4.2 Biological Environment

The following sections present an overview of relevant aspects of the biological environment of the SEA Study Area, including Fish and Fish Habitat, Marine Birds, Marine Mammals and Sea Turtles. A listing of the common and scientific names for all species referenced in these sections is provided in Appendix B.

4.2.1 Fish and Fish Habitat

Key elements of the SEA Study Area's marine ecosystem range from primary producers such as phytoplankton to consumers such as zooplankton, benthic invertebrates and fish. These ecosystem components form the bulk of the marine food web, have components that form the foundation of commercially important fisheries in the SEA Study Area, and have historic, socio-cultural and economic significance.

For the purposes of providing an overview of the existing environmental setting of the Eastern Newfoundland Offshore Area, the following includes a discussion of relevant fish species, as well as plankton, algae and benthos and relevant components of their habitats, given the clear interrelationships between these components of the marine environment.

4.2.1.1 Approach and Key Data Sources

The following sections include a description and discussion of key marine faunal assemblages and ecologically important and/or sensitive areas, as well as illustrating the rather dynamic nature of the SEA Study Area's marine communities. In addition, general ecological information is provided for many of the taxa that characterize the habitats of the SEA Study Area. While the majority of this information has been obtained from existing and available literature, further analysis of available data has also been conducted to characterize the contemporary distributions of abundant, commercially important and/or protected and otherwise ecologically significant marine fish and invertebrate species.

Two regulatory jurisdictions occur in the SEA Study Area. The Government of Canada manages fish stocks within the 200 mile limit and benthic invertebrates (e.g. crab) across the entire continental shelf. Beyond that 200 mile limit, the North Atlantic Fisheries Organization (NAFO) manages groundfish activities and other resources (such as corals) (NAFO 2013).

In addition to information provided through the published literature, fish survey (distribution and abundance) data from Fisheries and Oceans Canada (DFO) for the period up to 2009 were available for use, presentation and analysis in this SEA. These data, based on random, stratified sampling methodologies, provide the most up-to-date and useful information available that can be applied in a consistent manner across a large portion of the SEA Study Area. As a result, these data are used as the foundation for prioritizing focal species and for describing contemporary distributions. The methods used for doing so are further described below.

It is recognized that the sampling approach and area for these DFO survey data exclude portions of the SEA Study Area (e.g. particularly those under NAFO jurisdiction) and that certain taxa (e.g. pelagic, abyssal and infaunal species) are relatively less represented than others. Nonetheless, the available data and approach provide useful and illustrative information for a considerable portion of the SEA Study Area related to many ecologically and commercially important taxa.

Canadian Research Vessel Multi-Species Surveys

The long-term monitoring and management of fish resources in the Newfoundland and Labrador Region is based primarily on information derived through standardized, trawl-based, scientific surveys. DFO has jurisdiction over the Labrador Shelf south to the Grand Banks including NAFO Divisions 2GHJ3KLNMOPs (see Section 4.3.4). DFO's Newfoundland and Labrador Region surveys take place in different but overlapping areas, in the spring (1975-2009) in Divisions 3LNOPs and in the fall (1977-2009) in Divisions 2HJ3KLMNO. While survey design has remained somewhat constant, additional strata have been included in recent decades along with modifications to some of the original strata (Bishop 1994), including the addition of shallower (less than approximately 50 m depth) and deeper (greater than approximately 700 m) areas after 1993. Furthermore, whereas several demersal trawl gears have been deployed over the life of the NL Region surveys, both the spring and fall surveys have used the Campelen 1800 shrimp trawl since the fall of 1995.

Given these changes to the DFO surveys, and the overall recognition that fish distributions and community compositions have changed off Newfoundland in recent decades (Dawe et al 2012), data from the most recent period available (2005-2009) were used to describe general fish distributions in the SEA Study Area. Where available, both spring and fall survey data (3LNO) were used to characterize fish distributions, although mapping of fish distributions in 3K were derived from fall data only. Qualitative examination suggests that for most fish species, distributions are similar for the spring and fall survey in 3LMNO.

The data from the DFO surveys were further screened to identify the key fish species that occurred in high abundance (cumulatively exceeded greater than 90 percent of individuals captured) and had a relatively high degree of overlap with the SEA Study Area. From this screening process, 15 taxa (11 fish and 4 invertebrate species) were identified, and their distributions are described further and mapped in the following sections.

To produce these generalized distribution maps, the SPANS potential mapping surface function was used in a GIS system. The method is well suited for spatially analyzing research survey data because it converts point estimates (in this case, individual survey set catch rates) into continuous surfaces (density subareas) that perform as survey density strata with minimal extrapolation. Because observed fish density is used as the stratifying variable, it potentially reduces the variability of density within strata. Extent and location of density constant subareas is allowed to vary according to distributional changes of the fish. That is, the technique makes use of the geo-referenced survey catch rate data to define spatial differences in fish density. The strata vary over time taking into account stock distributional shifts with a resulting lower within strata variability. Application of this technique has also been further evaluated by overlaying the point data and their values to ensure that the surface properly represents density patterns in the catch rate data, and the method does not extrapolate beyond the data. Creation of a surface representative of the data is superior to a simple expanding symbol plot because it avoids the problem of masking of patterns in the data when the circles overlap.

This is a well established approach and has been used to describe fish distributions in numerous previous studies (e.g., Kulka 1998a, 1998b; Kulka et al 2003a, 2003b; Kulka et al 2007; Han and Kulka 2007; Kulka 2009).

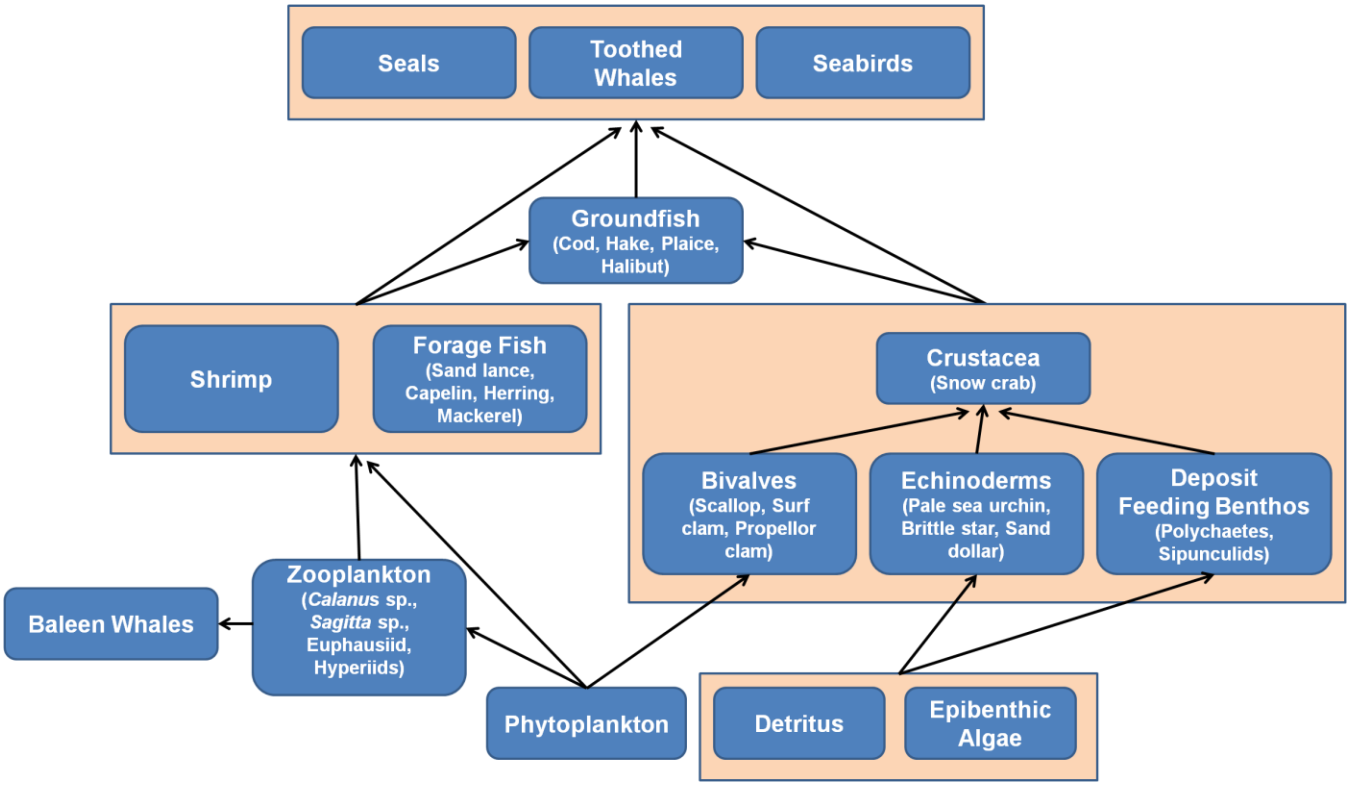
4.2.1.2 Key Taxa, Assemblages, Ecological Regimes

Marine species abundances and distributions have often been looked at independently and not as components of a complete ecosystem. Species vary in terms of their ecological, commercial, cultural and legislative importance but understanding of individual species is enhanced through knowledge of their interactions with the other species and through the environment. All taxa are associated with habitat-specific assemblages where they play a trophic role that interacts with many other taxa, either directly or indirectly (e.g. Gomes et al 1992; Templeman 2010; Dawe et al 2012; Figure 4.65).

In the SEA Study Area, primary production is derived through phytoplankton. These tiny photosynthetic organisms form the base of the food chain which flows through primary consumers such as zooplankton, through to planktivorous fish and invertebrates to fish, marine mammals and birds, and ultimately to the detritivores which return nutrients from dead animals back into the food chain.

This holistic, multi-species perspective and approach has helped researchers to better understand how the trophic and assemblage structure in the SEA Study Area's ecosystem has been changing as a result of anthropogenic (e.g. fishing) and environmental (e.g. temperature changes) disturbances (Rose 2004; Koen-Alonso et al 2010; Devine and Haedrich 2011; Dawe et al 2012).

Figure 4.65 Overview of Key Ecosystem Elements and Trophic Links in the SEA Study Area



Adapted from Gomes et al (1992) and Templeman (2010)

Recent work has, for example, indicated that the ecosystem structure of the Northwest Atlantic underwent a "regime shift" in the late 1980s to early 1990s, that included a decrease in the population of many long-lived groundfish species such as cod and redfish, an increase in invertebrate species such as shrimp and snow crab (deYoung et al 2004; Koen-Alonso et al 2010; Dawe et al 2012) and an

increase in primary production (deYoung et al 2004). The eventual collapse of the groundfish stocks were attributed to fishing pressure and colder environmental conditions (deYoung et al 2004; Rose 2004; Koen-Alonso et al 2010) that favoured invertebrate species such as snow crab and shrimp (deYoung et al 2004). For at least shrimp, the collapse of groundfish stocks and associated release from predation, further augmented their abundance (Worm and Myers 2003; Dawe et al 2012). Coincident declines in capelin, an important prey species along the Newfoundland Shelf, also forced species like cod to rely more heavily on lower quality prey such as shrimp (Dawe et al 2012) and deepwater species such as Greenland halibut to resort to feeding on alternate prey species such as grenadier.

The new regime, dominated by invertebrates, was maintained along the Newfoundland Shelf despite a refocus of fishing effort toward shrimp and crab and a great reduction in groundfish fishing activity (deYoung et al 2004). Notwithstanding relatively low levels of groundfish bycatch, fishing pressure on invertebrates has been linked, along with environmental conditions, to low groundfish abundance in many prominent groundfish species (Koen-Alonso et al 2010). The mechanism of this relationship, however, remains unknown.

Currently, the waters in the SEA Study Area are on a warming trend, which is coinciding with reports from fishermen (see Consultation Report, Appendix A) and scientists (Koen-Alonso et al 2010; Templeman 2010; Dawe et al 2012) regarding associated declines in snow crab and signals that some groundfish species are showing signs of recovery. These changes demonstrate the dynamic nature of the ecology of the SEA Study Area, and underscore the need for adaptive management in this climate sensitive ecosystem, particularly when climate effects in the northwest Atlantic are expected to be elevated relative to other areas (Greene et al 2008).

Key Marine Assemblages

Fauna in the North Atlantic have physiological, morphological, life history and trophic characteristics that dictate their distribution. Correspondingly, depth and temperature are important factors in species distributions, where increased species richness is generally observed in progressively warmer waters (Rose 2005a). Within these depth and temperature zones, differences in assemblages can be delineated with habitat types (e.g. Houston and Haedrich 1984; Baker et al 2012; Cote et al 2013). When distributions of fish overlap consistently in time and space, these groups of co-occurring species form an assemblage (Haedrich and Merritt 1990).

As is also often found at larger geographic and temporal scales, faunal assemblages within the SEA Study Area remain influenced by temperature and depth (Rose 2005a), but they can change across relatively short distances because of the varying prominence of cold (Labrador Current) and warm currents (Gulf Stream) as well as depth (shelf vs. slope vs. abyss) and habitat complexity (Houston and Haedrich 1984; Schneider et al 1987; Baker et al 2012). While some generalist species may be present in many areas (e.g. American plaice, Atlantic cod, thorny skate and striped wolffish; Gomes et al 1992), each assemblage has defining elements.

For example, the southwest edge of the Grand Banks has an assemblage that resembles the eastern Scotian Shelf, and has many species that are found near the northern extent of their range (e.g. white hake, argentine, silver hake, Atlantic halibut, longfin hake, butterfish, billfish). In contrast, the northern portion of the Grand Banks away from the shelf edge is perpetually cold on the bottom and is inhabited

by species typically found further north on the inner shelf where bottom waters are coldest (e.g. Arctic sculpin, Arctic cod, northern shrimp and snow crab).

Depth can also operate as a distinguishing environmental factor across relatively fine spatial scales (Gomes et al 1992; Baker et al 2012). Yellowtail flounder, sea ravens and longhorn sculpin, for example, are associated with the shallows of the Grand Banks (40-100 m). These species transition to slope species such as Greenland halibut and redfish and other less abundant species such as wolfish. At depths primarily greater than 400 m, shelf assemblages give way to semi pelagic and demersal species such as lanternfish, grenadiers, Greenland halibut, blue hake, deepwater eels and rocklings, many of which can extend beyond the SEA Study Area to abyssal depths. Some species such as deep sea lizardfish and Bean's sawtooth eel, for example, are found only at great depths (Baker et al 2012).

Structural habitat complexity further segregates these assemblages for both fish and benthos (Houston and Haedrich 1984; Schneider et al 1987; Baker et al 2012). On the Grand Banks, for example, Baker et al (2012) found snub-nosed eels exclusively in low complexity habitats.

In many cases, the key species of a marine assemblage can be determined based on dominance (e.g. numerical abundance or biomass), which can serve as a surrogate for a species' importance in the food chain and the resources they consume and pass through the ecosystem. Alternatively, the importance of a species can be considered through the number and strength of its linkages to other species. In the SEA Study Area, capelin and corals are 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 where possible. In most cases such species were determined through numerical dominance, although where available studies supported other definitions of key species these are also identified in the descriptions.

4.2.1.3 Plankton

Plankton consists of small marine organisms that move passively in aquatic ecosystems, drifting according to currents and other oceanographic processes. Taxa in this group include microscopic marine plants (phytoplankton), invertebrates (zooplankton), vertebrate eggs and larvae (ichthyoplankton), bacteria, fungi, and even viruses. Plankton comprise the largest group of organisms in the ocean in terms of both diversity and biomass. Consequently, marine plankton play a foundational role in the marine environment as they serve as the base layers of most food webs (primary and secondary production). For example, copepods are important food for larval commercial fish such as capelin. Other zooplankton, such as krill, are also an important food source for large marine mammals. In addition to being a food source, most commercial finfish and invertebrate species spend at least one of their life stages in the water column as plankton. Recent studies have also shown the importance that zooplankton play in the carbon and nitrogen cycle in terms of functioning as a biological pump that transfers organic matter from depth to the surface (benthic-pelagic coupling).

Although plankton are widespread across the SEA Study Area, the *Southeast Shoal and Tail of the Banks Ecologically and Biologically Significant Area* (EBSA) was identified in part based on its high primary productivity (Templeman 2007), as described further in Section 4.2.1.10.

Phytoplankton

Light and nutrients fuel phytoplankton growth in the SEA Study Area waters (Harrison et al 2013). The interaction of these limiting resources results in a spring and fall bloom in the waters of the Northwest Atlantic. Spring blooms are caused when strengthening sunlight interacts with well-mixed, nutrient-rich surface waters. The dominant bloom in the Northwest Atlantic typically occurs in early spring, usually April or May (Maillet et al 2004; Harrison et al 2013), and is dissipated over the summer as nutrient levels are prevented from replenishing by the formation of the summer thermocline (Harrison et al 2013). Fall winds and cooler temperatures break down this thermocline, permitting nutrients to recharge and facilitate a second somewhat weaker bloom (Maillet et al 2004). The timing of blooms typically progress south to north, and in waters off Newfoundland, Fuentes-Yaco et al (2007) determined that the bloom moves northward at a rate of approximately one degree latitude per week. Interestingly, the timing of the bloom has occurred progressively later in Newfoundland waters, which is counter to that observed in other areas of the North Atlantic (Harrison et al 2013).

Nitrate and silicate are considered limiting nutrients to phytoplankton and their relative abundance can affect community structure. For example diatoms, which are abundant in the SEA Study Area, are reliant on silicate for their skeletal integrity (Harrison et al 2013) and therefore depletion of this nutrient would have negative effects on their population growth. Relative to other areas of the Atlantic, SEA Study Area waters are largely nitrate limited and therefore favour growth of diatoms relative to waters of the northeastern Atlantic (Harrison et al 2013). In general, larger microplankton are dominated by diatoms (e.g. *Chaetoceros* sp.), but dinoflagellates (*Ceratium* spp.) become more abundant in fall/winter (Harrison et al 2013).

There has been an observed shift in the abundance, timing, and duration of some phytoplankton species in the Northwest Atlantic. This shift included a decrease in overall abundance in the 1970s, a return to maximum levels in the 1990s and a subsequent decline ever since (Maillet et al 2004; Head and Sameoto 2007). These changes are correlated with the Northern Atlantic Oscillation (NAO) (Harrison et al 2013) whereby an intensification of northwestern atmospheric flows cause increased mixing and sea ice extent and colder, fresher ocean conditions. These conditions are also correlated with an increased nutrient flux, which triggers higher primary productivity, and in turn, secondary productivity (zooplankton) (Maillet et al 2004).

The distribution of phytoplankton (primary producers) on the Grand Banks is controlled largely by upwelling and enhanced vertical mixing on the slopes shelf break and thermal gradients between the shelf and slope waters (Anderson and Gardner 1986; Templeman 2007). The most productive areas are typically in the waters on the shelf and the shelf break over the shelf slope. Areas of relatively high production across the Northwest Atlantic include the Southeast Shoal and the Tail of the Grand Banks (Templeman 2007).

Zooplankton (Secondary Production)

Zooplankton are the principal link between primary producers and higher trophic levels (e.g. fish, whales and seabirds) (Maillet et al 2004). Copepods make up over 85% of the zooplankton abundance, followed distantly by cladocerans (Table 4.56). Zooplankton species such as *Calanus finmarchicus* are considered keystone species (Head et al 2013), due to their importance to higher trophic levels, while others such as jellyfish may have a proportionally strong influence on the ecosystem through predation. The abundance of zooplankton on shelf waters follows that of phytoplankton populations, their primary

food source, in that they peak after the spring bloom and decline later in summer. Species such as *C. finmarchicus* return to shelf waters each spring to reproduce and feed on phytoplankton. Once this food source is sufficiently depleted, they abandon the shelf environment and descend to deepwater overwintering sites (Head et al 2013).

Variation in community structure and abundance are exhibited by zooplankton at several temporal and spatial scales (Morales 1999; Dalley et al 2001). For example, the copepod *C. hyperboreaus* has been increasing in abundance for several decades (Maillet et al 2004). At shorter timescales, numerous zooplankton species alter their local abundance by undertaking diel vertical migrations (DVM); rising up in the water column at night (Dalley and Anderson 1998). In the Northwest Atlantic, *Euchaeta norvegica and C. finmarchicus* are the most important contributors to total migrating biomass (Hays 1996). These migrations form a "biological pump" that transports organic carbon and nitrogen through the water column (e.g. thermoclines) and are an important component of benthic-pelagic coupling (Morales 1999). Surveys of the Grand Banks and Newfoundland Shelf indicate a north-south cline in total zooplankton biomass, with production declining from inshore areas to the shelf edge depending on the year (Dalley and Anderson 1998). However, taxa-specific distributions vary. For example, jellyfish are predominantly found in inshore areas and on the northern Grand Banks (Dalley and Anderson 1998), while *C. hyperboreus* are confined mostly to the outer shelf and slope waters (Maillet et al 2004). Similarly, euphausids (krill), an important prey species for marine mammals (Plourde and McQuinn 2009), have the highest densities in slope waters and offshore regions (e.g. the Laurentian Channel) (Maillet et al 2004).

Table 4.56 Main Zooplankton Taxa from Invertebrate Zooplankton 1997 Survey on the Newfoundland Shelf and Grand Banks.

Rank	Taxa / Taxon	% Total Zooplankton
1	Copepods	86.8
2	Cladocerans	5.2
3	Limacina	3.0
4	Larvaveans	2.3
5	Bivalve larvae	1.1
6	Tomopteris	0.4
7	Cnidarians	0.2
8	Euphausids	0.2
9	Chaetognaths	0.1
10	Snow crab	0.1
11	Hyperids	0.0
12	Mysids	0.0
13	Other Zooplankton	0.6
Source: Modified from Dalley et al (2001)		

Ichthyoplankton

For many marine fish species, eggs and larvae are pelagic and move passively in the water currents. These lifestages therefore act as an important period of dispersal and represent a key stage that can often affect recruitment success (Cushing 1990). Spawning periods of many species are synchronized with plankton blooms to provide access to seasonally abundant food supplies. As these taxa typically exhibit passive movement, they are often entrained in oceanographic features such as gyres, (Bradbury et al 2008), upwelling zones (Ings et al 2008) and thermoclines (Frank et al 1992). Ichthyoplankton

densities along the Northeast Newfoundland Shelf and the Grand Banks can vary by orders of magnitude (Dalley and Anderson 1998; Bradbury et al 1999) and community structure can differ according to year, season and location (Frank et al 1992; Dalley and Anderson 1998; Bradbury et al 2008). Assemblages on the Northeast Newfoundland Shelf are largely dominated by capelin (73.5%), sand lance (11.3%), lanternfish (5.9%) and Arctic cod (3.4%) (Table 4.57). Squid larvae were also noted for being widespread across the Grand Banks and Newfoundland Shelf and occurred in 67% of samples. Some species are generally distributed on the inner Shelf north of the Grand Banks (e.g. blennies, sculpins, squid, seasnails and alligatorfish) while others are found predominantly over the Grand Banks (sand lance and hake; Dalley and Anderson 1998).

Table 4.57: Relative Overall Abundance of Dominant Fish Species caught in the International Young Gadoid Pelagic Trawl during the Pelagic 0-group Survey (1997-1998)

Species	Scientific name	Relative Abundance (%)	Average Incidence (%)
Capelin	*Mallotus villosus*	73.5	51.1
Sand lance	*Ammodytes sp.*	11.3	36.4
Lanternfish	Myctophidae	5.9	2.5
Arctic cod	*Boreogadus saida*	3.4	56.2
Squid	Cephalopoda	3.1	67.1
Alligatorfish	Agonidae	0.9	60.3
Sculpins	Cottidae	0.8	47.9
Shannies / Blennies	Stichaeidae	0.4	12.9
Atlantic cod	*Gadus morhua*	0.2	33.5
Redfish	*Sebastes sp.*	0.2	17.7
Wolffish	*Anarhichas sp.*	0.1	28.8
Seasnail	*Liparis sp.*	0.1	15.6
American plaice	*Hippoglossoides platessoides*	0.1	10.6
Haddock	*Melanogrammus aeglefinus*	0.1	7.2
Witch flounder	*Glyptocephalus cynoglossus*	<0.1	4.9
Greenland halibut	*Reinhardtius hippoglossoides*	<0.1	4.9
Hake	*Urophycis sp.*	<0.1	3.4
Yellowtail flounder	*Limanda ferruginea*	<0.1	0.8
Source: Modified from Dalley et al (1999); Dalley and Anderson (1998)			

4.2.1.4 Plants and Macroalgae

Macroalgae (e.g. *Laminaria*, *Agarum cribrosum*) and sea grasses (*Zostera marina*) are important components of coastal areas of Newfoundland as they contribute to biodiversity and create important habitats for marine animals (e.g. Cote et al 2001, 2013). Their reliance on photosynthesis to produce energy, however, limits their distribution to areas reached by sunlight (Dayton 1985; Anderson et al 2002). For example, Anderson et al (2002) classified over 2,000 km of habitat in depths of 10-220 m and found the majority of algae (kelp and Irish moss) to occur in waters less than 30 m with no algae occurring in waters deeper than 50 m. Similarly, submersible surveys in coastal areas of Newfoundland (Gregory and Anderson 1997) detected most kelp at depths of less than 40 m. Other important factors for macroalgae include substrate, sedimentation, nutrients, water motion, salinity and temperature (Dayton 1985).

There is a paucity of published information regarding plants and macroalgae in the SEA Study Area. This is likely a reflection of the fact that this marine area contains habitat that is generally not conducive to seaweeds and macroalgae. Most of the SEA Study Area is too deep for these species, with the exception of the shallowest areas of the Grand Banks, where depths of less than 30 m can be found. In addition to the relatively deep water, most areas of the Grand Banks do not contain the hard substrates that most macroalgae need to establish holdfasts (Dayton 1985). Further illustrating the general absence of macroalgae and seaweeds in the SEA Study Area are the studies of Houston and Haedrich (1985), Schneider et al (1987) and Kenchington et al (2001), which did not characterize any habitats in their survey areas as including macroalgae.

The above notwithstanding, some areas of the SEA Study Area, such as Virgin Rocks, are known to have a diverse and profuse seaweed flora that resemble communities of Labrador. Elsewhere on the Grand Banks, a few seaweeds can be found at depths up to 100 m, but in these areas there are few species and low biomass (R. Hooper, pers. comm.). Macroalgae is likely to also benefit from the presence of drill rigs as substrate.

The dominant large seaweeds on Virgin Rocks are the kelps (Phaeophyta: Laminariales): *Laminaria digitata*, *Alaria esculenta*, *Saccharina longicruri,* and *Agarum cribrosum*. Understory seaweeds include *Desmarestia viridis, D. aculeata, Palmaria* (Dulse), *Ptilota, Phycodrys, Membranoptera, Polysiphonia* and numerous other cold-water species. In past surveys, almost all available substrate was covered by coralline seaweeds: *Lithothanionglaciale*, *L. lemoineae, Clathromorphum compactum, C. circumscriptum* and *Corallina*. The deepest seaweed was the coralline *Leptophyum leave*, which was still very abundant below 70 m (R. Hooper, pers. comm.).

4.2.1.5 Benthic Communities

Benthic invertebrates are animals associated with the sea floor. They can be categorized as those that are infaunal (i.e. that live in the substrate) and those that are epifaunal (i.e. that live on or attached to the substrate). These are a group comprised of diverse taxa that play a variety of roles in the ecosystem (e.g. detritivors, filter feeders, carnivores) and form an important part of the food chain (Templeman 2010). Benthic communities are considered sensitive to anthropogenic disturbance (Husky Energy 2010; Suncor Energy 2010; Warwick 1993) and also account for the bulk of commercial fish landings in the SEA Study Area over the last two decades (Dawe et al 2012).

Despite their ecological significance, these taxa are generally poorly studied in the SEA Study Area with the exception of a few commercially valued species and in a few spatially restricted areas (LGL 2003; Templeman 2010). Studies to date indicate that, like fish, benthic assemblages respond to environmental variables such as depth, substrate and flow field (Houston and Haedrich 1984; Schneider et al 1987).

Three main contemporary sources of information illustrate benthic community composition in the SEA Study Area, and are derived predominantly from the Grand Banks area. These include resource descriptions and environmental effects monitoring associated with oil and gas development (e.g. Husky Energy 2010; Suncor Energy 2010), research initiatives (e.g. Houston et al 1984; Schneider et al 1987; Kenchington et al 2001) and DFO RV Surveys. The latter provides more widespread information on benthic taxa accessible to trawls (e.g. LGL Limited 2012, 2013). It is also important to note that characterizations of benthic communities are also inevitably biased according to sampling method. For

example, visual assessments often poorly assess infaunal communities whereas grabs may have challenges sampling communities over harder substrates.

Recent oil and gas environmental monitoring associated with the White Rose and Terra Nova Oilfields indicate that polychaetes were numerically dominant (greater than 72 percent) in Grand Bank grabs followed by amphipods and bivalves (Husky Energy 2010; Suncor Energy 2010). In both of these study programs, these three taxa made up 89 percent of the individuals sampled. For Terra Nova samples, taxonomic richness was linked to areas of relatively high benthic invertebrate abundance (Suncor Energy 2010).

A number of research initiatives have also characterized benthic communities on the Grand Banks (Schneider et al 1987; Kenchington et al 2001) and associated slopes (Houston and Haedrich 1984). Schneider et al (1987) documented benthic communities of the northeastern part of the Grand Banks using video and determined that epifaunal communities were dominated by echinoderms (brittlestars, urchins and sand dollars) as well as bivalves (primarily Icelandic scallop).

In contrast, grab samples in the vicinity of Carson Canyon (continental edge and slope) on the southeastern Grand Banks revealed communities dominated by polychaetes, hooded shrimp, sipunculid worms, amphipods, echinoderms, isopods and bivalves (Houston and Haedrich 1984). The relative dominance of these taxa depended on the substrate, although polychaetes were among the top four abundant taxa in each of sand, gravel and silt. These authors also noted a relatively low biomass of benthic invertebrates compared to other areas of the North Atlantic, which was a somewhat unexpected outcome given that these waters are known for fish production. They concluded that much of the production in the area must derive from pelagic sources instead of benthic pathways.

Perhaps the most holistic sampling was done on the Grand Banks as part of a series of trawling impact studies (Prena et al 1999; Kenchington et al 2001). These researchers used video and grabs (Kenchington et al 2001) and a benthic sled (Prena et al 1999) to sample and characterize communities on the northeast slope of the Grand Banks over a three year period. Kenchington et al (2001) documented 246 benthic taxa (mostly echinoderms, polychaetes, crustaceans and molluscs), of which abundance was dominated by a polychaete (*Prionospio steenstrupi*) and a mollusk (*Macoma calcarea*), and biomass was dominated by propeller clams and sand dollars. The epibenthic sled samples were also dominated by mollusks and echinoderms such as brittle stars, sand dollars and urchins, as well as by snow crab and soft corals (Prena et al 1999). The epibenthic samples were also characterized by a reduced taxonomic richness (115 taxa detected) relative to that collected with the grab/video system. Kenchington et al (2001) also documented significant and naturally occurring variation in structure between years in the benthic invertebrate community.

In contrast to other survey types, DFO RV trawl surveys were dominated by sponges, anemones, shrimp, crab and urchins. Other taxa included echinoids such as sand dollars, sea stars, brittle stars and basket stars (LGL 2012, 2013). As trawls would be considered an epibenthic sampling technique, it is not surprising that the sampled community aligns well with those of Prena et al (1999).

Collectively, these studies confirm that benthic communities in the SEA Study Area are quite diverse compared to higher trophic levels, as well as being somewhat sensitive to anthropogenic effects, and these communities can be expected to vary over time and with changing environmental conditions.

Life Histories, Habitat, and Spawning (Benthos)

An overview of the key characteristics of some of the numerically dominant benthic taxa that are known to occur in the SEA Study Area is provided in Table 4.58. As DFO RV surveys do not properly represent many benthic invertebrates, the Table has also been further augmented with important taxa identified from other literature specific to the SEA Study Area, including Houston and Haedrich (1984), Schneider et al (1987), Prena et al (1999), Kenchington et al (2001), Ollerhead et al (2004) and LGL (2012, 2013). Additional information on reproduction is provided in Table 4.59, while the regional distributions of key species are further described in subsequent sections.

Table 4.58 Overview of Some Key Shellfish Species in the SEA Study Area

Species	Habitat and Distribution	Biology and Ecology	Use / Importance
Icelandic scallops (*Chlamys islandica*)	• Distributed in the northwest Atlantic Ocean. • Occurs in depth ranges from subtidal depths to 180 m. • In Newfoundland waters, scallops occur generally in depths >55 m on variable hard substrates. • Icelandic scallops are associated with gravel and cobble substrates on the Grand Bank.	• Broadcast spawns in Newfoundland around April-May. • Planktonic larvae remain in the water column for 10 weeks before settling. • Spat settle primarily between August and November at depths of 10-15 m. • Suspension feeders on phytoplankton.	• Commercially significant species.
Sea scallop (*Placopecten magellanicus*)	• Distributed in the northwest Atlantic Ocean from Labrador to North Carolina. • Occurs in shallow depths of <20 m in the northern part of its range on sand, gravel and pebble substrates.	• Sea scallops spawn from September to October in Newfoundland triggered by a rise in water temperature. • Large females are able to produce over a hundred million eggs each. • Planktonic larvae remain in the water column for four weeks before settling. • Suspension feeders on phytoplankton.	• Commercially significant species.
Northern Shrimp (*Pandalus borealis*)	• Distributed from west Greenland to Georges Bank. • Occupies areas with mud and silt substrates in temperature ranges from 1-6°C. • Northern shrimp was the most commonly observed species in 3NLOPs area from RV surveys. • Northern Shelf Assemblage.	• Spawns once a year around late June or early July. • During late summer, fertilized eggs are attached to the female's abdomen. • The eggs hatch the following spring and summer. • Feeds on polychaetes, small crustaceans, detritus, marine plants, copepods and euphausiids. • Prey for Greenland halibut, Atlantic halibut, cod redfish and harp seals.	• Commercially significant species. • Important forage species.
Striped pink shrimp (*Pandalus montagui*)	• Undergoes diel vertical migrations in association with pelagic feeding (Hudon et al 1992). • Northern Shelf Assemblage.	• Eggs are laid between November and January and hatch by the end of April (Allen 1963). • In pelagic waters, it feeds	• Commercially significant species. Important forage species.

Species	Habitat and Distribution	Biology and Ecology	Use / Importance
		mainly on copepods. At benthic depths, it feeds on polychaetes and foraminiferans (Hudon et al 1992). • Prey for Greenland halibut, Atlantic halibut, cod, redfish and harp seals.	
Snow crab (*Chionoecetes opilio*)	• Distributed in the northwest Atlantic Ocean from Greenland to the Gulf of Maine. • Occupies on soft bottoms at depth ranges from 60-400 m and temperature ranges from -1-6°C. • Commonly observed species in 3NLOPs from RV surveys. • Commonly observed during the 2005-2011 DFO RV Surveys of the Orphan Basin (LGL 2012). • Dominated otter trawl sampling on sandy areas of the Grand Bank (Prena et al 1999). • Cold Shelf Assemblage	• Fertilized eggs are attached to the hairs on the female's pleopods. • Eggs are carried for 12-27 months. • Eggs hatch during the peak phytoplankton bloom between April and June. • Larvae feed on microplankton. • Feeds on polychaetes, bivalves, echinoderms and fish carcasses. • Various groundfish, other snow crabs and seals prey on snow crabs.	• Commercially significant species.
Surf clam (*Spisula solidissima*)	• Distributed in the northwest Atlantic Ocean along the continental shelf from southern Gulf of St. Lawrence to North Carolina. • Occurs at depths from the subtidal zone to <50 m. • High abundance along the eastern edge of the Grand Banks (Ollerhead et al 2004).	• Spawns in summer to early fall when water temperatures reach 12-15°C. • Larvae settle on sand substrates. • Suspension feeders. • Preyed upon by rock crabs, seastars, hermit crabs, moon snails, whelks and various groundfish including cod, flounder, sculpin and ocean pout.	• Commercially significant species.
Pale sea urchin (*Strongylocentrotus pallidus*)	• High abundance on sandy bottoms of the Grand Bank (Kenchington et al 2001). • Distributed in deep waters up to depths of 1600 m (Bluhm et al 1998). • Found on a mixture of cobble and sand substrates (Gilkinson et al 1998). • Dominant sea urchin at depths >60 m (Gilkinson et al 1998).	• Feeds on epibiotics on stones, infaunal meiobenthos and detritus (Bluhm et al 1998). • Preyed upon by commercially important groundfish species including American plaice (Gilkinson et al 1998).	• Not commercially significant in the region.
Hooded shrimp (Cumacea)	• Distributed from Newfoundland to Cape Cod (Gosner 1979). • Common on gravel and sand substrates on the Grand Bank (Houston and Haedrich 1984).	• Preyed upon by American plaice, yellowtail flounder and cod (Bruno et al 2000; Pitt 1973). • Spawning varies depending on the species. As a group	• Not commercially significant in the region.

Species	Habitat and Distribution	Biology and Ecology	Use / Importance
		spawning times range from February to December (Corey 1981).	
Amphipoda	• Distributed on silt, sand and gravel substrates on the Grand Bank (Houston and Haedrich 1984).	• Spawning occurs throughout the year (Sheader 1983). • Feeds on seaweed and algae (Duffy and Hay 1991). • Preyed upon by commercially important groundfish species including American plaice and yellowtail flounder (Pitt 1976).	• Not commercially significant in the region.
Polychaete worms (Polychaeta)	• Important component of marine benthic communities on a variety of substrates. • Variety of species found on the Grand Bank. • Distributed throughout the North Atlantic including the Grand Banks at depths >50m. • Common on silt substrates on the Grand Bank (Houston and Haedrich 1984).	• Spawning times vary between species. Spawning times take place throughout the year. I.e. *Spriobis* spp. spawn from January-February, sandworms, *Nereis* spp., spawn from April to May, Lugworm, *Arenicola marina*, spawns from October-November. • Important prey species for a variety of invertebrates and groundfish.	• Not commercially significant in region.
Propellor clam (*Cyrtodaria siliqua*)	• High abundance on sandy bottoms of the Grand Bank (Kenchington et al 2001).	• Population dominated by older individuals to ages exceeding 100 years (Kilada et al 2009). • Prey species of American plaice and Atlantic wolfish (Templeman 1984).	• Commercially significant species.
Sipunculan worms (Sipuncula)	• Common on sand substrates on the Grand Bank (Houston and Haedrich 1984). • Burrowing worms found on sandy-mud to coral-rock substrates (Gosner 1979).	• Many species are generally deposit feeders (McMahon et al 2006). • Spawning times vary between species. • Preyed upon by groundfish and other invertebrates.	• Not commercially significant in Region.
Whelk (*Buccinum* sp.)	• Distributed throughout the northwest Atlantic Ocean from Labrador to New Jersey. • Common in cold waters from tidal levels to depths of 180 m. • Common in otter trawl sampling on sandy areas of the Grand Bank (Prena et al 1999).	• Copulates from May to July. • Fertilized eggs are laid approximately 2-3 weeks after copulation. • Eggs are enclosed in masses that may contain about 340,000 developing embryos. • Feeds on urchins, polychaetes, amphipods, crustaceans and fish eggs. Also known to feed on animal carcasses. • Preyed upon by lobsters, cod, crabs, seastars and dogfish.	• Commercially significant species.

Species	Habitat and Distribution	Biology and Ecology	Use / Importance
Sponges (*Geodia* sp.)	• Commonly observed during the 2005-2011 DFO RV Surveys of the Orphan Basin (LGL 2012). • Variety of species found on the Grand Bank. • The most dominant species observed on sponge grounds on the Grand Bank, Flemish Cap and Flemish Pass (Murillo et al 2012).	• In Scandinavia, *G. barretti* undergoes sexual reproduction and releases gametes 1-2 periods per year (Spetland et al 2007). • Gamete release coincides with phytoplankton blooms (Spetland et al 2007).	• Not commercially significant in region.
Jellyfish (Scyphozoa)	• Occur inshore and offshore. • Commonly captured during plankton tows on the Grand Bank (LGL 2012). • Main species captured include *Cyanea capillata* and *Aurelia aurita*.	• Planulae larvae appear during early to mid spring. • Major predator of fish eggs and larvae.	• Not commercially significant in region.
Brittlestar (Ophiuroidea)	• Comprised of several species of brittle star. • Generally occurs from the Arctic to Cape Cod in the intertidal zone to depths >300 m.	• Undergo asexual and sexual reproduction. • Larvae settle during late July to early August. • Feeds on small crustaceans, polychaetes and detritus. • Important prey species for lobster and American plaice.	• Not commercially significant in region.
Basket star (*Gorgonocephalus arcticus*)	• Dominated otter trawl sampling on sandy areas of the Grand Bank (Prena et al 1999). • At subtidal depths to >1200m. (Gosner 1979).	• Primarily feeds on euphausids (Emson et al 1991). • Associated with deep sea corals (Rosenberg et al 2005).	• Not commercially significant in region.
Sand dollar (*Echinarachnius parma*)	• Distributed in the northwest Atlantic Ocean from Labrador to North Carolina. • Occurs mainly on sandy substrates at depths ranging from shallow waters to >800 m. • Burrows in soft substrates and reaches densities of 100 individuals/m^2. • High abundance on sandy bottoms of the Grand Bank (Kenchington et al 2001).	• Spawning occurs in late spring to early summer. • Preyed upon by American plaice (Bruno et al 2000). • Stomach gut contents include diatoms, sand grains, sponge spicules and detritus.	• Important food source for commercially important groundfish species.
Sea anemones (Actiniaria)	• Commonly observed during the 2005-2011 DFO RV surveys of the Orphan Basin (LGL 2012). • Variety of species found on the Grand Bank.	• Feed on echinoderms and other invertebrates. • Have planktonic larvae	• Not commercially significant in Region.
Sources: Summarized from Christian et al (2010) unless otherwise noted			

Table 4.59 Spawning Periods and Locations of Some Key Invertebrate Taxa

Common Name	Scientific Name	Spawning Time												Known Spawning Locations
		J	F	M	A	M	J	J	A	S	O	N	D	
Deep sea corals[1,2]	-													
Iceland scallop[3]	*Chlamys islandica*													NAFO areas 3LNP
Northern shrimp[3]	*Pandalus borealis*													NAFO areas 3LNP
Pink shrimp[4]	*Pandalus montagui*													
Sea scallop[3]	*Placopecten magellanicus*													NAFO areas 3P
Snow crab[5]	*Chionoecetes opilio*													
Sponges[6]	*Geodia* sp.													
Surf clam[3]	*Spisula solidissima*													NAFO areas 3N

Dark shading represents breeding and copulation periods, light shading indicates spawning periods.
[1] Sun et al (2010); [2] Mercier et al (2011); [3] Ollerhead et al (2004); [4] Allen (1963); [5] Hooper (1986); [6] Spetland et al (2007)

Benthic Invertebrate Distributions

Despite considerations related to the particular invertebrate species sampled, the Canadian RV surveys provide the most comprehensive and geographically extesive and "mappable" invertebrate data for the SEA Study Area. A total of four invertebrate taxa (snow crab, northern shrimp, pink striped shrimp, and shrimp *Pandalus propinquis*) were available from the Canadian RV surveys (Table 4.60). These species do, however, include the two species of greatest commercial importance (northern shrimp and snow crab) along the Newfoundland Shelf.

Table 4.60 Representation of Invertebrates During DFO RV Surveys from 2005-2009 in the SEA Study Area

Common Name	Scientific Name	Abundance (%)
Northern Shrimp	*Pandalus borealis*	74.83
Striped Pink Shrimp, Aesop Shrimp	*Pandalus montagui*	2.51
Snow Crab	*Chionoectes opilio*	0.12
Shrimp	*Pandalus propinquus*	0.01
[1]Percentages include finfish as well as crab and shrimp species		

Shrimp

More than 30 species of shrimp are found off Newfoundland (Templeman 2010), with Northern shrimp being the most abundant and commercially important. Northern shrimp are also the most abundant of all animals captured in DFO RV surveys along the Newfoundland shelf, and constitute the bulk of commercial fish landings (Dawe et al 2012). Pink striped shrimp were the fourth most abundant species collected in the RV surveys over this period, and this species and *P. propinquus* are considerably less studied than Northern shrimp.

Northern shrimp experienced an increase in numbers prior to the collapse of groundfish stocks and another increase following the collapse. It is thought that the latter event was caused in part by a release from the predation pressure of groundfish (Lilly et al 2000; Ramseier et al 2000). Consequently, with the observed recovery of some groundfish and ocean temperatures returning to pre 1990s levels, shrimp have shown signs of decline, particularly in southern parts of its range (Orr et al 2011).

Northern shrimp can live up to eight years, with the early years being spent as males before they morph into females later in life (Fuentes-Yaco et al 2007; Templeman 2010). Northern shrimp typically live in association with the bottom, particularly older individuals, but younger males undergo vertical feeding migrations at night (Fuentes-Yaco et al 2007). At larval stages, survival and recruitment is closely linked to the extent of phytoplankton blooms and sea surface temperatures (Ouellet et al 2011). Later in life, growth rates are influenced by the amount of particulate organic carbon (e.g. detritus from decomposing phytoplankton; Ramseier et al 2000) and latitude (Fuentes-Yaco et al 2007).

The 2005-2009 DFO RV surveys indicate that Northern Shrimp have been concentrated in the northeast portions of the SEA Study Area, at the edge of the continental shelf and in the Flemish Pass (Figure 4.66). They are at relatively low biomass across the shallow sections of the Grand Banks. Similarly, striped pink shrimp are distributed primarily in the northern parts of the SEA Study Area, but compared to northern shrimp they are found in greater abundance in coastal areas and on the Grand Banks (Figure 4.67). *P. propinquus* are the most spatially restricted of the shrimp species being found primarily along the northern portions of the shelf slope in the SEA Study Area (Figure 4.68).

Snow Crab

Since the early 1990s, snow crab has become an important component of the fishery in the SEA Study Area (Dawe et al 2012). Snow crab hatch in the spring and undergo several planktonic larval stages before settling to the ocean bottom (DFO 2008). The species is sexually dimorphic, with males achieving larger sizes than females (Mullowney et al 2013). Springtime molts allow crabs to grow, but females cease molting upon sexual maturity at sizes that exclude them from commercial exploitation. Similarly, not all males undergo their termial molt at a size that makes them accessible by the fishery. Males can live 6-8 years as adults, where they are most common over mud or mud / sand bottom types, while smaller crabs are common on harder substrates. Crabs feed on a variety of animals that include polychaetes, brittle stars, crustaceans, shrimp and fish, and they in turn are preyed upon by groundfish, seals and other snow crabs (DFO 2008).

Cold ocean conditions are believed to improve crab recruitment (DFO 2008). Unusually cold ocean temperatures in the SEA Study Area resulted in a rapid increase in crab abundance in the early 1990s, although snow crab stocks have declined in recent years and are expected to continue to decline in the near to mid term due to unfavourable environmental conditions (Dawe et al 2012; Mullowney et al 2012). In the SEA Study Area, DFO RV surveys indicate that snow crab are widely distributed, with the exception of the shallows of the Grand Banks and the deep continental slopes (Figure 4.69). Concentrations occur in the colder waters of the northern slopes of the Grand Banks and Flemish Pass as well as in northern portions of the Newfoundland Shelf. These distributions roughly correspond to crab grounds indicated by fishermen during SEA consultations (Appendix A), who indicated the northwest portion of the SEA Study Area was used most frequently for this fishery.

Figure 4.66 Distribution and Abundance of Northern Shrimp in the SEA Study Area (2005-2009 Surveys)

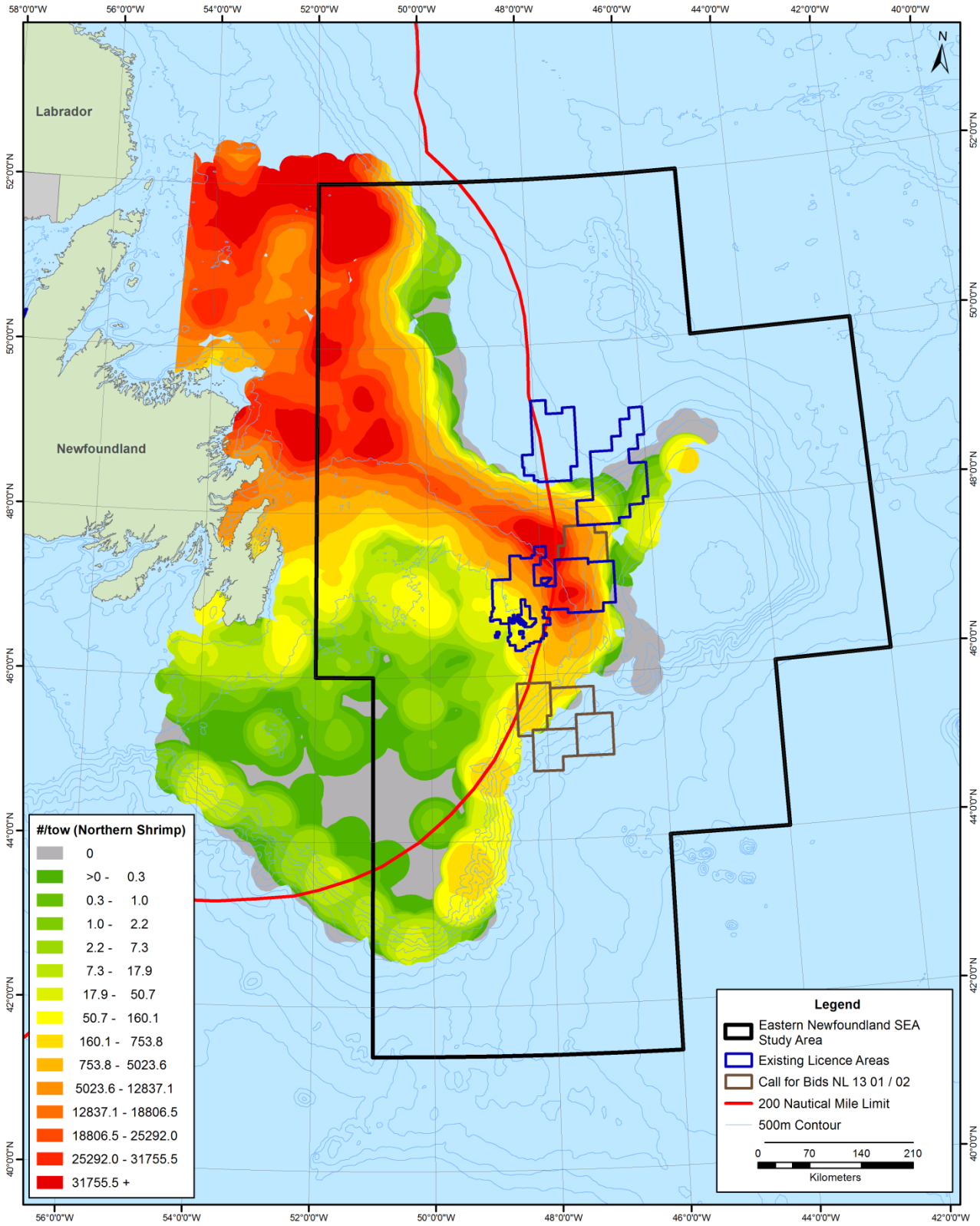


Figure 4.67 Distribution and Abundance of Striped Pink Shrimp in the SEA Study Area (2005-2009 Surveys)

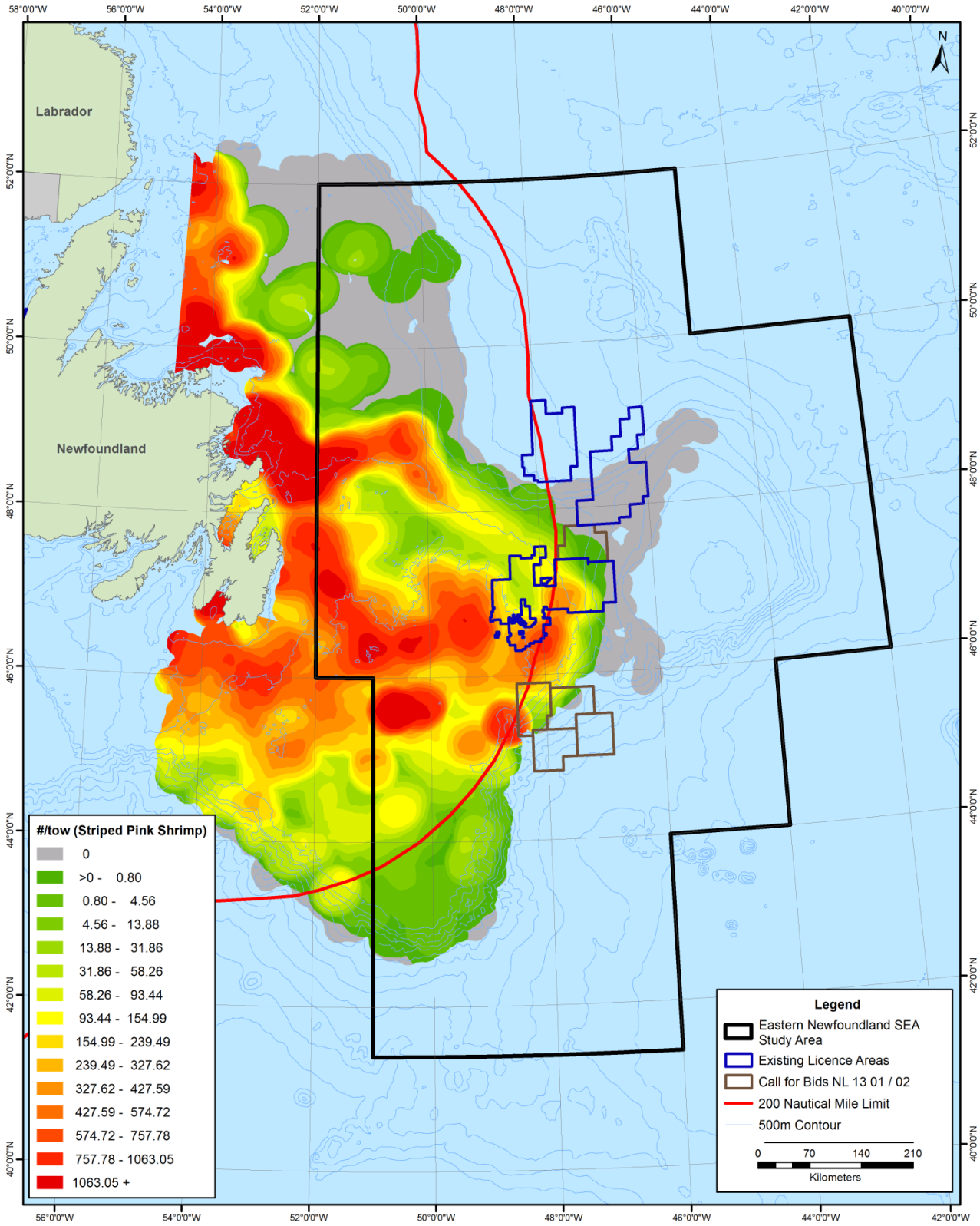


Figure 4.68 Distribution and Abundance of Shrimp *Pandalus propinquus* in the SEA Study Area (2005-2009 Surveys)

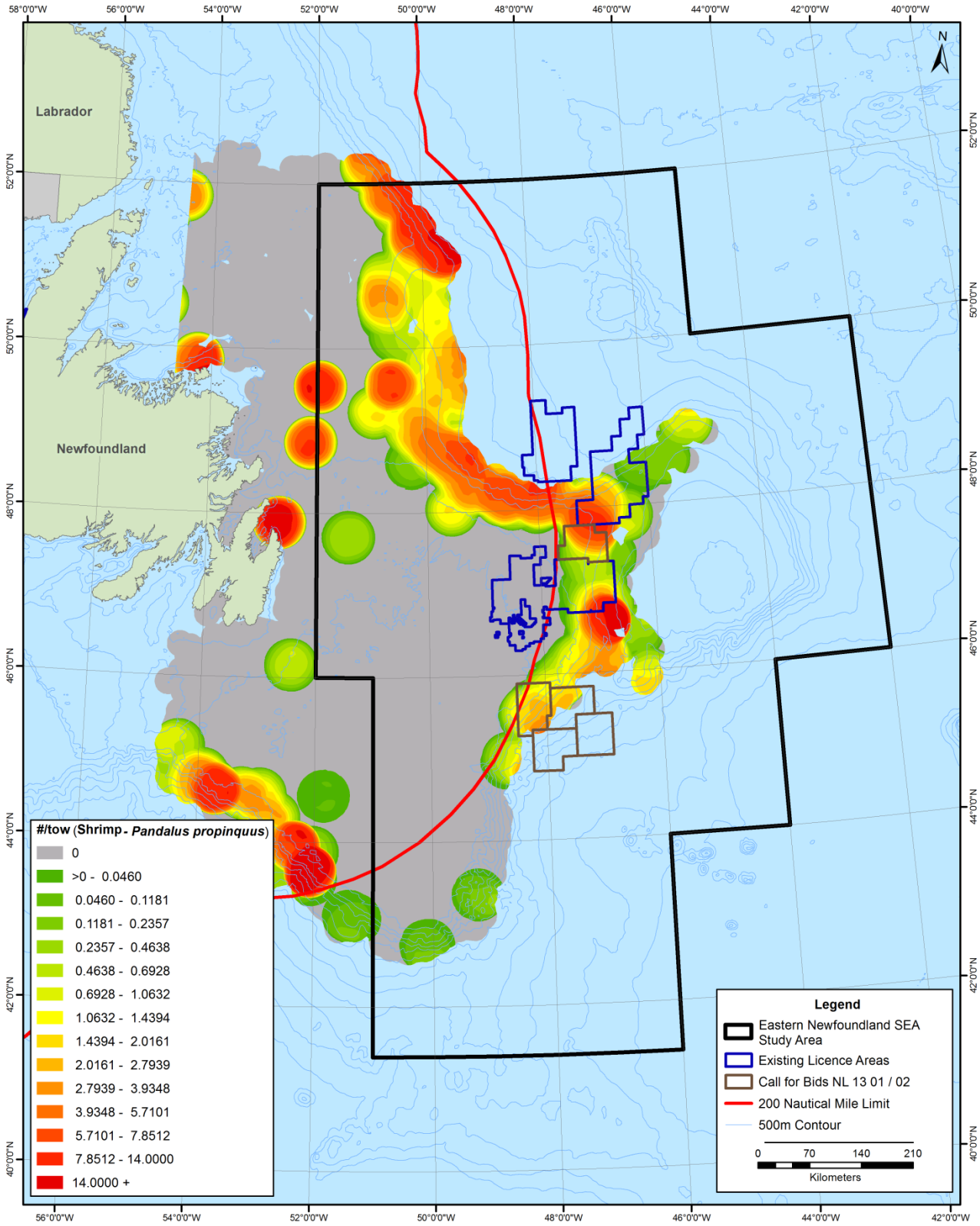
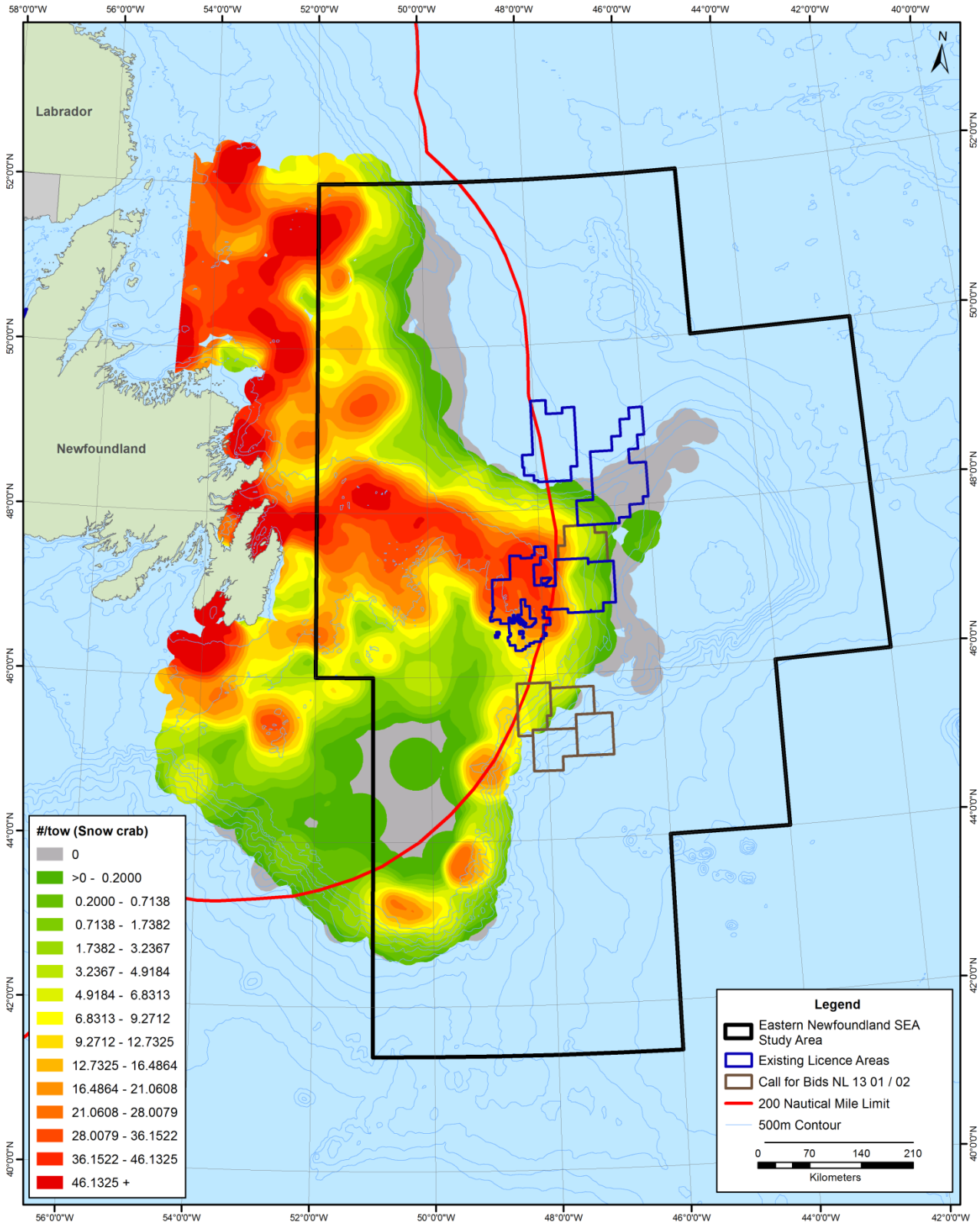


Figure 4.69 Distribution and Abundance of Snow Crab in the SEA Study Area (2005-2009 Surveys)



Corals and Sponges

Deep-sea corals and sponges are sessile, habitat-forming organisms that are an important component of the deep sea environment. They provide structural complexity on the seafloor, thus creating refuge and foraging habitat for a variety of fish and invertebrates (Watanabe et al 2009; NAFO 2010) including those harvested commercially (Gilkinson and Edinger 2009; Baillon et al 2012). The provision of such habitat is reflected by the increased biodiversity associated with deep-sea corals and sponges (Buhl-Mortensen et al 2010; NAFO 2010; Beazley et al 2013).

Corals and sponges are sensitive to bottom disturbance such as trawling and oil and gas infrastructure placement due to their vertical structure, fragile nature and slow growth (Campbell and Simms 2009, Watanabe et al 2009). Within the coral group, black corals, and large and small gorgonians are considered most vulnerable to disturbance due to the inability of these organisms to reattach to the substrate after being dislodged (Gilkinson and Edinger 2009).

Collectively, sea pens, soft corals, stony corals, and sponges are represented across the shelf, slopes and banks of the Study Area but are found at their highest densities along the slopes (Gilkinson and Edinger 2009; DFO 2010; NAFO 2010; Murillo et al 2011). This is reflected in the distribution of corals and sponges found within the Canadian EEZ shown in Figure 4.70. Beyond the Canadian EEZ, corals are abundant along the slopes of the Flemish Cap (600 m to 1,300 m; Murillo et al 2011) and along the western Tail of the Grand Banks (NAFO 2010). The coral diversity of the Flemish Cap include 21 species of soft corals and gorgonian sea fans (alcyonaceans), 11 species of sea pens (pennatulaceans), two species of cup corals (solitary scleractinians), and three species of black coral (antipatharians) (Table 4.61; Murillo et al 2011). Mud substrates were used by sea pens and cup corals while black corals, soft corals and sea fans were common on bedrock and gravel. NAFO models derived from known coral locations (Knudby et al 2013), indicate that the slopes of the Flemish Cap (except the southern portion) and the Tail of the Grand Banks are important for sea pens, the eastern slopes of the Flemish Cap and the northern Flemish Pass are important for large gorgonians and the slopes around the entire Flemish Cap are important for black corals. The Flemish Cap, the Flemish Pass and the Tail of the Grand Banks are considered important for sponges (NAFO 2011). The slopes of the Flemish Cap are dominated by axinellid and polymastid sponges, while deeper areas of the Flemish Pass were characterized by geodiids and Asconema sp. (Beazley et al 2013).

Areas of high abundance for corals and sponges have been identified by DFO and NAFO in the SEA Area (Figure 4.71). For example, large gorgonians are found at relatively high density on the Flemish Pass, the eastern tip of the Flemish Cap and along the continental slope in the northern parts of the SEA Area. High densities of small gorgonians are also found on the northern slope but other locations occur on the Tail of the Grand Banks. Black corals are found at their highest densities in the Flemish Pass and northern Flemish Cap while important areas for sea pens are aggregated in the Flemish Pass and in one location on the Tail of the Grand Banks. Sponges, in contrast are more widely distributed and high densities can be found along the eastern slopes of the Grand Banks, around the Flemish Cap and along the northern slopes of the SEA Area.

In response to the known sensitivity of coral and sponge grounds, many important coral and sponge areas have been designated as Vulnerable Marine Ecosystems (VMEs) (DFO 2012b) and are protected from damaging fishing activities in Canadian and NAFO waters (Campbell and Simms 2009, NAFO 2013; Figure 4.71). However, some other areas that host considerable diversity (Beazley et al 2013), such as the southern slope of the Flemish Cap are unprotected.

Table 4.61 Coral Occurrence Within the SEA Study Area

Order	Family	Species	Area				Occurrence (%)
			Flemish Cap	Flemish Pass	Grand Banks	Northeastern Slope	
Alcyonacea		Alcyonacea indet.	●				1.23
	Clavulariidae	Clavulariidae indet.	●		●		1.47
		Telestula septentrionalis	●				2.7
	Alcyoniidae	*Anthomastus* spp.	●	●	●		4.17
		Anthomastus sp.	●	●	●		14.22
	Nephtheidae	*Duva florida*	●	●	●	●	62.25
		Gersemia rubiformis		●	●		6.13
		Nephtheidae indet.	●	●	●	●	25
	Anthothelidae	*Anthothela grandiflora*	●				0.74
	Paragorgiidae	*Paragorgia arborea*		●		●	0.49
		Paragorgia johnsoni	●				0.98
	Acanthogorgiidae	*Acanthogorgia armata*	●	●			2.7
	Plexauridae	*Paramuricea* sp.	●				0.25
		Paramuricea spp.	●	●		●	3.68
		Placogorgia sp.	●				0.49
		Swiftia sp.	●				0.74
	Chrysogorgiidae	*Radicipes gracilis*	●	●	●		4.66
	Isididae	*Acanella arbuscula*	●	●	●	●	12.5
		Keratoisis sp.	●	●	●		1.23
	Primnoidae	*Parastenella atlantica*	●				0.25
		Primnoa resedaeformis	●			●	0.74
Pennatulacea	Kophobelemnidae	*Kophobelemnon stelliferum*	●				2.7
	Funiculinidae	*Funiculina quadrangularis*	●	●	●		12.5
	Protoptilidae	*Distichoptilum gracile*	●	●	●		1.23
		Protoptilum sp.	●				0.25
	Umbellulidae	*Umbellula lindahli*	●	●	●		8.09
	Anthoptilidae	*Anthoptilum grandiflorum*	●	●	●	●	29.9
	Halipteridae	*Halipteris finmarchica*	●	●	●		13.48
		Halipteris cf. *christii*	●				3.43
	Virgulariidae	*Virgularia* sp.	●				0.25
	Pennatulidae	*Pennatula aculeata*	●	●	●	●	12.01
		Pennatula grandis	●	●	●	●	7.6
Antipatharia	Antipathidae	*Stichopathes* sp.	●				0.25
	Leiopathidae	*Leiopathes* sp.		●			0.49
	Schizopathidae	*Stauropathes arctica*	●	●		●	6.62
Scleractinia	Caryophylliidae	*Desmophylllum dianthus*	●	●			0.25
	Flabellidae	*Flabellum alabastrum*	●	●	●	●	13.48
Total Species		**37**	**34**	**22**	**17**	**11**	

Source: Murillo et al (2011)

Figure 4.70 Distribution of Corals (NAFO Zones 3MNLO) Derived from DFO RV Surveys

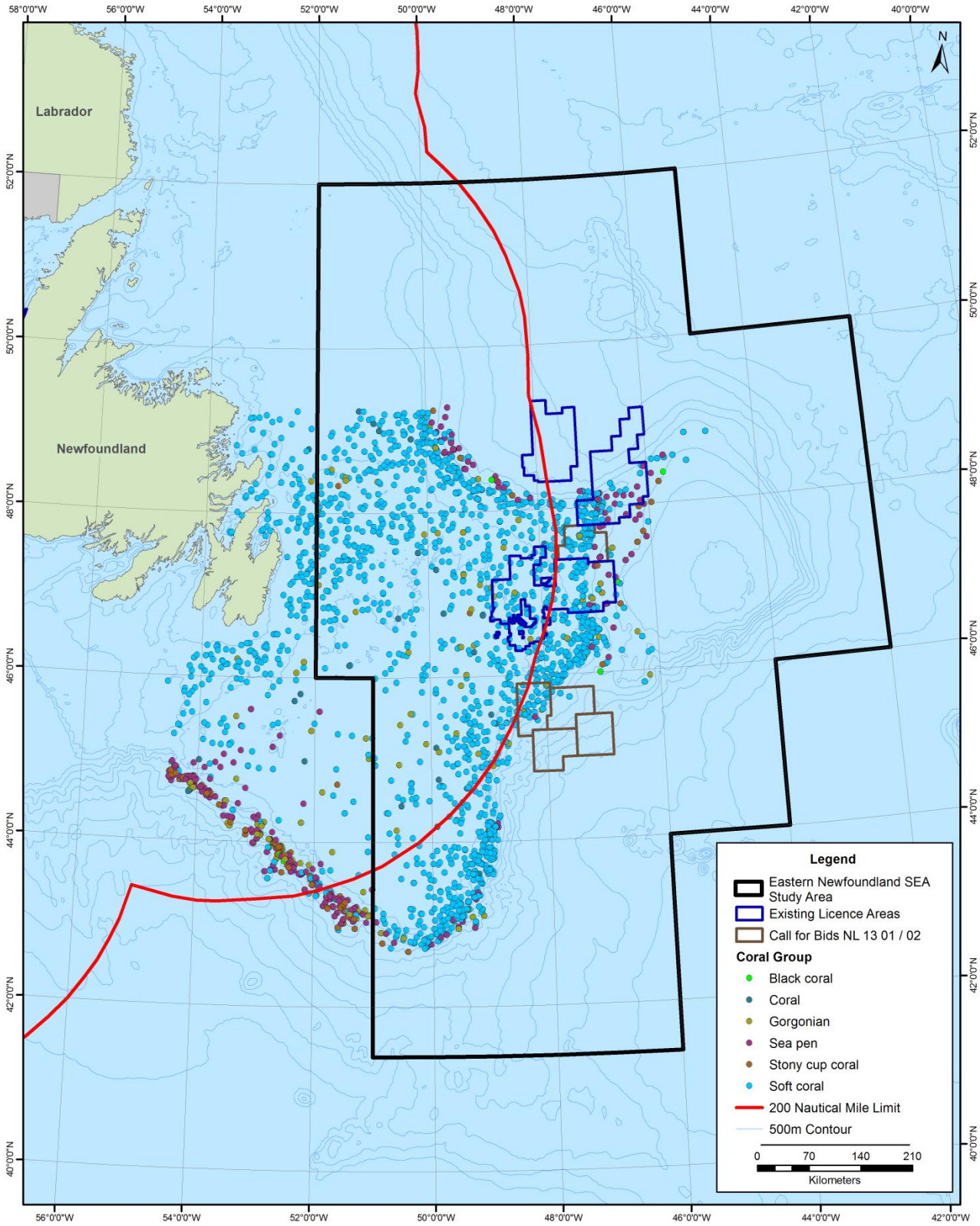
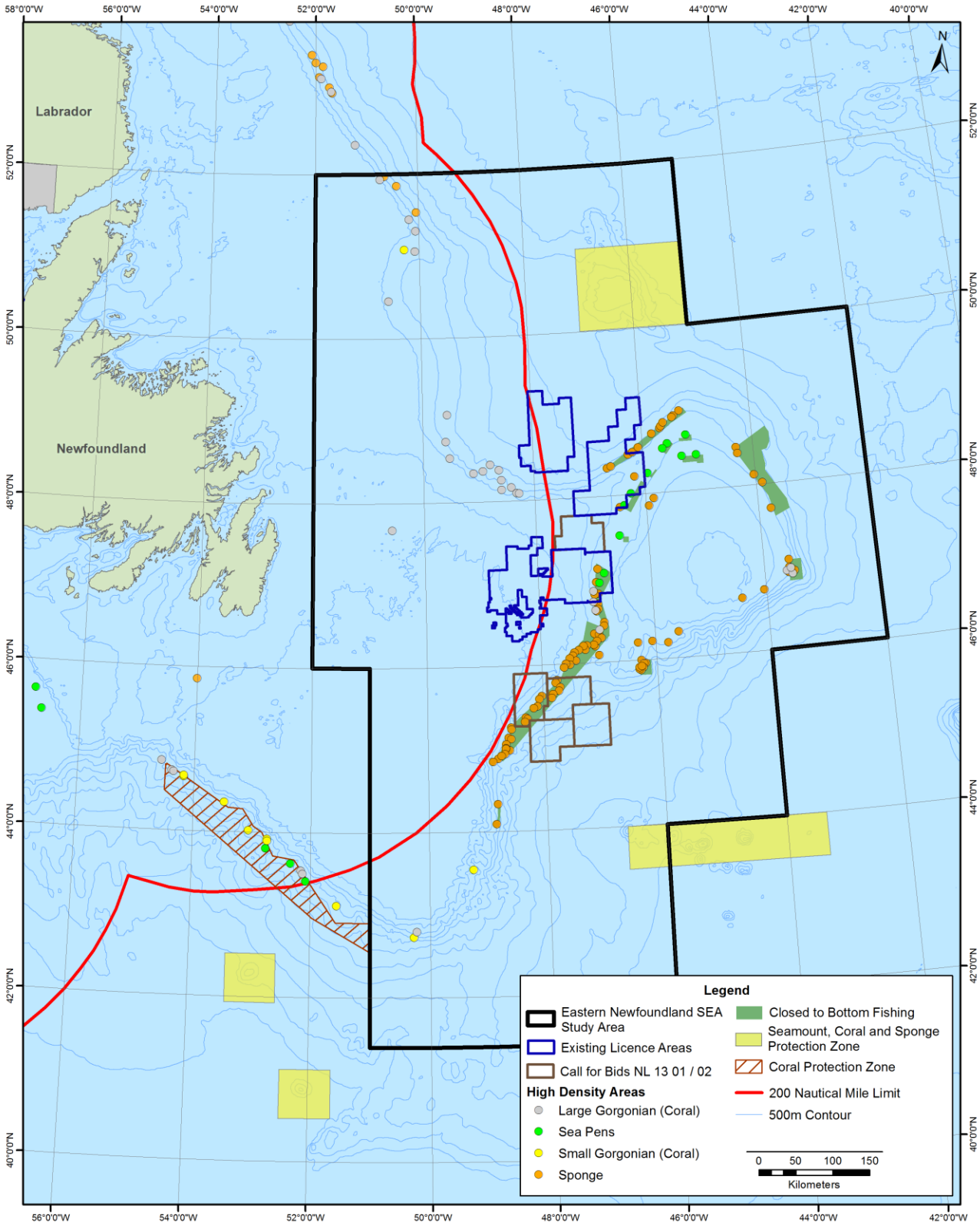


Figure 4.71 Identified Sensitive Coral Areas and Protection Zones for Corals, Seamounts and Sponges Within and Adjacent to the SEA Study Area



4.2.1.6 Marine Fish

A large number (approximately 188) and variety of marine fish species are known to occur in Newfoundland and Labrador waters (Templeman 2010). The occurrence of these species reflects their physiological and life history requirements, and their presence may vary according to habitat, environmental conditions and life history stage.

This section gives an overview of key marine fish species in the SEA Study Area, including general (and summarized) information on their ecology including life history, habitat preference and reproduction. Again, the tables and text that follow are not intended to provide an exhaustive list of every fish species that occurs in the region. Rather, the focus is on those that are known to represent the most numerically abundant, ecologically relevant and/or societally important species. This is followed by general information related to fish distribution and migration.

Life Histories, Habitat, and Spawning (Finfish)

Tables 4.62 and 4.63 describe demersal and pelagic marine fish species that are of particular ecological, socioeconomic and/or conservation importance in the SEA Study Area. These include their preferred habitats, distributions, spawning behaviour, and highlighting their known ecological and/or socioeconomic importance. Additional information on marine fish spawning, migration and regional distributions within the SEA Study Area is provided in subsequent sections.

Table 4.62 Overview of Some Key Groundfish Species in the SEA Study Area

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
Atlantic cod (*Gadus morhua*)	• Occurs on both sides of the North Atlantic. • Found in cool-temperature to subarctic waters from inshore regions to the edge of the continental shelf. • Depth of habitat is usually related to temperature; cool temperatures are preferred, in 0.5–10°C range. • Cod occur throughout the Canadian Atlantic Area, and each region has unique stocks. • Juveniles are found in greater abundance in inshore areas (Gregory and Anderson 1997). • Commonly observed species in 3NLOPs from RV surveys. • Widespread Shelf Assemblage.	• Over the whole Canadian Atlantic region, spawning begins in the north as early as February and ends in the south as late as December. • Due to the fact that cod spawn over such a large area, it is difficult to generalize about specific conditions. • The depth at which cod spawn varies according to the particular stock, locality, and temperature and can vary from 110 m to 182 m. • Cod are broadcast spawners and fertilized eggs drift toward nursery areas in surface currents. • EBSA sites Southeast Shoal and Tail of the Banks and Virgin Rocks are spawning areas for Atlantic cod (Templeman 2007).	• Has COSEWIC and IUCN status. • Commercially significant species. • Culturally and ecologically important species.
American plaice *(Hippoglossoides platessoides)*	• Usually considered a coldwater species, with a preference for temperatures from just below 0 to 1.5°C and a depth range of	• Spawning occurs in spring, beginning early April on the Flemish Cap and Late April on the Grand Bank.	• Has COSEWIC status. • Commercially significant species

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
	90–250 m. • Occurs on both sides of the Atlantic, can tolerate lowered salinities and have been reported in salinities as low as 20 – 22 ppt. • Commonly observed species in 3NLOPs from RV surveys. • Widely distributed on the shelf. • Widespread Shelf Assemblage.	• Eggs float near the surface and drift widely from their point of origin. • Time to hatching depends on water temperature in the surface layers, but at 5°C hatching occurs in 11 – 14 days. • EBSA sites Southeast Shoal and Tail of the Banks and Virgin Rocks are spawning areas for American plaice (Templeman 2007). • Feeds on polychaetes, echinoderms, molluscs, crustaceans and fish.	
Atlantic halibut (*Hippoglossus hippoglossus*)	• The largest of the flat fishes, and typically found along the slopes of the continental shelf. • Atlantic halibut move seasonally between deep winter waters and the shallow waters of the Gulf where they feed. • The migration allows them to avoid temperatures below 2.5°C. • Found almost exclusively in the spring in the Southwest Shelf Edge and Slope EBSA. • Warm Southern Shelf Assemblage.	• Spawning grounds of the Atlantic halibut are not clearly defined. • Fertilized eggs are slightly positively buoyant so that they naturally disperse and only gradually float toward the ocean's surface. • Once hatched, the developing larvae live off their yolk for the next six to eight weeks while their digestive system develops so they can begin feeding on zooplankton. • Feeds on polychaetes, molluscs, crustaceans and fish.	• Commercially significant species
Atlantic wolffish (*Anarhichas lupus*)	• Occurs on both sides of the North Atlantic Ocean. • Commonly an inhabitant of deep water along the shelf (Dutil et al 2010). • In the Newfoundland area, it occurs over hard clay bottom in depths of 25 – 250 m and bottom temperatures of 1 to 4°C (Kulka et al 2004). • Warm Southern Shelf Assemblage.	• Shows a wide variability in time and place of spawning. • Demersal eggs. • Feeds mainly on bottom invertebrates including echinoderms, molluscs, and crustaceans and some fish. • Spring surveys indicated that Atlantic wolffish are concentrated in EBSA site Southeast Shoal and Tail of the Banks (Templeman 2007).	• Has SARA and COSEWIC status. • Not commercially significant in the region
Barndoor skate (*Dipturus laevis*)	• Found on a variety of substrates from shoals to depths of 750 m. Common at depths of 50-150 m (COSEWIC 2010). • Preferred Temperature range is 3-13°C. • Migrates offshore to seek cool temperatures. • High catch rates of this species	• Spawning likely takes place during winter months. • Eggs are laid in large yellowish egg capsules. • Feeds on bivalves, squid, rock crabs, lobster, shrimp and polychaetes.	• Has IUCN status. • Not commercially significant in the region

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
	in Southeast Shoal and Tail of the Banks EBSA (Kulka et al 2002; Templeman 2007). • Warm Southern Shelf Assemblage.		
Black dogfish (*Centroscyllium fabricii*)	• Small, deepwater shark occurring near bottom, at times forming schools. • Usually occurring at depths of 350 - 500m in Canadian waters (Kulka 2006). • Bottom temperatures where most captures have occurred were 3.5 – 4.5°C. • Deep Demersal Assemblage.	• Fertilized eggs develop within the brood chamber of the female. • Feeds mainly on squid, crustaceans, jellyfish and small redfish.	• Not commercially significant in the region
Blue hake (*Antimora rostrata*)	• Benthopelagic species associated with mud bottoms. • Distributed in slope waters along the eastern Grand Bank at depths >1400m (Kulka et al 2003) • Bottom temperatures where most captures have occurred were 3 – 4.5°C (Kulka et al 2003b). • Deep Demersal Assemblage.	• Little is known about the reproductive phase of this species. Blue hake may spawn in Canadian waters though it has not been confirmed (Kulka et al 2003b). • Feeds on benthic invertebrates including crustaceans and squids.	• Not commercially significant in the region
Cusk (*Brosme brosme*)	• Lives on hard, rough or rocky bottom, preferring relatively warm water and intermediate depths. • Found in moderately deep water on both sides of the North Atlantic. • In the Canadian region more common on southwestern Scotian Shelf and Slope and Fundian Channel. • Warm Southern Shelf Assemblage	• Reproductive biology not known for the northwest Atlantic. • Larvae are pelagic until they reach about 50 mm, after which they seek bottom areas. • Feed on crustaceans, molluscs and echinoderms.	• Has COSEWIC status. • Not commercially significant in the region
Greenland halibut (*Reinhardtius hippoglossoides)*	• A deepwater flatfish species that occurs in water temperatures ranging from -0.5 to 6°C but appears to have a preference for temperatures of 0 to 4.5°C. • Occupies an extensive depth range from 200m to 2200 m. • Unlike many flatfishes, the Greenland halibut spends considerable time in the pelagic zone (Morgan et al 2013). • Distributed across areas of the Grand Bank and Flemish Pass (Morgan et al 2013). • Aggregates in Northeast Shelf and Slope EBSA in the spring	• These halibut are believed to spawn in Davis Strait during the winter and early spring at depths ranging from 650 to 1,000 m. • The large fertilized eggs are benthic but the hatched young move upwards in the water column and remain at about 30 m below surface until they attain an approximate length of 70 mm. • As they grow, the young fish move downward in the water column and are transported by the currents in the Davis	• Commercially significant species

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
	(Templeman 2007). • Deep Demersal Assemblage.	Strait southward to the continental shelf and slopes of Labrador and Newfoundland. • Bathypelagic predator that feeds on capelin, Atlantic cod, polar cod, roundnose grenadier, redfishes, sand lance, shrimp, squid and other benthic invertebrates.	
Haddock (*Melanogrammus aeglefinus*)	• Found in southwest Newfoundland and St. Pierre Bank. • High concentrations observed in the Southwest Slope of the Grand Banks EBSA (Templeman 2007). • Found in water depths of 27 to 366 m and prefer temperatures of 1 to 13°C. • Occurs in a variety of habitats; juveniles have higher survival rates when they settle on sand or gravel bottoms.	• Generally haddock spawning on the Grand Banks begins in March and continues through to August or September. Spawning peaks in March. • Pelagic eggs and larvae. Larvae seek the bottom once they reach about 50 mm. • Haddock on the Grand Banks primarily spawn in Southwest Shelf Edge and Slope EBSA (Templeman 2007). • Bottom feeding fishes that consume crustaceans, molluscs, echinoderms, polychaetes and fish.	• Commercially significant species
Longnose eel (*Synaphobranchus kaupi*)	• Occurs on both sides of the North Atlantic Ocean to South Atlantic Ocean, in the Pacific Ocean and Gulf of Mexico. • Bottom-dwelling fish occurring in deep water between 240-3650 m. • Commonly observed in the Grand Bank and Eastern Offshore SEA Study Area (Baker et al 2012; LGL 2012). • Deep Demersal Assemblage.	• Spawns during summer months.	• Not commercially significant in the region.
Longfin Hake (*Physis chesteri*)	• Deepwater species that occupies a depth range of 160-1290 m. • Occurs along Labrador to the southern edge of the Grand Bank. • Commonly observed species in 3NLOPs from RV surveys. • Warm Deep Offshore Shelf Assemblage.	• On the Grand Bank and Flemish Pass, spawning is estimated to take place between fall and winter. • Larvae and juveniles remain pelagic during winter and spring. • Juveniles and larvae are preyed upon by white hake and cod. • Feeds mainly on shrimp, euphausiids and amphipods. Also known to feed on vertically migrating fishes including lanternfish and hatchetfish.	• Not commercially significant in the region

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
Marlin-spike (*Nezumia bairdi*)	• A benthic species, usually living on mud bottoms. • It has been caught at depths of 16 – 2285 m but was found to be most abundant off Newfoundland in 183 – 732 m. • Its distribution in the western Atlantic occurs in deeper parts of the Gulf of St. Lawrence; in the Bay of Fundy; from the southwestern Grand Bank; banks of the Scotian Shelf; and southward along the continental slope of the West Indies. • Bottom temperatures where marlin-spike have been found range between 3 and 8°C. • Commonly observed species in 3NLOPs from RV surveys. • Deep Demersal Assemblage.	• Information on reproduction is sparse, but the species most likely spawns in summer and autumn. • Assumed to be a long-lived, slow growing species. • Feeds on benthic euphausiids and amphipods. • Preyed upon by swordsfish.	• Not commercially significant in the region
Monkfish (*Lophius americanus*)	• Bottom-dwelling sluggish fish living over a variety of substrates, from tideline down to 668 m. • Tolerates a wide variety of temperature, 0 to 21°C. Common in areas >4°C (Kulka and Miri 2001). • Research shows that they invade shallow waters of the banks in summer and migrate to deeper waters in winter. Associated with deep waters along the western Grand Bank (Gomes et al 1992). • High concentrations observed in the Southwest Shelf Edge and Slope EBSA (Templeman 2007). • Warm Southern Shelf Assemblage	• Spawning occurs from June to September in Canadian waters. • Larvae hatch on the surface and descend to the bottom where they seek protection among algae-covered rocks. • Feeds on fish including herring, sand lance, smelt, cod, haddock, cunner, sculpin, flounder, skates and invertebrates including crab, squid, molluscs, echinoderms and polychaetes.	• Commercially significant species
Northern wolffish (*Anarhichas denticulatus*)	• Occurs in Arctic seas on both sides of the North Atlantic Ocean. • The preferred temperature of wolffish is less than 5°C. • Found in deep waters (150-1000 m) on the Grand Bank and Flemish Cap in the spring and fall (Simpson et al 2012). • Widespread Shelf Assemblage.	• Information on reproduction is limited. • Critical spawning habitats have not been identified. • Pelagic larvae. • Feeds on bathypelagic and benthic invertebrates that include crustaceans, jellyfish and echinoderms.	• Has SARA and COSEWIC status. • Not commercially significant in the region
Northern Sand Lance (*Ammodytes dubius*)	• Occurs on sandy or fine gravel bottoms at offshore depths <91 m. • Inhabit localized areas. • High densities observed on the	• On the Scotian Shelf spawning occurs from November to March. Spawning peaks from December to January.	• Not commercially significant in the region. • Important forage fish species.

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
	eastern and South East Shoal of the Grand Bank. • Grand Bank Shelf Assemblage.	• Aggregate on the Southeast Shoal and Tail of the Banks EBSA to spawn. • Larvae are planktonic until they reach 35 mm, after which they seek bottom areas. • Feeds mainly on copepods and other planktonic organisms. • Important forage species that are prey for a variety of fish, birds and mammals.	
Pollock (*Pollachius virens*)	• Juveniles are common in shallow inshore waters, while adults live in deeper inshore waters or on offshore banks. • Adults prefer a depth range of 110 to 181 m. • Can withstand a range of temperatures, from 0 to 18°C, but prefer a range of 7.2 to 8.6°C. • Distributions mainly restricted to the slope waters of the Burgeo and St. Pierre Banks. • Congregates mainly in Southwest Shelf Edge and Slope EBSA (Templeman 2007). • Warm Southern Shelf Assemblage.	• On Burgeo and St. Pierre Banks, pollock of various stages of maturity are encountered during surveys indicating spawning. • An average female produces approximately 225 000 pelagic eggs. • Feed mainly on copepods.	• Not commercially significant in the region
Redfish (*Sebastes mentella*, *Sebastes fasciatus)*	• Redfish typically occur in cool waters (3.0 to 8.0ºC) along the slopes of fishing banks and deep channels in depths of 100 to 700 m. • In the western Atlantic, redfish species range from Baffin Island in the north to the waters off New Jersey in the south. • The three redfish species that occur in the Northwest Atlantic include *Sebastes mentella*, *S. fasciatus*, and *S. marinus*. The latter species is relatively uncommon except in the area of the Flemish Cap. • *S. mentella* is typically distributed deeper than *S. fasciatus* (Gascon 2003). • *S. mentella* a commonly observed species in 3NLOPs from RV surveys. • Warm Deep Offshore Shelf Assemblage.	• Ovoviviparous, the fertilized eggs develop within the brood chamber of the female. • Mating occurs in the fall months and the larvae subsequently hatch from the eggs inside the female. • The larvae feed exclusively on energy stored in the yolk, develop inside the female and eventually are released as young fish sometime between April and July (Gascon 2003; Ollerhead et al 2004). • Southwest Shelf Edge and Slope EBSA is an important spawning area for redfish.	• Has COSEWIC and IUCN status. • Commercially significant species.

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
Roughhead grenadier (*Macrourus berglax*)	• Mainly inhabits bottom depths between 700-800 m (Lorance et al 2008). • On the Grand Banks, greatest catches occur in areas between 2.0 – 3.5°C and depths of 183 – 503 m. • Deep Demersal Assemblage.	• Little is known about spawning habits. • Spawning is predicted to occur between winter and early spring on the southern and southeastern slopes of the Grand Banks. • Slow growing species with late maturation. • Feeds on benthic invertebrates including bivalves, shrimp, echinoderms and some fish.	• Has COSEWIC status. • Not commercially significant in the region
Roundnose grenadier (*Coryphaenoides rupestris*)	• Inhabits deep water between 400-1,500 m (Lorance et al 2008). • In Newfoundland waters greatest catches occurred at depths >500 m at temperatures between 3.5 – 4.5°C. • Deep Demersal Assemblage.	• Little is known about spawning habits. • Spawning is predicted to occur in late autumn and spring. • Vertically distributed by maturity. Percentage of mature fish captured increases with depth. • Feeds on small crustaceans, euphausiids, squid and small fishes.	• Has COSEWIC status. • Not commercially significant in the region.
Sculpin (*Triglops* sp.)	• Boreal cool-water benthic marine group of species that occur from shallow to deep depths. • Commonly observed species in 3NLOPs from RV surveys. • Grand Bank Shelf Assemblage.	• Spawning generally occurs from late summer to late fall. • Feeds on small crustaceans including mysids and amphipods. • Preyed upon by cod and thick-billed murres.	• Not commercially significant in the region • Important forage fish species.
Smooth skate (*Malacoraja senta*)	• Distributed between depths of 70 – 480 m (Kulka et al 2006). • Generally occur on soft mud and clay substrates over a range of depths (COSEWIC 2012a). • Densest concentrations of this species are in waters between 3 - 10°C (COSEWIC 2012a; (Kulka et al 2006). • Widespread Shelf Assemblage	• Slow to reproduce with 40-100 large egg capsules per year (COSEWIC 2012a). • Hatching takes 1-2 years and have been found on the bottom at various times of the year (COSEWIC 2012a). • Egg capsules are eaten by gastropods, halibut, monkfish and Greenland sharks (COSEWIC 2012a). • Feed mainly on crustaceans, euphausiids, mysids and some fish.	• Has COSEWIC and IUCN status. • Not commercially significant in the region.
Spotted wolffish[1] (*Anarhichas minor*)	• Occurs on both sides of the North Atlantic. • Mainly captured in deeps waters of <500 but large catches have occurred at depths of <350 m. • Usually occurs at temperatures below 5°C. • Tagging studies indicated that migrations are local and limited.	• Information on reproductive activities in western North Atlantic Ocean is minimal. Studies have shown that wolffish in the Newfoundland area appeared to spawn in late autumn or early winter. • Feeds mainly on invertebrates including	• Has SARA and COSEWIC status. • Not commercially significant in the region

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
	• Greatest proportion of this species aggregates in the Northeast Shelf and Slope EBSA in the spring (Templeman 2007). • Warm Deep Offshore Shelf Assemblage.	molluscs, crustaceans, echinoderms and polychaetes and some fish.	
Spiny dogfish (*Squalus acanthias*)	• Widely distributed in coastal waters of temperate seas throughout the world. • Small, schooling shark frequenting coastal and inshore waters in cold to warm temperate oceans. Usually found at temperatures of 6 – 15°C. Tolerant at low salinities and may ascend estuaries. • Preferred depth of 100-250m (Kulka 2006). • Warm Southern Shelf Assemblage.	• Ovoviviparous, developing young are in the brood chamber of the female. • Gestation period is long, about 22 months, one of the longest for any vertebrate animal. • Spiny dogfish is slow-growing and long-lived. • Opportunistic feeder that consumes mainly small fishes. • Juvenile dogfish are prey to various fish and sharks.	• Has COSEWIC and IUCN status. • Commercially significant species.
Thorny skate (*Amblyraja radiata*)	• A boreal to arctic species living offshore on hard and soft bottoms at depths of about 18 – 966 m and at temperatures of -1.4 to 14°C. • Occurs in eastern and western North Atlantic. • Widespread Shelf Assemblage	• Spawning on the Scotian Shelf peaks in May and October. • Feeds mainly on polychaetes, amphipods, decapods and fishes. • Egg cases are eaten by Greenland sharks and halibut. •	• Has COSEWIC and IUCN status. • Commercially significant species.
Vahl's eelpout (*Lycodes vahlii*)	• Occurs of Newfoundland in depths of 200-600 m in temperatures from 2.0-4.5°C. • Captured at average depths of 410 m in the Orphan Basin during the spring and fall respectively (LGL 2012). • Occurs on both sides of the Atlantic Ocean. • Northern Shelf Assemblage.	• Feeds on polychaetes, small crustaceans and molluscs. • Has large eggs and low fecundity.	• Not commercially significant in the region
White hake (*Urophycis tenuis*)	• Prefer temperatures 4.0 to 8.0°C (Kulka et al 2005) • Occurs at depths between 200-1,000 m over mud bottoms. • Occurrence on the Grand Bank mainly along the southwest slope (Templeman 2007). • *U. chesteri* commonly observed species in 3NLOPs from RV surveys. • Warm Southern Shelf Assemblage.	• Spawning is thought to occur in spring and early summer. • Eggs, larvae and juveniles are pelagic and remain close to the surface. • Sand-hiding behaviour has been observed in young hake. • Feeds mainly on fish including herring, other hake species, and mackerel.	• Not commercially significant in the region
Winter skate (*Leucoraja*	• Restricted to the northwest Atlantic.	• Mating most likely occurs throughout the year and	• Has COSEWIC and IUCN status.

Species	Habitat and Distribution	Biology and Ecology	Use and Importance[1]
ocellata)	• A benthic species living over sand or gravel bottoms usually in depths less than 110 m. • Warm Southern Shelf Assemblage.	peaks offshore in the summer. • Slow to reproduce with 6-50 egg capsules per year (Kearley 2012). • Feeds mainly on amphipods and polychaetes and some fish • Sand lance are an important prey species.	• Not commercially significant in the region.
Witch flounder (*Glyptocephalus cynoglossus*)	• Inhabits mud or mud-sand bottoms. • Mainly occurs at depths of 185 – 366 m in areas associated with deep holes and channels between banks. • Captured at average depths of 432 and 487 m in the Orphan Basin during the spring and fall respectively (LGL 2012). • Deep Demersal Assemblage.	• Spawning occurs between March and September and peaks in July and August on the Grand Bank Region. • Eggs and larvae are pelagic. • Young flounder remain in a pelagic state for about a year before settling on the bottom. • Slow growing, long lived species. • Feeds mainly on polychaetes, amphipods, molluscs and small fishes.	• Not commercially significant in the region.
Yellowtail flounder (*Limanda ferruginea*)	• Inhabits mud or mud-sand bottoms. • On the Grand Banks mainly found at depths between 57 – 64 m and temperatures between 3.1 - 4.8°C. • Commonly observed species in 3NLOPs from RV surveys. • Grand Bank Shelf Assemblage.	• Spawning occurs between spring and summer with peaks from mid- late June on the Grand Banks. • Eggs are deposited near the bottom and float to the surface where they drift during development. • Aggregates in Virgin Rocks EBSA to spawn (Templeman 2007). • Southeast Shoal and Tail of the Banks EBSA is an important nursery area for this species (Templeman 2007). • Feeds mainly on polychaetes and amphipods and some small fish.	• Commercially significant species

Sources: Summarized from Scott and Scott (1988) unless otherwise noted
[1]Species conservation status or designation is described further in a later Table

Table 4.63 Overview of Some Key Pelagic Species in the SEA Study Area

Species	Habitat and Distribution	Biology and Ecology	Use and Impotance[1]
Albacore tuna (*Thunnus alalunga*)	• Albacore tuna is a cosmopolitan species and has been captured on the Grand Banks. • Epipelagic and mesopelagic oceanic species. • Abundant in surface waters at 15.6 - 19.4°C (Collette et al 2011). • Pelagic Assemblage.	• Spawns during spring and summer in sub-tropical waters (DFO 1998). • Spawning occurs at surface temperatures of <24°C (Collette et al 2011). • Feeds on pelagic fish, crustaceans and squid (Pusineri et al 2005).	• Has IUCN status. • Commercially significant species.
Atlantic bluefin tuna (*Thunnus thynnus*)	• Moves northward into Canadian waters in summer and southward again in late fall. • They occur over the continental shelf, off Newfoundland, and in the Gulf of St. Lawrence, at depths of 27–183 m, often in schools of less than 50 fish. • Bluefin tunas undertake extensive migrations, moving from the waters off Florida and the Gulf of Mexico as far as Newfoundland and the Gulf of St. Lawrence. • Pelagic Assemblage.	• Bluefin tuna do not reproduce in Canadian waters. Two major spawning areas in the western Atlantic are the Straits of Florida and the Gulf of Mexico. • Spawning occurs during April, May, and June in subsurface waters • At temperatures of 24.9 – 29.5°C in the Straits of Florida, hatching of eggs occurs in a few days. • Feed on pelagic and bottom fishes including capelin, saury, herring, mackerel and lanternfishes. Around Newfoundland, squid and capelin are important food sources.	• Has COSEWIC and IUCN status. • Commercially significant species.
American eel (*Anguilla rostrata*)	• Found in the western North Atlantic. • Abundant in many tributaries of the St. Lawrence River and Gulf, and rivers of Newfoundland and the Maritime Provinces. It occurs in estuaries, lakes and rivers (Jessop et al 2002) that have access to the sea. • During the freshwater phase of their life, eels move into streams, rivers, and muddy or silt-bottomed lakes.	• The eel is unique to other fish in that it breeds at sea and the young move into fresh water where they feed and grow. • After a number of years in freshwater they return to the sea to spawn, and presumably die. • The larvae feed on plankton. • Larvae are preyed upon by predaceous fishes.	• Has COSEWIC status. • Recreational and commercial significance
Atlantic herring *(Clupea harengus harengus)*	• Primarily pelagic, and often in schools, occurring in the shallow inshore waters, or offshore from surface to depths of 200 m. • Research has demonstrated that Atlantic Herring has annual migratory patterns, such as movements to spawning grounds and feeding and wintering areas. • Occurs on both sides of the North Atlantic. It occurs in commercial quantities along the coast of southern Labrador, around the coast of Newfoundland and offshore banks, in the Gulf of St. Lawrence, along the coast of Nova Scotia and offshore banks, and the Bay of Fundy. • Pelagic Assemblage.	• Atlantic herring are demersal spawners depositing their adhesive eggs on stable bottom substrates (Reid et al 1999). • The species is known to spawn in coastal and offshore areas • Spawning times are stock specific. • Feeds mainly on plankton. • Important food source for other fishes, marine birds and marine mammals.	• Commercially significant species

Species	Habitat and Distribution	Biology and Ecology	Use and Impotance[1]
Atlantic mackerel *(Scomber scombrus)*	• A pelagic fish common to the temperate waters of the open sea and is one of the most active and migratory fishes. • Occurs on both sides of the Atlantic Ocean. Mackerel are seen in Canadian coastal and inshore waters only during summer and fall. • Pelagic Assemblage.	• Usually spawn in coastal waters between Cape Cod and Cape Hatteras. • Larval hatching generally occurs within five to seven days at water temperatures of 11 to 14°C. • Strong schooling species. • Filter and selectively feeds on planktonic organisms. • Preyed upon by porbeagles, dogfish, Atlantic cod, bluefin tuna, swordfish, and marine mammals.	• Commercially significant species.
Atlantic salmon (*Salmo salar*)	• Occurs on both sides of the North Atlantic Ocean. • An anadromous species, living in fresh water and estuaries for at least the first 2 to 3 years of life before migrating to sea. • Cool rivers with extensive gravelly bottom headwaters are important habitat. • When about 15 cm long, young salmon migrate to sea, where they may live for 1, 2, or more years before returning to freshwater. • Salmon from various designated populations migrate through the SEA Study Area.	• Atlantic salmon spawn in October and November in Canadian waters. • Eggs are buried in gravel by females and development continues over the winter. • The time required for the eggs to hatch varies with water temperature but is about 110 days at 3.9°C. • Atlantic salmon at sea consume amphipods and euphausiids, and fish including herring, alewives, smelt, capelin, mackerel, sand lance and cod.	• Has COSEWIC and IUCN status. • Important recreational fishery. • Historically commercially important species but no longer fished commercially in the area.
Basking Shark (*Cetorhinus maximus*)	• Highly migratory. • Pelagic shark occurring in coastal warm waters around Newfoundland during the summer and fall. • Mainly caught in waters ranging from 8-12°C. • Distributed mainly off southern Newfoundland, on the Scotian Shelf and in the Gulf of Maine (DFO 2008). • Pelagic Assemblage.	• Considered ovoviviparous with about 6 pups born at a time during summer (DFO 2008). • Aggregates from September to October for mating (Jacoby et al 2012). • Filter feeds on planktonic organisms.	• Not commercially significant in the region.
Bigeye tuna (*Thunnus obesus*)	• Distributed worldwide in Atlantic, Indian and Pacific Oceans (FAO 2013). • Pelagic species occurring from the surface to 250 m depth in temperatures ranging from 13-29°C (FAO 2013). • Young fish school near the surface with other tuna species (DFO 1998). • Migrates through temperate waters such as the Eastern SEA Study Area after spawning. • Pelagic Assemblage.	• Spawning takes place approximately twice a year in inter-tropical waters (FAO 2013; DFO 1998). • Approximately 2.9 million to 6.3 million eggs released per spawning (FAO 2013).	• Has COSEWIC and IUCN status. • Commercially significant species.
Blue shark (*Prionace glauca*)	• A wide-ranging pelagic species in temperate waters, often occurring near the surface, preferring temperatures of 7 to 16°C.	• As with all sharks, fertilization is internal. After eggs are fertilized, gestation requires 9 – 12 mo., and birth usually occurs during March	• Has COSEWIC and IUCN status.

Species	Habitat and Distribution	Biology and Ecology	Use and Impotance[1]
	• Occurs worldwide in both inshore and offshore waters. In the western Atlantic from Newfoundland and the Gulf of St. Lawrence southward to Argentina. Most occurrences in Canadian waters are during summer months. • Pelagic Assemblage.	to July. • Feeds mainly on fish and squids. Species consumed include herring, hake, cod, haddock, pollock, mackerel, butterfish, sea raven and flounders.	• Commercially significant species.
Capelin (*Mallotus villosus*)	• A marine fish of cold, deep waters, found in the Atlantic Ocean on the offshore banks and in coastal areas. • The largest concentrations in Canadian waters are found off Newfoundland and the Labrador Coast. • Commonly observed species in 3NLOPs from RV surveys. • Pelagic Assemblage.	• In the Northwest Atlantic spawning is typically conducted on beaches though some deepwater spawning sites are known (e.g. Southeast Shoal) • Spawning is marked by an intensive migration inshore in early spring to spawn on beaches throughout the spring-summer and return to offshore waters in autumn. • Where substrate conditions are suitable spawning beaches may be found in exposed, moderately exposed, and sheltered locations throughout the region. • Beach spawning is demersal with the eggs being deposited in the intertidal zone. Larvae are dispersed passively via currents. • Feeds mainly on planktonic organisms. • Major food source for other fish, marine birds and marine mammals. Preyed upon heavily by Atlantic cod.	• Commercially significant species. • Important forage fish species.
Greenland shark (*Somniosus microcephalus*)	• Inhabits cool northern waters from 0.6-12°C. • Occupies near surface areas in winter months in estuaries, shallow bays and coastal waters. • Occupies deep (600-1,200 m) cool waters during summer months. • Pelagic Assemblage.	• Ovoviviparous, with more than 10 pups at a time. • Feeds on a variety of fishes including herring, Atlantic salmon, Arctic char, capelin, redfish, sculpin, lumpfish, cod, haddock, halibut, and skate.	• Not commercially significant in the region.
Lanternfish (Myctophidae)	• Commonly observed species in 3NLOPs from RV surveys. • Deep sea pelagic fish. • Generally occur at depths of 300-1,200 m during the day and may migrate to surface waters at night. • Deep Pelagic Assemblage.	• Generally spawns during the spring to summer in the northwest Atlantic. • This group of fish are opportunistic planktivores that feed on copepods, euphausiids, ostracods and occasionally fish eggs and larvae.	• Not commercially significant in the region • Important forage fish species.
Porbeagle shark (*Lamna nasus*)	• A pelagic, epipelagic, or littoral shark usually more common on continental shelves but occurring sometimes well offshore. • Occurs in Atlantic, Pacific, and Indian	• Ovoviviparous, developing young are in the brood chamber of the female. Young sharks are born alive. • Mating grounds South of	• Has COSEWIC and IUCN status. • Commercially

Species	Habitat and Distribution	Biology and Ecology	Use and Impotance[1]
	Oceans. • More common in the Canadian region during spring, summer, and fall, usually found in temperatures below 16°C. • Pelagic Assemblage.	Newfoundland (DFO 2013). • Little information on the rate of growth. • Feeds mainly on pelagic fish including herring, mackerel, cod, hake, haddock, and cusk. Squid are also eaten.	significant species.
Shortfin mako shark (*Isurus oxyrinchus*)	• Extremely active, the shortfin mako shark is the fastest shark and one of the swiftest fishes. • The species is circumglobal in temperate and tropical waters. Individuals found in Atlantic Canada are considered part of a larger North Atlantic population. • Highly migratory with distribution apparently dependent on water temperatures (between 17 and 22°C). • They migrate to the Atlantic coast of Canada generally in the late summer and fall where they are usually associated with the warm waters of the Gulf Stream (DFO 2010b). • Pelagic Assemblage.	• Females mature at lengths of 2.7 to 3 m (corresponding to an age of about 17 years) and give birth to a litter size of 4 to 25 pups after a gestation period of approximately 15 to 18 months. • Lifespan has been estimated at 24 years with a maximum life expectancy of up to 45 years (DFO 2010b). • Feeds on fish including mackerel, tuna, swordfish and bonitos.	• Has COSEWIC and IUCN status. • Commercially significant species.
Swordfish (*Xiphias gladius*)	• Occurs in Canadian waters between June to November. • Distributed throughout a variety of depths from surface to over 500 m. • Pelagic Assemblage.	• Spawning occurs in the area of the Gulf of Mexico, Florida, the Caribbean Sea, south of the Sargasso Sea and waters off Brazil (Neilson et al 2006). • Eggs are buoyant. • Opportunistic feeders that feed on squid, mackerel, barracudinas, hake, redfish, herring and lanternfishes. • Young swordfish are consumed by blue shark, tunas and marlins.	• Commercially significant species.
White shark[1] (*Carcharodon carcharias*)	• Occurs in coastal and offshore waters of continental shelves, from surface waters to depths of 1,280 m. • Widespread in warm and cool temperate seas of all oceans, antitropical in Atlantic and Pacific oceans and contiguous waters. • Pelagic Assemblage.	• Little information available on reproductive habits. Presumed to be ovoviviparous. • Feeds on salmon, hake, halibut, mackerel, and tunas. Also known to consume other sharks, sea turtles, seabirds and marine mammals.	• Has SARA, COSEWIC and IUCN status. • Not commercially significant in the region

Sources: Summarized from Scott and Scott (1988) unless otherwise noted
[1]Species conservation status or designation is described further in a later Table.

Key Spawning Times and Areas

Various spawning behaviours are exhibited by marine fish in the SEA Study Area, which include broadcast spawners such as Atlantic cod, oviviparous spawners such as redfish, and species who leave eggs in demersal cases (e.g. skates). Moreover, spawning occurs in a variety of habitats both within and outside the SEA Study Area. Some species spawn in multiple locations across the Newfoundland Shelf, while others may be restricted to certain areas (e.g. yellowtail flounder are thought to be restricted to the Grand Banks in the SEA Study Area). Other species spawn outside the SEA Study Area in areas that include freshwater rivers (e.g. Atlantic salmon), beaches (e.g. capelin), or warm temperate or tropical waters (e.g. tunas and sharks).

A summary of spawning seasons and known spawning areas for key fish species is provided in Table 4.64. It is noteworthy that while a large number of fish species are spring and early summer spawners, a few (such as Greenland halibut) are winter spawners.

Table 4.64 Spawning Periods and Locations of Some Key Fish Species

Common Name	Scientific Name	Spawning Time[1]												Known Spawning Locations
		J	F	M	A	M	J	J	A	S	O	N	D	
Sand Lance	*Ammodytes dubius*													Grand Bank
Capelin	*Mallotus villosus*													Southeast shoal of Grand Bank[2]
Deepwater Redfish	*Sebastes mentella*													Southwest Shelf Edge and Slope of Grand Bank[2,3]
Yellowtail Flounder	*Limanda ferruginea*													Grand Bank
American Plaice	*Hippoglossoides platessoides*													Grand Bank
Sculpin	*Triglops* sp.													
Lanternfish	Myctophidae													
Atlantic Cod[4]	*Gadus morhua*													Southeast shoal of Grand Bank and Virgin Rocks[2]
Greenland Halibut	*Reinhardtius hippoglossoides*													Davis Strait
Blue Hake	*Antimora rostrata*													Not known to spawn in Canadian waters[5]
Roughhead Grenadier	*Macrourus berglax*													Grand Bank

Shading indicates spawning periods.
Sources: [1] Scott and Scott (1988); [2] Templeman (2007); [3] COSEWIC (2010a); [3] COSEWIC (2010b); [5] Kulka et al (2003a).

Fish Migration Patterns

Migration is recognized as an adaptation to resources that fluctuate in their availability across space and time (Dingle and Drake 2007). Migrations are typically costly from an energetic and risk perspective, but can provide a means to exploit patterns in resource availability (food, spawning habitats, refuge etc.) and to avoid unfavourable conditions that vary in their occurrence over time. Individuals undertaking migration can accrue benefits such as higher growth and fecundity and populations of fish can have greater biomass than those that do not migrate (Robichaud and Rose 2004).

Fish species that are found in the SEA Study Area exhibit a variety of migration strategies that reflect the life history and ecology of each species and the oceanographic conditions they occupy. One general migration pattern, exhibited by important ecosystem components such as capelin and cod on the Newfoundland Shelf, entails a migration to shallow coastal areas in summer from offshore wintering habitats in deep warm water along the continental shelf edge. Capelin, are triggered by warm water to move northwards and shoreward each spring against the Labrador Current to spawn on beaches and shallow coastal areas of eastern Newfoundland (Shackell et al 1994; Carscadden et al 1997). Subsequently, spent adults and developing young ride the prevailing currents offshore and to the south where they winter at greater depths that have more favourable temperatures (Nakashima 1992). Offshore components of Atlantic cod, a key predator of capelin, follow their prey to coastal areas in spring / summer using deep warm water channels and return to warm deep water along the continental shelf in the fall where they eventually spawn during winter and spring (Lear and Green 1984; Hutchings et al 1993; Rose et al 2013). Like capelin, cod rely on the currents to transport developing young to favourable nursery habitats (Lear and Green 1984; Hutchings et al 1993), which for cod occur in shallow, coastal areas (Gregory and Anderson 1997). These relatively safe and rich feeding areas are occupied by juvenile cod, despite harsh winter temperatures, for several years before they commence the onshore-offshore migration displayed by adults.

For some species, the SEA Study Area is used only during the summer. Highly migratory warm water pelagics such as tunas, swordfish and a variety of sharks spawn in southerly latitudes as far south as the Caribbean and migrate northward to feed in productive northern waters during the summer when water temperatures in the SEA Study Area and adjacent marine regions are warmest. Each fall they return southward to avoid the cold water temperatures that characterize these areas in winter.

Diadromous fish, namely those that migrate between fresh and salt water, exhibit a third migration strategy. The catadromous American eel, for example, spawns in the Sargasso Sea off Bermuda and their larvae move northward to freshwater habitats where they enter rivers along the eastern seaboard of North America including those of Newfoundland. After many years rearing in freshwater or coastal areas, adults return to southern spawning grounds. Other anadromous species such as Atlantic salmon migrate from oceanic feeding grounds in the northwest Atlantic to freshwater habitats to spawn. Migration pathways are region-specific but Atlantic salmon from Newfoundland, the Gulf of St. Lawrence, the Canadian Maritimes and Maine at least pass through (and may feed in) the SEA Study Area from January through April (Lear 1976; Reddin 1985) on their journey to and from spawning grounds.

Other species are not known to undertake notable coastal migrations. Many deep water species occupy habitats with relatively warm and stable water temperatures and can carry out their life cycle without moving to coastal habitats. These species include redfish, witch flounder, wolffish (Templeman 1984)

and Greenland halibut (Bowering and Chumakov 1989). Even species that exhibit migratory strategies may have components that are resident (e.g. inshore components of Atlantic cod; Ruzzante et al 1996). Nonetheless, some of these species may exhibit migrations on smaller scales. For example, Greenland halibut are known to move to progressively deeper water as they age and many species, including redfish, undertake vertical feeding migrations (Beamish 1966).

Although defined migration corridors are perhaps less obvious in the SEA Study Area than in other marine areas (such as the Gulf of St. Lawrence, where movements are more constricted by landmasses), there remain areas where migrations can be channelled due to favourable environmental conditions. For example, warmer deep water channels (e.g. the Bonavista Corridor) that serve as refuge from cold water while providing access to inshore areas are used by Atlantic cod on their migrations (Rose et al 2013). Other areas, such as the southern Grand Banks, are likely to experience more use by migrating pelagics such as tuna, which are less likely to occur in more northerly areas of the SEA Study Area.

Marine fish species generally exhibit less population structure than freshwater and anadromous species (Ruzzante et al 1998), in part due to the prevalence of species which have eggs and/or larvae that drift passively in the ocean currents (e.g. Frank et al 1992; Nakashima 1992). Nonetheless, for some marine species, distributions are separated across the SEA Study Area. For example, Atlantic cod along the Grand Banks are segregated from more northerly conspecifics along the northeast Newfoundland Shelf (Wroblewski et al 1995; Taggart 1997; Ruzzante et al 1998; COSEWIC 2010b). Similarly, mark-recapture studies indicate that herring appear to segregate latitudinally in their migrations (Wheeler and Winters 1984). This segregation can result from oceanographic barriers (Ruzzante et al 1998) and/or genetic adaptations associated with regional environmental conditions. In the case of Atlantic cod, anti-freeze proteins that help individuals tolerate cold water temperatures are more prominent in individuals derived from more northern areas (COSEWIC 2010b).

Finfish Species Distributions

Marine habitats within the the SEA Study Area vary in their use by, and importance to, the species and assemblages that occupy them. Table 4.65 presents the 30 most abundant finfish species observed during the 2005-2009 DFO RV surveys. Distribution maps are provided for the top eleven of these species, which comprise over 90 percent of the individuals captured.

Again, while the Canadian DFO RV surveys represnet the most current and geographically extensive data set for marine fish in the Eastern Newfoundland Offshore Area, they are focussed in terms of the areas they cover, and some portions of the SEA Study Area (particularly those off the continental shelf and beyond the 200 mile limit) are not included. The distribution and relative abundance and importance of some fish species across the entire SEA Study Area may therefore be similalrly underrepresented. For example, lanternfish are considered to be amongst the most abundant fish taxa in the world's oceans, and are likely abundant in deep areas beyond the 200 mile limit. However, they represent only a very small percentage of fish species captured in the DFO RV surveys. A second consideration is that rankings of fish are reported in terms of their relative abundance, which inevitably marginalizes the importance of large bodied fish species (e.g. Atlantic cod) at the expense of small bodied individuals (e.g. sand lance).

The fish species that have been listed in the Table below, however, represent those that are dominant throughout much of the SEA Study Area, and include many of those that are of importance to commercial fisheries.

Table 4.65 Representation of Finfish Taxa During DFO RV Surveys from 2005-2009 in the SEA Study Area

Common Name	Scientific Name	Individuals Captured in RV surveys (%)[1]	Assemblage
Sand Lance	*Ammodytes* sp.	6.60	Shallow Shelf
Capelin	*Mallotus villosus*	6.09	Pelagic
Redfish	*Sebastes mentella*	4.12	Shelf/Slope
Yellowtail Flounder	*Limanda ferruginea*	1.14	Shallow Shelf
American Plaice	*Hippoglossoides platessoides*	0.92	Shelf
Sculpins	*Triglops* sp.	0.81	Shelf
Lanternfish	Myctophidae	0.55	Oceanic
Atlantic Cod	*Gadus morhua*	0.22	Shelf
Greenland Halibut, Turbot	*Reinhardtius hippoglossoides*	0.20	Shelf/Slope
Blue Hake	*Antimora rostrata*	0.15	Slope
Roughhead Grenadier	*Macrourus berglax*	0.14	Slope
Hookear Sculpin	*Artediellus* sp.	0.14	Shelf
Common Grenadier	*Nezumia bairdi*	0.14	Slope
Longnose Eel	*Synaphobranchus kaupi*	0.12	Slope
Common Alligatorfish	*Aspidophoroides monopterygius*	0.11	Shelf
Roundnose Grenadier	*Coryphaenoides rupestris*	0.10	Slope
Vahl's Eelpout	*Lycodes vahlii*	0.09	Shelf
Snake Blenny	*Lumpenus lumpretaeformis*	0.08	Shelf
Shanny	*Lumpenus maculatus*	0.07	Shelf
Thorny Skate	*Amblyraja radiata*	0.06	Shelf
Arctic Alligatorfish	*Aspidophoroides olriki*	0.06	Shelf
Eelpout sp	*Lycodes* sp.	0.06	Shelf
Arctic Cod	*Boreogadus saida*	0.06	Shelf
Northern Alligator fish	*Agonus decagonus*	0.06	Shelf
Spatulate Sculpin	*Icelus spatula*	0.05	Shelf
Witch Flounder	*Glyptocephalus cynoglossus*	0.04	Deep shelf
Barracudina	*Paralepididae*	0.04	Slope
Arctic Eelpout	*Lycodes reticulatus*	0.03	Shelf
Striped Wolffish	*Anarhichas lupus*	0.03	Shelf
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	0.02	Shelf

[1] Percentages reflect composition of total catch and include finfish as well as crab and shrimp species. Values may differ from those presented in the text which reflect the composition of a specific taxonomic group (e.g. fishes only).

Sand Lance: These are small schooling fish that occur in both inshore and offshore areas (Scott and Scott 1988). Of the fish species captured in DFO RV surveys, this species was most abundant (representing about 30 percent of fish captured). Within the surveyed portion of the SEA Study Area,

this species occupies shallow shelf areas of the Grand Bank and is found in high concentrations in regions of the northern Grand Bank (Figure 4.72) Relatively few captures of sand lance were obtained in areas north of Bonavista or in deep water (e.g. the Flemish Pass) within the SEA Study Area. Sand lance are a critical part of the food web in areas where they occur, and are important prey for commercially important species such as Atlantic cod, American plaice and yellowtail flounder (Gomes et al 1992).

Capelin: A schooling pelagic, planktivorous species that is typically associated with cold waters, they are accordingly found at their highest concentrations along the northern edge of the Grand Banks and in the northwest portions of the SEA Study Area (Figure 4.73). Due to the species' abundance (27 percent of the fish caught in RV surveys) and richness in lipids, it serves as a critical prey source for a multitude of fish, marine mammals and seabirds (Scott and Scott 1988; Gomes et al 1992; Davoren and Montevecchi 2003; Rose 2005b; Templeman 2010; Dawe et al 2012). Their ecological importance is exemplified by the large variety of piscivores which shadow their migrations to and from coastal waters each year. Relatively low numbers of capelin in recent years have forced predators like Atlantic cod (Dawe et al 2012) and gannets (Montevecchi 2007) to rely to a greater extent on other prey. In addition to serving as an important prey source, capelin are also a commercially harvested species. Capelin are a temperature sensitive species and their distributions are known to respond quickly to changing environmental conditions. For this reason, Rose (2005b) proposed that they can serve as a key indicator of climate change.

Deepwater Redfish: A slow growing, deep water species that can live in excess of 40 years (DFO 2011a). The species is associated with the sea bottom, but moves into the water column at night to feed on zooplankton and fish (Scott and Scott 1988; Templeman 2010). It is abundant along the slopes of the continental shelf, particularly along the southern edge of the Grand Banks (Figure 4.74) and it represented approximately 18 percent of the fish caught in DFO RV surveys. It is also commercially harvested and valued. COSEWIC has listed the designatable unit which encompasses the SEA Study Area as Threatened, due to its poor condition (DFO 2011a). It has, however, been showing signs of recovery since the early 1990s (DFO 2011a). In the southern portions of the SEA Study Area, the stock health of redfish is primarily influenced by environmental conditions. For example, in years of unfavourable currents, redfish larvae can be pushed off the shelf and experience low survival (Devine and Haedrich 2011). In the northern areas of the SEA Study Area, however, both exploitation and environmental conditions are linked to redfish abundance (Devine and Haedrich 2011).

Yellowtail Flounder: A warm water flatfish that is common on shallow offshore banks, typically less than 100 m in depth (Scott and Scott 1988; Gomes et al 1992). In the SEA Study Area, this commercially valuable species is found primarily in the shallow regions of the Grand Bank and occurs at the highest densities on the warmer southern portions that are shielded from the cold Labrador Current (Figure 4.75). In recent years, yellowtail flounder abundance has increased from the low levels observed during the early 1990s (Templeman 2010). Having a relatively small mouth, it feeds primarily on invertebrates but can also take small fish such as sand lance (Scott and Scott 1988). In the surveyed portions of the SEA Study Area, this species represented five percent of the catch from 2005-2009 and is one of the dominant species where it occurs (Gomes et al 1992).

American Plaice: A demersal flatfish that burrows in sandy habitats and ambushes its prey, they are widespread across the continental shelf and slope habitats in the SEA Study Area, particularly in areas to the south of Bonavista (Figure 4.76). In contrast to yellowtail flounder, American plaice are much more tolerant of colder water temperatures (Scott and Scott 1988; Morgan and Brodie 1991).

Nonetheless, both species are found in their highest concentrations on the southern portion of the Grand Banks. This species does not undertake significant migrations, but its eggs float to the surface and are dispersed by the currents (Scott and Scott 1988; Frank et al 1992). This fish species was the basis for the largest flatfish fishery in the world, but over the last three generations the Newfoundland and Labrador population has declined by 96 percent due to overfishing and increased natural mortality (COSEWIC 2009a). The population is currently listed as Threatened by COSEWIC.

Sculpins (Triglops sp.): These small cold water sculpins are found through much of the SEA Study Area on the continental shelf and shallow slope (Figure 4.77). Within this area the highest concentrations occur on the eastern edge of the Grand Banks and along the Bonavista corridor. They are numerous (representing four percent of the fish captured in RV surveys), and could therefore be ecologically important as predators of invertebrate prey (Scott and Scott 1988). Their ecology is, however, not well studied (Scott and Scott 1988).

Lanternfish: A family of small, pelagic fishes characterized by having light producing organs on their body (Scott and Scott 1988). They occur in oceans across the world from pole to pole in deep oceanic waters, where they perform vertical feeding migrations to feed on plankton. These species can be extremely abundant in deep water habitats and form a critical prey base for commercially valued species such as cod, hake, tunas, salmon and marine mammals (Scott and Scott 1988). In the SEA Study Area, they represented only 2 percent of all the fish caught during RV surveys, but are probably amongst the most abundant species in deeper areas not reached by these DFO surveys. This is supported by the fact that their highest densities from the trawl surveys were in the deep waters of the Flemish Pass (Figure 4.78).

Atlantic Cod: Formerly a dominant groundfish in the SEA Study Area, so much so that this valued species was a primary stimulus for European settlement of Eastern Canada (COSEWIC 2010b). The fishery for this species was also a key regional economic driver for centuries until the stocks collapsed in the early 1990s from high fishing levels and unfavourable environmental conditions. This demersal groundfish was also very important from an ecological perspective through the predation pressure it exerts on other species (Worm and Myers 2003; Dawe et al 2012). Although cod remain widespread along the continental shelf of the SEA Study Area, particularly along the southern Grand Banks and the Bonavista corridor (Figure 4.79), its densities (one percent of all fish captured in RV surveys) are a small proportion of what they once were (COSEWIC 2010b) and they have shown only modest signs of recovery despite the cessation of a directed fishery for two decades (Koen-Alonso et al 2010). This has resulted in a designation of Endangered by COSEWIC for the stock that corresponds with the SEA Study Area (COSEWIC 2010b). It is expected, however, that with warming ocean temperatures groundfish such as cod will experience a re-emergence at the expense of key invertebrate species.

Greenland Halibut: A commercially pursued flatfish species that are found along the shelf and slope of the SEA Study Area, particularly in the northern areas (Figure 4.80). It is largely absent from shallow areas of the Grand Bank but can be found at modest abundance along its slopes. Unlike most flatfish, this species spends a considerable amount of time feeding off the bottom on a variety of fish and invertebrates (Scott and Scott 1988). Larger individuals are typically found at greater depth than smaller conspecifics (Bowering and Chumakov 1989). This fish is common member of the deepwater demersal assemblage.

Blue Hake: Found in deep waters over mud bottoms, it feeds on invertebrates and squid (Scott and Scott 1988; Kulka et al 2003b). In the SEA Study Area it was detected in its highest densities at the

limits of the RV surveys (Figure 4.81). Therefore, its abundance in the SEA Study Area (one percent of all fish captured) likely underestimates its importance, and little is known about its ecology (Scott and Scott 1988; Kulka et al 2003b).

Roughhead Grenadier: An important member of the deepwater demersal community, this species feeds on a variety of benthic invertebrates and small fish and they themselves are prey to piscivorous fish (Scott and Scott 1988). They are typically found along the continental slope and, in the SEA Study Area, extend to depths beyond the limits of the RV surveys (Figure 4.82). The highest densities of this fish in the SEA Study Area are found along the margins of the survey area along the continental slope. Therefore, like other deep water species, their abundance across the entire SEA Study Area (one percent of the catch in RV surveys) is likely underestimated. Of the species of grenadier known to occupy the area, Roughhead grenadiers were the most abundant in RV surveys from 2005-2009.

Atlantic Salmon: This species exhibits a wide variety of life histories, but they are most commonly anadromous (spawn in freshwater and migrate to sea) (COSEWIC 2010c). Salmon spend 2-7 years in freshwater as parr before they transform to smolt and migrate to sea. Seaward migrations typically occur in spring. Salmon were not captured in RV surveys but are known to migrate through the SEA Study Area on their way to (Figure 4.83) and from (Figure 4.84) oceanic feeding grounds. These migrants originate from several areas of Atlantic Canada and Maine and are populations that are listed by COSEWIC (2010c). Known salmon rivers along the east coast of the Newfoundland are illustrated in Figure 4.85.

Figure 4.72 Distribution and Abundance of Sand Lance in the SEA Study Area (2005-2009 Surveys)

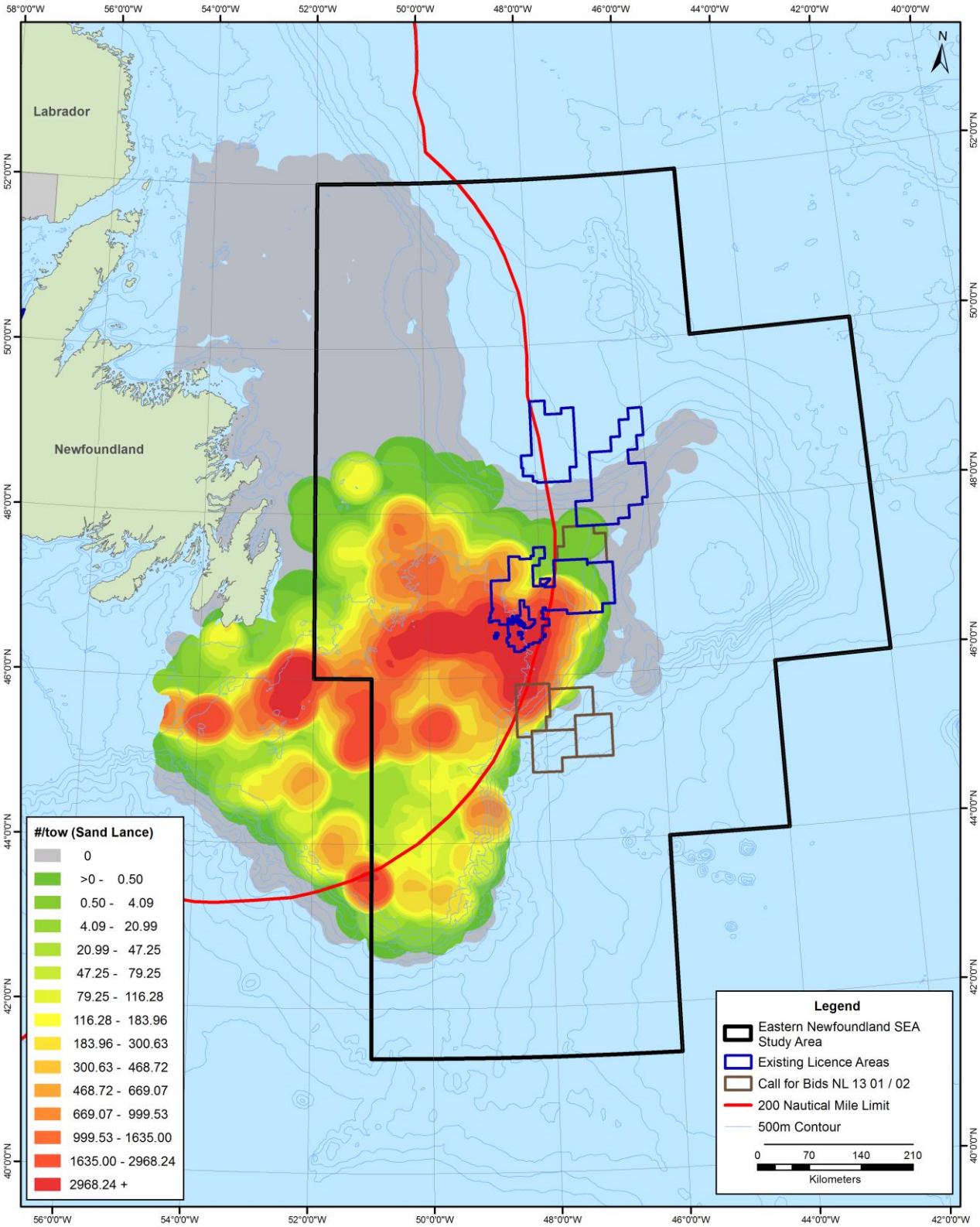


Figure 4.73 Distribution and Abundance of Capelin in the SEA Study Area (2005-2009 Surveys)

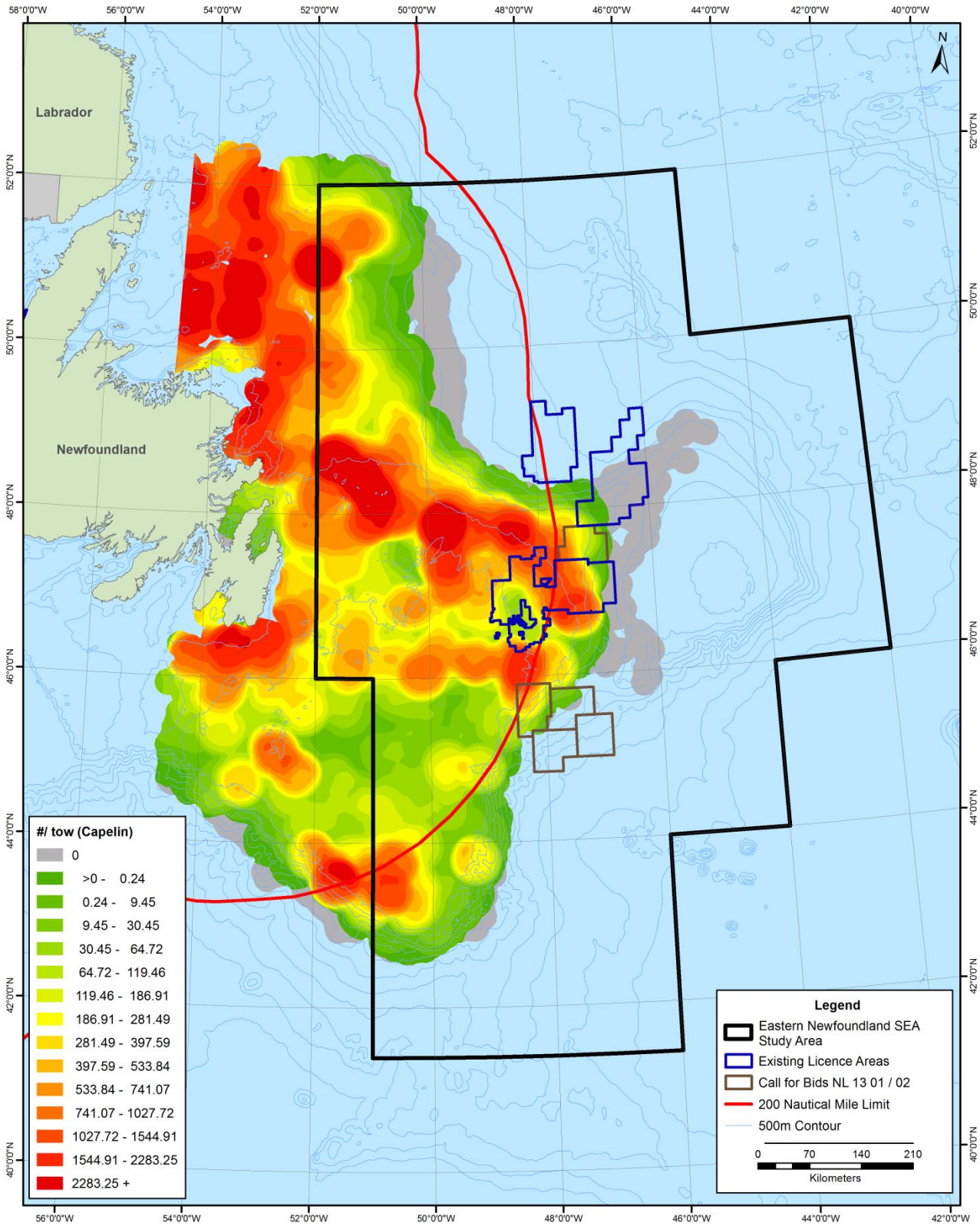


Figure 4.74 Distribution and Abundance of Redfish in the SEA Study Area (2005-2009 Surveys)

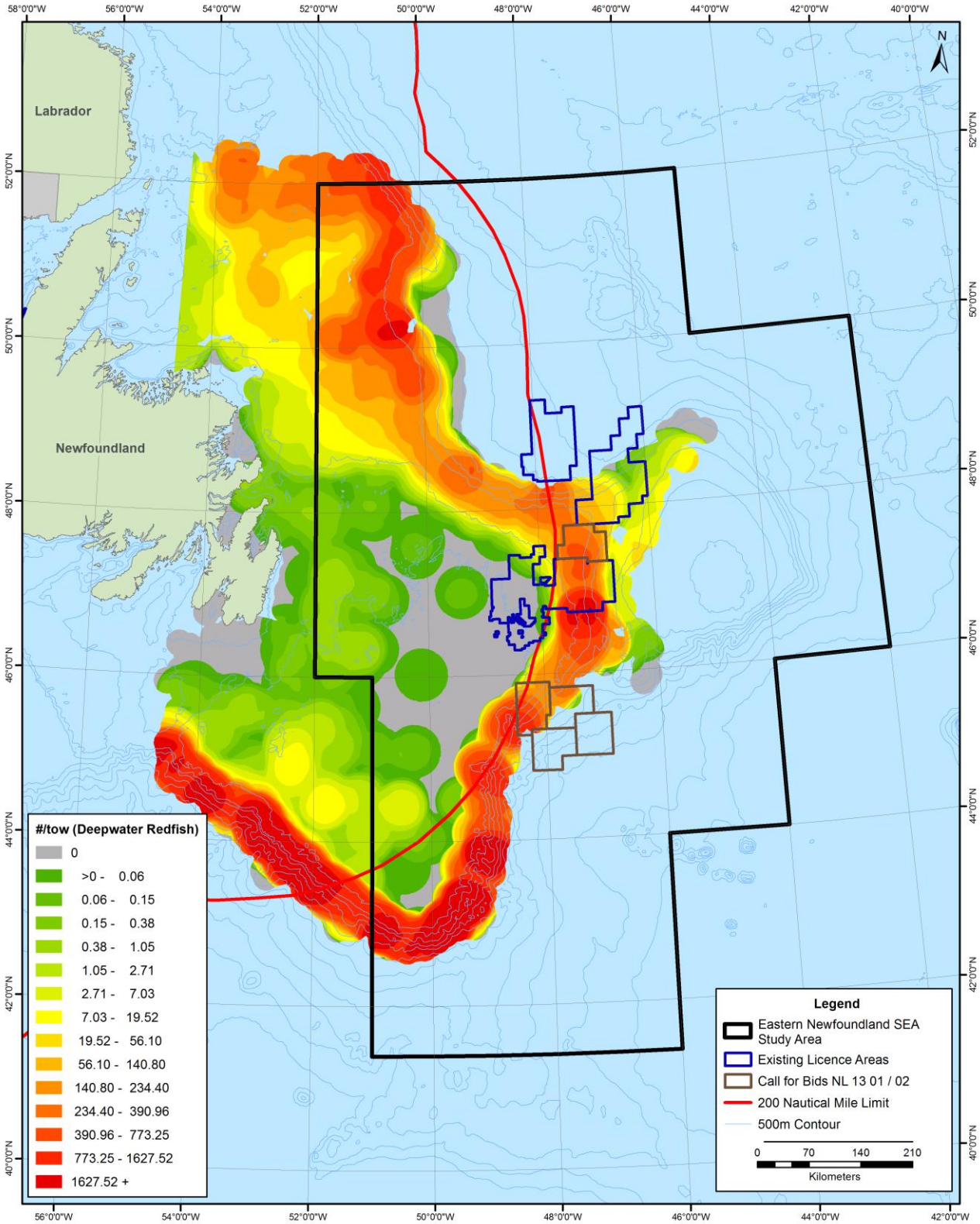


Figure 4.75 Distribution and Abundance of Yellowtail Flounder in the SEA Study Area (2005-2009 Surveys)

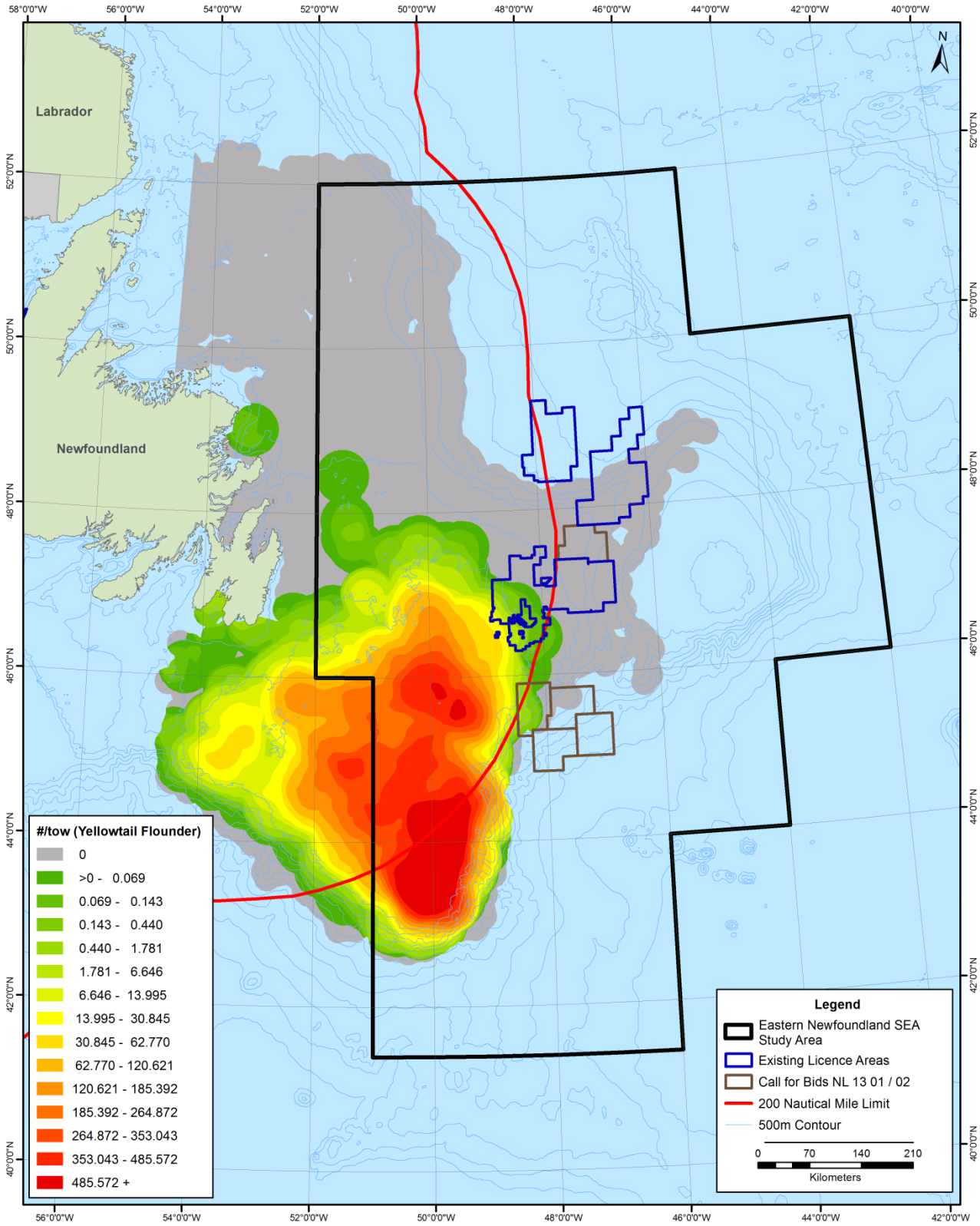


Figure 4.76 Distribution and Abundance of American Plaice in the SEA Study Area (2005-2009 Surveys)

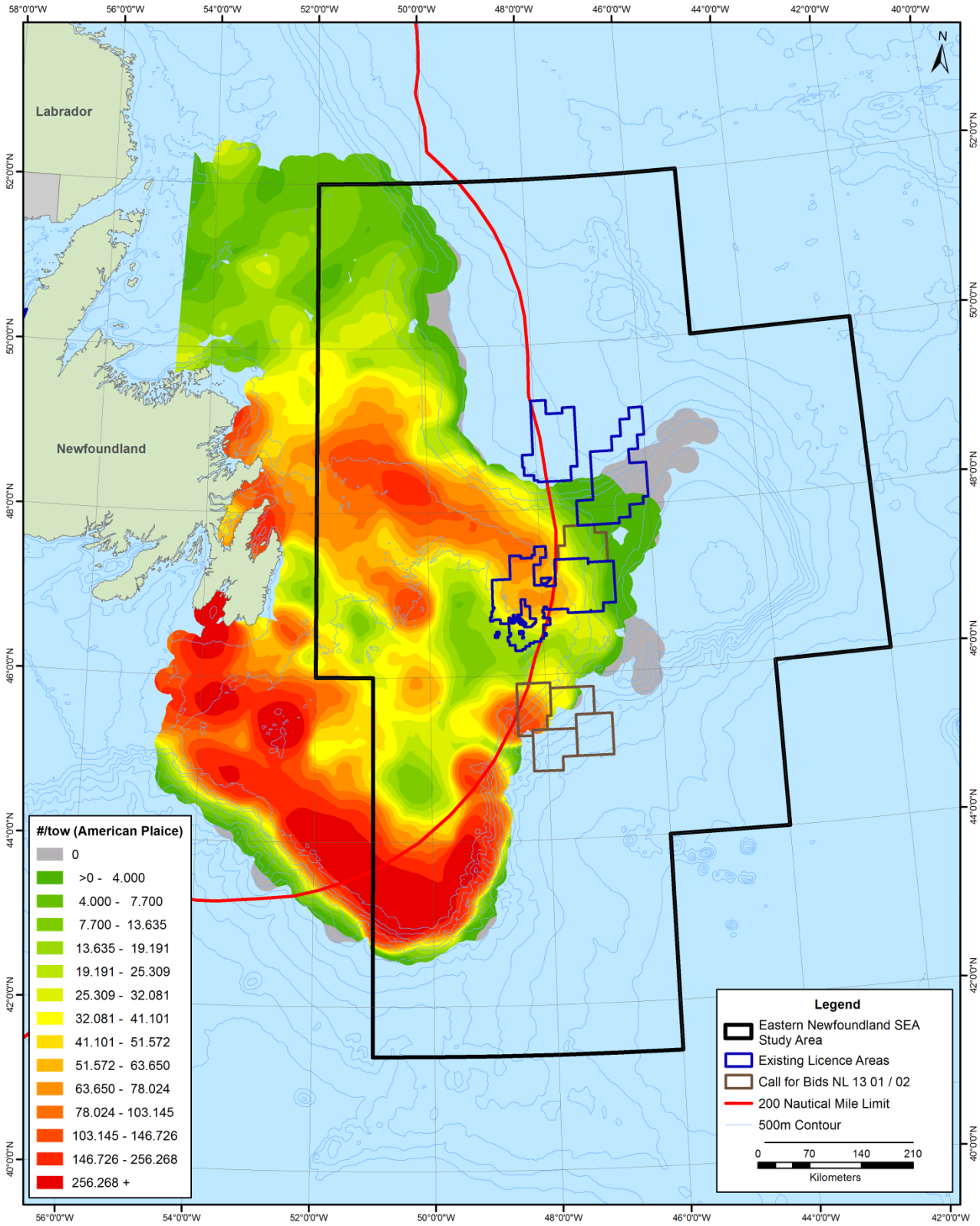


Figure 4.77 Distribution and Abundance of Sculpins in the SEA Study Area (2005-2009 Surveys)

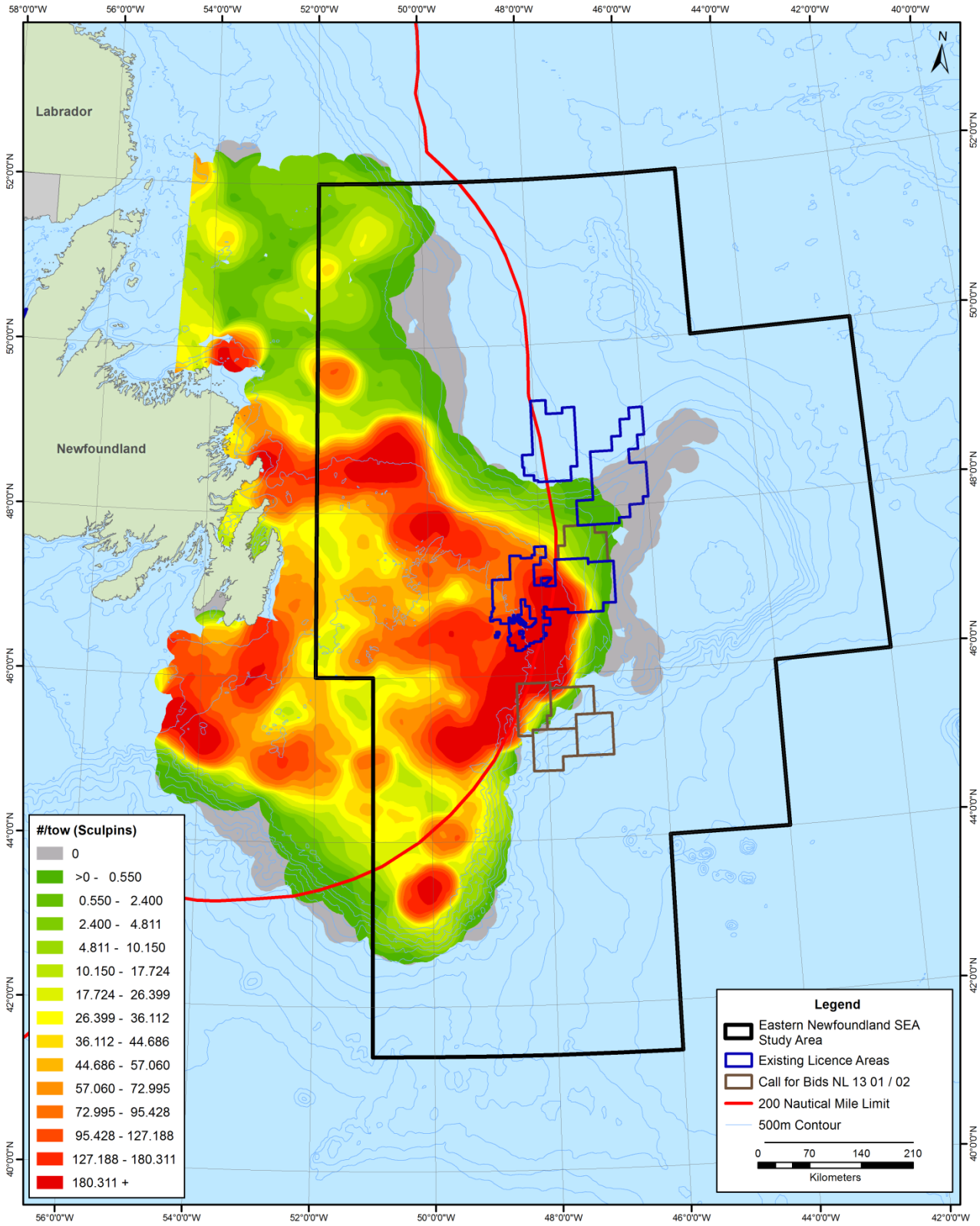


Figure 4.78 Distribution and Abundance of Lanternfish in the SEA Study Area (2005-2009 Surveys)

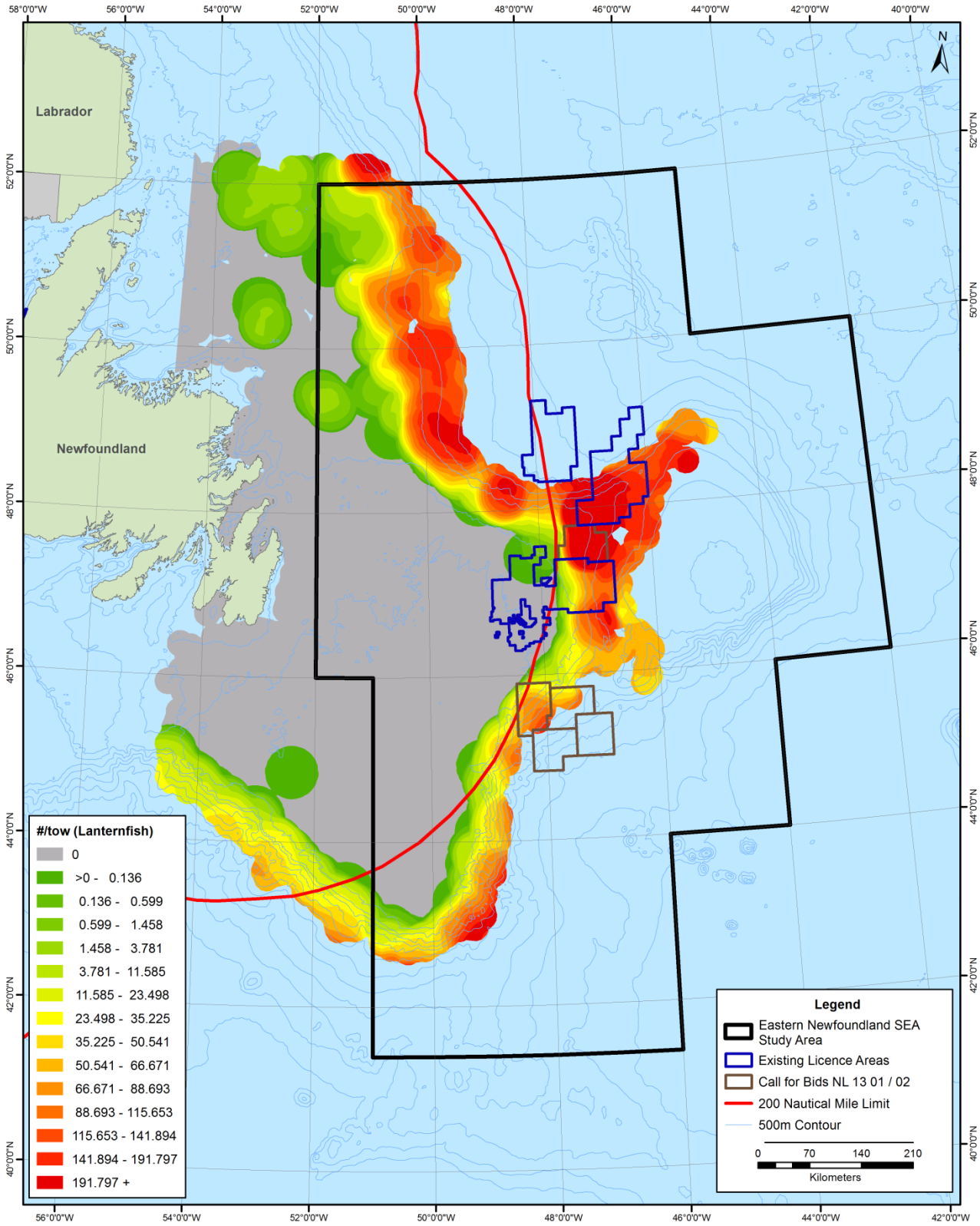


Figure 4.79 Distribution and Abundance of Atlantic Cod in the SEA Study Area (2005-2009 Surveys)

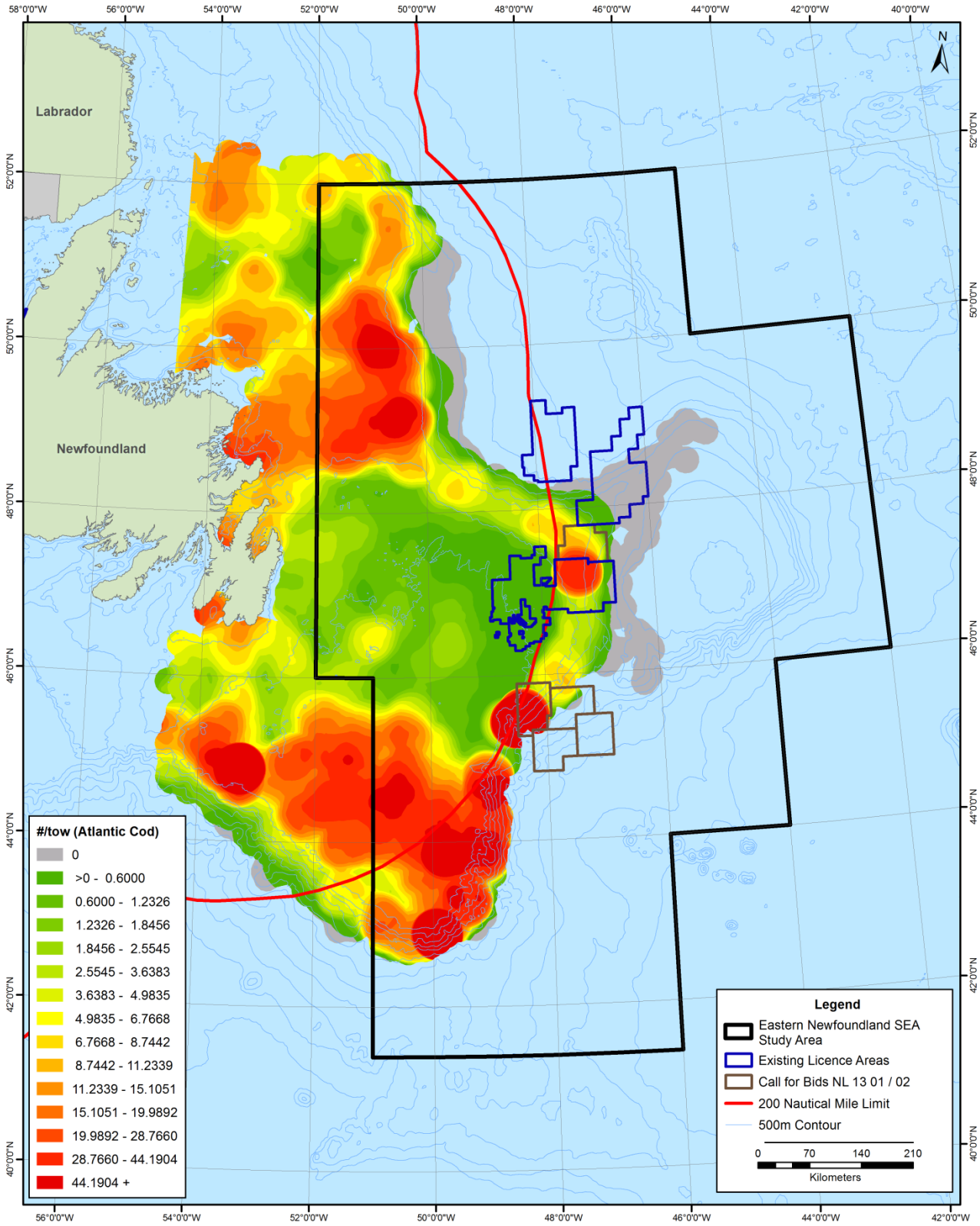


Figure 4.80 Distribution and Abundance of Greenland Halibut in the SEA Study Area (2005-2009 Surveys)

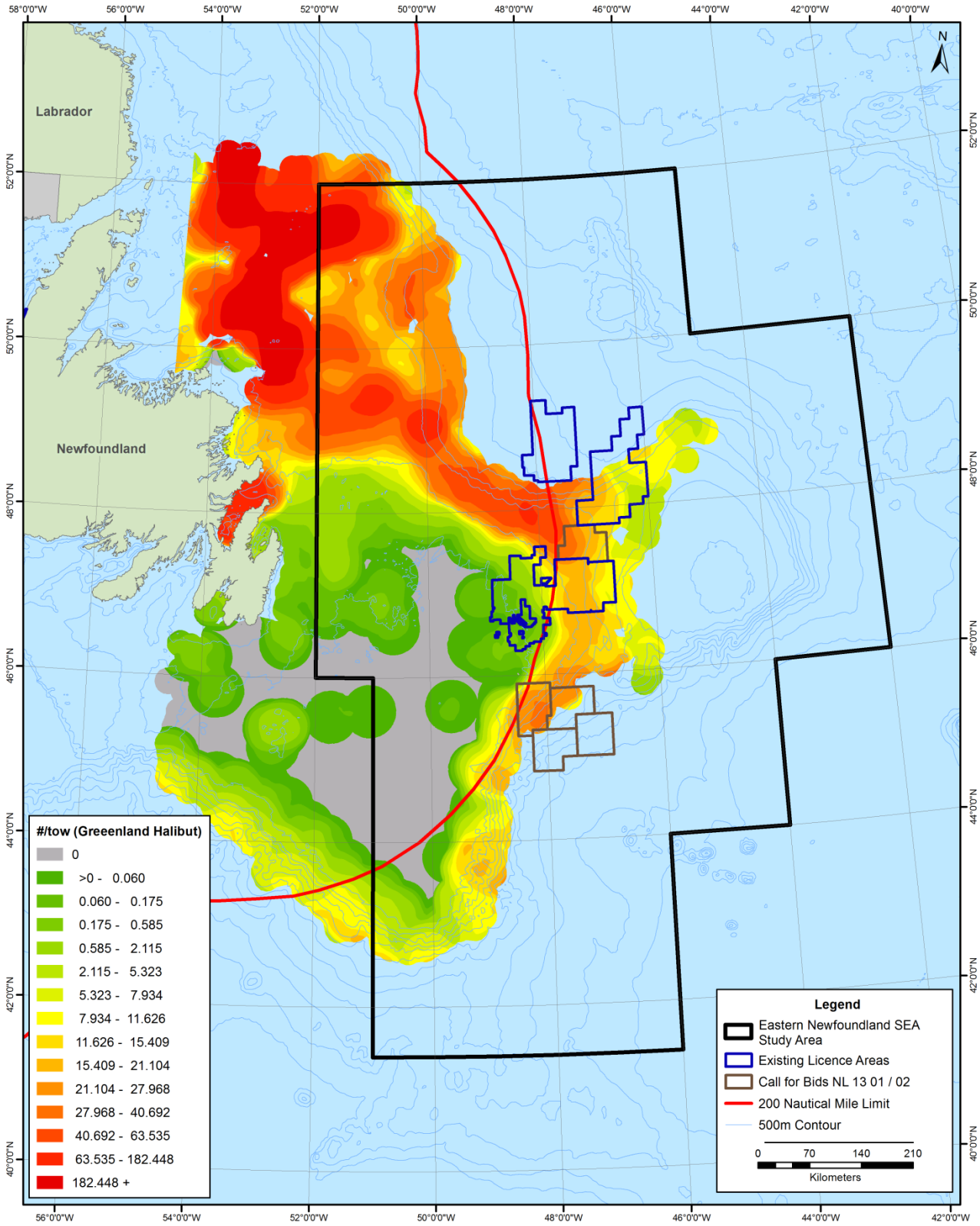


Figure 4.81 Distribution and Abundance of Blue Hake in the SEA Study Area (2005-2009 Surveys)

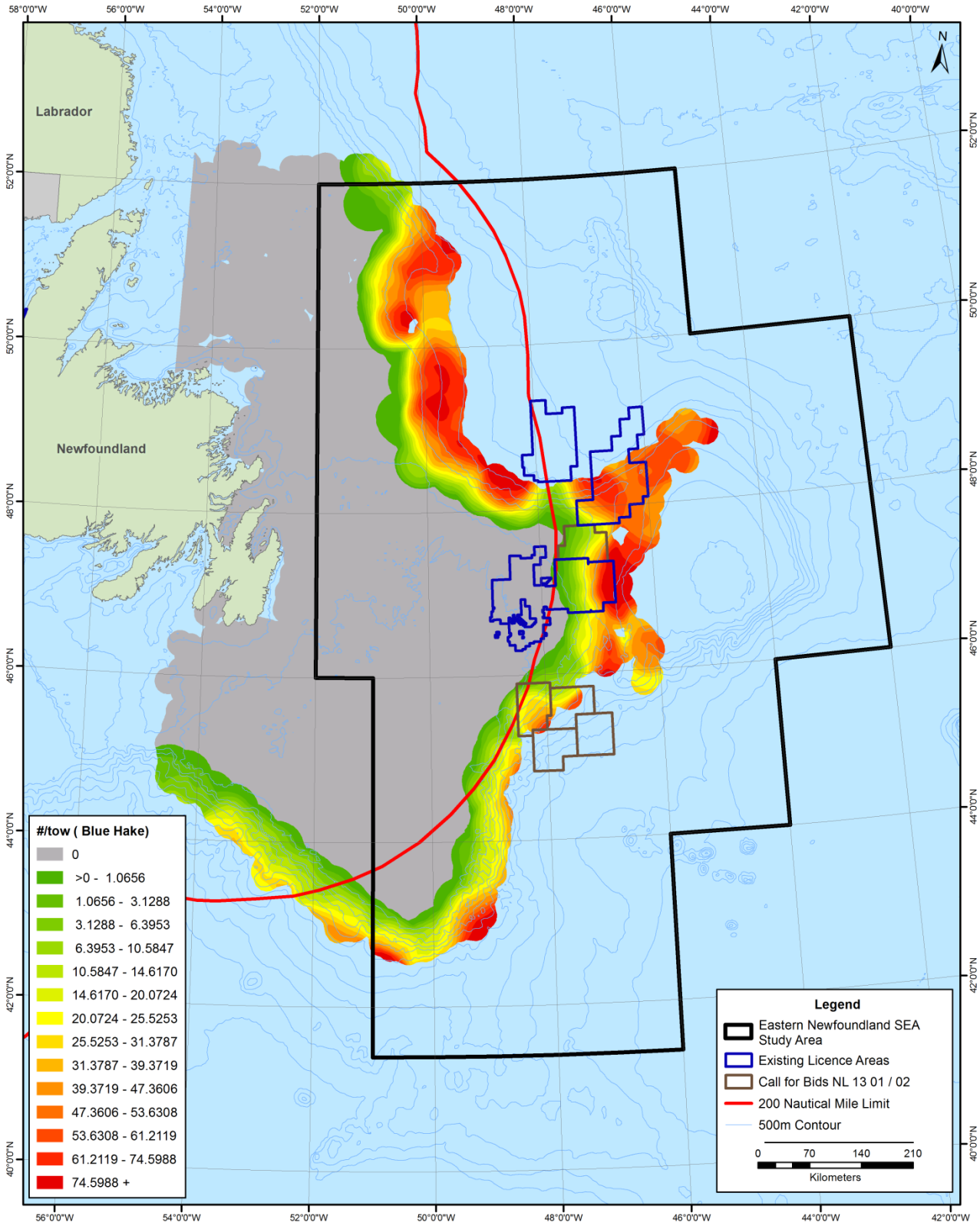


Figure 4.82 Distribution and Abundance of Roughhead Grenadier in the SEA Study Area (2005-2009 Surveys)

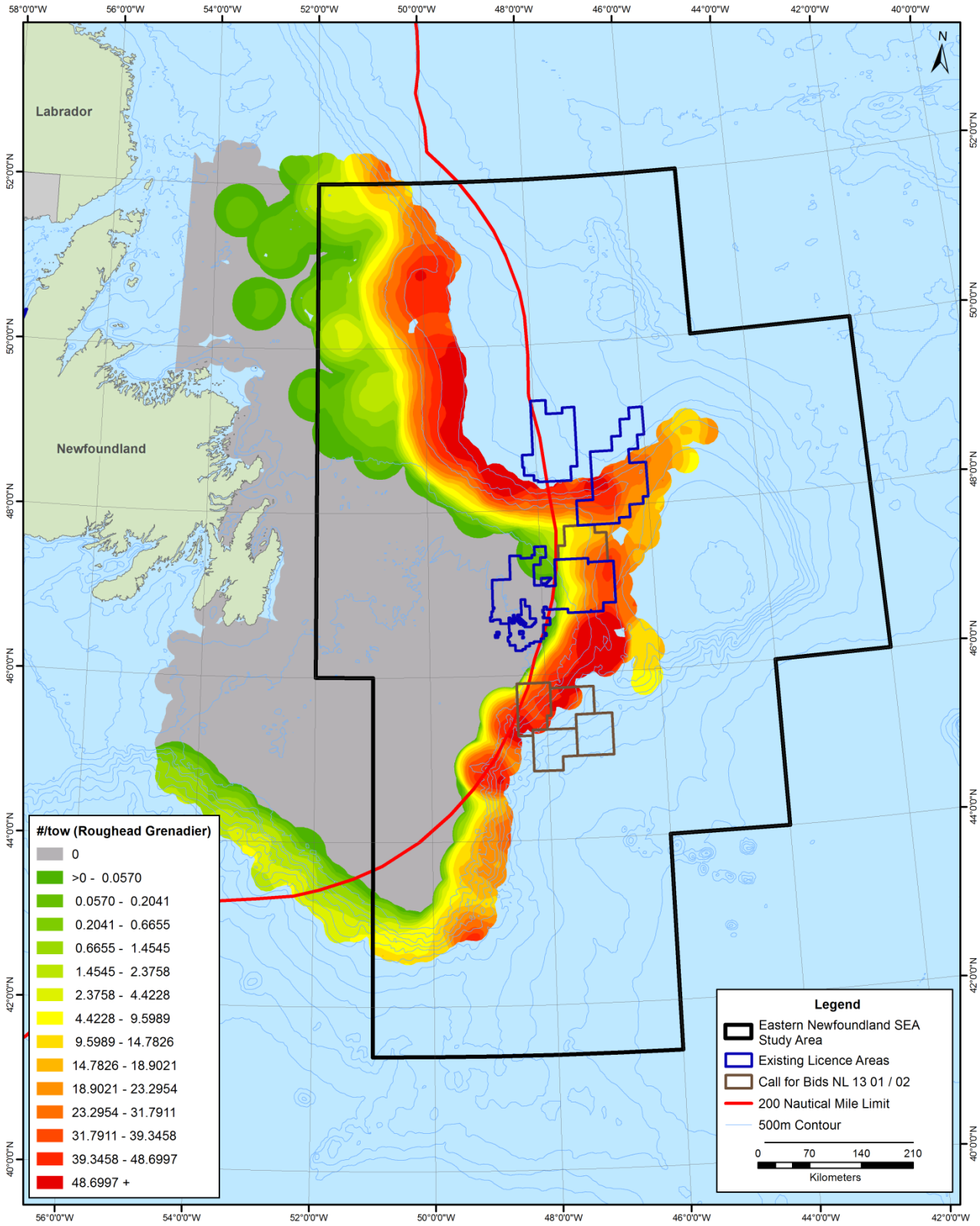


Figure 4.83 Generalized Migration Routes of Atlantic Salmon to Oceanic Feeding Grounds in Relation to the SEA Study Area

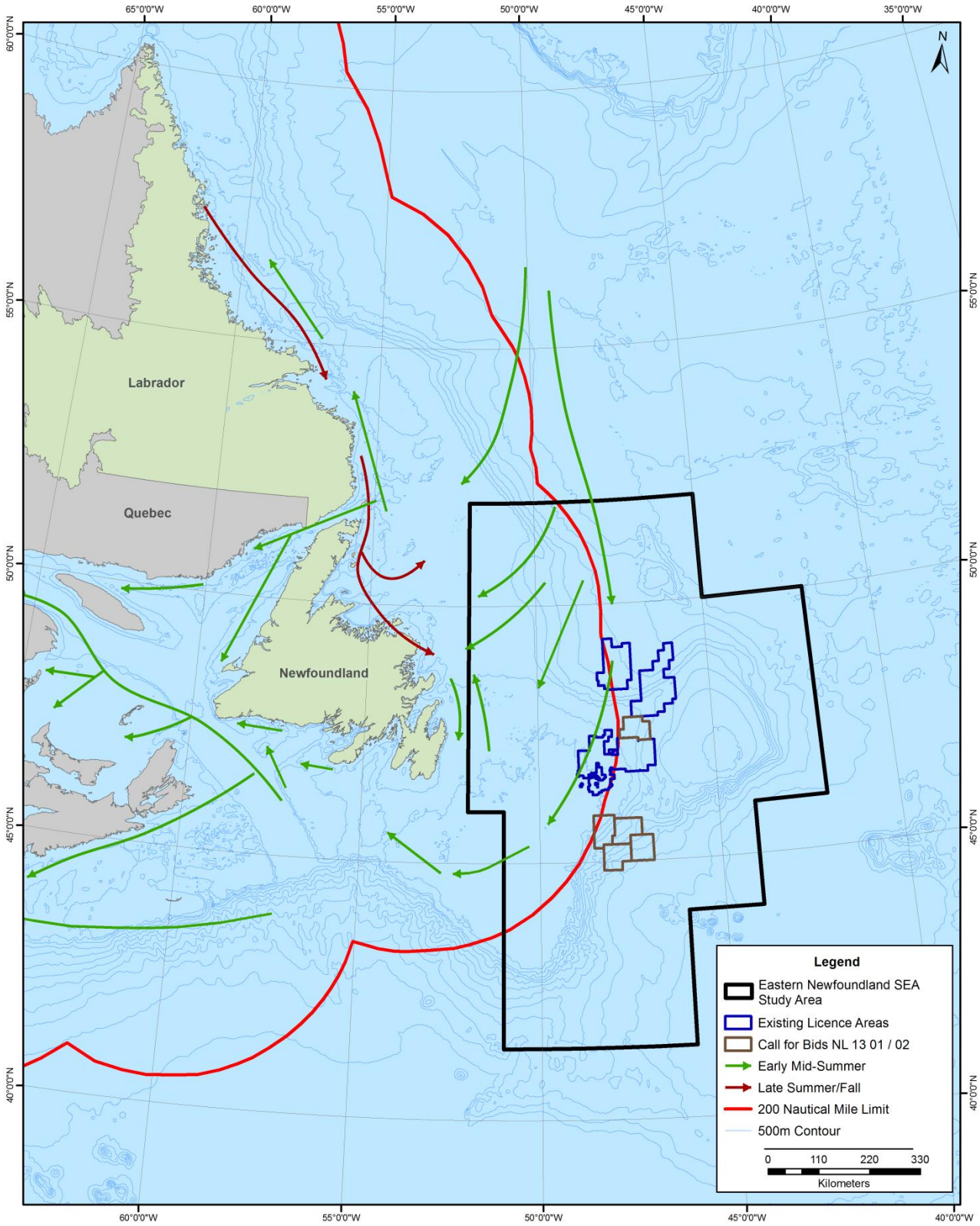


Figure 4.84 Generalized Migration Routes of Atlantic Salmon from Oceanic Feeding Grounds in Relation to the SEA Study Area

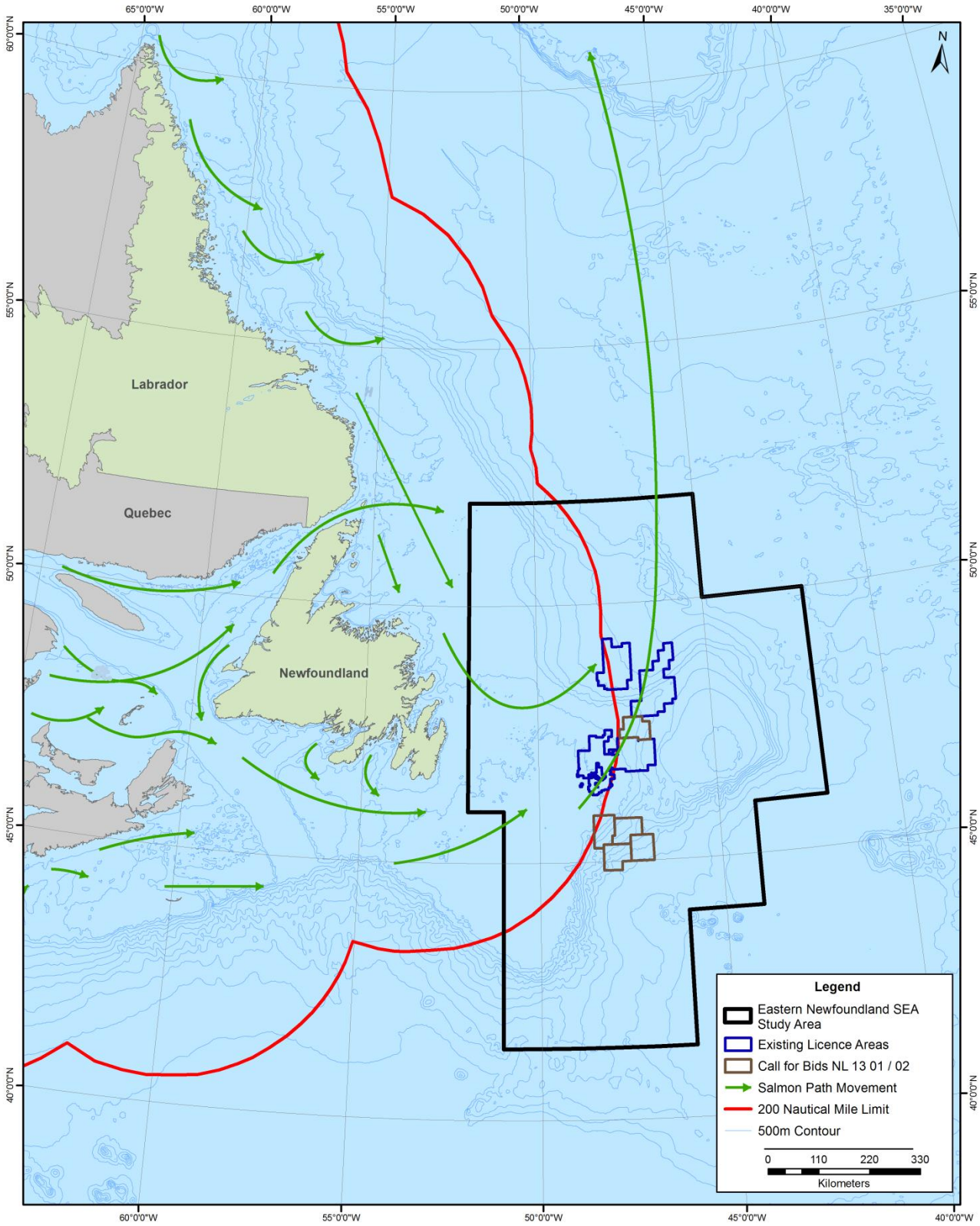
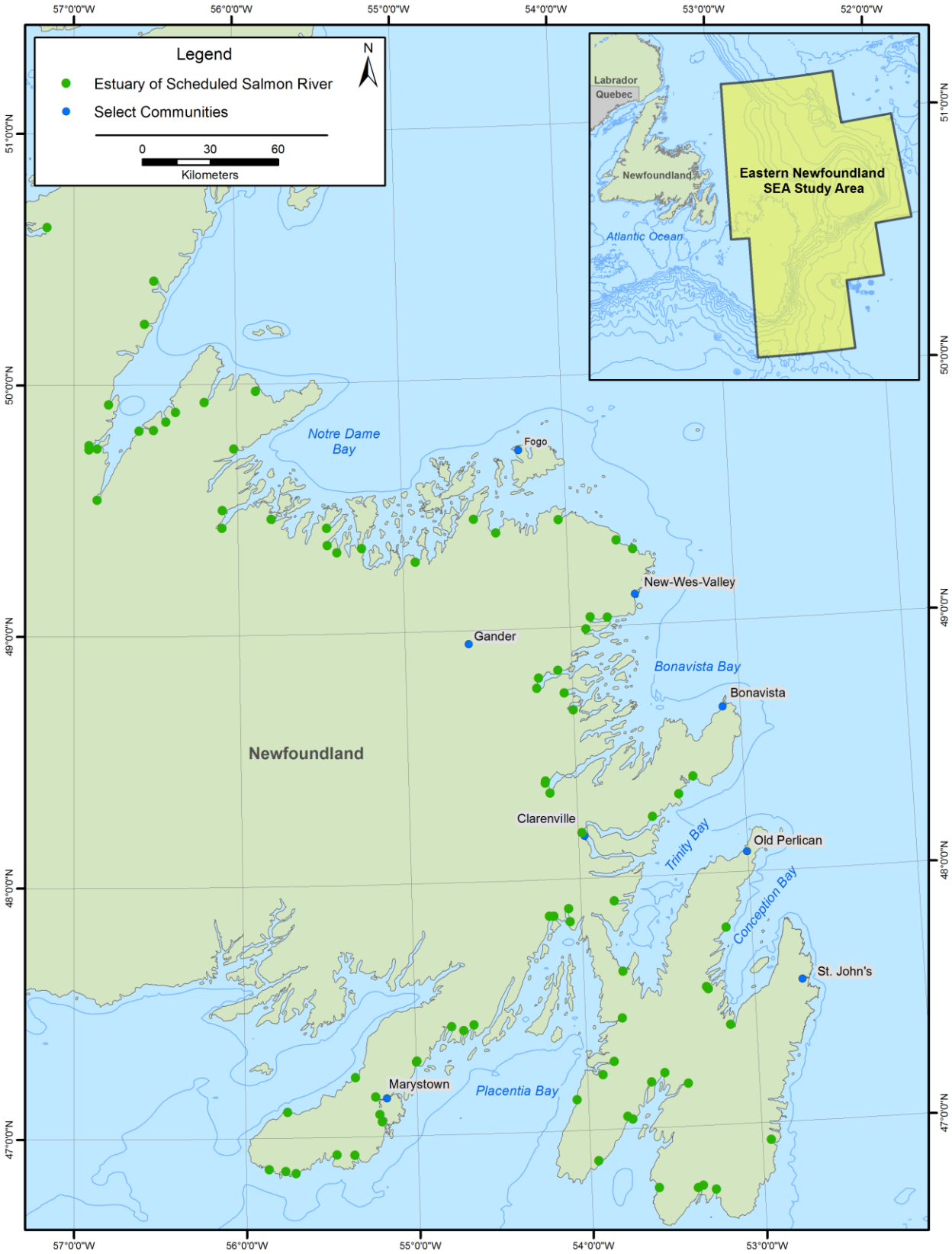


Figure 4.85 Scheduled Atlantic Salmon Rivers of Eastern Newfoundland



4.2.1.7 Fish Species at Risk

A number of species of special conservation concern occur in the SEA Study Area. These include marine fish species that have varying degrees of formal protection under provincial and/or federal legislation, or that have been otherwise identified as a conservation concern and/or regionally rare by conservation bodies such as COSEWIC (Committee on the Status of Endangered Wildlife in Canada) or the IUCN (International Union for the Conservation of Nature).

The Newfoundland and Labrador *Endangered Species* Act (NL ESA) provides protection for indigenous species, sub-species and populations considered to be endangered, threatened, or vulnerable within the province. These potential designations under the legislation are defined as follows:

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

There are currently 35 species, subspecies, and populations designated under the *NL ESA*, of which 13 are listed as endangered, nine as threatened, and 13 as vulnerable. Designations are based on recommendations from the national Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and/or the provincial Species Status Advisory Committee (SSAC). Both COSEWIC and SSAC are independent committees that consist of government and non-government scientists who determine the status of species, subspecies and significant populations considered to be at risk of extinction or extirpation. The evaluation processes of both are independent, open and transparent, and based on the best available information on the biological status of species including scientific, community and traditional knowledge. Habitat that is important to the recovery and survival of endangered or threatened species can also be designated as critical habitat or recovery habitat, and protected under the *NL ESA*.

The Canadian *Species at Risk Act* (*SARA*) provides protection to species at the national level to prevent extinction and extirpation, facilitate the recovery of endangered and threatened species, and to promote the management of other species to prevent them from becoming at risk in the future. Designations under the Act follow the recommendations and advice provided by the COSEWIC.

There are currently various schedules associated with the SARA. Species that have formal protection are listed on Schedule 1, which includes the following potential designations:

- *Extirpated*: A species that no longer exists in the wild in Canada, but exists elsewhere;
- *Endangered*: A species that is facing imminent extirpation or extinction;
- *Threatened*: A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction; and

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

Schedule 1 of *SARA* is the official federal list of species at risk in Canada. Once a species is listed, measures to protect and recover a listed species are established and implemented, including the development of a Recovery Strategy. These are detailed plans that define conservation goals and objectives, identify critical habitat, and describe the research and management activities required for the species in question, by:

- describing the particular species and its needs;
- identifying threats to survival;
- identifying and classifying the species' critical habitat (namely, that which is required for the species' survival or recovery), where possible;
- providing examples of activities that are likely to result in destruction of the critical habitat;
- setting goals, objectives and approaches for species recovery;
- identifying information gaps that should be addressed; and
- stating when one or more action plans relating to the strategy will be completed.

Once a species is added to the list and protected officially under *SARA*, a Recovery Strategy must be developed. For endangered species, this strategy must be developed within a year of the listing; for threatened or extirpated (extinct in Canada) species, it must be developed within two years. Action Plans summarize the projects and activities required to meet Recovery Strategy objectives and goals. They include information on habitat, details of protection measures, and evaluation of socioeconomic costs and benefits. Action Plans are the second element of the Act's two-part recovery planning process, and are used to implement projects and activities to improve species status. Management Plans set goals and objectives for maintaining sustainable population levels of one or more species that are particularly sensitive to environmental factors, but which are not yet considered in danger of becoming extinct. Where possible, these plans are prepared for multiple species on an ecosystem or landscape level.

Although the information presented in this SEA is considered current as of the time of writing, it should be noted that the provisions of and associated requirements under *SARA* can change over time (for example, there may be new species added to Schedule 1, new recovery strategies, action plans or management plans, identification of critical habitat). It is therefore important to refer to the *SARA Public Registry* (*www.sararegistry.gc.ca*) to get the most up-to-date information and requirements for species at risk in Canada.

In addition to species that are listed under the provincial and/or federal legislation, there is also often a degree of interest around species that are considered to be regionally rare, even though these are not necessarily provided with formal, legal protection. Although the designation of a species by COSEWIC, the IUCN or other such organizations, for example, does not in itself constitute such legal protection, they do provide a general indication of species that may be considered rare, and thus, of some degree of potential conservation interest.

There are currently 25 fish species that are listed by *SARA* (four species), *NL ESA* (one species), COSEWIC (21 species) and/or the IUCN Redlist (15 species) that do or may occur in the SEA Study Area (Table 4.66). Many of these species remain relatively common across the SEA Study Area, but exist at a small fraction of their former abundance since the groundfish collapse of the early 1990s (e.g.

American plaice, Atlantic cod, redfish). Others probably never occurred in great densities relative to collapsed groundfish stocks (e.g. tunas and sharks).

The four marine fish species that have formal designation and protection under *SARA* include three species of wolffish (family *Anarhichadidae*) and the white shark (Table 4.66). These are described in further detail below.

The Northern wolffish has been designated as threatened as numbers of this large, slow-growing, long-lived, solitary, nest-building fish have declined over 95 percent in three generations, and the number of locations where the fish is found has likewise decreased. Spotted wolffish were designated for similar reasons, as its populations have declined over 90 percent in three generations, and the number of locations where the fish is found has also decreased. Although the striped wolffish has a lower designation (Special Concern), it also underwent a decline similar to that observed for the two Threatened species. Specific threats identified by COSEWIC included bycatch mortality in commercial fisheries and habitat alteration by trawling gear.

All three wolffish species were reassessed by DFO (2013b) and their recommended statuses have not changed. There is, however, a Recovery Strategy and Management Plan outlined in Kulka et al (2007) and reviewed by DFO (2013b) to increase the population levels and distributions of the three wolffish species. This includes the enhancement of biology and life history knowledge, the identification and protection of critical habitats, mitigation of human impacts and the development of education programs related to these species (DFO 2013b). Although critical habitat under *SARA* has yet to be defined, it is in progress (DFO 2013b). In the meantime, recent research indicates that Northern wolffish are found in the deepest water (300-1,200 m), with striped wolffish in the shallowest water (50-450 m) and spotted wolffish at intermediate depths (100-800 m). Interestingly, Northern wolffish are believed to spend considerable time off the bottom based on the prevalence of pelagic prey items (e.g. squid) in their diet (D. Kulka pers. comm.). Some studies have shown that spotted and striped wolffish showed no preference for substrate, while Northern wolffish were found most often on sand / shell / pebble habitats (as reviewed in DFO 2013b). Other studies however, have indicated a preference for rocky substrates for both striped (Kulka et al 2004a) and spotted wolffish (Baker et al 2012). The distributions of these wolffish species, as determined by DFO RV surveys in the SEA Study Area, are presented in Figures 4.86 to 4.88. All three species were associated with deep shelf areas but the more abundant striped wolffish was also found in areas of the continental shelf at lower abundance. The Bonavista corridor also appeared to be an area of relatively high concentration for the spotted wolffish. Of the three species, the northern wolffish was typically distributed in deeper waters.

The range of the white shark extends to the Canadian waters of the North Atlantic, although it is considered to be quite rare (with only 32 records over 132 years for Atlantic Canada; COSEWIC 2006a). Its numbers are estimated to have declined by about 80 percent over 14 years (less than one generation) in areas of the northwest Atlantic Ocean outside of Canadian waters. This species was assessed in 2006 as being endangered under Schedule 1 of *SARA*, with no update since that time. An assessment of the recovery potential of the white shark (DFO 2006) underscored a poor understanding of the species' biology, particularly in Canadian waters where it is less common. Consequently, critical habitat for this species has not been identified and designated under *SARA*. The greatest source of human induced mortality (by-catch in the American long line fishery) also does not occur in Canadian waters (DFO 2006).

Figure 4.86 Distribution and Abundance of Northern Wolffish in the SEA Study Area (2005-2009 Surveys)

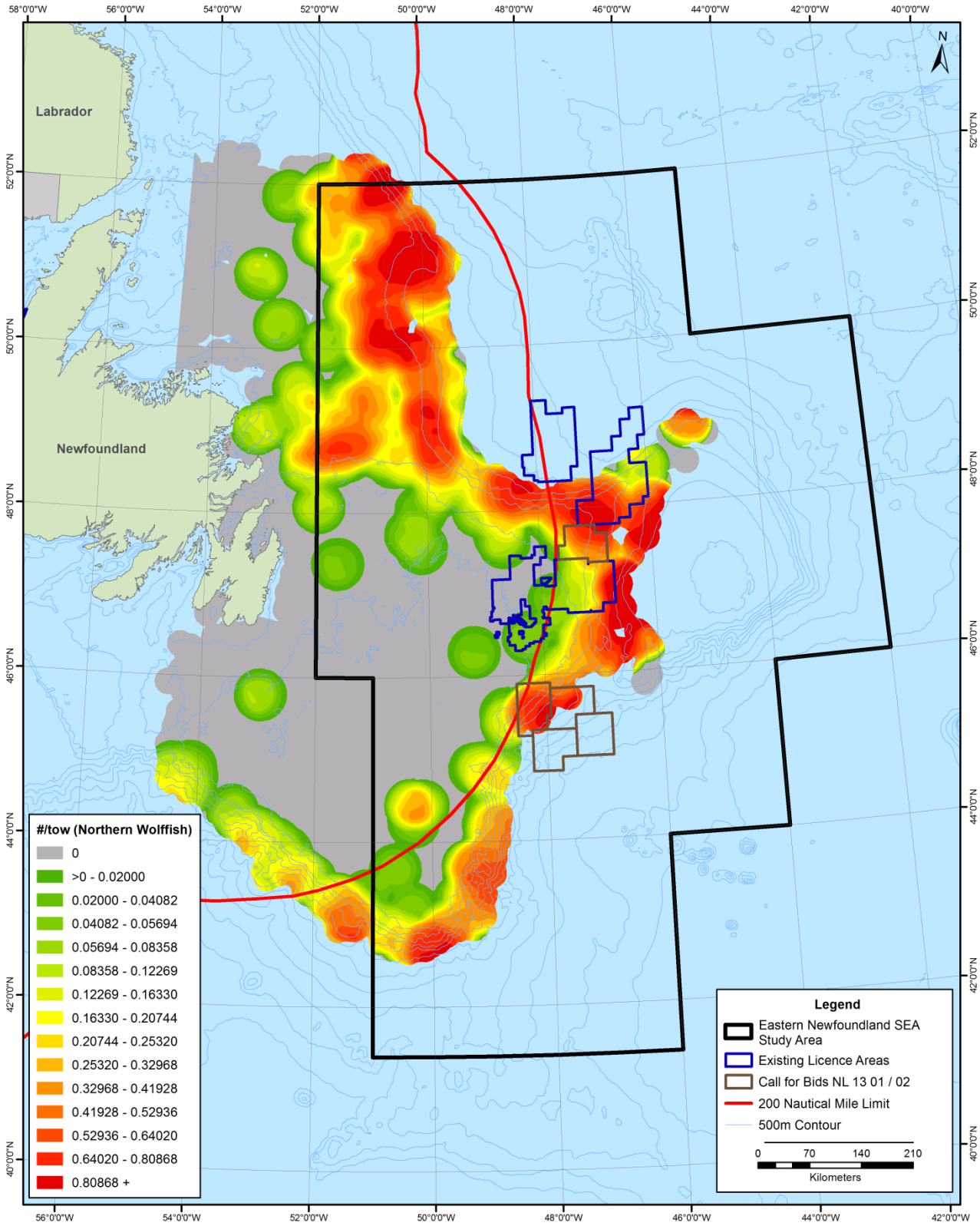


Figure 4.87 Distribution and Abundance of Striped Wolffish in the SEA Study Area (2005-2009 Surveys)

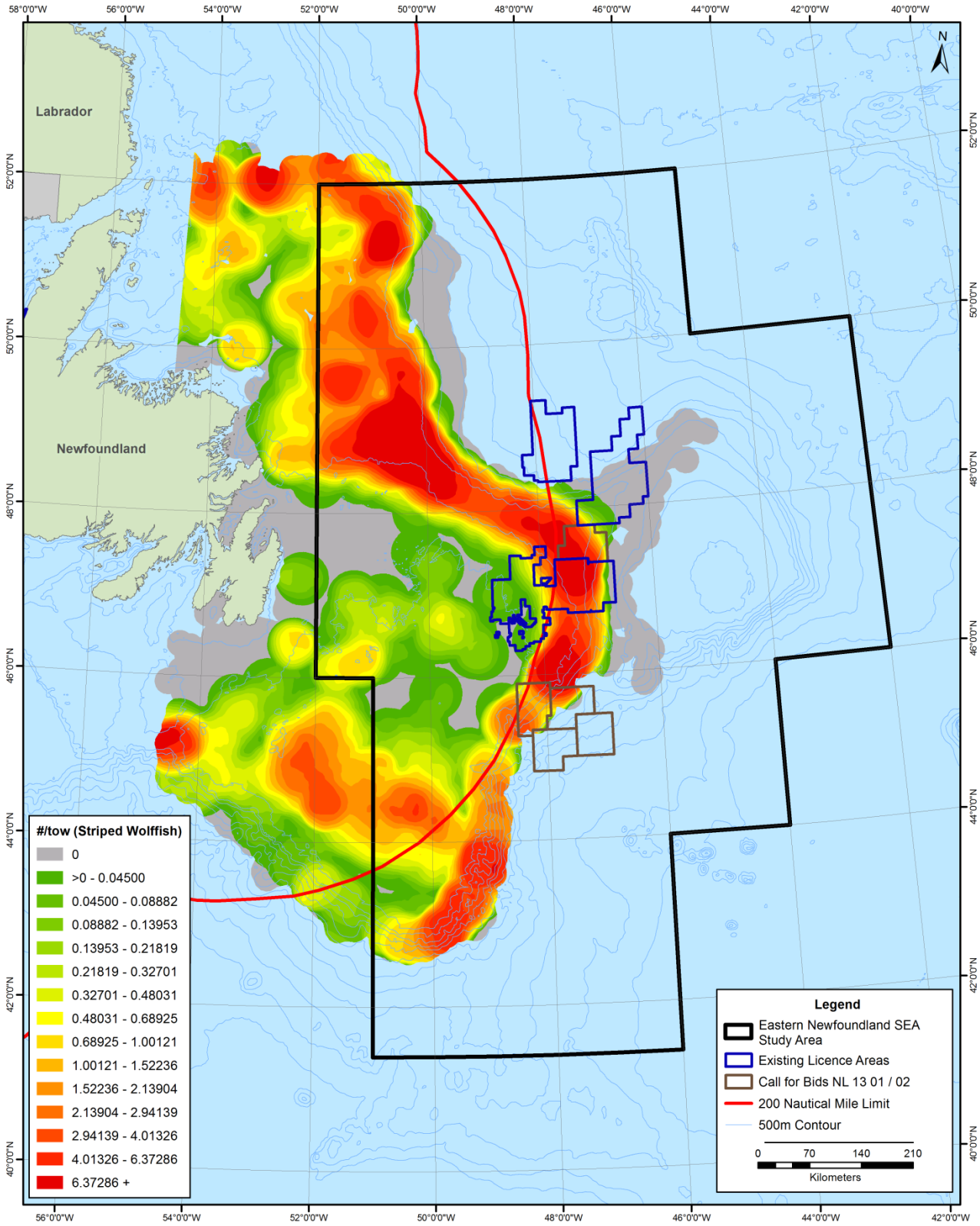


Figure 4.88 Distribution and Abundance of Spotted Wolffish in the SEA Study Area (2005-2009 Surveys)

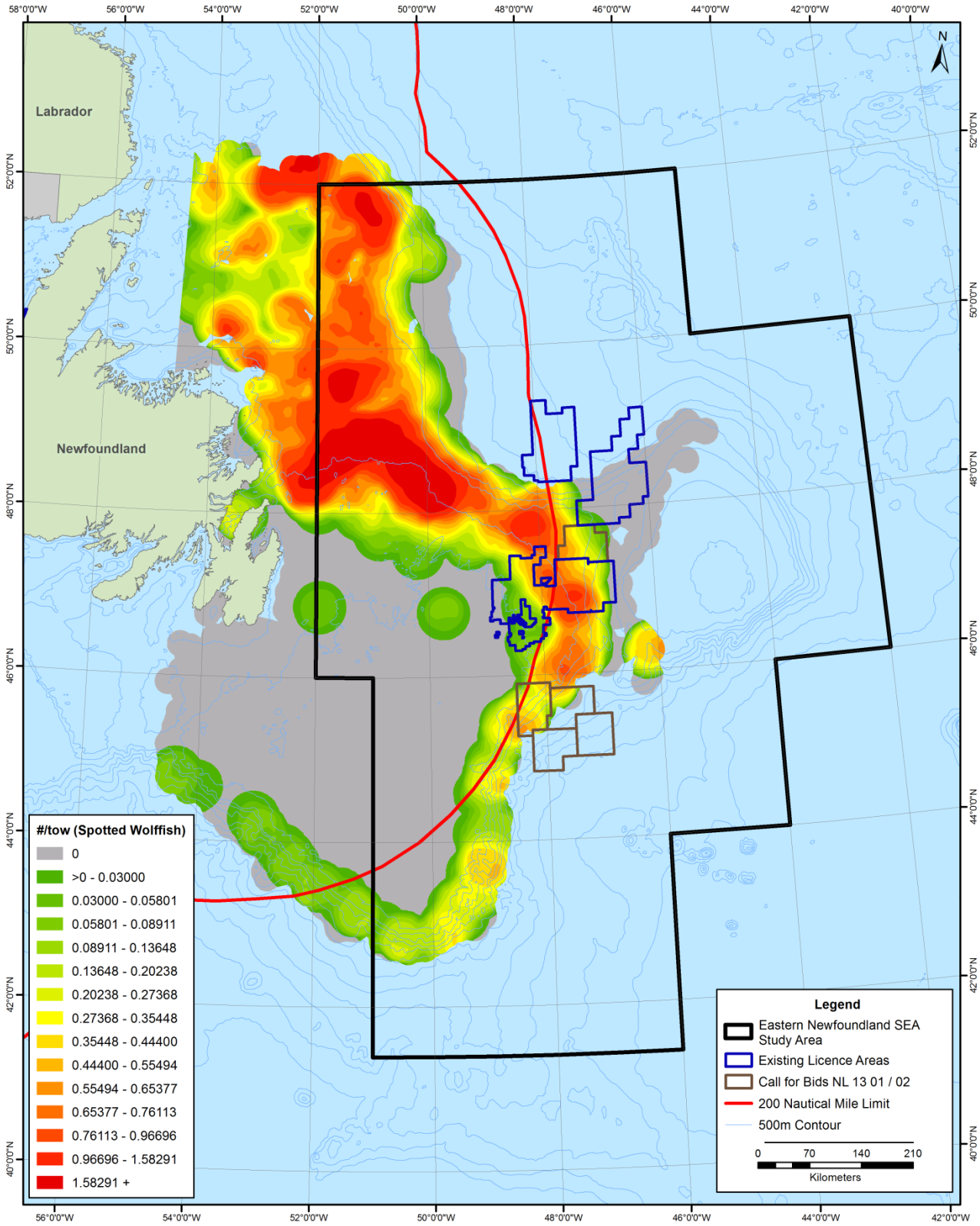


Table 4.66 Marine Fish Species at Risk that are Known to or May Occur within the SEA Study Area

Species		NL Provincial Designation			SARA Status			COSEWIC Assessment			IUCN				
Common Name	***Scientific Name***	***Endangered***	***Threatened***	***Vulnerable***	***Endangered***	***Threatened***	***Special Concern***	***Endangered***	***Threatened***	***Special Concern***	***Endangered***	***Vulnerable***	***Near Threatened***	***Least Concern***	*Population**
American Eel	*Anguilla rostrata*			●											NL, AO
White Shark	*Carcharodon carcharias*				●			●				●			AO
Northern Wolffish	*Anarhichas denticulatus*					●			●						AO
Spotted Wolffish	*Anarhichas minor*					●			●						AO
Striped Wolffish	*Anarhichas lupus*						●			●					AO
Bluefin Tuna	*Thunnus thynnus*							●			●				AO
Atlantic Cod	*Gadus morhua*							●				●			NL, AO
Cusk	*Brosme brosme*							●							AO
Roundnose Grenadier	*Coryphaenoides rupestris*							●							AO
Porbeagle	*Lamna nasus*							●				●			AO
Smooth Skate	*Malacoraja senta*							●			●				NL, AO
Spiny Dogfish	*Squalus acanthias*								●			●			AO
Shortfin Mako	*Isurus oxyrinchus*								●			●			AO
American Plaice	*Hippoglossoides platessoides*								●						NL, AO
Acadian Redfish	*Sebastes fasciatus*								●		●				AO
Deepwater Redfish	*Sebastes mentella*								●					●	AO
Atlantic Salmon	*Salmo salar*								●					●	NL, AO
Roughhead Grenadier	*Macrourus berglax*									●					AO
Basking Shark	*Cetorhinus maximus*									●		●			AO
Blue Shark	*Prionace glauca*									●			●		AO
Thorny Skate	*Amblyraja radiata*									●		●			NL, AO
Winter Skate	*Leucoraja ocellata*									●	●				AO
Barndoor Skate	*Dipturus laevis*										●				AO
Albacore Tuna	*Thunnus alalunga*												●		AO
Bigeye Tuna	*Thunnus obesus*											●			AO

* Population: AO – Atlantic Ocean; NL – Newfoundland and Labrador

4.2.1.8 Environmental Influences and Changes

The importance of ecosystem change in the Northwest Atlantic has gained increased attention in recent years (e.g. Dawe et al 2012). Climate changes are now recognized as having a major influence over ecosystem characteristics on the Newfoundland Shelf, with fishing pressure also being a strong forcing factor (Dawe et al 2012). It has long been known to fisherman and scientists that fish and invertebrate abundance and distribution within the SEA Study Area are not static, with dramatic changes in both abundance and species composition occurring as a direct or indirect result of environmental conditions and exploitation (Worm and Myers 2003; deYoung et al 2004; Drinkwater 2006). Recognizing that such changes have happened and will occur in the future (Frank et al 1990; Drinkwater 2005) is critical when considering important and sensitive areas in time and space within the SEA Study Area. During 2013 consultations with fishers that use the SEA Study Area, it was underscored that important fishing grounds have changed from year to year. Similarly, scientific surveys have identified regime shifts of entire communities (Dawe et al 2012), distribution shifts of species (Rose 2005a) and altered migration patterns (Kulka et al 1995) that have occurred over several decades.

A key environmental driver in the North Atlantic has been the North Atlantic Oscillation (NAO), an atmospheric phenomenon that affects the movement of weather systems and currents in the region. In recent years it has fluctuated on decadal scales, and is strongly correlated with environmental variables such as sea surface temperature and rainfall (deYoung et al 2004). NAO oscillations have been linked to changes in stock health of shelf species (such as cod; Stige et al 2006) and deep water fish species (such as redfish; Devine and Haedrich 2011) and to plankton abundance and biomass (Greene and Pershing 2000; Pershing et al 2001; Head and Sameoto 2007). For example, changes to redfish abundance in the SEA Study Area vary with bottom temperature, sea surface temperature and NAO. These variables can, in turn, affect fecundity, growth and recruitment of redfish. Furthermore, changes to salinity can alter redfish larval survival and/or affect their plankton prey sources (Devine and Haedrich 2011). These effects can manifest in fish communities over years to decades.

Studies have attempted to predict ocean conditions in the Northwest Atlantic under the climate warming scenarios expected in the coming years (Frank et al 1990; Drinkwater 2005). Models predict a general warming and freshening of shelf waters that will move fish distribution of some species northward (e.g. cod, crab), extend the summer use of SEA Study Area by pelagic migrants, enhance fish growth and production and alter migration patterns (Frank et al 1990; Drinkwater 2005). In addition to these direct temperature effects, climate warming is also expected to increase stratification and alter current circulation patterns. These changes could reduce the transport of nutrients to benthic food webs and favour pelagic production (Frank et al 1990). Due to the complexity of the ecosystem and the unpredictable nature of fishing intensity, however, the authors of these studies recognize the speculative nature of these predictions.

The interconnected nature of the food webs in the SEA Study Area also means that changes to one species will inevitably affect various others (e.g. increases in cod abundance will likely negatively affect shrimp abundance; Worm and Myers 2003). Furthermore, not all species respond to perturbations in the same way. For example, deepwater species such as redfish are typically long lived, and their responses to changes in environmental conditions often lag as compared to shelf species (Devine and Haedrich 2011). In much the same way, Rose (2005a) determined that fish in the Northwest Atlantic can be classified into four general groups, which have varying responses to environmental perturbations: 1) small pelagics that frequent shallow and cool water; 2) large, warm water pelagic species; 3) cool, shallow water demersal fish; and 4) deep water species. Each group has distinct life

history characteristics and population resilience that influence how they are affected by and respond to environmental conditions. For example, cold water pelagics such as capelin have a relatively small environmental tolerance range and can quickly increase their population size and therefore shift distributions and show demographic responses to environmental conditions (Rose 2005a). Variability in these distributions has been shown to align with temperature in the historical record (Rose 2005a). In contrast, more deep water species such as Greenland halibut and redfish, which occupy more stable habitats and have low rates of population increase, are expected to demonstrate less and/or delayed population responses (Rose 2005a; Devine and Haedrich 2011).

4.2.1.9 Aquatic Invasive Species

Aquatic invasive species (AIS) can threaten aquatic ecosystems, either by out-competing native species, preying on native species or through habitat disturbance. These species may show rapid population growth in the absence of natural predators and may soon become established to the point where eradication is not possible.

The most devastating recent example of this is the tunicate species *Didemnum vexillum*, which invaded Georges Bank off the New England coast. George's Bank is an area very similar to the Grand Banks, and is known for its very productive fishing grounds. This tunicate was first observed on Georges Bank in 2002 and has since covered an estimated 50-90 percent of hard substrates with a dense mat that smothers benthic organisms, reduces larval settlement, reduces shelter for juvenile fish, and prevents groundfish from feeding on benthic organisms (Leeuw at al 2013). Although this particular species has not been identified in the SEA Study Area, it is an important example of what can potentially occur. Local and international marine transport in general is implicated in many of the accidental introductions of marine AIS, as ship hulls and bilge water serve as vectors for AIS range expansion (McKenzie et al 2010). In addition to industry-related shipping, oil and gas development can also increase spread of AIS propagules when offshore drilling units and other installations are moved about the globe (Benoit et al 2012). For this reason, fishers during SEA consultations expressed concerns about increases of AIS when shipping traffic increases to support the offshore oil and gas industry.

Seven aquatic invasive species have been identified in the Newfoundland and Labrador Shelf Ecozone, including the European green crab, Japanese skeleton shrimp, golden star tunicate, violet tunicate, oyster thief algae and the coffin box bryozoan (Table 4.67). All of these species have been shown to have detrimental effects on native species and local ecosystems, but these effects are generally thought to be more important to benthic coastal communities as compared to the open ocean (Templeman 2010).

Table 4.67 Invasive Marine Species on the Newfoundland Continental Shelf

Taxa	Species	Dispersal Routes	Potential Effects
Crustacean	European green crab[1] (*Carcinas maenas*)	Spread through movement of fishing gear, and transport via ballast water.	Prey on invertebrates. Extremely efficient predators and colonizers.
	Japanese skeleton shrimp (*Caprella mutica*)	Spread through movement of fishing gear, offshore buoys, and boats (Cook et al 2007)	Interferes with aquaculture operations.
Tunicate	Golden star tunicate (*Botryllus schlosseri*)	Spread through movement of fishing gear, shellfish and boats Interferes with bivalve larvae settlement.	Interferes with aquaculture operations.
	Violet tunicate (*Botrylloides violaceus*)	Spread through movement of fishing gear, shellfish and boats Interferes with bivalve larvae settlement.	Interferes with aquaculture operations.
	Vase tunicate (*Ciona intestinalis*)	Spread through movement of fishing gear, shellfish and boats Interferes with bivalve larvae settlement.	Interferes with aquaculture operations.
Bryozoan	Coffin box bryozoans (*Membranipora membranacea*)	Spread through movement of boats and planktonic larvae	Devastates kelp beds.
Algae	Oyster thief (*Codium fragile* spp. *fragile*)	Spread through movement of fishing gear, shellfish and boats	Replaces native species including eel grass and kelp.

Source: Modified from DFO (2014); Matheson (2013); Templeman (2010)
[1] This is a coastal species but has been included here for completeness

4.2.1.10 Ecologically and Biologically Significant Areas (EBSAs)

A number of Ecologically and Biologically Significant Areas (EBSAs) have been identified by DFO for the Placentia Bay-Grand Banks Large Ocean Management Area (Templeman 2007). This exercise was undertaken through an analytical ranking system of candidate areas in which DFO identified various thematic layers and criteria (Table 4.68), from which 11 EBSAs were eventually identified and evaluated. For each of these EBSAs, the various layers were evaluated independently using the three primary criteria (fitness consequence, aggregations and uniqueness) and two secondary criteria (naturalness and resilience).

Table 4.68 Layers and Criteria for EBSA Designation

Attributes	Types	Description
Thematic Layers	Topography and Physical Processes	Physical information layer
	Primary Production	Biological information layers
	Secondary Production	
	Meroplankton	
	Benthic Invertebrates	
	Demersal Fishes	
	Pelagic Fishes	
	Pinnipeds and Cetaceans	
Criteria/	Uniqueness	Areas whose characteristics are unique, rare, distinct, and for which

Attributes	Types	Description
Dimension		alternatives do not exist.
	Aggregation	Areas where (i) most individuals of a species are aggregated for some part of the year; or (ii) some important function in their life history; or (ii) some structural feature or ecological process.
	Fitness Consequence	Areas where the life history activity(ies) undertaken make a major contribution to the fitness of the population or species present.
	Resilience*	Areas where the habitat structure or species are highly sensitive, easily perturbed, and slow to recover.
	Naturalness*	Areas which are pristine and characterized by native species.
*Resilience and naturalness are usually captured within the first three Criteria/Dimensions and are considered secondary dimensions (Templeman 2007)		

Several EBSAs (Figure 4.89, from Templeman 2007) were selected based on their importance to marine fish, invertebrates and planktonic components and characteristics. The identified EBSAs that are located within or in close proximity to the SEA Study Area are described below using information from Templeman (2007) and DFO (2013).

- *Southeast Shoal and Tail of the Banks:* This EBSA falls within the SEA Study Area, and has been identified due to its importance to the finfish, invertebrate, and plankton community. The Southeast Shoal has been designated primarily because of its importance as a spawning area for several commercial (American plaice, yellowtail flounder, capelin and Atlantic cod) and non-commercial (northern sand lance) fish species. For capelin, the EBSA contains a rare offshore spawning and aggregation area. It is also the single nursery area for the entire stock of yellowtail flounder. The Tail of the Grand Banks has been identified because it has the highest density of American plaice and yellowtail flounder on the Grand Banks. This area is also important to the benthic community, where offshore blue mussels and wedge clams have the highest benthic biomass on the Grand Bank. This is in addition to this EBSA being an area of high productivity and having the densest concentrations of the listed striped wolffish.

- *Lilly Canyon and Carson Canyon*: Key reasons for the identification of this EBSA include its importance as a feeding and high production area for Iceland scallops.

- *Northeast Shelf and Slope*: This EBSA has been identified as having the highest concentrations of Greenland halibut and spotted wolffish, which aggregate in this area in the spring.

- *Virgin Rocks*: This area includes high aggregations of capelin, as well as being a point of aggregation for several other spawning groundfish species such as Atlantic cod, American plaice and yellowtail flounder. The Virgin Rocks also are an area of relatively high macroalgae / seaweed abundance and diversity (R. Hooper, pers. comm.), although this has not been identified as a reason for EBSA designation.

- *Orphan Spur*: Corals occupy this EBSA as well as high densities of species of conservation concern (including Northern, Spotted and Striped wolffish, skates, roundnose grenadier, American plaice, redfish) and sharks.

- *Labrador Slope*: This area was designated for its biodiversity which include corals and sponges, several species of conservation concern (including Northern, Spotted and Striped wolffish, skates, roundnose grenadier) and high densities of Northern shrimp, American plaice, redfish, Atlantic cod and Greenland halibut.

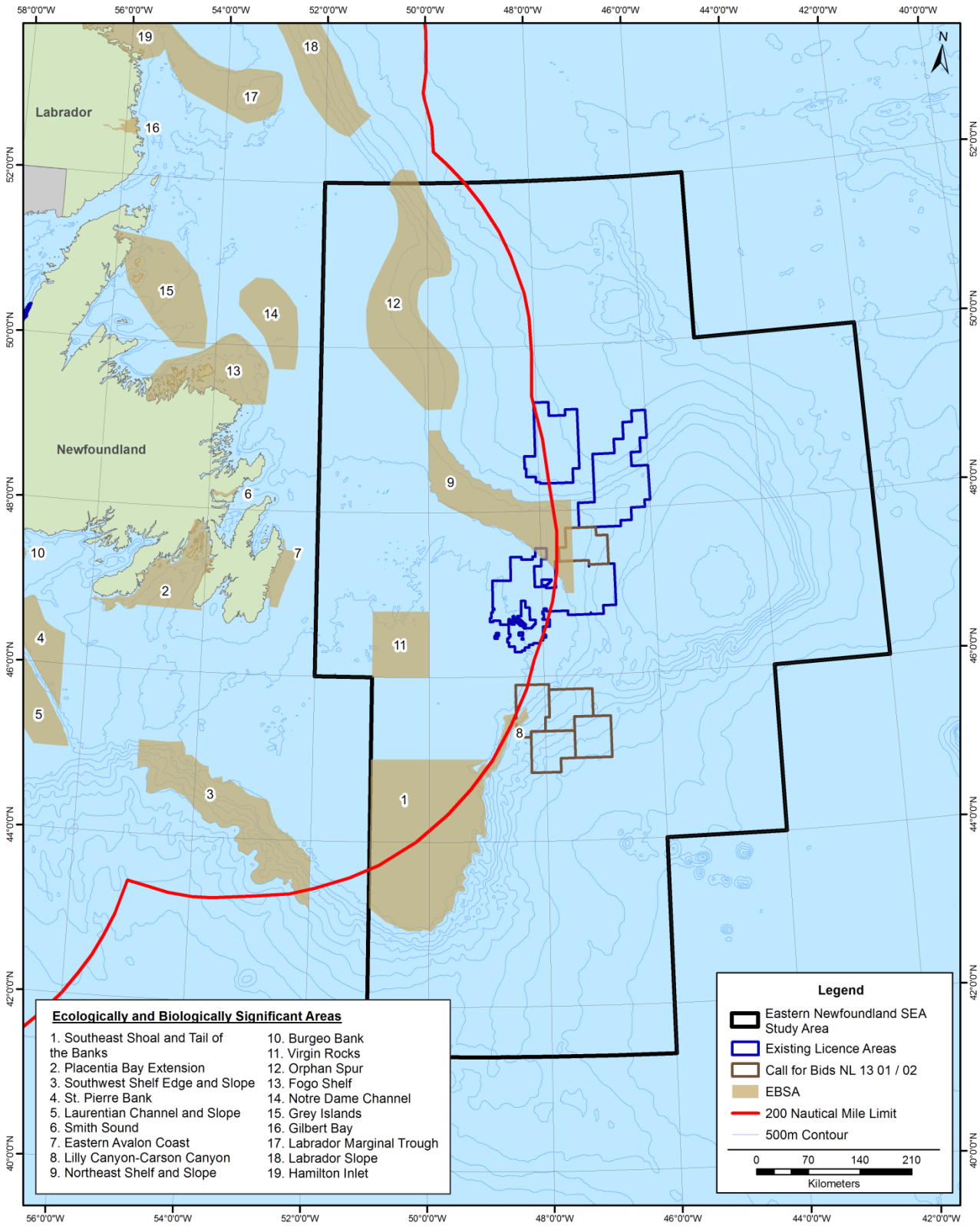
- *Southern Pack Ice*: Southern Pack Ice is an EBSA that occurs in the Study Area seasonally. While important to marine mammals and seabirds, there is no direct reason for sensitivity from a benthic invertebrate or marine fish perspective.

Other identified EBSAs in general proximity to the SEA Study Area (within 100 km) include those summarized in Table 4.69.

Table 4.69 Fish and Invertebrate Characteristics of Other EBSAs within Proximity of the SEA Study Area

EBSA Name	Description as it Relates to Benthic Invertebrates and Finfish	EBSA #
Southwest Shelf and Edge and Slope	*Benthic Invertebrates:* The area has structure-forming gorgonian corals in high concentrations and high concentrations of other cold-water corals *Finfish:* This area is important to finfish as a result of the following attributes: • Host to northernmost population of haddock in NW Atlantic Ocean, with highest concentrations along the SW slope • Key area for Atlantic halibut along SW slope during spring • Haddock spawning (along edge of SW slope in spring) • Important spawning area for redfish • Migration routes for cod • A greater portion of the biomass of most of the groundfish species present occurs along the SW slope • Monkfish, pollock, and white hake in region occur exclusively along the SW slope and within the Laurentian Channel with higher concentrations in the spring	3
Eastern Avalon Coast	• Identified only in relation to marine mammals and seabirds (see subsequent sections for details)	7
Fogo Shelf	• Finfish: The area is important for beach and subtidal spawning capelin and as a migratory path and feeding area for Atlantic salmon.	12
Notre Dame Channel	• Benthic invertebrates: High densities of snow crab and shrimp occur in this area. • Finfish: High finfish diversity including high densities of smooth and thorny skates as well as high densities of capelin, American plaice and Greenland halibut	14
From Templeman (2007) and DFO (2013)		

Figure 4.89 Ecologically & Biologically Significant Areas (EBSAs)



4.2.1.11 Other Ecologically Important Areas

As described above, a number of ecologically important habitats have been identified through the EBSA process and are also reflected in the designation of Vulnerable Marine Ecosystems based on sensitive coral areas and NAFO coral, seamount and sponge protection zones. NAFO also has several areas closed to shrimp trawling in the area of the Flemish Cap and the Nose of the Grand Banks (NAFO 2013).

Additional areas were also defined for the Orphan Basin area in that previous SEA (LGL Limited 2003) and include the following (Figure 4.90):

1) The “Bonavista Cod Box”, an important spawning and migration area for Atlantic cod, American plaice and redfish;

2) Enhanced production / important feeding areas, such as a) the slope of Northern Grand Banks; and b) high productivity frontal zone associated with the Labrador Current and on the continental slope, in the northern portions of the SEA Study Area; and

3) Various potential biophysical “zones” for planning purposes based on water depths: *Zone A*: Top Shelf (< 200 m); *Zone B*: Low Shelf (200 m to < 400 m); *Zone C*: Deep Break (400 m to < 2,000 m); *Zone D*: Deep Basin (2,000 m to 3,000 m); *Zone E*: Orphan Knoll (1,800 m to 2,000 m); and *Zone F*: Very Deep Basin (3,000 m to 4,000+ m).

Additional sensitive and special areas can be found in coastal areas outside of but adjacent to the SEA Study Area, where eelgrass beds serve as important fish nurseries (Cote et al 2013) and estuaries are important staging areas for diadromous species such as American eels and Atlantic salmon.

Ecologically important zones may also be reflected by their relatively high levels of faunal abundance, biomass and/or species richness. Canadian RV survey data indicate that important areas vary for each metric (Figures 4.91 to 4.93). For example, the relative abundance of fish (individuals) captured was relatively high on the northeast slope of the Grand Banks, the Bonavista Corridor and the northeast corner of the SEA Study Area. High biomass areas were also located in these areas, but the tail of the Grand Banks had particularly high concentrations of biomass. This divergence is likely at least partially explained by the biases associated with each measure. For example, the distribution of small bodied animals like shrimp can dominate abundance measures, but are less important in measures of biomass. However, many large-bodied groundfish (such as cod) occur on the Tail of the Grand Banks, where shrimp are scarce. Species richness was found to be particularly high along northern sections of the continental slope, but also saw elevated levels in the Bonavista Corridor and on the slope of the Flemish Cap.

Areas of high marine fish abundance, biomass and species richness often coincide with previously identified sensitive and special areas, including the Bonavista Corridor / Bonavista Cod Box (abundance, biomass and richness), some sensitive coral areas and NAFO coral protection zones (species richness, and the Southeast Shoal and Tail of the Grand Banks EBSA (biomass).

Figure 4.90 Ecologically Important Areas Identified in the Orphan Basin SEA (2003)

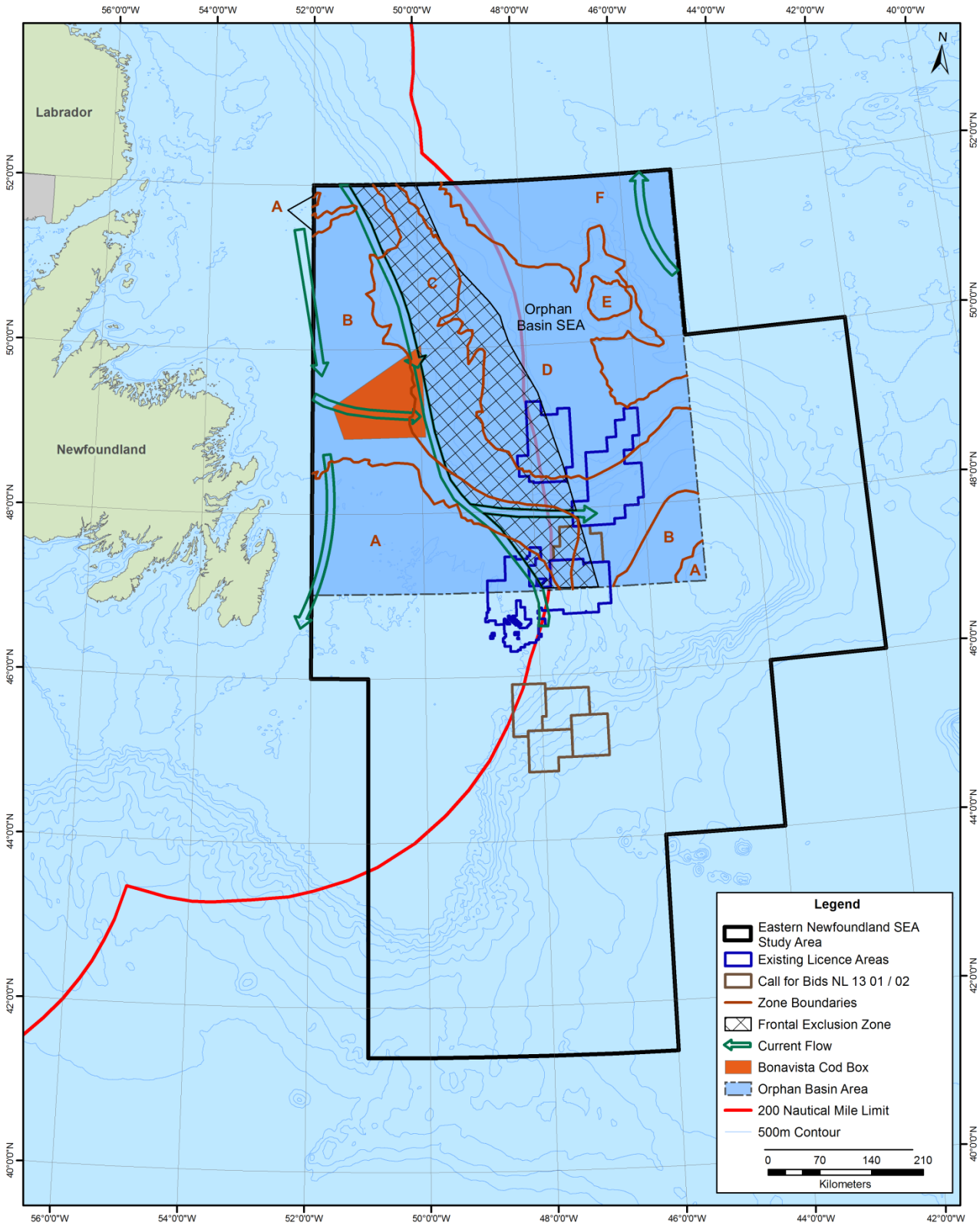


Figure 4.91 Areas of Relatively High Faunal Abundance as Identified by Canadian RV Surveys, 2005-2009 (Finfish and Invertebrates)

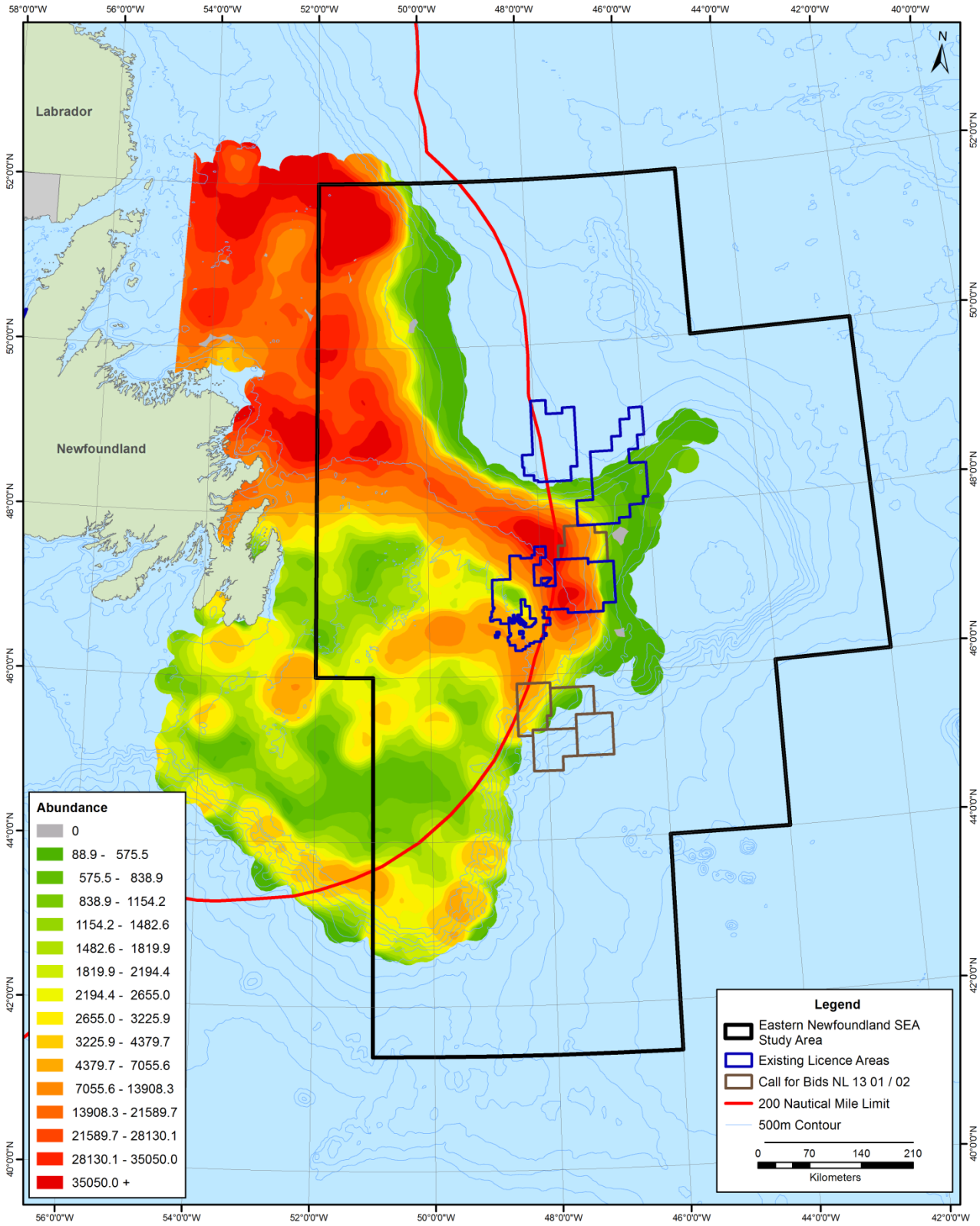


Figure 4.92 Areas of Relatively High Faunal Biomass as Determined by Canadian RV Surveys, 2005-2009 (Finfish and Invertebrates)

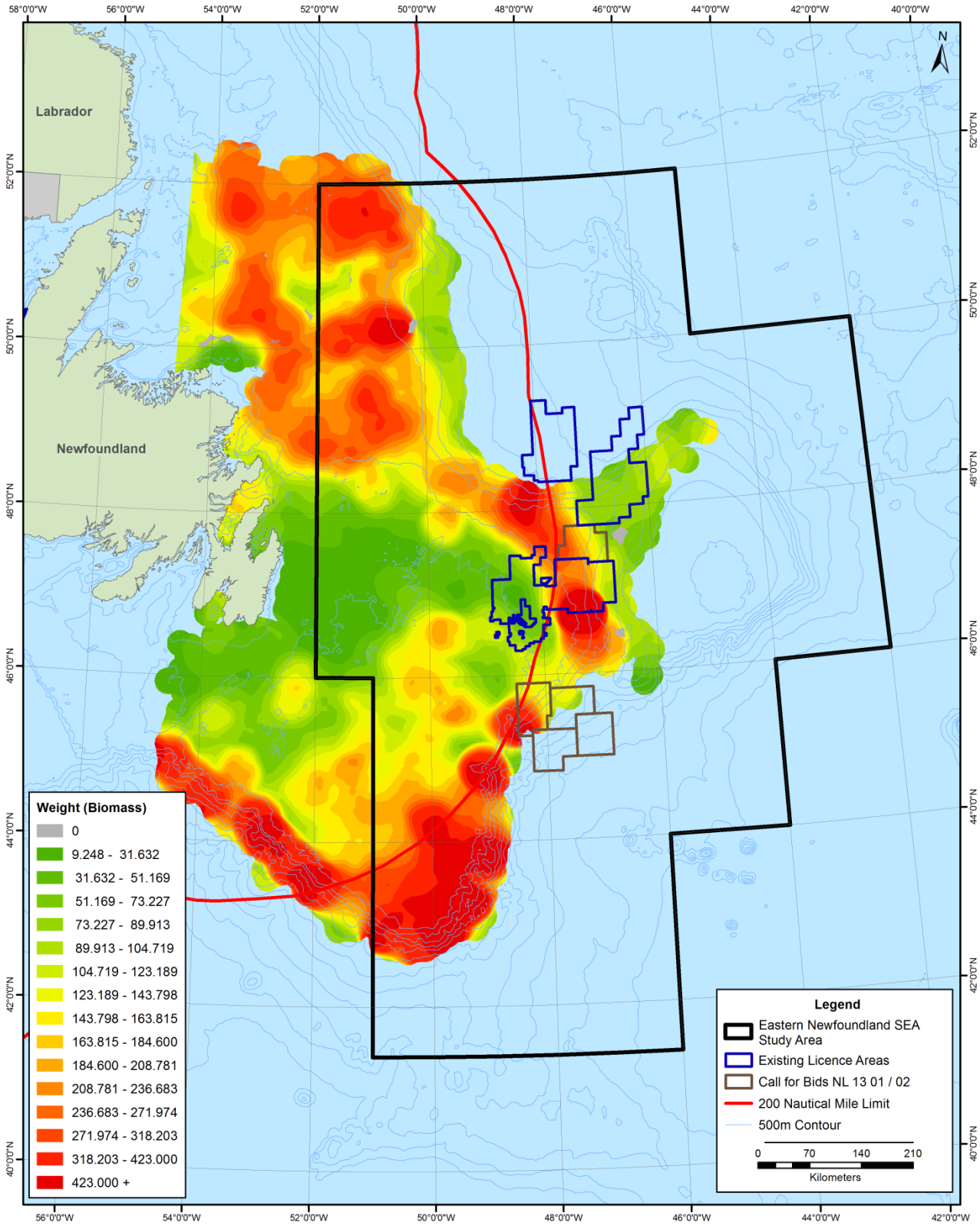
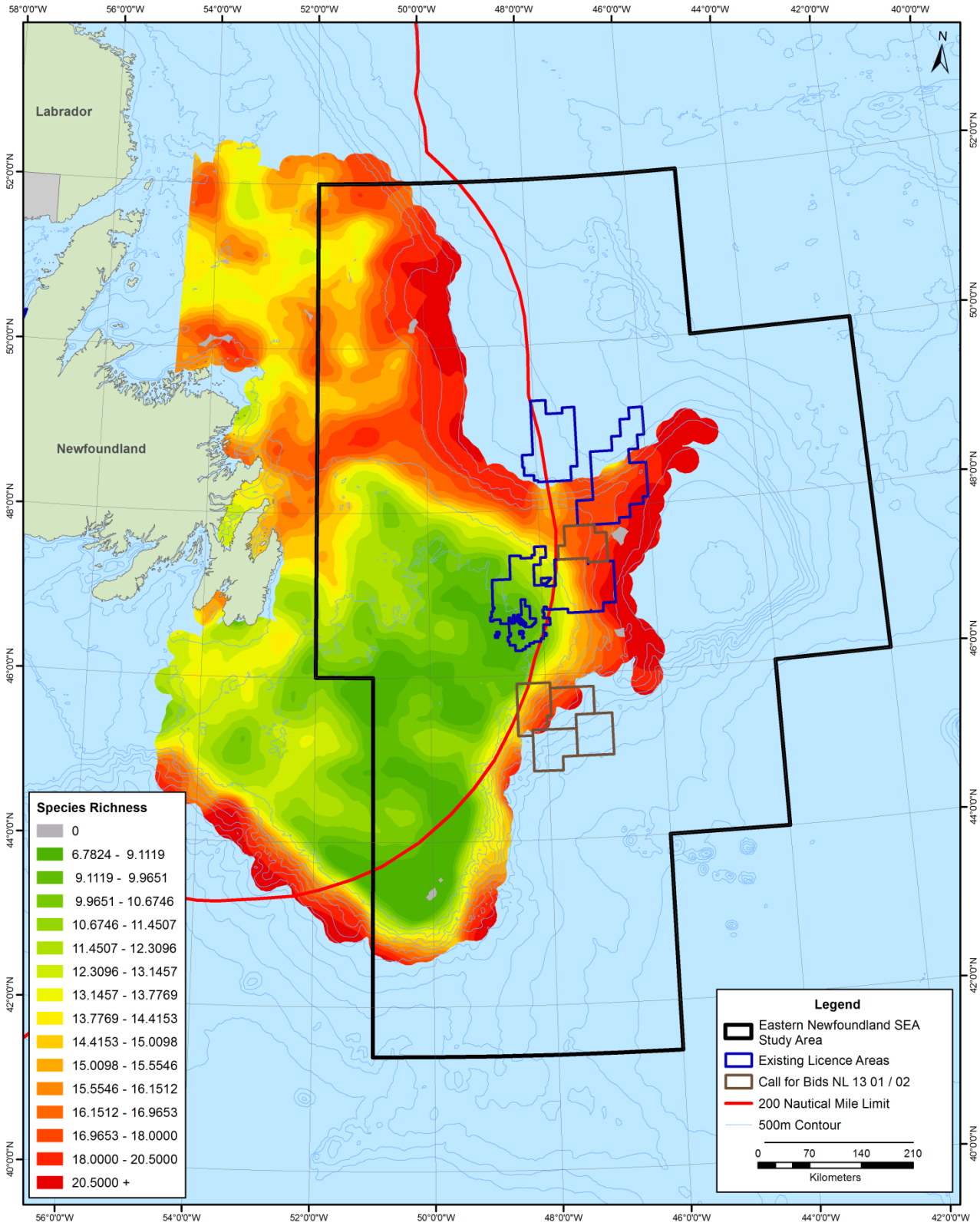


Figure 4.93 Areas of Relatively High Taxonomic Richness as Determined by Canadian RV Surveys, 2005-2009 (Finfish and Invertebrates)



4.2.2 Marine Birds

This section describes the overall presence, distribution and seasonal abundance of marine-associated bird species in the SEA Study Area. For the purposes of this discussion, these avifauna are grouped into several categories: 1) seabirds, 2) coastal waterfowl (including loons and grebes), 3) shorebirds, and 4) landbird species, including passerines. Seabirds, coastal waterfowl and shorebirds are considered to be the most vulnerable to perturbation as they spend much of their life in the marine environment, although some landbird species may also be affected, particularly those that are associated with coastal habitats.

Data on avian presence and abundance in and near the SEA Study Area were obtained from various sources. The Canadian Wildlife Service branch of Environment Canada (EC-CWS) was consulted for information on seabird colonies off Eastern Newfoundland, as well as for recent data on seasonal and spatial trends in seabird abundance from the Eastern Canadian Seabirds at Sea (ECSAS) program. Records from the Atlantic Canada Shorebird Survey (ACSS) and the Important Bird Areas (IBAs) of Canada programs provided further information on species presence and were used to identify avian "hotspots". Both the Wildlife Division and the Parks and Natural Areas Division of the Newfoundland and Labrador Department of Environment and Conservation were contacted for information on presence of endangered species in coastal habitats of Eastern Newfoundland, and the e-Bird database (e-Bird 2013) was consulted to obtain additional sightings information for rare species.

4.2.2.1 Seabirds

Seabirds are of high intrinsic ecological importance, often serving as indicators of ecosystem health. Furthermore, there are also typically of socioeconomic importance as a food source (especially, murres, known locally as "turrs") and in tourism, particularly in the Witless Bay and Cape St. Mary's Ecological Reserves. The nutrient-rich Grand Banks provide an extremely important feeding area for seabirds, and tens of millions of these birds representing numerous species nest off Eastern Newfoundland (Russell and Fifield 2001a,b; Fifield et al 2009a). Seabirds that occur in the marine waters off Eastern Newfoundland include cormorants, gannets, phalaropes, gulls, terns, alcids (auks), jaegers and skuas, and tubenoses (fulmars, petrels and shearwaters), each of which is discussed in turn below. Most seabird nesting in the area takes place on islands off the coast, although some species nest on inaccessible mainland cliffs or on sandy beaches and peninsulas. Generally speaking, seabirds occurring in the SEA Study Area are long-lived with low fecundity, delayed recruitment and low rates of population growth. Seabirds are present at the colonies throughout much of the year. Some species arrive at the colonies as early as February (Black-legged Kittiwakes) and March (Northern Gannet), and egg-laying commences in mid to late May and into June. The young of most species depart the colony by July to August, and as late as November for Northern Gannets.

EC-CWS has reinvigorated its efforts to monitor seabird species at sea, and in 2006 initiated the ECSAS program (Gjerdrum et al 2008; Fifield et al 2009b). According to data from Fifield et al (2009b), the largest concentration of seabirds in the SEA Study Area is from March to August. Seabirds are least abundant in the SEA Study Area in the fall (September - October), when most survey blocks had fewer than 10 birds per square kilometre.

Figures 4.94 to 4.97 (modified from Fifield et al 2009b) show the seasonal trends in abundance for all seabird species in the offshore seabird monitoring program data from 2006 to 2009. In these figures, the numbers represent the total seabird density within the 1 degree survey block (top) +/- standard

error (bottom), while one degree blocks without a coloured block were not surveyed. The seasonal trends observed largely correspond with earlier seabird survey data from Lock et al (1994). In both data sets, the geographical survey coverage was considerably greater in the spring and summer months than in the fall and winter. The ECSAS monitoring program is ongoing, and its Working Group is in the process of developing a publically available interactive online atlas of seabird density and distribution that will provide up-to-date information on the status of seabirds in the region (C. Gjerdrum, pers. comm.).

ECSAS data for the SEA Study Area from 2010 to 2013 were obtained from EC-CWS, and while these data cannot be used to calculate densities (as they have not been corrected for detectability, unlike the data in Fifield et al 2009b), they do provide additional information on seasonal and spatial trends in abundance for the different seabird groups. For groups that were commonly observed in the SEA Study Area, figures have been generated to illustrate these survey data for the spring (March-April), summer (May-August), fall (September-October) and winter (November-February) periods. It should be noted that the data are geographically limited, particularly in the fall months, as the survey program relies heavily on the use of vessels of opportunity rather than dedicated survey vessels.

Figure 4.94 Distribution and Seasonal Abundance of Seabirds (March-April)

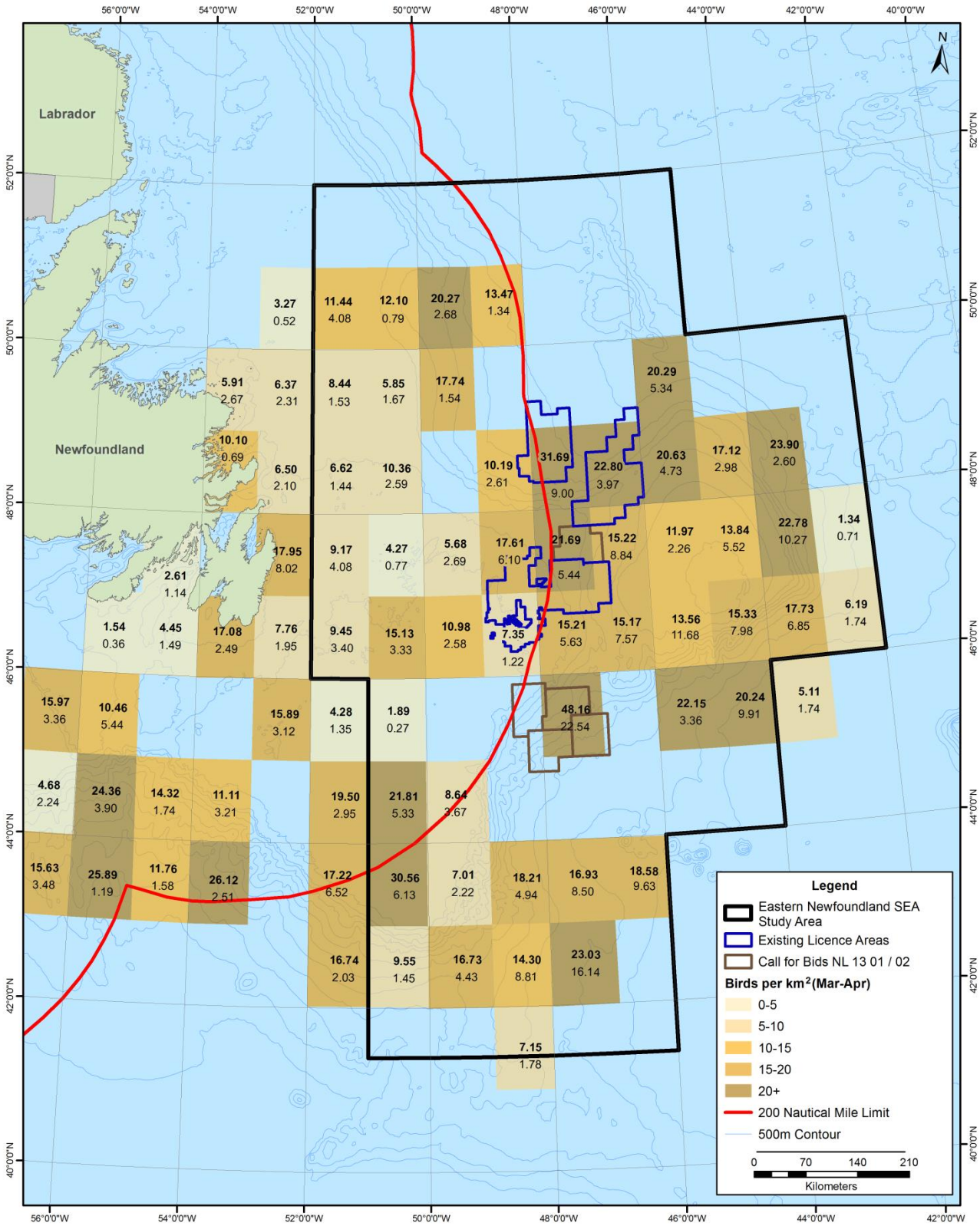


Figure 4.95 Distribution and Seasonal Abundance of Seabirds (May-August)

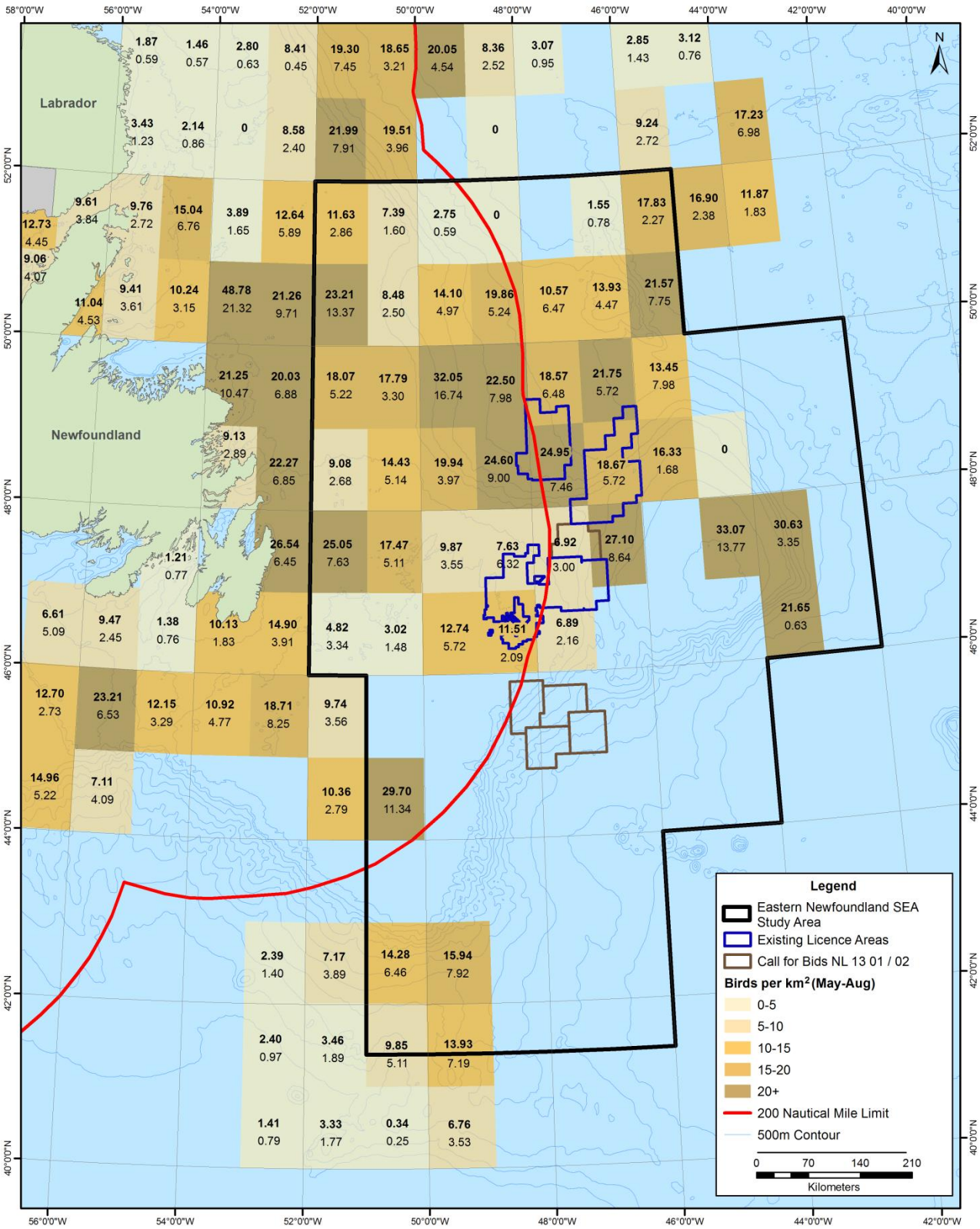


Figure 4.96 Distribution and Seasonal Abundance of Seabirds (September-October)

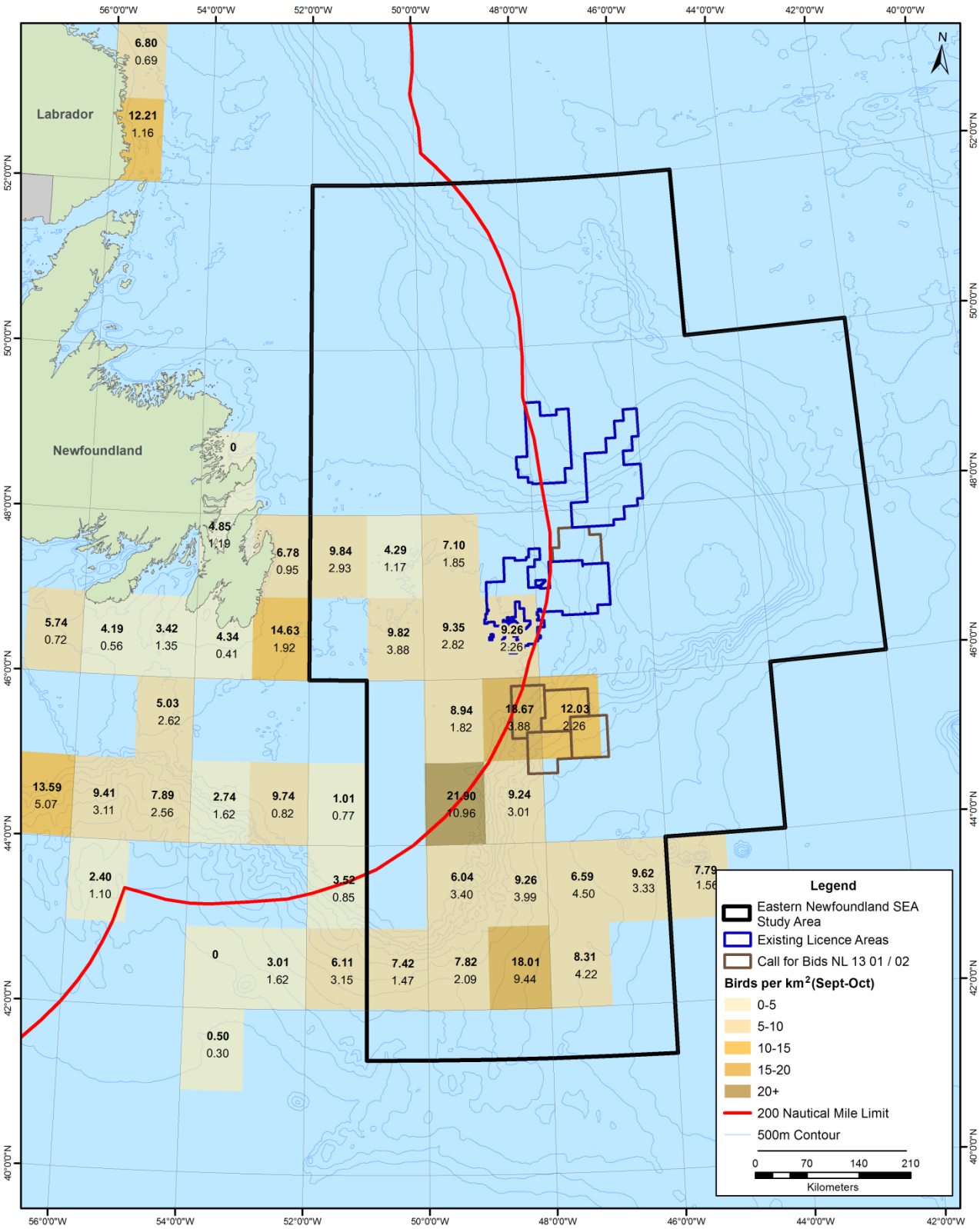
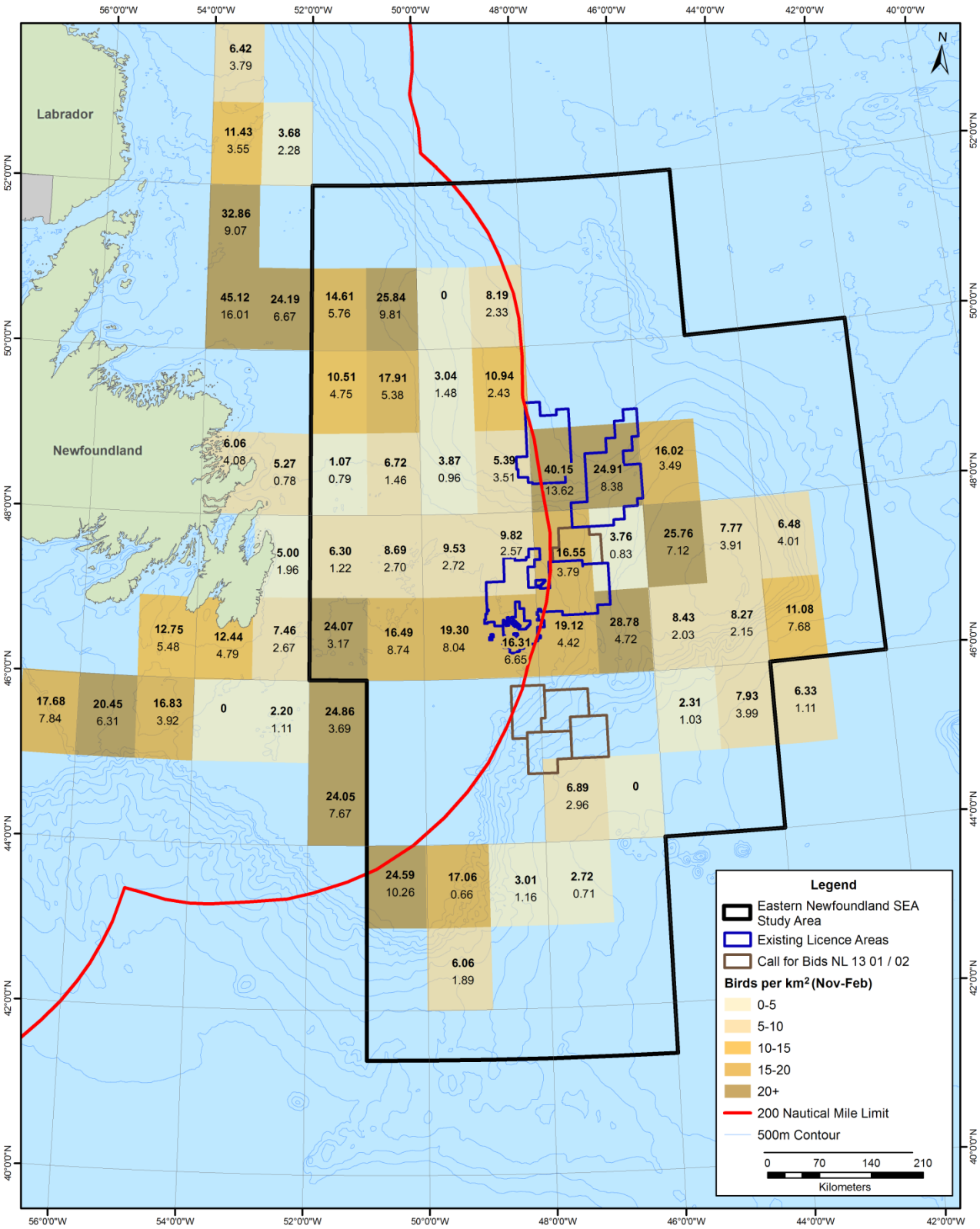


Figure 4.97 Distribution and Seasonal Abundance of Seabirds (November-February)



Cormorants

The cormorant family is represented by two species in the SEA Study Area. Table 4.70 summarizes the habits, habitats and key life history characteristics of these cormorant species.

Table 4.70 Overview of Cormorant Species Occurring in the SEA Study Area

Cormorants (*Phalacrocoracidae*)	Summary	Reference(s)
Description	• Large-bodied, long-necked black seabirds with colourful bare facial patches. • Long-lived colonial seabirds. • Two species found in SEA Study Area: Double-crested Cormorant and Great Cormorant. • Great Cormorant is widespread along the eastern coast of North America, while Double-crested is found on east and west coasts as well as inland. • Both species are secure in Canada. Double-crested Cormorant populations have increased significantly since 1970.	Hatch and Weseloh (1999); Hatch et al (2000); Environment Canada (2011)
Habitats and Movements	• Coastal species; typically found in shallow (< 8 m) waters. • Arrive at breeding territory in early spring • North Atlantic populations of Double-crested Cormorants migrate south in late fall • Great Cormorants are partial migrants, with some individuals remaining within the breeding range year round.	Hatch and Weseloh (1999); Hatch et al (2000)
Reproduction	• Nests may be constructed on cliffs, artificial platforms, rocky ground, shrubs or trees. • Begin to breed at 3 (sometimes 2) years of age. • Mean clutch size: 4 eggs (range 1-7). • Great Cormorant: Egg-laying begins in mid-April. Chick rearing takes place from mid-May until mid-August. • Double-crested Cormorant: Egg-laying begins in early May. Chick rearing is from early June until late August. • Number of fledglings per breeding pair for populations in eastern Canada range from 0.98 - 2.35 (Double-crested) and 1.2 - 1.97 (Great).	Hatch and Weseloh (1999); Hatch et al (2000)
Foraging Strategy and Food Sources	• Feed by pursuit diving to depths of up to 35 m, though typically 10 m or shallower • Prey on a wide variety of small fish (typically < 20 cm) and invertebrates, predominantly marine bottom species	Hatch and Weseloh (1999); Hatch et al (2000)

As with all seabird species, breeding colonies are particularly sensitive areas for populations. Although Double-crested Cormorants have a wide breeding distribution in Newfoundland, the breeding range of Great Cormorants is restricted to the south and southwest coast of the Island (Cairns et al 1989). In Southeastern Newfoundland, both Great and Double-crested Cormorants are reported to nest at Cape St. Mary's (IBA 2013). A coastal species seldom found in deep waters, cormorants were only rarely observed in the ECSAS surveys in the waters off Eastern Newfoundland (ECSAS 2013).

Gannets

A single gannet species, the Northern Gannet, is found in the SEA Study Area. Table 4.71 summarizes the habits, habitats and key life history characteristics of the Northern Gannet.

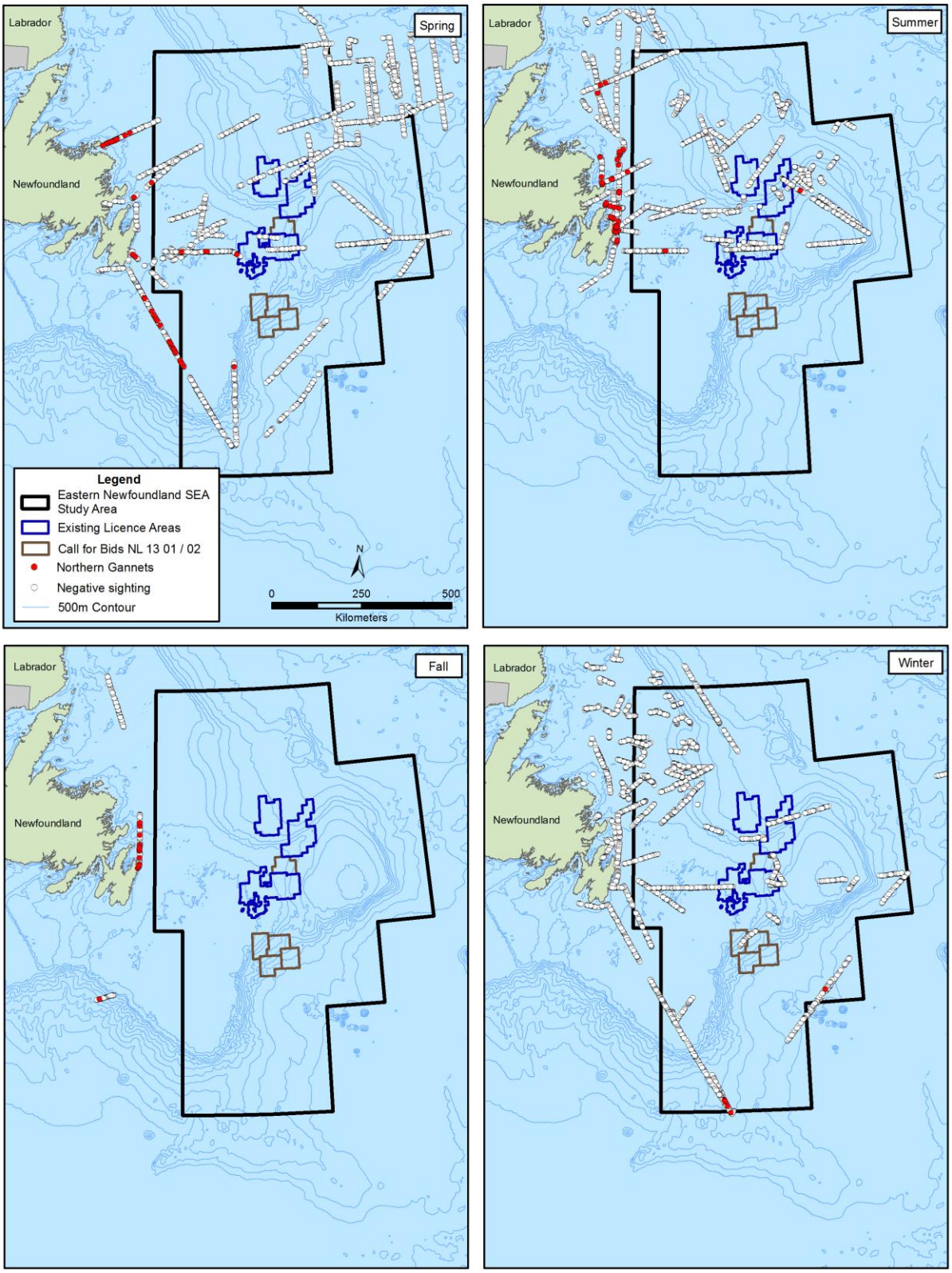
Table 4.71 Overview of Gannet Species Occurring in the SEA Study Area

Gannets (*Sulidae*)	Summary	Reference(s)
Description	• Northern Gannet is a large-bodied seabird with long neck and large, bluish bill. Adult plumage is white with yellowish-buff wash on head and neck, black wing tips. Long-lived colonial seabird. • Entire Northwest Atlantic breeding population is confined to six colonies in eastern Newfoundland and Québec. Winter range extends along the eastern coast of the United States, as far as northern Mexico. • Gannets are secure in Canada, with a steadily increasing population of between 200,000 and 300,000 breeding adults.	Mowbray (2002); Environment Canada (2011)
Habitats and Movements	• Gannets typically inhabit continental shelf waters at all times of the year. • Adults arrive at breeding territory in mid-March, followed a few weeks later by subadults. • Juvenile gannets begin a southward migration in September. Adults and older immatures may travel north from the breeding colonies in order to feed along the Labrador Coast before beginning southward migration. • Winter range is south of the SEA Study Area, extending from the Gulf of Maine as far south as Mexico.	Mowbray (2002)
Reproduction	• Nests in dense colonies on cliff ledges, typically on islands, but occasionally inaccessible mainland areas. • Age at first breeding between 4 and 7 years. • Clutch size: 1 egg. • Egg-laying begins in mid-May. Chick rearing takes place from late June until early October. • Number of fledglings per year per breeding pair: 0.81.	Mowbray (2002); Montevecchi and Porter (1980)
Foraging Strategy and Food Sources	• Feeds by deep plunge diving from a height of 10 - 40 metres above the surface. • Large flocks (up to 1000 birds) may congregate over shoals of food fish. • Descends to depths of up to 15 m. • During breeding season, may travel up to 180 km from breeding colony to forage. • Preys on shoaling fish, predominantly herring, mackerel and capelin, as well as invertebrates such as squid.	Mowbray (2002); Montevecchi and Porter (1980)

Northern Gannets breed in Eastern Newfoundland, with three large colonies situated in Funk Island, Baccalieu Island and Cape St. Mary's (EC-CWS 2013; IBA 2013). Gannets are common off Eastern Newfoundland in the spring, summer and fall, and are absent in winter (Husky Energy 2000). In the summer months, areas of high prey density where individuals may forage in groups of more than 1,000 are particularly sensitive for this species. During the 2006 - 2009 ECSAS summer surveys, the largest concentration of gannets was found near the breeding colonies in the spring and summer months,

typically close to shore in Southern and Eastern Newfoundland. In September and October, gannets were more common in the southern portion of the survey area, and uncommon in the SEA Study Area itself (Fifield et al 2009b). Similar seasonal trends for gannets in the SEA Study Area were observed in ECSAS sightings data from 2010 to 2013 (Figure 4.98), with the majority of gannet observations occurring in the spring and summer months and relatively close to shore at most times of year.

Figure 4.98 Seasonal Distribution of Northern Gannet Observations



Phalaropes

The Red Phalarope and Red-necked Phalarope are occasionally encountered in the SEA Study Area. Although taxonomically aligned with shorebirds such as sandpipers and plovers (Family: *Scolopacidae*), the phalaropes that occur in the region are pelagic outside of the breeding season (Table 4.72), and so are grouped with the seabirds for the purposes of this discussion.

Table 4.72 Overview of Phalarope Species Occurring in the SEA Study Area

Phalaropes (*Scolopacidae*)	Summary	Reference(s)
Description	• Two species occur offshore in the SEA Study Area, the Red Phalarope and the Red-necked Phalarope. • Among the smallest seabirds, phalaropes are unusual in that they display reverse sexual dimorphism, females being larger and more brightly coloured than males. • Both species breed throughout the Arctic and winter in offshore waters, mostly in tropical and sub-tropical regions. • Red-necked Phalarope populations have decreased slightly, while insufficient data exists to determine population trends for Red Phalaropes. Both species are estimated to have a population of over 1,000,000 adults in Canada.	Rubega et al (2000); Tracy et al (2002); Environment Canada (2011)
Habitats and Movements	• Phalaropes spend most of the year offshore, coming on land only during the summer months to breed. • Found in Arctic tundra during breeding season. • Typically spend winter along offshore ocean fronts, where upwellings are associated with higher prey densities.	Rubega et al (2000); Tracy et al (2002)
Reproduction	• Ground nester, lays eggs in short vegetation (e.g. sedges, mossy hummocks) typically close to fresh water. • Male is sole provider; female leaves shortly after egg laying. • Typically breed in first year. • Clutch size: typically 4. • Egg-laying begins in late May to early June. Chick rearing takes place from mid-July until early September. • Number of fledglings per year highly variable depending on predator populations; average believed to be approximately 10 percent in Canada for the Red Phalarope.	Rubega et al (2000); Tracy et al (2002)
Foraging Strategy and Food Sources	• Phalaropes employ a unique surface feeding strategy whereby they spin in tight circles on the water surface, churning prey upwards to within reach. • Feed on zooplankton and small aquatic invertebrates.	Rubega et al (2000); Tracy et al (2002)

Both phalarope species are absent from the region in winter, and uncommon or scarce in all other seasons (Husky Energy 2000). In vessel-based surveys conducted in the SEA Study Area from 2010 to 2013, phalaropes were reported in small numbers between May and December, but absent for the rest of the year (ECSAS Database 2013). The waters just offshore from Cape Spear are reportedly a good place to see both species during their fall migration (Environment Canada 2009). Individuals that

are present are likely to congregate in areas where prey items are most readily available, such as along ocean fronts and around upwellings, and it is in these areas where phalaropes are most vulnerable to disturbance.

Gulls

Several species of gulls occur in the SEA Study Area throughout the year, including three species that are known to breed in Eastern Newfoundland (Table 4.73).

Table 4.73 Overview of Gull Species Occurring in the SEA Study Area

Gulls (*Laridae*)	Summary	Reference(s)
Description	• Nine species occur in the SEA Study Area: Herring Gull, Iceland Gull, Glaucous Gull, Great Black-backed Gull, Ring-billed Gull, Black-headed Gull, Sabine's Gull, Ivory Gull and Black-legged Kittiwake. • One species, the Ivory Gull, is considered at risk at the federal and provincial level. This species has suffered a large decrease in numbers since 1970, with an estimated population of 500 - 1000 pairs in Canada. • There are insufficient data to estimate Sabine's Gull population trends. Glaucous Gulls are in global decline and are known to occur in the Eastern Newfoundland offshore area. Regional data concerning Glaucous Gulls are sparse, but it is likely that this species is in decline in the SEA Study Area as well. Further research is required. However, all other species are considered secure.	Gilchrist (2001); Good (1998); Pierrotti and Good (1994); Snell (2002); Mallory et al (2008); Pollet et al (2012); Day et al (2001); Fifield et al (2009b); Warkentin and Newton (2009); Environment Canada (2011)
Habitats and Movements	• Iceland, Glaucous, Ivory and Sabine's breed in the Arctic; Iceland and Glaucous occur in offshore and coastal areas outside the breeding season, while Ivory and Sabine's are restricted to offshore waters the rest of the year. • Herring, Great Black-backed, Ring-billed and Black-headed Gulls, as well as Black-legged Kittiwakes, are found in temperate areas year-round.	Fifield et al (2009b); Gilchrist (2001); Good (1998); Pierrotti and Good (1994); Snell (2002); Mallory et al (2008); Pollet et al (2012); Day et al (2001)
Reproduction	• Most species are ground nesters, although Black-legged Kittiwake breeds on cliffs. • Typically begin to breed at between 3 and 7 years of age • Clutch size: typically 2-3. • Egg-laying begins in late May to early June. Chick rearing takes place from mid-June to late August for Herring and Great Black-backed Gulls, and to late September for Black-legged Kittiwakes.	Gilchrist (2001); Good (1998); Pierrotti and Good (1994); Snell (2002); Mallory et al (2008); Pollet et al (2012); Day et al (2001)
Foraging Strategy and Food Sources	• Surface feeders. • Feed on invertebrates (cephalopods and crustaceans) and fish, as well as offal. • Large gulls including Herring and Great Black-backed also prey on eggs, young, and occasionally adults of other seabird species.	Gilchrist (2001); Good (1998); Pierrotti and Good (1994); Snell (2002); Mallory et al (2008); Pollet et al (2012); Day et al (2001)

Herring Gulls, Great Black-backed Gulls and Black-legged Kittiwakes breed in many locations, in colonies along the coastal reaches of the SEA Study Area (EC-CWS 2013). Ring-billed Gulls are known to breed in the Cabot Island and Wadham Islands Important Bird Areas (Warkentin and Newton 2009).

According to Husky Energy (2000), Herring and Great Black-backed Gulls are considered common in and around the SEA Study Area year-round (although Herring Gulls tend to be found closer to land; Fifield et al 2009b). Iceland and Glaucous Gulls are absent in summer and uncommon in the spring; in the fall and winter months, Iceland Gulls are common and Glaucous uncommon (Husky Energy 2000). Collectively, large gulls (including Herring, Iceland, Glaucous and Great Black-backed) tend to be more common closer to shore in the summer months, when breeding individuals return to their coastal colonies (Fifield et al 2009b; Figure 4.99); outside of the breeding season, they are more widespread, but the highest concentrations occur at the Nose and Tail of the Grand Banks where fishing activity is also high (Fifield et al 2009b).

Black-legged Kittiwakes are highly pelagic compared with the larger gulls, and are commonly observed in the SEA Study Area year-round (Husky Energy 2000; Fifield et al 2009b; Figure 4.100). Like the large gulls, they also tend to be more concentrated near the breeding colonies in spring and summer months, but are also abundant near the edge of the continental shelf and in the Orphan Basin (Fifield et al 2009b).

Ivory Gull and Sabine's Gull are high Arctic species which are occasionally found in offshore waters of the SEA Study Area. The former is absent off the coast of eastern Newfoundland in the summer and occurs only rarely in other seasons, while the latter is a rare autumn visitor (Husky Energy 2000).

Figure 4.99 Seasonal Distribution of Large Gull Observations

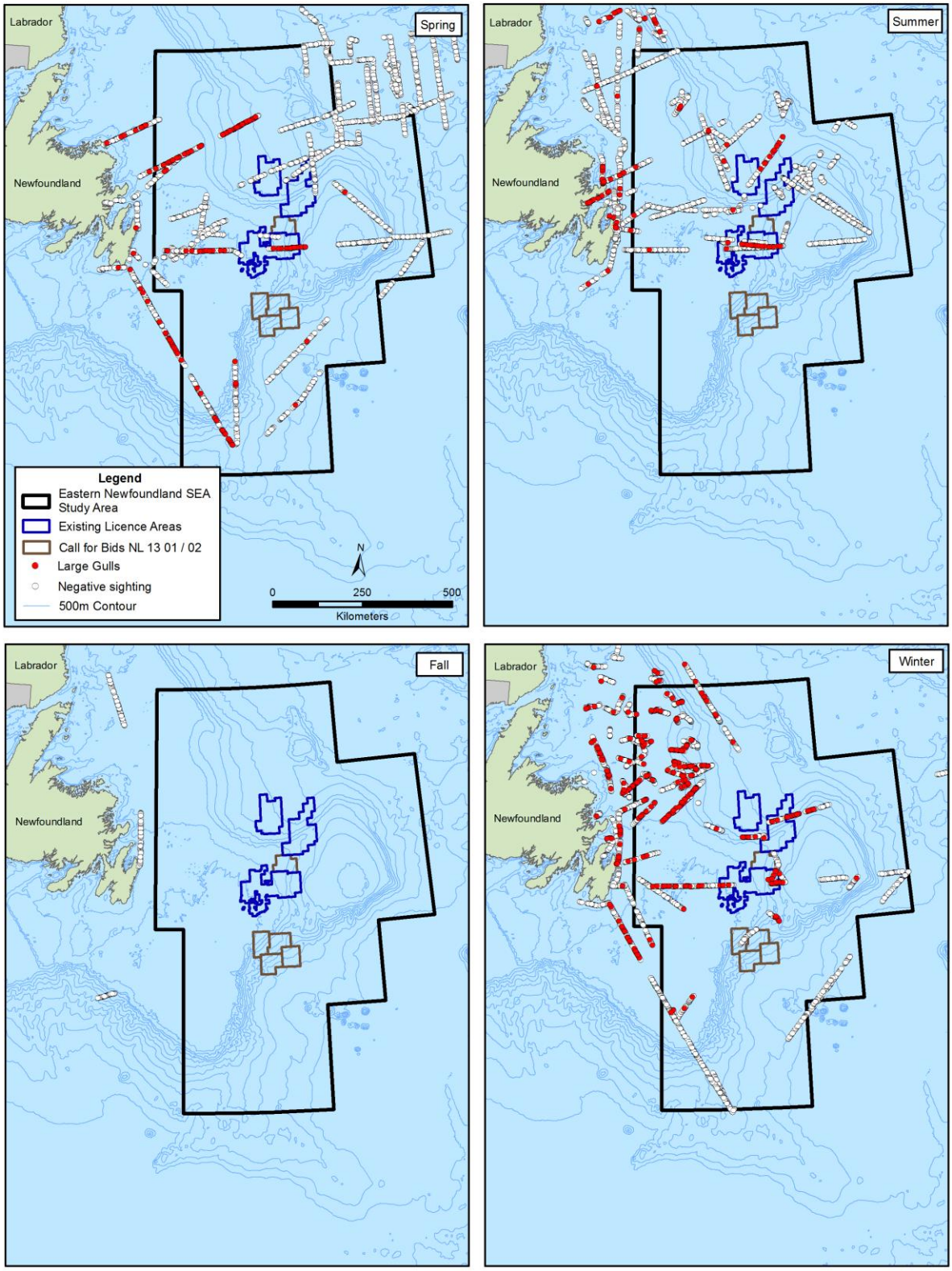
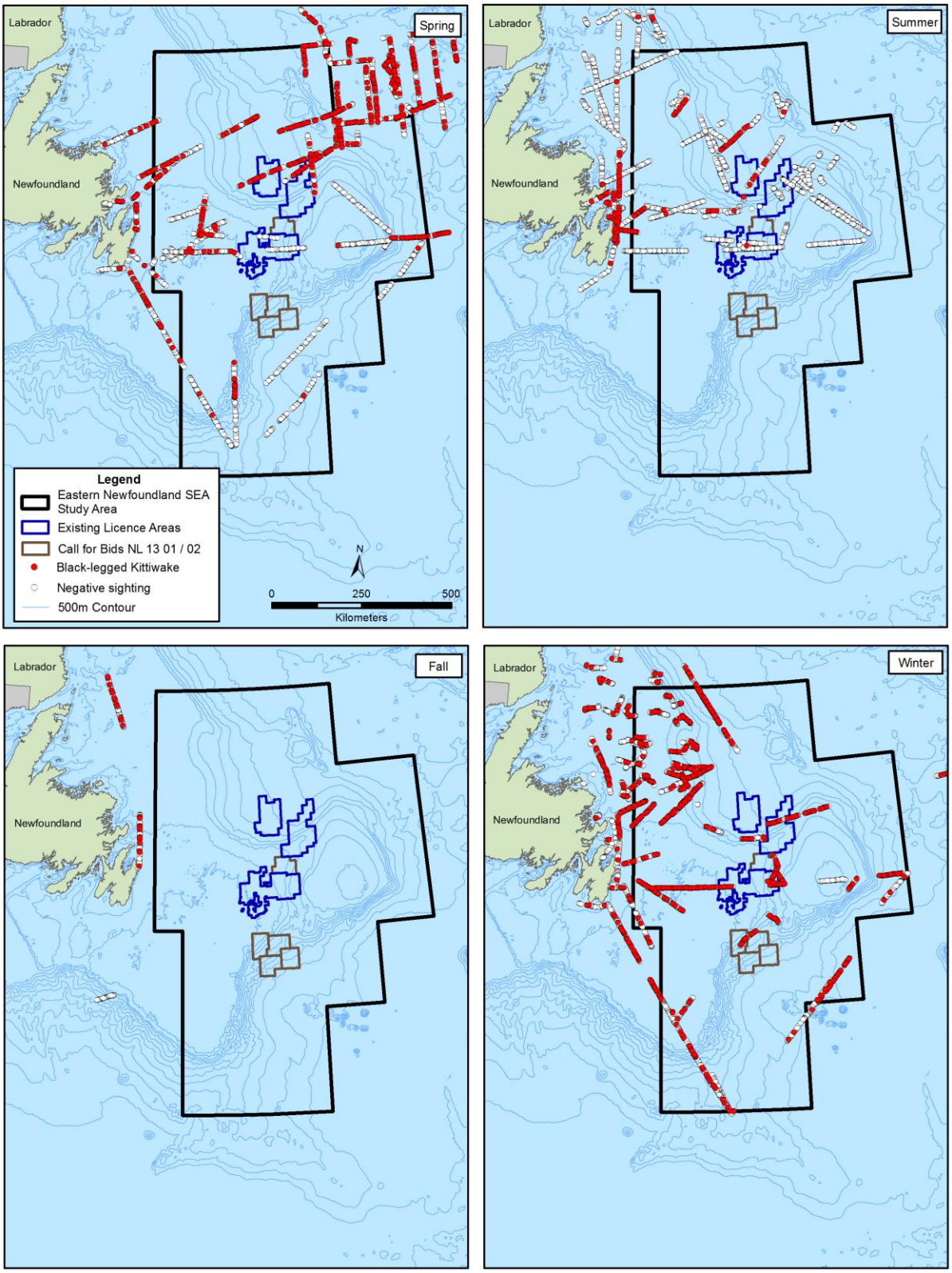


Figure 4.100 Seasonal Distribution of Black-legged Kittiwake Observations



Terns

Three tern species are known to occur in Eastern Newfoundland. Table 4.74 presents information on the habits, habitats and key life history characteristics of tern species in the SEA Study Area.

Table 4.74 Overview of Tern Species Occurring in the SEA Study Area

Terns (*Sternidae*)	Summary	Reference(s)
Description	• Three species occur in the SEA Study Area: Common Tern, Arctic Tern and Caspian Tern. • Widely distributed throughout North America, although the Caspian Tern is locally uncommon. • Populations are considered stable in Canada, with little change since the 1970s, at between 100,000 and 200,000 individuals for Common and Arctic Terns. Caspian Tern populations are somewhat smaller.	Hatch (2002); Nisbet (2002); Cuthbert and Wires (1999); Environment Canada (2011)
Habitats and Movements	• Breed in northern North America, often on islands and typically in areas with sand or low vegetation. • Found in coastal and offshore waters. • Arctic Terns undertake long migrations to the waters off of Antarctica, while Common and Caspian Terns winter in Central and South America.	Hatch (2002); Nisbet (2002); Cuthbert and Wires (1999)
Reproduction	• Ground nester. • Begin to breed at 2 to 4 years of age. • Clutch size: 1 - 3 eggs. • Egg-laying begins in early June. Chick rearing takes place from mid-July until early August. • Number of chicks fledged per pair varies between 0.59 and 2.0 in different studies.	Hatch (2002); Nisbet (2002); Cuthbert and Wires (1999)
Foraging Strategy and Food Sources	• Surface feeding and pursuit plunging. • Feed on fish and small crustaceans.	Hatch (2002); Nisbet (2002); Cuthbert and Wires (1999)

Terns are most vulnerable to perturbation during the breeding season, and near their colonies. The Wadham Islands and Cabot Island are known to support large colonies of Common and Arctic Terns (Russell and Fifield 2001a), and Caspian Terns also reportedly breed there (Warkentin and Newton 2009). Common and Arctic Terns also nest in several colonies within the Terra Nova National Park and on Green Island off the Burin Peninsula (IBA 2013). Terns are uncommon off Eastern Newfoundland in spring and summer, but generally rare in fall and absent in winter (Husky Energy 2000). During the ECSAS surveys in the waters off Eastern Newfoundland, terns were seldom observed.

Alcids

Six alcid species utilize the waters off of Newfoundland during at least part of the year, five of which are known to breed in the SEA Study Area (Table 4.75).

Table 4.75 Overview of Alcid Species Occurring in the SEA Study Area

Alcids (*Alcidae*)	Summary	Reference(s)
Description	• Six species occur in the SEA Study Area: Dovekie, Razorbill, Common Murre, Thick-billed Murre, Atlantic Puffin and Black Guillemot. • Alcids are heavy-bodied and proportionately small winged black-and-white birds of the northern hemisphere. • Distribution of alcids in eastern North America is from the high arctic to north of the Carolinas. • Alcid populations are considered secure, with many species showing slight increases in number in recent years.	Ainley et al (2002); Gaston and Hipfner (2000); Butler and Buckley (2002); Lowther et al (2002); Lavers et al (2009); Fifield et al (2009b); Environment Canada (2011)
Habitats and Movements	• Breed on offshore islands or inaccessible cliffs, away from terrestrial predators. • Typically found in offshore waters outside the breeding season; however, Black Guillemot tends to prefer more coastal environments, often close to breeding colonies. • Dovekie is a largely arctic species that ranges into offshore eastern Canada only in winter.	Ainley et al (2002); Gaston and Hipfner (2000); Butler and Buckley (2002); Lowther et al (2002); Lavers et al (2009)
Reproduction	• Cliff nesters and cavity nesters in inaccessible (typically island) colonies. • Typically breed at 2 years or older. • Clutch size: 1 for most species; 2 for Black Guillemot • Egg-laying begins in May to early June. Chick rearing takes place from mid-June until late August. • For Razorbills and the two murre species, instead of “fledging” in the typical sense, the chick departs the colony with the male parent; father and offspring remain together for several weeks before the chick attains independence. • Number of fledglings per breeding pair varies from 0.26 - 0.72 for Black Guillemot, and from around 0.40 to 0.60 for Atlantic Puffins (in eastern Newfoundland studies). Successful nest departures per breeding pair range from 0.65 - 0.75 for the Razorbill, from 0.35 - 0.85 for Common Murres (the *aalge* subspecies found in Newfoundland), and 0.48 - 0.79 for Thick-billed Murres in the Atlantic. Factors affecting breeding success include food availability, weather and parental experience.	Ainley et al (2002); Gaston and Hipfner (2000); Butler and Buckley (2002); Lowther et al (2002); Lavers et al (2009)
Foraging Strategy and Food Sources	• Feed by pursuit diving. • Primary food source for alcids in Newfoundland is small fish such as capelin and sandlance; also take some invertebrates such as copepods.	Ainley et al (2002); Gaston and Hipfner (2000); Butler and Buckley (2002); Lowther et al (2002); Lavers et al (2009)

Amongst seabirds, alcids (particularly murres) are considered to be particularly vulnerable to the effects of oil spills, because they spend a large proportion of their time on the water relative to more aerial species (Fifield et al 2009a). They are most vulnerable at sea in the winter months, when they spend the greatest proportion of their time on the water, and in fact they are rendered flightless for a period of several weeks during their winter moult (Gaston and Hipfner 2000). The coast of Eastern Newfoundland supports numerous alcid colonies, the largest being at Funk Island, Baccalieu Island, the Witless Bay islands and Cape St. Mary's (EC-CWS 2013). During the summer months, alcids tend to be most abundant in the waters near the colonies.

In the waters of the SEA Study Area, Black Guillemots are considered common year-round, while Common Murre and Atlantic Puffin are scarce in winter and common the rest of the year (Husky Energy 2000). Dovekies are common in the fall and winter months, uncommon in spring, and were reportedly absent from the SEA Study Area in the summer months year (Husky Energy 2000), although recent survey data indicate that this is not the case (Fifield et al 2009b; Figure 4.101). Thick-billed Murre is scarce in the summer months and common throughout the rest of the year. Razorbill is considered rare in the winter months and scarce throughout the rest of the year (Husky Energy 2000).

In recent surveys conducted in the SEA Study Area, alcids were the most commonly observed group at all times of year (Fifield et al 2009b; ECSAS Database 2013). In the spring and summer, Dovekies (although uncommon overall) were most concentrated along the continental shelf, although their distribution was more widespread in the fall and winter (Fifield et al 2009b). Murres were abundant throughout the SEA Study Area at all times of year, with the majority of survey blocks containing 1 - 10 birds/km^2; in the summer months. The greatest concentrations were seen in coastal waters near the breeding colonies, while in the winter, the Grand Banks had the greatest murre concentrations (Fifield et al 2009b). Murre abundance was relatively low in areas with water depths greater than 1,000 m (Fifield et al 2009b; Figure 4.102). Other alcids, including Atlantic Puffin, Razorbill and Black Guillemot as well as alcid species that could not be positively identified in the field, were most abundant closest to the breeding colonies. In the fall and winter, the highest densities were found close to shore in Eastern Newfoundland, and on the Grand Banks and Northeast Newfoundland shelf (Fifield et al 2009b; Figure 4.103).

Figure 4.101 Seasonal Distribution of Dovekie Observations

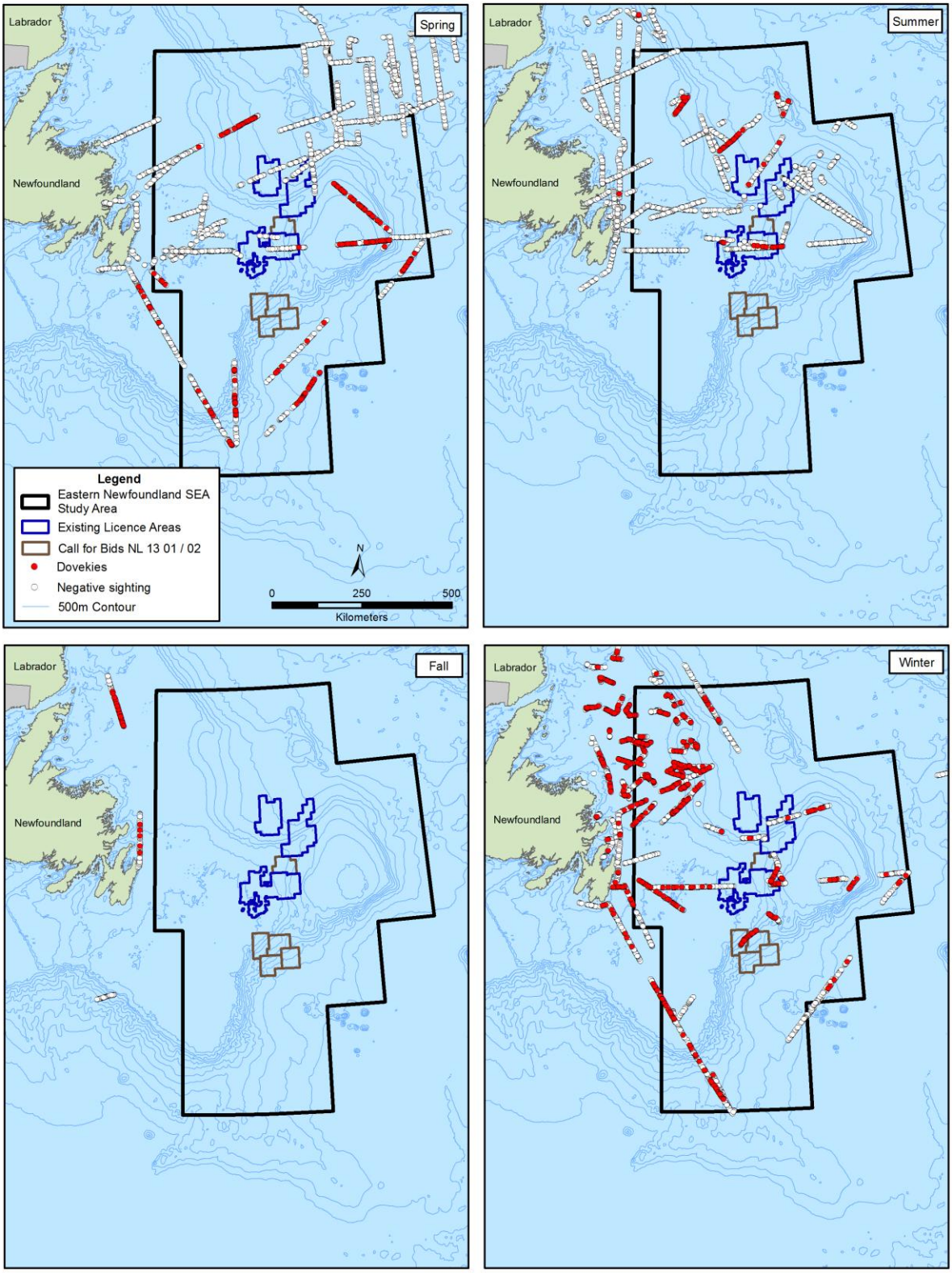


Figure 4.102 Seasonal Distribution of Murre Observations

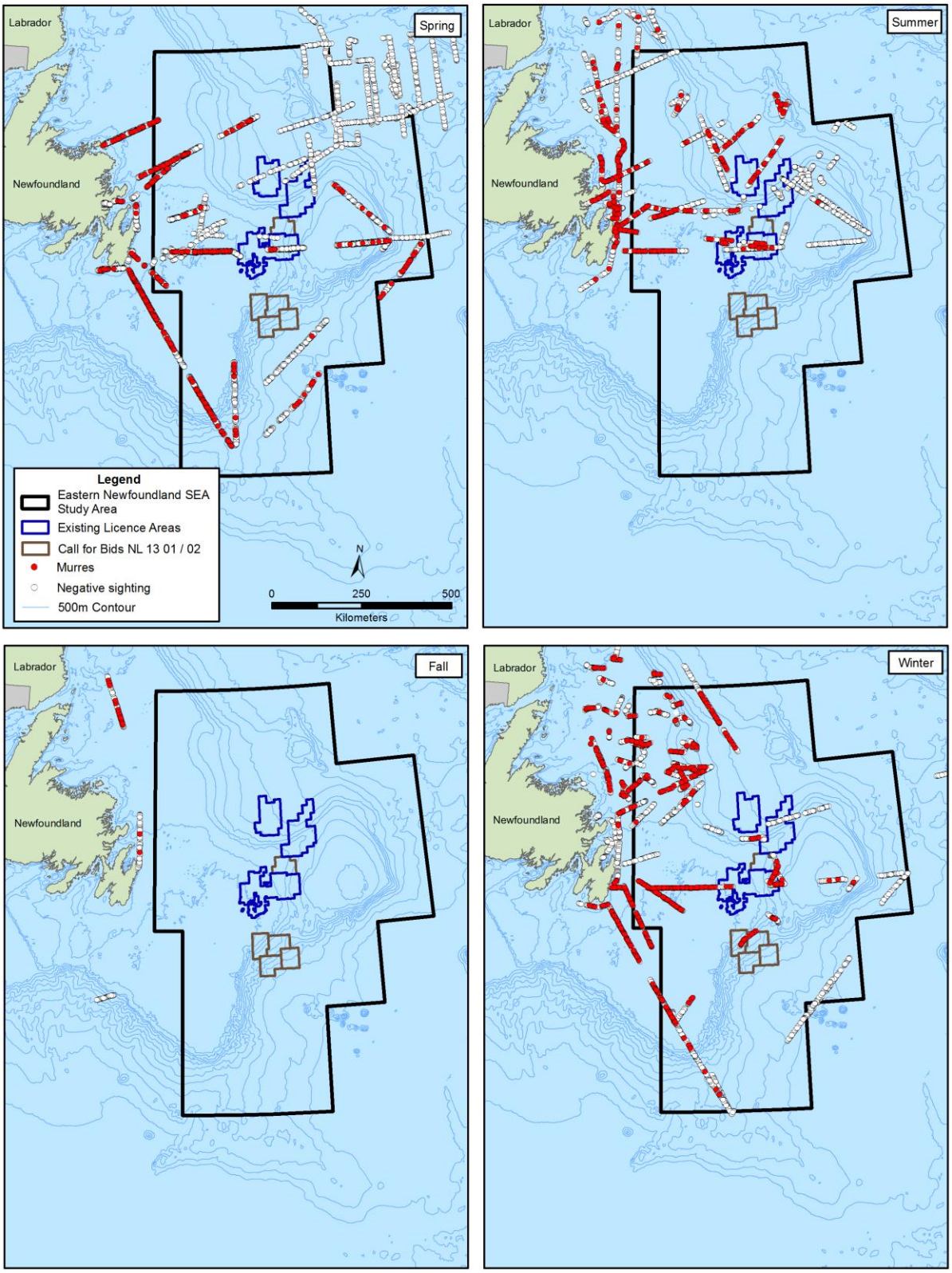
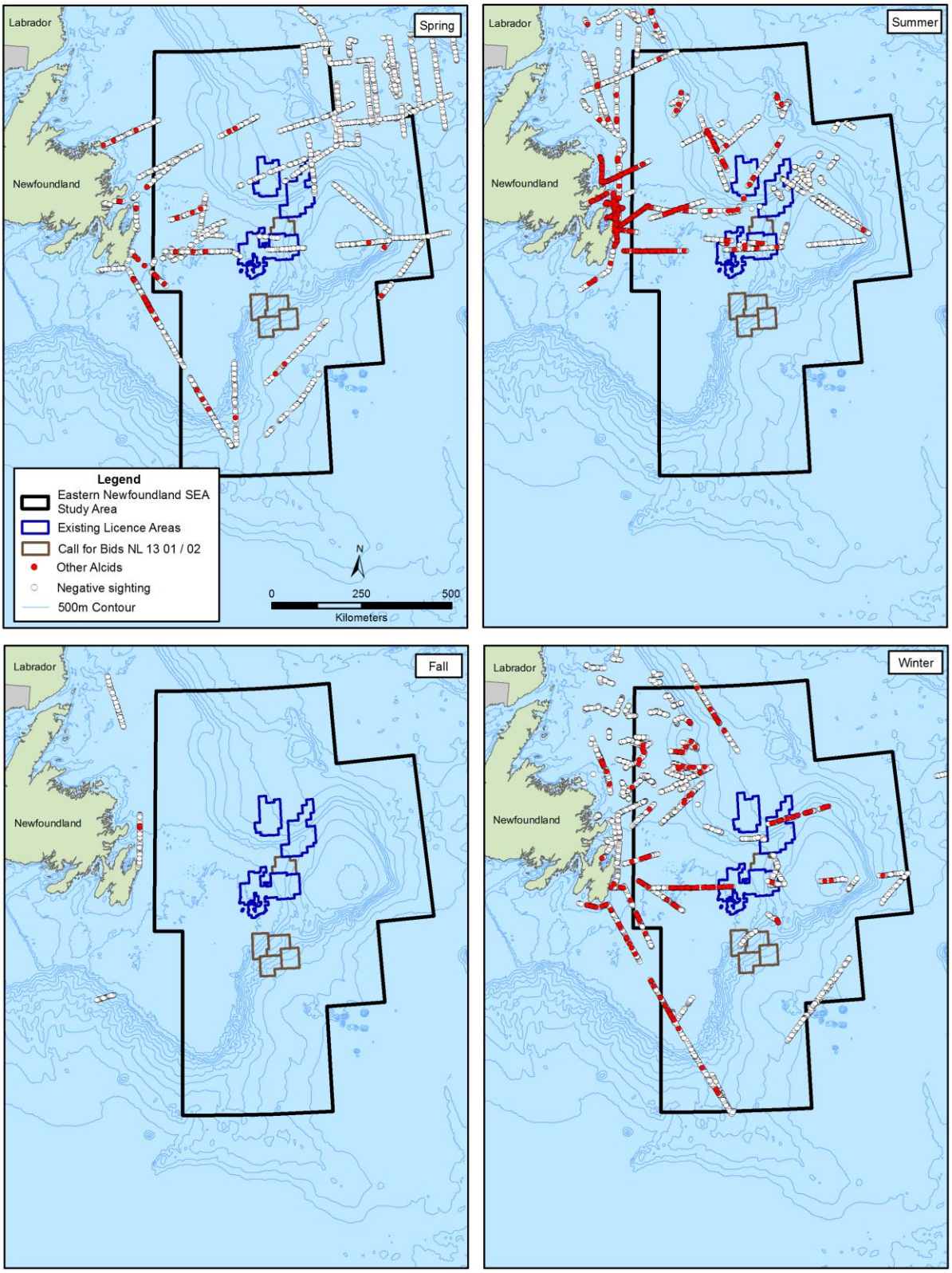


Figure 4.103 Seasonal Distribution of Other Alcids



Jaegers and Skuas

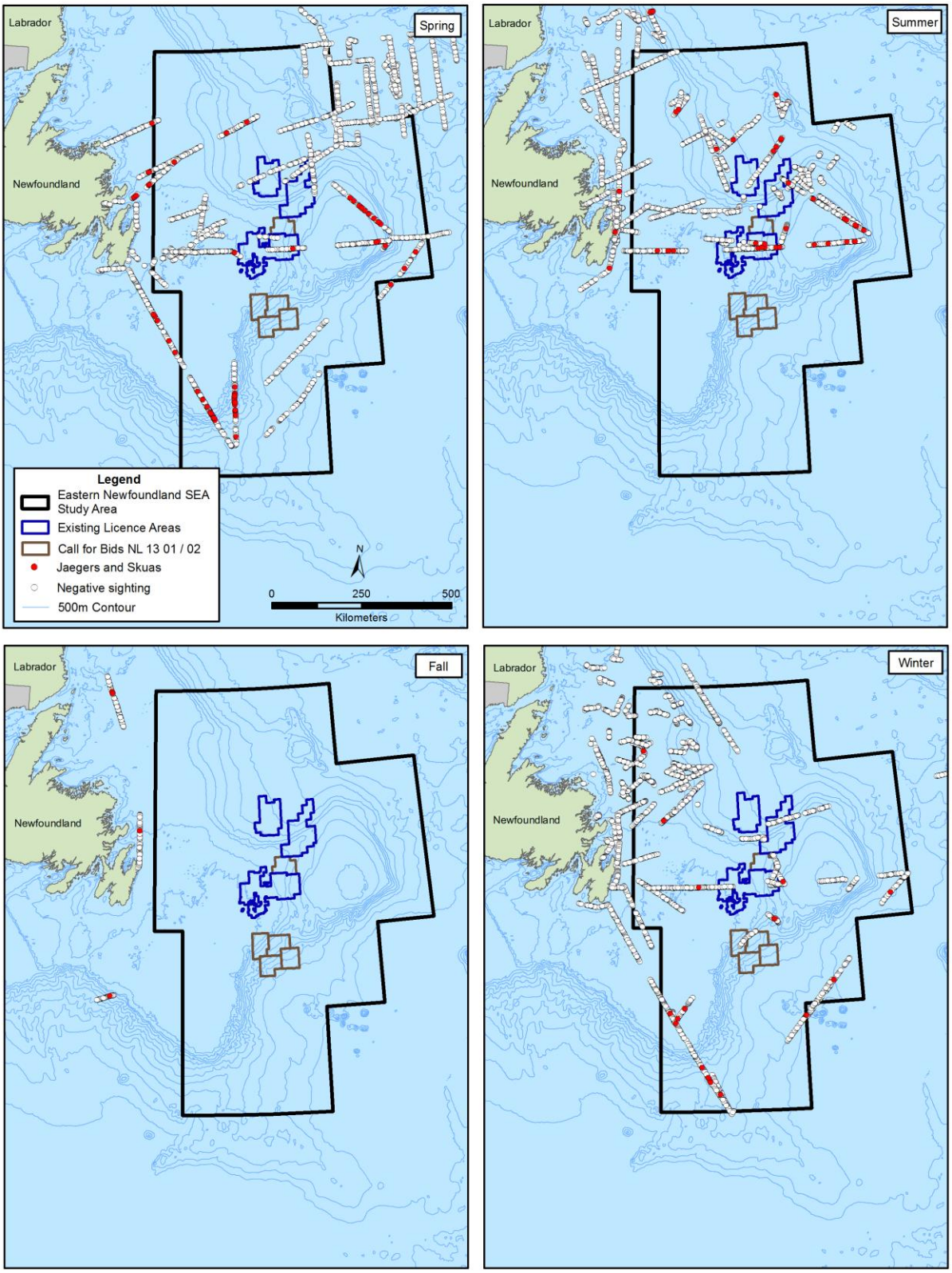
Jaegers and skuas are occasional visitors to the SEA Study Area. Five species occur with some regularity off Eastern Newfoundland (Table 4.76).

Table 4.76 Overview of Jaeger and Skua Species Occurring in the SEA Study Area

Jaegers and Skuas (*Stercorariidae*)	Summary	Reference(s)
Description	• Five species occur in SEA Study Area: Pomarine Jaeger, Parasitic Jaeger, Long-tailed Jaeger, Great Skua and South Polar Skua. • High arctic breeders which are found in offshore waters the rest of the year. • Great and South Polar Skuas do not breed in Canada, but are occasionally seen in offshore waters of the northwest Atlantic. • Insufficient data exist to determine population trends for jaegers. All three species are estimated to have a population of over 100,000 – 200,000 adults in Canada.	Wiley and Lee (1998, 1999, 2000); Environment Canada (2011)
Habitats and Movements	• Jaegers and skuas spend most of the year offshore, coming on land only during the summer months to breed. • Breed in Arctic tundra.	Wiley and Lee (1998, 1999, 2000)
Reproduction	• Age at first breeding believed to be typically 4 years. • Clutch size: typically 2. • Egg-laying begins in late May to early June. Chick rearing takes place from mid-July until early September. • Number of fledglings per pair varies with factors such as parental experience and prey density; range is between approximately 0.5 - 1.5.	Wiley and Lee (1998, 1999, 2000)
Foraging Strategy and Food Sources	• Frequently engage in kleptoparisitism, stealing food items from other seabirds, especially in winter; Long-tailed and Pomarine Jaegers largely predatory during breeding, feeding on lemmings and voles.	Wiley and Lee (1998, 1999, 2000)

Jaegers and skuas are scarce or rare in the waters off Eastern Newfoundland, and with the exception of the Great Skua, they are absent in winter (Husky Energy 2000). Combined, jaegers and skuas are rarely observed but widespread throughout the SEA Study Area, and at least in the spring they appear to be somewhat more common along the continental shelf (Figure 4.104). They are high Arctic breeders, not known to breed in the SEA Study Area itself. Therefore, their populations are not considered highly vulnerable to the effects of offshore activities relative to some other seabird groups found in the SEA Study Area.

Figure 4.104 Seasonal Distribution of Jaeger and Skua Observations



Fulmars and Shearwaters

Four members of the shearwater family occur in the SEA Study Area. Table 4.77 presents information on the habits, habitats and key life history characteristics of these species in the SEA Study Area.

Table 4.77 Overview of Fulmar and Shearwater Species Occurring in the SEA Study Area

Fulmars and Shearwaters (*Procellariidae*)	Summary	Reference(s)
Description	• Northern Fulmar and three shearwater species, Great Shearwater, Sooty Shearwater and Manx Shearwater, occur in the SEA Study Area. Cory's Shearwater is also known to occur off the southern Grand Banks. • Wide-ranging at sea outside of the breeding season. • Only the Northern Fulmar and Manx Shearwater nest in Canada; the other three shearwater species breed in the Southern hemisphere. • Fulmar populations have shown little change in recent years, with a stable population of 300,000 – 400,000 individuals in Canada. • Manx Shearwaters breed in one small colony of less than 20 pairs in southern Newfoundland.	Lee and Haney (1996); Fifield et al 2009b; Environment Canada (2011); Mallory et al (2012); EC-CWS (2013)
Habitats and Movements	• Spend most of the year in coastal and offshore waters, primarily along the continental shelf in temperate to cold water environments. • Breed on islands, often on cliffs.	Lee and Haney (1996); Mallory et al (2012);
Reproduction	• Most shearwaters are burrow nesters, while fulmars nest on cliffs. • Typically start to breed at 5-8 years, female fulmars generally older at first breeding. • Northern Fulmar: egg laying begins in mid June, and chick rearing is from mid July to end of September. Manx Shearwater: egg laying begins in mid April; chick rearing is from mid June to end of October. • Clutch size: 1. • Number of fledglings per pair per season ranges from 0.28 - 0.62	Lee and Haney (1996); Mallory et al (2012)
Foraging Strategy and Food Sources	• Shearwaters feed by pursuit plunging, while fulmars are typically surface feeders. • Feed on fish, offal, squid.	Lee and Haney (1996); Mallory et al (2012);

Northern Fulmar is considered common in the waters off Eastern Newfoundland year-round (Husky Energy 2000). They are primarily an Arctic-nesting species, but within this region they breed on Funk Island, Baccalieu Island, the Witless Bay Islands, Cape St. Mary's and Ship Island (EC-CWS 2013). In the winter months, fulmars were more abundant in the SEA Study Area than at other times of year, with densities generally between 2 and 5 birds / km^2 (Fifield et al 2009b). In the spring, summer and fall months, fulmars were most abundant on the continental slope in the southern Orphan Basin, as well as the tail and nose of the Grand Banks, and were less abundant in nearshore waters (Fifield et al 2009b; Figure 4.105).

Great and Sooty Shearwaters are common in the summer and fall months, uncommon in spring, and reportedly absent in winter (Husky Energy 2000). Manx Shearwater is also reportedly absent in the area in the winter, and scarce the rest of the year (Husky Energy 2000), and there are very few known breeding sites for this species in North America, including one small colony on Middle Lawn Island (EC-CWS 2013). In the spring, the ECSAS survey data showed that shearwaters were most abundant on the Grand Banks, particularly in the southeastern portion (Fifield et al 2009b). In the summer and fall, shearwaters are considerably more common overall in the SEA Study Area, and were particularly abundant on the east and northeast Grand Banks (Fifield et al 2009b; ECSAS Database 2013). In contrast to Husky Energy (2000), ECSAS surveys report small numbers of shearwaters in the winter months in the SEA Study Area on the Grand Banks (Fifield et al 2009b; Figure 4.106). Shearwaters are known to be strongly attracted to artificial light sources including flaring (Weise et al 2001).

Figure 4.105 Seasonal Distribution of Northern Fulmar Observations

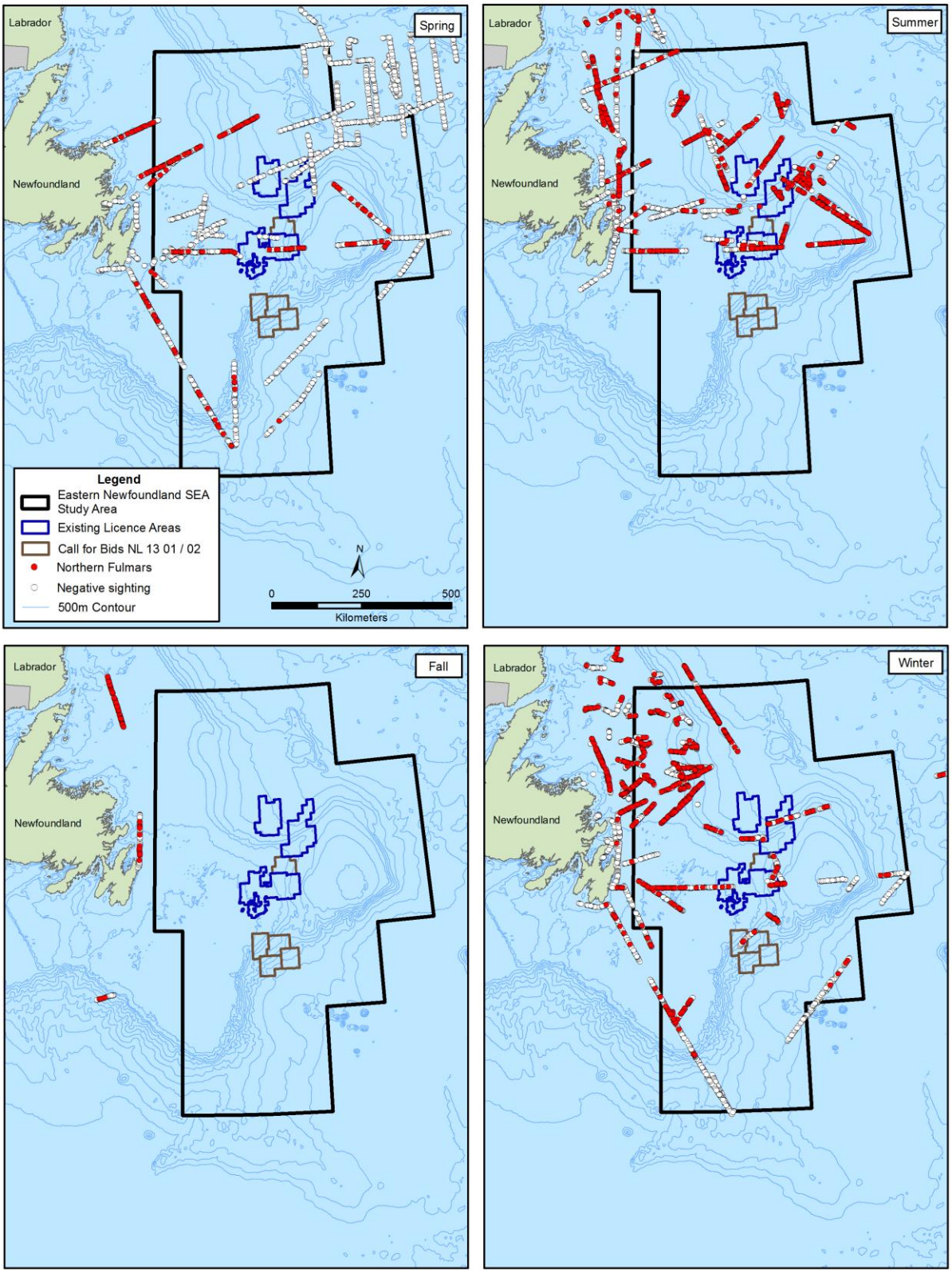
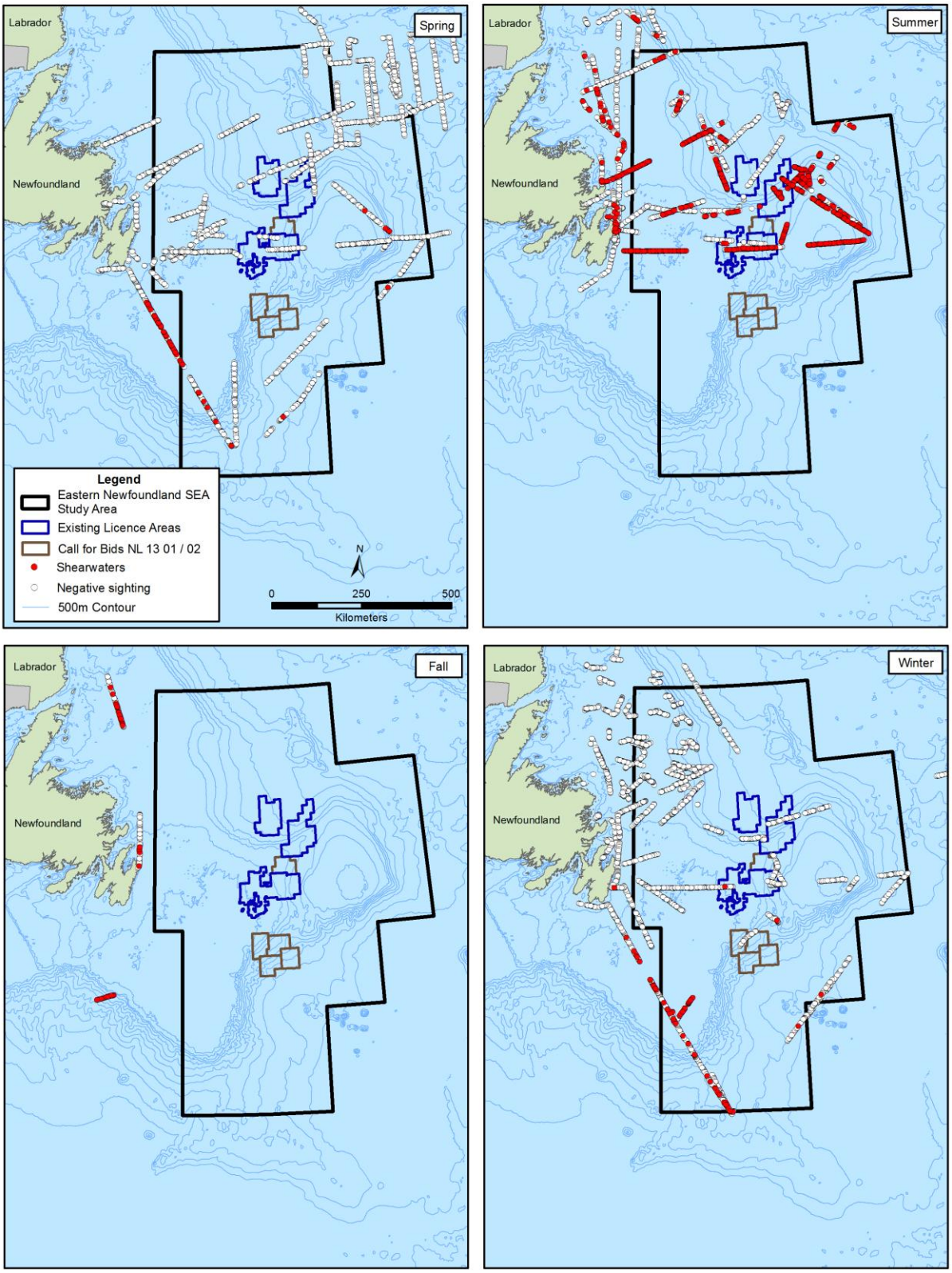


Figure 4.106 Seasonal Distribution of Shearwater Observations



Storm-petrels

Two species of storm-petrel (which are small relatives of shearwaters) are found in the SEA Study Area (Table 4.78).

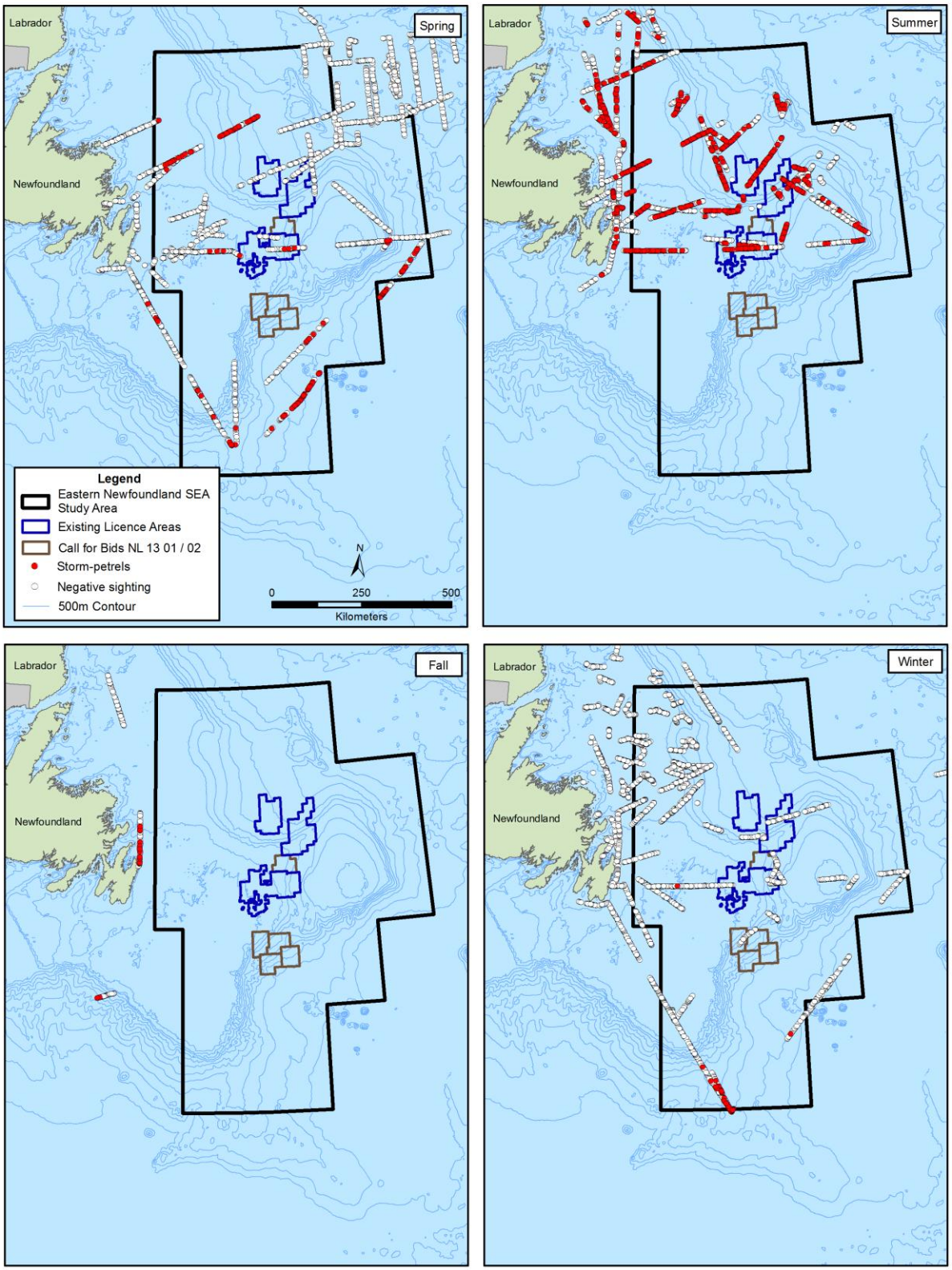
Table 4.78 Overview of Storm-petrels Occurring in the SEA Study Area

Storm-petrels (*Hydrobatidae*)	Summary	Reference(s)
Description	• Two species in SEA Study Area, Leach's Storm-petrel and Wilson's Storm-petrel. • Among the smallest of seabirds, both species are dark in colour with a white rump and with a decidedly bat-like flight. • Only Leach's breeds in Canada; Wilson's is an Antarctic breeder. • While there are insufficient data to assess population trends, there are over 10 million breeding Leach's Storm-petrels in Canada.	Huntington et al (1996); Fifield et al (2009b); Environment Canada (2011)
Habitats and Movements	• Breed on offshore islands • Nocturnal at the breeding colony, and are seldom seen from land. • Highly pelagic; even during breeding season, returns to land only at night.	Huntington et al (1996); Fifield et al (2009b)
Reproduction	• Nests in burrows in offshore islands. • Age at first breeding typically breed in fifth year. • Clutch size: 1. • Egg-laying begins in early June. Chick rearing takes place from mid-July until late October. • Fledging success in Newfoundland estimated at 48 percent.	Huntington et al (1996)
Foraging Strategy and Food Sources	• Surface feeders, hovering over the surface while gleaning prey items. • Often follow ships and fishing boats (particularly Wilson's) • Feed on zooplankton, small crustaceans.	Huntington et al (1996)

Wilson's Storm-petrels are rare to uncommon spring and summer visitors to Eastern Newfoundland and are absent in fall and winter. Leach's Storm-petrels are reportedly absent in winter and common for the rest of the year (Husky Energy 2000). In recent ECSAS surveys, storm-petrels were largely absent in the winter months, but present to the south of the tail of the Grand Banks (Figure 4.107), and were found in relatively low numbers in spring where the highest concentrations off the Newfoundland coast were to the south and east of the Grand Banks (Fifield et al 2009b). In the summer, storm-petrels were much more common in the SEA Study Area, particularly in the Orphan Basin and along the northern edge of the Flemish Cap, while in the fall, the highest densities were east of the Grand Banks and at the continental shelf break to the south of the Tail of the Bank (Fifield et al 2009b; Figure 4.107).

Over five million pairs of Leach's Storm-petrels breed on the eastern coast of Newfoundland, most on Baccalieu Island and the Witless Bay Islands (EC-CWS 2013). The former colony is home to more than a third of the world's population of the species (Fifield et al 2009b).

Figure 4.107 Seasonal Distribution of Storm-Petrel Observations



4.2.2.2 Coastal Waterfowl, Loons and Grebes

Waterfowl, loons, and grebes spend much of their time on the water's surface. Although loons and grebes are not waterfowl, they have fairly similar life histories and therefore similar vulnerabilities to offshore development. They have therefore been combined in this section.

Broadly, waterfowl may be categorized as dabbling ducks (primarily inland breeders) and diving ducks (most of which are considered "sea ducks" as they spend much of the non-breeding season at sea).

Table 4.79 presents information on the habits, habitats and key life history characteristics of waterfowl (including loons and grebes) in the SEA Study Area.

Table 4.79 Overview of Coastal Waterfowl, Loons and Grebes Occurring in the SEA Study Area

Waterfowl (Anatidae), Loons (Gaviidae), Grebes (Podicipedidae)	Summary	Reference(s)
Description	• The Common Loon, Pied-billed Grebe and at least fourteen species of waterfowl breed in Newfoundland, and over twenty species occur in the SEA Study Area during at least part of the year. • Populations of inland-breeding duck species surveyed by CWS (American Black Duck, Mallard, Green-winged Teal and Ring-necked Duck) are considered stable throughout Eastern Canada. Available information indicates that sea duck populations are stable; however, because most sea ducks breed in remote areas, population trends are relatively poorly known. • The Common Eider is the most abundant waterfowl species in all seasons in coastal Newfoundland	Lock et al (1994); CWS Waterfowl Committee (2012); Warkentin & Newton (2009); IBA 2012
Habitats and Movements	• Most nest inland on freshwater lakes and rivers; some (e.g. American Wigeon, Blue-winged Teal, Northern Shoveler, Pied-billed Grebe) nest in estuaries. Common Eider breeds in colonies on coastal islands. • In the fall, many species aggregate at staging areas • Many species spend winter months offshore in the study area (e.g. scoters, mergansers, Common Goldeneye, Long-tailed Duck, Common Eider).	IBA 2012; Lock et al 1994
Reproduction	• Loons, grebes and sea ducks typically have lower reproductive rates compared with inland duck species.	CWS Waterfowl Committee (2012); Warkentin & Newton (2009)
Foraging Strategy and Food Sources	• The main foraging strategies of this group are diving and dabbling (surface-feeding).	Warkentin & Newton (2009)

A great diversity of breeding waterfowl occur in the Bay du Nord Wilderness Reserve and Middle Ridge Wildlife Reserve, including American Black Duck, Canada Goose, Green-winged Teal, Common Goldeneye and Common Merganser (IBA 2013).

Sea ducks (White-winged Scoters, Surf Scoters, Black Scoters, Long-tailed Ducks and Common Eiders) occur in large flocks ("rafts") in coastal waters from autumn to spring (Lock et al 1994). The Witless Bay Islands are particularly important to sea ducks in the fall months, and large wintering congregations of up to 25,000 eiders can be seen between the Cape Freels coastline and nearby Wadham Islands. Other major wintering areas for Common Eider and other sea ducks include Grates Point, Cape St. Francis, Mistaken Point, Cape St. Mary's and Placentia Bay. Small numbers of Barrow's Goldeneye have been reported wintering in Eastern Newfoundland at Port Blandford and Newman Sound in Terra Nova National Park, as well as Traytown Bay, St. Mary's Bay, and Spaniard's Bay (Schmelzer 2006).

Harlequin Duck is thought to breed in the Bay du Nord Wilderness Reserve (IBA 2013). In late summer to fall, a small moulting concentration congregates at Cape St. Mary's (IBA 2013), one of just three such sites in Newfoundland. In the winter, Harlequin Ducks are found along rocky coastline, subtidal ledges, and exposed headlands, including the waters off Cape St. Mary's (IBA 2013; NLDEC 2013a).

4.2.2.3 Shorebirds

Shorebirds in the SEA Study Area are most abundant during fall migration, particularly from July to mid-October, when Arctic-nesting species migrate through the area en route to their wintering areas. Many species utilize coastal habitats such as sandy mudflats, and exhibit foraging strategies such as foraging at the water's edge, on flats exposed at low tide, or while wading in shallow water.

Table 4.80 presents information on the habits, habitats and key life history characteristics of shorebird species in the SEA Study Area.

Table 4.80 Overview of Shorebird Species Occurring in the SEA Study Area

Shorebirds (Scolopacidae, Charadriidae)	Summary	Reference(s)
Description	• At least 28 species of shorebirds pass through Eastern Newfoundland during fall migration. Commonly seen migrants include White-rumped Sandpiper, Greater Yellowlegs, Semipalmated Plover, Sanderling, American Golden-plover, Semipalmated Sandpiper, Whimbrel and Black-bellied Plover. Other species reported less frequently in the area include Dunlin, Hudsonian Godwit, Ruddy Turnstone, Least Sandpiper, Buff-breasted Sandpiper and the endangered *rufa* subspecies of Red Knot. Purple Sandpiper and Ruddy Turnstone are present in the winter months. • Small numbers of shorebirds breed in Newfoundland, including the Least Sandpiper, Spotted Sandpiper, Greater Yellowlegs, Semipalmated Plover, Piping Plover and Killdeer. The endangered Piping Plover's nesting range is concentrated in the western and southwestern portions of the Island, but they have	Warkentin & Newton (2009); Elphick and Tibbitts (1998); Nebel and Cooper (2008); Environment Canda (2009)

Shorebirds (Scolopacidae, Charadriidae)	Summary	Reference(s)
	recently been found breeding in Eastern Newfoundland.	
Habitats and Movements	• Shorebirds are generally long distance migrants, and most species that occur in the study area nest in the far north. • Most species that do nest in Newfoundland tend to breed close to inland freshwater bodies; the Greater Yellowlegs will nest in estuaries and tidal flats • Spring and fall migration routes differ; in Atlantic Canada, greater numbers of most species are seen during fall migration.	Morrison (2001); Warkentin & Newton (2009)
Reproduction	• Most species typically lay four eggs. Incubation lasts approximately three weeks. • Chicks are relatively precocious, leaving the nest within 24 hours of hatching, although they are unable to fully thermoregulate for the first few days.	Warkentin & Newton (2009); Morrison (2001)
Foraging Strategy and Food Sources	• Most shorebirds feed in tidal mudflats, probing the sand with their long bills. • Some species (e.g. Whimbrel) feed on berries in coastal barrens. The Purple Sandpiper feeds on small invertebrates (e.g. mollusks) along rocky shorelines and offshore ledges and islands.	Warkentin & Newton (2009)

Newfoundland does not host a high proportion of fall migrating shorebirds along the Atlantic Flyway, and the west coast of Newfoundland hosts the greatest proportion of migrating shorebirds within the province. However, results from the Atlantic Canada Shorebird Survey indicate that considerable numbers of shorebirds do stop along the eastern coast of the Island during their fall migration, particularly on the eastern side of the Avalon Peninsula (Witless Bay, Renews, Long Beach, St. Shotts, Spaniard's Bay, Bellevue Beach) as well as Cape Freels and Cape Bonavista (Environment Canada 2009). In the winter months, generally from November to April, Purple Sandpipers are present along rocky shorelines and offshore ledges and islands along the coast, including at Cape Spear, Witless Bay, Ferryland, Cape St. Francis and Mistaken Point in Eastern Newfoundland (IBA 2013; Environment Canada 2009). In 2013, the endangered Piping Plover, which nests on sandy shorelines, was found to be breeding in Deadman's Bay Provincial Park near the northwest head of Bonavista Bay. A small number of Ruddy Turnstones also overwinter at Mistaken Point, far north of the species' usual wintering grounds.

4.2.2.4 Other Birds, Including Passerines

Newfoundland is home to many breeding landbirds, most of which are migratory (Warkentin and Newton 2009). Although most of these species do not occur in the marine environment for most of the year, certain species of landbirds feed in coastal habitats (e.g. Savannah Sparrow, Short-eared Owl, some raptor species). In addition, during migration, many species fly long distances over water. In particular, passerines are primarily nocturnal migrants that are known to be attracted to artificial light sources including flares, particularly in inclement weather conditions (e.g. fog).

Terra Nova National Park, with its variety of coniferous and mixed forest, wetland and coastal habitats, is an area of particular importance to landbirds in Eastern Newfoundland in terms of both abundance and diversity (IBA 2013). This area supports populations of forest bird subspecies that have small ranges, the Ovenbird furvoir subspecies, the provincially vulnerable Gray-cheeked Thrush (minimus subspecies) and the federally and provincially endangered Red Crossbill *percna* subspecies. IBA (2013) provides a non-exhaustive list of some of the many landbird species that breed in the Park, including Black-backed Woodpecker, Boreal Owl, Ruby-crowned Kinglet, Northern Goshawk, Yellow-bellied Flycatcher and a number of warbler species (American Redstart, Black-throated Green Warbler, Magnolia Warbler, Mourning Warbler, Ovenbird, Palm Warbler and Tennessee Warbler).

4.2.2.5 Bird Species at Risk

A number of marine bird species that are at risk and are therefore protected under the Canadian *Species at Risk Act* (SARA) and/or the Newfoundland and Labrador *Endangered Species Act* (*NL ESA*) are known or likely to occur in the SEA Study Area and may be at risk of interactions with oil and gas activities. These include the: 1) Harlequin Duck; 2) Barrow's Goldeneye; 3) Ivory Gull; 4) Red Knot (*rufa* subspecies); 5) Piping Plover; 6) Peregrine Falcon; 7) Gray-cheeked Thrush; 8) Olive-sided Flycatcher; and 9) Short-eared Owl. In addition, species that may occur in the SEA Study Area that have been assessed by COSEWIC as being of conservation concern (but do not have formal protection under *SARA*) include the: 1) Buff-breasted Sandpiper; 2) Bank Swallow; and 3) Bobolink. These species are discussed below and summarized in Table 4.81.

Landbird species at risk that do not migrate over the offshore area, or that migrate during the day (and therefore are unlikely to be vulnerable to disorientation from marine artificial lighting), are not included here. The Red Crossbill (*percna* subspecies) is a year-round resident species inhabiting forests (Environment Canada 2006), and is not considered likely to occur in the Eastern Newfoundland Offshore Area. The Rusty Blackbird breeds throughout Newfoundland and may migrate over the offshore area, but as a diurnal migrant (Baird and Nisbet 1960). Other species at risk that may migrate over the offshore area but are not considered here because they are diurnal migrants are the Chimney Swift (Cink and Collins 2002) and Barn Swallow (Brown and Bomberger Brown 1999).

- *Harlequin Duck*: The eastern population of this species is listed as a species of special concern under SARA, and is considered vulnerable under the *NL ESA*. The Harlequin Duck breeds in fast-flowing streams; there is evidence to suggest that the Bay du Nord River in Southeastern Newfoundland may support nesting Harlequins. A few moulting individuals regularly congregate at Cape St. Mary's, one of only three such sites in Newfoundland (Parks Canada 2012). In the winter, they are found along rocky coastline, subtidal ledges, and exposed headlands, often remaining very close to shore (Goudie and Ankney 1986), including the waters off Cape St. Mary's. A small number of non-breeding individuals may be found here year round (Environment Canada 2007).

- *Barrow's Goldeneye*: Listed as a species of special concern and vulnerable under the *SARA* and *NL ESA*, respectively, the species moults and winters in small numbers, often in groups with Common Goldeneye, off the coast of Eastern Canada. Small numbers of Barrow's Goldeneye have been reported wintering in Eastern Newfoundland at Port Blandford and Newman Sound in Terra Nova National Park, as well as Traytown Bay, St. Mary's Bay, and Spaniard's Bay (Schmelzer 2006). These birds are known to congregate in relatively small geographic areas in important shipping corridors, and therefore the population is considered to

be particularly vulnerable to being affected by oil spills and the bioaccumulation of environmental contaminants (NLDEC 2013a).

- *Ivory Gull*: This species is listed as endangered under the federal and provincial legislation. It breeds in the far north and winters offshore, occurring in small numbers in the waters off Eastern Newfoundland (Ryan et al 2006). They are found most often among the pack ice, and are more rarely seen on the coast of the Northern Peninsula and ashore (Stenhouse 2004).

- *Piping Plover*: Listed as endangered under *SARA* and the *NL ESA*, the recovery plan for this species identifies a number of critical habitat beaches, including sites in the southern and southwestern part of Newfoundland, notably the Grand Bay West to Cheeseman Provincial Park IBA and Shallow Bay and Western Brook Beach in the Gros Morne IBA (Environment Canada 2012b). In 2013, Piping Plover nests were found in eastern Newfoundland at Deadman's Bay Provincial Park, near the northwest head of Bonavista Bay. Piping Plovers nest on sandy shorelines above the high water mark, and are present at the breeding grounds from April to September (Boyne and Amirault 1999).

- *Red Knot (rufa subspecies):* This species is currently listed as endangered under *SARA* and *NL ESA*, and has been sighted in several coastal Newfoundland locations. Red Knot sightings have been reported around almost the entire coast of Newfoundland. However, most have been seen on the west coast of the Island, with the majority of sightings being at Stephenville Crossing, Shallow Bay (Belldowns Point), Sandy Point and St. Paul's Inlet (Garland and Thomas 2009; Parks Canada 2012). During fall migration, from August 1st to October 31st, they frequent open sandy inlets, coastal mudflats, sand flats, salt marshes, sandy estuaries and areas with rotting kelp deposits (Garland and Thomas 2009; Baker et al 2013). In the Atlantic Canada Shorebird Survey, they are considered an occasional species during fall migration at Cape Freels (Environment Canada 2009). In general, however, Newfoundland is not considered to be a major stopover location, and so within the province threats to the species are considered unlikely to be severe (Garland and Thomas 2009).

- *Buff-breasted Sandpiper*: This species was recently assessed as a species of special concern by COSEWIC (2012c), but is not currently listed on Schedule 1. During fall migration surveys, they are typically observed in more upland grassy areas such as golf courses and airports (Campbell and Gregory 1976), but small numbers of this species have been observed in coastal areas during the Atlantic Canada Shorebird Survey. They are considered an occasional species at St. Shott's Sod Farm near the southern shore of the Avalon Peninsula and at Cape Bonavista (Environment Canada 2009), and it is considered to be a rare fall migrant in the province (COSEWIC 2012c).

- *Peregrine Falcon*: Listed as a species of special concern under *SARA* (both *anatum* and *tundrius* subspecies) and vulnerable under *NL ESA*, this species migrates along the coast of Newfoundland during the fall (particularly the west coast) and preys on concentrations of migrating shorebirds (Parks Canada 2012; COSEWIC 2007). In Eastern Newfoundland, Peregrine Falcon sightings have been reported in the fall on the Bonavista Peninsula and at all times of year (but most frequently during the fall) on the Avalon Peninsula (e-Bird 2013).

- *Bank Swallow*: Assessed by COSEWIC as threatened, this colonial species nests in burrows. They frequently construct their burrows in banks created through coastal erosion, and therefore

may be located in close proximity to the marine environment during the breeding season. They are diurnal migrants (Garrison 1999). Within the province, Bank Swallows nest primarily in southwestern Newfoundland (Warkentin and Newton 2009); however, sightings have been reported in Eastern Newfoundland (e-Bird 2013).

- *Gray-cheeked Thrush*: Considered vulnerable under *NL ESA*, this species occurs in suitable dense coniferous forest habitat throughout insular Newfoundland (Lowther et al 2001). It is most common on the Northern Peninsula and along the northeast coast, as well as the northern Avalon Peninsula (Endangered Species and Biodiversity Section 2010). It has also been reported in Placentia Bay (Endangered Species and Biodiversity Section 2010) and is reportedly breeding in Terra Nova National Park (IBA 2013).

- *Olive-sided Flycatcher*: Listed as threatened under both *SARA* and *NL ESA*, this species is found in boreal forest habitat, particularly open areas such as wetlands with tall trees and snags, and migrates to south and central America to overwinter (Altman and Sallabanks 2012). It breeds throughout insular Newfoundland as well as Southern Labrador (COSEWIC 2007), and in Eastern Newfoundland it has been reported at several locations on the Avalon Peninsula as well as at Terra Nova National Park (e-Bird 2013).

- *Bobolink*: Assessed as threatened by COSEWIC, the Bobolink nests in agricultural and natural grasslands. In the fall, they migrate to wintering grounds in South America; like most passerines, they are nocturnal migrants (Pettingill 1983). Breeding has been reported in western Newfoundland at Codroy Valley IBA (IBA 2013), and there have been sightings in eastern Newfoundland on the Avalon Peninsula and Terra Nova National Park in the summer months (e-Bird 2013).

- *Short-eared Owl*: This species, listed as being of special concern under *SARA* and vulnerable under *NL ESA*, occurs in low numbers on the coast of Newfoundland where it typically nests in coastal barrens and grasslands (Schmelzer 2005). Suitable habitat occurs in much of coastal Southeastern Newfoundland, and sightings of this species have been reported throughout the eastern portion of the Island from Wadham Islands to the Avalon Peninsula, mainly in June and July (Schmelzer 2005; e-Bird 2013).

Several additional marine-associated avian species at risk in Eastern Canada, Roseate Tern and Eskimo Curlew, are not considered likely to occur in the SEA Study Area. Within North America, the Roseate Tern breeds in Southern Nova Scotia and the Northeastern United States, and winters further south (Gochfeld et al 1998). The Eskimo Curlew once bred in large numbers in the Arctic and passed through Newfoundland and Labrador on its migration to the South American wintering grounds in the fall. However, the species' numbers have declined sharply, and there have been no confirmed sightings of the Eskimo Curlew since 1963 (and the species is therefore considered to possibly be extinct) (COSEWIC 2009b).

Table 4.81 Bird Species at Risk that are Known to or May Occur within the SEA Study Area

Common Name	Scientific Name	Population/Occurrence	Provincial Designation	SARA Listing			COSEWIC Assessment
				Endangered	Threatened	Special Concern	
Barrow's Goldeneye	*Bucephala islandica*	Québec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador	Vulnerable			Schedule 1	Special Concern
Harlequin Duck	*Histrionicus histrionicus*	Québec, New Brunswick, Nova Scotia, Newfoundland and Labrador	Vulnerable			Schedule 1	Special Concern
Ivory Gull	*Pagophila eburnean*	Newfoundland and Labrador	Endangered	Schedule 1			Endangered
Piping Plover (*Melodus* subspecies)	*Charadrius melodus melodus*	Québec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador	Endangered	Schedule 1			Endangered
Red Knot (*Rufa* subspecies)	*Calidris canutus rufa*	Québec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador	Endangered	Schedule 1			Endangered
Buff-breasted Sandpiper	*Tryngites subruficollis*	Yukon, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Nova Scotia, Newfoundland and Labrador					Special Concern
Peregrine Falcon	*Falco peregrinus anatum* and *tundrius*	Yukon, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Newfoundland and Labrador	Vulnerable			Schedule 1	Special Concern
Bank Swallow	*Riparia riparia*	Yukon, Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador					Threatened
Gray-cheeked Thrush	*Catharus minimus*	Newfoundland (*minimus* ssp.)	Vulnerable				
Olive-sided Flycatcher	*Contopus cooperi*	Yukon, Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Prince Edward Island,	Threatened		Schedule 1		Threatened

Common Name	Scientific Name	Population/Occurrence	Provincial Designation	SARA Listing			COSEWIC Assessment
				Endangered	Threatened	Special Concern	
		Nova Scotia, Newfoundland and Labrador					
Bobolink	*Dolichonyx oryzivorus*	British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador					Threatened
Short-eared Owl	*Asio flammeus*	Yukon, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador	Vulnerable			Schedule 1	Special Concern

Locally Rare and Restricted Range Species

The Manx Shearwater has only recently been discovered nesting in North America, and the largest confirmed breeding colony on the continent (and the only colony in Newfoundland) is found on Middle Lawn Island (IBA 2013; EC-CWS 2013). Northern Gannets in Newfoundland breed in just three colonies: Funk Island, Baccalieu Island and Cape St. Mary's (EC-CWS 2013). Terra Nova National Park supports a breeding population of the Newfoundland (*furvoir*) subspecies of Ovenbird, a migratory warbler species (IBA 2013).

4.2.2.6 Identified Important Times and Significant Bird Habitat Areas (Including IBAs)

Designated Important Habitat Areas

Areas of particular importance to the survival of bird species may be given the designation of Important Bird Area (IBA). The IBA program is coordinated by BirdLife International, and administered in Canada by the Canadian Nature Federation and Bird Studies Canada (IBA 2013). The criteria used to identify important habitat are internationally standardized, and are based on the presence of species at risk, species with restricted range, habitats holding representative species assemblages, or a congregation of a significant proportion of a species' population during one or more season. These criteria are used to identify sites of national and international importance.

There are a total of 17 IBA sites in Eastern Newfoundland, in proximity to the SEA Study Area (IBA 2013), which are summarized in Table 4.82 and illustrated in Figure 4.108.

Table 4.82 Important Bird Areas (IBAs) in Eastern Newfoundland Near the SEA Study Area

IBA Name	Description and Significance
Funk Island (NF004)	• Located approximately 60 km from shore in Northeastern Newfoundland, and with an area of 135.18 m^2, Funk Island supports a very large concentration of nesting seabirds, including a globally significant Common Murre population, as well as large numbers of Northern Gannets. Funk Island is also a provincially protected Seabird Ecological Reserve, and access to the island is restricted to persons conducting approved scientific research.
Wadham Islands and adjacent Marine Area (NF013)	• Located 40 km from shore (15 km from Fogo Island), the Wadham Islands are composed of 7 main islands and several smaller rocks and shoals within a 159.23 km^2 area. This IBA supports a globally significant number of wintering Common Eiders (approximately 25,000 were recorded in a 1995 survey). Many seabirds nest on the Wadham Islands, including large numbers of Atlantic Puffin, Leach's Storm-Petrel and Razorbill.
Cape Freels Coastline and Cabot Island (NF025)	• Located at the head of Bonavista Bay and including several small islands and shoals offshore, this 334.48 km^2 IBA supports a large number of nesting Common Murres, and a few pairs of Razorbills. Atlantic Puffins have been reported as breeding here in the past, although none were recorded in recent EC-CWS surveys. As well, up to 25,000 wintering Common Eiders have been reported in the waters between the Cape Freels coastline and Wadham Islands.
Terra Nova National Park (NF017)	• This large park (655.56 km^2) is situated on the inner reaches of Bonavista Bay. Much of the area is forested, but there are numerous lakes and wetlands, and a significant coastal component. The Park supports numerous forest species, including two subspecies with restricted ranges: the federally-listed Red Crossbill (*percna* ssp.) and Ovenbird (*furvoir* ssp.). Shorebirds can be seen on the flats at the outlet of Big Brook, as well as Newman Sound. These areas are also frequented by gulls and waterfowl.

IBA Name	Description and Significance
	At least six tern colonies, totalling between 1000 and 1500 pairs, are known in the park; these colonies include both Common and Arctic Terns.
Grates Point (NF019)	• This IBA, on the northern tip of the Bay de Verde Peninsula separating Trinity Bay from Conception Bay, has an area of 66.55 km^2 and supports a large number of wintering Common Eiders; typically around 2,800 individuals, although as many as 12,000 have been recorded. Other species frequenting this IBA in the winter include Black-legged Kittiwake, Thick-billed Murre and Dovekie. In the summer months, Atlantic Puffin and Northern Gannet are found in the area.
Baccalieu Island (NF003)	• Located 5.5 km from the northern tip of the Avalon Peninsula, this IBA has an area of 45.22 km^2 and, like Funk Island, is a provincially designated Seabird Ecological Reserve. Baccalieu Island has the greatest species abundance and diversity in Eastern North America, and supports the largest known population of Leach's Storm-petrels in the world, including 70 percent of the North American population. Significant breeding populations of Atlantic Puffin, Black-legged Kittiwake and Northern Gannet also occur here, as well as smaller numbers of Common Murre, Thick-billed Murre, Razorbill, Black Guillemot, Northern Fulmar, Herring Gull and Great Black-backed Gull.
Cape St. Francis (NF021)	• Located on the Avalon Peninsula at its northern tip, and with an area of 70.21 km^2, this IBA is a known congregating area for Common Eiders in the winters, with up to 5000 individuals recorded. As well, Purple Sandpipers regularly occur along the rocky shoreline in the wintertime.
Quidi Vidi Lake (NF022)	• This lake is situated within the St. John's city limits, and is fed by the Virginia River and Rennies River. The IBA has an area of 7.0 km^2. From late fall to early spring, the lake is important as a daytime resting site for gulls, including significant numbers of Herring, Great Black-backed, Iceland, Glaucous and Common Black-headed Gulls. Ring-billed, Mew and Lesser Black-backed Gulls have also been recorded on occasion. Waterfowl including American Black Ducks, Mallards and Northern Pintails are common here in the winter, subsisting on food handouts from people.
Witless Bay Islands (NF002)	• This IBA, which has a total area of 62.08 km^2 and includes four small islands off the east coast of the Avalon Peninsula, is also a provincially designated Seabird Ecological Reserve. These islands support a globally significant colony of breeding seabirds, including more than half of the eastern North American population of Atlantic Puffins, as well as large numbers of Leach's Storm-petrels, Common Murres, Black-legged Kittiwakes and Herring Gulls. Great Black-back Gulls, Northern Fulmars, Thick-billed Murres, Razorbills and Black Guillemots also nest in smaller numbers. Most of the colonies are located on Great Island, Gull Island and Green Island; the smaller Pee Pee Island hosts small colonies of Herring Gull and Great Black-Backed Gull, along with a small number of Puffins. During the fall migration, the surrounding marine area is important to sea ducks including White-winged Scoter, Surf Scoter, Long-tailed Duck and Common Eider.
Mistaken Point (NF024)	• Located near the southeastern corner of the Avalon Peninsula, Mistaken Point has an area of 102.77 km^2 and is a provincially designated Ecological Reserve because of its rich fossil deposits. This IBA is an important wintering area for Common Eiders, with as many as 12,000 birds recorded. This area is also important for wintering shorebirds; the Purple Sandpiper occurs here in significant numbers, and small numbers of Ruddy Turnstone overwinter regularly at this site, far north of its usual wintering range. Black-legged Kittiwake, Common Murre and Razorbill breed at Mistaken Point.
Cape St. Mary's (NF001)	• This IBA, also a provincial Seabird Ecological Reserve, has an area of 329.39 km^2 and is located at the entrance to Placentia Bay on the southwestern Avalon Peninsula. Significant numbers of Northern Gannet, Common Murre and Black-legged Kittiwake nest here, as well as smaller populations of Thick-billed Murre, Razorbill, Great Cormorant and Double-crested Cormorant. Herring Gull, Great Black-backed Gull and

IBA Name	Description and Significance
	Black Guillemot have also been reported nesting at Cape St. Mary's. In the winter, large numbers of migrating sea ducks occur here, including scoters, Common Eider, Long-tailed Duck and the endangered Harlequin Duck.
Placentia Bay (NF028)	• This IBA, including the eastern half of Placentia Bay between the Avalon and Burin peninsulas in southeastern Newfoundland and extending out 25 km from shore, has a total area of 1398.05 km^2. It is an exceptional feeding area for seabirds during the summer capelin spawning season; more than 100,000 shearwaters have been recorded during a survey, consisting of mostly Greater and Sooty Shearwater, with smaller numbers of Manx Shearwater. Large numbers of other species breeding in nearby Cape St. Mary's feed here, including Northern Gannet, Black-legged Kittiwake, Atlantic Puffin, Thick-billed Murre and Common Murre. Pomarine and Parasitic Jaegers may also be found in large numbers, kleptoparasitizing foraging kittiwakes. In the winter, more than 1,000 Common Eiders regularly congregate in the area.
Cape Pine and St. Shotts Barren (NF015)	• Located on the southern tip of the Avalon Peninsula, this 57.4 km^2 IBA attracts large, possibly globally significant numbers of American Golden-Plover during their fall migration (August to mid-October). Dozens of Whimbrel are also seen during fall migration.
Corbin Island (NF030)	• Located at the southeast corner of the Burin Peninsula, this 5.25 km^2 IBA supports a colony of an estimated 100,000 Leach's Storm-petrels. Historically, colonies of Herring Gull, Great Black-backed Gull, Black Guillemot and Black-legged Kittiwake have also been reported.
Middle Lawn Island (NF031)	• Off the southern tip of the Burin Peninsula, Middle Lawn Island is a small, rugged island within the 4.17 km^2 IBA. This island supports the largest, and one of the few, known colonies of Manx Shearwaters in North America. As many as 100 pairs have been reported breeding on the island, with another 300 non-breeding individuals estimated to occur. As well, large numbers of Leach's Storm Petrels breed on the island, and nesting Black Guillemot, Herring Gull and Great Black-backed Gull have been reported. Middle Lawn Island is part of the Lawn Islands Archipelago, which is a provisional Seabird Ecological Reserve.
Green Island (NF032)	• Located midway between the Burin Peninsula and the French islands of St. Pierre and Miquelon, this IBA has an area of 5.61 km^2. It supports a large colony of Leach's Storm-petrels. Common and Arctic Terns have been reported breeding on this island, as well as very small numbers of Herring Gull. Spotted Sandpipers have been reported on the island during the summer months. While not confirmed, Manx Shearwaters and Black Guillemots are suspected to breed on the island.
Bay du Nord Wilderness Reserve and Middle Ridge Wildlife Reserve (NF018)	• This large (3804.04 km^2) IBA is composed of two large inland reserves in southeastern Newfoundland. It is an upland plateau with extensive barrens, heaths and wetlands, supporting several species of breeding waterfowl (including Canada Goose, American Black Duck, Green-winged Teal, Common Goldeneye and Common Merganser), and there is evidence that the endangered Harlequin Duck may breed on Bay du Nord River. The Newfoundland (*welchii*) subspecies of Rock Ptarmigan, which is a restricted-range species, is believed to breed in small numbers in this IBA.
Source: Important Bird Areas of Canada (IBA 2013); Atlantic Canada Colonial Waterbird database (EC-CWS 2013)	

Environment Canada has designated several Migratory Bird Sanctuaries in Canada. These are protected by the *Migratory Bird Sanctuary Regulations* which prescribe rules and prohibitions regarding the taking, injuring, destruction or molestation of migratory birds or their nests or eggs in the sanctuaries. Hunting of migratory species not permitted in any Migratory Bird Sanctuary. There is one Migratory Bird Sanctuary (MBS) in the area, the Terra Nova MBS, which is also an IBA.

Provincially, there are a number of protected Wilderness and Ecological Reserves including six designated Seabird Ecological Reserves, four of which are within the SEA Study Area (NLDEC 2013b). These sites, Witless Bay, Baccalieu Island, Cape St. Mary's and Funk Island, are also IBAs and have been discussed in Table 4.82. In 2009, the Lawn Islands Archipelago (which includes Middle Lawn Island) was named as a provisional Seabird Ecological Reserve, and as such has been afforded interim protection until the site assessment process has been completed (Government of NL 2009). The provincial *Seabird Ecological Reserve Regulations* prohibit or limit industrial development as well as certain activities that can cause disturbance to breeding seabirds, including limitations on hiking, boat traffic and low-flying aircraft near the colonies during the breeding season, and prohibition of ATVs at all times. Mistaken Point is also a designated Ecological Reserve because of its rich assemblage of fossils, and as such is afforded similar protection from development and off-road vehicles.

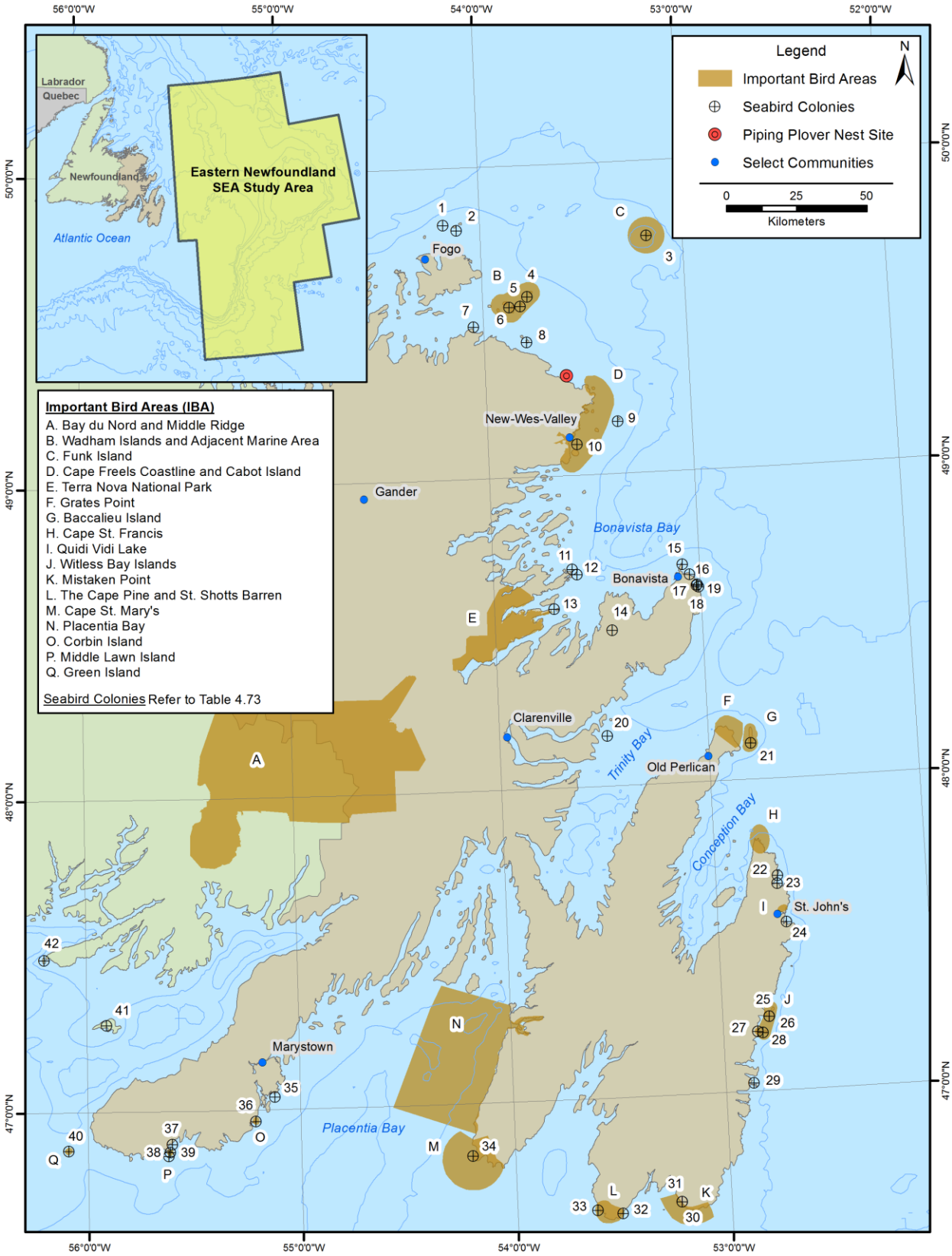
Other Important Habitat Areas

In addition to designated IBAs and MBSs, locations of colonial and rare species nesting sites as well as select areas of regional importance are also considered important. Breeding sites for colonial species and species at risk also constitute particularly important areas and habitats for marine birds. Figure 4.108 shows the locations of major seabird colonies in the SEA Study Area; these numbered colonies are summarized in Table 4.83. In addition to these major colonies, there are several smaller colonies along the eastern coast of Newfoundland that have not been included in the Table. In coastal surveys of insular Newfoundland conducted in 2005 - 2007, there were a total of 81 tern colonies (Common and/or Arctic Terns) in Eastern Newfoundland, totalling more than 10,000 individuals (Thomas et al n.d.). These surveys also recorded gull colonies, although due to constraints, the colony sizes were reported as range counts rather than numbers of individuals. In Eastern Newfoundland, there were 126 Herring Gull colonies, most of them small (1 - 100 individuals), but some with more than 1,000 individuals (Thomas et al n.d.). There were more than 100 Great Black-backed Gull colonies in Eastern Newfoundland (112 in total; mostly small colonies with 1 - 100 individuals), as well as several Ring-billed Gull (14 colonies, most of them medium-sized with 101 - 500 individuals) and Black-legged Kittiwake colonies (44 colonies, mostly small to medium-sized) (Thomas et al n.d.).

In 2013, evidence of Piping Plover nesting activity was observed at Deadman's Bay Provincial Park (Figure 4.108). While this site is not among the identified critical habitat beaches for the species (Environment Canada 2012b), the Piping Plover and its habitat are protected under *SARA*.

As discussed previously, a number of Ecologically and Biologically Significant Areas (EBSAs) have also been identified within the Placentia Bay Grand Banks Large Ocean Management Area. Among the criteria for selection and ranking of these important areas was their importance to marine birds and mammals in terms of biodiversity, density and importance to reproduction and survival. A discussion of key relevant characteristics of EBSAs that were identified as possessing important attributes to marine mammals and birds is provided later in this report. For seabirds, these are primarily important offshore feeding areas.

Figure 4.108 Important Bird Areas and Seabird Colony Locations



Seasonal Considerations

Figure 4.109 provides an overview of the seasonal patterns of abundance and life cycles of marine-associated bird species found in the SEA Study Area. Within this area, the Grand Banks region supports large concentrations of seabirds year-round (Fifield et al 2009), including species that breed on the eastern coast of Newfoundland and many non-breeding migrant seabirds. In the winter, it is the main wintering area for Dovekies and Thick-billed Murres (Lock et al 1994), and supports high concentrations of Black-legged Kittiwakes and other gulls, as well as Northern Fulmars and shearwaters (Fifield et al 2009). Throughout the year, but mainly in the summer and fall months (May to November), large numbers of Southern Hemisphere species such as Great and Sooty Shearwaters and Wilson's Storm-petrels arrive to feed in the area (Fifield et al 2009; Lock et al 1994). Shearwaters are particularly vulnerable in the early summer at the southernmost tip of the Grand Banks, the South-east Shoal, as moulting of their flight feathers takes place from May until late July, which impairs their ability to become airborne (Lock et al 1994). The northeast section of the Bank, which is also the location of the Jeanne D'Arc Basin oil production area, has a particularly high abundance of murres year-round, and in the spring, supports a high concentration of kittiwakes and large gulls, Dovekies, and Northern Fulmars (Fifield et al 2009). In the fall and winter, some of the highest observed densities of many seabird species are within the Orphan Basin, and the Flemish Cap and Pass areas are also considered hotspots for Black-legged Kittiwake, Dovekie, murres and Northern Fulmar (Fifield et al 2009).

During the summer breeding season, the greatest abundance of seabirds is concentrated around nesting colonies (Lock et al 1994). Seabirds are relatively long-lived, and in many species, individuals do not breed until four or five years of age. Large groups of non-breeding immature birds will tend to congregate in waters close to the breeding grounds and offshore.

Waterfowl that breed in coastal and estuarine environments in Newfoundland, particularly the colonial Common Eider, are particularly vulnerable in the summer months. In the fall staging period and in the winter, large numbers of wintering duck species such as eiders, scoters and mergansers are found in coastal waters. The endangered Harlequin Duck and small numbers of Barrow's Goldeneye may be found in coastal waters outside of the breeding season.

In the late summer and fall months, from early August to late October, migratory species that nest in Newfoundland move southward to their wintering grounds. Many species migrate over the SEA Study Area, and those that migrate at night are vulnerable to disorientation from or collision with artificial light sources, including flares. As well, from July to October, many shorebird species utilize coastal habitats (e.g., sandy mudflats, salt marshes and river outlets) during their migration. Purple Sandpipers and a small number of Ruddy Turnstones are present on rocky shorelines and islands in the winter months.

Figure 4.109 Summary of Seasonal Patterns of Bird Presence in the SEA Study Area

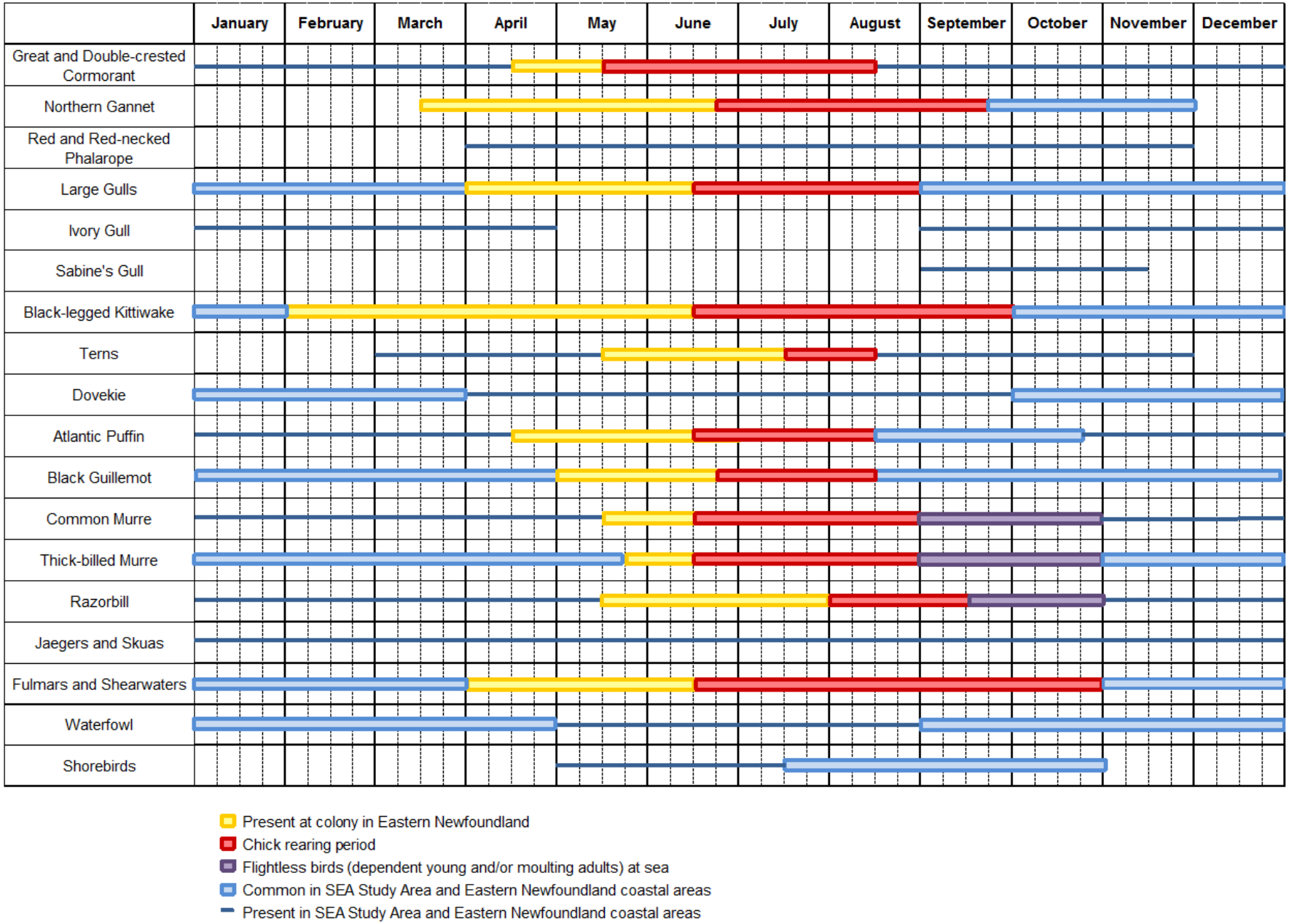


Table 4.83 Estimated Number of Breeding Pairs of Seabirds at Marine Colonies in Eastern Newfoundland

Nesting Areas and Important Bird Areas[1]	Colony # (Refer to Figure)[2]	Fulmars and Shearwaters		Storm-Petrels	Gannet	Gulls				Terns	Alcids (Auks)				
		N Fulmar	Manx Shearwater	Leach's Storm-petrel	N Gannet	Herring Gull	Great Black-blacked Gull	Ring-billed Gull[3]	Black-legged Kittiwake	Common and Arctic Terns[3]	Common Murre	Thick-billed Murre	Razor bill	Black Guillemot[4]	Atl Puffin
Storehouse Islets	1			100		1 - 100[3]	1 - 100[3]			48					
Little Fogo Islands	2			38,000		506	67		110		15		265	290	12,015
Funk Island	3	85			9,043	150	75		100		470,000	250	200		2,000
Small Island, *Wadham Island*	4			1,038			1 - 100[3]						273		6,190
Coleman Island	5			5,000			1 - 100[3]	101 - 500[3]		85			10		950
Pigeon Island (NDB)	6									28					120
Ladle Island	7			20		1 - 100[3]	1 - 100[3]								
Penguin Island, South	8			7,800		101 - 500[3]	1 - 100[3]			80					1,500
Cabot Island, South	9					1 - 100[3]	1 - 100[3]				10,000		4		
Pound Island	10			1,000		101 - 500[3]	1 - 100[3]								
Shag Islands	11			1,700						200					
Little Denier Island	12			1,300		1 - 100[3]	1 - 100[3]		101 - 500[3]						1,000
Copper Island	13			10		1 - 100[3]	1 - 100[3]								
Green Island, Trinity Bay	14					>1000[3]	1 - 100[3]	101 - 500[3]							1,277
Cape Bonavista, uni E. of	15														120
Spillars Point	16								501 - 1000[3]						250
North Bird Island	17					101 - 500[3]			1 - 100[3]						1,000
Elliston Point Island	18					101 - 500[3]									400
Bird, South	19			50		101 - 500[3]	1 - 100[3]		1 - 100[3]						1,000
Duck Island, Trinity Bay	20					101 - 500[3]									3,000
Baccalieu Island	21	13		4,623,911	2,157	180	9		5,096		1,440	73	1,500	143	75,000
Flatrock	22								1,644						

Nesting Areas and Important Bird Areas[1]	Colony # (Refer to Figure)[2]	Fulmars and Shearwaters		Storm-Petrels	Gannet	Gulls				Terns	Alcids (Auks)				
		N Fulmar	Manx Shearwater	Leach's Storm-petrel	N Gannet	Herring Gull	Great Black-blacked Gull	Ring-billed Gull[3]	Black-legged Kittiwake	Common and Arctic Terns[3]	Common Murre	Thick-billed Murre	Razor bill	Black Guillemot[4]	Atl Puffin
Torbay	23								115						
Freshwater Bay	24								2,747						
Gull Island, Witless Bay	25	7		170,000		1,881	33		4,530		3,496		294	2	140,429
Green Island, Witless Bay	26	1		20		100	20		2,188		250,000	242	170		9,300
Pee Pee Island, Witless Bay	27					present	present								1,850
Great Island, Witless Bay	28	10		134,000		1,640	28		6,710		4,656		117	3	174,500
Ship Island	29	10				101 - 500[3]	1 - 100[3]								
The Drook	30														50
Mistaken Point	31								4,170		84		72		
Cape Pine Head	32								575		9		189		259
Western Head	33										27		7		
Cape St. Mary's	34	9			14,696				10,000		15,484	1,000	100		
Iron Island	35			10,000		101 - 500[3]	1 - 100[3]								
Corbin Island	36			100,000		1 - 100[3]									
Swale Island	37			88											
Middle Lawn Island	38		13	8,773		1 - 100[3]									
Lawn Island, Offer	39			224		1 - 100[3]	1 - 100[3]								
Green Island, Fortune Bay	40			103,833											
Brunette Island (north of Harbour Breton)	41					1 - 100[3]	1 - 100[3]						50		
Pass Island	42			100			1 - 100[3]		1 - 100[3]						

Notes: Data obtained from the Atlantic Canada Colonial Waterbird database maintained by Environment Canada - Canadian Wildlife Service (EC-CWS 2013) unless otherwise noted.
1. Bird colonies in *italics* are IBAs. 2.Colony # corresponds to the numbered seabird colonies in Figure 4.108
3. Data obtained from Thomas et al (n.d.). Tthese numbers are reported as individual birds, not breeding pairs. Common and Arctic Terns are combined, as the two species cannot be reliably distinguished from aerial surveys.
4. Black Guillemot numbers are likely to be underestimates due to the loose colony distribution and solitary nature of the species.

4.2.3 Marine Mammals and Sea Turtles

Over 20 marine mammal and sea turtle species are known to occur with some degree of frequency in the waters off Eastern Newfoundland, many of which are considered to be at risk or otherwise of special conservation concern. A number of Ecologically and Biologically Significant Areas have also been identified in the SEA Study Area, due in part to their known importance to a number of marine mammal species (Templeman 2007).

4.2.3.1 Mysticetes

Six species of the cetacean suborder Mysticetes (the baleen whales) have been reported in the waters off Eastern Newfoundland. These large whales are characterized by having plates of baleen (instead of teeth), which filter food items from seawater. They are typically solitary or clustered in small groups called pods. The Tables that follow summarize key life history and habitat information for each of the species of baleen whales that do or may occur in the SEA Study Area.

Table 4.84 Overview of the North Atlantic Right Whale

North Atlantic Right Whale	Summary	Reference(s)
Description	• Adult North Atlantic right whales average 13-16 m in length and 40,000 to 70,000 kg in weight. • Concentrated in the western North Atlantic, but may occur further east to Europe. • Considered to be the most endangered large whale in the world, with approximately 300-350 individuals remaining. • Endangered (*SARA* Schedule 1).	COSEWIC (2003a); Kraus et al (2001)
Habitats and Movements	• Generally found in waters with surface temperatures ranging from 8-15°C, in areas that are 100-200 m deep. • Shifts in the distribution and abundance of their primary prey items can dramatically affect right whale distribution within their range.	COSEWIC (2003a); Kenney (2001)
Reproduction	• Mean age at first reproduction is 10 years for females and is likely similar for males. • Gestation period is unknown; may be >12 months. • Interval between births typically 3 - 5 years (mean: 3.7).	COSEWIC (2003a)
Foraging Strategy and Food Sources	• Plankton feeders. The primary prey item of the North Atlantic Right whale is the copepod *Calanus finmarchicus*, which they capture by filtering seawater through the baleen plates in their mouths.	Kenney (2001)

North Atlantic Right Whales are known to aggregate in five seasonal habitat areas along the east coast of North America, all of which are south of Newfoundland (COSEWIC 2003a). In Canada, they can be found in the Bay of Fundy from June-November, with peak abundance in August to early October, and in the Roseway Basin south of Nova Scotia from July to November. Right whales are only rarely sighted in the SEA Study Area, and none were observed during aerial surveys conducted in 2007 in the areas off Eastern and Southern Newfoundland (Brown et al 2009; Lawson and Gosselin 2009). Occurrences are therefore likely to be extremely rare in the Eastern Newfoundland Offshore Area.

Table 4.85 Overview of the Humpback Whale

Humpback Whale	Summary	Reference(s)
Description	• Adult humpback whales average 13-16 m in length with females growing larger than the males. • It has unusually long pectoral flippers. • Known for its surface displays and breaching acrobatics. • Special concern (*SARA, Schedule 1).*	COSEWIC (2011a); IWC (2002)
Habitats and Movements	• Highly migratory, with seasonal movements between temperate to arctic feeding areas and low-latitude breeding areas. • In the North Atlantic, six distinct feeding areas: Gulf of Maine, Gulf of St Lawrence, Newfoundland and Labrador, West Greenland, Iceland and North Norway. • One common breeding area located in the West Indies. • Often sighted singly or in groups of two or three, except during breeding and feeding times, where groups can be as large as 15 individuals.	IWC (2002); Lesage et al (2007)
Reproduction	• Average age at sexual maturity is 9 years. • Calving occurs between January and April after a gestation of approximately 12 months. • Inter-calving interval of 2 years.	COSEWIC (2011a)
Foraging Strategy and Food Sources	• Humpback whales feed on small schooling fishes and krill. • They often feed cooperatively in groups and have been observed using specialized feeding techniques such as bubble net feeding.	COSEWIC (2011a)

Humpback whales are considered to be relatively common within the SEA Study Area. Based on surveys conducted off Southern and Eastern Newfoundland in 2007, the abundance of humpback whales in these areas is estimated at 1,427 individuals (95 percent confidence range of between 952 and 2,140 individuals). These estimates are considered by the authors to be preliminary, however, as they have not been corrected for perception biases (Lawson and Gosselin 2009).

Table 4.86 Overview of the Blue Whale

Blue Whale	Summary	Reference(s)
Description	• The largest animal ever known to live, an adult blue whale can reach up to 30 m in length. • All populations have been exploited commercially. It is estimated the western North Atlantic population to be on the order of a few hundred individuals. • Widely distributed throughout the world's oceans and occurs in coastal, shelf and oceanic waters. • Endangered (*SARA* Schedule 1).	COSEWIC (2002)
Habitats and Movements	• In the western North Atlantic, blue whales occur in the Gulf of St. Lawrence and east of Nova Scotia in spring, summer and fall and off southern Newfoundland in winter. • Usually occur alone or in small groups. • Distribution during feeding seasons is largely dependent on the areas of high concentrations of their primary food item.	Waring et al (2002); Leatherwood and Reeves (1983)

Blue Whale	Summary	Reference(s)
Reproduction	• Mate and calve from late fall to mid-winter in Northern hemisphere. • Age at sexual maturity: 5 - 15 years for both sexes. • Gestation period 10 - 11 months. • Interval between births is 2 - 3 years.	COSEWIC (2002)
Foraging Strategy and Food Sources	• The primary prey item of the blue whale is euphausiids.	Yochem and Leatherwood (1985)

The Western North Atlantic population of blue whales was severely depleted by whaling, and sightings of this species anywhere within its range are quite uncommon. Sightings occur predominantly along the Quebec North Shore between Saguenay River and the Strait of Belle Isle, and along the southwest and eastern coasts of Newfoundland during winter and early spring (Sears et al 1990; Lesage et al 2007). Small numbers of blue whales (four sightings totalling six individuals) were observed during aerial surveys off the South and East Newfoundland coasts in the summer of 2007 (Lawson and Gosselin 2009).

Table 4.87 Overview of the Fin Whale

Fin Whale	Summary	Reference(s)
Description	• Adult fin whales average 18-20 m in length. • Lower jaw is white on the right side while the left side is gray or black. • One of the fastest whales on earth and nicknamed “the greyhound of the sea”, the fin whale can sustain speeds of up to 37km/h and burst speeds of over 40km/h. • Atlantic population: Special Concern by *SARA* (Schedule 1) and COSEWIC.	COSEWIC (2005)
Habitats and Movements	• Widely distributed in all the world’s oceans but typically occur in temperate and polar regions. • Appear to have complex seasonal movements and are likely seasonal migrants. • Mate and calve in temperate waters during winter but migrate to northern latitudes during the summer to feed. • Occur in coastal and shelf waters, as well as in oceanic waters. • Observed alone or in pairs but groups of up to 20 individuals are often seen on feeding grounds.	Gambell (1985); COSEWIC (2005)
Reproduction	• Average age of sexual maturity: 6-7 years for males 7-8 years for females. • Conception and calving typically in winter. • Average 2.7 years between births.	COSEWIC (2005)
Foraging Strategy and Food Sources	• The primary prey of the fin whale is small schooling fishes such as capelin, as well as krill.	Kenney (2001)

The fin whale is common in the Grand Banks, particularly during the summer months, and its distribution is associated with the presence of abundant food supply (e.g. capelin). Based on surveys conducted off Southern and Eastern Newfoundland in 2007, the abundance of fin whales in the area is

estimated at 890 individuals (95 percent confidence range of between 551 and 1,435 individuals). Again, these estimates are considered by the authors to be preliminary and likely negatively biased, as they have not been corrected for perception biases (Lawson and Gosselin 2009).

Table 4.88 Overview of the Sei Whale

Sei Whale	Summary	Reference(s)
Description	• Adult sei whales can reach up to 18 m in length. • A relatively tall sickle shaped dorsal fin that may appear simultaneously as the blow, as seen from the surface. • Atlantic population considered Data Deficient by COSEWIC.	COSEWIC (2003b)
Habitats and Movements	• Migrate between tropical to subtropical latitudes in winter and temperate and subpolar latitudes in summer, staying mainly in water temperatures of 8 - 18°C. • Winter distribution seems to be widely dispersed and is not fully mapped; summer distribution is highly variable, but in the western North Atlantic, generally north of southern Nova Scotia. • Typically occur in offshore, pelagic habitats; appear to be associated with the continental shelf edge in the northwest Atlantic. • Highly mobile and are known to make unpredictable movements. • Not considered deep divers.	Reilly et al (2008a); COSEWIC (2003b)
Reproduction	• Reach sexual maturity at 5 to 15 years of age; mean age at first reproduction has apparently decreased since the 1930s. • Gestation period 10.5 - 12 months. Conception and birth typically occur in winter months. • Calving interval of 2 - 3 years.	COSEWIC (2003b)
Foraging Strategy and Food Sources	• Diet includes copepods, euphasids and small fish.	COSEWIC (2003b)

Although it has a relatively wide distribution overall, this species is considered uncommon in the Eastern Newfoundland Offshore Area. An assessment of stocks in the Northwest Atlantic indicated two main concentrations, one off southern Nova Scotia and one in the Labrador Sea (Mitchell and Chapman 1977). Just one sei whale was observed during aerial surveys conducted off Eastern Newfoundland in 2007 (Lawson and Gosselin 2009).

Table 4.89 Overview of the Minke Whale

Minke Whale	Summary	Reference(s)
Description	• Adult minke whales average 7-10 m in length, the smallest of the baleen whales. • Like most whale species, females are larger. • White band on each flipper is diagnostic. • Assessed as Not at Risk by COSEWIC; populations are considered to be more secure than other baleen whales.	ACS (2006); COSEWIC (2006b)
Habitats and	• Cosmopolitan distribution that spans ice-free latitudes. Prefer colder waters.	Stewart and Leatherwood (1985);

Minke Whale	Summary	Reference(s)
Movements	• Very little information on winter distribution; have been reported along the western North Atlantic south of 40 degrees latitude. • Migrate northward from calving grounds during spring and summer. • Appear to prefer shallow water (less than 200 m). • Relatively solitary; usually seen individually or in small groups of two or three. • Larger groups have been observed in areas of concentrated feeding.	Reilly et al (2008b); ACS (2006)
Reproduction	• Both sexes reach sexual maturity at about 7 to 8 years • Gestational period of 10-11 months • Produce calves every 2 years on average	ACS (2006)
Foraging Strategy and Food Sources	• The preferred prey items of the minke whale are sand lance and capelin, although other small schooling fishes likely make up a large part of their diet as well. Copepods and krill are also taken.	Naud et al (2003); ACS (2006)

Minke whales are commonly observed on the Grand Banks in the summer, associated with the presence of their prey species (Piatt et al 1989). As with the other baleen whale species, minke whales are more common off Eastern Newfoundland than the west and southwest coasts of the Island (Kingsley and Reeves 1998). Based on surveys conducted off Southern and Eastern Newfoundland in 2007, the abundance of minke whales in the area is estimated at 1,315 individuals (95 percent confidence range of between 855 and 2,046 individuals), although again these estimates are considered by the authors to be preliminary and likely biased (Lawson and Gosselin 2009).

4.2.3.2 Odontocetes

The cetacean suborder Odontoceti includes toothed whales, dolphins and porpoises. Five species of larger toothed whales, three dolphin species and one porpoise have been reported in the waters off Eastern Newfoundland. The following Tables summarize key life history and habitat information for toothed whales, dolphins and porpoises that do or may occur in the SEA Study Area.

Table 4.90 Overview of the Sperm Whale

Sperm Whale	Summary	Reference(s)
Description	• Largest of the toothed whales, growing to a length of approximately 20.5 m with a worldwide distribution. • Routinely dive to depths of hundreds of meters and may occasionally dive as deep as 3000 m. • Considered to be Not At Risk by COSEWIC.	Rice (1989)
Habitats and Movements	• Range as far north and south as the edges of the polar pack ice, although they are most abundant in tropical and temperate waters where temperatures are higher than 15°C. • Distribution is linked to social structure; adult females and juveniles generally occur in tropical and subtropical waters, whereas adult males are commonly alone often occurring in higher latitudes outside of the breeding	Rice (1989); Best (1979); Watkins and Moore (1982); Arnbom and Whitehead (1989); Whitehead and Waters (1990)

Sperm Whale	Summary	Reference(s)
	season. • Generally distributed over large areas that have high secondary productivity and steep underwater topography.	
Reproduction	• Females reach reproductive maturity at 7 to 13 years, males somewhat later. • Gestation is 14 to 16 months. • Interval between births is typically 3 to 6 years.	Shirihai and Jarrett (2006)
Foraging Strategy and Food Sources	• The primary prey item of the sperm whale is squid.	Shirihai and Jarrett (2006)

Sperm whales were observed in small numbers in the waters off Eastern and Southern Newfoundland during aerial surveys conducted in the summer of 2007 (two and nine individuals, respectively; Lawson and Gosselin 2009). The species feeds in deep water and is likely to be found in such habitats, although researchers have also sighted sperm whales in shallow water and close to the coastline in Southern Newfoundland.

Table 4.91 Overview of the Northern Bottlenose Whale

Northern Bottlenose Whale	Summary	Reference(s)
Description	• Adult northern bottlenose whales grow to approximately 10 m in length. • Pronounced beak that is white on males and grey on females. • Davis Strait-Baffin Bay-Labrador Sea population listed by COSEWIC as a species of Special Concern, while localized Scotian Shelf population considered endangered by *SARA* (Schedule 1) and COSEWIC. • Scotian Shelf population is believed to be non-migratory, while the Labrador population migrates north to south seasonally.	COSEWIC (2011b)
Habitats and Movements	• Live in deep water areas of the North Atlantic and are rarely found in waters less than 800 m deep. • Capable of remaining submerged for over an hour. • Can be found in groups ranging in size from one to 20 individuals. • Two areas of abundance in the western North Atlantic: Davis Strait off northern Labrador and “the Gully” on the Scotian Shelf.	Gowans (2002)
Reproduction	• Mate and give birth in April in the Labrador population. • Females reach reproductive age at 8 - 13 years, males somewhat earlier. • Single offspring produced every two years.	COSEWIC (2011b)
Foraging Strategy and Food Sources	• The primary prey item of the Northern bottlenose whale is deep water squid.	Gowans (2002)

Northern bottlenose whales are known to occur in the Grand Banks, and were sighted in the waters off Eastern and Southern Newfoundland during aerial surveys conducted in 2007 (Lawson and Gosselin 2009). Any individuals of this species that are found in the SEA Study Area may be of either the Labrador (Davis Strait) population or the endangered Scotian Shelf population, although the latter is considered to be less wide-ranging (COSEWIC 2011b).

Table 4.92 Overview of the Killer Whale

Killer Whale	Summary	Reference(s)
Description	• Killer whales, also known as orcas, are large members of the dolphin family. They are black with distinct white patches on the chest, sides and above the eye. • Adult male killer whales can reach a length of 6-8 m while females can reach a length of 5-7 m. • Have tall dorsal fins that can reach a height of 2 m. • Northwest Atlantic / Eastern Arctic population assessed as Special Concern by COSEWIC.	COSEWIC (2008)
Habitats and Movements	• Cosmopolitan and globally fairly abundant; have been observed in all oceans of the world. • Prefer warm waters but have been reported in cold waters as well. Not known to be reliably migratory. • The greatest abundance of killer whales is found within 800 km of major continents. • Often travel in close-knit matrilineal groups of a few to tens of individuals.	Ford (2002); COSEWIC (2008)
Reproduction	• Males reach sexual maturity at about 13 years, females at 14 - 15 years. • Calving peaks from fall to spring. • Average period between calving is approximately 5 years.	COSEWIC (2008)
Foraging Strategy and Food Sources	• Prey on a diverse variety of items including marine mammals, fish and squid.	COSEWIC (2008)

Killer whales occur year round in small numbers within the SEA Study Area (Lien et al 1988). They have been sighted in the marine areas off Eastern Newfoundland in small numbers (Weise and Montevecchi 1999; Lawson and Gosselin 2009). Based on the available information, this species is likely to be present but uncommon in the Eastern Newfoundland Offshore Area.

Table 4.93 Overview of the Long-finned Pilot Whale

Long-finned Pilot Whale	Summary	Reference(s)
Description	• Members of the dolphin family. • Adult long-finned pilot whales reach a length of approximately 3.5 - 4.5 m, with males somewhat larger than females. • Bulbous forehead and sickle shaped dorsal fin. • Population considered Not At Risk by COSEWIC.	ACS (2006)
Habitats and Movements	• Widely distributed throughout the world's oceans, and abundant throughout the North Atlantic as far north as 70°N.	Bernard and Reilly (1999); Olson and Reilly (2002); Lesage

Long-finned Pilot Whale	Summary	Reference(s)
	• No evidence for marked north-south migration, but may migrate inshore-offshore seasonally in response to prey availability. • Pods are known to strand frequently en masse. • Typically only found in cold waters.	et al (2007)
Reproduction	• Gestation period is 12 - 15 months. • Age at first breeding: 6 to 7 years. • Calving occurs every 3 to 5 years. • Calving may occur year round, but typically in summer.	ACS (2006)
Foraging Strategy and Food Sources	• Long-finned pilot whales feed primarily on squid but known to consume octopus, cuttlefish and some fish species as well.	ACS (2006)

During aerial surveys conducted in summer of 2007, 10 observations totalling 65 individual long-finned pilot whales were recorded off Southern Newfoundland, although none were observed in the Eastern Newfoundland Offshore Area (Lawson and Gosselin 2009). This species is, however, generally considered to be abundant in the Grand Banks area from July to December (LGL Limited 2003). Observations from the Gulf of St. Lawrence suggest that the species is typically found in deep water with steep bottom topography (Kingsley and Reeves 1998).

Table 4.94 Overview of the Sowerby's Beaked Whale

Sowerby's Beaked Whale	Summary	Reference(s)
Description	• Up to 5.5 m long and dark grey in colour. • Small head with a long, narrow beak, and a small triangular dorsal fin and relatively long dorsal fins. Tail flukes lack center notch. • Species of special concern according to COSEWIC and *SARA* (Schedule 1).	COSEWIC (2006c)
Habitats and Movements	• Most northerly of the beaked whales; has been found on the eastern and western side of the North Atlantic. • No data on seasonal movements of the species. • Social structure poorly known, but most sightings and strandings have been of small groups of fewer than ten individuals.	COSEWIC (2006c)
Reproduction	• Poorly known. Females apparently sexually mature when they attain a length of between 4.6 and 4.8 m, while males are apparently sexually mature at 5.0 m.	COSEWIC (2006c)
Foraging Strategy and Food Sources	• Based on stomach contents and isotope analysis, diet appears to consist primarily of mid- to deep-water fishes and squid.	COSEWIC (2006c)

During aerial surveys conducted in summer of 2007, Sowerby's beaked whales were not observed in the areas off Eastern and Southern Newfoundland (Lawson and Gosselin 2009). The SEA Study Area

is, however, within the species' known range (COSEWIC 2006c). Moreover, Sowerby's beaked whales are known to prefer deep waters (> 1,000 m) which is present in the SEA Study Area, and so it is considered to possibly occur in this area (LGL Limited 2003). All confirmed sightings and strandings of this species off Newfoundland have been in the summer months, although this may be due to the relatively poor sighting conditions and lack of search effort in other times of the year (COSEWIC 2006c).

Table 4.95 Overview of Small Dolphin Species

Dolphins	Summary	Reference(s)
Description	• In addition to killer whale and Long-finned pilot whale, five dolphin species may be found in SEA Study Area: 1) Atlantic white-sided dolphin, 2) white-beaked dolphin, 3) common bottlenose dolphin, 4) Risso's dolphin and 5) short-beaked common dolphin. • All five species have been assessed by COSEWIC and populations were considered Not at Risk. Atlantic white-sided dolphins are considered abundant throughout their range.	Reeves et al (1999); Hammond et al (2008a,b)
Habitats and Movements	• All species occur in temperate to warm waters in the North Atlantic. The Atlantic white-sided dolphin and white-beaked dolphin also inhabit sub-Arctic portions of the North Atlantic. The short-beaked dolphin also inhabits southern waters off the coast of Venezuela and the Gulf of Mexico. • Seasonal migration patterns for these species are poorly understood. • Most commonly found in groups of 30 to 70 individuals; however, larger groups numbering several hundred individuals are also observed. • Often associate and feed with large baleen whales, and are known to form mixed dolphin species groups.	Reeves et al (1999); Kinze (2002); ACS (2006) Hammond et al (2008a,b)
Reproduction	• Reach sexual maturity at 3 to 4 years. • Gestation lasts from 10 - 14 months.	ACS (2006)
Foraging Strategy and Food Sources	• Diet for most species consists of a variety of small schooling fishes and squid; Risso's dolphin feeds almost exclusively on squid.	ACS (2006); Hammond et al (2008 a,b)

Atlantic white-sided dolphins may be found throughout the SEA Study Area, and have been recorded within 30 km of the White Rose site during vessel-based surveys (Wiese and Montevecchi 1999). White-beaked dolphins, although less abundant in the Western North Atlantic than in the eastern portion of their range, have also been observed in the SEA Study Area. This cool-water species is most likely to occur in coastal areas in relatively shallow waters (Reeves et al 1999). Short-beaked common dolphins are fairly common off the coast of Eastern Newfoundland, and are usually found in groups of 50 - 200 individuals with most of the Northwest Atlantic population being found south of Georges Bank (Reeves et al 1999).

Based on surveys conducted off Southern and Eastern Newfoundland in 2007, the abundance of these three dolphin species (at the 95 percent confidence level) is as follows: Atlantic white-sided dolphins: 1,507 (968 - 2,347); white-beaked dolphin: 1,842 (1,118 - 2,854); short-beaked common dolphins: 576 (314 - 1,056). These estimates are again considered by the authors to be preliminary and likely low, as they have not been corrected for perception biases (Lawson and Gosselin 2009).

Common bottlenose dolphin and Risso's dolphin both tend to be found in more tropical waters and are less common in the SEA Study Area. Neither species was identified in Newfoundland waters in the Lawson and Gosselin (2007) aerial surveys.

Table 4.96 Overview of Harbour Porpoise

Harbour Porpoise	Summary	Reference(s)
Description	• The harbour porpoise is a small compared to other cetaceans, growing to a length of 1.2 to 1.4 m. • Most commonly observed near the coast and will enter small bays and estuaries. • Harbour porpoises in the western North Atlantic have been divided into three different subpopulations: the Bay of Fundy/Gulf of Maine, the Gulf of St. Lawrence and the Newfoundland populations. The boundaries between these populations are not well defined as there is some genetic overlap.	COSEWIC (2006d); Wang et al (1996)
Habitats and Movements	• Found in shelf waters throughout the northern hemisphere, usually in waters colder than 17°C. • Usually seen in small groups of one to three animals often including at least one calf. Occasionally they form larger groups. • Present in northern coastal waters only during the summer months.	COSEWIC (2006d)
Reproduction	• Most mature females become pregnant each year. Gestational period is 10 - 11 months. • Mean age at sexual maturation is 3.5 years.	COSEWIC (2006d)
Foraging Strategy and Food Sources	• Feed on small schooling fishes.	COSEWIC (2006d)

Off Eastern Newfoundland, harbour porpoises are most likely to be found in the shallower waters of inshore areas. Bycatch data show that porpoises occur around the entire Island of Newfoundland, especially along the south coast, west coast and in Notre Dame Bay. However, in the 1980s, bycatches were particularly common in St. Mary's Bay and elsewhere in Southeastern Newfoundland during the early summer (COSEWIC 2006d). Harbour porpoise bycatch has also been reported across the entire Grand Banks (COSEWIC 2006d). Based on surveys conducted off Southern and Eastern Newfoundland in 2007, the abundance of harbour porpoises in the area is estimated at 1,195 individuals (95 percent confidence range of between 639 and 2,235 individuals), although again these estimates are considered by the authors to be preliminary (Lawson and Gosselin 2009).

4.2.3.3 Pinnipeds

Six seal species are known to occur regularly in the SEA Study Area, including two species that are considered occasional winter visitors.

Table 4.97 Overview of the Pinnipeds (Seals)

Seals	Summary	Reference(s)
Description	• Four species of seals commonly occur in the SEA Study Area: 1) harp seal, 2) harbour seal, 3) hooded seal and 4) grey seal. • Two additional pinniped species, ringed seal and the bearded seal, are typically Arctic dwellers but may occasionally be found in the SEA Study Area in winter. • Adult harp seals may reach a length of approximately 1.7-2.0 m, hooded seals approximately 2.0 m for females and 2.6 m for males, and grey seals can grow to a length of approximately 1.6-2.0 m for females and 2.5-3.3 m for males. • Populations of the three common pinniped species are all considered secure in the region; grey and hooded seals have all been assessed by COSEWIC as Not At Risk.	DFO (2000); Kovacs (2002)
Habitats and Movements	• All species inhabit most coastal waters of the North Atlantic. • Harp and hooded seals summer in the Canadian Arctic and Greenland, migrating to the Gulf of St. Lawrence in December and January and leaving the area in April to May. • Hooded seals are highly pelagic, and it is not uncommon to see them outside of their normal range. • Grey seals are year round residents in the SEA Study Area.	DFO (2000); Kovacs (2002); Hall (2002); Burns (2002); Lesage et al (2007)
Reproduction	• Harp seal pups are born on the ice and females will nurse their pups for approximately 12 days, then mate and disperse. • Hooded seals congregate to breed in spring. After breeding, they move to moulting areas off Greenland. • The largest colony of grey seals is found off Nova Scotia. Grey seals give birth between September and March, with peak pupping occurring in January.	DFO (2000); Kovacs (2002); Hall (2002); Burns (2002)
Foraging Strategy and Food Sources	• Diets for all species include a variety of fish species, including cod, haddock, herring and mackerel. Crustaceans, krill, squid, shrimp and other invertebrates are also taken.	Hammill and Stenson (2000)

Harp, harbour, hooded and grey seals are all likely to be relatively common in the Eastern Newfoundland Offshore Area for at least part of the year, with grey seals occurring primarily in the summer months, harp and hooded seals in the winter, and harbour seals throughout the year (Lesage et al 2007). Harbour seals are found year-round in Placentia Bay (Templeman 2007).

Harp seals and hooded seals feed in the northeastern Grand Banks, at the Sackville Spur west and Sackville Spur east respectively (Templeman 2007). The Grand Banks provides an important

overwintering area for some harp and hooded seals (Stenson and Kavanagh 1994), and an area called the Front, off Southern Labrador and Northeastern Newfoundland, provides an important whelping area for these species (DFO 2000). Grey seals in the SEA Study Area are primarily migrants from the Sable Island and Gulf of St. Lawrence breeding populations. They are seen year round, but most often in July and August (Stenson 1994), and are believed to occur in low numbers in the SEA Study Area (LGL Limited 2003).

4.2.3.4 Sea Turtles

Sea turtles are marine reptiles that are found in all but the polar regions of the world's oceans. All seven species of sea turtles are considered endangered by the IUCN, with fisheries bycatch, hunting, contamination and beach development all considered to be major threats.

Three species of sea turtles are or may be found in the waters of the SEA Study Area, as summarized in Table 4.98.

Table 4.98 Overview of Sea Turtle Species

Sea Turtles	Summary	Reference(s)
Description	• There are three species of sea turtles that do or may occur within the SEA Study Area; Leatherback turtle, Loggerhead turtle and Kemp's ridley turtle. • The leatherback is the largest living turtle, measuring up to 2.19 m in length. • The loggerhead is the largest hard-shelled turtle in the world, typically reaching 0.85-1.0 m in length. • Kemp's ridley is the smallest sea turtle, at 0.6 - 0.7 m in length. • Leatherback (Atlantic population) is listed as endangered under Schedule 1 of *SARA*, while the loggerhead is considered endangered by COSEWIC. • Kemp's ridley is only rarely found in Canadian waters (considered an accidental visitor), but is considered critically endangered by IUCN.	Ernst et al (1994); Marine Turtle Specialist Group (1996); COSEWIC (2010d); COSEWIC (2012d)
Habitats and Movements	• Leatherbacks range throughout the Atlantic, Pacific and Indian oceans. In Atlantic Canadian waters, present from April to December and most numerous from July to September. They are predominantly pelagic, typically inhabiting coastal shelf waters to a depth of <200m. • Loggerhead is the most abundant sea turtle in North American waters. Wander widely in their range from coastal areas to more than 200 km from shore. In Eastern Canada, seldom found in nearshore waters. • Adult Kemp's ridley turtles rarely range beyond the Gulf of Mexico, but juveniles can be found as far north as Newfoundland.	Ernst et al (1994); Marine Turtle Specialist Group (1996); COSEWIC (2010d); COSEWIC (2012d)
Reproduction	• Leatherbacks nest on open beaches in the tropics; females lay an average of 6 clutches per season. • Loggerheads nest in the southern United States and in tropical areas; they lay 4 clutches per season, and will go 2 - 3 years between breeding seasons.	COSEWIC (2010d); COSEWIC (2012d); National Marine Fisheries Service (2010)

Sea Turtles	Summary	Reference(s)
	• Kemp's ridley turtles nest exclusively in the Gulf of Mexico where they lay an average of 2.5 clutches per season. • Sex determination of marine turtle hatchlings is temperature dependent.	
Foraging Strategy and Food Sources	• The preferred prey for leatherbacks is jellyfish and other gelatinous organisms. • Loggerheads and Kemp's ridleys consume crustaceans, mollusks and jellyfish.	Ernst et al (1994); COSEWIC (2012d); Marine Turtle Specialist Group (1996)

Population estimates for leatherbacks in the North Atlantic range from 34,000 - 94,000 individuals, and they are thought to be a regular (albeit uncommon) part of the Newfoundland marine fauna in the summer and fall (COSEWIC 2012d; Goff and Lien 1988). The south coast of Newfoundland, in particular the Placentia Bay area, is a relatively high-use habitat for this species (Templeman 2007; COSEWIC 2012d). Loggerheads are less common than leatherbacks in Eastern Canadian waters (Breeze et al 2002). Off Eastern Newfoundland, the greatest concentration is found in the Grand Banks, where they tend to prefer warmer waters of 22°C and above (COSEWIC 2010b). The number of Kemp's ridley turtles that visit the Eastern Newfoundland Offshore Area is unknown, but this species is likely to be extremely rare in the SEA Study Area.

4.2.3.5 Marine Mammal and Sea Turtle Species at Risk

A total of five federally listed marine mammal species at risk and one listed sea turtle may occur or are known to be present in the Eastern Newfoundland Offshore Area: 1) blue whale - Atlantic population; 2) North Atlantic right whale; 3) Sowerby's beaked whale; 4) northern bottlenose whale - Scotian Shelf population; 5) fin whale - Atlantic population; and 6) leatherback turtle -Atlantic population (Table 4.99).

Four additional populations that do or may occur in the SEA Study Area have been assessed by COSEWIC as being of conservation concern, but do not have formal protection under *SARA:* 1) the northern bottlenose whale (Davis Strait population); 2) the killer whale (Northwest Atlantic and Eastern Arctic populations); 3) the harbour porpoise: Northwest Atlantic population; and 4) loggerhead sea turtle (Atlantic Ocean population) (Table 4.99). The harbour porpoise is listed on Schedule 2 of *SARA*, but is not subject to the same legal protections as Schedule 1 species.

A third sea turtle species, the Kemp's ridley, is not federally listed but is considered by the IUCN to be critically endangered.

Table 4.99 Marine Mammal and Sea Turtles Species at Risk that are Known to or May Occur within the SEA Study Area

Common Name	Scientific Name	Population / Occurrence	SARA Status		COSEWIC Assessment	
			Endangered	Threatened	Special Concern	
Marine Mammals						
Blue whale	*Balaenoptera musculus*	Atlantic population	Schedule 1			Endangered
North Atlantic right whale	*Eubalaena glacialis*		Schedule 1			Endangered
Northern bottlenose whale	*Hyperoodon ampullatus*	Scotian Shelf population	Schedule 1			Endangered
		Davis Strait population				Special Concern
Fin whale	*Balaenoptera physalus*	Atlantic population			Schedule 1	Special Concern
Sowerby's beaked whale	*Mesoplodon bidens*	Atlantic Ocean			Schedule 1	Special Concern
Killer whale	*Orcinus orca*	Northwest Atlantic population, Eastern Arctic population				Special Concern
Harbour porpoise	*Phocoena phocoena*	Northwest Atlantic population		Schedule 2		Special Concern
Sea Turtles						
Leatherback turtle	*Dermochelys coriacea*	Atlantic population	Schedule 1			Endangered
Loggerhead turtle	*Caretta caretta*	Atlantic Ocean				Endangered

4.2.3.6 Identified Important Areas and Times for Marine Mammals and Sea Turtles

Figure 4.110 provides information on marine mammal (baleen whales, large toothed whales, and dolphin and porpoises) sightings off Eastern Newfoundland, based on information obtained from DFO's current cetacean sightings database (J. Lawson, pers. comm.).

Although useful and informative at a regional scale, there are a number of caveats associated with this dataset which should initially be noted. Firstly, the sighting data have not been completely error-checked by DFO, and the quality of some of the information is therefore unknown. Most sightings are collected on an opportunistic basis and observations may come from individuals with varying degrees of experience and expertise in marine mammal identification. Most data have been gathered from platforms of opportunity that were vessel-based, and the possible negative or positive reactions by cetaceans to such vessels have not yet been factored into the data. As the sighting effort has not been quantified, the numbers cannot be used to estimate true species density or abundance for an area, and a lack of sightings does not necessarily indicate a lack of presence in a particular location. Numbers sighted have not been verified, especially in light of the significant differences in detectability between species. For completeness, these data represent an amalgamation of sightings from a variety of years and seasons; the effort is not necessarily consistent among seasons, years, and areas, and there are gaps between years. Finally, many sightings could not be identified to the species level, and these have been assigned to the smallest taxonomic group possible. Sightings of unidentified whales that were not identified as either toothed or baleen whales are not included in the Figure, although these make up only a small proportion (less than two percent) of the total number of sightings in the database.

From the data, the greatest concentration of marine mammal sightings within the SEA Study Area overall has occurred in the Southern Grand Banks area and within the 200 nautical mile limit. As noted above, this may not be representative of the true distribution of marine mammals, because the level of search effort was not consistent over the entire region. Despite these caveats, however, for a few species there were some apparent "hotspots", such as a relatively large proportion of the sightings of fin whale being clustered off the northeast coast of Newfoundland. Humpback whale sightings were somewhat widespread in continental shelf waters, but particularly abundant on the Tail of the Grand Banks. Sperm whale sightings appear to be highly associated with the continental slope.

As discussed previously in this report, a number of Ecologically and Biologically Significant Areas (EBSAs) have been identified by DFO within the Placentia Bay Grand Banks Large Ocean Management Area (Templeman 2007) and in the Newfoundland and Labrador Shelves Bioregion (DFO 2013). Among the criteria for the identification, evaluation and selection of these important areas was their importance to marine mammals and seabirds in terms of biodiversity, density and importance for reproduction and survival.

Table 4.90 provides an overview of the key relevant characteristics of those EBSAs that are located within or near the SEA Study Area, with particular reference to their use by and importance for marine mammals and seabirds.

Table 4.100 Ecologically and Biologically Significant Areas Within or in Proximity of the SEA Study Area and their Importance to Marine Mammals and Seabirds

EBSA Name	Description and Importance to Marine Mammals and Seabirds
Southeast Shoal and Tail of the Banks	• Defined as the area east of 51°W and south of 45°N extending to the edge of the Grand Banks, this EBSA includes an offshore spawning area for Capelin and Sand Lance, key prey species for marine birds. • The presence of a high concentration of forage species draws large and diverse aggregations of seabirds and marine mammals, especially humpback whale and northern bottlenose whale. • In terms of fitness consequences, this EBSA is an important seasonal foraging area for seabirds and cetaceans.
Placentia Bay Extension	• Includes all of Placentia Bay, across the mouth of the bay from Point Crewe (Burin Peninsula) to Point Lance (Avalon Peninsula), and extending out to the 50 m isobath. This EBSA has a high level of biodiversity. • It supports important seabird breeding areas along the coast, as well as a high biomass of birds and mammals typical of river and estuarine habitats. • In the spring and summer, this EBSA supports a high aggregation of cetaceans, as well as leatherback sea turtles. Otters and harbour seals use the area year round. • In terms of aggregation and fitness consequences, this EBSA is an important feeding area from spring to fall for many seabird species, cetaceans (especially humpbacks and porpoises) and leatherback turtles; otters, harbour seals and some cetaceans feed in the area year-round. • The area is important for reproduction of many seabird species, harbour seals and otters; female cetaceans with young inhabit the area during critical feeding periods. • It is thought to be a possible migratory path for leatherbacks.
Southwest Shelf Edge and Slope	• This is the area from 55°W to 52°W, encompassing the shelf edge of the Grand Bank to the 2000 m isobath. • This area is critical to a wide variety of seabirds, providing the highest density of pelagic seabird feeding within the Placentia Bay Grand Banks Large Ocean Management Area. • Further, many marine mammals and leatherback sea turtles aggregate here, particularly in the summer months.
St. Pierre Bank	• The northwest St. Pierre Bank to the south and west of the Canada-France International Boundary to the 200 m isobath, this EBSA is west of the SEA Study Area. • It serves as an important feeding area for several species of cetaceans, and in particular is considered a potentially important spring feeding area for migrating and overwintering whales.
Laurentian Channel and Slope	• This EBSA extends from 45°N to 47.5°N, from the slopes of the banks into the Laurentian Channel, westward to the boundary of the Placentia Bay Grand Banks Large Ocean Management Area. • It provides an important (in fact, the only) migratory corridor for marine mammals moving in and out of the Gulf of St. Lawrence.
Eastern Avalon Coast	• Defined as the area from Blackhead to Cappahayden, out to the 100 m isobath, this EBSA provides a potentially important feeding area for marine mammals, particularly humpback whales. • Many marine mammals aggregate here, especially in the summer months, although a variety of cetaceans, seals, leatherback sea turtles and seabirds feed in the area from spring to fall.
Lilly Canyon-Carson Canyon	• Defined as the area from 44.8°N to 45.6°N along the 200 m isobath of the southeast slope of the Grand Bank. • This EBSA is important as a seasonal refuge and feeding area for overwintering marine mammals.

EBSA Name	Description and Importance to Marine Mammals and Seabirds
Northeast Shelf and Slope	• The northeastern Grand Bank, starting at the nose of the Bank, from 48°W to 50°W, and from the edge of the shelf to the 1000 m isobath. • This EBSA has moderate fitness consequences as a potentially important marine mammal feeding area; harp seals, hooded seals and pilot whales in particular aggregate in this area.
Orphan Spur	• A large area extending along the Labrador Slope and Outer Shelf in NAFO Division 3K, including the Orphan Spur and part of the Trinity Trough Mouth Fan. • The northern portion extends from 400 m to 2,000 m depth; south of the Orphan Spur, the maximum depth is approximately 1,000 m. • Several marine mammal and seabird species frequent this area, including the Thick-billed Murre, Black-legged Kittiwake, Northern Fulmar, Greater Shearwater, Dovekie, storm-petrels, skuas and jaegers.
Fogo Shelf	• This EBSA extends from the headlands at the western entrance of the Bay of Exploits, and approximately follows the 200 m isobath eastward to the study area boundary near Cape Freels. • Includes Twillingate Island, New World Island, Fogo Island, and many smaller islands in the Bay of Exploits and Gander Bay areas, as well as Funk Island, home to the largest Common Murre colony in the western North Atlantic and the only Northern Gannet breeding colony the Newfoundland and Labrador Shelves bioregion. • Other bird species that aggregate in high concentrations throughout this EBSA include Common Eider, Atlantic Puffin, Great Black-backed Gull, Great Shearwater, Herring Gull, Northern Fulmar, Thick-billed Murre and terns. • An abundance of beach and sub-tidal capelin spawning areas in coastal portions of the EBSA, with the greatest concentrations on North Twillingate Island and along the coast west of Cape Freels. • Important cetacean feeding areas have also been identified in this area; community-based Coastal Resource Inventory data identified several areas of marine mammals presence.
Notre Dame Channel	• Part of a larger channel extending offshore from Notre Dame Bay towards the Labrador Slope, branching southward along the inner edge of Funk Island Bank; this EBSA includes only the southeast branch of the Channel between the Fogo Shelf area and Funk Island Bank. • This EBSA is significant for cetacean feeding and migration. • Also frequented by several species of seabirds, including Common Murre, Thick-billed Murre, Black-legged Kittiwake, Great Black-backed Gull, Northern Fulmar, phalaropes, skuas and jaegers, Sooty Shearwater and storm-petrels. • Harp seals are known to feed in this EBSA and surrounding areas during winter.
Grey Islands	• Located east of the Northern Peninsula, this EBSA includes the coastal areas surrounding the Grey Islands, extending inshore to include part of Hare Bay and southeast along the inner shelf towards Fogo Island. • Important for waterfowl, as well as seabirds in coastal areas and on the shelf. • Along the coast, Common Eider and Harlequin Duck occur in high concentrations. The Great Black-backed Gull, Herring Gull and terns also have important breeding colonies in this area. • A high diversity of seabird species (e.g. Common Murre, Atlantic Puffin, Black-legged Kittiwake, Dovekie, Great Black-backed Gull, Great Shearwater, Sooty Shearwater, Herring Gull, Northern Fulmar, Northern Gannet, phalaropes, skuas and jaegers, storm-petrels and terns) aggregate along the inner shelf area and may be considered an indication of high, year-round, productivity in that area.

EBSA Name	Description and Importance to Marine Mammals and Seabirds
Gilbert Bay	• The Gilbert Bay EBSA extends from the head of Gilbert Bay out to the headlands of Salmon Point to the north, and also includes Alexis Bay and surrounding coastal areas to Spear Point in the south. It is a shallow-water, low-gradient, sub-arctic fjord located on the southeast coast of Labrador, composed of a series of basins separated by sills that become shallower towards the head. The bay is 28 km long and is less than 4 km at its widest point, covering approximately 60 km². • Productive source of food for marine mammals and seabirds; capelin are known to spawn in the area.
Labrador Marginal Trough	• Extends from the Cartwright Saddle south through the Labrador Marginal Trough and into the Hawke Saddle, just inside Hamilton Bank. • The trough area is a potential corridor for several species of mammals. Cetaceans aggregate in this area for feeding during the fall, and also frequent Hamilton Bank and out to the Labrador Slope at the same time. • The EBSA contains part of the area identified as having highest probability of use for harp seal whelping and feeding. Important area for several species of seabirds, including murres, Black-legged Kittiwake, Great Black-backed Gull, Herring Gull, Northern Fulmar, Atlantic Puffin, skuas and jaegers, Sooty Shearwater, and Ivory Gull.
Labrador Slope	• The Labrador Slope EBSA generally includes the slope from the 400 m to 2,000 m isobaths, and extends from the outer edge of Makkovik Bank, southward along the slope to the outer edge of Belle Isle Bank. • In general, the area is high in diversity; it supports juvenile and female hooded seals, as well as a variety of cetaceans and seabirds which occur in high relative numbers for feeding. (e.g. Black-legged Kittiwake, Dovekie, Great Black-backed Gull, Great Shearwater, Sooty Shearwater, Northern Fulmar, skuas and jaegers and phalaropes).
Hamilton Inlet	• Includes the coastal and inner shelf area (approximately out to the 200 m isobath) outside of Hamilton Inlet, Sandwich Bay and south to Black Tickle-Domino on Island of Ponds. The EBSA occurs at the outflow of Lake Melville, which drains most of the Labrador plateau and provides nutrients that are critical to initiate primary productivity blooms along the Labrador coast. • Several Capelin spawning beaches occur at the southern end of the EBSA, while Paradise River, Eagle River, White Bear and North Rivers (Sandwich Bay area) are highly productive for Atlantic Salmon. • Several bird species are found here in high concentrations, including two of the three highest density Atlantic Puffin colonies, and all four of the highest density Razorbill colonies occurring within the Newfoundland and Labrador Shelves bioregion. Colonies of great Black-Backed Gull, Herring Gull and Northern Fulmars also occur in the area. • Polynyas, large and productive areas of open water surrounded by sea ice, also form in this EBSA annually. • The main harp seal whelping concentration usually forms on the pack ice in this EBSA, and the western portion of Inlet is an important fall and early winter feeding area for ringed seals. • The area is important for several waterfowl species (dabbling ducks, geese and sea ducks, including Common Eider and Harlequin Duck). • High concentrations of many other seabird species (Northern Gannet, Razorbill, Dovekie, murres, skuas, jaegers, and Sooty Shearwater) occur within this EBSA.

Figure 4.110a Marine Mammal Sightings off Eastern Newfoundland

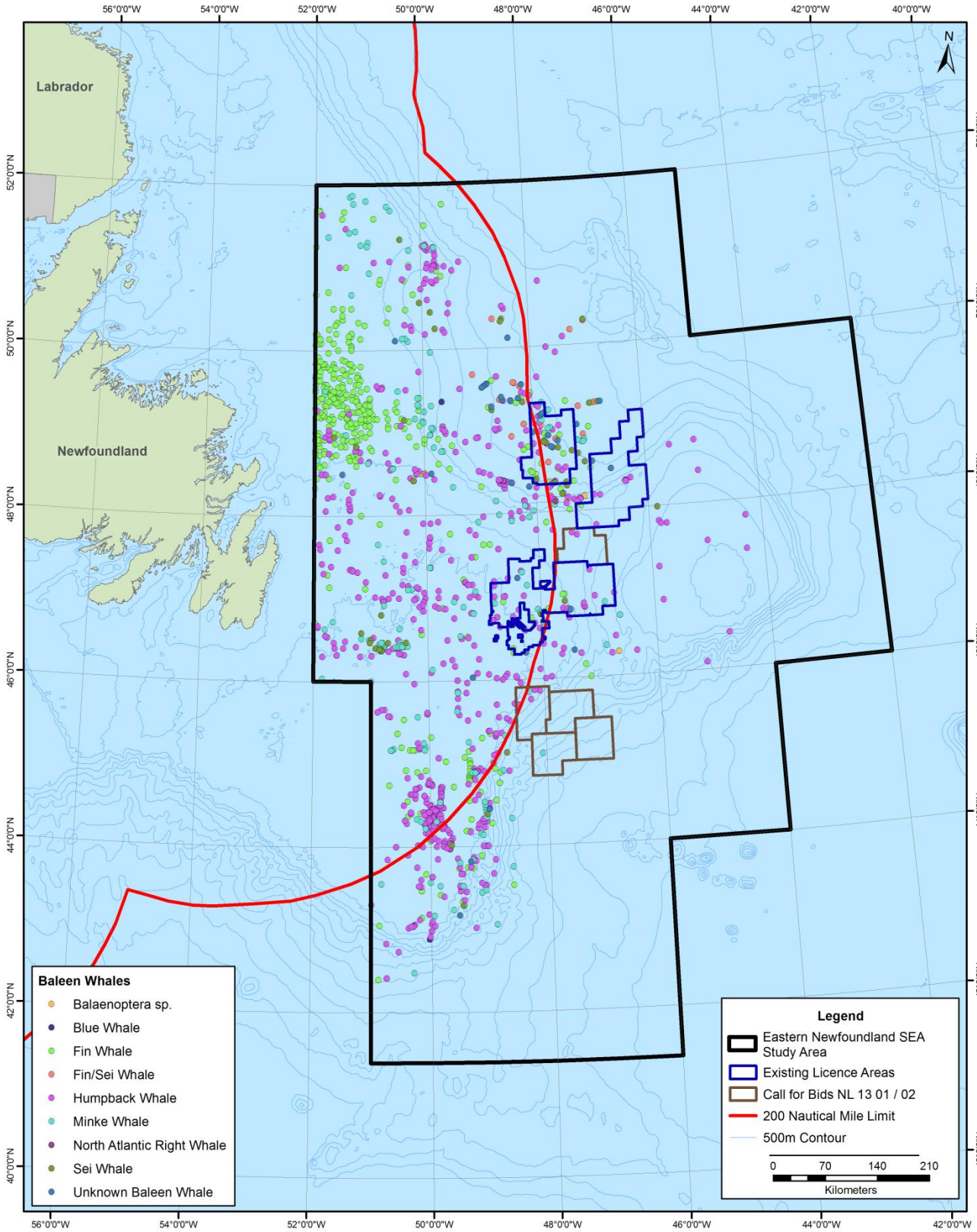


Figure 4.110b Marine Mammal Sightings off Eastern Newfoundland (Continued)

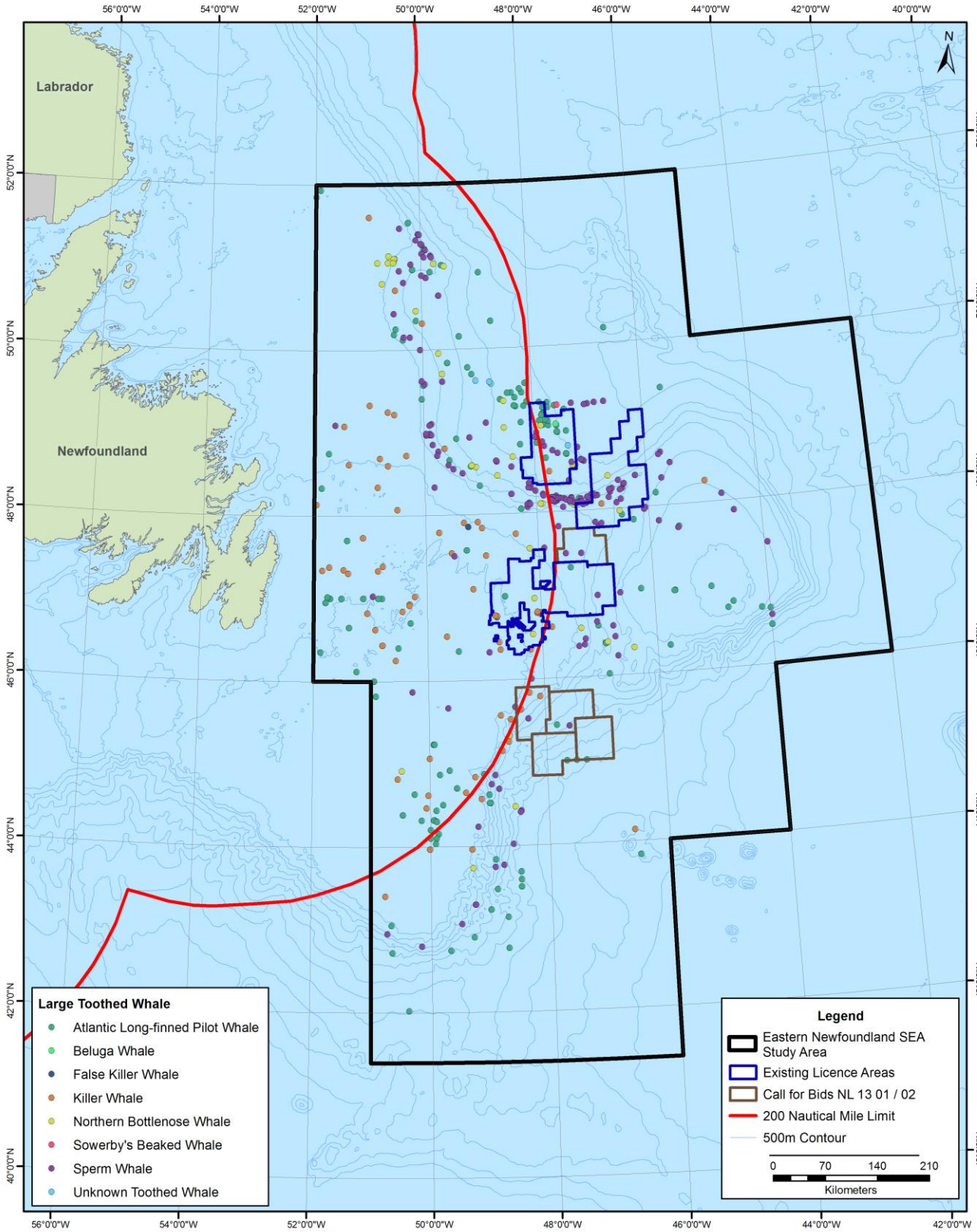
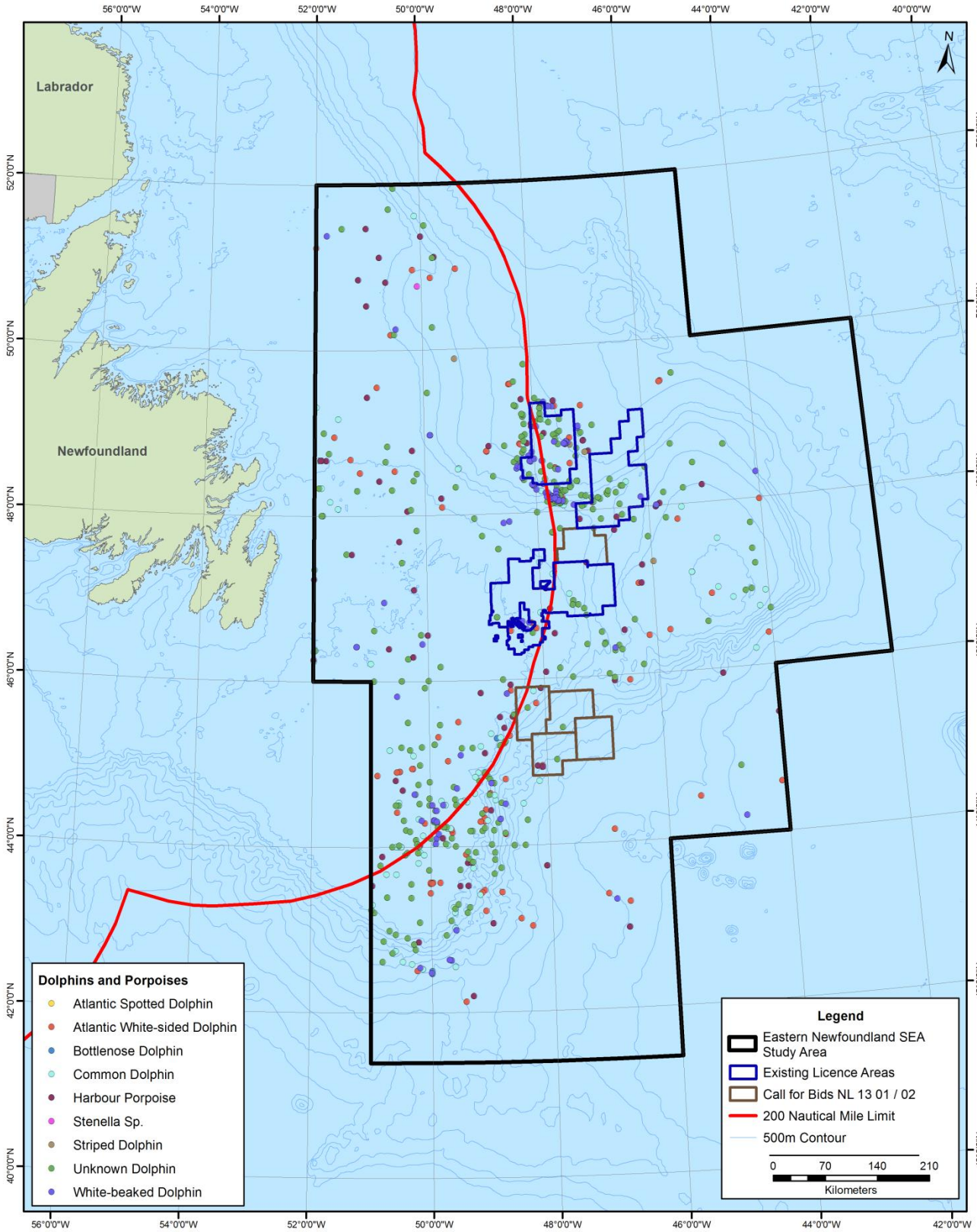


Figure 4.110c Marine Mammal Sightings off Eastern Newfoundland (Continued)



Critical habitat has been identified in the federal recovery strategies for two of the marine mammal species at risk that have been reported in the SEA Study Area: 1) the northern bottlenose whale (Scotian Shelf population); and 2) the North Atlantic right whale. Critical habitat for the northern bottlenose whale is located off the southern coast of Nova Scotia, along the Scotian Shelf (DFO 2010c). The North Atlantic right whale's critical habitat is located within the Bay of Fundy and off of southern Nova Scotia at Roseway Basin (Brown et al 2009). It is anticipated that the identification and delineation of critical habitat for the blue whale will be completed in 2014 (Beauchamp et al 2009).

Recovery strategies identifying critical habitat are not currently available for the other species at risk reported in the SEA Study Area. However, information from the COSEWIC species assessments indicate that sightings of the leatherback turtle and harbour porpoise occur throughout the Study Area (COSEWIC 2010d, 2012c). Analysis of data obtained from a tracking study show three high-use feeding areas for leatherback turtles: 1) waters east and southeast of Georges Bank, including the Northeast Channel near the southwestern boundary of the Canadian Exclusive Economic Zone; 2) the southeastern Gulf of St. Lawrence and waters off eastern Cape Breton Island, including Sydney Bight, the Cabot Strait, portions of the Magdalen Shallows and adjacent portions of the Laurentian Channel; and 3) waters south and east of the Burin Peninsula, Newfoundland, including parts of Placentia Bay (DFO 2012). Information from this DFO tracking study is being used to inform the identification of critical habitat in a forthcoming amendment to the species' Recovery Strategy (DFO 2013). The range of Sowerby's beaked whale encompasses much of the area as well (COSEWIC 2006c).

Although some marine mammal species are year-round residents (as detailed in the above sections), cetaceans and reptiles are most likely to occur in the SEA Study Area during the summer months, where the Grand Banks and surrounding waters provide important feeding habitat. With the exception of grey seals, which are present year-round, pinnipeds are most abundant in the winter.

4.2.4 Sensitive and Special Areas

In Canada, unique or sensitive environments may be designated as protected through federal or provincial legislation, with areas sometimes also being protected and/or managed by municipal or Aboriginal governments. These special places may be set aside to protect important or sensitive species and habitats, as representative natural areas, for cultural or historical reasons, and/or for human use and enjoyment.

This section describes various types of existing and proposed protected and designated sensitive and special areas in Eastern Newfoundland. Information was obtained from the Conservation Areas Reporting and Tracking System (CARTS) published by the Canadian Council on Ecological Areas, as well as through sources from and associated with Parks Canada, Environment Canada, Fisheries and Oceans Canada (DFO), the provincial Department of Environment and Conservation, the Placentia Bay / Grand Banks Large Ocean Management Area, Important Bird Areas Canada, the Convention on Wetlands of International Importance (Ramsar) and the Western Hemisphere Shorebird Reserve Network.

4.2.4.1 Eastern Newfoundland Protected Areas

Eastern Newfoundland currently has a number of protected areas, with other important and sensitive areas having been identified but not holding protected status.

National Parks

Parks Canada establishes National Parks (under the *National Parks Act)* to protect representative examples of Canada's 39 terrestrial natural regions. National historic sites commemorate significant historical locations or events.

Newfoundland and Labrador has three national parks and 45 national historic sites. Terra Nova National Park, located in Eastern Newfoundland, protects inland and coastal areas including offshore islands and estuarine and intertidal ecosystems (Figure 4.111) (Parks Canada 2013). Terra Nova is a popular recreational area especially for golf, camping and hiking and is also located near other amenities such as the T'Railway, which is used for snowmobiling (Table 4.101). Camping areas are located in the Park and a number of accommodations (e.g. rental cottages and motels) are located throughout the Eastport Peninsula.

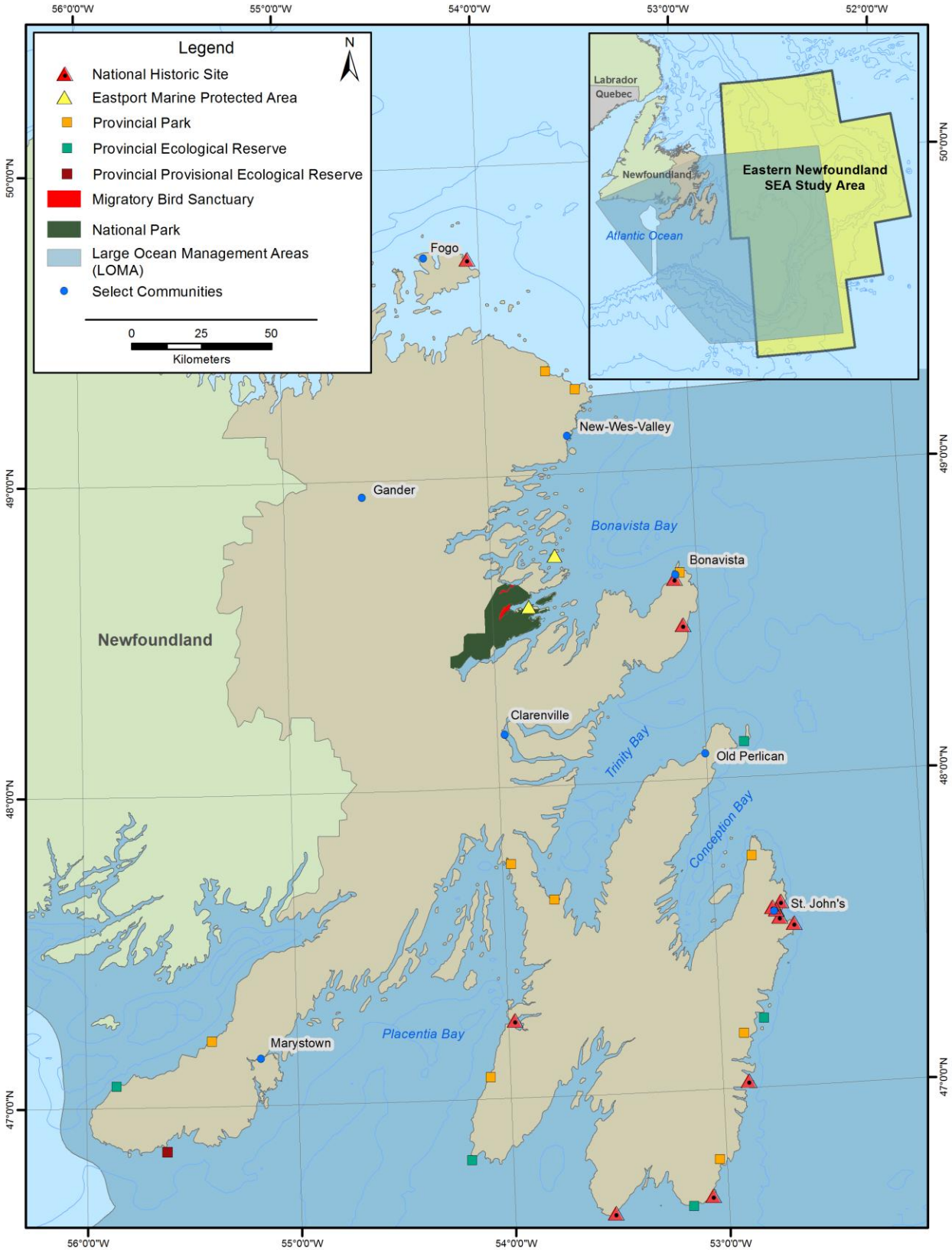
Of the nine National Historic Sites administered by Parks Canada, five are located in Eastern Newfoundland and four of these are located in coastal areas (Figure 4.111). The Ryan Premises, Signal Hill, Cape Spear and Castle Hill are located on the coast with property, elements and activities that occur in or near the marine environment (Table 4.101).

A number of National Historic Sites are managed by other entities, including provincial and municipal governments. Owing to the fact that the history of the province is rooted in the fishery and other seafaring activities, a number of these are located in coastal areas. In Eastern Newfoundland other historic sites include Boyd's Cove, Tilting, Port Union, Fort Amherst, Murray Premises, Colony of Avalon, Cape Race Lighthouse and Cape Pine Lighthouse.

Table 4.101 National Parks and National Historic Sites in Eastern Newfoundland

Park	Location	Key Characteristics and Features
Terra Nova National Park	Central, coastal Newfoundland	• Includes several offshore islands • Follows the coastline of Newman Sound and Clode Sound, both including rich estuarine and intertidal ecosystems • Bay du Nord Wilderness Reserve is located south of TNNP • Bay du Nord River is designated as a Canadian Heritage River • Kittiwake and Discovery Trail tourism regions • Provincial T'Railway system to the west • Two campgrounds and primitive camp sites • Terra Nova Resort and Golf Community • Trails including those in coastal areas
Ryan Premises National Historic Site	Bonavista Peninsula	• Restored merchant's premises on a Bonavista wharf • Includes the Bonavista Museum, displaying artifacts focusing on traditional Newfoundland seafaring life
Signal Hill National Historic Site	St. John's Harbour	• Historic site of military defence, marine communication and marine observation • Popular destination for residents and tourists • Whale, seabird and iceberg watching • Includes coastal hiking trails
Cape Spear Lighthouse National Historic Site	South of St. John's	• Restored historical lighthouse on most eastern point of North America • Follows the coastline and includes sections of the East Coast Trail system • Whale, seabird and iceberg watching
Castle Hill National Historic Site	Placentia Bay	• Site of 17th and 18th century French and English fortifications representing battles over Newfoundland fisheries resources • Hiking trails and picnic areas
Source: Parks Canada (2009, 2013)		

Figure 4.111 Marine and Coastal Parks, Other Protected Areas and Important Areas in Eastern Newfoundland



Provincial Parks and Protected Areas

The Newfoundland and Labrador Department of Environment and Conservation establishes and manages six types of provincial protected areas, each of which is designed to fulfill various conservation, recreation and / or cultural goals. The Parks and Natural Areas Division is responsible for wilderness and ecological reserves and provincial parks. The Wildlife Division manages wildlife reserves and an existing nature park. The Lands Branch and/or Parks and Natural Areas Division oversee Crown Reserves and other Special Management Areas (NLDEC 2013a, NLDEC 2013b). The Province has also developed a Parks and Natural Areas Systems Plan for Newfoundland and Labrador that has not yet been publicly released.

Existing provincial parks and protected areas in Eastern Newfoundland are listed and described briefly in Table 4.102. These include the marine and coastal parks and protected areas illustrated in Figure 4.111.

Table 4.102 Eastern Newfoundland Marine and Coastal Provincial Parks and Protected Areas

Park	Location	Purpose / Usage
Bellevue Beach Provincial Park Reserve	Isthmus of the Avalon	• Protects beach complex and saltmarsh • Habitat for migratory birds
Chance Cove Provincial Park	East of Trepassey	• Whale and seabird watching • Camping, picnicking
Deadman's Bay Provincial Park	Northeast coast of Lumsden	• Iceberg watching • Day use
Dildo Run Provincial Park	Near Twillingate and Moreton's Harbour	• Day and recreational vehicle camping • Hiking • Kayaking / canoeing
The Dungeon Provincial Park	Near Bonavista	• Scenic attraction • Day use, picnicking
Frenchman's Cove Provincial Park	West side of the Burin Peninsula	• Day use • Camping, picnicking, swimming, golf, playground • Bird watching
Gooseberry Cove Provincial Park	South of Placentia	• Day use, sandy beach
Marine Drive Provincial Park Reserve	Pouch Cove	• Day use, sandy beach • Swimming, mini golf, picnicking • Hiking trails
Windmill Bight Provincial Park Reserve	Near Lumsden	• Protection for plateau bog
Source: NLDEC (2013a)		

Provincial Wildlife and Ecological Reserves

Ecological Reserves are created to protect and conserve ecosystems or ecoregions and/or to protect rare, unique or endangered species of plants, animals and other identifiable components of natural heritage. Seven existing Ecological Reserves are found in marine and coastal areas of Eastern Newfoundland (Table 4.103). Of these, four are Seabird Ecological Reserves and one is a provisional Seabird Ecological Reserve (NLDEC 2013b).

Table 4.103 Eastern Newfoundland Marine and Coastal Ecological Reserves

Name / Location	Description / Special Features
Cape St. Mary's Ecological Reserve	• Numerous species of seabirds, all of which can be seen from land • Bird Rock, a sandstone stack, is inhabited by Gannets • 24,000 Northern Gannet, 20,000 Black-legged Kittiwake, 20,000 Common Murre, and 2,000 Thick-billed Murre • Razorbill, Black Guillemot, Double-Crested and Great Cormorant and Northern Fulmar nesting areas • Offshore waters are important wintering areas for numerous species of ducks
Baccalieu Island Ecological Reserve	• Largest protected seabird island in the province • More breeding seabirds than any other area of the province • Largest Leach's Storm Petrel colony in the world • Second largest Puffin colony in North America • Access limited to researchers with valid permits during breeding season (April 1-October 30)
Fortune Head Ecological Reserve	• Rocks exhibit geological boundary between Precambrian era and Cambrian period • Fossils mark a historical change in marine organisms
Funk Island Ecological Reserve	• Historic nesting place of the extinct Great Auk • Smallest seabird ecological reserve in NL • Access limited to scientific researchers
Lawn Islands Archipelago Provisional Ecological Reserve	• Consists of three islands: Middle, Offer and Columbier • Home to thousands of nesting seabirds of eight breeding species • Largest colony of Common Murres in the Western North Atlantic • Other species include Northern Gannet, Northern Fulmar, Atlantic Puffin, Razorbill, Thick-Billed Murre, Black-Legged Kittiwake, and Herring and Great Black-Backed Gulls • Middle Island is the only colony of Max Shearwater in North America • Area has been granted provisional status while a full site assessment is completed by Provincial Government
Mistaken Point Ecological Reserve	• One of the world's most significant fossil sites • Variety of fossils as more than 30 species have been identified • Fossils include Ediacara biota, organisms that lived 575-542 million years ago • On the Canadian Tentative List of potential UNESCO World Heritage sites
Witless Bay Ecological Reserve	• Contains four islands: Gull, Green, Great and Pee Pee • Home to a large number of bird species • North America's largest Puffin colony • Second largest Leach's Storm-Petrel colony in the world
Source: NLDEC (2013b)	

National Marine Conservation Areas

Parks Canada establishes National Marine Conservation Areas (NMCAs) under *the Canada National Marine Conservation Areas Act*. NMCAs are marine areas managed for ecologically sustainable use and contain smaller zones of protection. They include the seabed, the water column above it and they may also take in wetlands, estuaries, islands and other coastal lands (Parks Canada 2008). The NCMA program has generally subdivided the Atlantic Canada region into various subregions for the purposes of evaluation and the potential designation of additional areas for designation. No NMCAs have been established in the SEA Study Area or elsewhere in Eastern Newfoundland.

Marine Protected Areas (MPAs) and Areas of Interest (AOI)

Canada's *Oceans Act* mandates the Minister of Fisheries and Oceans to lead and coordinate the development and implementation of a national network of marine protected areas. These areas are ecologically significant, with species and / or properties that require special consideration. An *Oceans Act* Marine Protected Area (MPA) is a protective designation that protects the health of marine ecosystems and their resources. 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 whether to formally designate them as MPAs. There is one MPA (made up of two areas) located in Eastern Newfoundland, with no other AOIs identified (DFO 2013c). The Eastport MPA protects two marine and coastal areas of the Eastport Peninsula (Table 4.104 and Figure 4.111).

Table 4.104 Marine Protected Area in Eastern Newfoundland

Name	Description / Special Features	Purpose / Status
Eastport	• Coastline contains a number of headlands, coves and beaches, as well as islands that provide habitat for marine wildlife • Provides habitat to numerous species of pelagic fish, groundfish, shellfish, marine mammals, and aquatic plants • Contains two areas of lobster habitat closed to harvesting	• Creation of the Eastport Peninsula Lobster Protection Committee has promoted the rejuvenation of lobster stocks with the closure of habitats and various community initiatives
Source: DFO (2013c)		

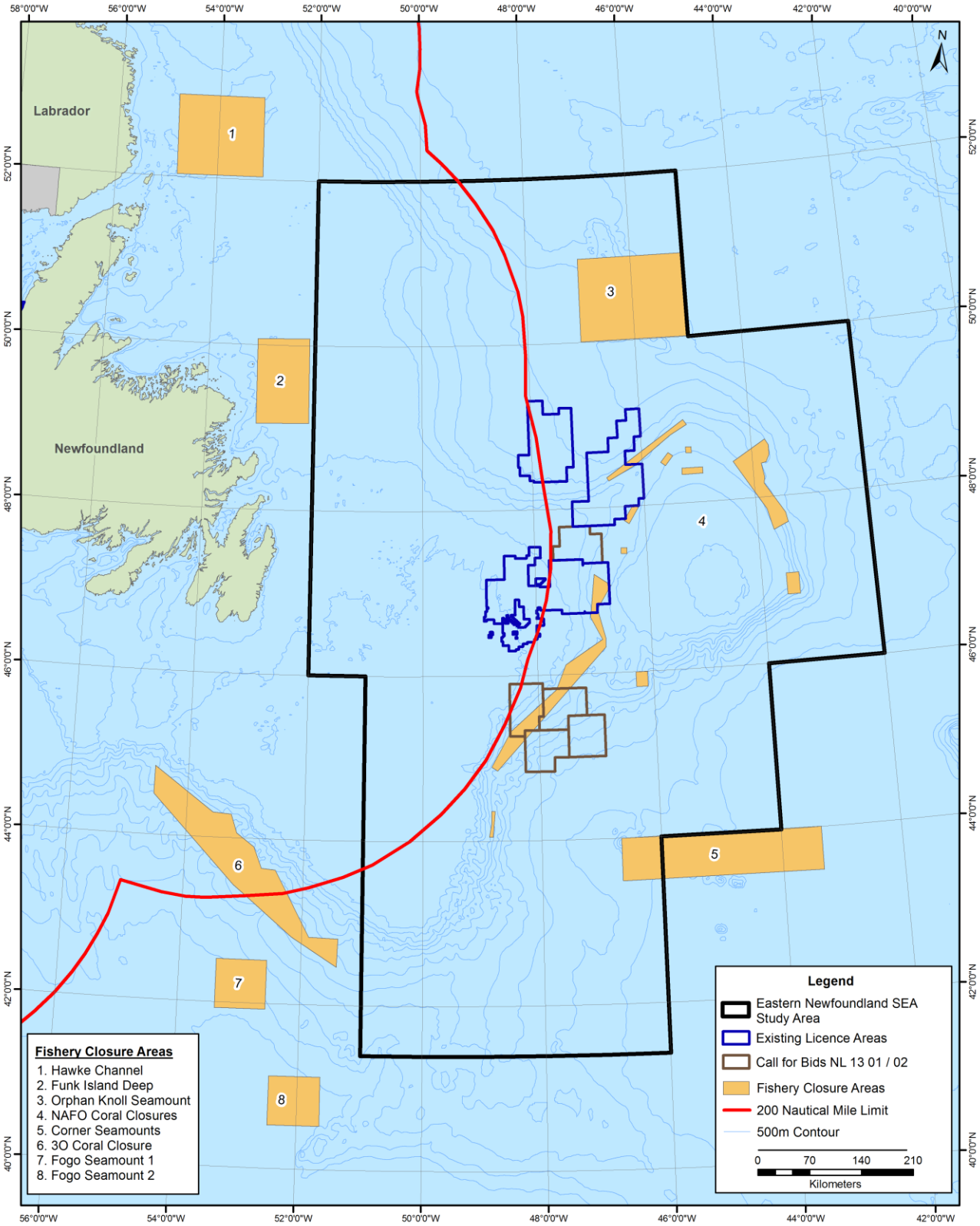
Fisheries Closures

Through the federal *Fisheries Act*, DFO has implemented various fisheries closures to help conserve ocean bottom (benthic) species, habitats and biodiversity. These fisheries closures restrict one or more types of bottom contact fishing gear (DFO 2009, 2011a). In response to the known sensitivity of coral and sponge grounds, several important coral and sponge areas have been designated as VMEs (DFO 2012b) and are protected from damaging fishing activities in Canadian and NAFO waters (Campbell and Simms 2009, NAFO 2013). A number marine areas in Eastern Newfoundland are subject to such fisheries closures, several of these are located within the SEA Study Area (DFO 2011a, Table 4.105 and Figure 4.112).

Table 4.105 Fisheries Closures in Eastern Newfoundland

Name	Size (km^2)
Orphan Knoll Seamount	15,737
Corner Seamounts	45,894
NAFO Coral Closures	8,844
Source: DFO (2011a)	

Figure 4.112 Fisheries Closure Areas off Eastern Newfoundland



National Wildlife Areas, Marine Wildlife Areas and Migratory Bird Sanctuaries

Through the *Canada Wildlife Act*, the Government of Canada has established 54 National Wildlife Areas 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 this total area protecting marine habitats. No National Wildlife Areas and thus no Marine Wildlife Areas (MWAs) are located in Newfoundland and Labrador (Environment Canada 2013b).

In 1994, the *Canada Wildlife Act* was amended to allow identification of MWAs beyond the 12 nautical mile territorial sea limit out to the 200 nautical mile exclusive economic zone limit. No such MWAs have yet been identified, but several candidate sites are currently being evaluated in Canada (ACZISC 2013).

On the Island of Newfoundland, Migratory Bird Sanctuaries (MBS) are located on the east coast of the Northern Peninsula (outside of the SEA Study Area) and in Terra Nova National Park (Figure 4.111). The 1,178 hectare Terra Nova MBS is located in two areas along Southwest Arm and Newman Sound (Environment Canada 2013).

4.2.4.2 Other Identified Important and Sensitive / Special Areas off Eastern Newfoundland

A number of other important, sensitive or otherwise special areas have been identified in the marine and coastal environments off Eastern Newfoundland.

Large Ocean Management Areas

Large Ocean Management Areas (LOMAs) are established for integrated management planning. Boundaries are determined using a combination of ecological and administrative considerations. Management of the Placentia Bay / Grand Banks Large Ocean Management Area (PB/GB LOMA), which overlaps the SEA Study Area, is led by DFO under Canada's *Oceans Act* (Figure 4.111). This area was identified because it possesses important living and non-living marine resources, areas of high biological diversity and productivity and increasing development pressures and competition for ocean space and resources (PB / GBLOMA 2013).

Ecologically and Biologically Significant Areas

DFO has identified eleven Ecologically and Biologically Significant Areas (EBSAs) within the Placentia Bay / Grand Banks LOMA: 1) Southeast Shoal and Tail of the Banks; 2) Placentia Bay Extension; 3) Southwest Shelf Edge and Slope; 4) Laurentian Channel and Slope; 5) St. Pierre Bank; 6) Smith Sound; 7) Eastern Avalon Coast; 8) Northeast Shelf and Slope; 9) Lilly Canyon-Carson Canyon; 10) Virgin Rocks; and 11) Burgeo Bank. These areas have relatively high ecological or biological activity that is important to ecosystem structure and function within the LOMA (DFO 2007a), and have been described in Sections 4.2.1 – 4.2.3 of this SEA Report in relation to particular biophysical components of the marine environment.

Vulnerable Marine Ecosystems and Important Coral Areas

The United Nations, General Assembly has defined Vulnerable Marine Ecosystems (VMEs) and mandated regional fisheries management organizations to adopt conservation measures to protect these areas from bottom fishing activities. The NAFO Scientific Council has identified VME candidate areas for

corals, sponges and seamounts in NAFO areas 3LMNO (WWF 2012). DFO has also identified various important coral areas in Eastern Newfoundland, as described and illustrated in Section 4.2.1.

Important Bird Areas

The Important Bird Areas (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 National Wildlife Areas or Migratory Bird Sanctuaries and all are included in science-based initiatives to identify, conserve and monitor a network of sites that provide essential habitat (BLI 2013). Seventeen IBAs are located in Eastern Newfoundland, some of which are also formally protected (see Section 4.2.2.6).

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. In 1981, Canada became a contracting party to the Ramsar Convention. To date, Canada has designated 37 Ramsar Sites of which 17 are also National Wildlife Areas or Migratory Bird Sanctuaries (Environment Canada 2012). The only Ramsar site in Newfoundland (Codroy Valley Estuary) is located on the west coast of the Island (Ramsar 2013).

Western Hemisphere Shorebird Reserve Network

North and South American scientists established the Western Hemisphere Shorebird Reserve Network (WHSRN) conservation strategy in 1986 to protect key habitats to sustain healthy populations of shorebirds. Of the seven identified Canadian sites, only one (i.e. Bay of Fundy) is located in Eastern Canada (WHSRN 2013). There are therefore no such designated sites located in Eastern Newfoundland.