest confirmed acoustic detection of a right whale occurred in slope waters off the south coast of NL (Delarue et al. 2018). However, the authors of the study caution that dedicated data analyses of additional acoustic sites may be warranted particularly given that the North Atlantic right whale has in recent years changed its distribution patterns.

6.3.7.3 Bowhead Whale

The Eastern Canada-West Greenland (EC-WG) population of bowhead whale is listed as a species of Special Concern by COSEWIC; bowhead whales that are occasionally found in NL waters likely come from this population (COSEWIC 2009c). 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 NL 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 2009c). The EC-WG population primarily summers in northwestern Hudson Bay, Foxe Basin, Lancaster Sound and western Baffin Bay, and winters in the Hudson Strait and Davis Strait off western Greenland (COSEWIC 2009c). 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 2009c). The most recent population estimates for EC-WG bowhead whales are 6,446 (95 percent CI 3,722 to 11,200) based on aerial surveys conducted by DFO in August 2013 (Doniol-Valcroze et al. 2015) and 7,660 (95 percent Highest Density Interval 4,500 to 11,100) based on a genetic capture-mark-recapture study (Fraiser et al. 2015). As with many large whales, commercial whaling was once the greatest threat to the bowhead whale. At present, killer whales may pose the greatest threat. Other threats may include underwater sound, net entanglements, collisions with ships, pollution and climate change.

Bowhead whales have been sighted in the waters off the coast of NL in Rattling Brook, Trinity Bay, and Witless Bay (Ledwell et al. 2007; The Telegram 2014). The occurrence of a stranded whale in Witless Bay is the southernmost occurrence of a bowhead whale on record (Ledwell et al. 2007). Bowhead whale sightings are rare in the eastern NL offshore area, with no sightings and acoustic detections in the Project Area (Table 6.51 and Figure 6-66; Maxner et al. 2018). Bowhead whales were not detected on acoustic recorders deployed during the ESRF study (Delarue et al. 2018).

6.3.7.4 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 2016d). 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 NL; though their wintering areas are not well known, there have been year-round observations of this species in the waters off Nova Scotia and NL (COSEWIC 2005; DFO 2016d). The highest densities of fin whales tend to occur in offshore waters off NL during June–August (see Edwards et al. 2015). Modelling efforts have suggested that fin whales in offshore NL prefer deep cold waters, and their periodic abundance in the eastern NL offshore has been linked to seasonal aggregations of capelin (DFO 2016d). The key threats to fin whales as identified by DFO in the Management Plan for this species are habitat degradation from anthropogenic sound, changes in prey availability and quality, ship strikes, and entanglement in fishing gear (DFO 2017f).

The scientific committee of the IWC classifies the fin whales off the eastern US, Nova Scotia, and the southeastern coast of NL as a single stock (Hayes et al. 2017). However, Delarue et al. (2014) suggested that there are four distinct stocks in the Northwest Atlantic based on geographic differences in fin whale calls. An abundance estimate of 1,352 individuals (95 percent CI: 821 to 2,226) for the Canadian TNASS area was calculated in 2007 (Lawson and Gosselin 2009). Lawson and Gosselin (2011) provided a corrected abundance estimate of 1,555. The current best abundance estimate for the Western North Atlantic stock is 1,618 (CV=0.33), using surveys conducted in 2011 (Hayes et al. 2017). Fin whales are considered to be relatively common in and near the Project Area (Table 6.51; Figure 6-67). During the ESRF acoustic study, fin whales were by far the most commonly detected mysticete. This species was acoustically detected year-round in offshore waters of NL, including at the Sackville Spur acoustic recorder location (Delarue et al. 2018). The authors suggest that fin whales may remain in offshore waters of NL year-round versus migrating south during winter (Delarue et al. 2018).

6.3.7.5 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 Davis Strait (DFO 2016e). 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 2016e). There are no areas of critical habitat overlapping the Project Area.

Northern bottlenose whales are primarily found in offshore waters deeper than 500 m, often near the 1,000 m isobath (DFO 2016e). They are excellent divers; a tagged whale was recorded diving to 1,453 m; they can remain underwater for up to two hours (DFO 2016e). The species mainly feeds on squid, which typically dwell at or near the bottom (DFO 2016e).

The Scotian Shelf population is estimated at 143 individuals (O'Brien and Whitehead 2013), but there are no estimates of the size of the Davis Strait-Baffin Bay-Labrador Sea population or the total number of northern bottlenose whales in the Northwest Atlantic (COSEWIC 2011b). During the 2007 TNASS, 42 northern bottlenose whales were observed in NL 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 2011b). Northern bottlenose whales were sighted in Orphan Basin during geophysical survey monitoring programs in 2004 (three sightings, totalling nine whales; Moulton et al. 2005) and 2005 (seven sightings, totalling 21 individuals; Moulton et al. 2006). Preliminary photo-ID work has found that at least 78 different animals occurred in the Grand Banks, Flemish Pass, and Flemish Cap area during 2016-2017 (L.J. Feyrer, pers comm, 2018). Although genetic and other tissue analyses are underway at Dalhousie University based on samples collected from those individuals, results are not yet available to indicate whether animals in that area were from the Scotian Shelf or Davis Strait-Baffin Bay-Labrador Sea populations (L.J. Feyrer, pers comm, 2018). It is also possible that there are more than two populations of this species in Atlantic Canadian waters. Gomez et al. (2017) reported sightings in and north of the Flemish Pass; their habitat suitability modeling showed that parts of the Project Area are high priority areas for enhanced monitoring for this species. Northern bottlenose whale clicks have been detected in the Project Area between June and September (the extent of the recording period) (Maxner et al. 2018). The ESRF acoustic study provides support that waters near the Project Area are regularly used by northern bottlenose whales—this species was detected year-round (with nearly daily detections) at the "Sackville Spur" acoustic recorder site, located 13 km to the northwest of the Project Area (as well as a Labrador Shelf acoustic recorder; Delarue et al. 2018). Likewise, an acoustic recorder located in slope waters off the mid-Labrador coast ("Stn 13", which was in 1750 m water depth) indicated that northern bottlenose whales occurred there year-round with near daily acoustic detections (Delarue et al. 2018). Available sightings and acoustic recording information indicates that northern bottlenose whales regularly occur in and near the Project Area and that the Sackville Spur area may represent important habitat for this species (Figure 6-68; Table 6.52). It is also possible that other deepwater areas offshore NL, including slope waters off Labrador and the Orphan Basin, provide important habitat for northern bottlenose whales.

The main threats facing northern bottlenose whales include entanglement in fishing gear, oil and gas activities, and acoustic disturbance (COSEWIC 2011b; DFO 2017g). 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 2011b; DFO 2017g).

6.3.7.6 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 NL, Nova Scotia, and the northeastern US (DFO 2016f). Little is known of this species' habitat preferences and life history requirements.

Sowerby's beaked whale is most often observed in deep water (more than200 m) along the continental shelf edge and slope (COSEWIC 2007c; DFO 2016f). Submarine canyons appear to be of importance to this species, and they demonstrate a strong affinity for canyon habitats along the Scotian shelf (Whitehead 2013; DFO 2016f). 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 2016f). There is currently no population estimate for this species in Canada (DFO 2016f). There were no observations of Sowerby's beaked whale in the 2007 TNASS in NL waters (Lawson and Gosselin 2009). However, there are several stranding records for NL (DFO 2017h). Threats to the species include acoustic disturbance, entanglement in fishing gear, vessel strikes, and exposure to contaminants (COSEWIC 2007c; DFO 2017h). Sightings records for this species were rare marine mammal datasets, with no sightings recorded in the Project Area (Table 6.52; Figure 6-68). During the ESRF acoustic study, Sowerby's beaked whale vocalizations were recorded at the "Sackville Spur" site during spring, summer and fall but were absent during winter months (Delarue et al. 2018). This species was detected throughout the year on the acoustic recorders in slope waters off the south coast of NL.

6.3.7.7 Killer Whale

Killer whales (Northwest Atlantic/Eastern Arctic 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 Northwest Atlantic/Eastern Arctic population is not known (COSEWIC 2009d; Waring et al. 2015); however, sightings have been reported in the waters of NL (COSEWIC 2009d). Killer whale sightings are most common from May to September and have been more frequent over the last decade (Lawson and Stevens 2013; Waring et al. 2015).

The main threats facing killer whales are disturbance (both physical and acoustic), prey depletion, and contaminants, though the exact threats facing the Northwest Atlantic/Eastern Arctic population are not well documented (COSEWIC 2009d). One killer whale was observed in the 2007 TNASS off NL (Lawson and Gosselin 2009). While killer whales are believed to be relatively uncommon in the region, there were sightings recorded in the Offshore NL Area in the marine mammal observation records, including in the Project Area (Table 6.52 and Figure 6-68). Consistent with this, killer whale vocalizations were sporadically detected on acoustic recorders in the RSA (mostly in summer and fall), with no acoustic detections made at the "Sackville Spur" recorder location (Delarue et al. 2018).

6.3.7.8 Beluga Whale

The St. Lawrence Estuary population of beluga whale is listed as Endangered under SARA (Schedule 1) and Endangered by COSEWIC. 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 2014b). 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 2014b). The critical habitat of the St. Lawrence beluga whale is located in the Gulf of St. Lawrence, more specifically from the Upper Estuary, from the Battures aux Loups Marins down into the Saguenay River, and in the southern portion of the Lower Estuary (DFO 2012b). There are no areas of critical habitat overlapping the Project Area. As a result, their occurrence in the Offshore NL Area are considered 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 (DFO 2012b; COSEWIC 2014b). Belugas show strong site fidelity which makes them vulnerable to site-specific anthropogenic threats (COSEWIC 2014b). As a result, the St. Lawrence Estuary population has experienced slow declines since the early 2000s; it was estimated there were 889 individuals in 2012 (COSEWIC 2014b). There are no records of beluga whales in the Project Area based on the records (Figure 6-68) but there are several sightings in the RSA. During the ESRF acoustic study, beluga whale vocalizations were not detected (Delarue et al. 2018).

6.3.7.9 Harbour Porpoise

The Northwest Atlantic population of harbour porpoise is listed as a species of Special Concern by COSEWIC and Threatened under Schedule 2 of SARA. 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 2006c). Range-wide estimates for the abundance of harbour porpoise in eastern Canada do not exist (COSEWIC 2006c).

Observations made from by-catches in groundfish gill nets indicate that this species can be found along the entire coast of NL, especially along the south and west coasts (COSEWIC 2006c). Harbour porpoises 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 2006c). The major threat facing harbour porpoises is bycatch in fishing gear. There were 58 sightings of harbour porpoise during the 2007 TNASS conducted off NL, resulting in an abundance estimate of 1,195 (95 percent CI: 639 to 2,235) (Lawson and Gosselin 2009). Lawson and Gosselin (2011) provided a corrected abundance estimate of 3,326. Harbour porpoises were detected acoustically in shelf and deeper waters off the east coast of NL during July 2012 (Ryan et al. 2013). According to DFO, C-NLOPB, and Equinor Canada marine mammal observation records, harbour porpoise have been observed off eastern NL, within the Project Area (Table 6.52 and Figure 6-68). The ESRF acoustic study had limited ability to detect harbour porpoise clicks, which are high-frequency, in deep slope waters in and near the Project Area. Harbour porpoise clicks were detected year-round in shallower waters of the RSA (Delarue et al. 2018).

6.3.7.10 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 NL 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 2012h). Recent efforts in Atlantic Canadian waters have yielded new insight into the foraging and movements of leatherback sea turtles using both satellite telemetry and camera tags, providing footage of leatherbacks searching for, capturing and handling their prey (from the turtle's perspective). This footage revealed that this species finds its prey by entirely visual means and feeds only during daylight hours, predominantly within the top 30 m of the water column (DFO 2016g).

The leatherback turtle does not nest in Canada, but rather, nesting occurs on tropical and subtropical beaches during the spring (COSEWIC 2012h). In Atlantic Canada, leatherback sea turtles occur in both coastal and offshore waters, although most sightings are from the continental shelf (COSEWIC 2012h). Leatherback turtles outfitted with satellite telemetry tags and vessel-based sightings have been reported in the offshore waters off Nova Scotia and NL (DFO 2012c; Stewart et al. 2013; Dodge et al. 2014; Archibald and James 2016; Chambault et al. 2017). 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 is in the thousands (COSEWIC 2012h). Archibald and James (2016) suggested that Canadian waters may have the highest density of foraging leatherbacks anywhere throughout their range. Although critical habitat has not yet been designated for this species in Atlantic Canadian waters (ALTRT 2006), areas previously identified as important foraging habitat have now been identified in the proposed recovery strategy as critical habitat areas for leatherbacks (DFO 2016h). Three proposed critical habitat areas have been identified: The Southwestern Scotian Slope Area, the Gulf of St. Lawrence-Laurentian Channel Area, and the Placentia Bay Area (DFO 2016h). These areas are outside the RSA. 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 2012h). Hamelin et al. (2017) reported several incidental captures of leatherback sea turtles in fishing gear in the waters off NL, including on the Grand Banks. Offshore NL, leatherbacks have been regularly recorded but typically well south and east of the Project Area (Figure 6-65).

6.3.7.11 Loggerhead Sea Turtle

Loggerhead sea turtles are designated as Endangered under SARA (Schedule 1) and COSEWIC (SAR 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). The size of the population is not known (COSEWIC 2010d). Loggerhead sea turtles in Atlantic Canada are generally associated with the warm waters (20°C to 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 US waters (COSEWIC 2010d). Additionally, neonate loggerheads from Florida beaches equipped with satellite tags travelled south of the Grand

Banks after release (Mansfield et al. 2014), and a juvenile loggerhead equipped with a satellite tag in the Canary Islands was also tracked to just east of the Grand Banks (Varo-Cruz et al. 2016).

The greatest threats that loggerheads face in the Northwest Atlantic include bycatch, harvesting, and artificial lights at nesting beaches (DFO 2017i). Hundreds (n=701) of incidental captures of loggerhead sea turtles 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). However, loggerhead encounters in the longline fishery were reported south of the Flemish Cap for 2002-2008 (Paul et al. 2010). Loggerhead turtles are considered rare in the Project Area with recorded sightings occurring well south and east of the Project Area (Figure 6-65).

6.3.8 Overview of Marine Mammals and Sea Turtles

The existing biological environment for Marine Mammals and Sea Turtles is described in Section 6.3 and key species and their prey are summarized below as context for the overall effects assessment. Information on marine mammals and sea turtles within the Project Area was based primarily on regional government datasets, ESRF acoustic study, observations made during Equinor seabed surveys, and inferences from the scientific literature. The life history characteristics, foraging strategies, and prey of marine mammals in the Project Area are poorly understood.

The Project Area incorporates areas of the Flemish Pass and slopes of the Grand Bank and Flemish Cap in water depths ranging from 340 m to 1,200 m. The Core BdN area is located in the northern part of the Flemish Pass and overlaps part of the Sackville Spur. These slope and canyon waters provide important habitat for several species of marine mammals including baleen whales, larger toothed whales, dolphins, and to a lesser extent seals. Sea turtles are considered rare in the Project Area. As reviewed in Section 6.3, fin whales, humpback whales, northern bottlenose whales, sperm whales, and delphinids including long-finned pilot whales, Atlantic white-sided dolphin, short-beaked common dolphin, and white-beaked dolphin are considered common in the Project Area and have been detected there year-round. Fin whales are listed as Special Concern under Schedule 1 of SARA and it is uncertain which population of northern bottlenose whales occurs in the Project Area. Based on acoustic recordings, the Flemish Pass/Sackville Spur area is considered important year-round habitat for dolphins, sperm whales, and northern bottlenose whales (Delarue et al. 2018). There are no direct studies of marine mammal prey preferences and foraging strategies in the Project Area or LSA. Information for the RSA is dated and limited to a few species. Capelin and herring are considered large components for most marine mammal diets during the summer, with mackerel serving as an important prey species in the fall on the west coast of Newfoundland and southern Labrador (Lawson, J., DFO Research Scientist, pers. comm., 12 May 2020). Short-finned squid where at one time an important prey item for long-finned pilot whales in nearshore waters of Newfoundland (Mercer 1975) but it is uncertain if that is still the case. Likewise, sperm whales consume squid (Lien 1985) as do northern bottlenose whales (DFO 2016e). In addition to capelin, sand lance and euphausiids are considered important prey for most baleen whales (Mitchell 1973, 1974, 1975), which may occur in the Project Area including the more prevalent fin whale and humpback whale. The potential relationships amongst marine mammal prey and their place in the larger context of a marine food web is discussed briefly in Section 9.2.

6.3.8.1 Summary of Key Areas and Times

An overview of key areas and times for marine mammals and sea turtles off eastern NL was provided in the Eastern Newfoundland SEA (Section 4.2.3.6; Amec 2014a). An overview of Special Areas, including 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 6.53 along with a preliminary Representative Marine Area (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 6.4.2.5) overlaps with the Project Area and has been noted as having concentrations of cetaceans and phocids. With respect to their relevance to marine mammals and sea turtles, most EBSAs and the RMA in the region (Table 6.53) serve as feeding aggregation areas, with some of the coastally-located areas also providing migration corridors or breeding and whelping areas for seals.

Table 6.53 Select Special 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

Table 6.53 Select Special 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	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 NL 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 and beaked 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; however, they regularly occur west of the RSA in the Placentia Bay area. 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 NL 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, Sackville Spur, 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 individuals that do not travel south to breed, have the potential to be found in the area year-round. Most of the phocid species can be found here throughout the year, but hooded seals primarily occur in the region during the winter and early spring. Sea turtles are expected to be found offshore NL in their highest numbers during the summer and fall.

A summary of known and expected key timing for marine mammals and sea turtles offshore eastern NL is presented in Table 6.54 and Table 6.55, respectively.

Table 6.54 Overview of Potential Marine Mammal Presence in the RSA

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mysticetes (Baleen Whales)												
Blue whale												
Fin whale [a]												
Sei whale												
Humpback whale												
Minke whale												
North Atlantic right whale												
Bowhead whale												
Odontocetes (Toothed Whales)												
Sperm whale [1]												
Northern bottlenose whale [a]												
Sowerby's beaked whale												
Killer whale												
False killer whale												
Long-finned pilot whale												
White-beaked dolphin												
Atlantic white-sided dolphin												
Short-beaked common dolphin												
Risso's Dolphin												
Common bottlenose dolphin												
Atlantic spotted dolphin												
Spinner dolphin												
Striped dolphin												
Harbour porpoise												
Beluga whale												

Table 6.54 Overview of Potential Marine Mammal Presence in the RSA

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Phocids (Seals)												
Harbour Seal												
Harp Seal												
Hooded Seal												
Grey Seal												

Notes:
Dark blue-filled cells indicate month(s) when marine mammals are likely to occur at their highest density
Light blue-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 and/or highly unlikely
There are insufficient data to depict potential presence by month in the Project Area
[1] Data from the ESRF acoustic report indicate that this species may be more common within the RSA throughout the year than previously thought (Delarue et al. 2018).
Source: Modified from Husky Energy (2012), Amec (2014a), and BP (2016)

Table 6.55 Overview of Potential Sea Turtle Presence in the RSA

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sea Turtles												
Leatherback sea turtle					x	x	x	x	x			
Loggerhead sea turtle					x	x	x					
Green sea turtle												
Kemp's ridley turtle												

Notes:
Dark blue-filled cells indicate month(s) when sea turtles will occur at their highest density
Light blue-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

Various marine and coastal areas in NL 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 biological environmental setting, including marine fish and fish habitat, marine and migratory birds and marine mammals and sea turtles (including SAR). This section identifies and describes the associated special areas within the Project RSA, LSA, Project Area, Core BdN Development Area (see Figure 6-69). For the purposes of identifying overlaps between special areas and the Project, additional consideration is given to whether special areas are proximate to the LSA around the Project Area or vessel traffic route. Special areas that fall within the mapping window are displayed and labelled on the corresponding figure. Each table identifies the special areas within the RSA with corresponding distances from the nearest point of the boundary of the special area to the nearest point of the boundary of the various spatial areas defined for the Project EIS. If there is no linkage with the Project Area, it is concluded that there is no linkage with the Core BdN Development Area. Special Areas that are not within the Project RSA are identified on figures but not further described.

6.4.1 Approach and Key Information Sources

The Project Area falls within the geographic scope of the Eastern Newfoundland SEA (Amec 2014a), which provides an overview of special areas that were applicable at the time the report was prepared. This section builds upon the information presented in the SEA, and provides new or updated information on these or subsequently identified or designated special areas in eastern NL based on a literature review up to and including November 16, 2018. 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.

The current condition of coastal and offshore special areas including NAFO delineated areas has been considered as the baseline. The existing environment therefore includes the continuing effects of past activities such as fishing. Further, no information is available to characterize the environment of these areas prior to disturbance.

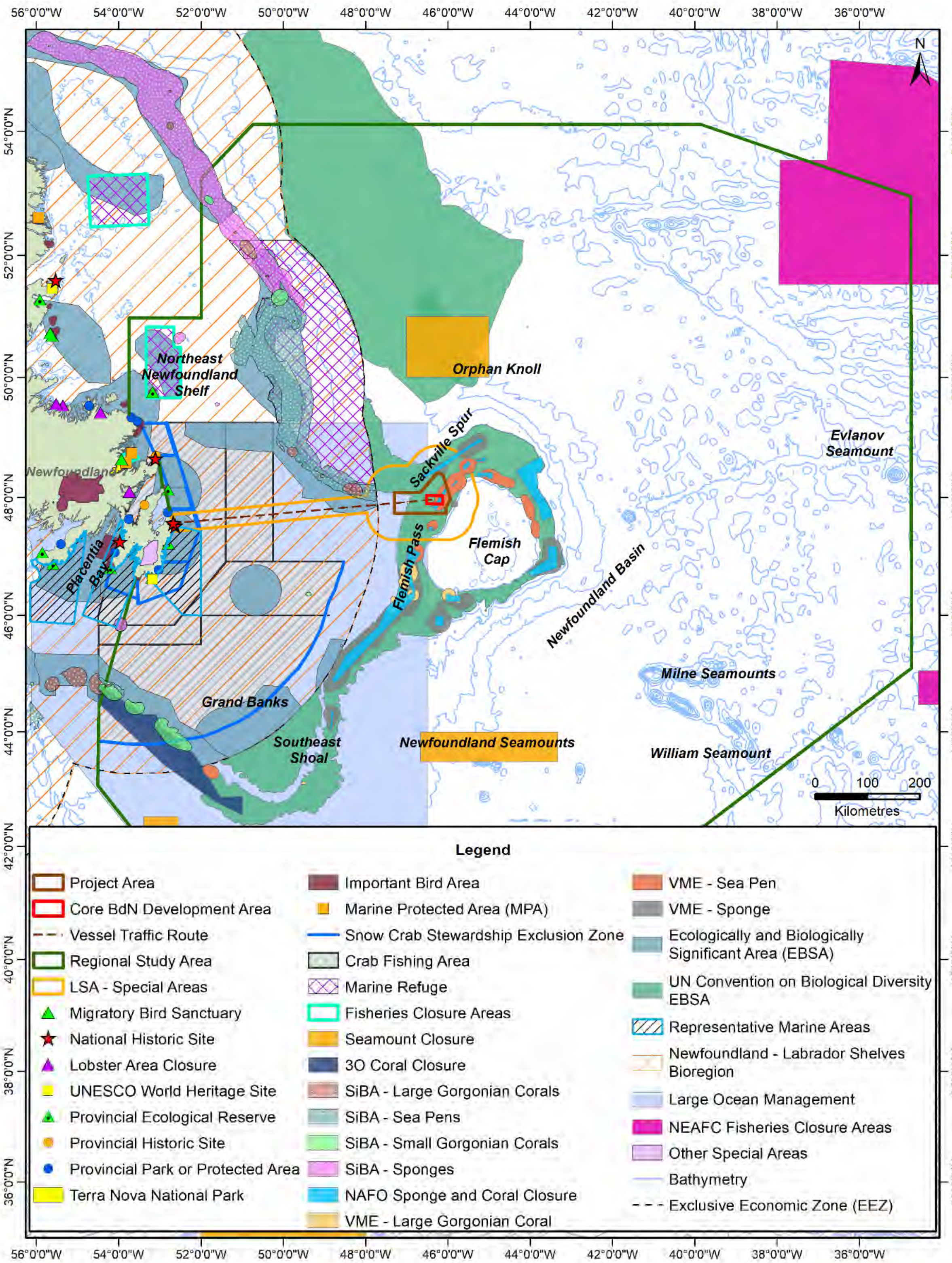

Figure 6-69 Special Areas in the RSA

A summary of these information sources and relevant documents that provided key information and data on special areas in the marine environment off eastern NL is provided in Table 6.56.

Table 6.56 Key Information Sources Used to Describe Special Areas

Reference	Relevant Studies and Documents
Amec (2014a)	Eastern Newfoundland SEA
BirdLife Canada (2016)	Important Bird Areas in Canada
DFO (2005)	Identification of Ecologically and Biologically Significant Areas
DFO (2007)	Northern Shrimp (Shrimp Fishing Areas 0-7 and the Flemish Cap): Resource Management Operations
DFO (2013)	Identification of Additional Ecologically and Biologically Significant Areas (EBSAs) within the Newfoundland and Labrador Shelves Bioregion
DFO (2014b)	Eastport Marine Protected Area (MPA) Case Study in Support of Ecosystems Goods and Services Valuation
DFO (2015c)	Integrated Fisheries Management, Plan Snow Crab (*Chionoecetes opilio*) - Newfoundland and Labrador Region Effective February 6
DFO (2016)	Refinement of Information Relating to Ecologically and Biologically Significant Areas (EBSAs) identified in the Newfoundland and Labrador Bioregion
DFO (2017b)	Report on Canada's Network of Marine Protected Areas
DFO (2018a)	Marine Protected Areas and Areas of Interest
DFO (2018b)	New Marine Refuges off the Coasts of Nunavut and Newfoundland and Labrador
EMPAAC (2013)	Eastport Marine Protected Areas Management Plan
Fisheries and Land Resources (2018)	Wilderness and Ecological Reserves
Government of Canada (2011)	National Framework for Canada's Network of Marine Protected Areas
NAFO (2015)	NAFO Fishing Closures
NAFO (2016b)	NAFO Strengthens its Protection Measures for Habitats and Species in the Northwest Atlantic
NAFO (2018)	Northwest Atlantic Fisheries Organization Conservation and Enforcement Measures
PB / GB LOMA Secretariat (2012)	Placentia Bay/Grand Banks Large Ocean Management Area Integrated Management Plan (2012 to 2017)
Parks Canada (2017)	National Marine Conservation Areas
Templeman, N.D. (DFO) (2007)	Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas
Tourism, Culture, Industry and Innovation (TCII) (2018)	Provincial Parks, Provincial Historic Sites
UN Convention on Biodiversity (2013)	Ecologically or Biologically Significant Areas (EBSAs)

Table 6.56 Key Information Sources Used to Describe Special Areas

Reference	Relevant Studies and Documents
UN Fisheries and Agricultural Organization (FAO) (2015)	Northeast Atlantic Fisheries Commission (NEAFC) Fisheries Closure Areas (FCAs)
UN FAO (2016)	VME Database
WG-EAFM (2008)	Report of the NAFO Joint Fisheries Commission-Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management. 26 to 30 May 2008. Dartmouth, Nova Scotia. NAFO SCS Doc. 08/10. Serial No. N5511
WG-EAFM (2016)	Report of the NAFO Joint Fisheries Commission-Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management. 10 to 12 August 2016. Halifax, Nova Scotia. NAFO FC-SC Doc. 16/03 Revised. Serial No. N6612
WWF (2012)	NAFO Supplement #2: VMEs
Wells, N. (DFO) (2018)	Refined Placentia Bay-Grand Banks Large Ocean Management Areas
Wells, N. (DFO) (2019)	Shape files for Significant Benthic Areas (SiBAs)

6.4.2 Canadian Designations of Special Areas and their Management

In Canada, various pieces of legislation and other processes are used to protect and conserve marine ecosystems. In 2016, the Government of Canada signed the United Nations Convention on Biological Diversity (UNCBD). Canada has committed to the UNCBD's Aichi Target 11, which includes a conservation objective of 10 percent of marine and coastal areas by 2020. In 2017, the Canadian Council of Fisheries and Aquaculture Ministers (CCFAM) prepared the *National Framework for Canada's Network of Marine Protected Areas* to provide a progress update and DFO announced that Canada had achieved an interim target of five percent conservation of marine and coastal areas (CCFAM 2017; DFO 2017a). 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 Area

Canada's Oceans Strategy (DFO 2002) outlines the federal government's approach to marine conservation through integrated resource management. DFO has defined 13 marine bioregions in the marine areas of Canada within the EEZ. Oceanographic and bathymetric similarities are important factors in defining marine habitats and as the ecological base for ocean management decisions (DFO 2002; Government of Canada 2011). The waters adjacent to the province of NL are included within two of these bioregions: 1) the Gulf of St Lawrence on the west coast of Newfoundland and 2) the NL Shelves, which extend from the east coast of NL to the limit of the EEZ (Figure 6-70). As the Project Area is outside the Canadian EEZ, it is not located within either of the DFO-designated bioregions. The LSA around the vessel traffic route intersects with the NL Shelves Bioregion. The LOMA is discussed below.

Within Canada's marine bioregions, DFO has identified five priority 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 marine areas off NL are included within the PBGB-LOMA, which includes more than 500,000 km² of nearshore and offshore areas of the Grand Banks (Figure 6-70, Government of Canada 2011). The PBGB-LOMA intersects with a portion of the Core BdN Development Area and Project Area, and the vessel traffic route transects the LOMA, as illustrated in Figure 6-70. 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 regarding resource use within the area (PBGB-LOMAS 2012).

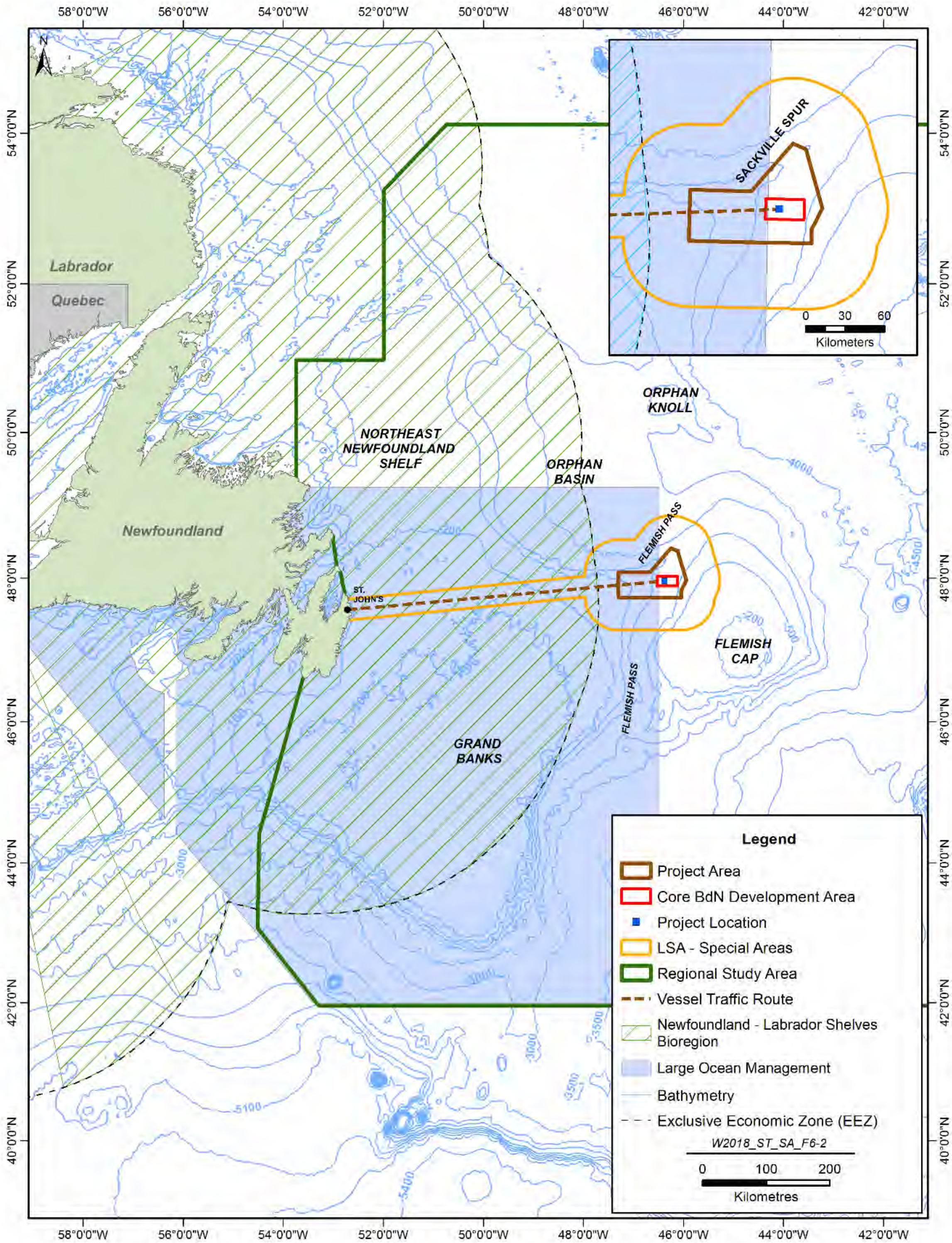

Figure 6-70 NL Shelves Bioregion and Placentia Bay/Grand Banks Large Ocean Management Area

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 2018d).

Three MPAs are located in the coastal waters of NL and two of these are within the Project RSA. Gilbert Bay MPA does not intersect with the RSA and is therefore not included in this discussion. None of the MPAs in the RSA, intersect with the Project Area or LSA (Figure 6-71; Table 6.57). Certain activities are prohibited within the NL MPAs including disturbing, damaging, destroying or removing living organisms or habitat; or depositing, discharging or dumping substances that may have the same result.

In 2017, the Government of Canada announced a consultation period on proposed Laurentian Channel Marine Protected Area Regulations for the Laurentian Channel AOI off the south coast of NL and the process of designating this MPA is ongoing. The Project Area and LSA do not intersect with the AOI. Within the proposed Laurentian Channel MPA, certain oil and gas activities (including exploration and production) may be permitted in specified areas and prohibited during sensitive foraging periods for leatherback sea turtles and mating periods for porbeagle sharks (DFO 2018d) (Figure 6-71; Table 6.57).

Table 6.57 Marine Protected Areas and Areas of Interest in the RSA

MPA	Rationale for Identification / Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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. Total area of 2.1 km^2 (2 islands)	536	478	136
Eastport-Round Island MPA		545	487	127
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 NL Shelves Bioregion. Area: 11,619 km^2	8,145	753	367
Source: EMPAAC (2013); DFO (2018d)				

DFO is currently undertaking various initiatives towards preparing a MPA Network Strategy and Plan for the NL Shelves Bioregion in consultation with federal and provincial agencies, Indigenous groups, industry and conservation groups. These initiatives include improving scientific knowledge and reviewing design strategies and targets for a MPA network (CCFAM 2017; DFO 2017j) (Figure 6-71).

In September 2018, the National Advisory Panel on MPA Standards submitted its final report to DFO. The report makes various recommendations regarding consultation and collaboration with communities, Indigenous Peoples, and other stakeholders. It also recommends incorporation of Indigenous knowledge in planning and managing MPAs. Regarding permitted uses, the report indicates that Canada should adopt the International Union for the Conservation of Nature standards and guidelines, which prohibit industrial activities such as oil and gas exploration and production, mining, dumping, and bottom trawling in MPAs. The report also recommends that where industrial activities are permitted to occur in other conservation areas, that the federal Government ensure that effective legislation or regulation is used to avoid or mitigate risks to biodiversity (DFO 2018e). These recommendations are currently under consideration by the Government of Canada.

6.4.2.3 Marine Refuges

Since December 2017, DFO has designated 14 Marine refuges in Newfoundland waters, 11 of which are in the NL Shelves Bioregion (Figure 6-71). Three of these marine refuges are within the RSA (Table 6.58). A small portion of the Northeast Newfoundland Slope Closure intersects the LSA.

Table 6.58 Marine Refuges in the RSA

Marine Refuge	Rationale for Identification / Designation	Distance to Special Area (km)		
		CBDN	PA	LSA
Northeast Newfoundland Slope Closure (formerly known as Tobin's Point)	Dense aggregations of corals provide niche space for other organisms. Prohibitions for bottom contact fishing activities. Area: 46,833 km²	92	34	Intersect
Funk Island Deep Closure	Conserves seafloor habitat important to Atlantic cod. Bottom trawl, gillnet and longline fishing activities are prohibited. Area: 7,274 km²	475	420	214
3O Coral Closure	Bottom fishing is prohibited to protect concentrations of corals and sponges. Area: 10,422 km²	646	588	321
Source: DFO (2019)				

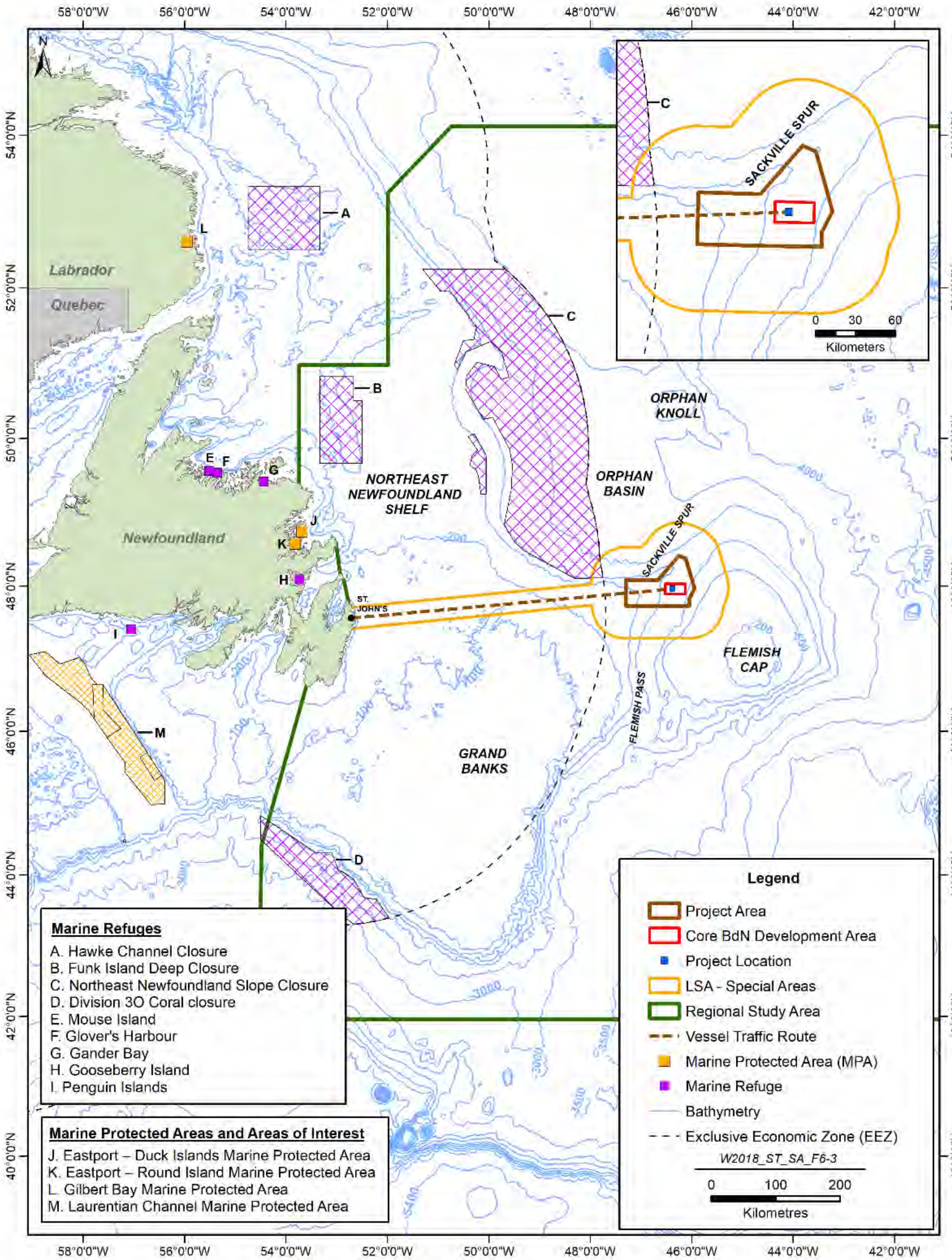

Figure 6-71 Canadian Marine Protected Areas/Areas of Interest and Marine Refuges

Canada committed to protecting 10% of marine and coastal areas by 2020. Marine refuges are a key component of conservation measures to meet this target. Marine refuges, which are established through licence conditions or variation orders under the *Fisheries Act*, are not specifically designed to address long-term biodiversity objectives, and are subject to potential amendments. Currently, any areas within a marine refuge, or other effective area-based conservation measure, where oil and gas extraction occurs will not be included in Canada's marine conservation targets (DFO 2019a; Cision 2019). The BdN Project Area does not intersect with any established marine refuges.

6.4.2.4 Fisheries Closure Areas within Canada's Exclusive Economic Zone

Within the Canadian EEZ, a number of marine areas off eastern NL have been closed to specific fishing activities through various means including voluntary closures, co-management approaches, licencing restrictions and/or under the *Fisheries Act* (Figure 6-72). FCAs are intended to protect and conserve productive fish and shellfish habitat for commercially important species and to permit ongoing monitoring and research (DFO 2007, 2014b, 2015c, 2017c; EMPACC 2013). Aside from the noted fishing restrictions, no other resource extraction activities are prohibited in these areas (Table 6.59). None of the FCAs intersect with the Project Area. However, the LSA around the vessel traffic route transects Crab Fishing Areas 6C and Near Shore (Table 6.59). The Hawke Box FCA and various Lobster Area Closures are outside of the RSA.

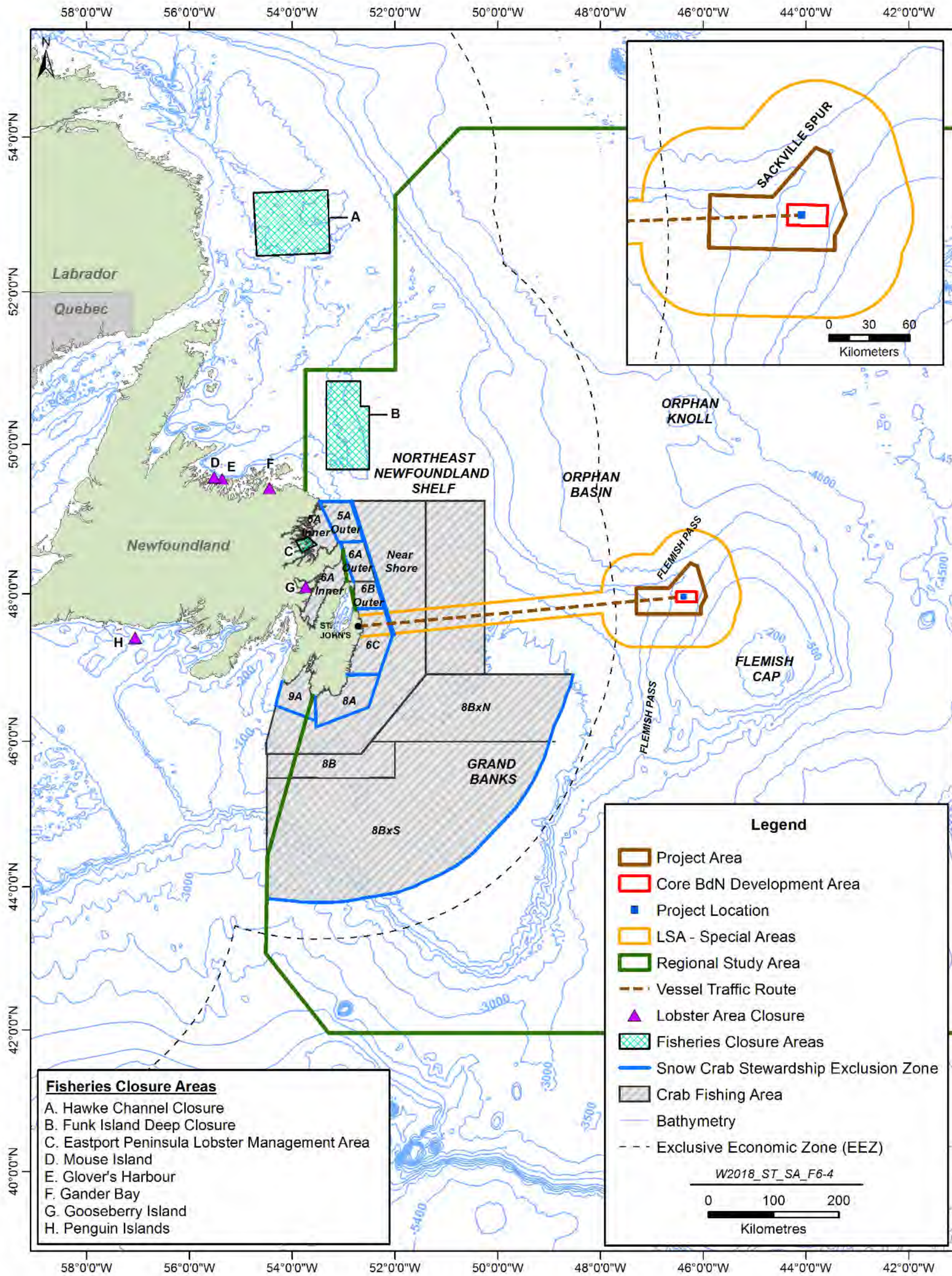

Figure 6-72 Canadian Fisheries Closure Areas

Table 6.59 Fisheries Closure Areas in the RSA

Closure Area	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBDN	PA	LSA
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*. Area: 400 km²	523	465	122
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. Area: 7,272 km²	475	420	214
Crab Fishing Area 5A	Snow crab fishing is prohibited in various Stewardship Exclusion Zones, which are 0.5 or 1.0 NM wide corridors along the length of crab fishing area boundaries to delineate fishing areas and provide a refuge area for snow crab. These Exclusion Zones are portions of NAFO 3LNO inshore and mid shore fishing areas in Bonavista Bay, Trinity Bay, Conception Bay, the Eastern Avalon and St. Mary's Bay. Area not available.	457	399	108
Crab Fishing Area 6A		456	399	51
Crab Fishing Area 6B		426	369	6
Crab Fishing Area 6C		420	359	Intersect (TR)
Crab Fishing Area 8A		450	389	57
Crab Fishing Area – 8BX		187	130	89
Crab Fishing Area 9A		550	490	113
Near Shore		415	356	Intersect (TR)
Source: DFO (2007, 2014b, 2015, 2017); EMPAAC (2013)				

6.4.2.5 Ecologically and Biologically Significant Areas

DFO identifies 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.

In 2007, DFO identified 11 EBSAs within the PBGB-LOMA through a ranking process using criteria of fitness consequence, aggregations, uniqueness, naturalness and resilience NL (Templeman 2007). In 2013, 15 additional EBSAs were identified in the NL Shelves Bioregion outside of the PBGB-LOMA (DFO 2013). In 2016-2017, DFO revaluated the PBGB-LOMA EBSAs to align with the process that was used to delineate the remainder of the NL Shelves Bioregion EBSAs (DFO 2016b). The amended PBGB-LOMA EBSAs, along with the rest of the NL Bioregion EBSAs are shown in Figure 6-73.

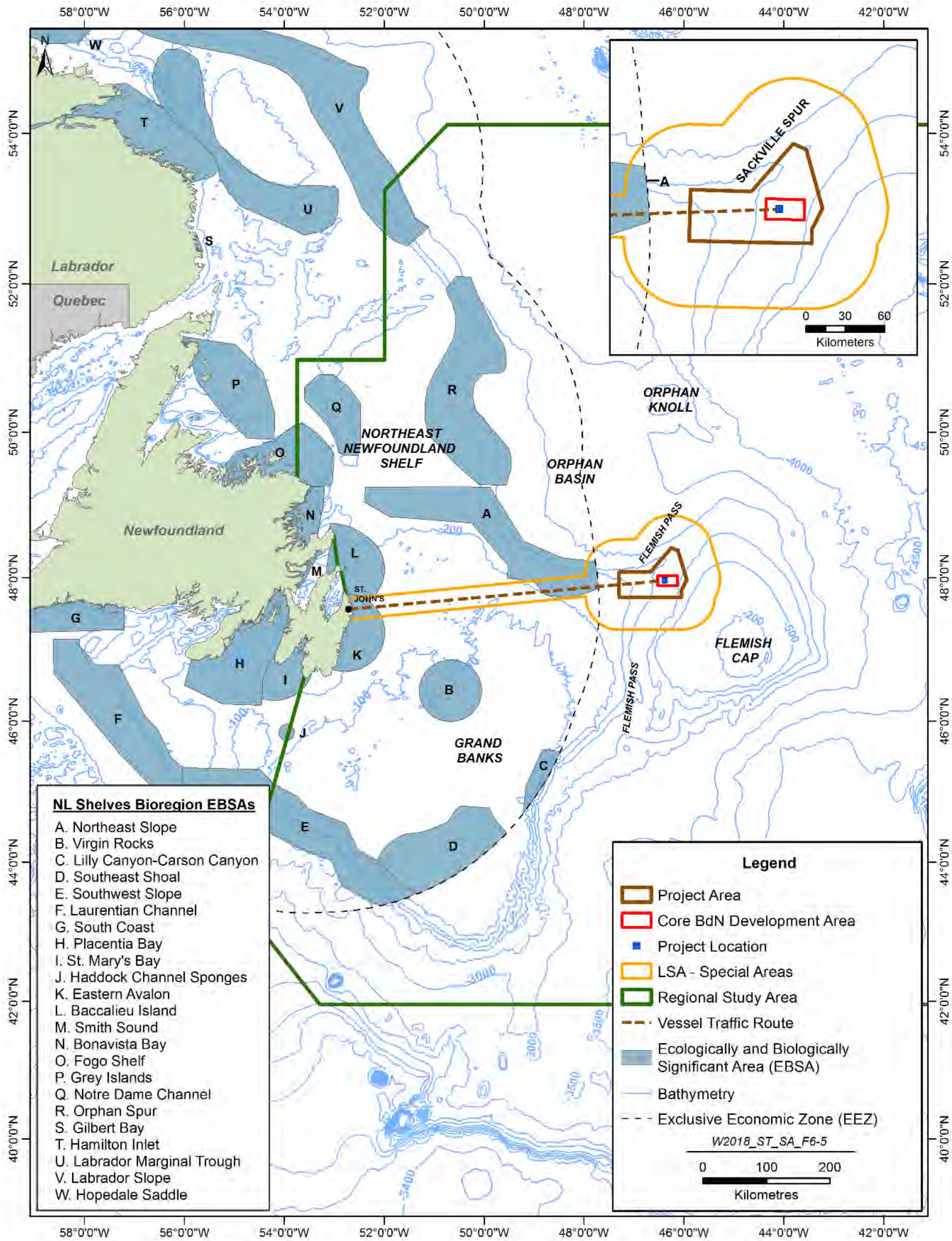

Figure 6-73 Canadian Ecologically and Biologically Significant Areas in the RSA

Complete detailed information on the revised PBGB-LOMA EBSA areas have not yet been released publicly (N. Wells pers comm 2018). Based on the draft information, the existing PBGB-LOMA EBSAs have generally increased in area, five new EBSAs have been delineated, two areas are no longer listed as EBSAs and the total combined EBSA area has been increased by 26 percent.

Portions of the PBGB-LOMA EBSAs that previously extended beyond the Canadian EEZ into the NAFO regulatory area are no longer considered to be within EBSA boundaries (though they may still be identified and/or protected through international processes). The Southeast Shoal EBSA has been reduced in area as a large portion was outside of the EEZ prior to the refinement exercise. Portions of the Northeast Slope and the Lilly Canyon-Carson Canyon EBSAs, beyond the EEZ, are now also considered to be outside of EBSA boundaries though the overall areas of these EBSAs have been increased within the EEZ. Descriptive information is not yet available for the newly identified EBSAs: Haddock Channel Sponges, St. Mary's Bay, Bonavista Bay, Baccalieu Island and South Coast (Figure 6-73).

None of the Canadian EBSAs intersect with the Project Area. The LSA around the Project Area intersects the Northeast Slope EBSA (Figure 6-73). This EBSA along with eastern Avalon and Baccalieu Island EBSAs also overlap with the LSA around the TR. Southern Pack Ice EBSA does not have a defined geographic area and may intersect with Project Study Areas. Table 6.60 provides a description of each EBSA within the RSA; EBSAs which are outside the RSA are not included.

Table 6.60 Canadian Ecologically and Biologically Significant Areas in the RSA

EBSA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Northeast Slope	High aggregations of Greenland halibut and spotted wolffish, which congregate in spring. Concentrations of cetaceans, pinnipeds and corals. Area: 19,731 km²	89	31	Intersect (PA/TR)
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. Area 7,294 km²	308	247	80
Lilly Canyon-Carson Canyon	Concentration, reproduction and feeding area for Iceland scallop. Aggregation and refuge/overwintering for cetaceans and pinnipeds. Area: 2,180 km²	300	257	207
Southeast Shoal	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. Area: 15,402 km²	435	386	310

Table 6.60 Canadian Ecologically and Biologically Significant Areas in the RSA

EBSA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Southwest 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. Area: 25,181 km²	610	552	273
St. Mary's Bay	Significant colonies and foraging area for common murre, northern gannet, razorbill and black-legged kittiwake. Aggregations of harlequin duck (species of Special Concern under SARA), salmon, capelin, common eider, Mysticetes functional group, hooded seal, leatherback turtle. Area: 3,989 km²	527	468	63
Haddock Channel Sponges	Largest sponge SBA on the shelf in the study area. Important aggregations of capelin and American plaice. Area: 490 km²	600	539	189
Eastern Avalon	Seabird feeding areas. Cetaceans, leatherback turtles and seals feed in the area from spring to fall. Area: 5,948 km²	418	358	Intersect (TR)
Baccalieu Island	Noted aggregations of killer whales, capelin, shrimp, plankpiscivores, spotted wolfish and seabird functional groups. Capelin spawning area. Important foraging area for Atlantic puffin, black-legged kittiwake and razorbill. Intersects an IBA and a Provincial Seabird Ecological Reserve. Area: 6,922 km²	409	351	Intersect (TR)
Bonavista Bay	Significant aggregations of eelgrass, salmon, killer whale, harbour seal, Mysticetes and duck functional groups. Important area for capelin and sea lamprey spawning. Significant foraging area for black-legged kittiwake and tern species. Area: 3,141 km²	508	450	103
Fogo Shelf	Funk Island, the largest common murre colony in the western North Atlantic and the only northern gannet breeding colony in the NL 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. Area: 9,403 km²	502	445	175
Notre Dame Channel	Recognized for cetacean feeding and migration. Frequented by several species of seabirds. Harp seals feed in the area during winter. Area: 6,222 km²	479	424	216

Table 6.60 Canadian Ecologically and Biologically Significant Areas in the RSA

EBSA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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). Area: 21,569 km²	264	214	147
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.	614	579	520
Southern Pack Ice	Seasonal pack ice recognized for its importance to marine mammals and seabirds.	Not applicable		
Source: Templeman (2007); DFO (2013, 2016e, 2019); Amec (2014a); N Wells (pers comm 2018)				

6.4.2.6 National Marine Conservation Areas

Parks Canada establishes National Marine Conservation Areas (NMCAs) under the National Marine Conservation Areas Act, 2002. The agency's long-term goal is to establish a network of NMCAs to protect and conserve representative ecosystems and key features within each of Canada's 29 marine regions (Parks Canada 2019). No NMCAs have been established in the RSA.

NMCAs are established through a process in which candidate areas are identified within a marine region. Three Representative Marine Areas (RMAs) have been identified within the Grand Banks Marine Region and one will be proposed as an NMCA. RMA III East Avalon/Grand Banks falls within the RSA (Parks Canada 2019) (Figure 6-74). Detailed descriptions of RMAs are not yet publicly available (Table 6.61).

Table 6.61 Representative Marine Areas in the RSA

RMA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
III-East Avalon / Grand Banks	Not Available. Area: 10,867 km2	415	356	Intersect (TR)
Source: Parks Canada (2019)				

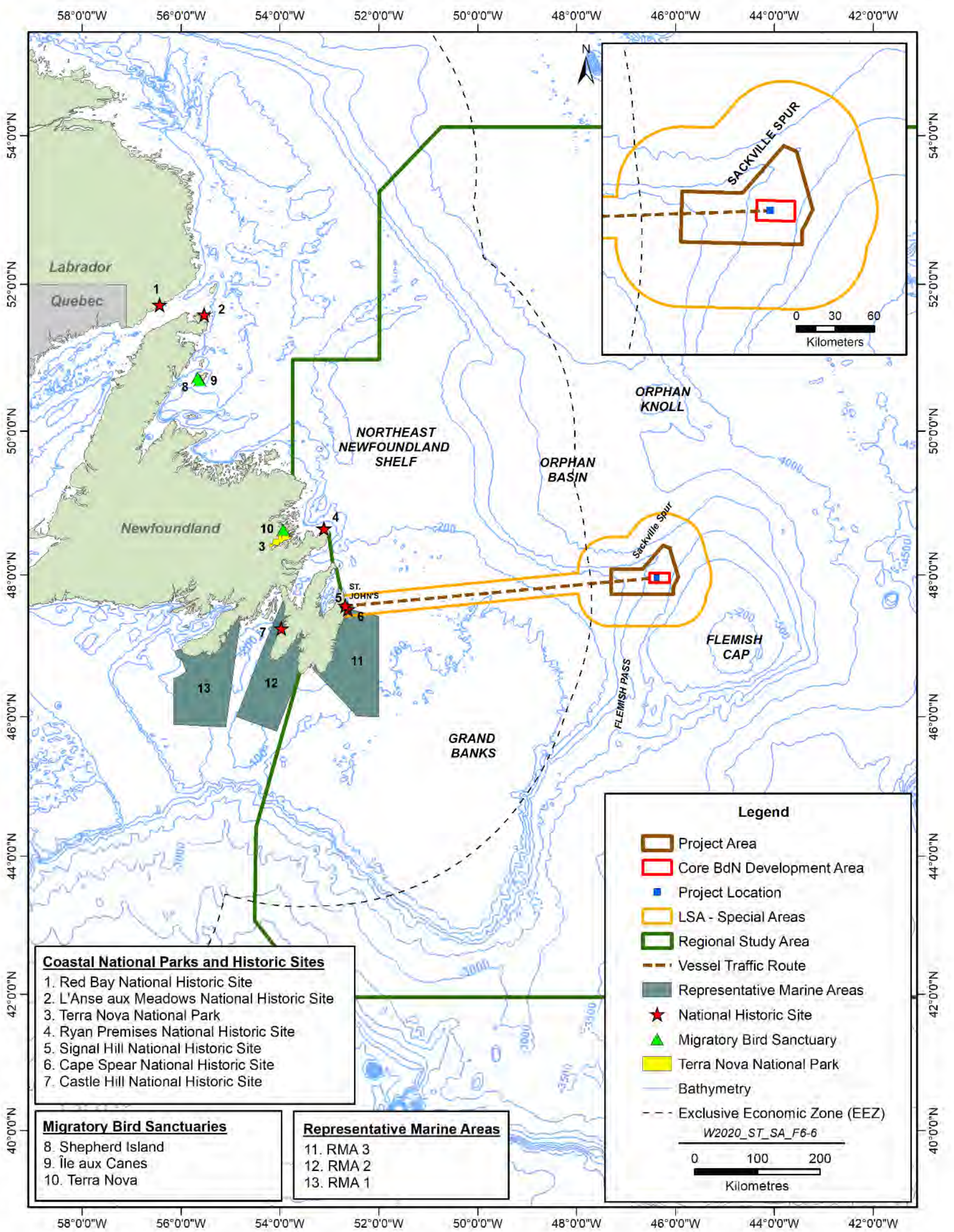

Figure 6-74 Canadian RMAs, Migratory Bird Sanctuaries, National Parks and National Historic Sites

6.4.2.7 National Wildlife Areas, Marine National 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 have been identified in NL; the nearest are in Cape Breton, Nova Scotia and the Northumberland Strait, New Brunswick (EC 2016c), which are outside the Project RSA.

In 1994, the *Canada Wildlife Act* was amended to allow for the identification of Marine National Wildlife Areas (MNWAs) beyond the 12 NM territorial sea limit out to Canada's 200 NM 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 2016d). Thus, none are located within the Project RSA.

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 (EC 2010b).

No MBSs have been identified in Labrador. Two are located on the Island of NL. Table 6.62 provides a description of Terra Nova MBS, which does not intersect with the LSA (Figure 6-74).

Table 6.62 Migratory Bird Sanctuaries in the RSA

MBS	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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. Area: 12 km²	553	495	137
Source: EC (2016c)				

6.4.2.8 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: 1) Gros Morne and 2) Terra Nova. The Torngat Mountains National Park is in northern Labrador and the Mealy Mountains National Park Reserve is in southeastern Labrador (Parks Canada 2018). Terra Nova National Park, along with various National Historic Sites

(NHS), designated through the *Historic Sites and Monuments Act*, are in coastal areas of NL (Parks Canada 2016).

Mealy Mountain National Park and Torngat Mountain National Park are outside the RSA. While Terra Nova National Park is within the RSA, it does not intersect with the Project Area or (Figure 6-74). Signal Hill and Cape Spear Lighthouse National Historic Sites intersect with the LSA around the TR (Table 6.63). National historic sites outside the RSA are not discussed.

Table 6.63 Coastal National Parks and Historic Sites in the RSA

Park/National Historic Site	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBDN	PA	LSA
Cape Spear National Historic Site	Restored historical lighthouse and lighthouse keepers home on most eastern point of North America.	460	401	Intersect (TR)
Signal Hill National Historic Site	Historic site of wireless communication and military defence of St. John's Harbour.	463	405	Intersect (TR)
Ryan Premises National Historic Site	Restored merchant's premises, displaying artifacts focusing on traditional NL seafaring life.	493	435	108
Terra Nova National Park	Protects 400 km² of boreal forest and rocky coastlines as a representative example of Natural Region 35: Eastern NL Atlantic Region. Area: 399 km²	553	495	137
Source: Amec (2014a); Parks Canada (2016, 2018)				

6.4.2.9 Significant Benthic Areas

Within the NL Shelves Bioregion, DFO has defined four types of Significant Benthic Areas (SiBAs), which are aggregations of sea pens, sponges, small gorgonian corals and large gorgonian corals, that form habitat for other species (DFO 2019b). In recent DFO modelling exercises, most of the shelf and slopes off Labrador were classified as likely to have sponge presence with the highest predicted sponge presence probabilities along the Labrador Slope and Saglek Bank. Based on the results of modelling, the highest predicted presence probabilities for sea pens were identified in the Laurentian Channel and on the slope of the Northeast Newfoundland Shelf. The highest predicted presence probabilities of large gorgonian corals were identified off the edge of Saglek Bank and Slope in Northern Labrador. The highest predicted small gorgonian presence probabilities were identified along the southwest slope of the Grand Banks (Kenchington et al. 2014).

Each of the four types of SiBAs identified through modelling, occur in the RSA (Figure 6-75 Significant Benthic Areas). None intersect with the CBDN or the Project Area. One SiBA identified for Sea Pens intersects with the LSA for the PA and traffic route and one identified for Large Gorgonian Corals intersects with the traffic route (Table 6.64). Detailed descriptions of the SiBAs are not publicly available.

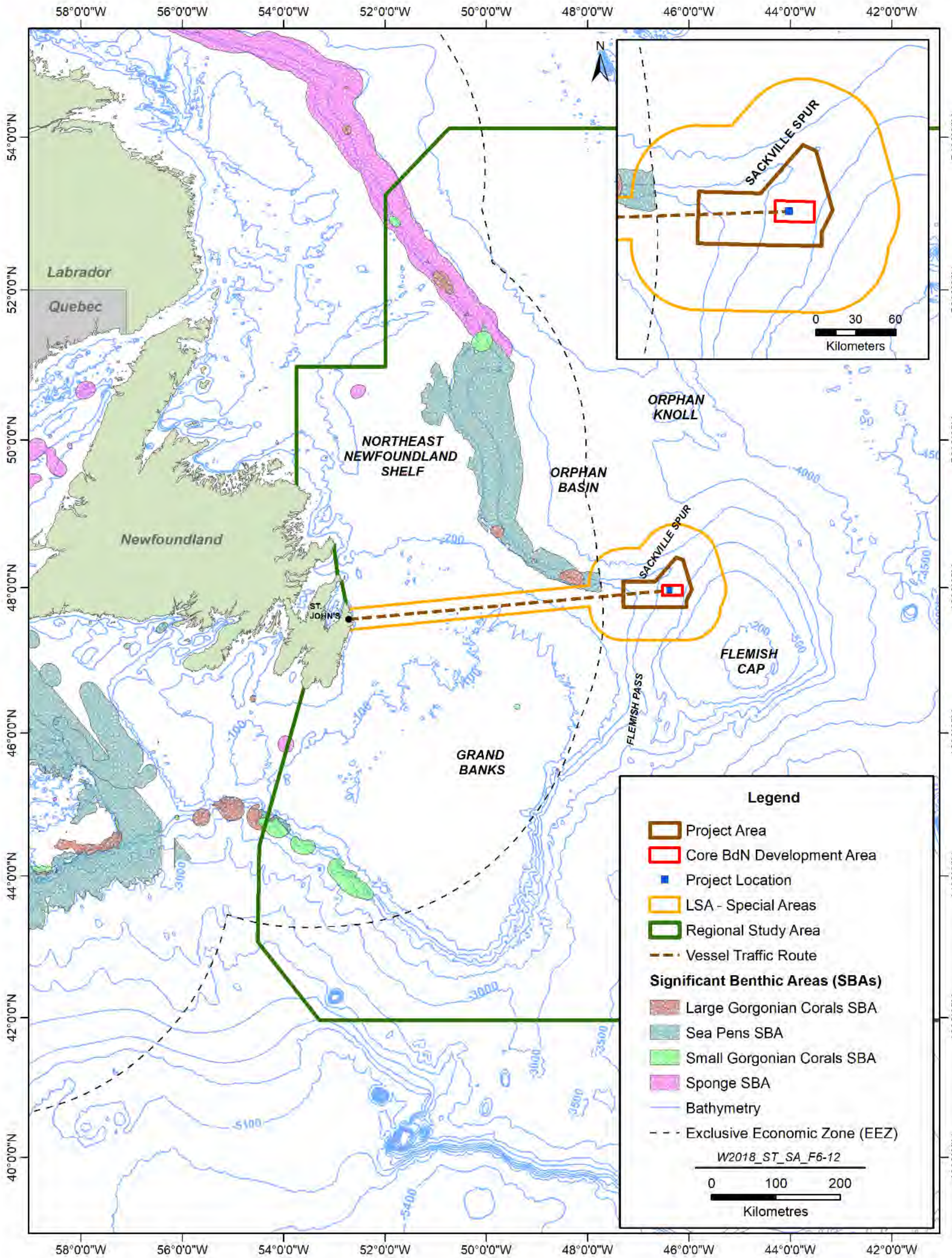

Figure 6-75 Significant Benthic Areas

Table 6.64 Significant Benthic Areas in the RSA

SiBA	Distance to Special Area (km)		
	CBDN	PA	LSA
Sea Pens	90	32	Intersect
Sponges	309	267	189
Large Gorgonian Corals	116	58	Intersect (TR)
Small Gorgonian Corals	272	215	141
Source: N. Wells (pers comm 2019)			
Note: Numbers in parentheses, indicate the number of this type of SiBA intersecting.			

NL Designations and their Management

The Government of NL establishes and manages six types of Provincial Parks and Protected Areas, each of which is designed to fulfill conservation and/or cultural mandates. The Department of Tourism, Culture, Industry and Innovation (TCII) is responsible for wilderness and ecological reserves and provincial parks, and the Department of Fisheries and Land Resources (FLR) 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 (FLR 2018).

6.4.2.10 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 (FLR 2018). Five seabird ecological reserves and two fossil ecological reserves are located in coastal areas of the RSA (Figure 6-76, Table 6.65). None intersect with the Project Area or LSA.

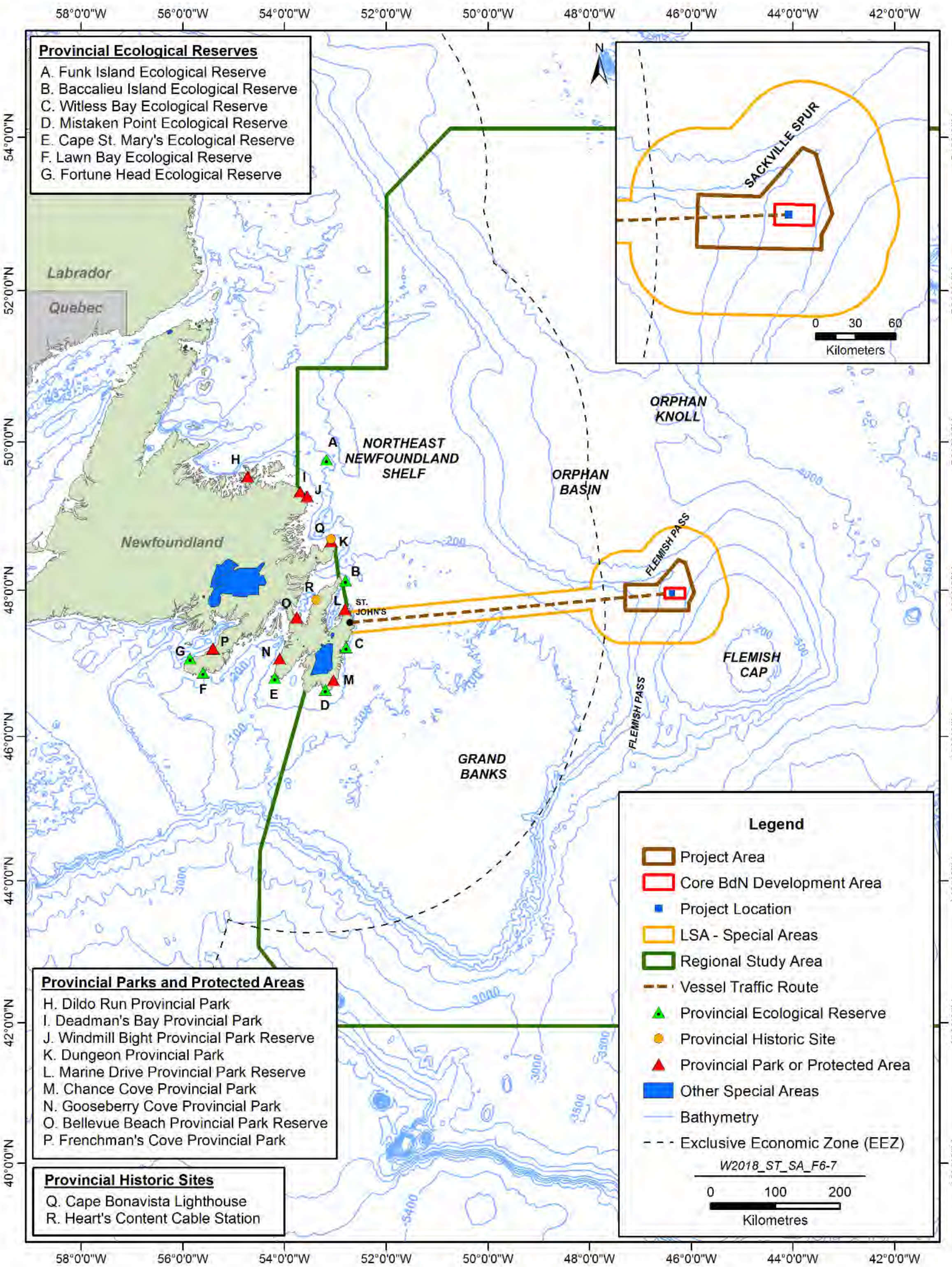

Figure 6-76 Provincial Protected and Special Areas

Table 6.65 Coastal Provincial Ecological Reserves in the RSA

Reserve	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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. Area: 30.5 km² on four islands	477	418	25
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. Area: 22.9 km²	468	410	47
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. Area: 5.7 km²	524	463	96
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. Area: 5.4 km²	524	469	230
Sources: Amec (2014a); FLR (2018); UNESCO (2017)				

6.4.2.11 Provincial Parks and Protected Areas

Through the *Provincial Parks Act* and *Regulations*, the Government of NL 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 (TCII 2018). Three provincial parks and protected areas, in coastal areas of eastern NL, are within the RSA (Table 6.66). As illustrated, none intersect with the Project Area or LSA (Figure 6-76).

Table 6.66 Coastal Provincial Parks and Protected Areas in the RSA

Park/Protected Area	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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. Area: 20.68 km²	507	447	78
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. Area: 0.02 km²	491	433	110
Deadman's Bay Provincial Park	Protects a sandy beach. Iceberg watching. Natural or scenic attraction. Park Type: Day use. Area: 0.70 km²	546	489	195
Source: TCII (2018)				

6.4.2.12 Provincial Historic Sites

The Government of NL 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 NL. Table 6.67 provides a description of Provincial historic sites in coastal areas of the RSA. None intersect with the Project Area and LSA (Figure 6-76).

Table 6.67 Coastal Provincial Historic Sites in the RSA

Historic Site	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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.	512	454	53
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.	492	434	113
Source: TCII (2018)				

6.4.3 International Designations of Special Areas and their Management

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

6.4.3.1 United Nations Convention on Biological Diversity

In 1992, Canada ratified the UNCBD, which came into effect in December 1993 (UNCBD 2017). The Convention is an important step towards conservation of global biodiversity and includes ocean habitat of eastern NL. Figure 6-77 illustrates the location of EBSAs in the Project RSA. The Slopes of the Flemish Cap and Grand Bank EBSA intersects with the Core BdN Development Area, Project Area and the LSA (Table 6.68). The Labrador Sea Deep Convection Area, a general area that changes from year to year is outside of the RSA.

Table 6.68 UN Convention on Biological Diversity EBSAs in the RSA

EBSA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Seabird Foraging Zone in the Southern Labrador Sea	Supports globally significant populations of marine vertebrates, including an estimated 40 million seabirds annually. Important foraging habitat for seabirds, including 20 populations of over-wintering black-legged kittiwakes, thick-billed murres and breeding Leach's storm-petrels. Encompasses the pelagic zone of the Orphan Basin, continental shelf, slope and offshore waters inside and outside the Canadian EEZ. Area: 152,841 km²	172	131	81
Orphan Knoll	Seamounts typically support endemic populations and unique faunal assemblages. This seamount is an island of hard substratum with uniquely complex habitats that rise from the seafloor of the surrounding deep, soft sediments of the Orphan Basin. Although close to the adjacent continental slopes, Orphan Knoll is much deeper and appears to have distinctive fauna. Fragile and long-lived corals and sponges have been observed and a Taylor Cone circulation provides a mechanism for retention of larvae. Area: 12,742 km²	208	168	118

Table 6.68 UN Convention on Biological Diversity EBSAs in the RSA

EBSA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Slopes of the Flemish Cap and Grand Bank	Contains most of the aggregations of indicator species for VMEs in the NAFO Regulatory Area. Includes NAFO closures to protect corals and sponges and a component of Greenland halibut fishery grounds in international waters. A high diversity of marine taxa, including Threatened and listed species, are found within the EBSA. Area: 87,817 km²	Intersect	Intersect	Intersect (PA)
Southeast Shoal and Adjacent Areas on the Tail of the Grand Banks	Southeast Shoal is a shallow, relatively warm, sandy habitat that supports offshore capelin-spawning grounds, nursery ground for yellowtail flounder and spawning areas for American plaice, Atlantic cod, and striped wolffish. Tail of the Grand Banks includes abundant forage fish and important feeding area for cetaceans, including humpback and fin whales, and is frequented by large numbers of seabirds: Area: not available.	396	353	304
Source: UNCBD (2019)				

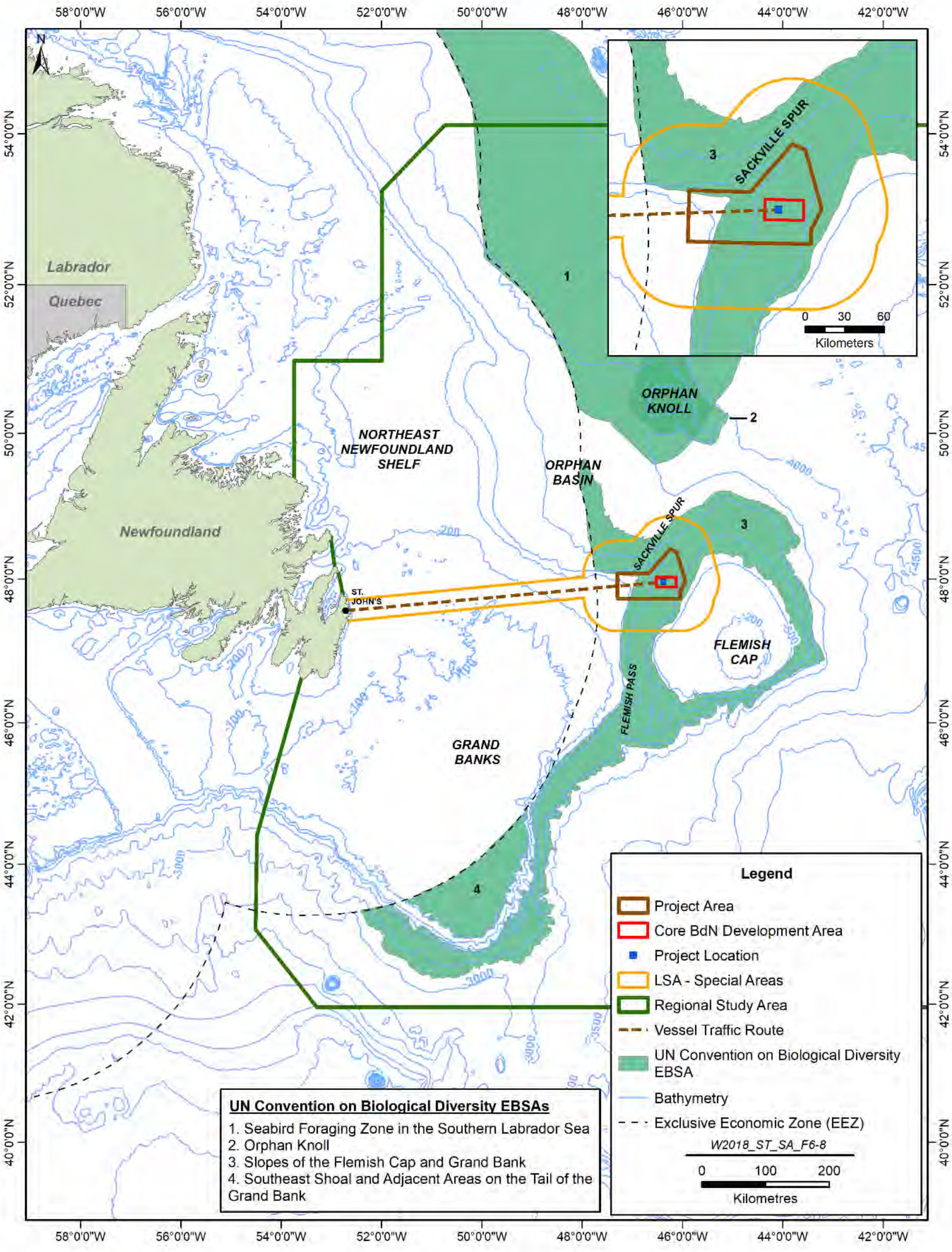

Figure 6-77 United Nations Convention on Biological Diversity EBSAs

6.4.3.2 Vulnerable Marine Ecosystems

The FAO of the United Nations is mandated by member countries to oversee the management and use of food resources, including marine fisheries. The FAO works with regional fishery bodies (RFB), such as NAFO, to sustainably manage seafood resources and habitats in marine areas beyond national jurisdictions. NAFO is the RFB responsible for fisheries management beyond Canada's EEZ. NAFO includes 12 member-nations from North America, Europe, Asia, and the Caribbean that collaborate on fisheries management within the NAFO Regulatory Area. 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. 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 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 2016).

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 can act as nurseries, refuges and as spawning and breeding grounds for many species (WG-EAFM 2008; FAO 2016).

Vulnerable Marine Ecosystems (VMEs) have been identified in the NAFO regulatory area (Figure 6-78; Table 6.69). Portions of VMEs may be closed to bottom fishing activities (Section 6.4.4.3). VME areas in the Newfoundland offshore area, which have been identified for sponges, sea pens and large gorgonian corals, were updated in 2016 based on modelling (NAFO 2016a). Descriptions of these VMEs are not publicly available.

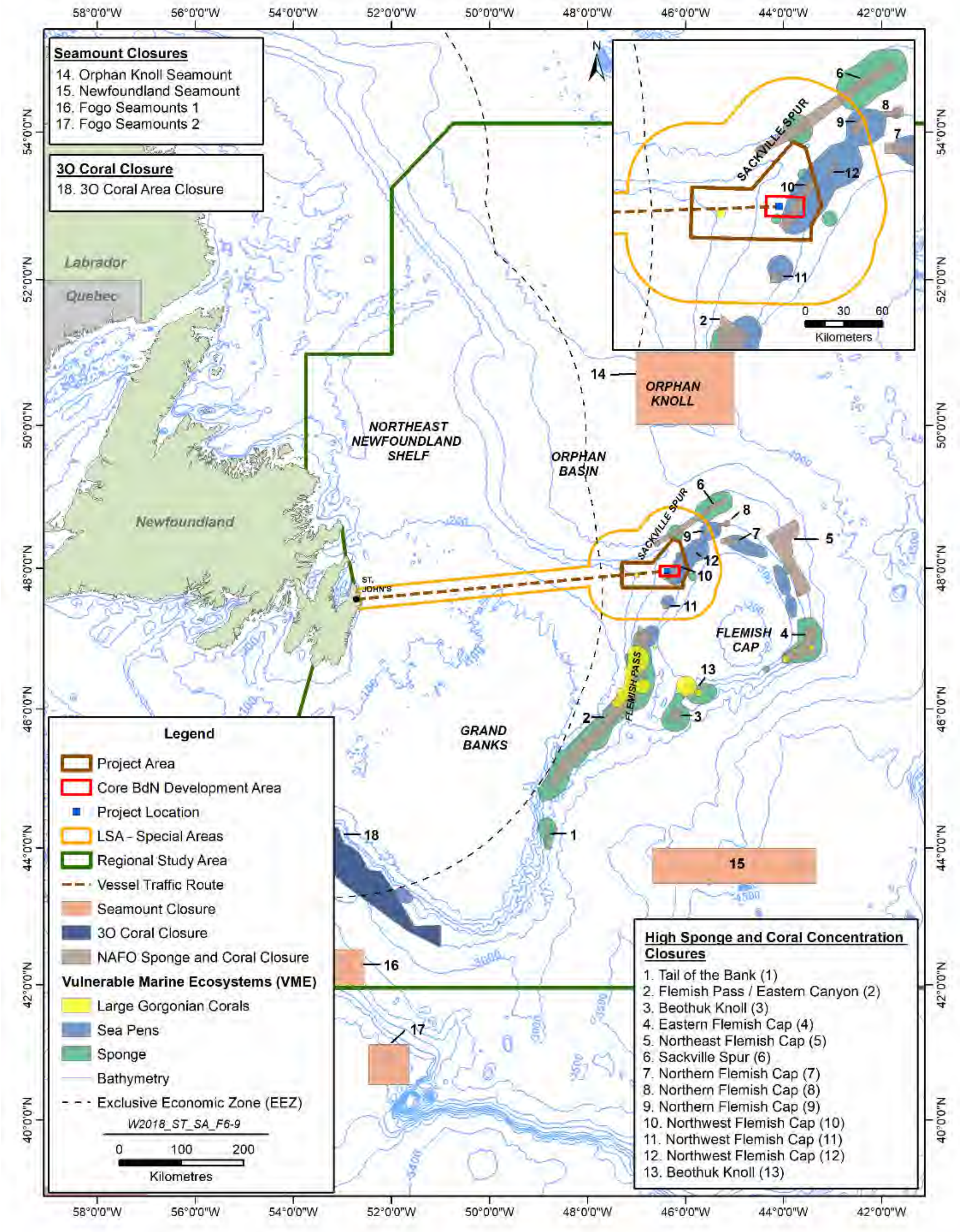

Figure 6-78 VMEs and NAFO Fisheries Closure Areas

Table 6.69 Vulnerable Marine Ecosystems (VMEs) in the RSA

VME	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Sponge	Description not available.	1	Intersect (3)	Intersect (6)
Sea Pen	Description not available.	Intersect	Intersect (1)	Intersect (2)
Large Gorgonian Coral	Description not available.	31	Intersect (1)	Intersect (1)
Source: NAFO (2016a)				
Note: Numbers in parentheses, indicate the number of this type of VME intersecting.				

6.4.3.3 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 VMEs. 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 amends boundaries of existing closures or adds new closure areas. Approximately 380,511 km² (15 percent) of the NAFO regulatory area is currently closed to bottom-contact fishing (WG-EAFM 2016; NAFO 2016c; NAFO 2018). Eighteen (18) NAFO FCAs, located within the RSA (Figure 6-78), are described in Table 6.70. The Core BdN Development Area intersects with the Northwest Flemish Cap (10) FCA. The Project Area intersects with that FCA as well as the Sackville Spur (6). A total of five FCAs: Sackville Spur (6), Northern Flemish Cap (9), Northwest Flemish Cap (10), Northwest Flemish Cap (11), and Northwest Flemish Cap (12) intersect with the LSA around the Project Area.

6.4.4 NEAFC Fisheries Closure Areas

The North East Atlantic Fisheries Commission (NEAFC) is the RFB responsible for fisheries in the Northeast Atlantic Ocean, which covers an area from the southern tip of Greenland, east to the Barents Sea and south to Portugal. NEAFC includes five contracting parties: Iceland, Norway, Denmark (also representing Greenland and the Faroe Islands), the European Union and the Russian Federation along with five Cooperating Non-Contracting Parties. Like NAFO, NEAFC adopts management plans for various fish stocks and legally-binding control measures to ensure that they are properly implemented within its Convention Area with a focus on its Regulatory Area outside of the relative EEZs. NEAFC also adopts measures to protect other parts of the marine ecosystem from potential negative impacts of fisheries (NEAFC 2011). Such activities include identification of VMEs and implementation of FCAs.

Table 6.70 NAFO Fisheries Closure Areas in the RSA

Closure Area	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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 of erect bryozoans, large sea squirts (*Boltenia ovifera*) and small gorgonian VME indicator species, along with crinoids and cerianthids. • Closure period: January 1, 2010 to December 31, 2020 • Area: 144 km²	430	392	342
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 like that of 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. • Closure period: January 1, 2010 to December 31, 2020 • Area: 5,418 km²	84	60	10

Table 6.70 NAFO Fisheries Closure Areas in the RSA

Closure Area	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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 the 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. • Closure period: January 1, 2010 to December 31, 2020 • Area: 309 km²	211	193	143
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. • Closure period: January 1, 2010 until December 31, 2020 • Area: 1,563 km²	203	187	137
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 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. • Closure period: January 1, 2010 until December 31, 2020 • Area: 2,892 km²	140	128	78

Table 6.70 NAFO Fisheries Closure Areas in the RSA

Closure Area	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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 approximately 1,300 m depth and extending down to approximately 1,800 m. These sponge grounds host a high diversity and abundance of associated megafaunal species. • Closure period: January 1, 2010 to December 31, 2020 • Area: 992 km²	32	3	Intersect
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 < 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. • Closure period: January 1, 2010 to December 31, 2020 except Northwest Flemish Cap (12), which is January 1, 2014 to December 31, 2020 • Areas: 259 km², 98 km², 128 km², 317 km², 61 km², 35 km²	71	58	8
Northern Flemish Cap (8)		87	64	14
Northern Flemish Cap (9)		63	37	Intersect
Northwest Flemish Cap (10)		Intersect	Intersect	Intersect
Northwest Flemish Cap (11)		44	26	Intersect
Northwest Flemish Cap (12)		25	10	Intersect

Table 6.70 NAFO Fisheries Closure Areas in the RSA

Closure Area	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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 > 400 m. • Closure period: January 1, 2015 until December 31, 2020 • Area: 340 km²	170	152	102
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 > 400 m in depth in the FCA have potential to have VME indicator species. • Closure period: January 1, 2008 to December 31, 2020 • Area: 13,995 km²	646	588	321
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. • Closure period: January 1, 2007 until December 31, 2020 • Area: 15,494 km²	433	415	365

Table 6.70 NAFO Fisheries Closure Areas in the RSA

Closure Area	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Orphan Knoll Seamount	• 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. • Closure period: January 1, 2007 until December 31, 2020 • Area: 15,815 km²	220	177	128
Fogo Seamounts (1)	• Closed to protect seamounts. • 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. • Closure period: January 1, 2009 to December 31, 2020 • Areas: 4,522 km², 4,616 km²	762	711	545
Source: NAFO (2016c, 2018); FAO (2016)				

The NEAFC Regulatory Area has a series of FCAs with restrictions for bottom-contact fishing activities. One FCA, Middle Mid-Atlantic Ridge (MAR), is located within the RSA. Table 6.71 provides a description of the Middle MAR. This FCA does not intersect Project Area or LSA (Figure 6-79).

Table 6.71 NEAFC VME Closure in the RSA

FCA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Middle MAR Area (Charlie-Gibbs Fracture Zone and Subpolar Frontal Region)	The MAR is dominated by sedimentary habitats, but also has hard-bottom hills, seamounts and fractures highly likely to be inhabited by VME indicator species. Studies of the benthic biodiversity of the MAR describe general distribution patterns of corals and sponges. No detailed data are available on the spatial distribution of VMEs in Middle MAR, but the closure area comprises the depth range and habitats likely to have VMEs. It constitutes a presumed representative section of the MAR situated in the Sub-Polar Frontal Zone, with seamounts, slopes and fracture features located on either side of the biogeographical boundary maintained by that hydrographical feature.	708	682	635
Source: FAO (2015)				

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 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 (Bird Studies Canada 2018; EC 2010b).

Bird Studies Canada has identified 43 IBAs in coastal and inland areas of NL. A number of these sites are located in the RSA on the coastline of eastern NL (Figure 6-80). As illustrated, Quidi Vidi Lake IBA intersects with the LSA (Table 6.72).

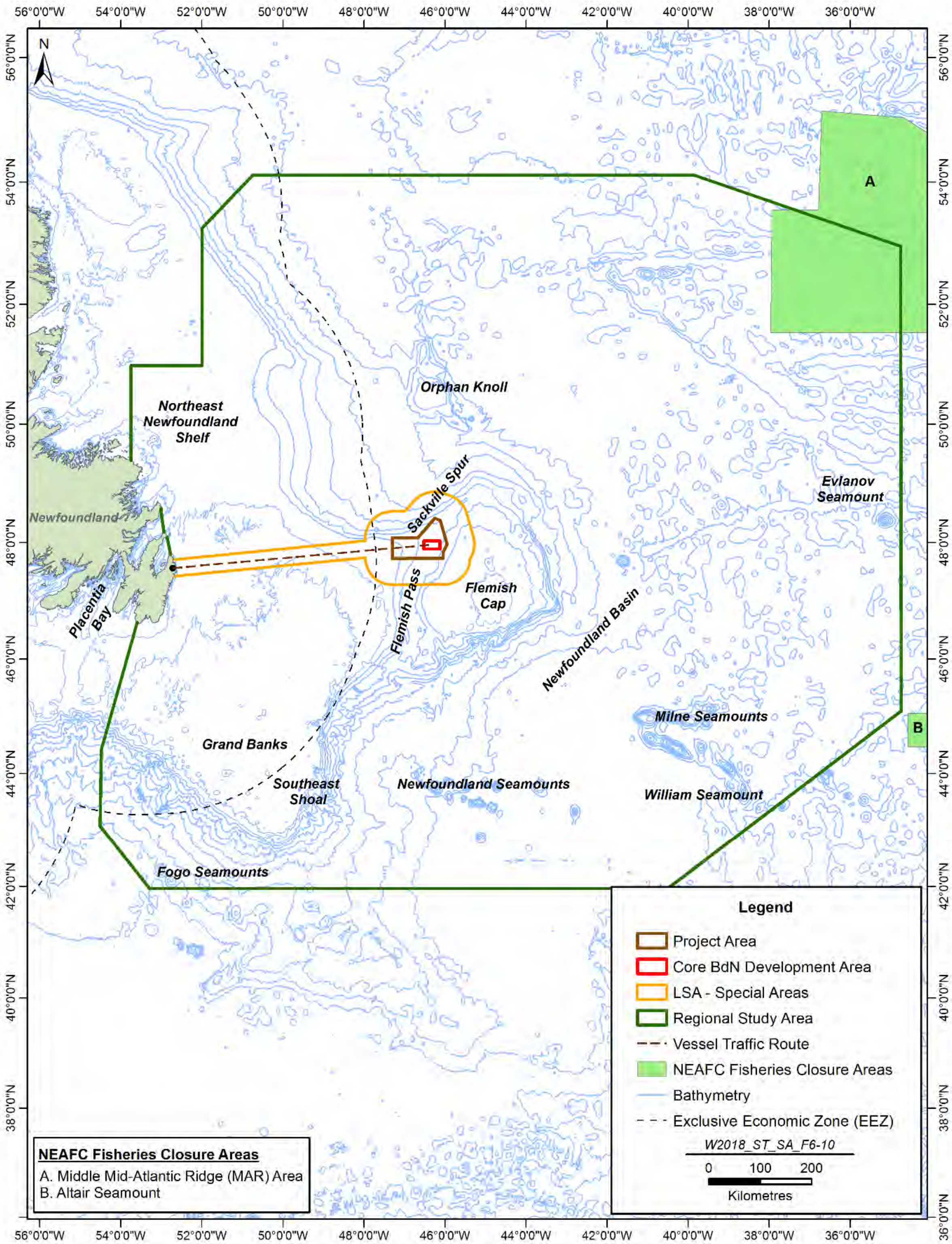

Figure 6-79 NEAFC Fisheries Closure Areas

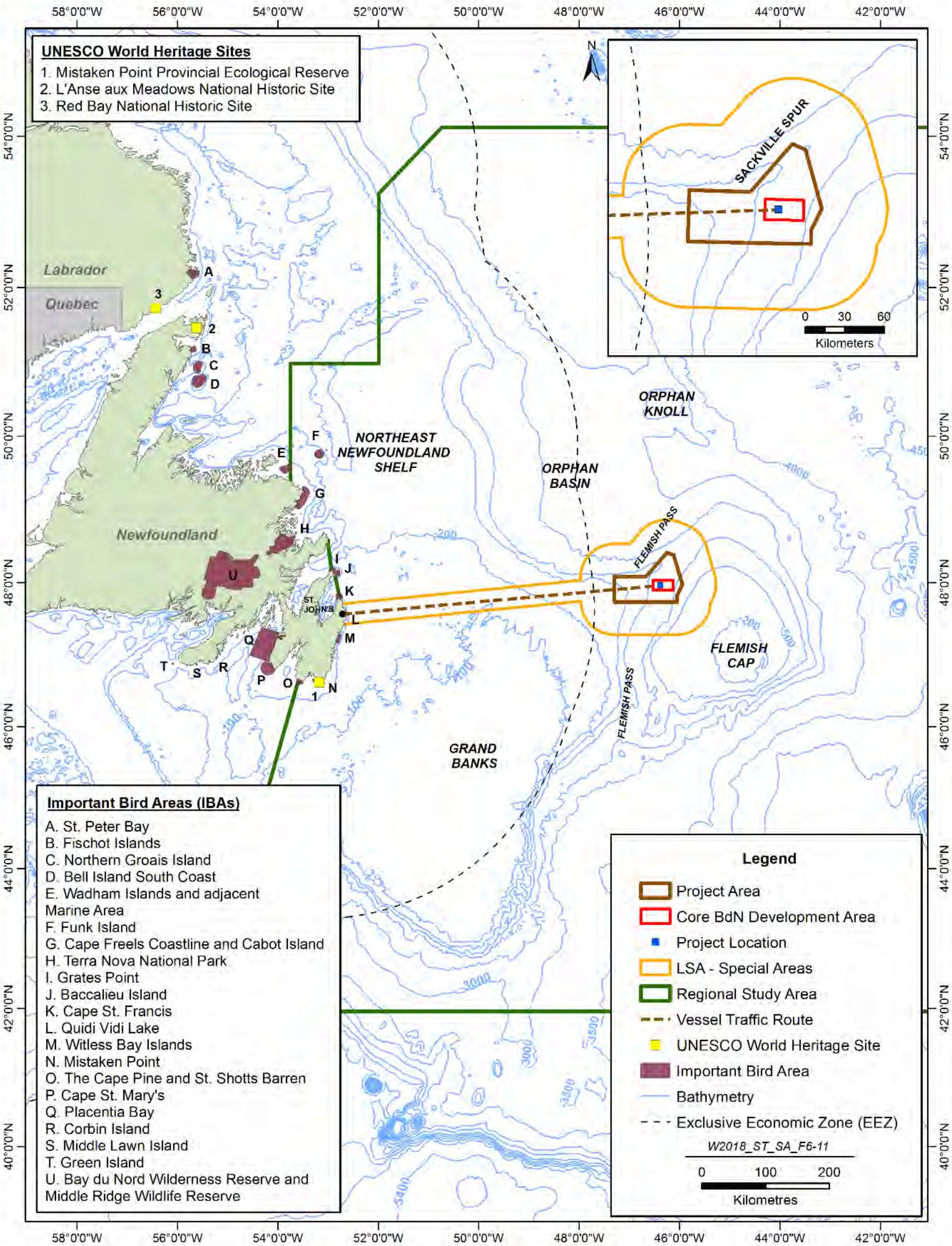

Figure 6-80 Important Bird Areas and World Heritage Sites

Table 6.72 Important Bird Areas in the RSA

IBA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Wadham Islands and adjacent Marine Area	Located near Fogo Island, approximately 40 km offshore, this IBA includes 7 main islands and several smaller rocks and shoals. Globally significant number of overwintering common eider (approximately 25,000 counted in a 1995 survey). Large numbers of nesting Atlantic puffin, Leach's storm-petrel and razorbill. Area: 159.23 km²	556	500	216
Funk Island	An island off northeastern NL, 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. Area: 135.18 km²	518	463	224
Cape Freels Coastline and Cabot Island	Located at the head of Bonavista Bay, this IBA includes several small islands and shoals. Up to 25,000 wintering Common eider 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. Area: 334.48 km²	522	465	158
Terra Nova National Park	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 designated as a Canadian Migratory Bird Sanctuary (MBS) and National Park. Area: 655.56 km²	533	475	117

Table 6.72 Important Bird Areas in the RSA

IBA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Grates Point	The northern tip of the Bay de Verde Peninsula, which separates Trinity Bay from Conception Bay. Large number of wintering common eider (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. Area: 66.55 km²	470	412	46
Baccalieu Island	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. Area: 45.22 km²	465	407	42
Cape St. Francis	Located at the northern tip of the Avalon Peninsula. Winter congregating area for common eider; up to 5000 individuals recorded. Purple sandpipers regularly observed along the rocky shoreline in the winter. Area: 70.21 km²	463	405	7
Quidi Vidi Lake	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. Area: 7.0 km²	462	404	Intersect (TR)

Table 6.72 Important Bird Areas in the RSA

IBA	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
Witless Bay Islands	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 percent 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. Area: 62.08 km²	473	413	18
Mistaken Point	Located near the southeastern portion of the Avalon Peninsula. Important wintering area for up to 12,000 common eiders. Continentally significant numbers of overwintering purple sandpiper (more than 1 percent 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. Area: 102.77 km²	516	455	93
The Cape Pine and St. Shotts Barren	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 whimbrels during fall migration. Area: 57.4 km²	546	486	109
Source: BSC (2018); CWS (2016)				

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 (UNESCO 2017). This international Convention identifies and encourages conservation of cultural and natural heritage sites considered to be of outstanding value to humanity. The province of NL has four UNESCO World Heritage Sites (WHSs), which are managed by the provincial or federal governments. One World Heritage Site is within the RSA – Mistaken Point Provincial Ecological Reserve (Figure 6-80). Mistaken Point does not intersect with the Project Area or LSA (Table 6.73).

Table 6.73 World Heritage Sites

WHS	Rationale for Identification/Designation	Distance to Special Area (km)		
		CBdN	PA	LSA
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 to 560 million years ago), illustrate the appearance of large, biologically complex organisms on earth. Area: 1.46 km²	524	462	98
Source: UNESCO (2017)				

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 2010b). The only Ramsar site identified in the province is the Grand Codroy Estuary on the west coast of the island of NL (Ramsar Convention 2001) and is not located within the Project RSA.

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 (WHSRN 2009). This site is not within the Project RSA.

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 none of which are located in NL (UNESCO 2016). Thus, no biosphere reserves within the Project RSA.

6.4.6 Overview of Special Areas

Chapter 6 identifies and describes the defining environmental features (and protection, as applicable) of special areas within the RSA, including recent or known upcoming changes to their status or their defined boundaries to the extent that this information is available. Information on the defining features of special areas is varied as agencies that identify or protect them have differing reporting systems and protocols meaning that publicly available information for some types of special areas is robust, while limited for others. In some cases, available information on special areas is based on modelling and / or likely presence of species and / or habitats based on known indicator features. The effects assessment for this VC is based on known information about special areas and closely linked to the assessment of Marine Fish and Fish Habitat (Chapter 9), Marine and Migratory Birds (Chapter 10) and Marine Mammals and Sea Turtles (Chapter 11).

Various special areas intersect with the Core BdN Area, the Project Area and / or LSA including the supply vessel route where marine vessels and aircraft are anticipated to transit. Summaries of the defining features of these special areas in the LSA (including any information on species for which they have been identified or protected) along with the distance between Project spatial boundaries and these special areas are included in Table 12.5. The Core BdN Area intersects three special areas: NAFO fishery closure area Northwest Flemish Cap (10), a VME identified for sea pens and the Slopes of the Flemish Cap and Grand Banks United Nations (UN) Convention on Biological Diversity (CBD) Ecologically or Biologically Significant Areas (EBSA). Each of these special areas has been identified and / or protected due to the presence of high concentrations of sensitive benthic species such as corals, sponges and sea pens. In addition to the special areas in the Core BdN Development Area, the Project Area also intersects the previous three special areas along with four other VMEs, which are identified for sponges and large gorgonian corals. The LSA intersects spatially with 18 additional special areas both in the offshore area and along the vessel traffic route (Figure 12.2).

6.4.6.1 Summary of Special Areas in the RSA

As described above, special areas in the offshore area have been identified and/or protected based on defining environmental features including the presence of sensitive habitats and species. Table 6.74 provides a summary listing of those special areas in the Project RSA, including those that intersect with the Core BdN Development Area, Project Area, and LSA and as noted the vessel traffic route.

Table 6.74 Summary of Special Areas in the RSA

Special Area	Distance to Special Area (km)		
	CBdN	PA	LSA
Marine Protected Areas (MPA) and Areas of Interest (AOI)			
Eastport – Duck Islands MPA	536	478	136
Eastport – Round Island MPA	545	487	127
Laurentian Channel AOI	815	753	367
Canadian Ecologically and Biologically Significant Areas (EBSAs)			
Orphan Spur	263	214	212
Notre Dame Channel	477	424	282
Fogo Shelf	501	445	243
Labrador Slope	612	579	568
Northeast Slope	89	31	Intersect (TR)
Virgin Rocks	308	247	46
Lilly Canyon-Carson Canyon	300	257	200
Southeast Shoal	435	386	276
Eastern Avalon	418	358	Intersect (TR)
Southwest Slope	610	552	234
Haddock Channel Sponges	600	539	151
St. Mary's Bay	527	468	20
Bonavista Bay	508	450	65
Baccalieu Island	409	351	Intersect (TR)
Marine Refuges			
Northeast NL Slope Closure	92	34	Intersect
Funk Island Deep Closure	475	420	214
3O Coral Closure	646	588	321
Canadian Fisheries Closures Areas (FCA) within the EEZ			
Eastport Lobster Management Area	523	465	122
Funk Island Deep Box	475	420	214
Snow Crab Stewardship Exclusion Zones			
Crab Fishing Area 5A	457	399	108
Crab Fishing Area 6A	456	399	51
Crab Fishing Area 6B	426	369	6
Crab Fishing Area 6C	420	359	Intersect (TR)
Crab Fishing Area 8A	450	389	57
Crab Fishing Area – 8BX	187	130	89
Crab Fishing Area 9A	550	490	113
Near Shore	415	356	Intersect (TR)

Table 6.74 Summary of Special Areas in the RSA

Special Area	Distance to Special Area (km)		
	CBdN	PA	LSA
Representative Marine Areas (RMAs)			
Ill-East Avalon / Grand Banks	415	356	Intersect (TR)
Migratory Bird Sanctuaries (MBSs)			
Terra Nova	553	495	137
Coastal National Parks and Historic Sites			
Cape Spear National Historic Site	460	401	Intersect (TR)
Signal Hill National Historic Site	463	405	Intersect (TR)
Ryan Premises National Historic Site	493	435	108
Terra Nova National Park	553	495	137
Significant Benthic Areas (SiBAs)			
Sea Pens	90	32	Intersect
Sponges	309	267	189
Large Gorgonian Corals	116	58	Intersect (TR)
Small Gorgonian Corals	272	215	141
Coastal Provincial Ecological Reserves			
Witless Bay Seabird Ecological Reserve	477	418	25
Baccalieu Island Seabird Ecological Reserve	468	410	47
Mistaken Point Fossil Ecological Reserve	524	463	96
Funk Island Seabird Ecological Reserve	524	463	230
Coastal Provincial Parks and Protected Areas			
Chance Cove Provincial Park	507	447	78
Dungeon Provincial Park	491	433	110
Deadman's Bay Provincial Park	546	489	195
Coastal Provincial Historic Sites			
Cape Bonavista Lighthouse Historic Site	492	434	113
Heart's Content Cable Station Historic Site	512	454	53
United Nations Convention on Biological Diversity (UNCBD) EBSAs			
Seabird Foraging Zone in the Southern Labrador Sea	172	131	81
Orphan Knoll	208	168	118
Slopes of the Flemish Cap and Grand Bank	Intersect	Intersect	Intersect
Southeast Shoal and Adjacent Areas on the Tail of the Grand Banks	396	353	304
Vulnerable Marine Ecosystems (VMEs)			
Sponge	1	Intersect	Intersect
Sea Pen	Intersect	Intersect	Intersect

Table 6.74 Summary of Special Areas in the RSA

Special Area	Distance to Special Area (km)		
	CBdN	PA	LSA
Large Gorgonian Coral	31	Intersect	Intersect
Northwest Atlantic Fisheries Organization (NAFO) FCAs			
Tail of the Bank (1)	430	392	342
Flemish Pass/Eastern Canyon (2)	84	60	10
Beothuk Knoll (3)	211	193	143
Eastern Flemish Cap (4)	203	187	137
Northeast Flemish Cap (5)	140	128	78
Sackville Spur (6)	32	3	Intersect
Northern Flemish Cap (7)	71	58	8
Northern Flemish Cap (8)	87	64	14
Northern Flemish Cap (9)	63	37	Intersect
Northwest Flemish Cap (10)	Intersect	Intersect	Intersect
Northwest Flemish Cap (11)	44	26	Intersect
Northwest Flemish Cap (12)	25	10	Intersect
Beothuk Knoll (13)	170	152	102
Orphan Knoll Seamount	220	177	128
Newfoundland Seamounts	433	415	365
Fogo Seamounts (1)	762	711	545
30 Coral Area Closure	646	588	321
Important Bird Areas (IBAs)			
Quidi Vidi Lake	462	404	Intersect (TR)
Witless Bay Islands	473	413	18
Cape St. Francis	463	405	7
Baccalieu Island	465	407	42
Grates Point	470	412	46
Mistaken Point	516	455	93
The Cape Pine and St. Shotts Barren	546	486	109
Terra Nova National Park	533	475	79
Funk Island	518	463	190
Cape Freels Coastline and Cabot Island	522	465	123
Wadham Islands and adjacent Marine Area	556	500	181
UNESCO World Heritage Sites (WHS)			
Mistaken Point Ecological Reserve	524	462	98
North East Atlantic Fisheries Commission (NEAFC) FCAs			
Middle Mid-Atlantic Ridge	705	682	635

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