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12.0 SPECIES AT RISK

For the purposes of this assessment, Species at Risk (SAR) refers to those species of marine fish, mammals, birds and reptiles listed under Canada's *Species at Risk Act* (SARA), or assessed as endangered, threatened, or special concern species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which could potentially occur in the Nearshore or Offshore Study Areas and be affected by WREP activities. Many of the mitigation measures and management strategies for Species at Risk are the same as for non-listed marine species discussed elsewhere in this environmental assessment (Chapters 8, 10 and 11).

12.1 Environmental Assessment Boundaries

12.1.1 Spatial Boundaries

The spatial boundaries of the Nearshore and Offshore Project and Study Areas are defined in the Effects Assessment Methods (Chapter 5). The Study Areas for the SAR VEC are illustrated in Figures 5-2 and 5-4 for the Nearshore and Offshore, respectively. The Affected Areas for the WREP with respect to this VEC have been determined based on the results of modelling.

12.1.2 Temporal Boundaries

The temporal boundaries for the assessment are defined in Chapter 5 and outlined in Table 12-1.

Table 12-1 Temporal Boundaries of Nearshore and Offshore Study Areas

Study Area	Temporal Boundary
Nearshore	• In the case of the WHP development option, site preparation, graving dock construction, construction of CGS, dredging, topsides mating and tow-out will occur over an estimated 30 to 38 months from 2013 to 2016. Various activities will occur at all times of year until completion • In the case of the subsea drill centre development option, no nearshore activities will occur
Offshore	• In the case of the WHP development option, site preparation, installation of the WHP and initial production/maintenance will occur from 2016 to 2017. The WHP will be decommissioned and abandoned in accordance with standard practices at the end of its production life, which is anticipated to be 25 years • The subsea drill centre option is scheduled to begin construction in 2014, with first oil expected in 2015. Under this option, the wells will be plugged and abandoned at the end of its production life (anticipated to be 20 years), and the subsea infrastructure removed or abandoned in accordance with relevant regulations

12.1.3 Administrative Boundaries

Species at Risk are protected federally under SARA and protection is administered by Environment Canada, DFO and Parks Canada. The goal of SARA is to facilitate the recovery of endangered or threatened species, to manage species of special concern to prevent them from becoming endangered or threatened and to prevent species and populations endemic to Canada from becoming extirpated or extinct (Section 6).

Species and populations that are protected federally are listed as endangered, threatened, of special concern, extirpated or extinct under Schedule 1 of SARA and are subject to permit and enforcement provisions of the Act. Under the Act (Section 32), the killing, harming, harassing, capturing, or taking of an individual that is listed as extirpated, endangered or threatened is prohibited. Section 33 prohibits the damage or destruction of an endangered, threatened, or extirpated species. Section 58 prohibits the destruction of critical habitat for any listed endangered or threatened species. Marine mammals are also protected under the *Fisheries Act*.

The main provisions of SARA are scientific assessment and listing of species, species recovery, protection of critical habitat, compensation, permits and enforcement. The Act also provides for development of official recovery plans for species found to be most at-risk, and management plans for species of special concern. As of April 2012, recovery strategies and/or management plans are in place for the following species that may occur within one or both of the Study Areas: white shark (*Carcharodon carcharias*); northern wolffish (*Anarhichas denticulatus)*; spotted wolffish (*Anarhichas minor*); Atlantic wolffish (*Anarhichas lupus)*; blue whale (*Balaenoptera musculus)*; North Atlantic right whale (*Eubalaena glacialis*); fin whale (*Balaenoptera physalus*); beluga whale (*Delphinapterus leucas*); northern bottlenose whale (*Hyperoodon ampullatus*); leatherback turtle (*Dermochelys coriacea*) (Atlantic population); Harlequin Duck (*Histrionicus histrionicus*); and Piping Plover (*Charadrius melodus melodus*).

Marine mammals and fish, including those species assessed at risk, are protected under the *Fisheries Act*. Section 35 of the Act prohibits the harmful alteration, disruption or destruction of fish habitat, while Section 36 prohibits the deposition of substances considered deleterious to fish. Marine mammals are included in the definition of fish under the Act. Environment Canada administers Section 36 of the *Fisheries Act* while DFO administers Section 35 of the Act.

Newfoundland and Labrador's *Endangered Species Act* also provides protection for animal species considered to be endangered, threatened, or vulnerable in the province. The act applies to species, subspecies and populations that are native to the province but does not include marine fish. Designation under the Act follows recommendations from the COSEWIC and/or the Special Status Advisory Committee (SSAC) on the appropriate assessment of a species. The SSAC is an independent provincial committee of government and non-government scientists who determine the provincial status of species, subspecies and populations.

12.2 Definition of Significance

A significant, adverse environmental effect is one that, after application of feasible mitigation and consideration of reasonable WREP alternatives, will: jeopardize the achievement of self-sustaining population objectives or recovery goals; is not consistent with applicable allowable harm assessments; will result in permanent loss of critical habitat as defined in a SAR recovery plan or action strategy; and/or where an incidental harm permit would not likely be issued. In the case of SAR, the killing, harming, harassing, capturing, or taking of an individual that is listed as extirpated, endangered or threatened may be considered significant if a population is vulnerable to extinction.

An adverse residual environmental effect that does not meet the above definition is considered to be not significant.

12.3 Existing Environment

A description of the physical environment of the Nearshore and Offshore Study Areas is provided in Chapter 4. Profiles for species not listed as SAR can be found in Marine Fish and Fish Habitat (Section 8.3), Marine Birds (Section 10.3) and Marine Mammals and Sea Turtles (Section 11.3). The SAR that are most likely to occur in the Nearshore and Offshore Study Areas are summarized in the following sections.

The SARA-listed species that could potentially occur in the Nearshore and Offshore Study Areas are listed in the Table 12-2. Species that are not on SARA Schedule 1, but have been assessed as endangered, threatened, or special concern species by COSEWIC and could potentially occur in the Nearshore or Offshore Study Areas, are listed in Table 12-3. The likelihood of occurrence provided in the tables is based on known distribution from available literature. Detailed descriptions of the biology, ecology, distribution and conservation status of each species are provided in the sections following Tables 12-2 and 12-3.

Table 12-2 List of Species Included on Schedule 1 of the *Species at Risk Act* that Could Occur Within the Nearshore and Offshore Study Areas

Common Name	Scientific Name	SARA Schedule 1 Status	Occurrence in Relation to the WREP
White shark (Atlantic population)	*Carcharodon carcharias*	Endangered	Low potential for occurrence in the Nearshore and Offshore Study Areas. Wide-ranging species. Rare in Canadian waters (32 records in 132 years), occurring mainly within the Bay of Fundy. Newfoundland represents northern limit of range
Northern wolffish	*Anarhichas denticulatus*	Threatened	Low potential for occurrence in the Nearshore Study Area. Moderate potential for occurrence in the Offshore Study Areas. Most commonly found in cold, deep water between surface and 1,000 m at temperatures below 5^{o}C, but can occur in surface waters. Commonly solitary and pelagic with little migratory behavior. In Newfoundland waters, it is common in the northeast and Flemish Cap, as well as in the northern Gulf of St. Lawrence, and occurs rarely further south on the Grand Bank
Spotted wolffish	*Anarhichas minor*	Threatened	Moderate potential for occurrence in Nearshore Study Area, and moderate potential for occurrence in the Offshore Study Area. Cold water species most commonly found in water depths of 50 to 750 m. Distribution is most concentrated in the deep shelf area off northeastern Newfoundland and Labrador
Atlantic wolffish	*Anarhichas lupus*	Special Concern	Moderate potential for occurrence in Nearshore and moderate to high potential in the Offshore Study Area. Demersal species commonly at depths from shallow to 918 m, but appears to prefer 100 to 150 m depth range. Widely distributed in Atlantic Canada. Most abundant in northeastern Newfoundland Labrador, Flemish Cap and southern Grand Bank
Blue Whale (Atlantic population)	*Balaenoptera musculus*	Endangered	Low to moderate potential for occurrence in the Nearshore Study Area. Low to moderate potential for occurrence in the Offshore Study Area. Observed in both coastal waters and open ocean

Common Name	Scientific Name	SARA Schedule 1 Status	Occurrence in Relation to the WREP
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered	Low to no potential for occurrence in the Nearshore Study Area. Moderate potential for occurrence in the Offshore Study Area. Ranges from coastal Newfoundland and Labrador and the Gulf of St. Lawrence to Florida. Congregates in the summer and fall in the lower Bay of Fundy, and in smaller numbers elsewhere on the Scotian Shelf and in the Gulf of St. Lawrence.
Fin Whale (Atlantic population)	*Balaenoptera physalus*	Special Concern	Low to moderate potential for occurrence in the Nearshore Study Area. High potential for occurrence in the Offshore Study Area. Worldwide distribution, but most common in temperate waters and the southern hemisphere. Found in summer feeding concentrations between the shore and the 1,800 m depth contour in the North Atlantic
Northern Bottlenose Whale (Scotian Shelf Population)	*Hyperoodon ampullatus*	Endangered	No potential for occurrence in the Nearshore Study Area. Moderate potential for occurrence in the Offshore Study Area. Prefers depths around 1,000 m, never seen in water less than 800 m deep. Found off the east coast of North America, ranging from Davis Strait to New York, particularly around Gully at edge of Scotian Shelf
Sowerby's Beaked Whale	*Mesoplodon bidens*	Special Concern	Low potential for occurrence in Nearshore Study Area. Moderate potential for occurrence in Offshore Study Area. Distribution is poorly known, but only found in the North Atlantic. Range offshore from Davis Strait to Cape Cod in the Northwest Atlantic ocean, and rarely seen in coastal waters
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Low potential for occurrence in the Nearshore Study Area. Low potential for occurrence in the Offshore Study Area. Occasionally observed in shore, but usually found offshore in Atlantic waters
Ivory Gull	*Pagophila eburnea*	Endangered	Low potential for occurrence in the Nearshore Study Area. Moderate potential for occurrence in the Offshore Study Area. Nest at certain specific sites in the Canadian Arctic in late May and early June. Occasionally venture inland to find suitable nesting sites. Wintering grounds poorly known, but include pack ice of the Davis Strait, Labrador Sea, Strait of Belle Isle, and northern Gulf of St. Lawrence
Harlequin Duck	*Histrionicus histrionicus*	Special Concern	High potential for occurrence in the Nearshore Study Area, it does not occur offshore. Cape St. Mary's supports the largest and most northerly over-wintering distribution of the eastern Harlequin Duck. Surveys for Harlequin Ducks were completed in the Placentia Bay area in winter-spring 2007 using low-level helicopter searches of marine archipelago and headland areas in western Placentia Bay and southern Burin Peninsula of Newfoundland (Goudie et al. 2007). A number of concentrations of sea ducks and considerable habitat were documented, and many of these areas appeared like suitable habitat for Harlequin Duck

Common Name	Scientific Name	SARA Schedule 1 Status	Occurrence in Relation to the WREP
Piping Plover *melodus* subspecies	*Charadrius melodus melodus*	Endangered	Low potential for occurrence in the Nearshore Study Area; it does not occur in the offshore. The Newfoundland breeding range is essentially the southwest corner of the island from Flat Bay Island in St. Georges Bay to Grand Barasway near Burgeo. There are no records of Piping Plover for Placentia Bay; however, a sighting from Bellevue Beach, Trinity Bay, indicates the possibility of rare occurrences of Piping Plover in the Nearshore Study Area during migration.

Table 12-3 List of Species Assessed as 'At Risk' by the Committee on the Status of Endangered Wildlife in Canada that Could Occur Within the Nearshore and Offshore Study Areas

Common Name	Species Name	COSEWIC Assessment	Occurrence in Relation to the WREP
Atlantic Cod (Newfoundland and Labrador population)	*Gadus morhua*	Endangered	High potential for occurrence in Nearshore and Offshore Study Areas. Atlantic cod from this population inhabit waters from the northern tip of Labrador to the southern Grand Banks
Atlantic Cod (Southern population)		Endangered	High potential for occurrence in the Nearshore and Offshore Study Areas. Atlantic cod from this population inhabit waters from the Bay of Fundy and southern Nova Scotia to the southern extent of the Grand Banks. Large numbers of this stock are known to spawn in Placentia Bay. This population has recovered better than other populations in Northwest Atlantic
Roundnose Grenadier	*Coryphaenoides rupestris*	Endangered	Moderate potential for occurrence in the Nearshore. Moderate to high potential for occurrence in Offshore Study Area. Closely associated with the seafloor and commonly found inhabiting depths of 800 to 1,000 m. Occurs year-round, with spawning in fall
Porbeagle Shark	*Lamna nasus*	Endangered	Moderate potential for occurrence in Nearshore and Offshore Study Areas. Migrant in Atlantic Canadian waters. Most common May to December in water depths of 35 to 100 m
Atlantic Bluefin Tuna	*Thunnus thynnus*	Endangered	Low to moderate potential for occurrence in Nearshore and Offshore Study Areas. Atlantic bluefin tuna may migrate through the Grand Banks following food stocks in July through December. May form schools
Smooth Skate (Funk Island Deep population)	*Malacoraja senta*	Endangered	Low potential for occurrence in Offshore Study Area. Low potential in Nearshore Study Area. Concentrates north of the Offshore Study Area. Occurs from 50 to 600 m (commonly 400 to 600 m) in Newfoundland waters
Deepwater Redfish (northern population)	*Sebastes mentalla*	Threatened	Low potential for occurrence Offshore Study Area. Not known to occur in Nearshore Study Area. Closely associated with the seafloor, commonly found inhabiting waters 350 to 500 m. Uncommon on the Grand Banks

Common Name	Species Name	COSEWIC Assessment	Occurrence in Relation to the WREP
Acadian Redfish (Atlantic population)	*Sebastes fasciatus*	Threatened	Unlikely to occur in Nearshore Study Area. Low to moderate potential for occurrence in Offshore Study Area. Closely associated with the seafloor and commonly found inhabiting waters 150 to 300 m. Mature individuals most common in area from May to October. Spawning occurs in fall. Larvae may be present in water column May to August
Shortfin Mako	*Isurus oxyrinchus*	Threatened	Low to moderate potential for occurrence in Nearshore and Offshore Study Areas. A pelagic species that migrates north following food stocks (i.e., mackerel, herring, tuna). Any occurrence would likely be transient in nature
American plaice (Maritime population)	*Hippoglossus platessoides*	Threatened	Low potential for occurrence in Nearshore Study Area. Moderate potential for occurrence in Offshore Study Area. Closely associated with the seafloor and commonly found at depths of 100 to 200 m where soft sediments are present. Spawning occurs in April/May. Larvae may be present in the water column between May and June. This species was once highly abundant
American plaice (Newfoundland and Labrador population)		Threatened	Low potential for occurrence in Nearshore Study Area. High potential for occurrence in Offshore Study Area. Closely associated with the seafloor, and found at 100 to 200 m where soft sediments are present. The Newfoundland and Labrador population is located from the Grand Banks north to the northern tip of Newfoundland
Cusk	*Brosme brosme*	Threatened	Low potential for occurrence in Nearshore and Offshore Study Area. Rare species that occurs in deep waters between the Gulf of Maine and southern Scotian Shelf. Rare along the continental shelf off Newfoundland and Labrador
Atlantic Salmon (South Newfoundland population)	*Salmo salar*	Threatened	Moderate to high potential for occurrence in Nearshore and Offshore Study Areas. Juvenile Atlantic salmon migrating from freshwaters streams to the North Atlantic may occur in Placentia Bay or on Grand Banks
American Eel	*Anguilla rostrata*	Threatened	Moderate potential for occurrence in Nearshore and low potential for occurrence Offshore Study Areas. Adult American eels migrate from freshwater streams to the Sargasso Sea. Juveniles and adults may occur on the continental shelf
Spiny Dogfish (Atlantic population)	*Squalus acanthias*	Special Concern	Low potential for occurrence in Nearshore Study Area and moderate to high potential for occurrence in Offshore Study Area. Commonly found from the intertidal zone to the continental slope in water depths up to 730 m. Most abundant between Nova Scotia and Cape Hattaras, less common in Newfoundland waters
Blue Shark (Atlantic population)	*Priomace glauca*	Special Concern	Moderate potential for occurrence in Nearshore and Offshore Study Areas during summer and late fall. Low potential for occurrence at other times of year. Commonly found in pelagic waters in water depths up to 350 m. Most abundant along the coast of Nova Scotia and offshore Scotian Shelf

Common Name	Species Name	COSEWIC Assessment	Occurrence in Relation to the WREP
Basking Shark (Atlantic population)	*Cetorhinus maximus*	Special Concern	Low potential for occurrence in Nearshore and Offshore Study Areas. Found in offshore waters and coastal waters of Newfoundland, concentrated between Port aux Basques and Hermitage. May be present feeding on plankton from May to September
Roughhead Grenadier	*Macrourus berglax*	Of Special Concern	Low potential for occurrence in Nearshore Study Area. Moderate to high potential for occurrence in Offshore Study Area. Demersal species that occur in deep water
Thorny Skate	*Amblyraja radiata*	Of Special Concern	Moderate potential for occurrence in Nearshore and Offshore Study Area. Occurs from 50 to 1,000 m, with depth preference varying spatially
Northern Bottlenose Whale (Davis Strait-Baffin Bay-Labrador Sea population)	*Hyperoodon ampullatus*	Special Concern	No potential for occurrence in the Nearshore Study Area. Moderate potential for occurrence in the Offshore Study Areas. Found most commonly in deep water around 1,000 m deep, only found in the North Atlantic
Killer Whale	*Orcinus orca*	Special Concern	Moderate potential for occurrence in the Nearshore Study Area. Moderate to high potential for occurrence in the Offshore Study Areas. Prefers deep water but often found in estuaries, shallow bays and inland seas
Harbour Porpoise	*Phocoena phocoena*	Special Concern	High potential for occurrence in the Nearshore Study Area. Low to no potential for occurrence in the Offshore Study Area. Found most commonly in harbours and bays
Loggerhead Sea Turtle	*Caretta caretta*	Endangered	Low potential for occurrence in the Nearshore Study Area. Low potential for occurrence in the Offshore Study Areas. Widely distributed in the Atlantic Ocean, with juveniles routinely found in Atlantic Canadian waters. Usually associated with warmer offshore waters of the Gulf Stream, most often on the Scotian Shelf, Scotian Slope, Georges Bank, and the Grand Banks
Sowerby's Beaked Whale	*Mesoplodon bidens*	Special Concern	Low potential for occurrence in Nearshore Study Area. Moderate potential for occurrence in Offshore Study Areas. Distribution is poorly known, but only found in the North Atlantic. Range offshore from Davis Strait to Cape Cod in the Northwest Atlantic ocean, and rarely seen in coastal waters
Red Knot *rufa* subspecies	*Calidris canutus rufa*	Endangered	Low potential for occurrence in the Nearshore Study Area; it does not occur offshore. It prefers open sandy beaches, often with rotting kelp piles and extensive mud flats, for feeding. Such habitats occur sparingly in Placentia Bay. Red Knot may occasionally occur in small numbers at various locations on the coast of Placentia Bay during fall migration in August to October

12.3.1 Marine Fish Species at Risk

Four fish species are listed under SARA and 18 fish species and 20 populations have been assessed as at risk by COSEWIC in the Nearshore and Offshore Study Areas.

12.3.1.1 White Shark

The white shark has been listed as Endangered under Schedule 1 of SARA since 2011 (SARA Registry 2012). This species is a large, apex predator that is globally distributed in both temperate and sub-tropical waters from 60°N to 60°S, most commonly over the continental shelf at a range of depths (nearshore to 1,280 m) (COSEWIC 2006b). White sharks undertake extensive migrations (Boustany et al. 2002; Bonfil et al. 2005); however, no abundance surveys, tagging or genetic studies of this species have occurred in Canadian waters. This species is considered rare throughout its range. It is not commonly encountered in Atlantic Canada, with 32 records occurring over a 132-year period; most of which occurred between June and September and within the Bay of Fundy and coastal Nova Scotia. However, there have been a very low number of sightings on the northeast Newfoundland Shelf, the Strait of Belle Isle, the St. Pierre Bank and Laurentian Channel, suggesting Newfoundland is at the northern fringe of its range (Templeman 1963; Mollomo 1998; COSEWIC 2006b).

As the species is rare and data are limited, there is little known about trends in abundance over time. However, in other areas of the Northwest Atlantic, the species is estimated to have declined by 59 to 89 percent between 1986 and 2000 (less than one generation) (COSEWIC 2006b). This species is long-lived with low reproductive rates and as such, it is unable to withstand substantial increases in mortality rates. Bycatch in pelagic long-line fisheries (particularly in the southern US) is considered to be the primary threat to the Atlantic population (average of greater than 400 captures annually between 1986 and 2000) (DFO 2006b).

The white shark can occur in both inshore and offshore marine waters with a known depth range from surface waters to at least 1,280 m (Bigelow and Schroeder 1948), and a known temperature range from 5°C to 27°C (Boustany et al. 2002). The white shark is extremely rare as far north as the Grand Banks and Placentia Bay and has a low likelihood of occurring in the Nearshore or Offshore Study Areas.

12.3.1.2 Wolffish

Wolffish are solitary demersal fishes distributed at northern latitudes in relatively deep waters. Wolffish are widely distributed in the Northwest Atlantic, extending from the Davis Strait to the Gulf of Maine (Kulka and DeBlois 1996) and occur on most of the Newfoundland and Labrador shelves.

Three species of wolffish are listed under Schedule 1 of SARA: spotted; northern; and Atlantic (or striped). All three species may occur in the Offshore Study Area and Nearshore Study Area (though are less common in the nearshore). The northern and spotted wolffish are designated as Threatened under SARA Schedule 1 (COSEWIC 2001a, 2001b); the Atlantic wolffish is designated as a species of Special Concern (COSEWIC 2000). These three species declined considerably in abundance in the 1980s and 1990s, with declines being greater in northern areas (NAFO Divisions 2J, 3K and northern 3L) than in southern areas (NAFO Division 3L, 3N, 3O) in Newfoundland waters (Simpson and Kulka 2002). Critical wolffish habitat has not been specifically defined, although Atlantic wolffish are known to densely concentrate at the Southeast Shoal and Tail of the Grand Bank Ecologically and Biologically Sensitive Area (EBSA), and spotted wolffish aggregate on the Northeast Shelf and Slope EBSA during spring (Section 13.3.2.1). These EBSAs occur the Offshore Study Area. No wolffish were observed during the nearshore ROV habitat survey of Argentia and area (Stantec 2012b).

A recent study by DFO (Simpson et al. 2012) analyzed the most recent wolffish abundance and distribution data from research surveys and commercial fisheries. Atlantic, northern and spotted wolffish are at the centre of their distribution in Newfoundland and Labrador, reaching highest densities and covering the largest area on the northeastern Newfoundland shelf and southern Labrador shelf (Simpson et al. 2012). The area north of the Grand Bank represents a persistent area of high concentrations for northern and spotted wolffish, and the southern Grand Bank is a persistent area of high concentration for Atlantic wolffish. Distribution appears to be driven in part by temperature preferences. In surveys of wolffish during the last decade, there have been positive signs of stock recovery for all three species, with indices of relative abundance and distribution increasing in most areas surveyed (Simpson et al. 2012). All three wolffish species have narrow temperature ranges; analyses of survey data indicated northern wolffish were caught in waters with temperatures ranging from -0.8°C to 7°C, spotted wolffish were caught in temperatures ranging from -1°C to 6°C and Atlantic wolffish were caught in waters ranging from -0.45°C to 6.5°C (Simpson et al. 2012). During periods of low abundance (i.e., 1980s and 1990s), distribution was reduced and restricted mainly to warmer waters along the outer shelf edge (Simpson et al. 2012). Consequently, temperature may be a limiting factor for the recovery of Newfoundland and Labrador populations (Simpson et al. 2012) and these species may be susceptible to environmental effects from climate change in the Northwest Atlantic (Reid and Valdes 2011).

A proposed Recovery Strategy for northern and spotted wolffish, and Management Plan for Atlantic wolffish has been developed to increase the population levels and distribution of the northern, spotted and Atlantic wolffish in eastern Canadian waters such that the long-term viability of these species is achieved (Kulka et al. 2007). Five primary objectives have been identified to achieve the long term viability of the three wolffish species. These objectives (Kulka et al. 2007) aim to:

- Enhance understanding of the biology and life history of wolffish species
- Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities
- Reduce the potential for wolffish population declines by minimizing human impacts
- Promote wolffish population growth and recovery
- Develop communications and education programs to promote the conservation and recovery of wolffish populations.

The primary objectives relate to activities that may be mitigated through human intervention and each objective is designed to achieve the goal of increasing population levels and distribution of the wolffish species such that long-term viability is ensured.

Wolffish are large, long-lived and slow-growing; characteristics that make them vulnerable to increased rates of mortality. The primary threats to wolffish are bycatch mortality and habitat alteration by trawling. Other potential sources of mortality include disturbance by oil and gas exploration and production, pollution, shipping, cables and lines, military activities and scientific research; however, mortality levels related to these activities are unknown. Directed fisheries and bycatch of wolffish occur in Iceland, the Faeroes, Greenland, and in other fisheries in the Northwest Atlantic by Canada, Greenland and Portugal (COSEWIC 2001b). Spotted and Atlantic wolffish have been collected (and released) in the Offshore Project Area as bycatch during the commercial fisheries component of Husky's environmental effects monitoring (EEM) program in the White Rose field. A total of six and nine individual spotted and Atlantic wolffish, respectively, were caught in five surveys. Species-specific information is provided in the following sections.

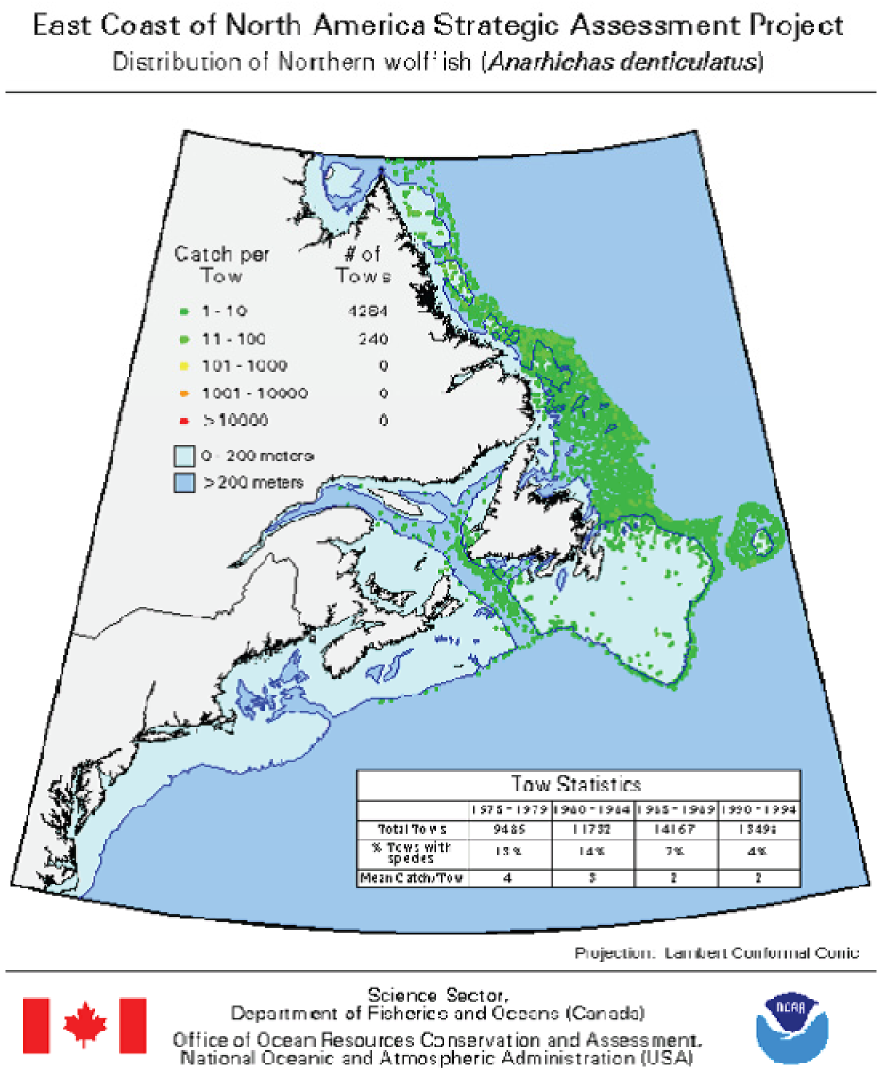
Northern Wolffish

The northern wolffish is a large, pelagic predator that preys on invertebrates including jellyfish, comb jellies, crabs, brittle stars and sea stars. This species occurs from surface waters to 1,000 m, but most often occurs between 500 and 1,000 m in offshore waters below 5°C (COSEWIC 2001a; Kulka et al. 2004, 2007). Given this range, there is potential for the northern wolffish to occur in both the Nearshore and Offshore Study Area; however, northern wolffish are pelagic fish and typically occurs in open waters over the continental shelf.

In Canada, northern wolffish are most common off northeast Newfoundland and Labrador, where it is thought to be much more abundant than in the Gulf of St. Lawrence and other areas of its range (Brown et al. 1996; COSEWIC 2001a). Tagging studies and observations of adults suggest this species is non-migratory. The East Coast of North America Strategic Assessment Project (ECNASAP) summarized twenty years of US and Canadian distributional data from marine surveys in the Northwest Atlantic (Brown et al. 1996), including distribution data on northern wolffish (Figure 12-1). The number of locations where the species occurs has appeared to decline over time (COSEWIC 2001a). Surveys in northeastern Newfoundland from 1978 to 1996 over a 265,365 km^2 area (Atkinson 1994) indicated the catch-per-unit-effort declined by 98 percent over the 16-year period (approximately three wolffish generations). Northern wolffish is listed as threatened under Schedule 1 of SARA due to this rapid decline. Numbers remain low and there is also evidence of declines in size, which may indicate that fewer large, older adults occur. ECNASAP data show that by the mid-1990s, wolffish were encountered are far fewer survey stations than they had been a decade earlier, and mainly occurred in deeper area at the periphery of their range. This species has not been subject to a directed fishery but there is a high amount of bycatch, which is discarded by fishers. Trawling is also a source of mortality and habitat disturbance.

Recent analyses by DFO (Simpson et al. 2012) indicate that during declines in the 1980s and 1990s, northern wolffish experienced a shift in distribution to greater depths, and that the area occupied by northern wolffish shrunk by more than 99 percent. Since 1995, the area occupied has varied, with the highest value observed in 2007 (20 percent occupancy in NAFO Divisions 2J3K) (Simpson et al. 2012). When abundance was highest (during 1978 to 1984 DFO surveys), locations occupied reached up to 57 percent. These indices suggest there has been some recovery of northern wolffish in Newfoundland and Labrador in recent years (Simpson et al. 2012).

Spawning in the northwest Atlantic is thought to occur between April and October. Females are highly fecund, laying up to 30,000 large eggs in a nest on the seafloor (Simpson and Kulka 2002). Females guard the nests and after hatching larvae are pelagic (Simpson and Kulka 2002; Kulka et al. 2007). Little is known about the reproduction of northern wolffish, but spawning is thought to occur late in the year (DFO 2004c).

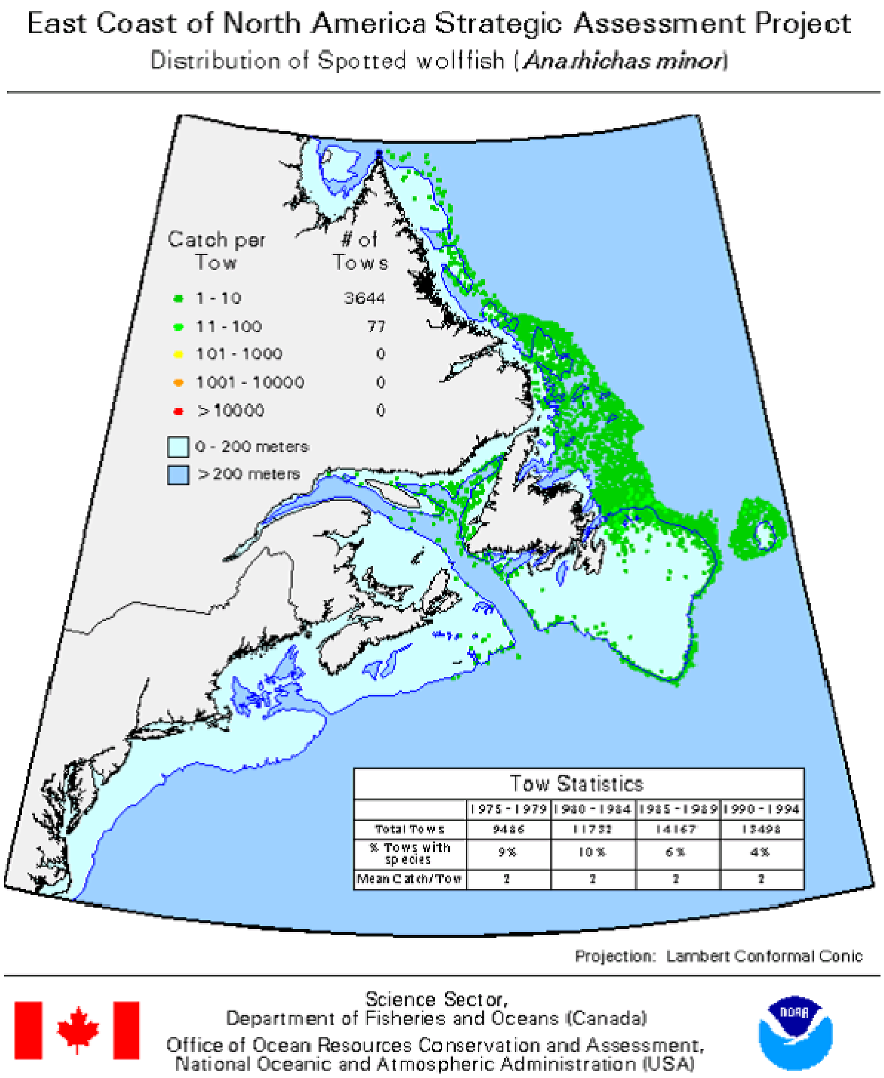


Source: COSEWIC 2001a

Figure 12-1 Distribution of Northern Wolffish in Northwest Atlantic

Spotted Wolffish

In the western North Atlantic, spotted wolffish occur primarily off Labrador and northeastern Newfoundland to Flemish Cap, as well as in the Gulf of St. Lawrence, and in lower abundance on the Grand Bank and Scotian Shelf (Figure 12-2. This species commonly inhabits depths of 50 to 750 m in waters less than 5°C, but have been reported to occur as deep as 1,046 m (COSEWIC 2001b; Kulka et al. 2007). They preferentially occur over sandy or muddy bottoms with boulders (COSEWIC 2001b).



Source: COSEWIC 2001b

Figure 12-2 Distribution of Spotted Wolffish off Newfoundland and Labrador

Survey data show steep declines in the population size of spotted wolffish between the 1970s and 1990s. The data from the ECNASAP (1978 to 1994) suggested a 93 percent decline, the same estimate obtained using DFO time series data from 1978 to 1993 (three generations) based on catch-per-unit-effort (Brown et al. 1996). Similar to the northern wolffish, the spotted wolffish occurred at much fewer survey stations in the 1990s than previously, and mean size also decreased over time. Data collected by DFO up to 1999 suggest that abundance was low (COSEWIC 2001b). The decline between 1978 and 1999 was estimated to be 96 percent over three generations based on survey data (COSEWIC 2001b). Consequently, the population was designated as threatened on Schedule 1 of SARA (COSEWIC 2001b). Analyses of data from the last decade (Simpson et al. 2011) indicate that the distribution of spotted wolffish is increasing in area and is similar to that of Atlantic wolffish (with the exception of the southern Grand Bank, where spotted wolffish are rare). In addition, the area occupied by spotted wolffish has increased to 37 (2008) and 49 percent (2009) of the area surveyed. This is within the range of occupancy (48 percent) observed during years of peak abundance (1978 to 1984). Abundance indices have also increased for both spring and fall DFO surveys (Simpson et al. 2012), suggesting this species is beginning to recover.

Spotted wolffish are slow-growing and do not become sexually mature until age 7 to 10. Consequently, the effects of increased mortality, decreased range, or decreased size are of concern. The spotted wolffish is not common enough to support a commercial fishery in Canada, though it does occur as bycatch in other offshore trawl fisheries. The spotted wolffish is a directed fishery in Greenland, where longlines are used, and directed fisheries also occur in the eastern North Atlantic (COSEWIC 2001b).

Spotted wolffish primarily feed on echinoderms, crustaceans, molluscs, sand eels and tube worms. The Northwest Atlantic is considered to be a single population. Concentrations are highest from June to November and spawning occurs during summer. Large eggs are deposited in a mass on the sea floor, and after hatching, larvae associate with the benthos and remain in the area where they were deposited. Adults make limited (possibly seasonal) migrations (Templeman 1984).

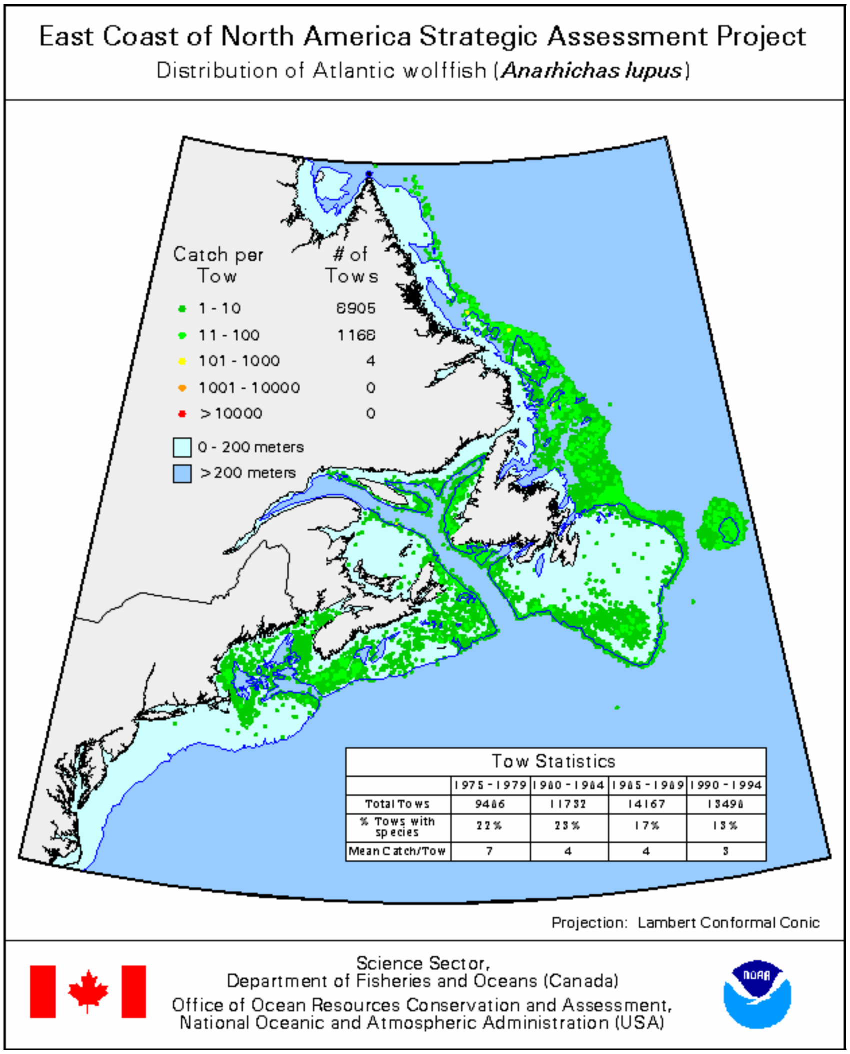
Spotted wolffish have moderate potential of occurring in the Nearshore Study Area and Offshore Study Area. The Northeast Shelf and Slope EBSA is an identified Sensitive Area (Section 13.3.2.1) that is known to support aggregations of spotted wolffish during spring months (DFO 2007b), and occurs within the Offshore Study Area.

Atlantic Wolffish

Atlantic wolffish inhabit cool to cold (-1°C to 10°C) waters with hard (clay) bottom along the continental shelf of Newfoundland and Labrador. They occur at depths up to 918 m, but show a preference for shallower depths of 100 to 150 m (Scott and Scott 1988; COSEWIC 2000; Kulka et al. 2007). DFO surveys in Newfoundland and Labrador between 1971 and 2003 (Kulka et al. 2004) suggest Atlantic wolffish were most concentrated in areas with depths around 250 m at all times of the year.

This species is widely distributed in the western Atlantic from west Greenland and southern Labrador down to the Gulf of St. Lawrence, east and west coast of Newfoundland, the Grand Banks, and as far south as the Scotian Shelf and Gulf of Maine (Figure 12-3) (COSEWIC 2000). Atlantic wolffish occur in greater abundance and further south than both the northern and spotted wolffish.

Adults undertake local migrations to shallower waters during spring and remain through the summer, spawning in coastal areas in September (Keats et al. 1985; Simpson and Kulka 2002); however, juveniles remain offshore year-round. Spawning occurs in boulder habitats and eggs are laid in a bunch and adhere to the seafloor. Males then guard the eggs until they hatch by mid-December (Keats et al. 1985, 2007). Larvae are pelagic but remain close to where they were deposited on the seafloor (Simpson and Kulka 2002).



Source: COSEWIC 2000

Figure 12-3 Distribution of Atlantic Wolffish in Northwest Atlantic

Diet is composed of hard-shelled benthic invertebrates and smaller fish (Kulka et al. 2007), and no predators of adult Atlantic wolffish have been identified, though juveniles have been found in Atlantic cod stomachs (Scott and Scott 1988). The Atlantic wolffish can be distinguished from the northern and spotted wolffish species by the presences of nine to thirteen irregular bars on its body (Whitehead et al. 1986).

Data from DFO surveys indicate shifts in the distribution and a decline in abundance occurred in Canadian Atlantic waters, particularly in the 1980s and 1990s (COSEWIC 2000; Simpson et al. 2012). However, of the three species, the relative abundance and distribution of Atlantic wolffish have varied least (Simpson et al. 2012). In the offshore Newfoundland area, Atlantic wolffish occurred at 88 percent of the stations where it was expected to occur in 1978, and this amount declined to 33 percent by 1993. Abundance is estimated to have declined by 87 percent from the late 1970s to the mid-1990s, although catches in Newfoundland suggest a decline of 91 percent over two generations (COSEWIC 2000). As a result of this observed rate of decline, Atlantic wolffish is listed as special concern on Schedule 1 of SARA. Mean size also declined over this period. As well, locations where the species occurred declined and the range shrank (COSEWIC 2000). Bycatch has been suggested as a primary cause of the declines (Kulka et al. 2007), although other factors could have driven the observed changes, including temperature changes. The most recent data (Simpson et al. 2012) indicate Atlantic wolffish are presently found over much of the survey area except at inner portions of the banks and along much of coastline, and occurs commonly over the shallow portion of the southern Grand Banks, an area where northern and spotted wolffish rarely occur (Simpson et al. 2012). Between 1995 and 2005, the distribution of Atlantic wolffish stabilized and changed little. However, in recent survey years (2007 to 2009), the area occupied in the fall survey ranged from 60 to 73 percent (NAFO Division 2J3KLNO), a greater extent than that observed during years of peak abundance between 1978 and 1984 (Simpson et al. 2012), suggesting recovery of Atlantic wolffish is occurring.

Atlantic wolffish is the most common of the three species, and occurs in shallower waters over a wide range. It has a moderate potential of occurring in the Nearshore and Offshore Study Areas. The Southeast Shoal and Tail of the Grand Banks EBSA (Section 13.3.2.1) is a sensitive area identified by DFO (2007b), which is known to have dense concentrations of Atlantic wolffish.

12.3.1.3 Atlantic Cod

Atlantic cod are widely distributed in the Canadian Atlantic from northern Labrador to the Gulf of Maine. Cod has been ecologically, economically and culturally important in Newfoundland and Labrador for centuries. The collapse of the cod fishery (Hutchings and Myers 1994; Myers et al. 1997), and limited recovery over the last two decades (Rose 2004; COSEWIC 2010a; Lambert 2011) has affected the Province through high unemployment and loss of livelihood, as well as the decline of small coastal communities, and the decline of a valued food source (Milich 1999). In addition to overfishing, the decline of cod coincided with environmental regime shifts in this system and changes in biological productivity, which require better understanding (Christensen et al. 2003; Choi et al. 2004; Bundy and Fanning 2005; Frank et al. 2005).

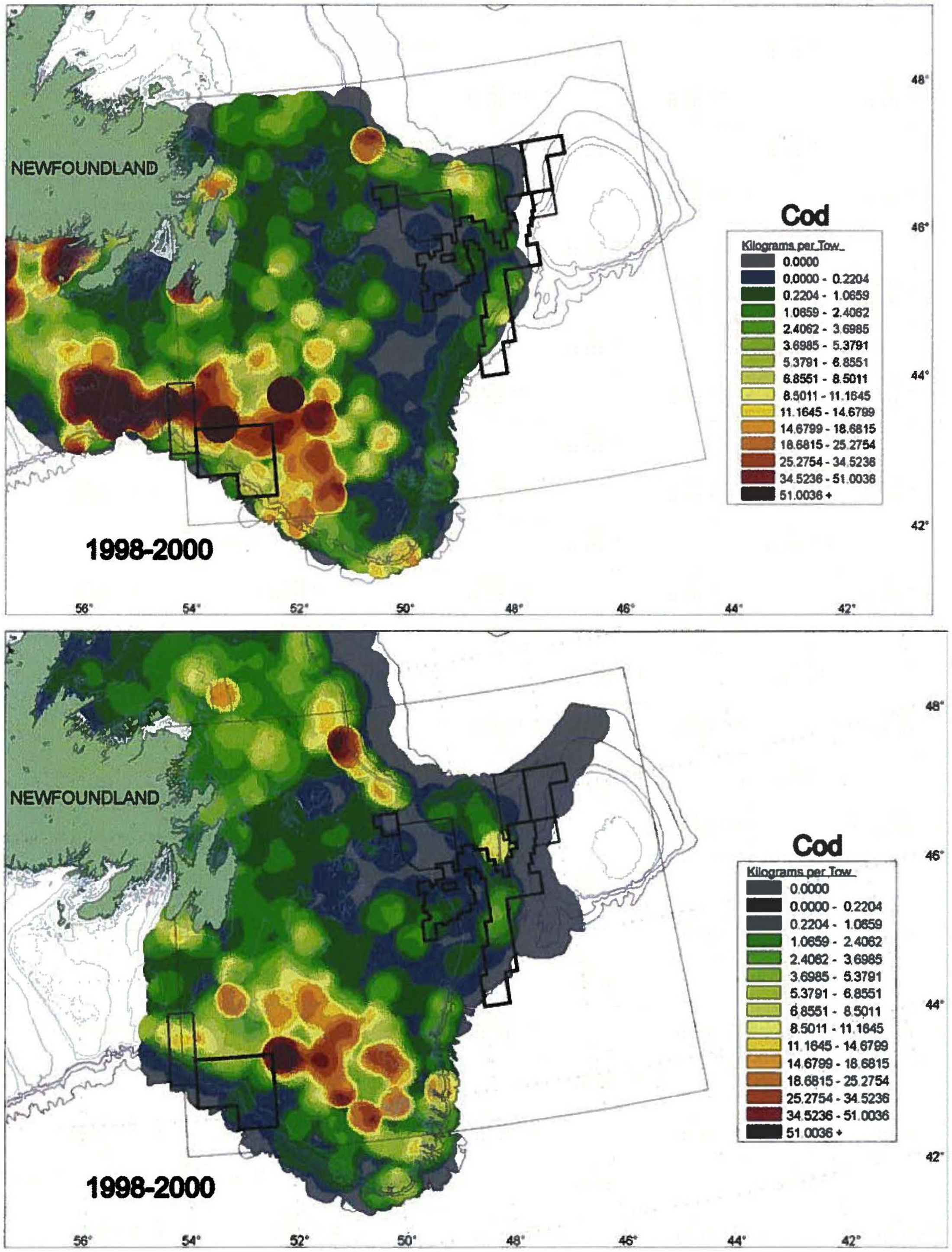
The two Atlantic cod populations that occur in the Offshore Study Area (the Newfoundland and Labrador population, and the Laurentian South population) have both been assessed as Endangered by COSEWIC (COSEWIC 2010a), but have not yet been granted federal protection under SARA. The main cause of the decline was overfishing, which was likely exacerbated by changes in life history traits as well as depensation effects (i.e., where a decrease in the spawning stock leads to reduced survival and production of eggs due to increased predation or reduced likelihood of finding a mate) (Rowe et al. 2004). Threats today to recovery include directed commercial fishing, recreational fishing, bycatch, habitat change, predation and increased natural mortality of older cod in some populations (Lindholm et al. 1999; COSEWIC 2010a). A factor that is only beginning to be understood and may exert strong influence on recovery is change in ocean climate (Choi et al. 2004; Drinkwater 2005).

The Newfoundland and Labrador population of the Atlantic cod includes those cod that inhabit waters ranging from the northern tip of Labrador as far south as the Grand Banks of Newfoundland. Three stocks of cod are recognized by DFO for this Designatable Unit: the Northern Labrador cod (NAFO Divisions 2GH); Northern cod (NAFO Divisions 2J3KL); and Southern Grand Bank cod (NAFO Divisions 3NO) (COSEWIC 2003b). Data indicate that cod in this area have declined by 97 to 99 percent in the past three generations (COSEWIC 2010a), with the major cause of the decline being overfishing. Even though fishing efforts have been reduced since the early 1990s, this population has shown very little sign of recovery (COSEWIC 2010a).

The status of Atlantic cod in NAFO Division 3Ps (which includes the Nearshore Study Area) was assessed by DFO in 2009 (Healey et al. 2011) based on R/V data, inshore sentinel surveys, logbooks and tagging studies. The total allowable catch (TAC) for 3Ps was set to 13,000 t for 2008/2009 fishing season, and lowered to 11,500 t for the 2009/2010 season. The removals by recreational fishing are unknown for 2008 and 2009, but are thought to represent a small amount (approximately 1 percent) of commercial landings (Healey et al. 2011). DFO R/V surveys indicate a decline in total biomass since 2004. The 2008 biomass estimate was less than 50 percent of the average biomass reported for 1997 to 2008. The survey spawning stock biomass is near the lowest levels observed and was continuing to decline as of 2009 (Healey et al. 2011). Annual total mortality rates inferred from DFO R/V data indicate the rate increased from an average of 23 percent (1997 to 2004) to an average of 55 percent (2005 to 2007). Data from tagging studies suggest fishing mortality has increased, and the trend in natural mortality is unknown. Nearshore sentinel survey data (conducted in the nearshore (shoreward of the DFO R/V survey)) suggest population indices have been stable in this area. Preliminary data indicate the 2006 cohort is strong following several years of weaker cohorts; however, this cohort did not enter catch records until 2011 (Healey et al. 2011). Data as of 2009 suggest that the TAC must be lowered to 10,000 t to stop current declines, and lower than 10,000 t to facilitate growth in the population (Healey et al. 2011).

The boundaries of the Laurentian South stock were designated in 2010 after the five previously recognized stocks of the Maritimes populations were divided into two: Laurentian South (4T, 4Vn, 4VsW); and Southern (4X, 5Zjm). The Laurentian South stock has experienced a decline by an estimated 90 percent in the past three generations (COSEWIC 2010a).

Surveys of cod on the Grand Banks (Kulka et al. 2003) indicate that this species is widely distributed throughout during both spring and fall (Figure 12-4). The main areas of concentration are the northeast slope of the Grand Bank (fall), and the central portion of the Grand Bank including the Virgin Rocks and the upper Southwest Slope of the Grand Bank (spring and fall). The Southeast Shoal and Tail of the Grand Banks EBSA has been identified as an important nursery area for NAFO Division 3NO Atlantic cod (DFO 2007b). The Southwest Shelf Edge and Slope EBSA and Virgin Rocks EBSA are also known to provide habitat that supports cod spawning, breeding, and migration (DFO 2007b). Refer to Section 13.3.2.1 for further information on these sensitive areas.



Source: Kulka et al. 2003

Figure 12-4 Spring (top) and Fall (bottom) Distribution of Atlantic Cod in Relation to Petroleum Licenses on the Grand Bank

The larval stage is planktonic and primarily feed on zooplankton. Upon settlement near the bottom, their primary food source are benthic and epibenthic invertebrates (Scott and Scott 1988). Coastal habitats including eelgrass beds, macroalgal habitat, sandy bottoms, cobble and rocky reefs have been found to be important to juvenile cod (Keats et al. 1987; Tupper and Boutilier 1995a, 1995b; Warren et al. 2010). The primary diet of juvenile cod includes pelagic crustaceans, especially zooplankton and benthic species (Grant and Brown 1998). In Placentia Bay, juvenile cod in shallow inshore waters move to deeper waters as they mature at age three, but surveys suggest they do not mix with adult cod until after age three to four (DFO 2005c).

Cod occurring within Placentia Bay are primarily a localized stock or “bay population”, but there is mixing with the offshore areas outside Placentia Bay and Fortune Bay (Brattey et al. 2002). Cod spawn during spring in Placentia Bay, and are concentrated near the Bar Haven Island shoals, off Cape St. Mary’s (Perch Rock) and on Oderin Bank (Bradbury et al. 1999; Lawson and Rose 1999a, 1999b, 2000) and eggs and larvae then tend to drift southwestward toward open ocean (Bradbury et al. 2000) and into embayments further north (Lawson and Rose 1999a, 1999b; Robichaud and Rose 2006). As part of the Cod Recovery Strategy, the areas of Sound Island, Woody Island and Bar Haven are closed to commercial harvesting from January 1 to May 2 each year to protect over-wintering and spawning aggregations of cod (Canada-Newfoundland and Labrador Action Team for Cod Recovery 2005). The Placentia Bay cod are considered a coastal population and appear to be spatially and temporally separated from nearby cod groups, and may even be genetically distinct (Ruzzante et al. 1998; Lawson and Rose 1999b). There is very little drift of eggs and larvae into the Bay from outside. Cod tagged at the head of Placentia Bay in the spring have been recaptured all over Placentia Bay, but the majority has been recaptured within inner Placentia Bay (Brattey et al. 2002), especially fish less than 50 cm (Lawson et al. 1998). Cod tagged near Cape St. Mary's did not move into the Bay during spring and summer, but remained at the mouth of the Bay or migrated into NAFO Division 3L (Lawson et al. 1998), which would indicate mixing with the Laurentian North population. Peak larval densities in Placentia Bay were observed in August (Bradbury et al. 1999), but vary annually according to water temperature during egg and larval development. Older juveniles (i.e., age one to four) were found near Long Island primarily between 25 and 75 m water depths, over gravel and cobble substrates (Gregory and Anderson 1997).

Juvenile cod in Placentia Bay are most commonly found in eelgrass habitat; however, in years of high abundance, aggregations also occur in unvegetated habitat (Robichaud and Rose 2006). This may be a behavioural change, with cod exploiting poor-quality habitats when high-quality (eelgrass) habitat is fully used by conspecifics (Robichaud and Rose 2006). It is unknown whether the sites where juvenile cod are most abundant are preferentially selected, or if the environment (i.e., currents) drives the density-dependent distribution of juvenile cod in Placentia Bay (Robichaud and Rose 2006). Regardless, there are clearly sites that contain the greatest amounts of juvenile cod relative to other sites.

Age 1 to age 4 juvenile cod were surveyed in the inshore using deep-sea submersibles (Gregory and Anderson 1997) at 18 to 150 m depth. Age 1 juveniles were frequently associated with areas with gravel substrate and low relief. In contrast, age 2 to 4 cod were commonly associated with coarse substrate and high relief (i.e., cliffs). There was no evidence of selecting for substrates with high macroalgal cover.

Surveys of adult cod suggest that the distribution, composition and abundance in Placentia Bay over a one-year period appears to be related to the movement and mixing of cod from different populations. After spawning occurs in spring, large resident cod commonly move southward along the eastern shore of Placentia Bay and may move out of the Bay entirely and migrate along the Avalon coast. Smaller resident fish may remain within the Bay throughout the year. Larger fish typically return to Placentia Bay in the fall and aggregate at the head and western side of the inner Bay to overwinter. There is evidence that cod from other areas (i.e., St. Pierre Bank, Fortune Bay, Grand Banks) visit the Bay from late spring to early fall, and this is why abundance of cod increases dramatically in summer and distribution is more widespread than during other seasons (Mello and Rose 2005).

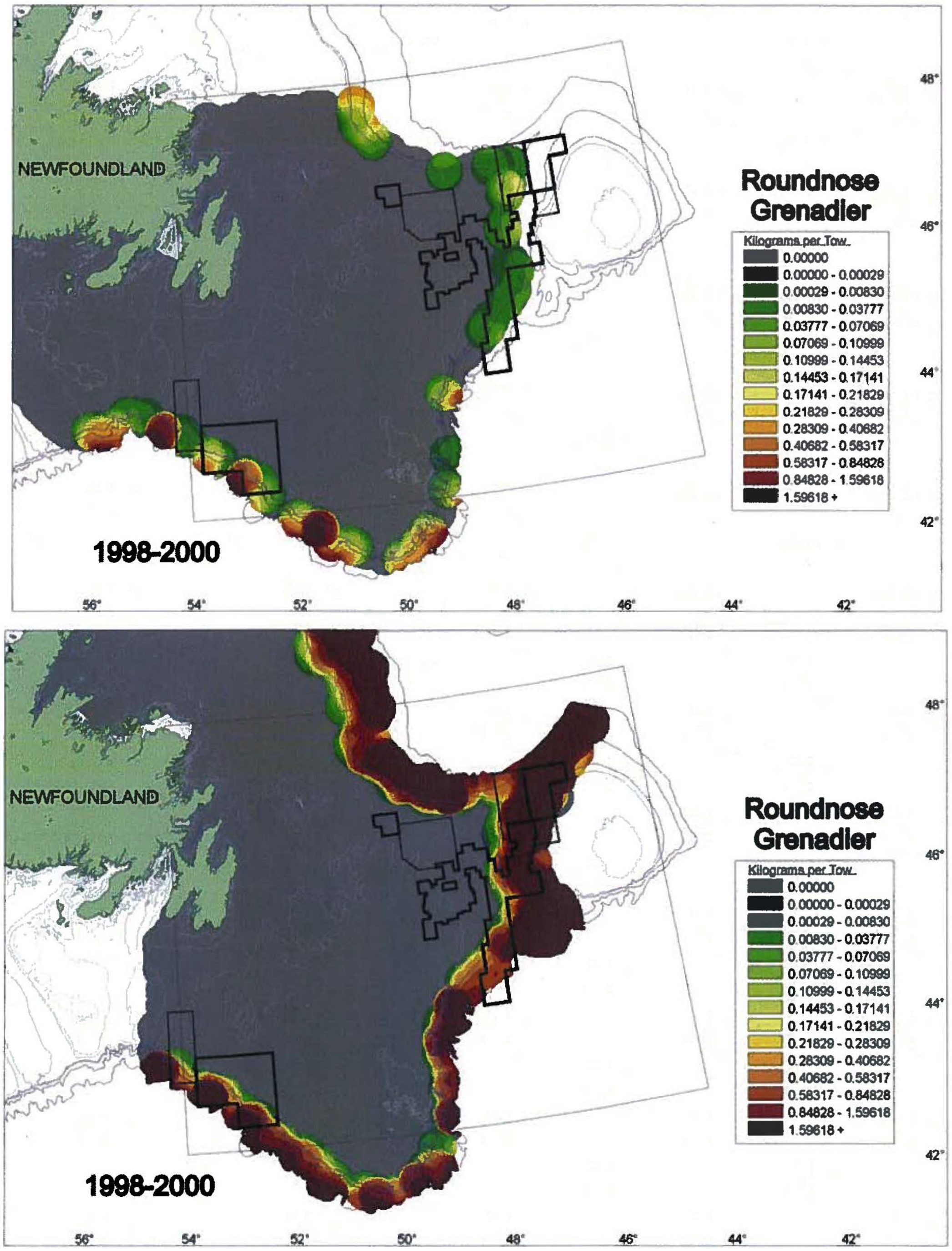
The cod stock found off the southern coast of Newfoundland is considered to be recovering much better than other cod populations that occur from west Greenland to George's Bank. This stock supports the largest cod fishery in the region (Brattey et al. 2002; Robichaud and Rose 2006), and Placentia Bay supports the majority of this stock. It is estimated the Bay has sustained from between one-third and one-half of the total catch since the cod fishery re-opened in 1997 following the moratorium (Robichaud and Rose 2006). In contrast, most other cod stocks have not recovered well and remain under moratoria.

Atlantic cod has a high potential for occurrence in the Nearshore and Offshore Study Areas.

12.3.1.4 Roundnose Grenadier

The roundnose grenadier (*Coryphaenoides rupestris*) is a long-lived, slow growing species with late maturity and low fecundity. It inhabits the continental slopes of the Northwest Atlantic from Baffin Island and Greenland to Cape Hatteras, North Carolina (COSEWIC 2008a, Simpson et al. 2011). Their distribution in Newfoundland and Labrador is shown in Figure 12-5. This species is typically found at depths between 180 and 2,600 m, and most commonly between 400 to 1,200 m (COSEWIC 2008a). This species migrates vertically at night to feed on squid, small fish and crustaceans (DFO 2010a). The species is considered a single population in the Northwest Atlantic (Simpson et al. 2011).

COSEWIC has assessed the roundnose grenadier as Endangered based on declines in abundance of an estimated 98 percent between 1978 and 2003 in NAFO Division 2J3K (COSEWIC 2008a). It has not been listed under SARA. Roundnose grenadier is no longer a directed fishery (since 1997), but does occur as bycatch, particularly in the Greenland halibut fishery (DFO 2010a; Simpson et al. 2011). Modelling suggests bycatch levels must be kept below 1kt/year to allow for slow recovery.



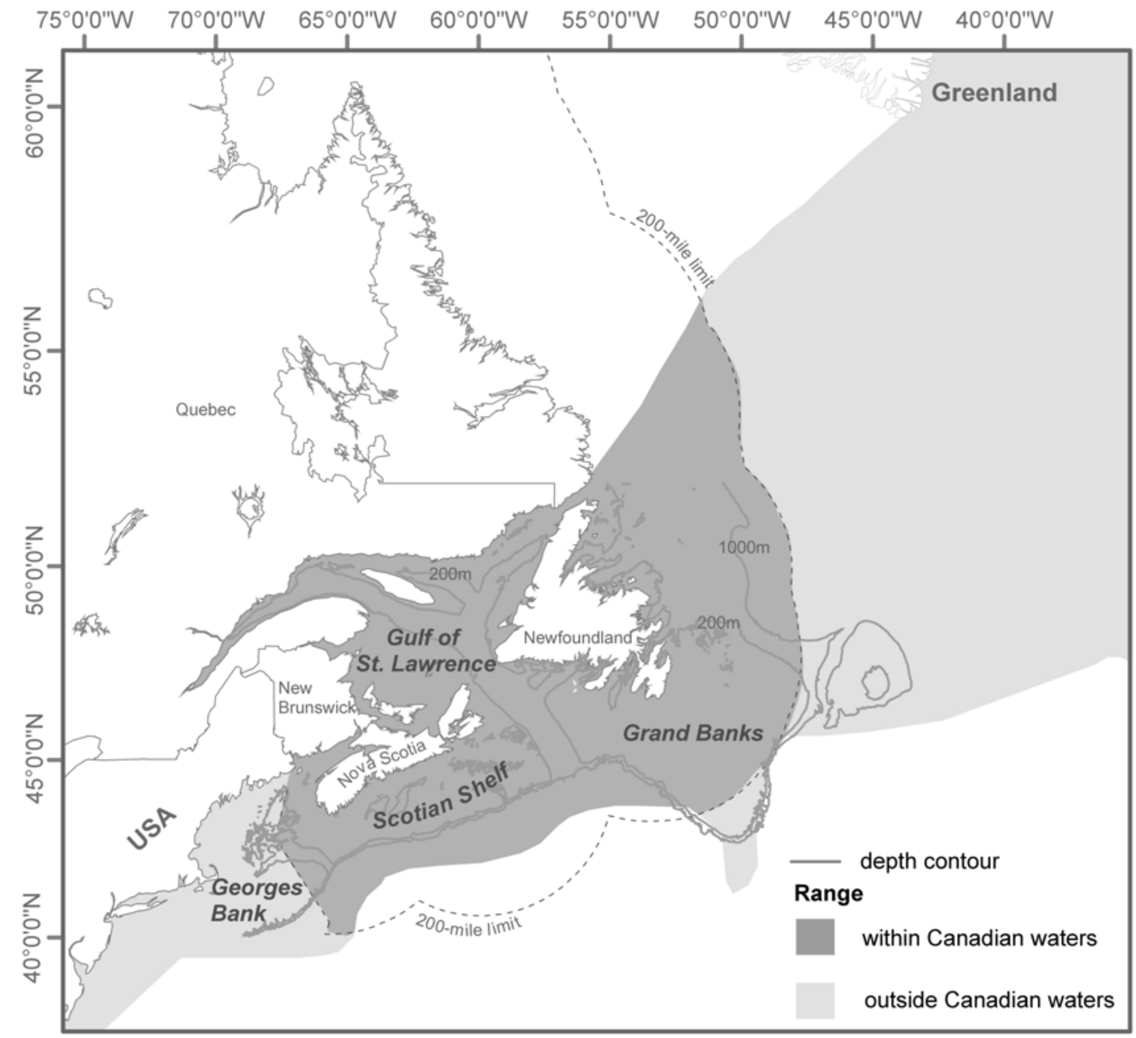
Source: Kulka et al. 2003

Figure 12-5 Spring (top) and Fall (bottom) Distribution of Roundnose Grenadier

There is moderate potential for occurrence in the Nearshore Study Area and moderate to high potential for occurrence in the Offshore Study Area.

12.3.1.5 Porbeagle Shark

The porbeagle shark (*Lamna nasus*) is a wide-ranging oceanic shark that occurs in cold temperate waters. In Canada, the porbeagle shark can be found from northern Newfoundland to as far south as the Bay of Fundy (O'Boyle 1998; Campana et al. 2001; Compagno 2001) (Figure 12-6). It is a pelagic species but is commonly found on continental shelves, in both offshore and nearshore waters. Their distribution appears to be primarily driven by temperature, with a preference for waters that are 5°C to 10°C. Porbeagle feed on a variety of pelagic and benthic species, with several bony fish species and squid accounting for much of their prey (Joyce et al. 2002).



Source: COSEWIC 2004
Note: Dark grey indicates within Canadian waters and light grey indicates range outside Canada

Figure 12-6 Range of the Porbeagle Shark (Northwest Atlantic Population)

Adults undertake annual migrations between the Gulf of Maine and Georges Bank to the waters off Newfoundland and the Gulf of St. Lawrence (Campana et al. 2001). They are both solitary and occur in schools, and are occasionally found close to shore during the summer (Campana et al. 2001). Mating is believed to occur from August to November in the Cabot Strait, off southern Newfoundland and on the Grand Banks. Catch data suggest that males migrate to three mating grounds (e.g., off southern Newfoundland, on the Grand Banks and at the entrance to the Gulf) in spring, and are followed later by females (Campana et al. 2003). Pregnant females are present in this area from late September to December, but seldom seen from January to June, and may undertake a return migration south (at least as far as Massachusetts) in winter (COSEWIC 2004).

Porbeagle are ovoviviparous and parturition occurs between early April and early June, suggesting a gestation period of eight to nine months. Litter size is typically one to six pups (Compagno 2001; Jensen et al. 2002). Juveniles are not known to migrate and are most common on the Scotian Shelf. Tagging data suggest the Northwest Atlantic and Northeast Atlantic populations are distinct (DFO 1999; Kohler et al. 2002).

Porbeagle is the only directly targeted shark species in Canada, though currently participation in the fishery has dropped to five to eight active vessels due to a small TAC (DFO 2006d). Like other elasmobranchs, the porbeagle is long-lived (estimated 25 to 46 years) (O'Boyle et al. 1998; Campana et al. 2001), has low natural mortality, late sexual maturity, low fecundity and a long gestation period. These characteristics make the porbeagle vulnerable to increased mortality (Jensen et al. 2002). Fisheries data and population models suggest the abundance of this species has declined by 89 percent between 1961 (prior to porbeagle fishing in Canada) and 2001 (Campana et al. 2001). There have also been size changes and declines in the proportion of mature porbeagle sharks on the mating grounds (Campana et al. 2002; COSEWIC 2004). It is uncertain if reductions in fishing will allow for recovery. Porbeagle are also caught as bycatch in other fisheries (Campana et al. 2011), including the extremely valuable Atlantic bluefin tuna and swordfish fishery (accounts for approximately 58 percent of the 57 mt of discards annually). In 2004, COSEWIC assessed the species as Endangered in Canada. However, to date, the species has not gained federal protection under SARA.

There is moderate potential for porbeagle to occur in both the Nearshore and Offshore Study Areas.

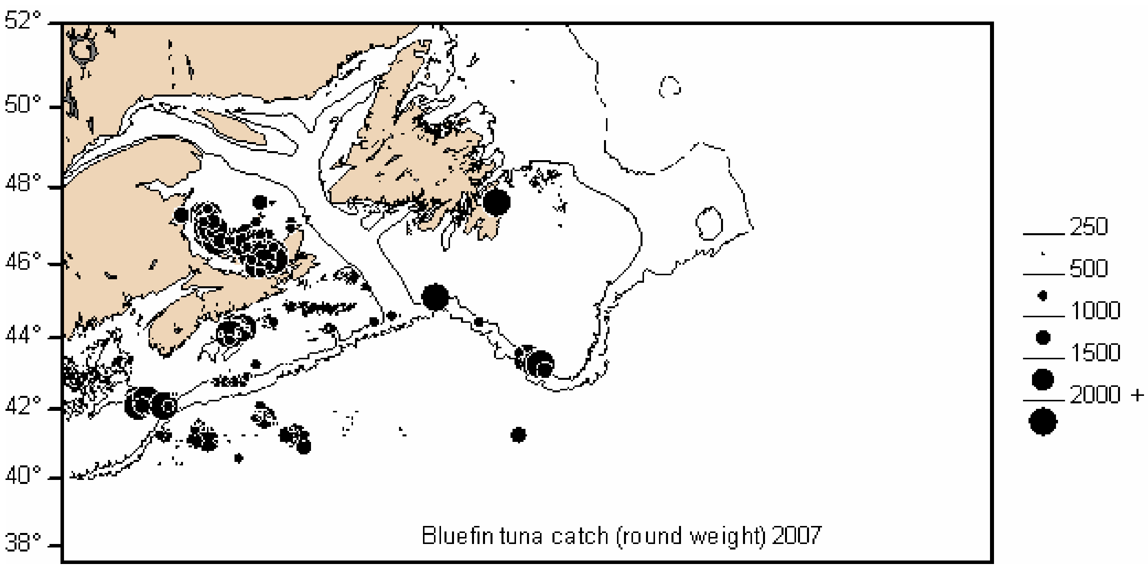
12.3.1.6 Atlantic Bluefin Tuna

Atlantic bluefin tuna is a large, highly-migratory pelagic fish that occurs on both sides of the Atlantic. In the western Atlantic, this species is distributed from Newfoundland as far south as the coastal waters of Venezuela and Brazil (COSEWIC 2011b; DFO 2011e). The species has become an iconic fish both for its speed and size, as well as very high market value in recent years, owing to demand in food markets as well as its decline in abundance.

Bluefin tuna prey on both pelagic and demersal fishes, but themselves have few predators as adults (mako shark, orca). However, they are highly exploited by fisheries. Bluefin tuna were assessed as Endangered by COSEWIC in 2011 but have not received federal protection under SARA at this time.

There are two recognized stocks of bluefin tuna based on their high site fidelity to distinct spawning areas: the eastern population, which spawns in the Mediterranean Sea; and the western population, which spawns in the Gulf of Mexico. Tagging studies have shown that movement does occur between the two stocks. Both stocks occur seasonally within Atlantic Canada (e.g., Gulf of St. Lawrence, Grand Banks, Scotian Shelf) (Walli et al. 2009), although the Canadian fishery for the larger size classes ('giants') relies almost entirely on individuals from the western stock. The western Atlantic bluefin tuna spawn between mid-January and late March, with the eastern population spawning in late May. Sexual maturity is thought to occur around age eight (DFO 2009b); however, there is considerable uncertainty for the western Atlantic population (COSEWIC 2011b).

Atlantic bluefin tuna are highly migratory and both stocks straddle several international boundaries and consequently, are difficult to manage and monitor (COSEWIC 2011b). Declines in abundance are largely due to overfishing, bycatch and possibly due to shifts in their pelagic prey. Additionally, the oil spill caused by the April 2010 *Deepwater Horizon* explosion overlapped with the only known spawning area of the western stock, and this may have consequences for present and future year-classes (Bjorndal et al. 2011; Campagna et al. 2011; Muhling et al. 2012). Atlantic bluefin tuna are seasonal migrants to Atlantic Canadian waters, where they come to feed in schools of less than 50 individuals. These tuna are fished from July to December in four main areas (Bay of Fundy, Scotian Shelf, Gulf of St. Lawrence and off Newfoundland). The Canadian fishery is conducted by rod and reel, tended line and harpoon and offshore longline. The occurrence and abundance of Atlantic bluefin tuna in Canadian waters has considerable inter-annual variation (COSEWIC 2011b). The distribution of the catch of Atlantic bluefin tuna in the western Atlantic is presented in Figure 12-7.



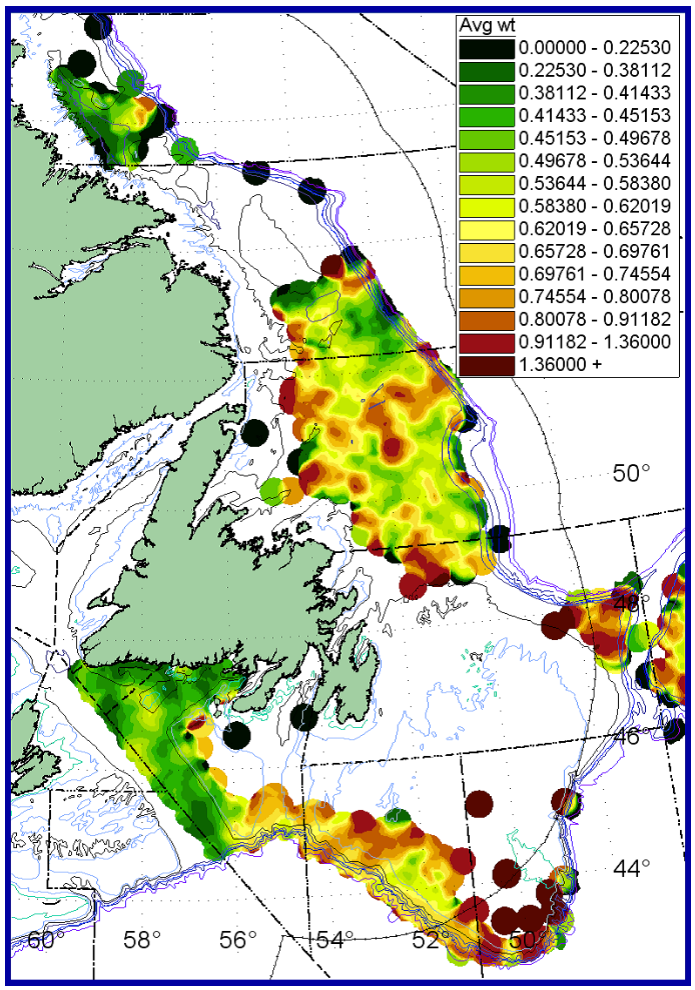
Source: DFO 2009b

Figure 12-7 Atlantic Bluefin Tuna Catch Distribution in Atlantic Canada

This species has a low to moderate potential for occurrence within the Nearshore and Offshore Study Areas, as it is a seasonal visitor to Canadian waters, highly migratory and does not concentrate on the northeastern Grand Banks or in Placentia Bay. However, this species does occur elsewhere around the Avalon Peninsula and on the southern Grand Banks and is capable of travelling great distances while pursuing pelagic prey. Adults follow Atlantic herring and Atlantic mackerel stocks (Walli et al. 2009).

12.3.1.7 Smooth Skate

Smooth skate is a small elasmobranch that occurs from the Labrador Shelf and Gulf of St. Lawrence as far south as South Carolina (Kulka et al. 1996, 2006; Simpson et al. 2011). Survey data from Atlantic Canadian waters (Figure 12-8) indicate smooth skate occurs as several geographically distinct and persistent concentrations. The species was concentrated around Funk Island Deep in Newfoundland until the early 1980s (NAFO Division 2J3K); however, this population has shown declines since the 1990s (Simpson et al. 2011). Kulka et al. (1996) noted a southerly shift in distribution; it appeared to be more common on the southern Grand Bank during 1991 to 1994 (collected during 1981 to 1994).



Source: Simpson et al. 2011
Note: Mean size distribution based on catch weight per tow/catch number per tow from DFO surveys (1971 to 2009).

Figure 12-8 Mean Size Distribution of Smooth Skate in Newfoundland and Labrador

Data from Newfoundland surveys suggest that smooth skate tends to occur in deeper waters (200 to 600 m) in the northern part of its range (NAFO Division 2HJ3K), shallower waters in more southern areas (NAFO Division 3NOPs) and at 200 to 300 m in intermediate regions (NAFO Division 3LM) (Simpson et al. 2011). These depth ranges differ from that reported for the Gulf of St. Lawrence (Kulka et al. 2006) and from the Gulf of Maine (Packer et al. 2003). In Newfoundland waters, smooth skate most commonly occurred at temperatures of 0.1°C to 7.1°C (Simpson et al. 2011).

Recent reviews by DFO of the smooth skate in Newfoundland (Kulka et al. 2006; Simpson et al. 2011) note that there is little information on this species in Newfoundland waters; much of the research comes from the Gulf of Maine (Packer et al. 2003; Sulikowski et al. 2007). Large gaps remain in knowledge on biology, life history and effects of commercial fisheries and environmental change. McPhie and Campana (2009) reported length at 50 percent maturity was 10 years for females and 12 years for males.

Smooth skate (Funk Island Deep population) was assessed by COSEWIC as Endangered in May 2012 (COSEWIC 2011a) due to steep declines in the abundance of juveniles and adults since the early 1980s. Mean catch rates for the Funk Island Deep Designatable Unit peaked in 1978/1979 and then declined for both juveniles and adults until 1994. Catch rates remained consistently low but stable through to 2005. Slight increases have been observed since 2005 (Simpson et al. 2011). Although the abundance of adults appears to have increased in recent years, the overall abundance remains very low. These trends in abundance are matched by strong reductions in area of occupancy. Smooth skate will be considered for listing under SARA but, to date, do not have status. Although there is no directed fishery in Canadian waters, smooth skate is taken as bycatch. It is vulnerable to increased mortality as it is long-lived, slow-growing and late maturing (Frisk et al. 2001; Simpson et al. 2011). The period of decline in the Funk Island Deep Designatable Unit corresponds with the coldest water temperatures reported (Colbourne et al. 2006) and may also relate to high bycatch rates; however, other factors may be at play (Simpson et al. 2011).

Survey data suggest smooth skate concentrate north and south of the Nearshore and Offshore Project Areas. There is low potential for smooth skate to occur in the Nearshore and Offshore Project Areas.

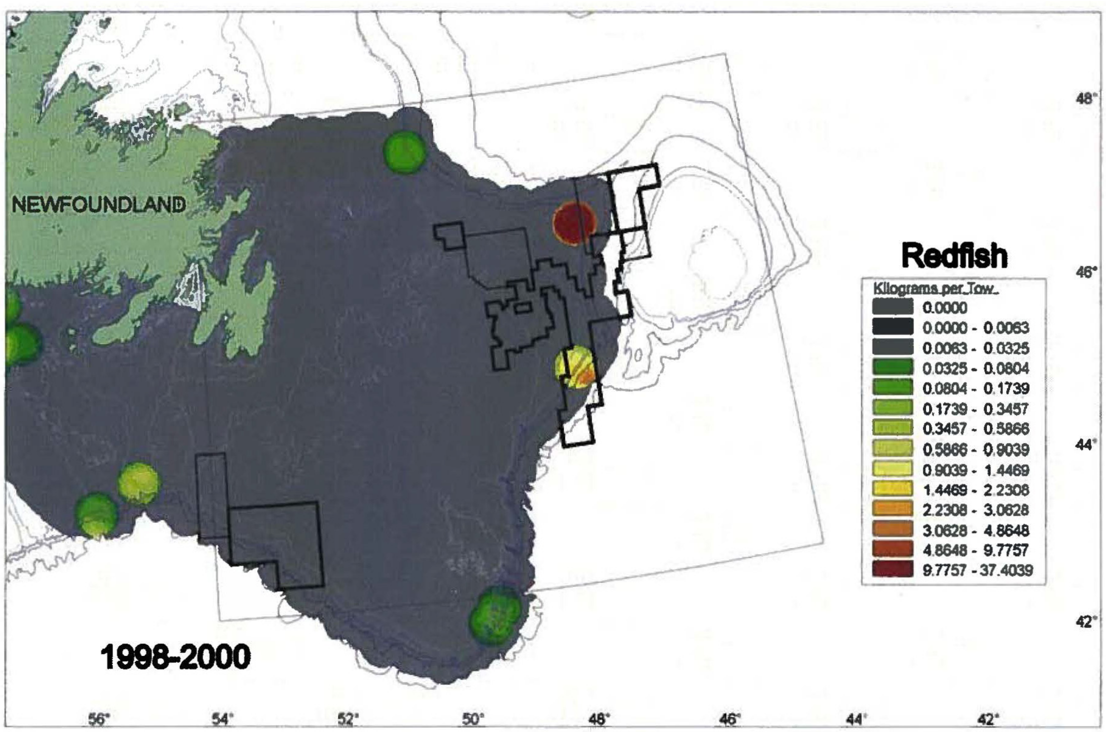
12.3.1.8 Redfish

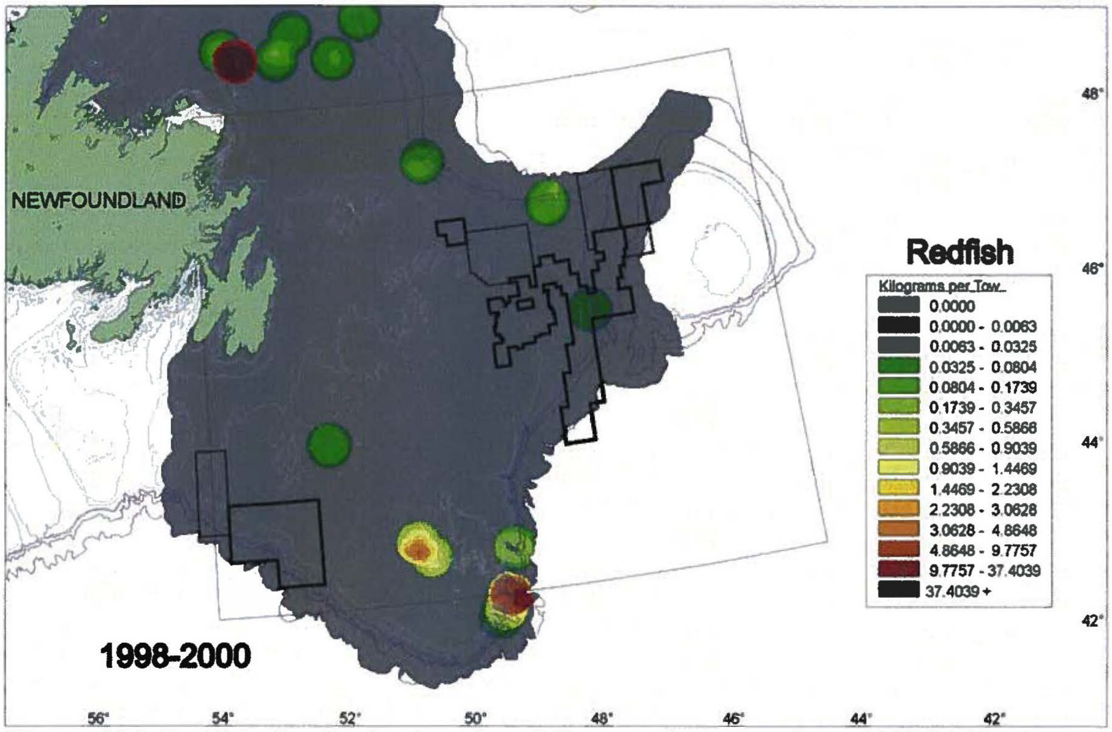
Two species of redfish occur in Newfoundland and Labrador, Acadian (Atlantic population) and deepwater (northern population) redfish. These species are very difficult to distinguish and because of this, the two species are managed together in the fishery (DFO 2004d). However, there is a latitudinal and depth gradient in distribution, with only deepwater redfish occurring in the far north (e.g., Davis Strait), and only Acadian redfish occurring in the far south of their range (e.g., Gulf of Maine) (DFO 2004d), and deepwater redfish occurring in deeper water than Acadian redfish. Redfish are very long-lived (approximately 75 years), late-maturing, slow-growing, deep water (150 to 700 m) species (COSEWIC 2010b). Mating occurs in fall and larvae hatch within the female and are released between April to July.

In 2010, the status of these populations was re-examined and both were assessed as Threatened by COSEWIC. The deepwater redfish (northern population) has declined by 98 percent since 1978 (one generation), though declines slowed in the mid-1990s and some increases have been noted. The Acadian redfish (Atlantic population) has declined by 99 percent, in areas of historical abundance over two generations. The major threats to both species are directed fishing and bycatch (COSEWIC 2010b). Bycatch in the northern shrimp fishery has been substantially reduced since the 1990s, but bycatch may still be considerable in other fisheries (COSEWIC 2010b).

In the Offshore Study Area, both the Acadian and deepwater redfish occur at depths of 100 to 700 m, but their occurrence is patchy and varies spatially and temporally (Figure 12-9). They are more common in NAFO Division 3L in spring surveys than in fall surveys (Kulka et al. 2003). Spawning occurs on the northeastern edge of the Grand Banks during June at more than 200 m depth. Larvae have been abundant during summer pelagic surveys of the Grand Banks (Anderson et al. 1999). The Southwest Shelf Edge and Slope EBSA has been identified as an important area for redfish spawning (DFO 2007b), and this area occurs within the Offshore Study Area (refer to Section 13.3.2.1).

Redfish are not expected in the relatively shallow waters of the Nearshore Study Area. There is low potential for the deepwater redfish, and low to moderate potential for Acadian redfish, to occur in the Offshore Project Area at all times of the year (Figure 12-9).





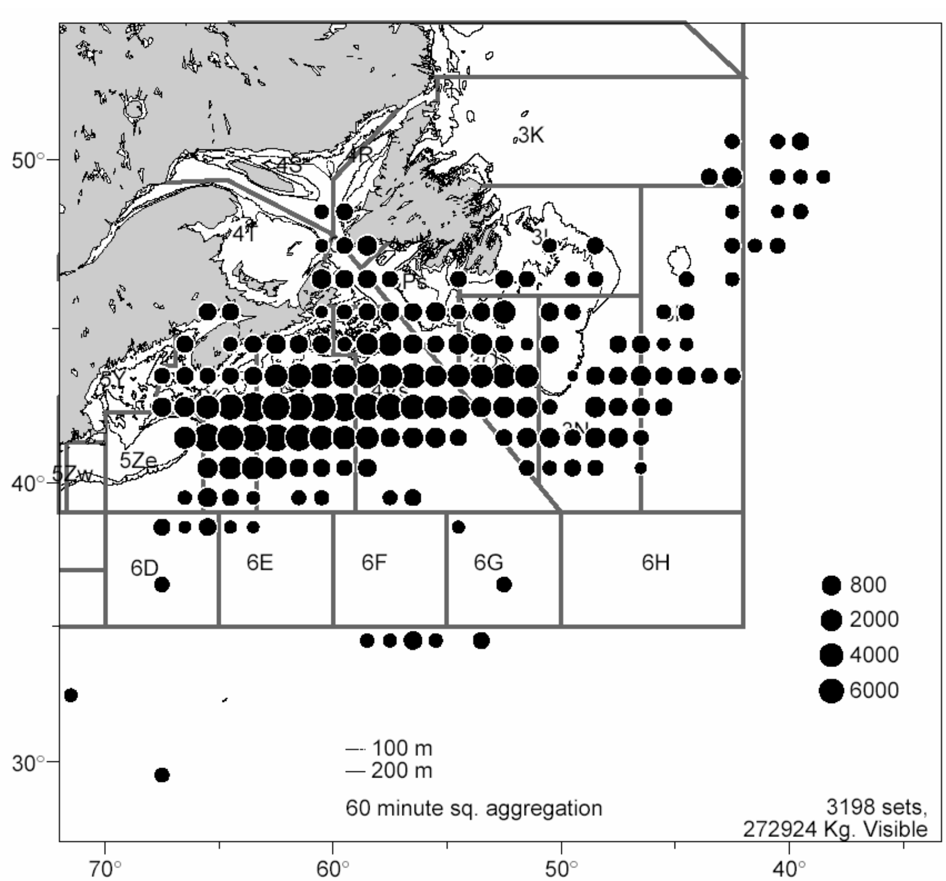
Source: Kulka et al. 2003.

Figure 12-9 Spring (top) and Fall (bottom) Distribution of Redfish in Relation to Petroleum Licenses on the Grand Bank

12.3.1.9 Shortfin Mako

The Atlantic population of shortfin mako (*Isurus oxyrinchus*) is assessed as Threatened by COSEWIC (2006c) but, to date, has not gained federal protection under SARA. Shortfin mako are apex predators that feed mainly on tuna, mackerel, swordfish and marine mammals. This shark is highly migratory and distributed globally. Its distribution pattern is largely driven by following sub-temperate waters (preferring waters 17°C to 22°C), but it can withstand substantial changes in temperature, as it is able to thermoregulate and raise its internal body temperature above the surrounding marine environment. Shortfin mako can reach very high swimming speeds and are considered to be one of the fastest sharks. Migration to the Atlantic coast of Canada typically occurs in later summer and fall. This species is rare north of the Gulf Stream, Gulf of Maine and Scotian Shelf; however, sightings have been recorded on the Grand Banks (Templeman 1963; COSEWIC 2006c). Few mature individuals are known to occur in Canadian waters.

The species was assessed as threatened owing to its population status within the entire Atlantic Ocean basin, high mortality in fisheries (bycatch) and life history traits (COSEWIC 2006c). There are little data on population trends or mortality rates, as the species is not managed as a commercially fished species in Canada (no stock assessment); however, analyses of US pelagic longline logbook data (Baum et al. 2003) suggested that catch rates of mako species (likely mainly shortfin mako) declined by 40.7 percent between 1986 and 2000. In that time, 65,795 mako sharks were reported to be caught in this fishery. Shortfin mako are long-lived (estimated 24 to 45 years), with a long gestation period and few offspring. Consequently, high anthropogenic-driven mortality can greatly affect survival. In Canadian waters, all catch of shortfin mako is non-directed (bycatch in pelagic longlines); therefore, catch limits have limited benefit. Distribution in Atlantic Canada based on catch data are shown in Figure 12-10.



Source: Campana et al. 2004
Note: Based on recorded catch (kg) from the International Observer Program Database (1986 to 2004)

Figure 12-10 Distribution of Shortfin Mako in Atlantic Canada

Shortfin mako is considered to have a moderate potential of occurring in the Nearshore and Offshore Study Areas during summer and fall, and a low potential during winter and spring, as they prefer warmer waters.

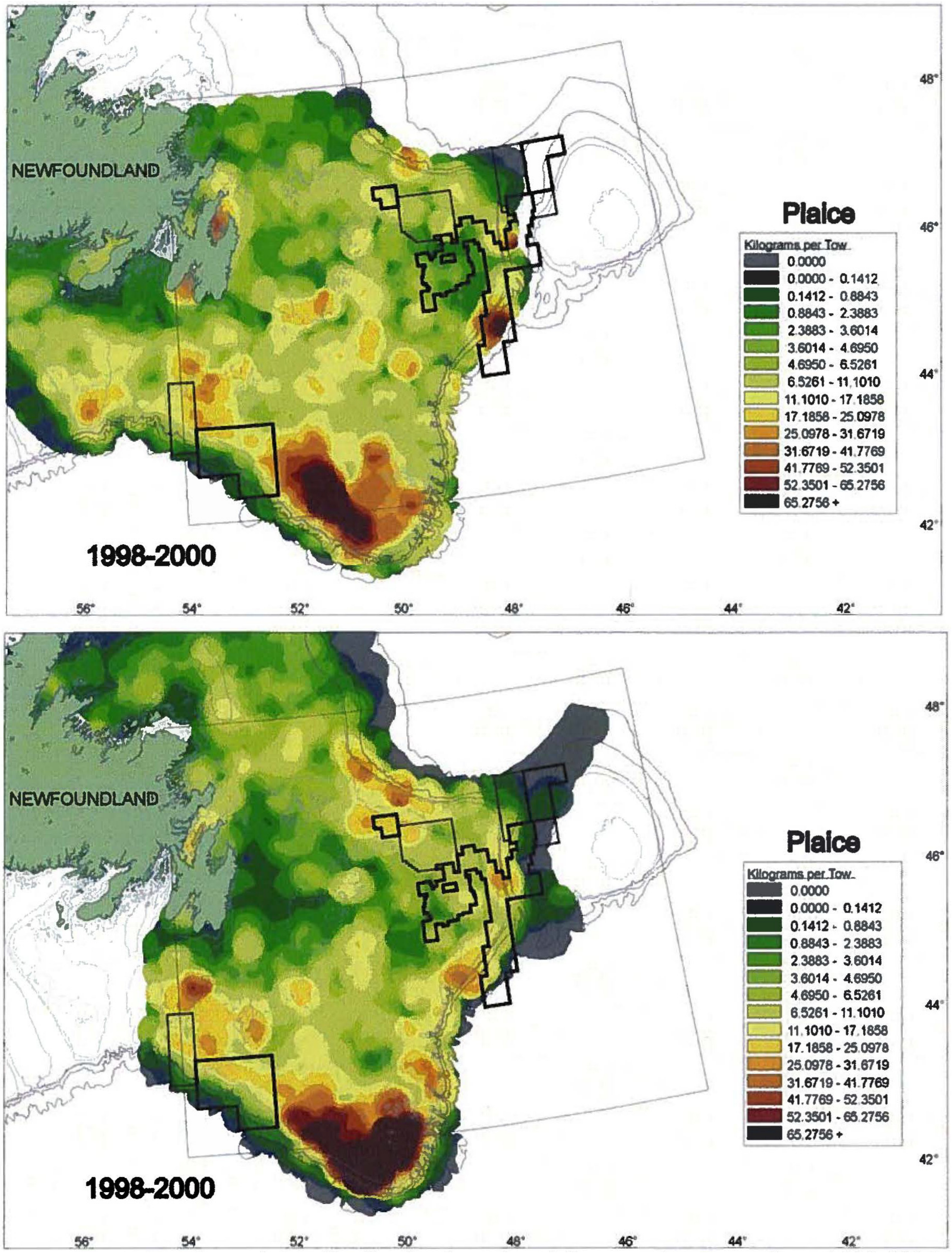
12.3.1.10 American Plaice

American plaice are demersal as adults, and occur across a broad depth range (36 to 713 m), with the highest catches occurring between 125 and 200 m (Scott and Scott 1988; DFO 2011f). This species occurs on both sides of the Atlantic, and in the Northwest Atlantic occur from Baffin Bay to as far south as the Gulf of Maine and George's Bank. It is considered a cold-water species (-1.5°C to 13°C), and is most abundant at temperatures below 0°C.

American plaice are a slow-growing, moderately long-lived species, with females reaching sexual maturity at 4 to 15 years, and males at three to seven years. Large, mature females are highly fecund. Spawning typically occurs between March and September, with peak activity in April and May, and occurs in both inshore and offshore areas. American plaice reproduce synchronously in groups and are batch spawners; a female may spawn for more than a month. Eggs and larvae of this flatfish are pelagic, with larval hatch typically occurring within two weeks of spawning. Previous surveys in August and September have indicated the presence of pelagic juvenile plaice in inshore waters. Once the pelagic juveniles switch to demersal habitat and develop into adults, the typical depth range is 55 to 130 m (DFO 2005c; Morgan et al. 2011). Larval and pelagic juvenile plaice feed on small phytoplankton and zooplankton. When they settle to the ocean bottom, the diet switches to larger food items, including echinoderms and sand lance (Scott and Scott 1988). This species is a highly opportunistic feeder that will feed on variety of prey items, including polychaetes, echinoderms, molluscs, crustaceans, capelin and sand lance.

The Newfoundland and Labrador population of American plaice have been designated as Threatened by COSEWIC (2009a). Data suggest that over a 47 year period (three generations), abundance declined by an estimated 96 percent. This population occurs from south of Hudson Strait to the Grand Banks in the east, and to Cape Ray in the west. The Maritimes population (includes NAFO Divisions 4RS) were assessed as Threatened (COSEWIC 2009a; DFO 2011f) based on a rate of decline in abundance of mature individuals of 86 percent in the Gulf of St. Lawrence, and 67 percent on the Scotian Shelf, over 36 years (two-plus generations). American plaice were historically very abundant (COSEWIC 2009a) and the fishery in Newfoundland and Labrador was once the largest flatfish fishery in the world; however, declining stocks resulted in a fishing moratorium in 1993 (DFO 2005c; Morgan et al. 2011). Overfishing is likely the primary cause of the decline for both stocks, but there was also increased natural mortality at the time of the greatest population declines. Today bycatch in other fisheries remains an issue.

There is low potential for occurrence of American plaice in the Nearshore Study Area. There is moderate to high potential for American plaice (particularly the Newfoundland and Labrador population) to occur in the Offshore Study Area (Figure 12-11). The Southeast Shoal and Tail of the Grand Banks EBSA and Virgin Rocks EBSA have been identified by DFO (2007b) as important breeding, spawning, and/or nursery habitat for American plaice (refer to Section 13.3.2.1).

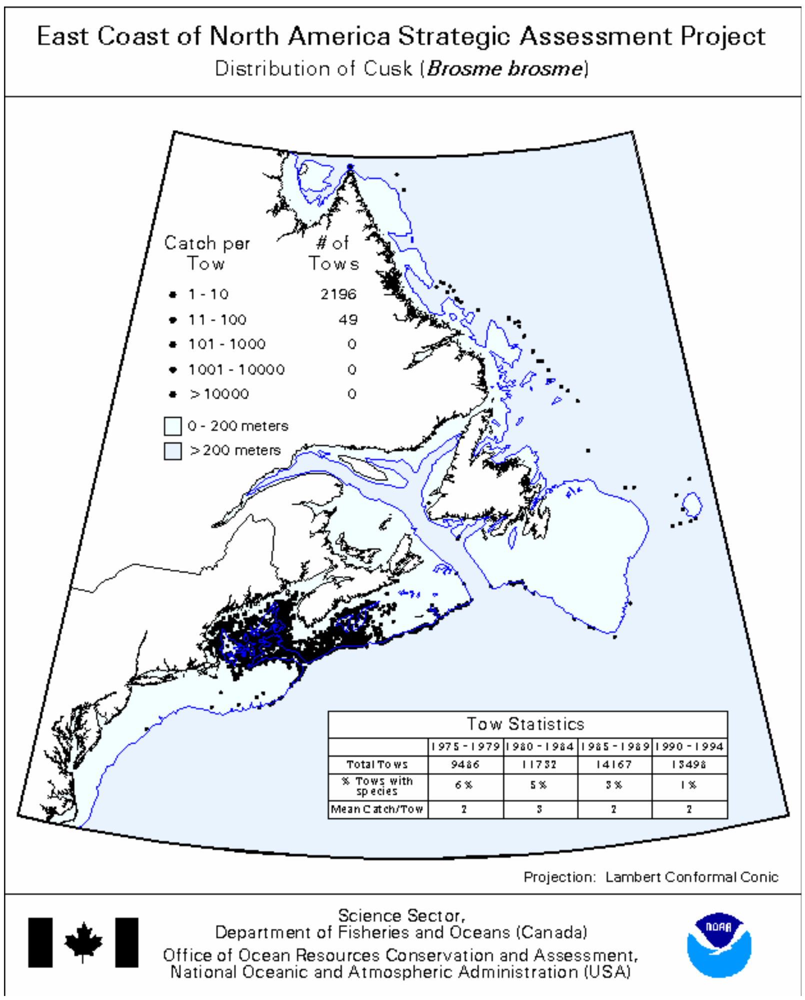


Source: Kulka et al. 2003

Figure 12-11 Spring (top) and Fall (bottom) Distribution of American Plaice in Relation to Petroleum Licenses on the Grand Bank

12.3.1.11 Cusk

Cusk are a slow-growing, large, solitary species, and are most common on hard, rocky substrates in deep water. They usually occur at depths of 150 to 400 m and are concentrated in waters that are 6°C to 10°C (COSEWIC 2003c). Cusk are relatively rare and have a limited distribution in the Northwest Atlantic, with much of the population concentrated within the Gulf of Maine and southern Scotian Shelf, as well as in the deep waters along the continental slope off Newfoundland and Labrador (Figure 12-12) (COSEWIC 2003c; Harris and Hanke 2010). Cusk are known to live to 20 years and grow to more than 100 cm, with at least half of the adults reaching sexual maturity when they are approximately 50 cm in length (five or six years old). Predators include Atlantic cod, Atlantic halibut and hooded seals; fishing (bycatch) is also an important source of mortality. Most of the landings in eastern Canada come from NAFO Division 4X (southwest Nova Scotia). Data from trawl surveys collected by DFO since 1970 suggest cusk has declined by 90 percent since 1970 (three generations) in Atlantic Canada. It was assessed as Threatened by COSEWIC in 2003.



Source: COSEWIC 2003c

Figure 12-12 Distribution of Cusk in the Northwest Atlantic

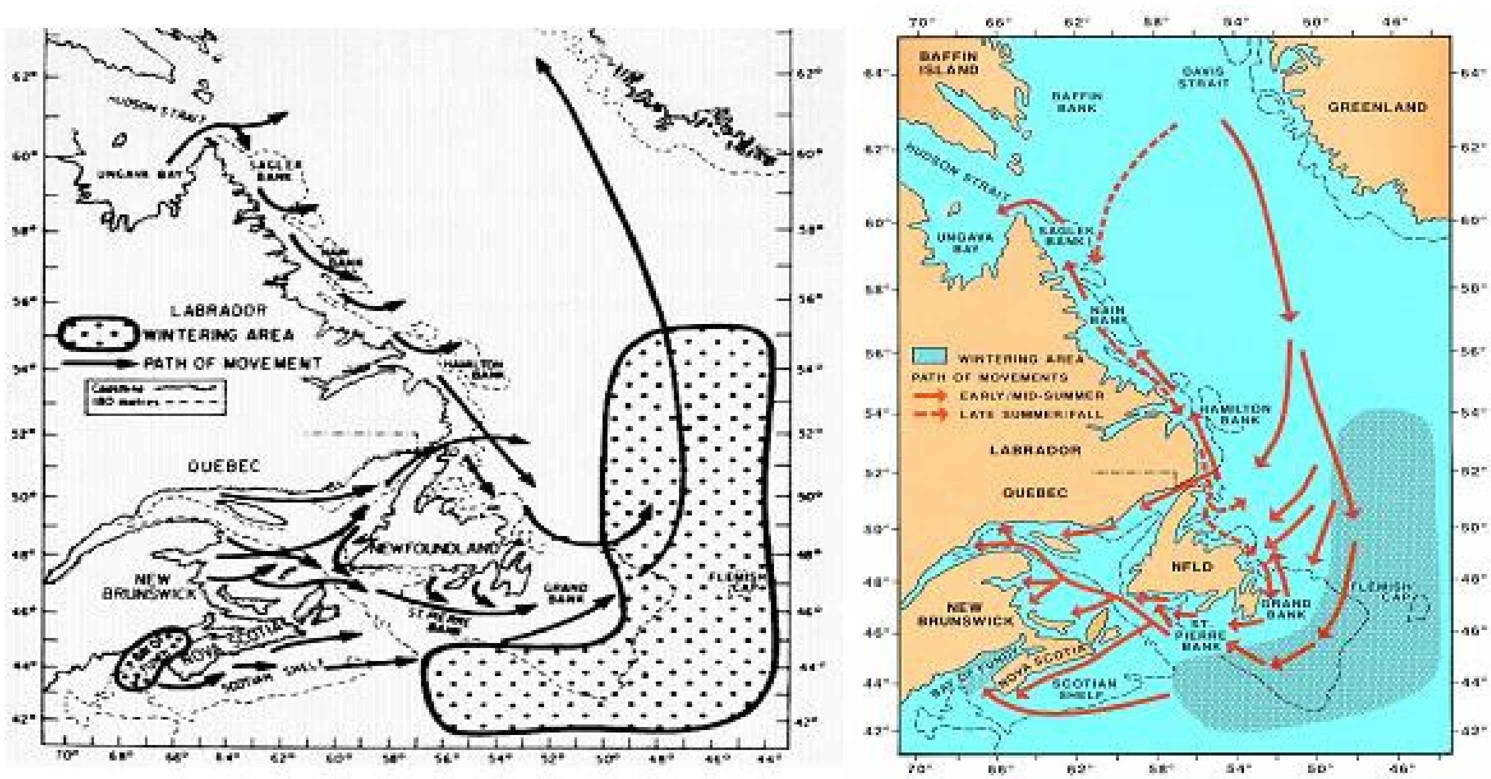
Cusk were rare or absent during DFO surveys from 1980 to 2000 within the Offshore Study Area. Sporadic occurrences on the Flemish Cap and around the Nose and Southwest Slope of the Grand Banks were noted (Kulka et al. 2003). Based on its known distribution and rarity, there is low probability that cusk will occur in the Nearshore or Offshore Study Areas.

12.3.1.12 Salmon

Atlantic salmon are an anadromous species that inhabit freshwater rivers until age two and then migrate seaward. Atlantic salmon are ecologically important in both freshwater and marine systems, and are also valued by Aboriginal peoples, commercial fisheries and recreational fisheries in Canada (DFO and MRNF 2009). Atlantic salmon require rivers that are clear, cool and well-oxygenated, and prefer bottom substrates with gravel, cobble and boulder (COSEWIC 2010c). Older juvenile and adult Atlantic salmon generally return to their natal river or tributary each year for spawning, although some do stray from their natal river, and not all adults are anadromous (Hendry and Beall 2004). While at sea, adult salmon are known to occur mainly in the upper portion of the water column and to undertake long migrations that include the Nearshore and Offshore Study Area (Figure 12-13) (Reddin 2006). Tagging studies of post-smolts also indicated they spend most of their time near the surface, but also undergo deep dives, likely in search of prey (Reddin et al. 2004).

The South Newfoundland population has a moderate to high potential to occur in the Nearshore and Offshore Study Areas year-round. This population has been assessed as Threatened by COSEWIC (2010c); however, it is not currently listed under SARA. This population is found from Cape Ray and along the south coast of Newfoundland, and breeds in rivers from the southeast tip of the Avalon (Mistaken Point). The numbers of both small and large salmon in this population have declined over the last three generations (COSEWIC 2010c).

The observed declines in Atlantic salmon in the late 1980s and 1990s were unprecedented and very widespread. Because of this widespread mortality, the main source of mortality has been thought to occur during the ocean phase (Reddin and Friedland 1993); however, more recently, the main causes of population decline for Atlantic salmon have been recognized to be interrelated and complex. The declines are likely not attributable to a single cause (Cairns 2001; Russell et al. 2012). Of the many factors proposed for the declines in survival, experts consider the main causes to be predation, changes in life history, fishing, historical and current changes to river habitat (e.g., dams, culverts, deforestation, low water flow, pollution, changes in sedimentation), large-scale climate change (e.g., changes in productivity, prey distribution) and acidification of freshwater habitats. The interaction between farmed (i.e., aquaculture pens) and wild stocks is also a concern (Carr et al. 1997). Efforts to mitigate these problems have been attempted (e.g., fish passage structures have been found to be highly effective, riparian habitat has been restored in many areas and emissions of sulphur dioxide have been greatly reduced in North America allowing rivers to recover in part (Russell et al. 2012)).



Source: COSEWIC 2010c (modified from Reddin 2006)

Figure 12-13 Migratory Routes of Post-smelt (left) and Returning Adults (right) in Atlantic Canada

Atlantic salmon rely on a wide variety of prey, and are consumed by a variety of predators. While at sea, Atlantic salmon consume euphausiids, amphipods and fishes such as herring, capelin, small mackerel, sand lance and small cod. Eggs and smolt are preyed upon by birds (Common Merganser, Belted Kingfisher, Common Loon and Double-crested Cormorant) (Chaput and Cairns 2001) and fish (including Atlantic salmon, brook trout and American eel). Juveniles and adult salmon at sea are prey of seals, river otter, seabirds (e.g. Northern Gannet), harbour porpoise, beluga whale, porbeagle shark, Greenland shark (*Somniosus microcephalus*), gadoids, skate, halibut and tuna (Scott and Scott 1988). Salmon migrating through rivers and estuaries are also preyed upon by Osprey, Bald Eagle, otter and mink.

To counter declines, restrictions on commercial Atlantic salmon harvests were first initiated in the 1970s, and additional measures were implemented in the 1980s. Commercial fisheries were closed in 1984 in the Maritimes and portions of Quebec, and a moratorium on commercial fishing for insular Newfoundland occurred in 1992, followed by Labrador fisheries in 1998, and finally, all commercial fisheries for Atlantic salmon were closed in eastern Canada in 2000 (COSEWIC 2010c). From 1992 to 1996, salmon stocks on the south coast of Newfoundland declined by 20 percent for smaller fish and by 11 percent for adults (DFO 1997).

There are five identified salmon rivers at the head of Placentia Bay: Come By Chance River; Watson River; North Harbour River; Black River; and Pipers Hole River. Commercial fishing occurs between North Harbour and Sound Island during May and June (Coastal Resource Inventory 2007). Measures have also been put in place for recreational fisheries, including daily and season bag limits, mandatory catch and release of large (in some cases all) individuals, and direct closures in parts of Maritimes. Within Newfoundland and Labrador, there are 15 Atlantic salmon management areas, known as Salmon Fishing Areas 1 to 14B, and the salmon in Placentia Bay are part of Salmon Fishing Areas 10. Surveys of abundance of salmon in insular Newfoundland from 2005 to 2010 indicate considerable variation from year to year, with 2010 being a stronger year than the previous five-year mean, including in Salmon Fishing Areas 10 (Robertson et al. 2011).

12.3.1.13 American Eel

American eel occur in the Western Atlantic from northern South America to Labrador (Figure 12-14). Historically, eels were found in all accessible freshwater, estuarine and coastal marine waters within their range that were also connected to the Atlantic Ocean. Historically, this species had the largest range of any fish in the Western Hemisphere and was very abundant. Evidence suggests Aboriginal peoples fished eel in Canada as early as 3,000 years ago, and eel has traditionally been an important resource for Aboriginal peoples in eastern Canada. In May 2012, American eel was upgraded by COSEWIC to Threatened due to continuing sharp declines, as well as continuing degradation of habitat. American eel have no SARA status to date.

Source: Lee 1980

Figure 12-14 Global Distribution of American Eel

Eel are catadromous and semelparous; they begin their life cycle in the Sargasso Sea, return to fresh water to feed and grow, and then return to the sea to spawn once before dying. All spawners are considered part of a single breeding unit. The life cycle includes six main stages: egg; leptocephalus (larval form); glass eel (upon reaching the Continental Shelf; unpigmented); elver (progressively pigmented as they approach shore); yellow eel (the growth stage); and silver eel (the spawning stage) (COSEWIC 2006d). Eels use the continental shelf prior to and following their migration to the Sargasso Sea, and are able to tolerate salinities ranging from freshwater to seawater. Growth is more rapid for eels reared in marine habitats than in freshwater habitats. In Newfoundland and Labrador, female silver eels leave freshwater systems and migrate to the Sargasso Sea to spawn between August to October (COSEWIC 2006d). Large eels are highly fecund and may account for a large proportion of the entire reproductive output. American eel are a long-lived species, and generation time is 22 years on average, though much less (approximately nine years) for those reared in salt water due to fast growth rates in that environment. In winter, eels bury themselves in mud.

There are no long-term data for most of Canada's eel populations. The Great Lakes is the one area where data have been collected, and indices of abundance in the Upper St. Lawrence River and Lake Ontario suggest a decline of 99 percent since the 1970s. COSEWIC (2006d) has assessed eel as of special concern in Canada. A recent assessment of the status of this species in Newfoundland and Labrador (Veinott and Clarke 2011) found evidence of declines from the 1980s to 1990s, but more recent fisheries independent data are lacking. Data from salmon counting fences and commercial catch data suggest the abundance of eel is now stable or improving. In Newfoundland (Freshwater Ecological Area 4) and Labrador (Freshwater Ecological Area 5), yellow and silver eels are fished principally in rivers, but there are many rivers which are not exploited.

Due to its long lifespan, semelparous reproductive system and long migrations between freshwater and marine systems, the American eel is vulnerable to a wide variety of natural and anthropogenic threats. Natural threats include large-scale climate changes that effect productivity and transport of the larval stage and relatively high disappearance rates (natural mortality and emigration of larval stage in Sargasso Sea). Anthropogenic threats include barriers preventing migration, habitat loss and fragmentation (e.g., hydroelectric dams, turbines), directed fisheries and pollution (COSEWIC 2006d).

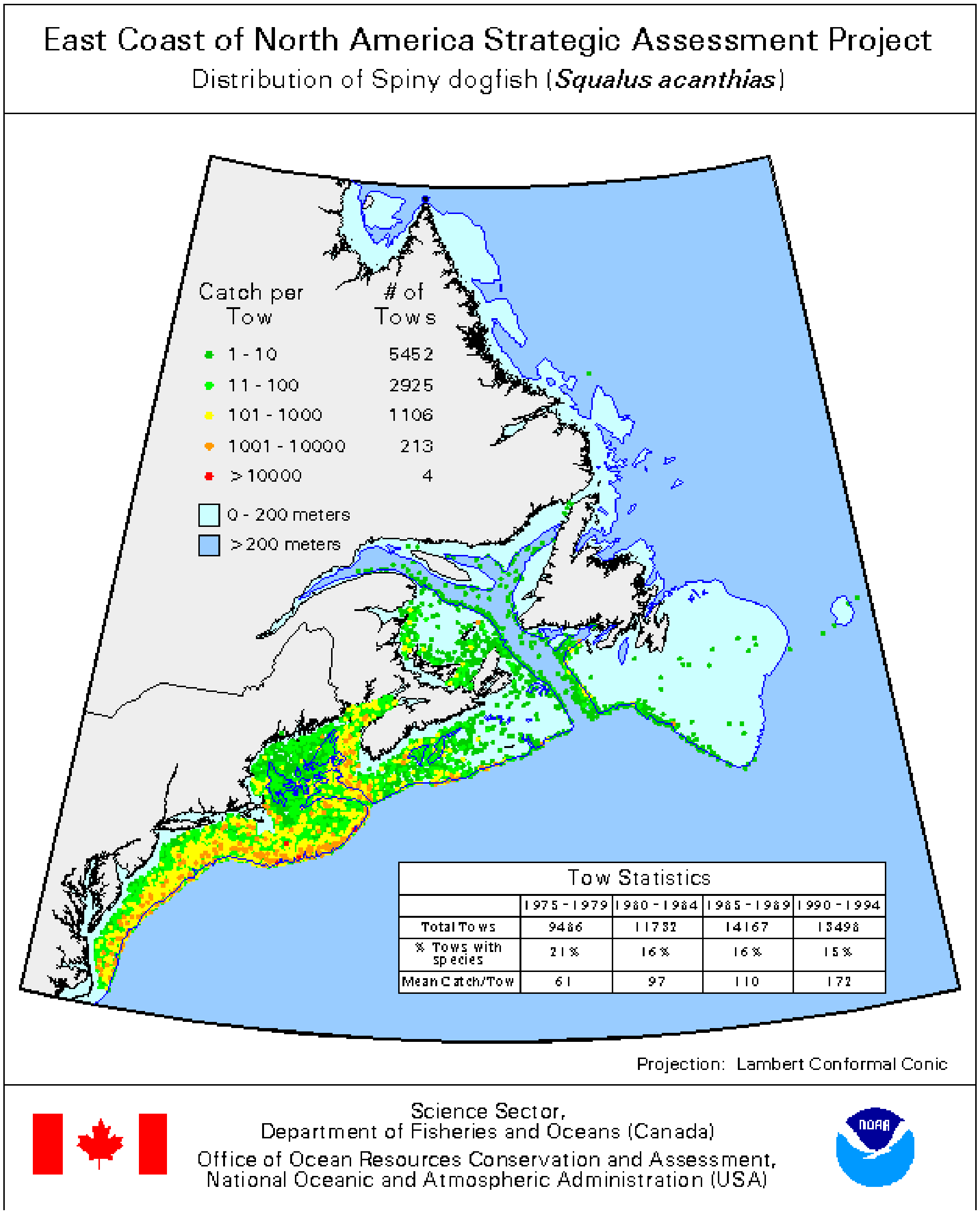
There is moderate potential for American eel to occur in the Nearshore Study Area and low potential to occur in the Offshore Study Areas.

12.3.1.14 Spiny Dogfish

Spiny dogfish are widely distributed in boreal to warm temperate species, spread over continental and insular shelves and upper slopes of the Pacific and Atlantic Oceans (Kulka 2006). This small shark is commonly distributed over the continental shelf of temperate regions, and is most abundant in waters 5°C to 15°C (Kulka 2006). The Atlantic population extends from Labrador to Cape Hatteras and is most abundant south of Nova Scotia; however, there are areas of concentration around Newfoundland and Labrador, including on the eastern edge of the Grand Banks (Figure 12-15).

There are indications of a local inshore/offshore migration pattern (Kulka 2006), with spiny dogfish most likely to occur in Placentia Bay during the summer or early fall. The distribution of spiny dogfish distributions is patchy, as they can form dense aggregations, causing high variability in survey indices. The absence of young juveniles, as well as high variability in abundance estimates from surveys, suggests that the early life history stages (pupping and juveniles) occur elsewhere.

The Atlantic population of spiny dogfish has been assessed as a species of Special Concern by COSEWIC (2010d). This shark has a very long gestation period (18 to 24 months), long generation time (23 years) and low fecundity (average of six pups every two years) and as such, is vulnerable to exploitation. There is also uncertainty about long-term trends in abundance, and particularly the abundance of mature females. The western Atlantic population is known to be broken into several well-defined 'groups', with concentrations in the southern Gulf of St. Lawrence, around Newfoundland, on the eastern and central Scotian Shelf, the Bay of Fundy and southwest Nova Scotia, as well as in Massachusetts and North Carolina. These groups undertake seasonal migrations and it is unclear how much mixing there is among groups.



Source: Brown and O'Boyle 1996

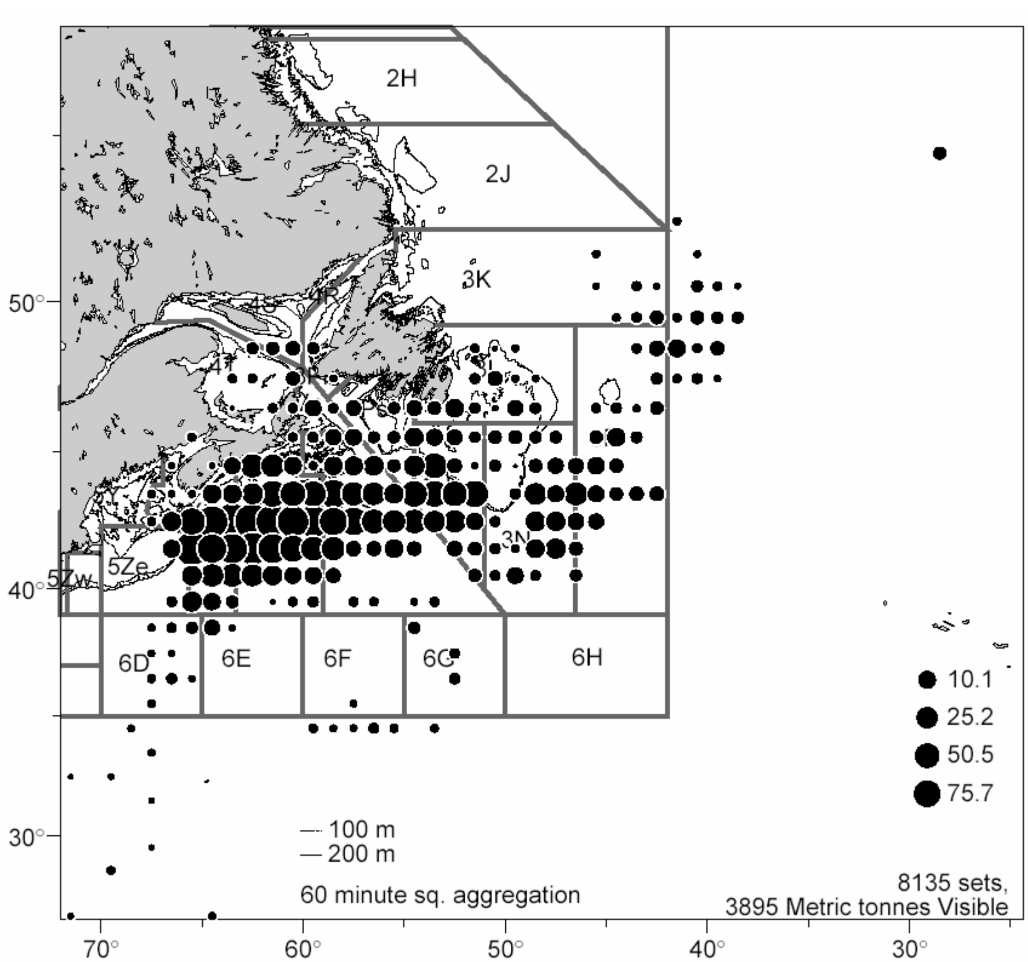
Figure 12-15 Distribution of Spiny Dogfish in the Northwest Atlantic

Spiny dogfish are threatened by overfishing, as well as high bycatch and discard rates. Commercial fisheries often target the large, sexually mature females, further endangering the population (COSEWIC 2010d). The species has been caught for various markets historically and today, including for its meat, as fertilizer, vitamins, fishmeal and in the shark fin trade.

There is low potential for occurrence in the Nearshore Study Area and moderate to high potential for occurrence in the Offshore Study Area.

12.3.1.15 Blue Shark

The blue shark (*Prionace glauca*) is widespread and highly migratory and is considered to be one single population in the North Atlantic. In Canada, they occur along the shelf break from northeastern Newfoundland to the Bay of Fundy (Figure 12-16) (COSEWIC 2006e), in offshore waters from the surface down to a depth of 350 m. This species is most common in Newfoundland waters in late summer and fall. Blue sharks have been found in southeastern Newfoundland and on the Grand Banks. In Canadian waters, immature (sub-adult) individuals are encountered most frequently. Water temperature appears to drive distributions (COSEWIC 2006e). Blue sharks are opportunistic feeders and tend to eat a variety of prey including squid, birds and marine mammal carrion (COSEWIC 2006e).



Source: COSEWIC 2006e
Note: Based on all known commercial catch records between 1986 and 2004

Figure 12-16 Distribution of Blue Shark in Atlantic Canada

The blue shark is more productive than most other shark species, since it sexually matures relatively early (age four to six), is able to produce litters approximately every two years and has a 9 to 12 month gestation period, with litters of 25 to 50 pups. However, like all elasmobranchs, they have low natural mortality rates and are vulnerable to increased mortality.

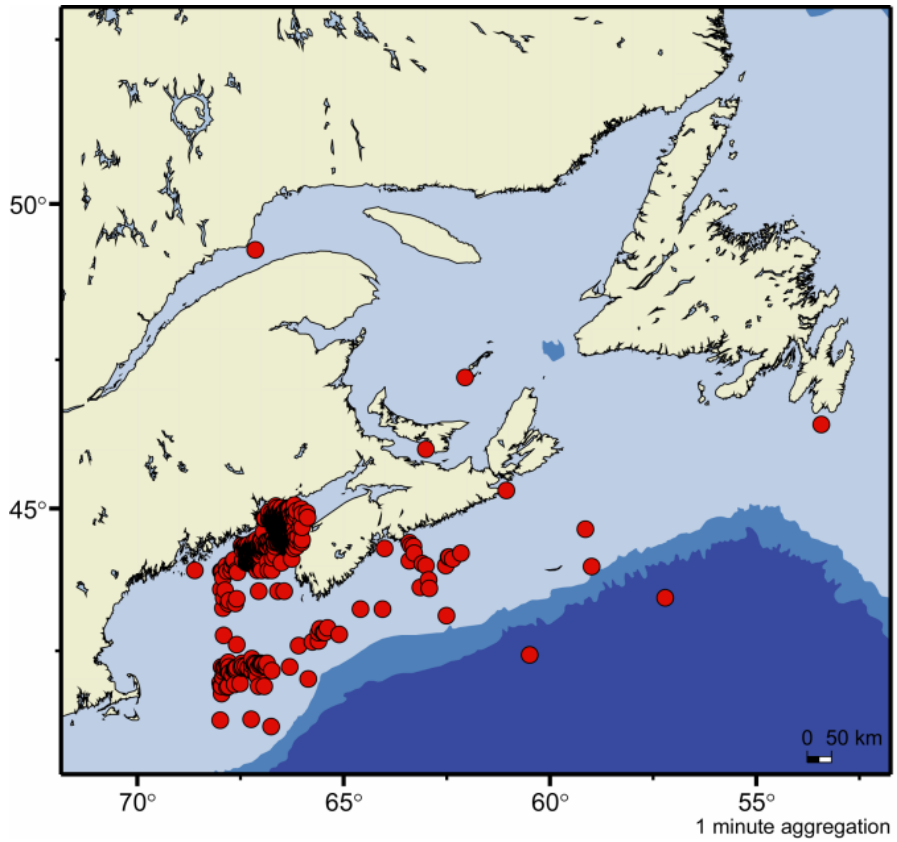
The Atlantic population was assessed as a species of Special Concern by COSEWIC in 2006. In Atlantic Canada, approximately 600 t of blue shark are harvested annually, which is estimated a small fraction of the total fishing removals in the North Atlantic (and globally) each year. The Atlantic recreational blue shark fishery is catch and release only. Pelagic longline fisheries also regularly catch blue sharks as bycatch, and it has been estimated that blue shark accounts for one-third of biomass caught in the Canadian tuna and swordfish pelagic fishery; with a large portion discarded (COSEWIC 2006e; Campana et al. 2009). The fins have low value in comparison to other shark species; however, due to the abundance and distribution of blue sharks globally, this species accounts for a large proportion of fins traded internationally in the shark fin market (Nakano and Seki 2002; Clarke et al. 2006; Dulvy et al. 2008).

This species is considered to have a moderate potential for occurrence in the Nearshore and Offshore Study Areas during July to December and low potential at other times of year.

12.3.1.16 Basking Shark

The Atlantic population of basking shark (*Cetorhinus maximus*) is distributed in coastal waters from northern Newfoundland to Florida. The species is frequently sighted in Canadian waters from May to September (Figure 12-17), but rarely seen at other times of year, and their winter distribution is not well known (COSEWIC 2009b). Basking shark are plankton feeders and concentrate in highly productive areas where oceanographic conditions and bathymetry promote zooplankton growth. They are highly migratory (DFO 2008c).

The basking shark is the second largest fish in the world, and is a commonly-sighted species owing to its large size and behaviour of ‘basking’ (feeding) at the surface. However, despite this, very little is known about the species. Basking sharks are thought to live at least 50 years, with males reaching sexual maturity between 12 and 16, and females between 16 and 20. Information about reproduction is only known from one female who had a litter with six pups. Gestation is estimated to 2.6 to 3.5 years, with time between litters of two to four years. The Emerald Basin on the Scotian Shelf is thought to be a mating area (DFO 2008c). A total population of 10,125 individuals was estimated for Atlantic Canada based on aerial and shipboard surveys, but has high uncertainty (DFO 2008c; COSEWIC 2009b).



Source: COSEWIC 2009b
Note: As recorded in aerial and shipboard surveys of right whales combined with reports phoned in to DFO Shark Laboratory between 1997 and 2006

Figure 12-17 Confirmed Basking Shark Distribution in Atlantic Canada, 1997 to 2006

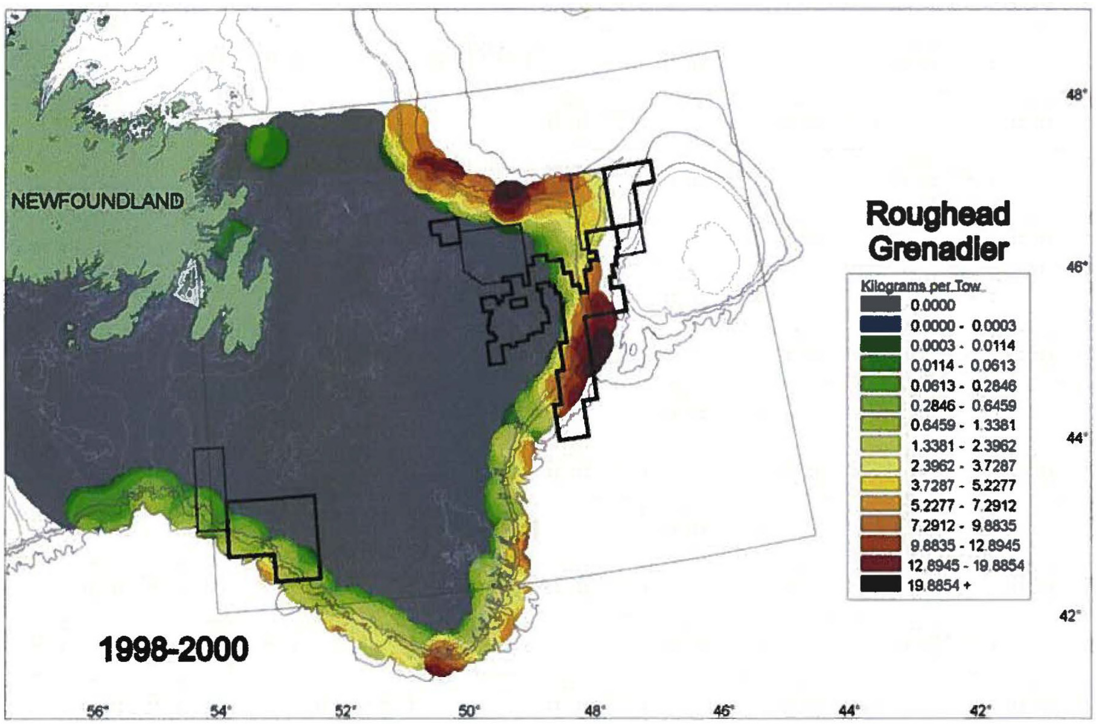
The Atlantic population of basking shark has been assessed as a species of Special Concern by COSEWIC (2009b); it has not yet gained federal protection under SARA. The greatest threat to this shark in Canada is bycatch in fisheries causing mortality; the number of deaths caused by ship strikes in unknown and has potential to be a threat. In the past, basking sharks were also directly hunted and up until 1982, there was a Faroese fishery in the southern Gulf of St. Lawrence (COSEWIC 2009b). Globally, the basking shark is at risk in the shark fin trade, owing to its very large and valuable fins, and Convention on International Trade in Endangered Species of Wild Fauna and Flora has added the basking shark to its list in order to regulate the trade (Magnussen et al. 2007).

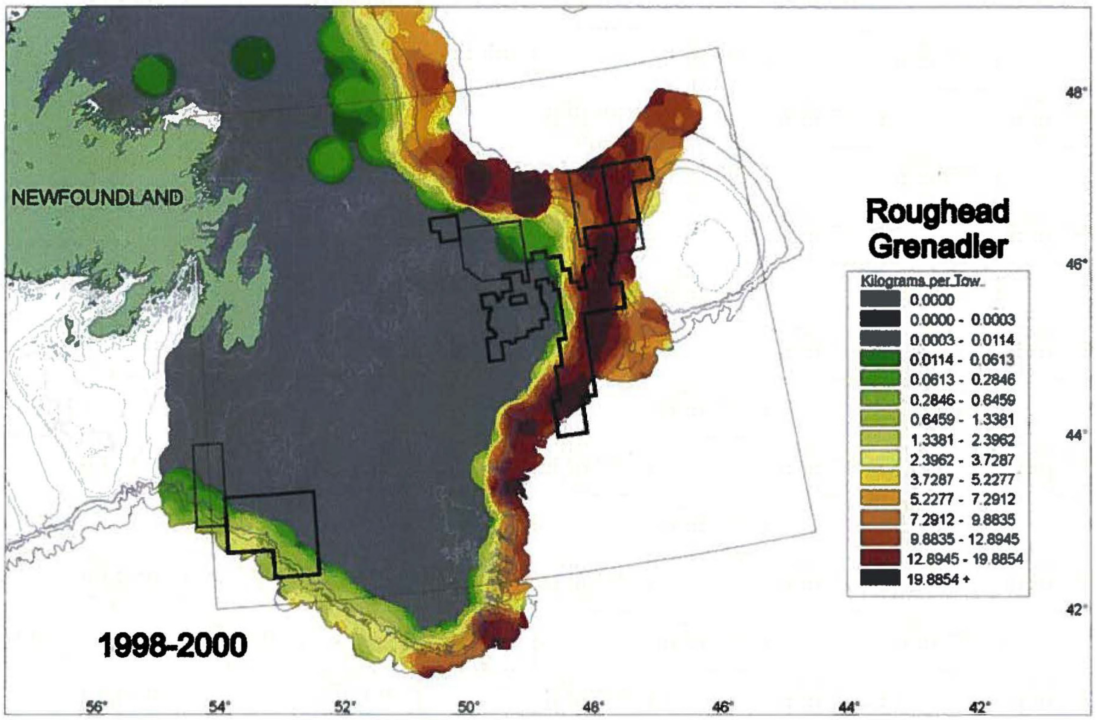
This species is considered to have low potential for occurrence near the Offshore or Nearshore Study Areas during May to September, and is unlikely to occur at other times of the year.

12.3.1.17 Roughhead Grenadier

The roughhead grenadier (*Macrourus berglax*) is assessed as a species of Special Concern by COSEWIC (2007b), but has no SARA status. It is widespread across the upper continental slope and deep continental shelf from Davis Strait to Georges Bank (Figure 12-18). Their total range is not covered by Canadian research surveys, particularly in deep waters (greater than 1,000 m); however, data suggest decline rates of more than 90 percent over 15 years (one generation). It is possible that these declines are in part due to a shift in distribution to deeper areas as a result of cooling shelf waters in the 1980s, though there is also evidence of intensive fishing pressure. It is caught mainly as bycatch in the Greenland halibut fishery. There are no catch limits or management plans for this species in Canada, and as such, the rates of bycatch are concerning as it is a long-lived, slow-growing species. This species is a generalist and preys upon a variety of invertebrates.

There is low potential for the Roughhead grenadier to occur in the Nearshore Study Area and moderate to high potential to occur within the Offshore Study Area.





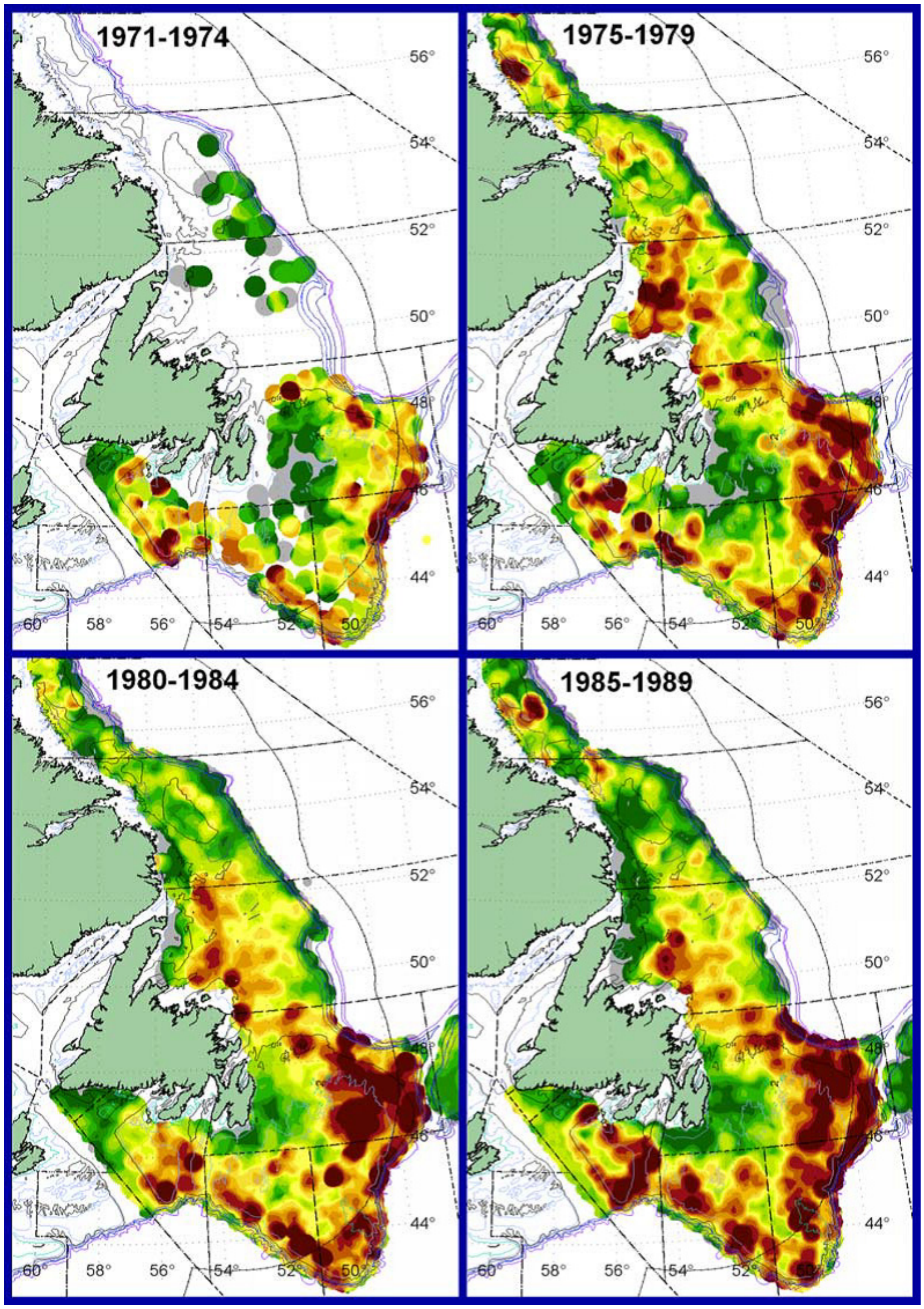
Source: Kulka et al. 2003

Figure 12-18 Spring (top) and Fall (bottom) Distribution of Roughhead Grenadier in Relation to Petroleum Licenses on the Grand Bank

12.3.1.18 Thorny Skate

Thorny skate are distributed from Greenland to South Carolina, and in Canada occur along the continental shelf from Davis Strait to the Gulf of Maine, with the population concentrated on the southern Grand Bank (Figure 12-19) (Kulka and Miri 2003; Simon et al. 2011). Data from DFO surveys indicate that thorny skate tend to be found at 200 to 600 m depth in NAFO Divisions 2HJ3KLMN, but to occur in shallower and narrower layers (50 to 300 m) in Division 3Ops. They were rarely reported below 1,000 m (Simon et al. 2011).

McPhie and Campana (2009) reported maturation of thorny skate to occur between 53.4 cm (female) and 62.6 cm (males). Age at 50 percent maturity occurs between 10.7 and 14.7 years with large variation between males and females (McPhie and Campana 2009). The presence of egg cases (e.g., 'mermaid's purses') reported year-round throughout their range suggests spawning occurs year-round (Templeman 1984; Simpson et al. 2011). Spawning appears to peak in fall and winter. Fully mature females produce 40 to 45 eggs (Templeman 1984). Diet is highly varied and includes decapod crustaceans, euphausiids, polychaetes and demersal fish such as Atlantic haddock, flounder species, scup and croaker (McEachran et al. 1976; Simpson et al. 2011).



Source: Simpson et al. 2011.
Note: Based on DFO spring and fall surveys.

Figure 12-19 Distribution of Thorny Skate in Newfoundland and Labrador

Like other elasmobranch species, thorny skate have a low reproductive output as they have slow growth, are long lived, low fecundity, and long reproductive cycles (Templeman 1987), which make them vulnerable to increased levels of mortality. Survey data suggest thorny skate have experienced severe population declines over the southern part of their Canadian distribution and that their range has shrunk (Simpson et al. 2011). Bycatch of thorny skate is not well known because skate bycatch is typically reported without specifying species. A study by Gavaris et al. (2010) estimated bycatch from total discard rates of skate, and a study by Simon and Frank (2000) found that in the skate fishery on the eastern Scotian Shelf between 1994 and 2005, thorny skate accounted for approximately 1.7 to 8.6 percent of landings, and the majority of the catch was winter skate. Declines in thorny skate have continued in their southern range despite reductions in fishing mortality in recent decades. In contrast, abundance of thorny skate has been increasing in their northern range to population levels observed in the 1970s (Simpson et al. 2011). Due to the observed declines in its southern range, thorny skate was assessed as Special Concern in the Northwest Atlantic by COSEWIC in May 2012 (COSEWIC website), but does not have SARA status at this time.

On the Grand Bank (NAFO Division 3LNO), catch data suggests concentrations were more widespread during 1970s and 1980s, but abundance declined in late 1990s, and since then has been more concentrated on the southwest Grand Bank (Kulka et al. 2004). There is moderate potential for occurrence of thorny skate in the Nearshore Study Area, and moderate potential for occurrence in the Offshore Study Area. Skate is fished in Placentia Bay, and the species primarily caught is thought to be thorny skate.

12.3.2 Marine Mammal and Sea Turtle Species at Risk

Nine species are included in marine mammal and sea turtle SAR: blue whale; fin whale; North Atlantic right whale; killer whale; northern bottlenose whale; Sowerby’s beaked whale; harbor porpoise; leatherback sea turtle; and loggerhead sea turtle (see Tables 12-2 and 12-3). Blue whale, fin whale, Sowerby’s beaked whale and leatherback sea turtle (Atlantic population) are listed on Schedule 1 of SARA. Neither the Nearshore nor Offshore Study Areas represent critical habitat for these species. It is also possible that North Atlantic right whale may occur in the Offshore Study Area, although its status there is regarded as extremely rare. Northern bottlenose whale is separated into two populations that differ in conservation status. The Davis Strait-Labrador Sea-Baffin Bay population is the most likely source of any individuals of that species occurring within the Offshore Study Area because the movement of individuals from the Scotian Shelf population is restricted to a small area of that shelf (Gowans et al. 2000).

At the time of this writing, recovery strategies were available for blue whale (Beauchamp et al. 2009), the North Atlantic right whale (Brown et al. 2009) and, leatherback sea turtle (Atlantic Leatherback Turtle Recovery Team 2006).

Species profiles for each of the marine mammal and sea turtle SAR are provided in the following sections.

12.3.2.1 Blue Whale

The blue whale are cosmopolitan in distribution, but tend to be more common in pelagic than coastal environments (Jefferson et al. 2008). Following large-scale depletion from industrial whaling, blue whales occur at low densities in the North Atlantic (COSEWIC

2002a). The National Marine Fisheries Service (NMFS) (1998) estimated that up to 1,400 individuals are found in the North Atlantic. The size of the Northwest Atlantic population is currently unknown, but Beauchamp et al. (2009) cites experts that estimate that the number of mature animals is unlikely to exceed 250 individuals and are observed year-round on the Grand Banks. Blue whales are assessed as Endangered by COSEWIC and listed on Schedule 1 (Endangered) of SARA.

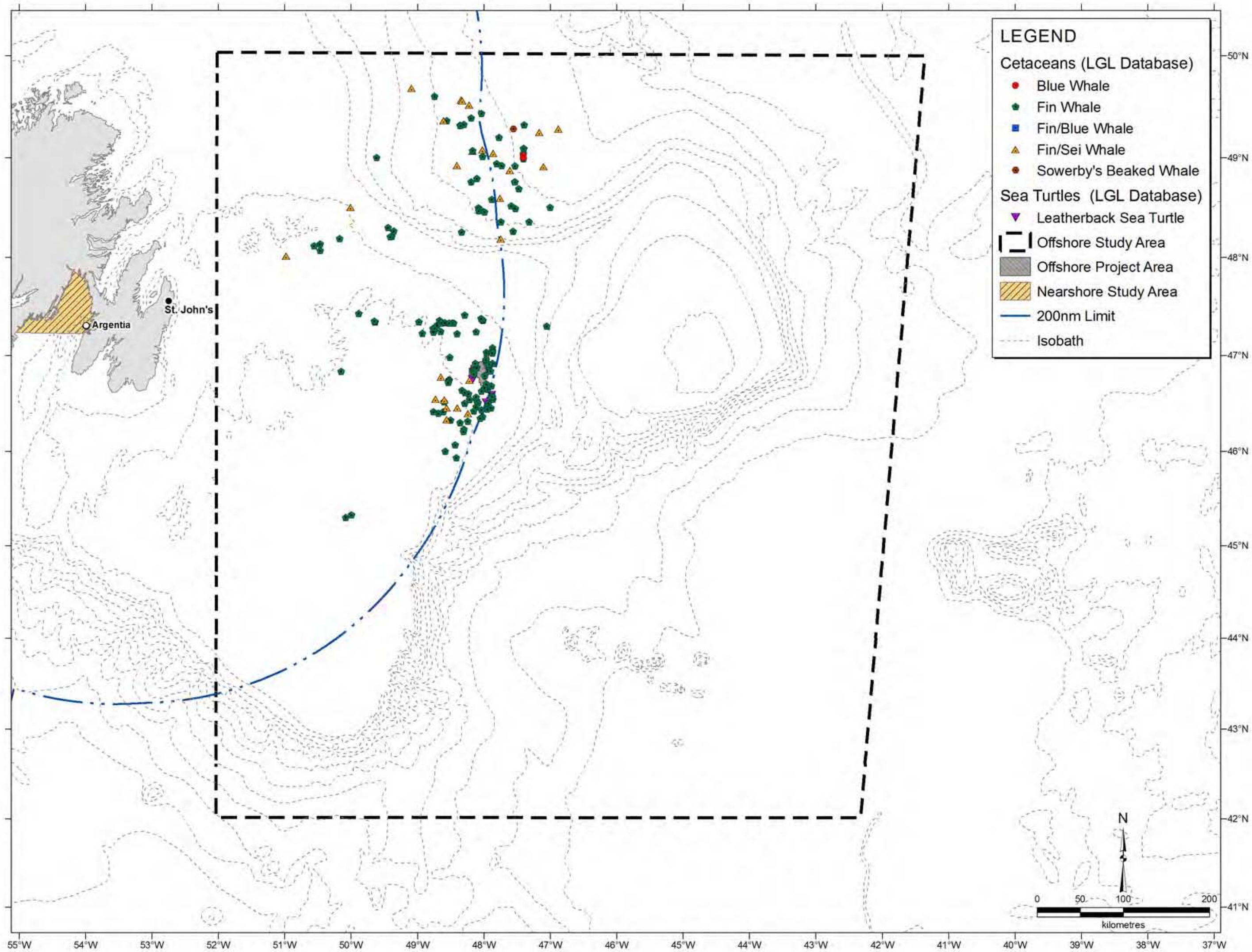
A Recovery Strategy has been published for the Northwest Atlantic population of blue whale (Beauchamp et al. 2009). The Recovery Strategy targets the identification of critical habitat for the blue whale by 2014. The Strategy identifies nine threats to the blue whale population, including whaling, natural mortality, anthropogenic noise, food availability, contaminants, collisions with vessels, whale watching, accidental entanglement in fishing gear, epizootics and toxic algal blooms and toxic spills (Beauchamp et al. 2009). It concludes that the recovery of the Northwest Atlantic blue whale population is feasible and sets a target of increasing the current population to 1,000 mature individuals.

Blue whales are most often observed as single animals, but also occur in small groups (Jefferson et al. 2008). Blue whales are regular occupants of the Gulf of St. Lawrence, where at least 308 individuals have been uniquely identified (Sears et al. 1987) and average group size is 1.4 (although concentrations of 20 to 40 animals have also been seen) (Sears et al. 1991). Euphausiids are its primary prey in the Gulf of St. Lawrence, where they commonly feed near the 100 m depth contour (Sears et al. 1987) and their distribution has been linked to heterogeneous seafloor topography and the presence of thermal fronts (Doniol-Valcroze et al. 2007).

Compared with other cetacean species, blue whales are uncommon in eastern Newfoundland waters. There was a single possible blue whale sighting (recorded as a fin or blue whale) during seismic monitoring programs in the Jeanne d'Arc Basin, and only two sightings in the adjacent Orphan Basin (both occurring in August and water depths >2,000 m; Abgrall et al. 2008b) (see Figure 12-20). There were only six sighting of blue whale reported in the DFO cetacean sightings database (DFO 2007c) within the borders of the Offshore Study Area (Figure 12-21). However, there is one sighting in the database (DFO 2007c) from within the Nearshore Study Area approximately 6 km northwest of Fair Haven (Figure 12-22). Blue whales are not expected to commonly occur in the Offshore Study Area.

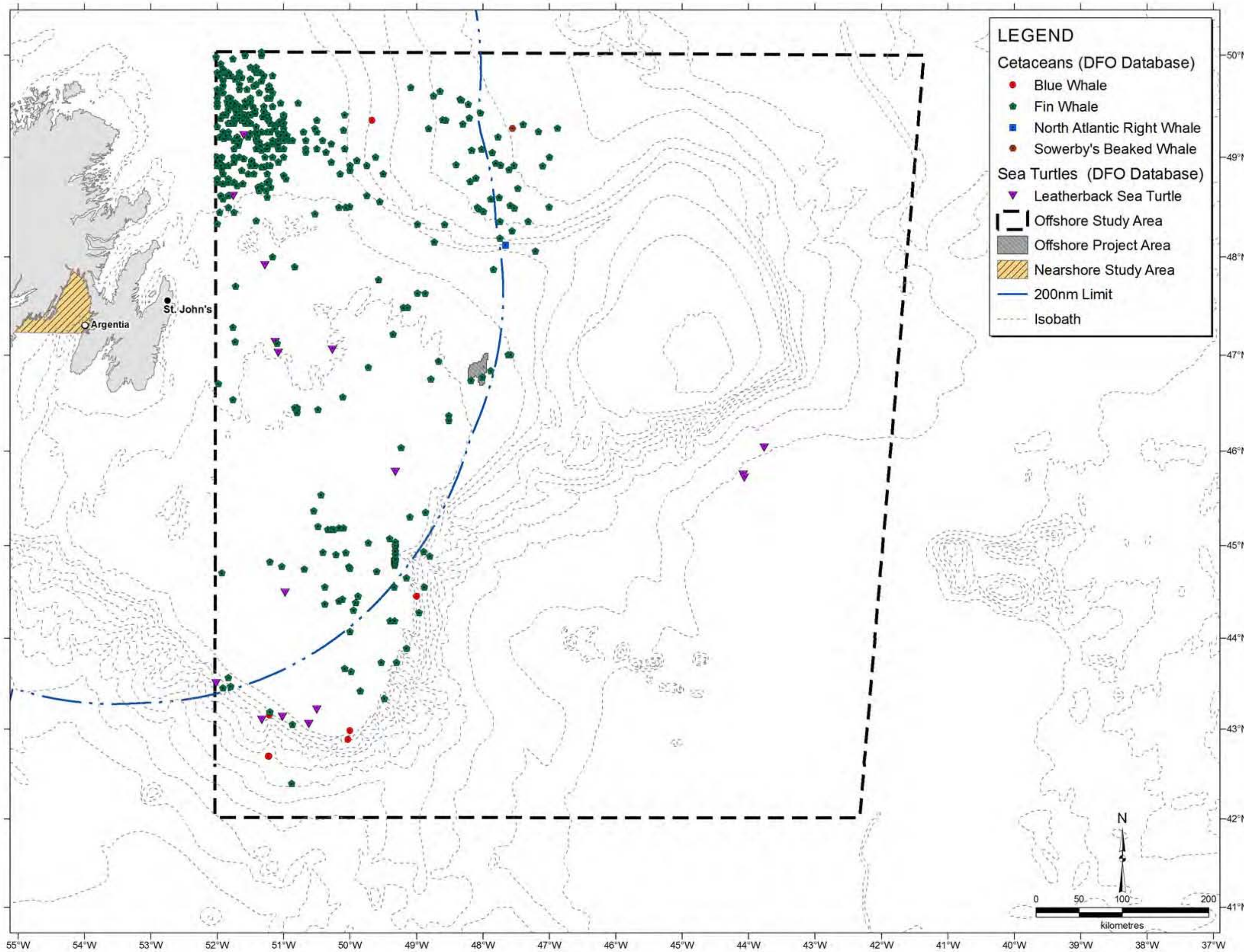
Blue whale records have been more common off the south coast of Newfoundland. In general, the available monitoring results suggest that baleen whales are typically less abundant on the Grand Banks in late fall versus summer, and it is possible that blue whales occur in the Offshore Study Area at low densities.

Blue whales are not expected to commonly occur in the Nearshore Study Area. There is little available information on the presence of blue whales in Placentia Bay. No blue whales were reported in the DFO cetacean sightings database (DFO 2007c) in the Nearshore Study Area.



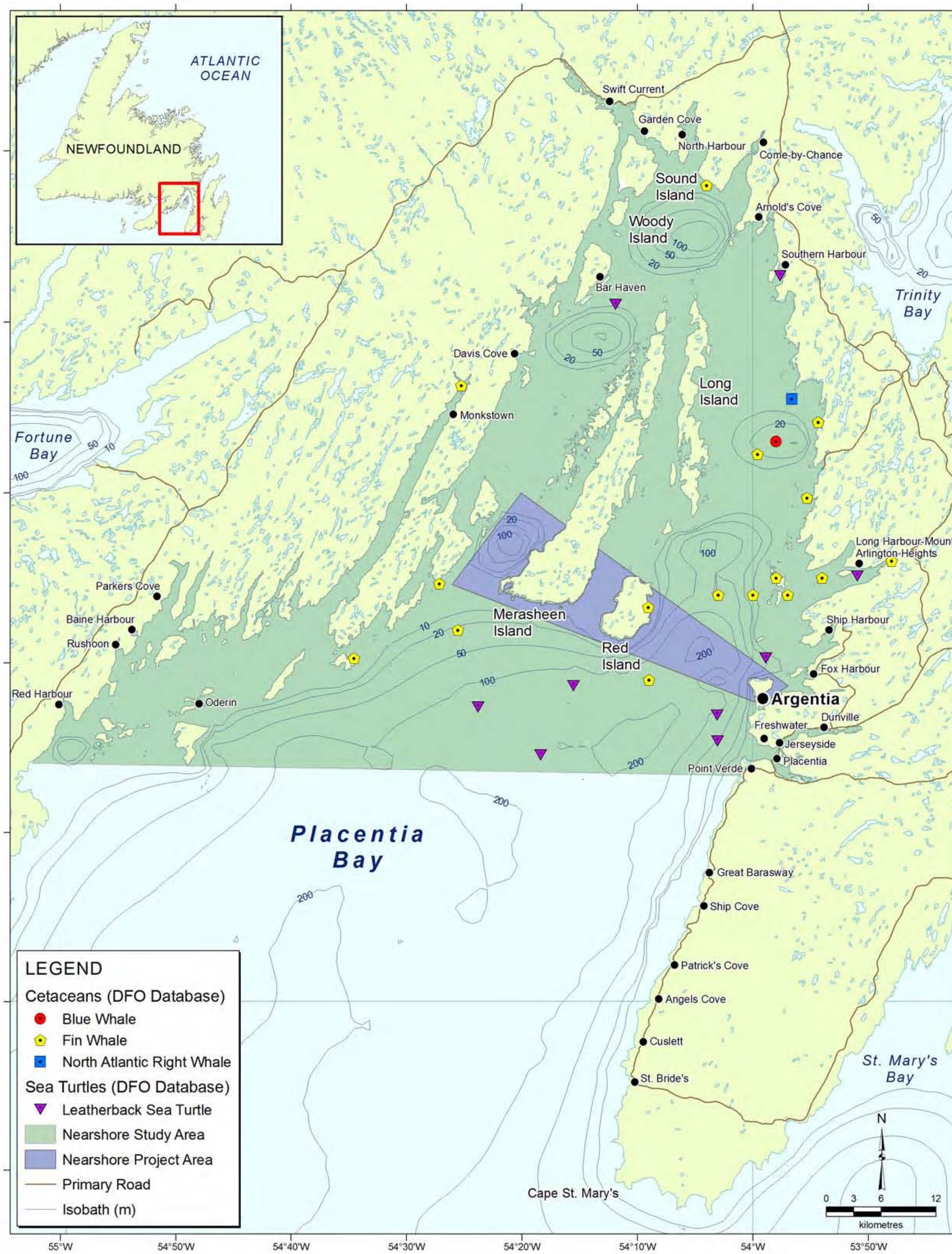
Source: Lang and Moulton 2004, 2008; Moulton et al. 2005, 2006a; Lang 2007; Abgrall et al. 2008a, 2008b, 2009; Lang et al. 2008

Figure 12-20 Locations of Marine Mammal and Sea Turtles Species at Risk Sightings Observed during Jeanne d'Arc Basin and Orphan Basin Seismic Surveys (2005 to 2008), In the Offshore Study Area



Source: DFO cetacean sightings database (DFO 2007c); J. Lawson 2009, pers. comm.

Figure 12-21 Locations of Historical Marine Mammal and Sea Turtle Species at Risk Sightings in the Offshore Study Area



Source: DFO cetacean sightings database (DFO 2007c); J. Lawson 2009, pers. comm.

Figure 12-22 Locations of Historical Marine Mammal and Sea Turtle Species at Risk Sightings in the Nearshore Study Area (1945 to 2007)

12.3.2.2 Fin Whale (Atlantic population)

Fin whale are found in oceans worldwide, making seasonal migrations between low-latitude wintering areas and high-latitude feeding grounds (COSEWIC 2005). Fin whale have a cosmopolitan distribution, but are most common in temperate and polar regions (Jefferson et al. 2008). It is one of the most frequently observed cetacean species in Continental Shelf waters of the Northwest Atlantic, from the mid-United States to eastern Canada (Waring et al. 2009). An estimated 35,500 fin whales occur in the North Atlantic (IWC 2007), with 2,269 to 2,814 found in the Northwest Atlantic (COSEWIC 2005; Waring et al. 2009). In Canada, fin whales (Atlantic population) are listed as Special Concern on Schedule 1 of SARA and assessed the same by COSEWIC (COSEWIC 2010e).

Genetic analyses suggest that there are likely several different populations of fin whales in the North Atlantic, with western North Atlantic animals distinct from those in Iceland, West Greenland and the eastern North Atlantic (Bérubé et al. 1998). Fin whales use lunge feeding to consume euphausiids and small fishes, and their distribution has been associated with thermal fronts or shallow areas with heterogeneous subsurface topography that may help concentrate their prey (Woodley and Gaskin 1996; Doniol-Valcroze et al. 2007). They often occur singly or in small groups of two to seven animals, but have also been observed in feeding aggregations of up to 20 individuals, sometimes with humpback and minke whales (Jefferson et al. 2008). Average fin whale group size off eastern Newfoundland was reported as 2.6 during an aerial survey in August 1980 (Hay 1982).

Fin whales regularly occur in eastern Newfoundland waters, particularly from early summer to late fall. Of the identified baleen whales, fin whales were the second most commonly sighted species (after humpback whales) in the Jeanne d'Arc Basin during seismic monitoring programs from 2004 to 2008, with 110 sightings; there was at least one sighting each year from May to October (Figure 12-20). There were also several fin whale sightings within the Offshore Study Area west of the Jeanne d'Arc Basin in 2005, and six other sightings in 2008 (Figure 12-20). Fin whales were also frequently observed in deep waters (typically >2,000 m) of the adjacent Orphan Basin during summer, most often in July and August (Moulton et al. 2005, 2006a; Abgrall et al. 2008b). According to the DFO cetacean sightings database (DFO 2007c), fin whale were the second most frequently sighted species in the Offshore Study Area; there were 80 sightings of 162 individuals (Figure 12-22; DFO 2007c). Fin whales likely occur in the Offshore Study Area year-round, but are most common from June to October.

Fin whales are also common in coastal regions of Newfoundland, with group size linked to the size of capelin schools, their primary summer prey. In the nearshore, group sizes ranged from 1 to 10 individuals (Whitehead and Carlson 1988). Fin whale appear to be slightly less common than minke and humpback whales in the nearshore environment (Piatt et al. 1989), and have occasionally been recorded as entangled in nearshore fishing gear (Lien 1994). Fin whale are more often observed feeding in the middle of large deep-water bays, over 1.9 km (1 nm) from shore, in contrast with minke and humpback whales that most frequently fed less than 1.9 km from shore (Perkins and Whitehead 1977). A fin whale density of 0.007 individuals per km^2 was observed during an aerial survey conducted in Placentia Bay on 6 August 1980 (Hay 1982). Fin whales were occasionally reported in the Nearshore Study Area in the DFO cetacean sightings database (DFO 2007c); there were 16 sightings reported (Figure 12-22). Fin whales could commonly occur in the Nearshore Study Area, especially from June to October.

12.3.2.3 Sowerby's Beaked Whale

The Sowerby's beaked whale are found only in the cold temperate waters of the North Atlantic, where just one record in the Northwest Atlantic occurs outside the area between Labrador and New England (MacLeod 2000; MacLeod et al. 2006). The number of Sowerby's beaked whales in eastern Newfoundland is unknown, and the best population estimate for the Northwest Atlantic (of 3,513 individuals) combines sightings of all *Mesoplodon* spp. and *Ziphius cavirostris* (but these other species have more southerly distributions) (Waring et al. 2009). Sowerby's beaked whales are considered of Special Concern by COSEWIC and are listed on Schedule 1 (Special Concern) of SARA (COSEWIC 2010e).

Little is known about beaked whales in general, and most information on Sowerby's beaked whales in Newfoundland is based on stranding records or a few opportunistic sightings (Lien and Barry 1990). Sowerby's beaked whales are also relatively difficult to detect at sea due to their short surface durations, apparent offshore distribution and barely detectable blows (Hooker and Baird 1999a). They have most often been observed in deep waters and continental shelf edges or slopes (Kenney and Winn 1987; COSEWIC 2006f) and presumably make deep dives to forage on medium to large-bodied squid (COSEWIC 2006f).

Sowerby's beaked whales are expected to occur most frequently in deeper waters, although in relatively low numbers, of the Offshore Study Area. There were two unidentified beaked whale sightings during seismic monitoring in the Jeanne d'Arc Basin during 2005 to 2008 (Table 11-2, Figure 12-20). One of these sightings was deemed a species other than a northern bottlenose whale, and the observer suggested that it was likely a Sowerby's beaked whale (Lang et al. 2006). There was only one confirmed sighting of a Sowerby's beaked whale during four years of monitoring in the adjacent and deeper Orphan Basin; the sighting of four individuals occurred in 2,500 m of water during September (Table 11-2, Figure 12-20). There was one sighting of Sowerby's beaked whale reported in the DFO cetacean sightings database (DFO 2007c) in the Offshore Study Area (Figure 12-21).

Lien (1994) reported that there was one record of a Sowerby's beaked whale entangled in nearshore fishing gear during the period of 1979 to 1990. There have also been occasional strandings of individuals or groups (of up to six individuals) in eastern Newfoundland, dating from 1952 to 2004 (COSEWIC 2006f). Causes of death were typically not determined, and it is unknown if these whales entered nearshore waters prior to death or if the carcasses washed ashore. There were no sightings of Sowerby's beaked whales reported in the DFO cetacean sightings database (DFO 2007c) in the Nearshore Study Area. It is possible, but very unlikely, that Sowerby's beaked whales will occur in the Nearshore Study Area.

12.3.2.4 Killer Whale (Northwest Atlantic-Eastern Arctic population)

Killer whales have a cosmopolitan distribution, occurring in oceans from polar pack-ice to the equator, but seem to be most common in coastal waters at higher latitudes (COSEWIC 2008b; Jefferson et al. 2008). It is unknown how many killer whales occur in the Northwest Atlantic (Waring et al. 2009). In Newfoundland and Labrador, at least 63 animals have been individually identified to date (Lawson et al. 2007). Killer whales in Atlantic Canada were recently assessed by COSEWIC as of Special Concern, but currently have no status under SARA (COSEWIC 2010e).

Killer whales exhibit marked sexual dimorphism, with adult males having a much more pronounced and taller dorsal fin and being generally larger than females (Ford et al. 2000). Generally, killer whale movements are linked to the distribution and abundance of their primary prey, which can include fish, marine mammals, marine birds and cephalopods (Ford et al. 2000). Sympatric killer whales populations in some regions have divergent preferred prey, presumably as a mechanism to share available resources (Baird 2000). For example, there are distinct fish- or marine mammal-eating killer whale populations in the northeast Pacific that sometimes overlap temporally and geographically. Killer whales in Atlantic Canada have been observed approaching, attacking, and/or consuming other cetaceans, seals, marine birds and several species of fish; it is not known if local populations specialize on particular prey groups (Lawson et al. 2007). Most groups in Newfoundland and Labrador are comprised of three to seven individuals, and some individuals have been documented moving as much as hundreds of kilometres between re-sightings from year to year (Lawson et al. 2007). In the northeast Pacific, long-term and stable associations are maintained among matrilineal-related individuals and pods within fish-eating populations, as well as within mammal-eating populations, although to a lesser extent among the latter (Bigg et al. 1990). It is unknown whether such associations are maintained in the Northwest Atlantic, but preliminary social groups have been identified by Lawson et al. (2007).

Killer whales are considered a year-round resident of eastern Newfoundland, although they occur in relatively low densities (Goff and Lien 1988; Lawson et al. 2007). In the Jeanne d'Arc Basin, there were four killer whale sightings (totalling 21 individuals) during the 2008 seismic monitoring program (Table 11-2, Figure 11-1); two sightings occurred in each of June and September, group sizes ranged from 1 to 12 individuals, and water depths ranged from 65 to 153 m (Abgrall et al. in prep.). Outside of Jeanne d'Arc Basin, a single killer whale was also sighted to the northwest in October 2005 (Lang et al. 2006). There was also one sighting of three individuals in August 1999 during a supply vessel transit between oil platforms in the Jeanne d'Arc Basin and St. John's (Wiese and Montevecchi 1999).

Whitehead and Glass (1985) recorded two sightings (one of 15 individuals and the other of 12) during surveys of the Southeast Shoal (southeastern Grand Banks) during June and July in 1982 and 1983. In August 2007, a single killer whale was sighted during monitoring in the Orphan Basin (Abgrall et al. 2008b). There were 42 sightings of killer whales reported in the DFO cetacean sightings database (DFO 2007c) in the Offshore Study Area (Figure 12-21). The available information suggests that killer whales occur year-round at low densities in the Offshore Study Area, but are most common during summer.

Killer whales have also been observed in coastal areas of eastern Newfoundland (Mitchell and Reeves 1988). There were three sightings of killer whales reported in the DFO cetacean sightings database (DFO 2007c) in the Nearshore Study Area (Figure 12-22). Given the available information, killer whales likely occur year-round in the Nearshore Study Area, but only occasionally and predominantly during spring to fall.

12.3.2.5 Harbour Porpoise (Northwest Atlantic population)

Harbour porpoises are found in Continental Shelf regions of the Northern Hemisphere, and from southern Baffin Island to New England in the Northwest Atlantic (Jefferson et al. 2008). At least three populations of harbour porpoises exist in the Northwest Atlantic, including the eastern Newfoundland and Labrador, Gulf of St. Lawrence and Gulf of Maine/Bay of Fundy populations (Palka et al. 1996; Wang et al. 1996). There are an unknown number of harbour porpoises in the Northwest Atlantic, as well as in the Newfoundland population (COSEWIC 2006a). The Northwest Atlantic population of harbour porpoises was assessed by COSEWIC as a species of Special Concern and is listed as Threatened on Schedule 2 of SARA (COSEWIC 2010e).

Harbour porpoises tend to occur singly or in small groups of up to three animals, but occasionally form larger groups (COSEWIC 2006a). They consume small schooling fishes and apparently prefer areas with coastal fronts or topographically generated upwellings over the Continental Shelf, although there also appears to be an offshore component to their distribution (Westgate et al. 1998; Read 1999). Harbour porpoises appear to have an annual reproduction cycle; pregnant females were collected during late summer and early autumn from the Gulf of Maine/Bay of Fundy population (Palka et al. 1996).

There is little information regarding movements and distribution of the Newfoundland and Labrador population (COSEWIC 2006a). Harbour porpoises occur in coastal shelf waters of Labrador and the eastern and southeastern Newfoundland coasts during spring and summer. They range up to Baffin Bay and deeper waters of the Labrador Sea during summer, but the offshore boundaries of their spring and summer distributions are unknown (Palka et al. 1996). The winter range for this population is undefined (Palka et al. 1996; COSEWIC 2006a). During summer and fall monitoring in the Jeanne d’Arc Basin from 2005 to 2008, there was a single harbour porpoise sighting of two individuals; the water depth at the time of the sighting was 165 m (Lang et al. 2006). Harbour porpoises were sighted more frequently in the deeper Orphan Basin, including nine and one sighting during monitoring programs in 2005 and 2004, respectively (Table 11-2, Figure 12-20). There were 13 sightings of harbour porpoises reported in the DFO cetacean sightings database (DFO 2007c) in the Offshore Study Area (Figure 11-4;). While harbour porpoises may occur in the Offshore Study Area throughout the year, they are likely uncommon relative to other cetacean species and generally are observed from spring to fall.

Harbour porpoises often occur in coastal Newfoundland waters during summer months. Based on DFO’s database (DFO unpublished data), there have been 14 sightings of harbour porpoises scattered throughout waters of the Nearshore Study Area (Figure 12-22). Based upon DFO data, this species appears to be most abundant in the Nearshore Study Area from June to September; one harbour porpoise was observed in each of November and December. Based on bycatch events involving harbour porpoise in the fixed-gear fishery for Atlantic cod in 2002 in Newfoundland, the highest bycatch rates were recorded in Placentia Bay during April to June (Lawson et al. 2004). Relative to other coastal areas of Newfoundland, bycatch data suggest that Placentia Bay (and St. Mary’s Bay) may be harbour porpoise “hotspots” (Lawson et al. 2004). The density of harbour porpoises based upon boat-based surveys in the Study Area during August 2006 to April 2007 was 0.065 harbour porpoise per km^2 (Figure 11-3; Abgrall and Moulton 2007). Harbour porpoise were sighted in all survey months with the exception of

September and October and along all survey routes. Harbour porpoise are expected to be common in the Nearshore Study Area based on available reports and sighting data, at least during summer.

12.3.2.6 Northern Bottlenose Whale

Northern bottlenose whale occur only in the North Atlantic, predominantly in deep offshore areas, and have two (known) primary areas of concentration in the Northwest Atlantic: The Gully and adjacent canyons of the eastern Scotian Shelf; and Davis Strait, Baffin Bay and Labrador Sea (Reeves et al. 1993). The abundance of northern bottlenose whales in the Northwest Atlantic is unknown (Waring et al. 2009), but there are an estimated approximately 163 individuals in the Scotian Shelf population (Whitehead and Wimmer 2005). The Scotian Shelf population is assessed as Special Concern by COSEWIC and listed as Endangered on Schedule 1 of SARA (COSEWIC 2002b), but the Davis Strait-Baffin Bay-Labrador Sea population has no status under SARA and is assessed as Special Concern by COSEWIC (COSEWIC 2011ba).

It appears that the Scotian Shelf population has a relatively restricted distribution. This population spends the majority of its time in The Gully (with a third of the population present there at any time), but nearby Shortland and Haldimand canyons are also extensively used; their home range is thought to be a few hundred kilometres or less (Wimmer and Whitehead 2004). On the Scotian Shelf, tagged northern bottlenose whales routinely dove to depths over 800 m and remained submerged for over an hour; the maximum recorded depth was 1,453 m (Hooker and Baird 1999b). Foraging appears to occur at depth, primarily for large and medium-bodied squid. Group sizes on the Scotian Shelf average around three individuals, and are rarely more than 10 individuals, with males forming long-term bonds while females do not seem to have preferred associates (Gowans et al. 2001).

For the purposes of this environmental assessment, it is assumed that northern bottlenose whales that occur in the Offshore Study Area would belong to the Davis Strait-Baffin Bay-Labrador Sea population. There have been two sightings of beaked whales in the Jeanne d’Arc Basin during summer and fall seismic surveys (Table 11-2, Figure 11-1), one of which was confirmed as a species other than the northern bottlenose whale (Lang et al. 2006). However, there have been several confirmed sightings of northern bottlenose whales in the deeper Orphan Basin (Table 11-2, Figure 11-1). There were six sightings of northern bottlenose whales totaling 41 individuals reported in the DFO cetacean sightings database (DFO 2007c) in the Offshore Study Area (Table 11-3, Figure 11-2). The available literature and data suggest that northern bottlenose whales likely occur at low densities, possibly year-round, in the deeper waters of the Offshore Study Area (COSEWIC 2011c).

Northern bottlenose whales have occasionally been observed in coastal eastern Newfoundland, although most records are based on carcasses that have washed ashore. Lien (1994) reported that northern bottlenose whales were entrapped in inshore fishing gear on two occasions from 1979 to 1990. There were no sightings of northern bottlenose whales reported in the DFO cetacean sightings database (DFO 2007c) in the Nearshore Study Area (Table 11-4, Figure 12-22). It appears remotely possible that northern bottlenose whales may occur in the Nearshore Study Area, but sightings would be considered rare. The probability that such individuals would come from the Scotian Shelf population is likely low, given that population’s strong fidelity to Sable Gully and nearby canyons (Gowans et al. 2000). As a result, individuals in the Nearshore Study Area would likely come from the Davis Strait-Baffin Bay-Labrador Sea population.

12.3.2.7 North Atlantic Right Whale

The North Atlantic right whale is listed as Endangered on Schedule 1 of SARA and assessed the same by COSEWIC. The North Atlantic right whale population is one of the world's most critically endangered large whale populations (Clapham et al. 2001; International Whaling Commission (IWC) 2001). Originally severely depleted by commercial whaling, the population is currently estimated to remain below 350 individuals. A lack of recovery has been attributed to direct and indirect effects from human activities, especially collisions with ships and entanglement in fishing gear (IWC 2001; Brown et al. 2009). North Atlantic right whales are generally found in continental shelf waters off the eastern US and Canada, but have been known to range as far north and east as Greenland, Iceland and Norway (Winn et al. 1986; Knowlton et al. 1992). Within Canadian waters, important habitats include summer and fall feeding and nursery grounds in Grand Manan Basin in the lower Bay of Fundy and Roseway Basin on the western Nova Scotian Shelf (Brown et al. 2009). There is a general seasonal north-south migration, but right whales may be seen anywhere within their range throughout the year (Gaskin 1982). Sparse sightings or information from whaling logbooks include a few winter records from the Gulf of St. Lawrence and coasts of Newfoundland and Labrador (Lien et al. 1989; Knowlton et al. 1992). Historical whaling also occurred during summer in waters near the eastern edge of the Grand Banks (Reeves and Mitchell 1986). Animals migrate from northern feeding grounds to calving grounds off the southeastern US in late fall to winter and return northward in late winter to early spring. Peak sightings on Canadian feeding grounds occur from August to early October, coinciding with the abundance of their primary prey, calanoid copepods (Baumgartner et al. 2003). Sightings in very deep, offshore waters of the Northwest Atlantic are rare. Right whales usually occur singly or in small groups, and aggregations are generally associated with feeding (Jefferson et al. 2008). Right whales are slow swimmers and exhibit surface behaviours that make them particularly susceptible to vessel strikes (summarized in Baumgartner and Mate 2003; Brown et al. 2009). As noted in LGL (2005e), North Atlantic right whales could occur in the Offshore Study Area; however, their occurrence is unlikely.

Right whales are generally found in waters with surface temperatures ranging from 8°C to 15°C in areas that are 100 to 200 m deep (Winn et al. 1986). In the lower Bay of Fundy, right whales are generally distributed in an area where the bottom topography is relatively flat and the water column is stratified (Woodley and Gaskin 1996). Right whales tagged with satellite-monitored radiotags in the Bay of Fundy were found to range widely (Mate et al. 1997) and were most often located along bank edges, in basins, or along the continental shelf in water less than 182 m deep. Tagged whales were also noted to spend extended periods of time at the edge of a warm core ring and in upwellings.

The primary prey item of the North Atlantic right whale is the copepod *Calanus finmarchicus*, and shifts in the distribution and abundance of this species can dramatically affect right whale distribution (Kenney 2001). Certain characteristic behaviours of right whales, during which they may be less aware of their surroundings, make this species especially vulnerable to ship collisions. These behaviours include: surface active group activity (individuals interacting at the surface with frequent physical contact); skim feeding (swimming slowly at the surface with mouth open); and logging (resting motionlessly at the surface), an activity frequently observed in nursing mothers (Knowlton 1997). Controlled exposure experiments in the right whale summer feeding area in the Bay of Fundy showed that right whales did not respond to the playback of the sound made by a 120 m container ship passing within 100 m, in spite of the fact that they were apparently able to hear it (Nowacek et al. 2004). There is a Recovery Strategy for the SARA-listed North Atlantic right whale (Brown et al. 2009). Critical habitat was proposed for Grand Manan Basin in the Bay of Fundy, but insufficient data were available to propose critical habitat elsewhere. The Recovery Strategy also recommended a schedule of studies to further investigate critical habitat for North Atlantic right whale, including research to determine whether Roseway Basin on the Scotian Shelf constitutes critical habitat. At least historically, some right whales may have moved through the Offshore Study Area during north-south migrations (Knowlton et al. 1992), and there have been rare sightings off southern Newfoundland (Sergeant 1966; Gaskin 1991). There are no sightings of right whale in the Offshore Study Area in the DFO cetacean sightings database (DFO 2007c) (Table 11-4, Figure 12-21), and none occurred during monitoring in the Orphan Basin during 2004 to 2007 (Table 11-3, Figure 12-20).

There has been one sighting of right whale in Placentia Bay (Figure 12-22). During a PAL flight in August 2005, a right whale was sighted and photographs were taken by the crew; the whale in the photos was later confirmed by DFO as a right whale (J. Lawson, DFO, pers. comm.). There have been rare sightings of this whale species in the Laurentian Sub-basin (Sergeant 1966) and speculation of some movement of these whales to and from the Gulf of St. Lawrence and western Newfoundland waters. No right whales were seen during boat-based surveys from August 2006-April 2007 in the Nearshore Study Area (Abgrall and Moulton 2007). Hence, while it is possible that right whale could occur in the Nearshore Study Area between late spring and early fall, its presence is likely extremely rare.

12.3.2.8 Leatherback Sea Turtle

The leatherback sea turtle is the largest and widest ranging of sea turtles, occurring from sub-polar foraging grounds to tropical and sub-tropical nesting areas; it is found in all the world's oceans (Spotila 2004). Globally, there are an estimated 26,000 to 43,000 individuals (Dutton et al. 1999), but there are no estimates of the population size in Canada. Adult leatherbacks are considered regular, seasonal inhabitants of Newfoundland waters (Goff and Lien 1988; Witzell 1999). Leatherback sea turtle is assessed as Endangered by COSEWIC and listed as Endangered on Schedule 1 of SARA (COSEWIC 2010e).

Adult leatherback sea turtles make routine migrations between temperate and tropical waters, presumably to optimize foraging in high latitudes and nesting in the tropics (Spotila 2004). In the North Atlantic, they are predominantly pelagic, with wide-ranging oceanic movements, and consume primarily gelatinous zooplankton (Hays et al. 2004; Eckert 2006; Witt et al. 2007). They nest from March to July in the Caribbean and Central and South America (Spotila 2004). Leatherbacks satellite-tagged off of Cape Breton and mainland Nova Scotia during summer months remained off eastern Canada and the northeastern US coast before migrating south in October (James et al. 2005). Tags remained attached to some of these animals to observe return migrations northward; animals left their nesting areas during February and March and typically arrived in the Northwest Atlantic (north of 38°N) during June. Most individuals returned to within several hundred kilometres of where they were observed during the previous year, and some individuals ranged into areas just east of St. John's and along the edge of the Grand Banks. Individuals that have been sampled in Nova Scotia areas are either large sub-adults or adults, with a statistically significant sex-bias towards females (1.86 females:1 male) among mature individuals (James et al. 2007).

Leatherback turtle are often observed off Nova Scotia and Newfoundland from June to October, with peak occurrence in August and September. They are the most likely sea turtle to occur within either the Nearshore or Offshore Study Area. Witzell (1999) described the distribution of sea turtles incidentally captured in the US pelagic longline fishery from 1992 to 1995; nearly half of the leatherbacks caught in an area from the Caribbean to Labrador were captured in waters on and east of the 200 m isobath off the Grand Banks (although fishing effort was also predominantly concentrated in these areas). Animals were caught in this area from June to November, but catches were highest from July to September. Twenty leatherbacks were reported off Newfoundland between 1976 and 1985 (Goff and Lien 1988).

Three leatherbacks were sighted during summer and fall monitoring programs in the Jeanne d'Arc Basin (Figure 12-20; Abgrall et al. 2008a, 2009), and one sighting occurred in the Downing Basin (approximately 160 km northwest of the Offshore Project Area) in June 2008 (Ledwell and Huntington 2009). There were also 14 leatherback sea turtle sightings within the Offshore Study Area in the DFO database (DFO 2007c) (Figure 12-21). Leatherback sea turtles are expected to occur in low densities within the Offshore Study Area during summer and fall, particularly from July to September.

Little is known about the distribution and abundance of leatherback turtles in the Nearshore Study Area. As with marine mammals, the primary source of information on the distribution and occurrence of sea turtles is a DFO database (maintained by Dr. J. Lawson). This database primarily contains records of incidental sightings and as such, interpretation of the data must be made cautiously. Nonetheless, the database does offer valuable information about species occurrence in Placentia Bay. Overall, there have been nine sightings of leatherbacks reported in the Nearshore Study Area based upon incidental sightings, surveys, entanglements and stranding data (DFO unpublished data; see (Figure 12-22)). Most of these sightings have occurred in the southern half of the Nearshore Study Area. Based upon sightings data with month recorded, sightings were relatively more frequent in September and August vs. July in the Nearshore Study Area. One leatherback was reported in January near Fox Harbour. Most sightings have been made in coastal areas (Figure 12-22), but this may be related to observation effort. Two leatherback turtles were observed between Bar Haven and Merasheen Island on 3 September 1999 (DFO unpublished data; Figure 12-22). No sea turtles have been observed during boat-based surveys in 2006 and 2007. Three leatherbacks were seen in the middle of Placentia Bay on 23 August 2007 (B. Mactavish, pers. comm.). The available information suggests that leatherback sea turtles will occur occasionally within the Nearshore Study Area during summer and fall, particularly in August and September.

A Recovery Strategy for the Leatherback Turtle has been developed (Atlantic Leatherback Turtle Recovery Team 2006). It identifies several threats to turtles in the marine environment, including entanglement in fishing gear, collisions, marine pollution and acoustic disturbances. Critical habitat for this species has not yet been identified.

12.3.2.9 Loggerhead Sea Turtle

Loggerhead sea turtles occur in temperate and tropical areas of the Atlantic, Pacific and Indian oceans, with the majority of nesting occurring along the western rims of the mid- and equatorial Atlantic and Indian oceans (Spotila 2004). Globally, there are an estimated 43,000 to 45,000 nesting females (Spotila 2004). Its distribution is largely constrained by water temperature and it does not generally occur where the water temperature is below 15°C (Brazner and McMillan 2008), which limits its northern range. Loggerhead sea turtles are assessed as Endangered by COSEWIC (2010e) and have no status under SARA.

Loggerhead turtle can migrate considerable distances between near-equatorial nesting areas that are occupied from late April to early September (Spotila 2004) and temperate foraging areas, some moving with the Gulf Stream into eastern Canada waters during the summer and fall (Hawkes et al. 2007). Information to date indicates a seasonal population of juvenile loggerheads in Atlantic Canada (Witzell 1999; Brazner and McMillan 2008; COSEWIC 2010f) but the number occurring in Canadian waters is unknown. While foraging at sea, loggerheads likely consume gelatinous zooplankton and squid (Spotila 2004); there is no diet information available for Canadian waters (DFO 2010b).

Loggerheads may be seen in the open seas during migration and foraging. They have not been reported in the Offshore Project Area, but hundreds of loggerheads have been caught off the southeast side of the Grand Banks in continental shelf slope waters by the pelagic longline fishery since 1992 (McAlpine et al. 2007; Brazner and McMillan 2008); (Figures 6 and 7 in COSEWIC 2010f). Most of these individuals were juveniles. These data are from only the observed portion of the fishery, which is approximately 10 percent of the longline sets. No loggerheads were sighted during summer and fall seismic monitoring programs in the Jeanne d'Arc Basin, although one was observed 237 km south of that area in early September 2008 (Abgrall et al. 2009). The number of individuals and locations in the fishery bycatch suggests that loggerhead is fairly common in the far eastern portion of the Offshore Study Area during spring to fall.

The only record of loggerhead from nearshore Newfoundland is of a live individual found in a lagoon on Connaigre Bay at Sandyville in November 2006 (Ledwell 2007). It is possible that loggerhead sea turtle could occur in the Nearshore Study Area, but its presence is presumed to be very rare.

12.3.3 Marine Bird Species at Risk

A recover plan is in place for the Piping Plover (Environment Canada 2012f) and a management plan exists for the eastern population of Harlequin Duck (Environment Canada 2007).

12.3.3.1 Harlequin Duck

The eastern population of Harlequin Duck is considered of Special Concern and is listed as such on Schedule 1 of SARA (COSEWIC 2011a). It was downlisted from Endangered in 2011 after an increased effort in research and monitoring of the eastern Harlequin Duck was undertaken on breeding grounds, moulting sites and wintering sites, which resulted in improved knowledge of the species. Environment Canada's monitoring plan set a goal of maintaining a wintering population of 3,000 individuals in eastern North American for three of five consecutive years (Environment Canada 2007). The plan proposed the following objectives and actions: refining population monitoring programs; completing a comprehensive threat assessment; and developing approaches to addressing and mitigating the impacts of those threats. This species is designated Threatened under Newfoundland and Labrador's *Endangered Species Act*. The eastern Harlequin Duck breeds on rivers in northern Quebec (rivers draining in to the eastern side of Hudson Bay and Ungava Bay), Labrador (Nachvak Fiord to Hopedale), western coast of Great Northern Peninsula, Newfoundland, Gaspé Peninsula, Quebec and northern New Brunswick (Robertson and Goudie 1999). It winters on the coast, mainly from Newfoundland to Massachusetts, with more than half the population wintering in coastal Maine (Robertson and Goudie 1999). Cape St. Mary's supports the largest and most northerly over-wintering distribution of the eastern Harlequin Duck. Survey results in late winter 2005 and 2006 showed 200+ individuals between Point Lance and Cape St. Mary's (P. Thomas, CWS, pers. comm.). Cape St. Mary's Christmas bird count totals for the period from 1997 to 2006 range from 51 to 200 individuals, with an average of 120 (National Audubon Society 2012).

Surveys for Harlequin Duck were completed in the Placentia Bay area in winter-spring 2007 using low-level helicopter searches of marine archipelago and headland areas in western Placentia Bay and southern Burin Peninsula of Newfoundland (Goudie et al. 2007). A number of concentrations of sea ducks and considerable habitat were documented, and many of these areas appeared like suitable habitat for Harlequin Duck. The confirmation of only one isolated group of 12 Harlequin Duck near Lamaline (Allens Island), Burin Peninsula, highlighted the continued scarcity of this species, and the importance of concerted efforts to locate and protect remnant numbers resident to this area in winter-spring.

12.3.3.2 Piping Plover

Piping Plover is listed as Endangered on Schedule 1 of SARA and is designated Endangered under Newfoundland and Labrador's *Endangered Species Act*. A Recovery Strategy has been published for the melodus subspecies of Piping Plover (Environment Canada 2012f). The Recovery Strategy recommends the following broad strategies to address threats to this species: "*ensure enough suitable habitat to meet population objectives, reduce predation, reduce human disturbance, minimize impacts of adverse weather conditions, minimize impacts of poorly understood mortality factors, address key knowledge gaps to recovery, and monitor the population*" (Environment Canada 2012f). Critical habitat for this species is identified/defined under SARA as "*any site with suitable habitat occupied by at least one nesting pair of Piping Plovers (melodus subspecies) in at least one year since 1991 (the year of first complete survey coverage)*" (Environment Canada 2012f).

In 2001, the total global population (all North America) of Piping Plover was estimated at 5,945 individuals, with a breakdown of 1,454 in Canada, and 481 in Atlantic Canada (Haig et al. 2005). The 61 adults counted during the 2006 census of Newfoundland is a slight increase over recent years, probably as a result of continued protection of breeding sites (Paul Harris CWS, pers. comm.). The Newfoundland breeding range is essentially the southwest corner of the island from Flat Bay Island in St. Georges Bay to Grand Barasway near Burgeo. An isolated two pairs have been found (2006) breeding at Seal Cove, Fortune Bay (P. Harris, CWS, pers. com.). One or two pairs nesting at

Miquelon, St. Pierre et Miquelon, are the closest breeding birds to Placentia Bay. There are no records of Piping Plover for Placentia Bay; however, a sighting from Bellevue Beach, Trinity Bay indicates the possibility of rare occurrences of Piping Plover in the Nearshore Study Area during migration. The extensive sandy beaches required by Piping Plover for breeding sites do not exist in Placentia Bay.

12.3.3.3 Red Knot

The Red Knot, *rufa* subspecies, was assessed as Endangered by COSEWIC in April 2007. A consultation recently ended for an *Order Amending Schedule 1 to the Species at Risk Act* to add Red Knot, so this population will likely be added to Schedule 1 in the near future. This species is designated Endangered by the Government of Newfoundland and Labrador under the province's *Endangered Species Act*. The Red Knot breeds in the Arctic of both the Old and New Worlds. In the New World, it winters along coasts from California and Massachusetts south to South America. A substantial decrease in numbers at migration staging and wintering sites in North America have given cause for concern in the North American population (COSEWIC 2007c). The Red Knot is an uncommon southbound migrant in coastal Newfoundland, as its main migration corridor occurs west of Newfoundland. It is not expected to occur during spring migration. It prefers open sandy beaches, often with rotting kelp piles and extensive mud flats, for feeding. Such habitats occur sparingly in Placentia Bay. During shore-based surveys conducted during August to December 2006 at Arnold's Cove, Come By Chance, North Harbour and Southern Harbour, four and two Red Knot individuals were observed at Come By Chance lagoon and Southern Harbour estuary, respectively. Sightings were made in late August (at Southern Harbour) and late September (Come By Chance) (Goudie et al. 2007). Red Knot may occasionally occur in small numbers at various locations on the coast of Placentia Bay during fall migration in August to October.

12.3.3.4 Ivory Gull

The Ivory Gull has a circumpolar breeding distribution and is associated with pack ice throughout the year. In Canada, the Ivory Gull breeds exclusively in Nunavut. Breeding colonies occur on southeastern Ellesmere Island, eastern Devon Island and northern Baffin Island. Among Canadian waters, Ivory Gulls occur among the pack ice of the Davis Strait, the Labrador Sea, Strait of Belle Isle and northern Gulf of St. Lawrence. The Ivory Gull is assessed as Endangered by COSEWIC and listed as Endangered on Schedule 1 of SARA (COSEWIC 2011a). It is designated Endangered under Newfoundland and Labrador's *Endangered Species Act*.

In comparison to most gulls, Ivory Gulls have reduced reproductive output, in that they usually only lay one to two eggs (Haney and MacDonald 1995). They depart from colonies immediately following breeding for offshore foraging areas associated with the ice edge of permanent, multi-year pack ice. At sea, the Ivory Gull is a surface-feeder, where its main prey includes small fish and macro-zooplankton. It is also an opportunistic scavenger of carrion found on ice and marine mammals killed by large predators (Haney and MacDonald 1995).

Currently, the Canadian breeding population is estimated at 500 to 600 individuals (COSEWIC 2006g). Surveys conducted during 2002 to 2005 indicate a total decline of 80 percent and an annual decline of 8.4 percent over the last 18 years. If this decline continues at a steady rate, the breeding population will decrease by a further 62 percent over the next decade, to approximately 190 individuals. A March 2004 survey conducted within the pack ice off the coast of Newfoundland and Labrador observed a decrease in Ivory Gull observations as compared to 1978 results. Numbers of Ivory Gulls observed per 10-minute watch period were 0.69 and 0.02 individuals for 1978 and 2004, respectively (COSEWIC 2006g).

Considering that changes to the breeding environment have been insignificant, causes for the observed decline are likely related to factors occurring during migration or on the wintering grounds (Stenhouse 2004). During heavy ice winters, the Ivory Gull may occasionally reach the northern Grand Banks in the Offshore Study Area, late in the winter or early spring when sea ice reaches the maximum southern extremity. The 30-year median of ice concentration shows ice extending into the northern edge of the Grand Banks east to 48°W during late February to late March. A total of 21 Ivory Gulls, reported from drill platforms on the northeast Grand Banks during 1999 to 2002, seems improbable, especially considering that most sightings were reported during ice-free periods. Those sightings were probably misidentified Iceland and Glaucous Gulls. Ivory Gull is reported regularly along the coast of Labrador and the tip of the Great Northern Peninsula of Newfoundland in winter. There are occasional sightings of Ivory Gull south along the east coast of Newfoundland. It is expected to be very rare in the Nearshore and Offshore Study Areas.

12.3.3.5 Cape St. Mary’s Ecological Reserve

Cape St. Mary’s Seabird Ecological Reserve is a major seabird colony located at the eastern entrance to Placentia Bay. Approximately 200 km southwest of St. John’s, this reserve supports 15,000 Northern Gannet, 10,000 Black-legged Kittiwake, 16,000 Common Murre and 1,000 Thick-billed Murre (Cairns et al. 1989; Stenhouse and Montevecchi 1999; CWS unpublished data). Razorbill, Black Guillemot, Double-crested and Great Cormorants, as well as Northern Fulmar, can also be found within this ecological reserve. Cape St. Mary’s is an important wintering area for the eastern Harlequin Duck (P. Thomas, CWS, pers. comm.). This is described in more detail in Section 13.3.1.5.

12.4 Marine Fish Species at Risk

12.4.1 Project-Valued Environmental Component Interactions

The potential WREP-VEC interactions for marine fish SAR are similar to those described for non-listed Fish and Fish Habitat in Chapter 8. The main difference is that the abundance and spatial and temporal distribution of listed species may differ greatly from non-listed species. Species at risk are typically low in abundance and may have a reduced range, and have been designated by experts as at risk.

12.4.1.1 Nearshore

The nearshore activities that could potentially interact with marine fish SAR include those discussed in the Fish and Fish Habitat chapter (Section 8.4.1): water discharge from The Pond; dewatering of the graving dock; lighting, nearshore surveys (i.e. geotechnical, geophysical);; dredging; ballasting of the CGS; towing to the deep-water mating site; topsides mating; and the establishment of a no-fishing safety zone.

12.4.1.2 Offshore

The offshore activities that could potentially interact with marine fish SAR include those discussed in the Fish and Fish Habitat chapter (Section 8.4.3): clearance surveys (e.g., sidescan sonar); operation of vessels and barges; installation of flowlines and pipelines; possible use of rock berms on WHP; lighting; waste (domestic waste, sanitary waste) generation; wellsite surveys and VSPs; dredging and dredge spoils disposal; presence of WHP/subsea drill centre structure; presence of a safety zone; drilling; WBM and SBM cuttings; operation of seawater systems for cooling and firewater; surveys (geotechnical, geophysical, environmental); management of drilling fluids and cuttings (reconditioning, discharge or injection); and oily water treatment.

12.4.1.3 Decommissioning and Abandonment

The decommissioning and abandonment activities that could potentially interact with marine fish SAR include those discussed in the Fish and Fish Habitat chapter (Section 8.4.3.3). These include removal of the WHP; plugging and abandoning of wells; operation of vessels; lighting; surveys (geotechnical, geophysical and environmental; and the removal of a safety zone.

12.4.1.4 Accidental Events

The primary accidental events that could potentially interact with marine fish SAR include those discussed in the Fish and Fish Habitat chapter (Sections 8.4.2 and 8.4.3.5) and include a marine diesel fuel spill from a vessel or a graving dock breach in the Nearshore Study Area; and a SBM whole mud spill, subsea hydrocarbon blowout, hydrocarbon surface spill, marine vessel incident, other spill (e.g., fuel, waste materials) or collision (involving WHP, vessel and/or iceberg) in the Offshore Study Area.

12.4.1.5 Summary

Then potential environmental effect that could result from WREP-VEC interactions for marine fish SAR is provided below in Table 12-4, including planned future activities and potential accidental events.

Table 12-4 Potential White Rose Extension Project-Related Interactions – Marine Fish Species at Risk

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Nearshore (WHP only)			
Pre-construction and Installation			
Lighting	x		
Water Discharge from The Pond	x		
Construction of Graving Dock (include sheet pile/driving, potential grouting, if required)	x		
Dewater Graving Dock	x		
CGS Construction and Installation			
Onshore (Argentia Construction Site)			
Lighting	x		
Marine (Argentia and Deep-water Mating Site)			
Additional Nearshore Surveys (e.g., multibeam, sonar, environmental)	x		

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Dredging	x	x	x
CGS Solid Ballasting (which may include disposal of water containing fine material)	x		
CGS Water Ballasting and De-ballasting	x		
CGS Towing to Deep-water mating site	x		
Noise from Topsides Mating	x		
Lighting	x		
Safety Zone			+
Offshore			
Wellhead Platform Installation/Commissioning			
Clearance Surveys (e.g., sidescan sonar) prior to installation of WHP or pipelines/ flowlines	x		
Operation of Helicopters and Vessels/Barges	x		
Installation of Flowlines and Pipelines Between WHP, Subsea Drill Centre(s) and Existing Infrastructure	x		
Potential Rock Berms for Flowline Protection		x/+	
Lighting	x		
Safety Zone			+
Waste Generated (domestic waste, construction waste, hazardous waste, sanitary waste)	x		
Drilling-associated Seismic (VSPs and wellsite surveys)	x		
***Subsea Drill Centre Excavation/Installation* (Previously assessed; LGL 2007a)**			
Dredging and Disposal of Dredge Material	x	x	
Clearance Surveys (e.g., sidescan sonar) prior to installation of pipelines/flowlines	x		
Operation of Helicopters and Supply, Support, Standby and Tow Vessels/Barges	x		
Lighting	x		
Safety Zone			+
Installation of Subsea Equipment, Flowlines and Tie-in Modules to Existing Subsea Infrastructure	x		
Waste Generated (domestic waste, construction waste, hazardous waste, sanitary waste)	x		
Drilling-associated Seismic (VSPs and wellsite surveys)	x		x
Production/Operation and Maintenance (Wellhead or Subsea Drill Centre)			
Presence of Structure	x	x/+	
Safety Zone			+
Noise from Drilling from a MODU and WHP	x		
WBM (from either WHP or MODU) and SBM (from MODU only) cuttings (A)	x	x	
Lighting	x		
Operation of Seawater Systems (cooling, firewater)	x		
Waste Generated (domestic waste, sanitary waste)	x		
Operation of Helicopters, Supply, Support, Standby and Tow Vessels/Barges/ROVs	x		
Surveys (geotechnical, geophysical and environmental)	x		x
Management of Drilling Fluids and Cuttings (reconditioning, discharge or injection) (B)	x		
Cementing and Completing Wells	x		
Oily Water Treatment (C)	x		
Decommissioning and Abandonment (WHP or Subsea Drill Centre)			
Removal of WHP		x/+	
Plugging and Abandoning Wells	x		
Operation of Vessels (supply/support/standby/tow vessels/barges/diving/ROVs	x		
Lighting	x		
Safety Zone			+
Surveys (geotechnical, geophysical and environmental)	x		x
Potential Future Activities			
Surveys (e.g., geophysical, geological, geotechnical, environmental, ROV, diving)	x		
Excavation of Drill Centres (including disposal of dredge spoils)	x	x	
Noise from Drilling from MODU at Potential Future Subsea Drill Centres	x	x	

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
WBM and SBM Cuttings [(A)]	x	x	
Installation of Pipeline(s)/Flowline(s) and Testing from Drill Centres to FPSO, including Flowline Protection	x	x	
Chemical Use and Management (e.g., BOP fluids, well treatment fluids, corrosion inhibitors [(B)])	x		
Accidental Events			
Marine Diesel Fuel Spill from Support Vessel	x		x
Graving Dock Breach	x	x	
SBM Whole Mud Spill	x		
Subsea Hydrocarbon Blowout	x		x
Hydrocarbon surface spill	x		x
Other Spills (e.g., fuel, waste materials)	x		x
Marine Vessel Incident Including Collisions (i.e., marine diesel fuel spill)	x		x
Cumulative Environmental Effects			
Commercial Fisheries (nearshore and offshore)	x		x
Marine Traffic (nearshore and offshore)	x		
White Rose Oilfield Development (including North Amethyst and South White Rose extension drill centre)	x	x	x
Terra Nova Development	x	x	x
Hibernia Oil Development	x	x	x
Hibernia Southern Extension Project	x	x	x
Hebron Oil Development	x	x	x
Offshore Exploration Seismic Activity	x		x
Offshore Exploration Drilling Activity	x	x	

(A) Water-based drilling fluids and cuttings will be discharged overboard. Husky will evaluate best available cuttings management technology and practices to identify a waste management strategy for spent non-aqueous fluid and non-aqueous fluid cuttings from the MODU. SBM cuttings will be re-injected into a dedicated well from the WHP, pending confirmation of a suitable disposal formation.
(B) Husky will evaluate the use of biocides other than chlorine. The discharge from the hypochlorite system will be treated to meet a limit approved by the C-NLOPB's Chief Conservation Officer.
(C) Water (including from open drains) will be treated prior to being discharged to the sea in accordance with OWTG

12.4.2 Environmental Effects Analysis and Mitigation Measures

Many of the potential environmental effects of the WREP on marine fish SAR, and associated mitigation measures are the same as those for non-listed marine fish species, and are discussed in further detail in Section 8.5 of the Fish and Fish Habitat Chapter.

The following categories are used to describe WREP-VEC effects on marine fish SAR:

- Change in Habitat Quantity – WREP activities that may result in physical alteration of fish habitat and may be declared a HADD of fish habitat by DFO and require a Section 35(2) *Fisheries Act* Authorization.
- Change in Habitat Quality - WREP activities that may result in a change in the biological or physical properties of fish habitat (e.g., smothering by sediment, contamination).
- Potential Fish Mortality – WREP activities that may result in marine fish SAR mortality.

12.4.2.1 Nearshore

In the Nearshore Study Area, the WREP activities that could affect marine fish SAR include water discharge from The Pond, dewatering of the graving dock, lighting, nearshore surveys (i.e., geotechnical, geophysical), dredging, ballasting of the CGS, towing to the deep-water mating site, topsides mating and the establishment of a no-fishing safety zone. The potential environmental effects from these activities include change in habitat quality, change in habitat quantity and potential mortality. Mitigation measures to be implemented are addressed below.

Marine fish SAR (includes SARA listed and COSEWIC assessed species) that are most likely to occur in the WREP Nearshore Study Area include Atlantic cod, American plaice, Atlantic salmon, American eel, porbeagle shark, shortfin mako, thorny skate and spiny dogfish. There is potential for normally deep-water species such as Atlantic wolffish, spotted wolffish and Acadian redfish to also occur. The entire Placentia Bay has been included as part of an identified EBSA (Placentia Bay Extension EBSA) within the PBGB-LOMA (DFO 2007b). The EBSA extends from Placentia Bay and from Point Crewe (Burin Peninsula) to Point Lance (Avalon Peninsula) out to the 50 m isobaths (DFO 2007b) and is known to be important habitat for both Atlantic cod and American plaice (refer to Sensitive Areas Section 13.3.1.1). High concentrations of ichthyoplankton (Atlantic cod, American plaice, cunner, capelin and others) occur in Placentia Bay (DFO 2007b; Snelgrove et al. 2008) and the Bay also supports a large spawning stock of Atlantic cod, as well as provides important nursery habitat for early larval stages. Bar Haven has been identified as an important spawning area for Atlantic cod in the Nearshore Study Area (Lawson and Rose 1999a, 1999b).

Pre-Construction and Graving Dock Construction

Change in Habitat Quality

WREP activities in the nearshore during the graving dock pre-construction and construction phase include lighting, noise from sheet pile driving (onshore), discharges from The Pond and dewatering of the graving dock. Lighting and noise have the potential to disturb or alter fish behavior in the vicinity of the site. Discharges from The Pond and graving dock dewatering activities may result in a short-term change in habitat quality due to sedimentation. Vibratory or impact pile driving (land-based), may be required during bund wall construction. Impact pile driving produces strong impulsive sounds. Sound levels typically recorded during in-water impact pile driving activities do not exceed 180 dB re 1 µPa (rms) beyond several hundred metres from the source (JASCO 2010). As pile driving will not occur in -water, it is unlikely to disturb marine fish. The above-listed activities may result in a decrease in habitat quality for marine fish species at risk; however, mitigations will be in place to use industry best practices, perform compliance monitoring, treat water as required prior to discharging and to reduce the amount of light occurring near the water at night. The potential environmental effects are predicted to be low or negligible in magnitude and highly reversible.

Concrete Gravity Structure Construction and Installation

Change in Habitat Quality

The potential change in SAR marine fish habitat quality in the Nearshore Study Area due to WREP activities during the construction and installation of the CGS include lighting (both onshore and at deep-water mating site), noise from nearshore surveys, topsides mating, CGS towing and solid ballasting and sedimentation due to dredging.

Sedimentation will occur as a result of dredging activities. In Argentia Harbour, 200,300 m^3 of sediment will be removed along the graving dock berm over the course of six to eight weeks. Dispersion modelling (AMEC 2012a) suggests that sediment concentrations from dredging using a backhoe dredge are expected to be generally low and below 1 mg/L within approximately 1 km of the dredge site (Section 3.3). Maximum TSS concentrations are predicted to be 5.5 to 28.5 mg/L and fall below 1 mg/L within approximately 230 m to 1 km of the site. The TSS plumes will likely occur along the shoreline in a southeast to northeast direction based on local tidal currents. There will also be dredging in Placentia Bay at two locations (Corridor 1 and Corridor 2) to allow for tow-out of the CGS to the deep-water mating site. Bathymetric studies have been carried out to select a suitable tow-out route and reduce the footprint of the dredged area. At Corridor 1, 25 m^3 of sediment will be dredged and at Corridor 2, 165,400 m^3 will be dredged (AMEC 2012a).

Sediment suspension modelling by AMEC (2012a) showed that suspended sediment levels from dredging of the shoreline (berm) and Corridor 1 and Corridor 2 tow-out routes will not exceed the thresholds for total particulate matter in the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002). According to AMEC (2012a), maximum plume concentrations above 25 mg/L are expected to persist for no more than four hours for an average dredging operation for all wind scenarios. Concentrations above 10 mg/L would persist for approximately six hours, and levels above 5 mg/L would last for approximately 10 hours for a single dredging operation. Plume concentrations above 25 mg/L are expected to occur within limited areas of approximately 0.7 km^2. The only measurable difference between the wind scenarios is observed in the extent and persistence of plume concentrations above 1 mg/L (but below 5 mg/L), where the southwesterly winds are about twice as efficient at dispersing these low levels of suspended sediment (within 21.9 hours) compared to the northwesterly winds (37.8 hours), and the most frequent, westerly wind conditions (32.6 hours).

The larval stages of marine fish SAR are more susceptible to the effects of sedimentation and noise (potential geophysical surveys) than adult fish. Atlantic cod and American plaice are two COSEWIC species known to spawn within Placentia Bay in spring and summer, and newly settled larvae of both species also use Placentia Bay. The nearest known spawning sites for cod are at Bar Haven (head of Placentia Bay), Oderin Bank (southeast of Jude Island) and Perch Rock (off Cape St. Mary's). Cod eggs and larvae then tend to drift southwestward toward open ocean and into embayments further north. The areas of Sound Island, Woody Island and Bar Haven are closed to commercial harvesting from January 1 to May 2 each year to protect over-wintering and spawning aggregations of cod. Placentia Bay itself is considered an EBSA in part due to its importance to spawning stages of many species and abundant ichthyoplankton (Lawson and Rose 1999a, 1999b; DFO 2007b; CPAWS 2009). Information on the spawning locations of American plaice is not available. Dredging could result in removal and mortality of benthic species which may be food and habitat for marine fish species at risk. However, given the abundance of similar habitat within the area, the area of disturbance within the tow-out channel, will not limit the habitat and prey available to SAR. The key mitigation to habitat disturbance is compliance with requirements under the *Fisheries Act*.

Dredging of the tow-out route is expected to require four to six weeks. Site-specific sedimentation models have demonstrated the lack of overlap with known cod spawning areas. The short timeframes, localized effect, TSS levels below CCME thresholds for *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002) and high potential for reversibility will limit the magnitude of environmental effects stemming from sedimentation. Dredging operations during the WREP will be temporary and of limited duration. Proper planning and equipment design will reduce the duration of dredging activities and hence the environmental effect on marine fish SAR.

In the case of noise from dredging, fish species differ in hearing ability and sensitivity to sound. Dredging can have a source level as high as 195.4 dB re µPa at 1 m (JASCO 2012). Results of acoustic modelling (JASCO 2012) for two different types of dredgers indicated that sound levels greater or equal to 180 dB re 1 µPa (rms) (un-weighted) occur at $R_{95\%}$ distances of 7 m or less. However, sound levels of 160 dB re 1 µPa (rms) occur within 248 m ($R_{95\%}$) of the dredging site, depending on dredge type and season. Fish with swim bladders and specialized auditory couplings to the inner ear such as herring, are considered to be the most sensitive to sound pressure. Fish with a swim bladder but without a specialized auditory coupling (e.g., Atlantic cod) are moderately sensitive to sound pressure, while those species with a reduced or absent swim bladder (e.g. wolffish species, American eel and American plaice) have low sensitivity (Fay 1988). Increased noise has the potential to cause avoidance or attraction of marine fish SAR, but studies by DFO (2004b) concluded that the most likely response is a startle response, a change in swimming pattern, and/or a change in vertical distribution. For Atlantic cod, a startle response would most likely be observed at ranges of 160 to 188 dB re 1 µPA (Turnpenny and Nedwell 1994). Literature to date suggests the effect of noise is typically temporary and outside critical reproductive periods are not expected to cause biological or physical effects. Behavioural effects (i.e., avoidance) are expected to have a negligible effect on populations of marine fish SAR as they are predicted to be short-term and reversible.

Change in Habitat Quantity

The potential change in marine fish habitat quantity of marine fish SAR during the construction and installation of the CGS would result from dredging. Dredging activities will remove sediment to allow for an 18 m (in Corridors 1 and 2) to 20 m (at the graving dock location) depth for tow out of the CGS. At the graving dock location, the nearshore area adjacent to the graving dock, *in situ* removal of approximately 200,300 m^3 of dredging material is anticipated (approximately 200 m wide by 130 m long along the irregularly-shaped shoreline). At Corridor 1, the *in situ* volume to be removed is approximately 25 m^3 (10 m wide by 15 m long along the centreline tow-route). At Corridor 2, the *in situ* volume to be removed is 165,400 m^3 (approximately 200 m wide by 1,250 m long along the centreline). Dredge spoils disposal from this nearshore dredging will occur on-land and therefore, will not result in smothering of benthic species and habitat. A detailed description of the habitat to be dredged has been submitted to DFO for review.

Summary of Nearshore Environmental Effects Assessment

The environmental effects of the WREP during the construction and installation phases in the Nearshore Study Area and the mitigations to be implemented are summarized in Table 12-5. Environmental effects are generally low in magnitude, of limited geographic extent and reversible. No significant adverse environmental effects on marine fish SAR from routine WREP activities are predicted with the application of mitigation measures.

Accidental Events in the Nearshore

The primary accidental events that could potentially interact with marine fish SAR include a marine diesel fuel spill from a vessel or a graving dock breach in the Nearshore Study Area. Potential environmental effects from an accidental event include change in habitat quality and potential mortality.

In the unlikely event there is a spill of marine diesel fuel in the nearshore, oil spill response plans will be initiated to contain and clean-up the spill to mitigate potential environmental effects. Nearshore oil spill modelling (Section 3.7) suggests that in the unlikely worst-case scenario, the maximum possible volume of a batch fuel spill (350 m^3) would be released. The tug boats, accommodation vessel and supply vessels that will be used in the Nearshore Study Area will use marine gas oil, which is similar in composition and spill behaviour to diesel fuel. Modelling of an unmitigated nearshore oil spill scenarios found that a high proportion (55 to 94 percent) of the modelled slicks reach the shoreline due to the close proximity of the spill sites modeled to shore (near Argentia and the two possible deep-water mating sites) and due to the prevailing westerly and southwesterly winds in Placentia Bay. The minimum time to shore ranged from two to five hours if there was no spill response (SL Ross 2012). During the months of March and July, over 55 percent of the modelled spills (diesel slick) reached the shore within less than 24 hours, and more than 75 percent of the modelled spills reached the shoreline within 48 hours. Survival time of the diesel fuel that did not reach the shoreline ranged from a minimum of 0.5 days to 8 days (SL Ross 2012). The average summer and winter conditions were modelled based on wind speed and water temperature. There are few differences in the fate of the spills between the two seasons. The nearshore oil spill model is discussed in detail in Section 3.7 and SL Ross (2012). The potential effects of diesel fuel reaching the identified Sensitive Areas in the Nearshore Study Area (e.g., coastal habitats) are discussed in Section 13.5.2.1.

Table 12-5 Environmental Effects Assessment for Marine Fish Species At Risk – Pre-Construction and Construction and Installation

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		
Nearshore (WHP only)										
Water discharge from The Pond	Change in habitat quality (N)	• Compliance monitoring and treatment as required before discharge	L	1	1	2	R	2	NS	H
Construction of graving dock (include sheet pile/driving)	Change in habitat quality (N)	• Use of industry best practices	L	2	1	2	R	3	NS	H
Dewater graving dock	Change in habitat quality (N)	• Compliance monitoring and treatment as required before discharge	L	1	1	1	R	3	NS	H
Lighting	Change in habitat quality (N)	• Investigate solutions to reduce the amount of light at night near the water	N	1	6	3	R	3	NS	H
Additional nearshore surveys	Change in habitat quality (N)	• Best management practices. • Obtain necessary permits	L	3	1	1	R	3	NS	M
Dredging	Change in habitat quality (N) Change in habitat quantity (N)	• Use of in-water sound control measures, if practical • Proper disposal site selection • Compliance with *Fisheries Act* Authorization	L	2	1	2	R	3	NS	H
CGS solid ballasting (noise)	Change in habitat quality (N)	• Use of industry best practices	L	1	1	1	R	3	NS	H
CGS water ballasting and de-ballasting	Change in habitat quality (N)	• Use of fish screens on water intake pipes • Use of industry best practices	L	1	1	1	R	3	NS	H
CGS towing to deep-water mating site	Change in habitat quality (N)	• Use of industry best practices	N	2	1	1	R	3	NS	H
Noise from topsides mating	Change in habitat quality (N)	• Use of industry best practices	N	1	1	1	R	3	NS	H
Safety zone	Potential decrease in mortality (P)		L	1	6	2	R	3	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		
Offshore (both WHP and Subsea Drill Centre unless noted)										
Lighting	Change in habitat quality (N)	• Use only lights as necessary for safe operations	N	1	6	3	R	3	NS	H
Dredging and disposal of dredge materials (subsea drill centre only)	Change in habitat quality (N) Change in habitat quantity (N)	• Fish habitat compensation, if required • Compliance with *Fisheries Act* Authorization	L	3	1	2	R	3	NS	H
Clearance surveys (e.g., sidescan sonar) prior to installation of WHP or pipelines/ flowlines	Change in habitat quality (N)	• Use of best practices and improvement programs	N	1	1	1	R	3	NS	H
Operation of vessels and barges	Change in habitat quality (N)	• Adhere to *Canada Shipping Act, 2001* and industry best practices • Follow marine traffic rules and regulations	N	4	6	5	R	3	NS	H
Safety zone	Potential decrease in mortality (P)		L	2	6	5	R	3	NS	H
Installation of flowlines and pipelines between WHP, subsea drill centre(s) and existing infrastructure	Change in habitat quality (N)	• Minimize seabed disturbance • Compliance with terms of Section 35(2) of *Fisheries Act* • Use of best practices and improvement programs	N	1	1	2	R	3	NS	H
Installation of subsea equipment, flowlines and tie-in modules to existing subsea infrastructure	Change in habitat quality (N)	• Minimize seabed disturbance • Use of best practices and improvement programs	N	1	1	2	R	3	NS	H
Potential rock berms for flowline protection	Change in habitat quantity (P)	• Fish habitat compensation program, if required.	N	1	6	5	R	3	NS	H
Waste generated (domestic and sanitary waste)	Change in habitat quality (N)	• Adhere to OWTG and industry best practices • Solid waste must be disposed of properly onshore	N	1	6	5	R	3	NS	H
Drilling-associated seismic (VSPs and wellsite surveys)	Change in habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	2	1	1	R	3	NS	M

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological/Socio-cultural/Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.

Change in Habitat Quality

A change in marine fish SAR habitat quality may result from an accidental release of marine diesel or due to a graving dock breach. In the unlikely event of a fuel spill or graving dock breach, contamination of the marine environment or sedimentation could occur. Nearshore oil spill modelling (Section 3.7) suggests that in the unlikely worst-case scenario, the maximum possible volume of a batch fuel spill (350 m^3) would be released. The potential environmental effects of a batch diesel spill on fish habitat are described in detail in Section 8.5.1.3. In the case of an accidental release, oil spill response plans will be initiated to contain and clean-up to mitigate environmental effects. To prevent such an event, vessels will not be re-fueled in the Nearshore Project Area, and use of best practices and improvement programs will be implemented.

The collapse of the bund wall could result in a sudden increase in sedimentation in the immediate vicinity of the breach. A breach in the bund wall surrounding the graving dock would result in an influx of water into the dry graving dock. Water could become contaminated with cement, lube oils and other chemicals contained within the graving dock. The bund wall will be specifically designed to prevent such a breach.

Potential Mortality

Potential mortality of marine fish SAR may occur in the case of a marine diesel fuel spill or a graving dock breach. Of particular concern would be fish SAR that spawn in Placentia Bay (such as Atlantic cod), and the potential for sensitive life stages to interact with marine diesel fuel and experience toxic (acute or chronic) effects or smothering, as early larval stages may be unable to avoid oiled sites. The potential effects of marine diesel on marine fish are discussed further in Section 8.5.1.3 and 8.5.2.5. Marine fish SAR could also experience mortality in the case of a graving dock breach due to contamination or injury.

Summary of Environmental Effects Assessment from Accidental Events in the Nearshore

A hydrocarbon spill, although highly unlikely, could result in effects with high magnitude and have a relatively large geographic extent and have effects for up to one year. The environmental effects resulting from an accidental event in the Nearshore Project Area and the mitigation to be implemented are summarized in Table 12-6. In the unlikely case of a marine diesel fuel spill, the potential adverse effects are predicted to result in the killing or harming of a fish species that is listed as extirpated, endangered or threatened, even with mitigations in place. However, as none of the Schedule 1 marine fish SAR are a population that is vulnerable to extinction, environmental effects are considered not significant.

Table 12-6 Environmental Effects Assessment for Marine Fish Species at Risk – Accidental Events in the Nearshore

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A): Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance	Significance Rating	Level of Confidence
Hydrocarbon spill from vessel (marine diesel) due to collision or accidental release	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Vessels will not be re-fueled in the Nearshore Project Area • Use of best practices and continual improvement programs	H	3	1	2	R	3	NS	M
Graving dock breach	Change in habitat quality (N) Potential mortality (N)	• Use of best practices and continual improvement programs	L	1	1	1	R	3	NS	H

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological/Socio-cultural/Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.

12.4.2.2 Offshore

In the Offshore Study Area, the primary WREP activities that could affect marine fish SAR include clearance surveys (e.g., sidescan sonar), operation of vessels and barges, installation of flowlines and pipelines, possible use of rock berms on WHP, lighting, waste water discharge, wellsite surveys/VSPs, dredging and dredge spoils disposal, presence of WHP/subsea drill centre structure, presence of a safety zone, drilling noise, WBM and SBM cutting releases, operation of seawater systems for cooling and firewater, surveys (geotechnical, geophysical, environmental), management of drilling fluids and cuttings (reconditioning, discharge or injection) and oily water treatment.

The potential environmental effects from these activities include change in habitat quality, change in habitat quantity and/or potential mortality. The potential environmental effects and mitigations that apply to Fish and Fish Habitat (Chapter 8) are the same as those for SAR; these include continuous improvement programs, and reliable best practices. All waste streams will be treated and discharged in accordance with the OWTG. SBM cuttings will be re-injected from the WHP. SBMs cannot be re-injected from a MODU, but the SBMs will be treated and discharged overboard in accordance with the OWTG.

Marine fish SAR (includes SARA listed and COSEWIC assessed species) that may occur in the WREP Offshore Study Area include Atlantic cod, American plaice, Atlantic wolffish, northern wolffish, spotted wolffish, roundnose grenadier, porbeagle shark, Acadian redfish, shortfin mako, American eel, spiny dogfish, blue shark, roughhead grenadier and thorny skate. The WREP Offshore Project Area has not been identified as critical habitat for any marine fish SAR. Any change in habitat quality, habitat quantity or potential mortality is anticipated to occur within the WREP Offshore Project Area. There are four identified EBSAs (Southeast Shoal and Tail of the Grand Banks EBSA, Southwest Shelf Edge and Slope EBSA, Virgin Rocks EBSA and the Northeast Shelf and Slope EBSA) (DFO 2007b) that occur within the Offshore Study Area (DFO 2009) that are known to be important habitat for Atlantic cod, American plaice and spotted wolffish (refer to Sensitive Areas Section 13.3.2.1).

Wellhead Platform Installation and Commissioning

Change in Habitat Quality

WREP activities occurring in the Offshore Project Area during the WHP installation and commissioning phase (should that development option be selected) that could affect marine fish SAR habitat quality includes clearance surveys (e.g., sidescan sonar), operation of vessels and barges, lighting, waste generation and drilling-associated seismic surveys. There is potential for these activities to reduce habitat quality through noise, sedimentation, contamination and lighting effects (Table 12-5) (see Section 8.5.2.1 for a discussion of these potential environmental effects).

Change in Habitat Quantity

WREP activities occurring in the Offshore Project Area during the WHP installation and commissioning phase (should that development option be selected) that could reduce marine fish SAR habitat quantity include installation of the WHP, flowlines and pipelines. As with the Nearshore Study Area, WREP activities will occur in accordance with the *Fisheries Act*. There is potential for the rock berms installed over the flowlines to create productive new fish habitat by increasing habitat complexity (i.e., creating a reef effect). If required, a habitat compensation program will be developed in conjunction with DFO and commercial fisheries representatives to mitigate the potential net loss of fish habitat resulting from a WHP in the Offshore Study Area (Table 12-5).

Subsea Drill Centre Excavation and Installation

Change in Habitat Quality

WREP activities occurring in the Offshore Project Area during the subsea drill centre excavation and installation phase, and during activities related to excavation and installation of potential future subsea drill centres, that could change marine fish SAR habitat quality include lighting, dredging and dredge spoils disposal, clearance surveys (e.g., sidescan sonar), operation of vessels and barges, lighting, installation of subsea equipment, waste generation, and drilling-associated seismic surveys (Table 12-5).

Habitat quality may be reduced through contamination, sedimentation, noise (vessel and wellsite surveys and VSP) and lighting. The increased noise and activities as well as lighting may cause avoidance or attraction of marine fish SAR. An EEM program by Hunt Oil in November 2005 in Sydney Bight (CEF 2005) investigated whether Atlantic cod exhibited sublethal ear damage in response to seismic noise. There appeared to be no detectable damage to fish ear structures (or other organs) of cod as a result of exposure to seismic air guns at ranges as close as 55 m.

Change in Habitat Quantity

Habitat quantity may be affected due to the dredging and disposal of dredge material during excavation of the subsea drill centre and installation of the subsea equipment, flowlines and tie-in modules to existing subsea infrastructure (Table 12-5).

At the offshore dredge spoil disposal site, benthic production may decrease temporarily due to smothering under the disposed sand and gravel (expected to be several centimetres). On the surface of the disposal pile, infauna will emerge and a new food source will be available to local benthic predators such as snow crab, skate and flounder species. At the edges of the dredge disposal site, sessile (or slow moving) epifauna (e.g., barnacles, bryozoans, sponge, sea stars, brittle stars, urchins) will be smothered, whereas infaunal species are capable of burrowing and can be expected to resurface and have little effect from the disposal of dredge material. Studies suggest epifauna at dredge spoil disposal sites return to baseline conditions after dredging ceases.

The installation of the WHP or subsea drill centre and installation of flowlines will create a footprint on the seafloor that may result in loss of benthic habitat or restrict access to fish in some areas. However, the presence of vertical hard artificial structures, rock walls and unburied or rock berm-protected flowlines are expected to create habitat by increasing the amount of habitat available to be colonized, thereby providing a reef effect for fish in an otherwise flat, soft-sediment environment. Artificial structures in the water column and on the seafloor can increase the amount of available habitat (i.e., settling areas) and increase vertical complexity (Hueckel et al. 1989; Rilov and Benayahu 1998; Ponti et al. 2002; Kaiser et al. 2005). In addition to providing more complex, rocky habitat, the construction and installation activities may create a reef effect, by drawing higher trophic levels to the Offshore Project Area to feed on lower trophic levels or use habitat provided by settling sponge, coral and other epifauna (Clynick et al. 2007). It remains unclear whether artificial reefs have increases in fish abundance due to recruitment or attraction (i.e., movement from elsewhere) (Brickhill et al. 2005).

A Disposal at Sea permit would be required to dredge any drill centres, including chemical analyses of the substrate to be dredged). As with the Nearshore Study Area, WREP activities will occur in accordance the *Fisheries Act*. A fish habitat compensation agreement (Authorization No. 07-01-002) has been in place with DFO since 2007 to compensate for the excavation of up to five subsea drill centre sites, of which two have been excavated to date (the NADC and SWRX). The change in habitat quantity due to dredging and installation activities are assessed in Table 12-5, and the potential environmental effects are predicted to be negligible to low in magnitude and reversible and considered to be not significant.

Potential Mortality

There is potential for mortality of fish SAR larval stage if wellsite surveys occur during sensitive periods and spawning occurs in the vicinity of the survey (Table 12-5). Atlantic cod occur within the Offshore Study Area and may occur within the Offshore Project Area. Although it is not listed under SARA, it has been assessed by COSEWIC as Endangered. Compared to other species, Atlantic cod is considered a moderately sensitive species in terms of hearing. A measureable behavioural response is expected in the range of 160 to 188 dB re 1 µPA (Turnpenny and Nedwell 1994). A startle response, change in swimming patter, or change in vertical distribution is the expected response of adult marine fish to seismic noise (DFO 2004b). These effects are expected to be short-term and have negligible effect. The greatest concern would apply to cod eggs and larvae near the surface during May to July (Dalley et al. 2000). Atlantic cod historically spawned near the Offshore Project Area (Ollerhead et al. 2004), but have not been reported to do so in recent years. Wolffish may also occur in the WREP Offshore Project Area, though there area is not known to provide critical habitat. As reported earlier, the *Recovery Strategy for Northern Wolffish and Spotted Wolffish and Management Plan for Atlantic Wolffish in Canada* (Kulka et al. 2007) addresses the potential effects of seismic activity on wolffish and concludes the environmental effects need to be quantified for wolffish and their habitat. Of greatest concern are the larval stages that occur near surface that may be affected by seismic noise, or the possibility that adult wolffish guarding their nests may abandon the eggs in the case of disturbance. They also note there has been no evidence of mortality of any fish species exposed to seismic noise under field operating conditions (DFO 2004b). Wellsite surveys are of shorter duration and spatial extent than 2-D and 3-D seismic surveys. Wellsite survey activities will adhere to the *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment*, as referenced in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d).

Production/Operation and Maintenance

WREP activities occurring in the Offshore Project Area during the production/operation and maintenance phase that could affect marine fish SAR includes the presence of the structure, drilling noise, WBM and SMB (MODU only) cuttings, lighting, operation of seawater systems for cooling and firewater, waste generation, corrosion protection system (inhibitors or biocides), surveys (geotechnical, geophysical, environmental), operation of vessels, cementing and completion of walls, management of drilling fluids and cuttings (reconditioning, discharge or injection) and oily water treatment.

Change in Habitat Quality

Habitat quality for marine fish SAR is expected to be reduced by operational discharges (e.g., WBMs, seawater discharges, drill cuttings, grey and black water). These releases have been modelled and are detailed in Chapter 3 and discussed in the context of fish in Section 8.5.2.2 and considered applicable to SAR fish species. The activities occurring during production and maintenance may also cause sedimentation, contamination and noise.

Noise would be generated by vessel/helicopter traffic and wellsite and VSP surveys. Sound levels of 160 to 180 dB re 1 µPa (rms) were estimated to occur within less than 5 to 22 m of an offshore vessel, respectively (JASCO 2012). A measureable behavioural response in Atlantic cod is expected in the range of 160 to 188 dB re 1 µPA (Turnpenny and Nedwell 1994). JASCO (2012) described the sound levels of a helicopter at an altitude of 91 m hovering over water and found that received levels did not exceed 157 dB re 1 µPa at depths greater than 3 m. Transfer of sound from helicopters to the water is likely minimal. Continuous noise from the drilling operations at the White Rose field is predicted to be 160 dB re 1 µPa (rms) less than 5 m from the drilling operation.

Modelling of WBM cuttings deposition (AMEC 2012b) indicate that cuttings from drilling will be released close to the seafloor, via a chute release under the WHP option, or with MODU riserless drilling under the subsea drill centre option. The drift of cuttings from the WHP is predicted to be within a range of 2 to 4 km for 40 wells, with a maximum extent of 5 km to the southeast and northeast. WBM cuttings are expected to be less than 1 mm over this area. Cuttings thicknesses directly under the WHP are modelled to be 1.8 m; however, from 200 to 500 m, thicknesses average 1.8 mm.

The footprint of WBM cuttings released from a MODU is smaller than the WHP option, with a range generally restricted to within 2 km due to fewer wells. Cuttings thicknesses directly under the MODU (subsea option) are modelled to be 72 cm. In general, MODU drilling results in mean WBM cuttings thicknesses out to 100 m that are approximately one-third to one-quarter the thickness of the WHP drilling. There is little difference outside of 100 m.

SBM will be used for drilling of the deeper intermediate and main hole sections for both development options. Under the WHP option, cuttings will be re-injected into a suitable formation. EEM programs to date have demonstrated that reinjection of SBMs reduces the footprint of contaminants associated with the SBM release (Hibernia Management Development Company 2007).

Under the subsea drill centre option, SBM cuttings will be treated and discharged from the MODU as per the OWTG. In the immediate vicinity of the drill centre, within 100 m, initial SBM cuttings thicknesses (overlain on top of WBM cuttings from the top two well sections), are predicted to be 11.7 cm on average, with 0.1 mm average thickness from 200 to 500 m.

Results from the ongoing White Rose EEM program have confirmed original assessment predictions (Husky Oil 2000; LGL 2007a) of no significant environmental effect on the marine environment as a result of discharges. American plaice, a marine fish SAR, is collected for the commercial fish component of the White Rose EEM program and results to date indicate no project-related tissue contamination. Plaice is not tainted and plaice health was similar between White Rose and distant Reference Areas (Husky 2009, 2011).

Change in Habitat Quantity

The presence of a structure (WHP or subsea drill centre) on the seafloor and/or in the water column could reduce habitat quantity for marine fish SAR such as wolffish and American plaice; however, the change in habitat quantity will be minimal in comparison to the widespread distribution of these species and their habitat in the Offshore Study Area (Kulka et al. 2007). In addition, the presence of the WHP structure may actually attract fish due to the increase in vertical habitat and create a reef effect, thereby increasing habitat quantity available to marine species. WREP activities will occur in accordance with the *Fisheries Act*. A fish habitat compensation agreement (Authorization No. 07-01-002) has been in place with DFO since 2007 to compensate for the excavation of up to five subsea drill centre sites, including the NADC and SWRX and those drill centres currently proposed and will be revised or amended as necessary for the WREP.

Potential Mortality

Mortality is a potential effect arising from wellsite surveys that may occur as part of maintenance and routine operations. The potential effects of seismic noise on marine fish SAR are discussed above. Seismic activities will adhere to the *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment*, as referenced in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d).

Summary of Environmental Effects Assessment

The environmental effects of the WREP during the production/operation and maintenance phases in the Offshore Study Area and the mitigations to be implemented are summarized in Table 12-7. Environmental effects are generally low in magnitude and reversible. No significant adverse environmental effects on marine fish SAR from routine WREP operational activities are predicted.

Table 12-7 Environmental Effects Assessment for Marine Fish Species at Risk– Production/Operation and Maintenance

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(a)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		
Presence of structure	Change in habitat quantity (P/N)	• Minimize seabed disturbance where possible • Potential for reef effect	N	1	6	5	R	3	NS	H
Noise from drilling from a MODU and WHP	Change in habitat quality (N)	• Use of best practices and continual improvement programs	N	1	6	5	R	3	NS	H
WBM and SBM cuttings	Change in habitat quality (N)	• Use of best practices and continual improvement programs • Reinjection of SBM cuttings if WHP is used • Adhere to OWTG	N	2	6	5	R	3	NS	H
Operation of seawater systems (cooling, firewater)	Change in habitat quality (N)	• Use of best practices and continual improvement programs • Adhere to OWTG	N	1	6	5	R	3	NS	H
Chemical use and management	Change In habitat quality (N)	• Use of best practices and continual improvement programs • Follow Offshore Chemical Selection Guidelines • Adhere to OWTG	N	1	6	5	R	3	NS	H
Cementing and completing wells	Change in habitat quality (N)	• Use of best practices and continual improvement programs • Adhere to OWTG	N	1	1	2	R	3	NS	H
Oily water treatment	Change in habitat quality (N)	• Use of best practices and continual improvement programs • Adhere to OWTG	N	1	6	5	R	3	NS	H
Lighting	Change in habitat quality (N)	• Use of best practices and continual improvement programs to minimize disturbance	N	1	6	5	R	3	NS	H
Waste generated (domestic, and sanitary waste)	Change in habitat quality (N)	• Adhere to OWTG • Solid waste is disposed of on land	N	1	6	5	R	3	NS	H
Operation of Vessels	Change in habitat quality (N)	• Adhere to *Canada Shipping Act, 2001* and industry best practices • Follow marine traffic rules and regulations	N	3	6	5	R	3	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (a)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		
Surveys (geotechnical, geophysical and environmental)	Change in habitat quality (N) Potential mortality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	3	1	1	R	3	NS	M

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological/Socio-cultural/Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.

Potential Future Activities

Potential future activities associated with the WREP include: excavation of drill centres (including dredge spoils disposal); surveys (e.g., geophysical, geological, geotechnical, environmental, ROV, diving); drilling operations from MODU at potential future subsea drill centres; discharge of WBM and SBM cuttings; installation of pipelines/flowlines and testing from drill centres to the *SeaRose FPSO*; and chemical use and management. Anticipated environmental effects are changes in habitat quality and habitat quantity and are expected to be the same as for similar routine activities assessed for subsea drill centre excavation/installation and operations.

Change in Habitat Quality

Habitat quality may be reduced through contamination, sedimentation, noise and lighting. The increased noise and activities as well as lighting may cause avoidance or attraction of marine fish SAR.

Change in Habitat Quantity

Habitat quantity may be altered due to potential future dredging and disposal of dredge material activities during excavation of the subsea drill centres. A Disposal at Sea permit would be required to dredge any drill centres, including chemical analyses of the substrate to be dredged). Future activities will occur in accordance the *Fisheries Act*.

Summary of Environmental Effects

The environmental effects of the WREP from potential future activities in the Offshore Study Area and the mitigations to be implemented are summarized in Table 12-8. Environmental effects are generally low in magnitude and reversible. No significant adverse environmental effects on marine fish SAR are predicted.

Offshore Decommissioning and Abandonment

At the end of its production life, the WHP or subsea drill centre will be decommissioned and abandoned according to C-NLOPB requirements and in accordance with *Newfoundland Offshore Petroleum Production and Conservation Regulations*, as well as any other applicable laws and industry standards at the time. Refer to Section 8.5.2.3 for a discussion of the WREP activities related to decommissioning and abandonment that may have environmental effects on non-listed marine fish; the same environmental effects are also anticipated for marine fish SAR.

Table 12-8 Environmental Effects Assessment for Marine Fish Species at Risk – Potential Future Activities

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(a)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		
Future excavation of drill centres (including disposal of dredge spoils)	Change in habitat quality (N) Change in habitat quantity (N)	• Use of industry best practices and improvement programs	L	2	1	2	R	3	NS	H
Surveys (e.g., geophysical, geological, geotechnical, environmental, ROV, diving)	Change in habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	1	2	2	R	3	NS	H
Future drilling operations from MODU at potential future subsea drill centres	Change in habitat quality (N) Change in habitat quantity (N)	• Use of industry best practices and improvement programs	L	1	6	5	R	3	NS	H
Future WBM and SBM cuttings	Change in habitat quality (N) Change in habitat quantity (N)	• Use of industry best practices and improvement programs • Adhere to OWTG	L	2	6	5	R	3	NS	H
Future installation of pipelines/flowlines and testing from drill centres to FPSO including flowline protection	Change in habitat quality (N) Change in habitat quantity (N)	• Use of industry best practices and improvement programs	L	1	1	2	R	3	NS	H
Future chemical use and management	Change in habitat quality (N)	• Use of industry best practices and improvement programs • Follow Offshore Chemical Selection Guidelines	N	1	6	5	R	3	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(a)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		

Key:

Magnitude:
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3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.

The activities involved in decommissioning and abandonment that may have environmental effects on marine fish SAR include removal of the WHP, plugging and abandoning of wells, operation of vessels, lighting, the removal of a safety zone and conducting surveys (geotechnical, geophysical and environmental).

Change in Habitat Quality

Reduction in habitat quality may result from sedimentation, noise (vessel, geophysical) and lighting. The environmental effects from removal of infrastructure are expected to be similar to those during construction and installation, but of less magnitude and geographic extent.

Change in Habitat Quantity

Reduction in habitat quantity may arise from decommissioning of the subsea infrastructure since the removal of these structures will end the reef effect and refuge that this large vertical structure has provided.

Potential Mortality

Following abandonment of the field, the safety zone may cease which may increase fishing mortality of marine fish SAR.

Summary of Offshore Environmental Effects Assessment

The environmental effects resulting from decommissioning and abandonment and potential future activities and the mitigations to be implemented are summarized in Table 12-9. Significant adverse environmental effects from routine activities in the Offshore Project Area on marine fish SAR are not predicted. Environmental effects are generally low in magnitude, of limited geographic extent and reversible.

Table 12-9 Environmental Effects Assessment for Marine Fish Species at Risk – Decommissioning and Abandonment

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [a]: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance	Significance Rating	Level of Confidence
Removal of WHP	Change in habitat quantity (N/P)	• Use of industry best practices and improvement programs	L	1	6	2	R	3	NS	H
Plugging and abandoning wells	Change in habitat quality (N)	• Use of industry best practices and improvement programs	L	1	6	2	R	3	NS	H
Operation of vessels	Change in habitat quality (N)	• Adhere to *Canada Shipping Act, 2001* and industry best practices • Follow marine traffic rules and regulations	N	1	6	2	R	3	NS	H
Lighting	Change in habitat quality (N)		N	1	6	2	R	3	NS	H
Safety zone	Potential decrease in mortality (P)		N	2	6	2	R	3	NS	H
Surveys (e.g., geophysical, geological, geotechnical, environmental, ROV, diving)	Change In habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	1	2	2	R	3	NS	M

Key:

Magnitude:
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L = Low: <10 percent of the population or habitat in the Study Area will be affected
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Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.

Accidental Events

There is potential for accidental events to occur in the Offshore Study Area during installation or operation phases of the project, including: a subsea hydrocarbon blowout, SBM whole mud spill, marine diesel fuel spill, other spills (e.g., fuel, waste materials), or a hydrocarbon surface spill. There is potential for such an accidental event to affect marine fish SAR through change in habitat quality or potential mortality. Models of oil spills (surface, diesel, subsea blowout) and SBM whole mud spills are summarized in Chapter 3.

Subsea blowouts are classified as shallow or deep water, based on how the gas behaves upon exiting and contacting the water. Well blowouts generally involve crude oil (or gas condensate) and natural gas; the volume ratio varies depending on the fluid characteristics and the reservoir itself. Models for both subsea and surface blowouts were produced by SL Ross (2012), based on oil flow rates of 6,435 m^3 per day and 3,963 m^3 per day for winter and summer subsea blowouts. Based on modelling results, the oil spill trajectory for the Offshore Project Area covers an extensive area due to the quick dispersal and the amount of hydrocarbons that could potentially be released in the offshore in the event of such an accident. The spatial extent of the area that could potentially be affected by a hydrocarbon spill is therefore much larger in the offshore than the nearshore (see a discussion of modelling results in Sections 3.7 and 3.8). These represent the maximum oil flow rate estimated from the reservoir and the reduced flow expected after a 120-day release period. An oil spill is predicted to be persistent under both summer and winter conditions due to formation of water-in-oil emulsions during summer, and because the water is colder than the oil's pour point in winter. Consequently, the natural dispersion would be low, and the oil would remain at the surface for an extended period. After approximately one day of exposure at the water surface, the oil will have lost between 18 and 21 percent of its volume due to evaporation, with the maximum anticipated amount of evaporation over the life of the surface oil estimated to be 31 to 36 percent (SL Ross 2012). Small batch spills could occur from hose ruptures or from platform storage facilities. A vessel collision could result in a larger batch spill of oil (up to the maximum volume of the vessel fuel tanks). Batch spills are considered instantaneous events.

Based on historical wind and current data, a potential oil spill was modelled for two seasonal periods of year to project the likely fate of a hydrocarbon spill in the offshore over a 30-day period. The winter zone of influence is smaller than in summer due to strong, persistent westerly winds. The summer wind direction is more variable and the modelled slick moves over a wider area. Overall, a release of crude oil from the Offshore Project Area would persist and surface slicks would remain for several weeks. A very small number of slicks are expected to reach the shore based on models, which predicted that 0.04 percent of the modelled 83,220 oil slicks reached shore in March (nine slicks), October (26) and November (one). The slicks reached the coast 45 to 92 days after the hydrocarbon release. Details on the oil spill fate and behaviour modelling can be found in Section 3.8 and SL Ross (2012).

Spill and blowout prevention will be incorporated into the design and daily operation and maintenance of the WREP. For example, there will be frequent maintenance, testing and inspection of all equipment, best practices put in place, good communication, audits of facilities and equipment and regular employee training in order to minimize the likelihood of an accident or malfunction. Husky has an existing oil spill response plan for the offshore operations; this will be modified to include the proposed WREP.

Small batch spills could occur from hose ruptures or from platform storage facilities. A vessel collision could result in a larger batch spill of fuel oil (marine diesel). Batch spills are considered instantaneous events. The potential environmental effects on Fish and Fish Habitat from the release of hydrocarbons have been previously discussed in the section on nearshore accidental events (Section 8.5.1.3) and include potential change in habitat quality and habitat quantity and potential mortality of fish and shellfish as a result of contamination from exposure to hydrocarbons.

SBM modelling was conducted to predict the dispersion footprint and potential effects of an SBM accidental release (AMEC 2012c). These models were based on the synthetic drilling fluid Puredrill IA-35LV (65 percent by volume), with a total density of 1,350 kg/m^3. Four spill scenarios were considered: a surface tank discharge; a rise flex joint failure (at two difference fall velocities); and a BOP disconnect. These were modelled over varying fall velocities and release times as well as seasons. The maximum deposition footprint occurred in winter for the riser flex joint scenario, with the lowest fall velocity and longest release period (three hours). The majority of modelled spills had a footprint of 1,800 m^2 or smaller (e.g., 30 m by 60 m). The smallest footprints (30 m b 30 m) were modelled for the BOP disconnect scenario over a relatively short release time (one hour) and at a high fall velocity. Details on the SBM modelling can be found in Section 3.5.

Potential environmental effects from an SBM release include smothering of individuals and food resources for fish and shellfish, sedimentation and contamination. The rate of biodegradation of these muds is driven by temperature, hydrostatic pressure and oxygen levels. Bioaccumulation of PAHs can occur; scallops have been found to be particularly sensitive to effects from drilling waste, even at low levels, and have demonstrated weight loss in somatic and reproductive tissue, although the effects were reversed once exposure ended (Cranford et al. 2005). SBMs are non-toxic, but it is likely such effects result from physical effects such as fine particles of bentonite and barite interfering with feeding and digestion. Released SBM cuttings would likely settle near the sediment-water interface and not be buried in sediment and consequently, those marine fauna (particularly sessile invertebrates) that are on the sediment surface would be most affected. Sessile organisms are likely to be smothered in areas where cuttings are greater than 1 cm thick (Bakke et al. 1989). Recruitment could also be reduced locally due to decreased habitat quality.

To reduce the potential for an accidental event in the offshore, the following mitigations will be implemented:

- All activities will adhere to Annex I of the *International Convention for the Prevention of Pollution from Ships* (MARPOL 73/78)
- An oil spill response plan will be in place
- An ice management plan will be in place to avoid collisions
- Adherence to standard navigation procedures, Transport Canada regulations and CCG requirements.

Change in Habitat Quality

The potential environmental effects on marine fish SAR from the accidental release of hydrocarbons include potential change in habitat quality (i.e., plankton, benthos, water column) as a result of contamination or sedimentation. Models have suggested bacterial respiration may cause oxygen depletion and lead to hypoxia in areas near an oil spill site (Adcroft et al. 2010). However, following the April 20, 2010, *Deepwater Horizon* spill in the Gulf of Mexico, there was no evidence of hypoxia, although oxygen drawdown did occur (Kessler et al. 2011). Bioaccumulation of hydrocarbons at the base of the food web from biodegradation of oil by bacteria and uptake and transfer of oil components through the planktonic food web is possible (Graham et al. 2010) and may increase exposure of higher trophic levels (Wolfe et al. 1998). However, as phytoplankton, zooplankton and fish are able to metabolize hydrocarbons, bioaccumulation to higher trophic levels should be limited.

Potential environmental effects from an SBM release include smothering of fish and shellfish (prey), sedimentation of habitat, and lethal or sublethal effects on marine fish SAR or their prey.

Potential Mortality

In the unlikely case of an accidental event in the offshore, toxic effects (contamination) or physical damage to marine fish SAR may occur if individuals interact with hydrocarbons. Of greatest concern may be potential effects on eggs and larval stages of marine fish SAR, as they are unable to actively avoid oil (unlike some juvenile and adult fish, which have been observed to alter direction to avoid oiling in some cases). Experimental studies of the effects of hydrocarbons on early life stages for a variety of other fish species (e.g., herring, salmon, minnow, mummichog) have demonstrated toxic effects, including pericardial and yolk sac oedema, small jaws, hemorrhages, spinal deformities, body axes defects and inhibited growth in response to exposure to petroleum products (Marty et al. 1997; Peterson and Kristensen 1998; Carls et al. 1999; Heintz et al. 1999; Couillard 2002; Pollino and Holdway 2002; Colavecchi et al. 2004; Incardona et al. 2004; Hendon et al. 2008).

On the Grand Banks, there are typically two main spawning times for fish when ichthyoplankton concentrations peak in surface waters (upper 50 m): April to May and August to September. Damage to eggs may occur and not be detected until the larvae hatch. Deformities have been observed in Atlantic cod larvae, which were exposed to oil during the egg stage (Kühnhold 1974). However, as the natural mortality rate of early life stages of fish is so high, it would be difficult to detect population level effects. Mortalities caused by an oil spill would likely not affect the year-class unless more than 50 percent of the larvae died in an area of spawning concentration (Rice 1985).

The potential effects of oil on juvenile and adult fish have been summarized by Rice et al. (1996). At sufficient concentrations, oil exposure may cause direct physical effects such as coating of fish gills and suffocation, physiological effects (e.g., decreased growth, organ damage, increased disease) and/or behavioural effects. Responses vary according to a variety of factors including species, life stage, species, condition of fish, volume and type of oil, and environmental conditions. Laboratory tests suggest pelagic fish are more sensitive to effects from oil than benthic or intertidal species (Rice et al. 1996). Following the April 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico, samples (n=278) of seafood species (fish, crab, shrimp, oyster) were collected from the closed fishing grounds along the Mississippi Gulf Coast. The seafood samples were analyzed for 25 different PAH contaminants one month after the spill began (Xia et al. 2012). The samples were collected and analyzed weekly from May 27, 2010, to October 2010, and then monitored monthly until August 2011. Higher levels of PAHs were detected in all four taxa groups during the early period of sampling in comparison to later months. The PAH levels in the tested seafood samples were similar to those detected in commonly consumed processed foods and overall, the levels of PAHs in all the tested seafood samples collected within the one-year period were far below allowable levels (Levels of Concern) (Xia et al. 2012).

Summary of Offshore Environmental Effects Assessment

The environmental effects resulting from an offshore accidental event and the mitigation to be implemented are summarized in Table 12-10. Environmental effects from an SBM whole mud spill or other type of spill (e.g., waste materials) are predicted to be not significant as the environmental effects are generally low in magnitude, of limited geographic extent and reversible.

Environmental effects on marine fish SAR from the release of marine diesel or hydrocarbons (subsea blowout or surface spill) are predicted to be high in magnitude and to cover a large geographic extent and result in change in habitat quality and potential mortality of marine fish SAR. In the unlikely case of a marine diesel fuel spill, subsea hydrocarbon blowout or surface spill, potential adverse environmental effects are predicted to result in the killing or harming of a fish species that is listed as extirpated, endangered or threatened, even with mitigations in place. However, as none of the Schedule 1 marine fish SAR are a population that is vulnerable to extinction, environmental effects are considered not significant.

Table 12-10 Environmental Effects Assessment for Marine Fish Species at Risk – Accidental Events

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(a)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		
SBM whole mud spill	Change in habitat quality (N)	• Oil Spill Response Plan • Use of best practices and continual improvement programs • Preparation for Contingency Planning and Clean Up	L	2	1	1	R	3	NS	H
Marine diesel fuel spill from a marine vessel incident (including collision)	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Use of best practices and continual improvement programs • Preparation for Contingency Planning and Clean Up	L	2	1	1	R	3	NS	M
Subsea hydrocarbon blowout	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Use of best practices and continual improvement programs • Preparation for Contingency Planning and Clean Up	H	4	1	3	R	3	NS	M
Hydrocarbon surface spill	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Use of best practices and continual improvement programs • Preparation for Contingency Planning and Clean Up	H	4	1	3	R	3	NS	M
Other spills (e.g., fuel, waste materials)	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Use of best practices and continual improvement programs • Preparation for Contingency Planning and Clean Up	L	2	1	1	R	3	NS	M

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (a)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological/Socio-cultural/Economic Significance		

Key:

Magnitude:
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12.4.2.3 Cumulative Environmental Effects

Nearshore

Cumulative environmental effects on marine fish SAR in the Nearshore Study Area could occur as a result of the WREP activities in combination with commercial fisheries and marine traffic. These activities can cause disturbance and destruction of marine habitat, increased noise and contamination, and are described below.

Placentia Bay has several busy ports and is a centre of transport for the oil and gas industry. The head of Placentia Bay has become essential to the oil and gas industry in Newfoundland because the bay is ice-free, it has the necessary infrastructure and facilities and has an existing skilled workforce. In addition to oil and gas, Placentia Bay has been used for mining, transport and military activities. Existing facilities include a transshipment terminal for crude oil at Whiffen Head, an oil refinery in Come By Chance, a large ferry terminal in Argentia, Marystown Shipyard, and the Cow Head Fabrication Facility. The Vale Newfoundland & Labrador Limited nickel processing plant in Long Harbour is in development. The Newfoundland and Labrador Refining Corporation is proposing to construct an oil refinery at Southern Head. There has been a proposal (currently suspended) for a liquefied natural gas (LNG) terminal near Grassy Point by Newfoundland LNG. Decommissioned or inactive facilities include a phosphorus plant in Long Harbour, a naval base in Argentia and mining sites in St. Lawrence.

The 1990 Public Review on Tanker Safety and Marine Spills Response Capability (Brander-Smith 1990) suggested Placentia Bay had the greatest risk of an oil spill in Canada. Prompted by this and environmental assessments, Transport Canada initiated an assessment of accidental spills along the south coast of Newfoundland in 2005 using quantitative modelling, as well as local knowledge, to identify risk and local concerns (BAE-Newplan Group Limited 2007). Risk analyses by Transport Canada and DFO found that the most probable area for a spill is inner Placentia Bay and likely in range of up to 1,590 m^3 (10,000 barrels) (SL Ross 2007) predicted to occur every 27 to 33 years (SL Ross 2007). They also note the risk of spill has decreased over time due to implementation of greater preventative measures.

In 2004, total annual movement in Placentia Bay was 8,286 vessels, including 1,276 oil tankers, 62 chemical tankers, 522 cargo ships, 2,046 tug boats, 1,501 ferry movements and 1,589 fishing boats and other small vessels (under 20 m) (Transport Canada 2007). Marine traffic data collected by Transport Canada for the ports of Come by Chance, Whiffen Head, Marystown and Long Harbour from May 2011 to April 2012 (with November 2011 and March 2012 data missing) reported 1,756 commercial vessels entering ports in Placentia Bay (C. McDonald, Transport Canada, pers. comm.). However, Transport Canada does not track commercial shipping traffic into ports of Argentia, Arnold’s Cove, Burin, Southern Harbour or North Harbour, and that value does not include ferry or fishing vessels. Marine Atlantic operates a car and passenger ferry from Argentia Harbour to North Sydney, Nova Scotia, from mid-June to end of September annually. For the 2012 season, there are 60 crossings scheduled to travel to or from Argentia. There is also recreational marine transportation in Placentia Bay, but data on recreational use of the Bay (e.g., by recreational fishers, boaters) are not available.

Atlantic cod, a species assessed as Endangered by COSEWIC, but which has not been listed under SARA, is an important species harvested in NAFO Unit Area 3PSc (Placentia Bay), accounting for just over half of the catch by weight between 2005 and 2010, followed by snow crab (16.3 percent) and herring (approximately 10 percent). The fisheries in Placentia Bay are conducted year-round, although in recent years, the overall catch has been much less evenly distributed throughout the year compared to a decade ago. Since the 3Psc groundfishery reopened in the mid-1990s, the peak harvesting months in terms of quantity of harvest have been June and July and this is still very much the case in 2012. This pattern is influenced by the cod fishing activities, which generally occur throughout all months except April. However, May and June are the two highest months by value, owing to the large harvest of high-value snow crab in May. For Atlantic cod, June and July accounted for more than 55 percent of the total cod catch during 2005 to 2010, but there is also a fairly strong fishery in the fall and early winter period, while the snow crab fisheries are concentrated in the May to July period. The herring fishery has a spring and late fall/winter component, with most taken in December. Lobster, following the open season for this species (typically mid- to late April to late June) in this area (LFA 10), is strongly focused in those months. Capelin are harvested in June and July, although this species fishery usually takes place in a very short period (six to eight days) during the season. As fishing will be prohibited within the safety zone during WREP activities in the nearshore, there is potential for the WREP to have a positive effect on fish, through decreases in fishing area.

The Placentia Bay Integrated Management Plan (DFO 2008b) also expressed concern about pollution due to onshore and nearshore sources, including sewage discharge, by-products of fish processing and aquaculture operations, and the discharge of toxic chemicals by fish processing, industrial and mining activities. There is also concern about the potential effects of the introduction of invasive species through vessel traffic and shipment of goods from other parts of the world.

WREP activities will represent a negligible incremental increase to the overall cumulative environmental effects of marine traffic and commercial fisheries. The Nearshore Project Area is not known to represent defined critical habitat to any marine fish SAR. The cumulative environmental effects of the WREP on marine fish SAR are predicted to be not significant.

Offshore

In the Offshore Study Area, cumulative environmental effects on marine fish SAR could occur as a result of the WREP in combination with other oil and gas activities, including the White Rose oilfield development (including North Amethyst), Terra Nova development, Hibernia oil development, Hibernia Southern Extension project, Hebron oil development, exploration seismic activity and exploration drilling activities, as well as commercial fisheries and marine traffic in the offshore. These activities can contribute to physical disturbance, contamination, chronic pollution, smothering effects and increased noise that have effects on marine fish SAR. Commercial fisheries can adversely affect fish and fish habitat through physical disturbance (i.e., trawling), degradation of habitat, removal of biomass and noise effects. Marine traffic contributes noise effects as well as chronic oil pollution. Wiese and Ryan (2003) report that due to the density of traffic off Newfoundland (i.e., between Europe and North America), the amount of persistent oil in the marine environment is very high along Newfoundland coastlines. These industries together can interact cumulatively with the WREP to have adverse environmental effects on fish and fish habitat in the Offshore Study Area.

As of June 2012, there are a total of 284 wells on the North Grand Banks (C-NLOPB website), and proposed future activities in the Offshore Study Area include a seismic program in Jeanne d'Arc Basin by Western Geco Canada (2012 to 2015), a seismic program in Flemish Pass by Husky (2012 to 2020), the WREP activities described in this document and the Hebron project. The proposed Hebron project is 46 km southwest from White Rose. The project will use a standalone GBS designed to store 190,000 m^3 (1.2 million barrels) of crude oil, with an estimated production rate of 23,900 m^3/day oil. The oil will be offloaded to shuttle tankers via an offshore loading system similar to that used at Hibernia.

Existing oil and gas activities in the offshore include those occurring in the White Rose field, Hibernia oil field and Terra Nova oil field, as detailed in Table 5.4 of the Methods Chapter, and summarized here. The Hibernia oil field is approximately 50 km northwest of the *SeaRose FPSO*. Hibernia includes a GBS with storage capacity for 1.3 million barrels of oil and has been in production since November 1997. Activities in the Hibernia oil field include drilling and production, three support and stand-by vessels, and three shuttle tankers that transport the crude oil to Whiffen Head (Placentia Bay) or direct to market. The Hibernia South Extension project is located approximately 6 km from Hibernia and may include up to six drill centres (each with up to 11 wells) that will be connected to the existing Hibernia GBS.

The Terra Nova oil field is located approximately 50 km southwest of the *SeaRose FPSO*, and has been in production since January 2002. Terra Nova uses an FPSO facility capable of storing up to 960,000 barrels of oil. The Terra Nova development includes four drill centres, and a total of 34 wellbores and sidetracks have been drilled to date: 14 development wells in the Graben area; 11 development wells in the East Flank; and one extended reach producer and extended reach water injection well in the Far East Central area. Two shuttle tankers and two to four support vessels are associated with the Terra Nova development.

The WREP will be located in the White Rose field. Existing operations use the *SeaRose FPSO* and have four drill centres (Northern, Central, Southern and North Amethyst) and subsea flowlines tied-back to the *SeaRose FPSO*. There are a total of 30 existing wells at the White Rose field. There are three shuttle tankers and four to six supply vessels that provide support services in the ice-free season, and an additional five supply vessels may be in service during the ice season. Husky is proposing to develop up to two additional drill centres within the White Rose field.

There is a potential cumulative environmental effect from the WBM discharge when considered together with other drilling projects. While it is acknowledged that each production or exploration well is contributing to a cumulative environmental effect on marine fish habitat, each of these projects is affecting a localized area and the environmental effects are reversible. All routine discharges from WREP activities will be in accordance with the OWTG (NEB et al. 2010) and related monitoring requirements.

Routine activities associated with marine transportation contribute to underwater noise and may affect marine fish SAR. However, the contribution of a small number of vessels in association with the WREP is not expected to considerably increase the amount of ambient noise.

Commercial fishing on the Grand Banks and Flemish Cap is considerable, although the WREP Offshore Project Area does not overlap with any major fishing areas. Important commercial fisheries in NAFO Division 3L are primarily snow crab and shrimp at this time. Although commercial fisheries can have an environmental effect on marine fish SAR through resource extraction, disturbance, degradation of habitat, pollution and noise, the current level of commercial exploitation within the Offshore Project Area is very limited and DFO manages commercial fisheries to keep populations at sustainable levels.

WREP activities will represent a negligible incremental increase to the overall cumulative environmental effects to marine fish SAR as the effect on the seafloor will be localized and unlikely to overlap in space or time with other activities. The Offshore Project Area is not known to represent defined critical habitat to any marine fish SAR. The cumulative environmental effects of the WREP on marine fish SAR are predicted to be not significant.

12.4.2.4 Determination of Significance

The determination of significance is based on the definition provided in Chapter 5 and the criteria described in Section 12.2. It considers the magnitude, geographic extent, duration, frequency, reversibility and ecological context of each environmental effect within the Nearshore and Offshore Study Areas, and their interactions. Significance is determined at the individual level within the Nearshore and Offshore Study Areas because of the rarity of some SAR fish species.

The significance of potential residual environmental effects, including cumulative environmental effects, resulting from the interaction between WREP-related activities and marine fish SAR, after taking into account any proposed mitigation, is summarized in Table 12-11. Construction, installation, operation, decommissioning and cumulative effects are predicted to be not significant after taking into account proposed mitigations. Potential accidental events that have been assessed are considered to be not significant at the population level (as none of the marine fish SAR populations are in danger of extirpation or extinction), and have low a likelihood of occurrence.

The potential residual adverse environmental effects of the WREP on marine fish SAR from routine Project activities are not considered of sufficient geographic extent, magnitude, duration, frequency and/or irreversibility to result in the killing or harming of a fish species that is listed as extirpated, endangered or threatened, even with mitigations in place, and therefore the effects are considered not significant in the Nearshore and/or Offshore Study Areas.

Table 12-11 Residual Environmental Effects Summary: Marine Fish Species at Risk

Phase	Residual Adverse Environmental Effect Rating (A)	Level of Confidence	Probability of Occurrence (Likelihood)
Construction (B)	NS	H	N/A (C)
Installation of WHP or Subsea Drill Centre	NS	H	N/A
Operation and Maintenance	NS	H	N/A
Decommissioning and Abandonment (D)	NS	H	N/A
Accidental Events	NS	M	N/A
Cumulative Environmental Effects	NS	H	N/A

Key:

Residual Environmental Effects Rating:

S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Level of Confidence in the Effect Rating:

L = Low level of Confidence
M = Medium Level of Confidence
H = High level of Confidence

Probability of Occurrence of Significant Environmental Effect:

L = Low Probability of Occurrence
M = Medium Probability of Occurrence
H = High Probability of Occurrence

NA = Not Applicable
(A) As determined in consideration of established residual environmental effects rating criteria
(B) Includes all Argentia activities (engineering, construction, tow-out) of the WHP option only
(C) Effect is not predicted to be significant, therefore the probability of occurrence rating is not required under CEAA
(D) Includes decommissioning and abandonment of the WHP and offshore site

Potential residual adverse environmental effects of the WREP on marine fish SAR will be mitigated. The potential residual adverse environmental effects of routine WREP activities on marine fish SAR are therefore predicted to be not significant. Given that routine activities associated with the WREP are localized, of low to medium magnitude and reversible, environmental effects on marine fish Species at Risk are not expected to contravene the prohibitions of SARA (Sections 32(1), 33, 58(1)). The residual adverse environmental effects of an accidental hydrocarbon spill on marine fish SAR are predicted to be not significant.

12.4.2.5 Follow-up and Monitoring

A fish habitat compensation program with associated monitoring will be implemented, if required.

12.5 Marine Mammal and Sea Turtle Species at Risk

12.5.1 Project-Valued Environmental Component Interactions and Existing Knowledge of Environmental Effects

WREP activities can interact with at-risk marine mammals and sea turtles by causing changes in habitat quantity, changes in habitat quality, or potential mortality. The interactions that are expected to have the most environmental effects on marine mammals and sea turtles were discussed in Section 11.4 and are summarized here as they pertain to at-risk species. Interactions with fewer expected environmental effects are discussed in Section 12.5.2.

Underwater sound produced by the WREP's activities will be the primary source of an effect on at-risk marine mammals and sea turtles. WREP activities that could produce substantial underwater noise include pile driving, vessel and helicopter traffic, dredging, drilling and geophysical surveys. These activities could affect the habitat quality for at-risk marine mammals and sea turtles. Marine mammals rely heavily on the use of underwater sounds to communicate and to gain information about their surroundings. Experiments also show that they hear and may react to many anthropogenic sounds.

The environmental effects of noise on at-risk marine mammals and sea turtles are highly variable, and can include one or more of the following: tolerance; masking; behavioural changes; hearing impairment; non-auditory injury; and mortality. To aid in the assessment of potential environmental effects of noise from WREP activities on at-risk marine mammals and sea turtles, a description of the hearing abilities of marine mammals and sea turtles and a review of noise criteria for assessing effects were summarized in Section 11.4.

12.5.1.1 Nearshore

Graving Dock Structure

During graving dock construction, underwater noise could result from WREP activities such as bund wall construction (including possible pile driving). However, pile driving during this phase would occur on shore and underwater noise from pile driving is expected to be negligible. Potential effects of sounds from pile driving on marine mammals and sea turtles were described in Section 11.4.1.1. The existing knowledge relevant to at-risk marine mammals and sea turtles is summarized below.

Behavioural reactions of at-risk marine mammals and sea turtles to sound are difficult to predict. If an at-risk marine mammal or sea turtle reacts to an underwater sound by changing its behaviour or moving a small distance, the effects of the change are unlikely to be critical to the individual, let alone the stock or population. However, if a sound source displaces at-risk marine mammals or sea turtles from an important feeding or breeding area for a prolonged period, effects on individuals and populations could be substantial (e.g., Lusseau and Bejder 2007; Weilgart 2007).

Effects of Pile Driving

Some vocalizations produced by at-risk marine mammals in the Nearshore Project Area may have overlapping frequencies with those produced by pile driving; thus, some marine mammal calls could be masked particularly during vibratory pile driving. Borsani et al. (2005) suggested that there was a high potential for low-frequency fin whale calls to be masked during pile driving in the Ligurian Sea; no calls from fin whales were recorded during and immediately after pile driving activities.

Harbour porpoises are known to be relatively responsive to sounds from anthropogenic activities (e.g., Richardson et al. 1995). Based on behavioural disturbance threshold criteria from Southall et al. (2007), Bailey et al. (2010) suggested that behavioural disturbance of harbour porpoise may occur at distances out to 70 km, with major disturbance at distances up to 20 km. During percussion pile driving at Horns Rev I windfarm in the Danish North Sea, harbour porpoise acoustic activity declined; however, it resumed to baseline levels several hours (3 to 4.5 hours) after the completion of pile-driving activities (Tougaard et al. 2003, 2005). The effects of pile-driving activity on harbour porpoises were observed at distances as far as 10 to 15 km from the activity, and included a decrease in feeding behaviours and a decrease in the number of harbour porpoises in the Horns Rev area during the construction period as compared to periods before and after construction (Tougaard et al. 2003). There were also fewer circling harbour porpoises during pile driving and a statistically significant increase in the number of harbour porpoises travelling within 15 km of the construction site (Tougaard et al. 2005). Behavioural effects may have extended as far as 20 to 25 km from the construction site (Tougaard et al. 2005, 2009, 2011). There was complete recovery of acoustic activity during the first year of regular operation of the windfarm; in fact, acoustic activity was higher during operation than baseline (Tougaard et al. 2006a; Teilmann et al. 2008).

In contrast to the Before After Control Impact Design used during previous studies at Horn Rev wind farm, a gradient sampling design showed that the behavioural responses of harbour porpoises to pile driving were longer than previously reported (Brandt et al. 2011). Brandt et al. (2011) recorded no porpoise clicks for at least 1 h at a distance of 2.6 km from the construction site at Horns Rev II, with reduced acoustic activity for 24 to 72 h. At a distance of 4.7 km, the recovery time was still longer than 16 h – the time between pile driving events (Brandt et al. 2011). Recovery time decreased with increasing distance from the construction site (Brandt et al. 2011). At a distance of approximately 22 km, negative effects were no longer detectable; rather, a temporary increase in click activity was apparent, possibly as a result of harbour porpoises leaving the area near the construction site (Brandt et al. 2011).

During pile driving activities (using both vibratory and impact techniques) at the Nysted offshore wind farm off the coast of Denmark, a statistically significant decrease in harbour porpoise echolocation activities and presumably abundance was reported within the construction area and in a reference area 10 to 15 km from the windfarm (Carstensen et al. 2006; Teilmann et al. 2008). Carstensen et al. (2006) reported a medium-term porpoise response to construction activities in general and a short-term response to ramming/vibration activities. Porpoises appeared to have left the area during piling but returned after several days (Tougaard et al. 2006b). Two years after construction, there was still a statistically significant reduction in echolocation activity and presumably porpoise abundance in the windfarm, but these had returned to baseline levels at the reference sites (Tougaard et al. 2006b; Teilmann et al. 2008).

Teilmann et al. (2006) speculated as to the difference in the response of harbour porpoises at Nysted vs. Horns Rev; the negative effect of construction persisted longer for porpoises at Nysted than it did at Horns Rev. Harbour porpoises at Horns Rev may have been more tolerant to disturbance, since the area is thought to be important to harbour porpoises as a feeding ground; the Horns Rev area has much higher densities of animals compared to Nysted (Teilmann et al. 2006). Another explanation proposed by Teilmann et al. (2006) took into account that the Nysted wind farm is located in a sheltered area whereas Horns Rev is exposed to wind and waves with higher background noise. Thus, noise from construction may be more audible to harbour porpoises at Nysted compared to Horns Rev.

Scheidat et al. (2011) suggested that harbour porpoise distribution was fairly quick to recover after construction of the Dutch offshore wind farm Egmond aan Zee, as acoustic activity of harbour porpoise was greater during the three years of operation than the two years prior to construction. In addition, Leopold and Camphuysen (2008) noted that construction of windfarm Egmond aan Zee did not lead to increased strandings in the area. Harbour porpoises near pile driving activities in Scotland may have exhibited a short-term response within 1 to 2 km of the installation site, but this was a short-term effect lasting no longer than two to three days (Thompson et al. 2010). During the construction of a harbour wall in Demark, which involved pile driving of 175 wooden piles, a 40 m-long air bubble curtain was constructed in hopes of reducing noise effects on three harbour porpoises in a facility on the opposite side of the harbour (Lucke et al. 2011). The bubble curtain was found to be helpful in reducing the piling noise, and the initial avoidance behaviour of the harbour porpoises to the piling sound was no longer apparent after installation of the bubble curtain (Lucke et al. 2011).

Temporary avoidance behaviour during pile driving activities has also been reported for belugas (Kendall 2010) and Indo-Pacific humpback dolphins (Jefferson et al. 2009). There have been no studies to examine hearing impairment of marine mammals or sea turtles during pile driving activities, although it is a possibility. There are currently no published data available for behavioural effects of pile driving on sea turtles.

Concrete Gravity Structure Construction

Underwater noise will be produced during WREP activities associated with the construction of the CGS. Underwater sounds will be produced by dredging of the bund wall and possibly sections of the tow-out route to the deep-water mating site. Noise from dredging could affect the habitat quality for at-risk marine mammals and sea turtles. The effects could include masking of natural sounds, behavioural disturbance and hearing impairment. The possible effects of dredging on marine mammals and sea turtles were described in Sections 11.4.1.1 and 11.4.1.2, respectively. The possible effects of dredging are summarized briefly below.

Effects of Dredging

In nearshore shallow water regions, dredges can be strong sources of low frequency underwater noise (Richardson et al. 1995). Dredging that occurs consistently over long periods can create a higher potential for disturbance, which could result in changes in habitat use for at-risk marine mammals and sea turtles. Limited information is available on the behavioural changes of marine mammals resulting from dredging operations, and there is no information on the effects of dredging on at-risk marine mammals and sea turtles. However, in general, cetaceans have been reported to continue using habitats near dredging operations. Dredging operations will be temporary and of limited duration. Proper planning and equipment design will reduce the duration of dredging activities and hence the environmental effect on at-risk marine mammals and sea turtles.

Concrete Gravity Structure Tow-out

Underwater noise will be produced during WREP activities associated with the tow-out of the CGS. Noise will be produced by vessels, helicopters and geophysical surveys (i.e., side scan sonar and geohazard surveys). These activities could affect the habitat quality for at-risk marine mammals and sea turtles. Vessel traffic could also affect at-risk marine mammals and sea turtles through direct mortality (i.e., collisions). The potential environmental effects of noise from vessels and helicopters were discussed in Section 11.4.1.2. The existing knowledge relevant to at-risk marine mammals and sea turtles is summarized below. The possible effects of geophysical surveys are discussed in terms of seismic surveys in Section 12.5.1.2.

Effects of Vessel Traffic

Sounds from vessel traffic associated with the WREP will likely result in a temporary change in habitat quality for at-risk marine mammals and sea turtles. Vessel noise is most likely to cause masking or behavioural responses in at-risk marine mammals and sea turtles. However, sound levels are not expected to be high enough to cause physical or physiological effects on at-risk marine mammals or sea turtles (see Richardson et al. 1995). The greatest and most continuous vessel noise sources during construction activities result from tugs and barges (see Blackwell and Greene 2006). Sound levels that would have the potential to induce hearing impairment in marine mammals and sea turtles (180 and 190 dB re 1 µPa (rms)) have been modelled to occur in an area less than 5 m from a tug (JASCO 2012).

Masking by vessel sounds of marine mammal calls may also occur if the frequencies produced overlap. Through use of an analytical paradigm, Clark et al. (2009) found that of the large baleen whales, the endangered North Atlantic right whale may be most prone to communication masking due to commercial vessel traffic. They found that two commercial ships in the Stellwagen Bank National Marine Sanctuary, US, could cause an 84 percent reduction in the whale's communication space for at least 13.2 h a day. Nieukirk et al. (2011) also suggested the potential of masking effects from vessel traffic on large whales, such as fin and blue whales, in Fram Strait and the Greenland Sea. However, the biological repercussions of a loss of communication space are unknown (Clark et al. 2009).

McKenna (2011) and Melcón et al. (2012) reported that blue whales changed their vocalization rates in response to nearby ship noise; calls increased with increasing received sound levels. In addition, Nieukirk et al. (2005) reported a change in frequencies of blue whale calls in the north Pacific. North Atlantic right whales have also been shown to change their vocalization behaviour and call source levels in response to increased noise (Parks et al. 2007, 2009, 2011). Similarly, killer whales are known to increase the source levels of their calls in the presence of vessel sounds (Holst et al.

2009). At-risk cetaceans may change their vocalization rates and call frequencies to overcome potential masking effects from ship noise. If cetaceans exposed to strong sounds sometimes respond by changing their vocal behaviour, this adaptation, along with directional hearing and preadaptation to tolerate some masking by natural sounds (Richardson et al. 1995), would all reduce the importance of masking by vessel noise.

The behavioural responses of cetaceans to vessels are variable. Baleen whales may approach or avoid boats (Watkins 1986). North Atlantic right whales in the Bay of Fundy showed no response to controlled sound exposure to ships as well as actual ships (Nowacek et al. 2004). The majority of baleen whales (including fin, humpback and minke whales) sighted from a high-speed, catamaran car ferry transiting the Bay of Fundy during the summers of 1998 to 2002 appeared to exhibit avoidance behaviour including heading away, changing heading, or diving (Dufault and Davis 2003). Fin whales responded to the close approach by a small inflatable boat (which also moved with sudden speed and made directional changes) by apparently ceasing feeding, beginning to travel at increased speed, and reducing the amount of time spent on the surface (Jahoda et al. 2003). One hour after close approach, the fin whales had not resumed to pre-disturbance behaviours. The authors noted that fin whale response may be, entirely or in part, a response to biopsy sampling, which was occurring as well.

Toothed whale responses to vessels include reductions in foraging, possible habituation, increased diving, frequent changes in direction, approach and bow-riding, increased rate and sound level of vocalizations, modified behavioural state, general avoidance, or selection of different habitat. Ships, in particular whale watching vessels, have been shown to affect the behaviour of SARA-listed resident killer whales in Washington and British Columbia (Kruse 1991; Williams et al. 2002a, 2002b; 2009; Lusseau et al. 2009). Lusseau et al. (2009) noted that vessel traffic substantially affected the transition probabilities between activity states and resulted in a reduction in time spent foraging. Whales were substantially less likely to be foraging and more likely to be travelling when vessels were in the area (Lusseau et al. 2009). Williams et al. (2002a) reported that the swim path of killer whales became less predictable around vessels, females swam faster and increased the angle between successive dives and males maintained their speed but altered their path when vessels were in the area. Kruse (1991) reported that killer whales increased their swim speed and tended to swim toward open water in response to approaching boats. Williams et al. (2009) observed that the distances travelled by killer whales increased in the presence of vessels. The authors raised concerns about the potential risk of such increased energy expenditures. As demonstrated in these two studies, long-term effects, and their individual and population effects, remain important data gaps for studies of the effects of vessel traffic on the behaviour of marine mammals, especially those that are at-risk.

Most beaked whales tend to avoid approaching vessels (e.g., Würsig et al. 1998). They may also dive for an extended period when approached by a vessel (e.g., Kasuya 1986). Aguilar-Soto et al. (2006) suggest that foraging efficiency of Cuvier's beaked whales may be reduced by close approach of a vessel based on dive and acoustic data received from one whale; the authors caution that no conclusions can be drawn based on their single observation. Harbour porpoise tend to be rather responsive to anthropogenic sound, including vessel traffic (Richardson et al. 1995; Southall et al. 2007). Palka (1996) reported that some harbour porpoises showed avoidance reactions at greater than 700 m from a survey vessel in the Gulf of Maine. Sea turtles generally flee or dive when approached closely by a vessel (e.g., Hazel et al. 2007).

Based on evidence from terrestrial mammals and humans, sound is also a potential source of stress (Wright and Kuczaj 2007; Wright et al. 2007a, 2007b, 2009, 2011). However, limited information is available on sound-induced stress in marine mammals, or on its potential (alone or in combination with other stressors) to affect the long-term well-being or reproductive success of marine mammals (Fair and Becker 2000; Hildebrand 2005; Wright et al. 2007a, 2007b). Such long-term effects, if they occur, would be associated with chronic noise exposure (see Tyack 2008). Rolland et al. (2012) suggested that ship noise causes increased stress in North Atlantic right whales; they showed that baseline levels of stress-related faecal hormone metabolites decreased in North Atlantic right whales with a 6 dB decrease in underwater noise from vessels. How this type of chronic stress may affect North Atlantic right whales or other at-risk species is unknown.

The presence of vessels during various WREP activities can also increase the risk of direct mortality via vessel collisions with at-risk marine mammals. Fin whales are the most commonly reported whale to be struck by vessels, followed by humpback whales and North Atlantic right whales (Jensen and Silber 2003; Vanderlaan and Taggart 2007). It is thought that North Atlantic right whales, particularly in the Bay of Fundy, may be susceptible to collisions with ships as they may have difficulty in locating the direction of the ship because of echoes off the sea bottom and surface (Terhune and Verboom 1999). North Atlantic right whales may swim into the acoustic shadow (quietest location usually ahead of the ship at the surface) of an on-coming ship, thus making them more susceptible to collisions (Terhune and Verboom 1999). Evidence suggests that a greater rate of mortality and serious injury to large whales is correlated with a greater vessel speed at the time of a ship strike (Laist et al. 2001; Vanderlaan and Taggart 2007). Most lethal and severe injuries to large whales resulting from documented ship strikes have occurred when vessels were travelling at 26 km/h (14 knots) or greater (Laist et al. 2001). Blue whales and fin whales are also known to be struck (Laist et al. 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007). Odontocetes are also at risk from vessel collision; killer whales, harbour porpoise and beaked whales have been reported struck by vessels (e.g., Vanderlaan and Taggart 2007).

Sea turtles are also at risk from ship strikes as they regularly surface to breathe and often rest at or near the surface. Hazel et al. (2007) suggested that sea turtle injury or mortality may occur due to collisions with vessels, particularly when vessels travel at speeds greater than 4 km/h. This study also indicated that a turtle's ability to detect an approaching vessel was vision-dependent and so directly related to water clarity. The study proposed that the vision-dependence of sea turtles explains their inability to evade fast vessels (Hazel et al. 2007).

Effects of Helicopter Overflights

In general, marine mammals show variable reactions to aircraft; often they startle and dive during low-altitude overflights. Richardson et al. (1995) summarized marine mammal responses to aircraft. Those observations showed that baleen whales often react to aircraft overflights by hasty dives, turns, or other changes in behaviour. Whales actively feeding or socializing often seem rather non-responsive, whereas whales in confined waters or with calves sometimes seem more responsive. Minke, bowhead and right whales reacted to aircraft overflights at altitudes of 150 to 300 m by diving, changing dive patterns, or leaving the area (Leatherwood et al. 1982; Watkins and

Moore 1983; Payne et al. 1983; Richardson et al. 1985a, 1985b). Odontocetes reacting to aircraft may dive, slap the water with flippers or flukes, or swim away.

There are currently no available systematic data on sea turtle reactions to helicopter overflights. Given the hearing sensitivities of sea turtles, they can likely hear helicopters, at least when the helicopters are at lower altitudes and the turtles are at relatively shallow depths. It is unknown how at-risk sea turtles would respond, but single or occasional overflights by helicopters would likely only elicit a brief behavioural response.

12.5.1.2 Offshore

During the construction and installation phase in the Offshore Project Area, underwater noise will result from activities such as (possible) clearance dredging, helicopter overflights, operation of vessels, geophysical and geotechnical surveys, installation of the flowlines, pipelines and the WHP, and subsea equipment and hook-up to WHP and commissioning. During production and operation, drilling will be taking place. These activities could affect habitat quality and habitat use by at-risk marine mammals and sea turtles. In addition, operation of vessels could lead to direct mortality of individuals via collisions. Placement of the WHP at the offshore site location may also affect at-risk marine mammals and sea turtles through a limited reduction in habitat quantity, but this is expected to have negligible effects. The potential environmental effects of subsea drill centre excavation and installation on marine mammals and sea turtles have been summarized previously by LGL (2007a), and include similar activities as outlined in Section 11.4.2.1 and below.

Wellhead Platform Installation/Commissioning

During the installation phase in the Offshore Project Area, underwater noise will result from activities such as dredging, operation of vessels (including tow-out), geophysical surveys and helicopter overflights. Helicopters will be used to transfer personnel to the WHP, drilling units and possibly seismic vessels. These activities could affect habitat quality and habitat use by at-risk marine mammals and sea turtles. In addition, operation of vessels could lead to direct mortality of individuals via collisions. The potential environmental effects of helicopters, vessels, geophysical surveys and dredging on marine mammals and sea turtles were discussed in detail in Section 11.4.1.2 and effects relevant to at-risk species are provided in Section 12.5.1.1. Existing knowledge of effects on at-risk species is summarized below.

Effects of Geophysical Surveys

In the Offshore Project Area, geophysical surveys will include VSP as well as geohazard surveys. Similar to seismic surveys, both VSP and geohazard surveys use airguns, but a key difference is the larger array size used in seismic surveys. The potential physical and physiological effects of noise from the geohazard survey equipment (typically a small airgun array, boomer, side scan sonar and echosounders) are of less concern than airgun pulses from 2-D and 3-D surveys given their relatively lower source levels, narrow energy beam, and short duration of the geohazards program. Some equipment also operates at frequencies outside the range of marine mammal and sea turtle hearing abilities. Potential effects of seismic surveys are summarized below including: masking, behavioural disturbance; hearing impairment; and non-auditory injury. The most likely effects include masking and behavioural disturbance (see Section 11.4.2.1).

The potential physical and physiological effects of seismic programs on marine mammals and sea turtles have recently been reviewed for StatoilHydro's 3-D program in Jeanne d'Arc Basin (LGL 2008) Petro-Canada's 3-D program in Jeanne d'Arc Basin (LGL 2007e) and for Husky's program in northern Jeanne d'Arc Basin (LGL 2005b; Moulton et al. 2006b). Geohazard surveys are less likely to affect marine mammals and sea turtles, as reviewed in several environmental assessments for Jeanne d'Arc Basin (LGL 2005a, 2005b, 2005c, 2005d, 2008).

Masking

Although masking effects of pulsed sounds on at-risk marine mammal calls are expected to be limited, there are few specific studies to demonstrate this. Some at-risk whales, such as blue and fin whales, continue calling in the presence of seismic pulses and calls often can be heard between the seismic pulses (e.g., McDonald et al. 1995; Nieukirk et al. 2004, 2011, 2012; Dunn and Hernandez 2009; Castellote et al. 2012). However, one summary report indicates that calling fin whales distributed in one part of the North Atlantic went silent for an extended period starting soon after the onset of a seismic survey in the area (Clark and Gagnon 2006). It is not clear from that preliminary paper whether the whales ceased calling because of masking, or whether this was a behavioural response not directly involving masking. Castellote et al. (2012) reported that singing fin whales moved away from an operating airgun array rather than ceasing vocalizations; fin whales also changed their acoustic behaviour in the presence of seismic sounds. Di Iorio and Clark (2010) found that blue whales in the St. Lawrence Estuary increased their call rates during operations by a lower-energy seismic source. The sparker, used to obtain seismic reflection data, emitted frequencies of 30 to 450 Hz with a source level of 193 dB re 1 µPa (peak to peak). If at-risk baleen whales exposed to airgun sounds sometimes respond by changing their vocal behaviour, this adaptation, along with directional hearing and preadaptation to tolerate some masking by natural sounds (Richardson et al. 1995), would all reduce the importance of masking by seismic pulses.

Gedamke (2011) suggested that blue and fin whale communication space may be reduced by 36 to 51 percent when seismic surveys are operating. Nieukirk et al. (2011, 2012) also suggested the potential of masking effects from distant seismic surveys on large whales, such as fin and blue whales, in Fram Strait, Greenland Sea and mid-Atlantic Ridge. Airgun sounds and fin whale calls were recorded at the mid-Atlantic Ridge, 4,000 km from seismic vessels (Nieukirk et al. 2012). Fin whale call rates where highest during winter, coinciding with the period that airgun noise was more prevalent (Nieukirk et al. 2012). In areas occupied by fin whales, airgun sounds were recorded more than 80 percent of days in the month for 12 consecutive months (Nieukirk et al. 2012). The biological repercussions of loss of communication space are unknown (Clark et al. 2009).

Dolphins and porpoises are also commonly heard vocalizing while airguns are operating (e.g., Gordon et al. 2004; Smultea et al. 2004; Holst et al. 2005a, 2005b, 2011; Potter et al. 2007). Masking effects of seismic pulses are expected to be negligible in the case of the smaller odontocetes, given the intermittent nature of seismic pulses plus the fact that sounds important to them are predominantly at much higher frequencies than are the dominant components of airgun sounds.

Although the best hearing sensitivity of sea turtles does include the low frequencies in the range of airguns, they are generally not known to be vocal while in the water. In any case, the intermittent nature of airgun pulses presumably reduces the potential for masking.

Disturbance

A change in behaviour, resulting from disturbance and avoidance, is the most likely effect, if any, of geophysical surveys on at-risk marine mammals and sea turtles. In general, there seems to be a tendency for most baleen and toothed whales to show some limited avoidance of seismic vessels operating large airgun systems. Blue, sei, fin, and minke whales often have been seen in areas ensonified by airgun pulses (Stone 2003; MacLean and Haley 2004; Stone and Tasker 2006; Moulton and Holst 2010), and calls from blue and fin whales have been localized in areas with airgun operations (e.g., McDonald et al. 1995; Dunn and Hernandez 2009; Castellote et al. 2012). Sightings by observers on seismic vessels during 110 large-source seismic surveys off the UK from 1997 to 2000 suggest that, during times of good visibility, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent (Stone 2003; Stone and Tasker 2006). However, these whales tended to exhibit localized avoidance, remaining substantially further (on average) from the airgun array during seismic operations compared with non-seismic periods (Stone and Tasker 2006). The average closest point of approach for baleen whales sighted when large airgun arrays were operating vs. silent were approximately 1.6 versus 1.0 km. Baleen whales, as a group, were more often oriented away from the vessel while a large airgun array was shooting compared with periods of no shooting (Stone and Tasker 2006). Similarly, Castellote et al. (2012) reported that singing fin whales in the Mediterranean moved away from an operating airgun array and avoided the area of operations for days after airgun activity had ceased. In addition, Stone (2003) noted that fin/sei whales were less likely to remain submerged during periods of seismic shooting.

During seismic surveys in the Northwest Atlantic, baleen whales as a group showed localized avoidance of the operating array (Moulton and Holst 2010). There was a statistically significant difference in sighting rates during seismic compared with non-seismic periods, with fewer baleen whales seen during seismic. Baleen whales were also seen on average 200 m farther from the vessel during airgun activities versus non-seismic periods, and these whales more often swam away from the vessel when seismic operations were underway compared with periods when no airguns were operating (Moulton and Holst 2010). Blue whales were seen at statistically significant greater distances from the vessel during single airgun operations, ramp-up and all other airgun operations compared with non-seismic periods (Moulton and Holst 2010). Similarly, there was a statistically significant difference between the mean approach distance for fin whales during ramp up compared with non-seismic periods, with distances being greater during ramp up (Moulton and Holst 2010). There was also a trend for fin whales to be sighted farther from the vessel during other airgun operations, but the difference was not statistically significant (Moulton and Holst 2010).

Dolphins and other small toothed whales are often seen by observers on active seismic vessels, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Goold 1996a, 1996b, 1996c; Calambokidis and Osmek 1998; Stone 2003; Moulton and Miller 2005; Holst et al. 2006; Stone and Tasker 2006; Weir 2008; Barkaszi et al. 2009; Richardson et al. 2009; Moulton and Holst 2010; Barry et al. 2012). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km or less, and some individuals show no apparent avoidance. During monitoring on seismic vessels operating off the UK from 1997 to 2000, there were statistically significant differences between sighting rates of all small odontocetes combined during seismic versus non-seismic period, with lower sighting rates during seismic operations with large arrays (Stone and Tasker 2006). There was also a statistically significant increase in the approach distances for all of the small odontocete species tested, including killer whales, from large airgun arrays during periods of shooting compared with periods of no shooting. Killer whales appeared to be more tolerant of seismic shooting in deeper waters. There are no specific data on responses of beaked whales to seismic surveys, but it is likely that most if not all species show strong avoidance due to their tendency to avoid vessels in general. Of note, northern bottlenose whales have been observed to approach within 600 m of seismic vessels operating in the Orphan Basin when the airgun arrays were active (Moulton and Holst 2010).

There have been fewer studies of the effects of airgun noise (or indeed any type of noise) on sea turtles than on marine mammals. Four studies (O'Hara and Wilcox 1990; Moein et al. 1994; McCauley et al. 2000a, 2000b; Lenhardt 2002) have focused on short-term behavioural responses of sea turtles in enclosures to airguns; these studies showed that sea turtles generally tend to show avoidance of an operating airgun at some received level. McCauley et al. (2000a, 2000b) noted behavioural responses (increased swimming speed) by caged green and loggerhead turtles when the received level from a single small airgun (20 in^3 at 1,500 psi) was 166 dB re 1 µPa (rms) and avoidance responses at 175 dB re 1 µPa (rms). Captive loggerhead sea turtles maintained a standoff range of approximately 30 m in response to a 10 in^3 airgun plus two 0.8 in^3 "poppers" operating at 2,000 psi (O'Hara and Wilcox 1990). Moein et al. (1994) also noted avoidance by enclosed loggerhead turtles in response to airgun sounds (up to 179 dB) at a mean range of 24 m; however, the avoidance response waned quickly. Lenhardt (2002) exposed captive loggerhead sea turtles while underwater to seismic airgun (Bolt 600) sounds in a large net enclosure. At received levels of 151 to 161 dB, turtles were found to increase swimming speeds. Similar to the McCauley et al. studies (2000a, 2000b), near a received level of approximately 175 dB, an avoidance reaction was common in initial trials, but habituation then appeared to occur. McCauley et al. (2000a, 2000b) estimated that, for a typical airgun array (2,678 in^3, 12-elements) operating in 100 to 120 m water depth, sea turtles may exhibit behavioural changes at approximately 2 km and avoidance around 1 km.

The limited available data indicate that sea turtles will hear airgun sounds and that they are likely to exhibit behavioural changes and/or avoidance within an area of unknown size near a seismic vessel. Holst et al. (2006) reported behavioural changes and/or avoidance near a seismic vessel, but the distances or sound levels at which these responses occurred could not be determined. Weir (2007) reported that 80 percent of basking sea turtles (olive ridley, leatherback and loggerhead) remained at the sea surface in response to airgun sound. The airguns produced source levels of 220 to 248 dB re 1 µPa at 1 m with peak energy from 10 to 200 Hz. There was no difference in median distance of sightings between full-array and guns-off. In contrast, 57 percent of loggerhead sea turtles in the Mediterranean interrupted basking behaviour and dove in response to airguns with a source level of 252 dB re 1 µPa (peak) (DeRuiter and Larbi Doukara 2012). Received levels of airgun sound ranged from 193 to 197 dB re 1 µPa (peak) at 72 m and from 190 to 193 dB re 1 µPa (peak) at 94 m. The median distance between the airgun array and the turtles when they dove was 150 m (range 50 to 839 m). The likelihood of diving increased as closest point of approach to the vessel decreased.

Hearing Impairment

Temporary or permanent hearing impairment is a possibility when at-risk marine mammals and sea turtles are exposed to very strong sounds. The minimum sound level necessary to cause permanent hearing impairment is higher, by a variable and generally unknown amount, than the level that induces barely-detectable temporary threshold shift (TTS). For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies at which baleen whales are most sensitive are lower than those at which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales.

Based on available data, TTS is not expected to occur among baleen whales exposed to seismic sound, given the strong likelihood that they would avoid an approaching airgun(s) (or vessel) before being exposed to levels high enough for there to be any possibility of TTS (NSF and L-DEO 2006a, 2006b; Wilson et al. 2006). However, Gedamke et al. (2011) suggested that some baleen whales whose closest point of approach to a seismic vessel is 1 km or more could experience TTS.

There are empirical data on the sound exposures that elicit onset of TTS in captive bottlenose dolphins, belugas and porpoise (e.g., Finneran et al. 2005; Lucke et al. 2009; Mooney et al. 2009a; Popov et al. 2011). The majority of these data concern non-impulse sound, but there are some limited published data concerning TTS onset upon exposure to a single pulse of sound from a watergun (Finneran et al. 2002). A detailed review of all TTS data from marine mammals can be found in Southall et al. (2007). Given the available data from beluga and bottlenose dolphins, the received sound energy level of a single seismic pulse (with no frequency weighting) might need to be approximately 186 dB re 1 $\mu Pa^2 \cdot s$ (i.e., 186 dB SEL or approximately 221 to 226 dB peak-peak) in order to produce brief, mild TTS (Southall et al. 2007). Exposure to several strong seismic pulses that each have received levels near 175 to 180 dB SEL might result in slight TTS in a small odontocete. For the one harbour porpoise tested, the received level of airgun sound that elicited onset of TTS was lower. The animal was exposed to single pulses from a small (20 in^3) airgun, and auditory evoked potential methods were used to test the animal's hearing sensitivity at frequencies of 4, 32, or 100 kHz after each exposure (Lucke et al. 2009). Based on the measurements at 4 kHz, TTS occurred upon exposure to one airgun pulse with received level of approximately 200 dB re 1 µPa (peak-peak), or an SEL of 164.3 dB re 1 $\mu Pa^2 \cdot s$. If these results from a single animal are representative, it is inappropriate to assume that onset of TTS occurs at similar received levels in all odontocetes (cf. Southall et al. 2007). Some cetaceans may incur TTS at lower sound exposures than are necessary to elicit TTS in the beluga or bottlenose dolphin.

There is no specific evidence that exposure to pulses of airgun sound can cause permanent threshold shift (PTS) in any marine mammal, even with large arrays of airguns. However, given the likelihood that some mammals close to an airgun array might incur at least mild TTS (see Finneran et al. 2002), there has been speculation about the possibility that some individuals occurring very close to airguns might incur PTS (Richardson et al. 1995). The specific difference between the PTS and TTS thresholds has not been measured for marine mammals exposed to any sound type. When exposure is measured in SEL units, Southall et al. (2007) conclude the PTS-onset to TTS-onset difference for marine mammal exposure to impulse sound is at least 15 dB. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis, and probably more than 6 dB.

There have been few studies that have directly investigated hearing or noise-induced hearing loss in sea turtles, and these limited numbers of studies have used net-enclosure experiments. The apparent occurrence of TTS in loggerhead turtles exposed to many pulses from a single airgun less than or equal to 65 m away (Moein et al. 1994) suggests that sounds from an airgun array could cause at least temporary hearing impairment in sea turtles if they do not avoid the (unknown) radius where TTS occurs. Similarly, Lenhardt (2002) reported a TTS of greater than 15 dB for a loggerhead turtle, with recovery occurring in two weeks. Turtles in the open sea might have moved away from an airgun operating at a fixed location, and in the more typical case of a towed airgun or airgun array, very few shots would occur at or around one location. Thus, exposure to underwater sound during net-enclosure experiments was not typical of that expected during an operational seismic survey. There are no data to indicate whether or not there are any plausible situations in which exposure to repeated airgun pulses at close range could cause permanent hearing impairment in sea turtles.

Non-auditory Physiological Effects

There is no specific evidence that airgun pulses can cause serious injury, death, or stranding, even in the case of large airgun arrays. However, the association of strandings of beaked whales with naval exercises (e.g., Simmonds and Lopez-Jurado 1991; Frantzis 1998; NOAA and USN 2001; Jepson et al. 2003; Barlow and Gisiner 2006; D'Amico et al. 2009; Filadelfo et al. 2009) and, in one case, a seismic survey (Malakoff 2002; Cox et al. 2006), has raised the possibility that beaked whales exposed to strong pulsed sounds may be especially susceptible to injury and/or behavioural reactions that can lead to stranding (e.g., Hildebrand 2005; Southall et al. 2007). These strandings are apparently at least in part a disturbance response, although auditory or other injuries or other physiological effects may also be a factor. Hildebrand (2005) reviewed the association of cetacean strandings with high-intensity sound events and found that deep-diving odontocetes, primarily beaked whales, were by far the predominant (95 percent) cetaceans associated with these events, with 2 percent mysticete whales (minke). However, as summarized below, there is no definitive evidence that airguns can lead to injury, strandings, or mortality even for marine mammals in close proximity to large airgun arrays.

Seismic pulses and mid-frequency sonar signals are quite different, and some mechanisms by which sonar sounds have been hypothesized to affect beaked whales are unlikely to apply to airgun pulses. Sounds produced by airgun arrays are broadband impulses with most of the energy below 1 kHz. Typical military mid-frequency sonars emit non-impulse sounds at frequencies of 2 to 10 kHz, generally with a relatively narrow bandwidth at any one time (though the frequency may change over time). Thus, it is not appropriate to assume that the effects of seismic surveys on beaked whales or other species would be the same as the apparent effects of military sonar. Nonetheless, evidence that sonar signals can, in special circumstances, lead (at least indirectly) to physical damage and mortality (e.g., Balcomb and Claridge 2001; NOAA and USN 2001; Jepson et al. 2003; Fernández et al. 2004, 2005; Hildebrand 2005; Cox et al. 2006) suggests that caution is warranted when dealing with exposure of marine mammals to any high-intensity pulsed sound.

Sea turtle mortality or injury has not been documented to occur as a result of exposure to sounds from seismic surveys. However, entanglement of sea turtles in seismic gear is also a concern; there have been reports of turtles being trapped and killed between the gaps in tail-buoys offshore of West Africa (Weir 2007). The probability of entanglements will be a function of turtle density in the Offshore Project Area, which is expected to be low.

Operations and Maintenance

During the operations and maintenance phase in the Offshore Project Area, underwater noise can result from activities such as drilling operations from the WHP and from a MODU, production operations, helicopter overflights, vessel traffic and geophysical and seismic surveys. In addition to activities that will produce noise, other activities that may affect habitat quality and habitat use include discharges (e.g., cooling water and drill cuttings discharges) and presence of structures (e.g., subsea equipment in drill centres, WHP). In addition, there is limited potential for direct mortality of at-risk marine mammals and sea turtles via collisions with vessels.

The potential environmental effects of drilling on marine mammals and sea turtles were detailed in Section 11.4.2.2 and are summarized here for at-risk marine mammals and sea turtles. The potential environmental effects of geophysical surveys, vessel traffic and helicopter overflights on marine mammals and sea turtles have been discussed in previous sections. The potential environmental effects of activities that are not associated with sound production are discussed in Section 12.5.2.

Effects of Drilling

Drilling may occur from the WHP or a MODU (including at potential future subsea drill centres). Kapel (1979) reported numerous baleen whales – mainly fin, minke and humpback whales – within visual range of active drillships off West Greenland. However, in general, marine mammals that are or are not at-risk are likely to show some short-term, localized avoidance of drilling operations (reviewed by Richardson et al. 1995). Dolphins and other toothed whales show considerable tolerance of drill rigs and their support vessels, particularly when there are no negative consequences from close approach to the activities (Richardson et al. 1995). There are no available systematic data on sea turtle reactions to noise from drilling rigs.

Decommissioning and Abandonment

During the decommissioning and abandonment phase in the Offshore Project Area, vessel traffic, helicopter overflights and geophysical surveys could produce underwater noise, which may affect at-risk marine mammals and sea turtles. These activities, as well as those that do not produce sound, could affect habitat quality. Also, there is some potential for direct mortality as a result of collisions with vessels. The possible effects of geophysical surveys, vessel traffic and helicopter overflights have been discussed previously. All of the activities during this phase of the WREP are expected to have no more than short-term and localized effects on at-risk marine mammals and sea turtles in the Offshore Project Area. In addition, collisions, although possible, are expected to be unlikely given the wide distribution of marine mammals and sea turtles in the Offshore Project Area and the relatively slow vessel speeds.

Potential Future Activities

Future activities in the Offshore Project Area may include, but are not limited to, geophysical surveys, drilling, vessel traffic and helicopter overflights. All of these activities will introduce sound into the water, which in turn may affect at-risk marine mammals and sea turtles. These activities, as well as those that do not produce sound (e.g., chemical use and management, cuttings), could affect habitat quality. Also, there is some potential for direct mortality as a result of collisions with vessels. The possible effects of geophysical surveys, vessel traffic and helicopter overflights have been discussed previously. All of the activities during this phase of the WREP are expected to have no more than short-term and localized effects on at-risk marine mammals and sea turtles in the Offshore Project Area. In addition, collisions are considered unlikely.

Accidental Events

There is a possibility of fuel or oil spills in the WREP Study Areas. There are several physical and internal functions that may be affected by oil fouling of at-risk marine mammals and sea turtles. Hydrocarbons can be inhaled or ingested, and may cause behavioural changes, inflammation of mucous membranes, pneumonia and neurological damage (see Geraci and St. Aubin 1990). Most marine mammals, with the exception of fur seals, polar bears and sea otters, are considered to be not directly susceptible to deleterious effects of oil. However, newborn seal pups and weak or stressed animals may also be vulnerable to oiling. The potential environmental effects of oil and fuel spills are discussed here for at-risk species.

Animals could ingest oil with water, contaminated food, or oil could be absorbed through the respiratory tract; absorbed oil could cause toxic effects (Geraci 1990). Species like the right whale and harbour porpoise that feed in restricted areas (for example, bays such as the Nearshore Study Area) may be at greater risk of ingesting oil (Würsig 1990). Some of the ingested oil is voided in vomit or feces, but some is absorbed and could cause toxic effects (Geraci 1990). When returned to clean water, contaminated animals can depurate this internal oil (Engelhardt 1978, 1982). Whales exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage (Geraci and St. Aubin 1980, 1982).

Inhalation of vapours from volatile fractions of oil from a spill or blowout could potentially irritate respiratory membranes and hydrocarbons could be absorbed into the bloodstream (Geraci 1990). Direct evidence of long-term effects from chronic exposure to hydrocarbons, either through surface contact or ingestion, is lacking for cetaceans. However, killer whales have been shown to be susceptible to accumulating high concentrations of persistent organic pollutants, as they are long lived and are top predators (Ross et al. 2000, 2002).

There has not yet been any clear evidence implicating oil spills with the mortality of cetaceans (Geraci 1990). Dead cetaceans have been found stranded after spills, including gray whales (e.g., Loughlin 1994; *Exxon Valdez* Oil Spill Trustee Council 2012) and dolphins (NMFS (2011) documented at least 10 dead, visibly oiled dolphins). There was a substantial decrease and lack of recovery in the population size of a fish-eating killer whale pod that uses the area of the *Exxon Valdez* oil spill (Dahlheim and Matkin 1994). Continued monitoring over 16 years indicates that the killer whale pod had still not returned to its pre-spill population abundance, and the population's rate of increase was substantially less than other fish-eating pods in the area (Matkin et al. 2008). Another mammal eating killer whale pod declined substantially following the spill and is now listed as "Depleted" under the *US Marine Mammal Protection Act*, although there may have been other contributing factors in the decline (Matkin et al. 2008). This group may even be at risk of extinction (Matkin et al. 2008). Harwell and Gentile (2006) recognize the continued effect to single pods of orcas, but not for the Prince William Sound population as a whole. They believe that this continuing effect relates to the altered social structure (loss of key matriarchs), which was partly a result of the oil spill and partly a result from preceding mortality from human conflicts over fish. In contrast to Harwell and Gentile (2006), Matkin et al. (2008) suggest that *Exxon Valdez* spill did and still does have a substantial effect on the lack of recovery of these groups.

Several species of cetaceans and seals have been documented behaving normally in the presence of oil (St. Aubin 1990; Harvey and Dahlheim 1994; Matkin et al. 1994, 1999). Killer whales did not show avoidance to the *Exxon Valdez* oil spill; resident killer whales surfaced in the slick less than a week after the spill (Matkin et al. 1999). Studies of both captive and wild cetaceans indicate that they can detect oil spills.

It is unknown whether sea turtles can detect and avoid oil slicks. Gramentz (1988) reported that sea turtles did not avoid oil at sea, and sea turtles experimentally exposed to oil showed a limited ability to avoid oil (Vargo et al. 1986). According to Milton et al. (2003), sea turtles appear to be at particular risk to oil spills, because they do not respond with avoidance behaviour; they also exhibit indiscriminate feeding in convergence zones and they take large pre-dive inhalations. The ingestion of tar or oil by sea turtles has been documented by numerous studies (e.g., Hall et al. 1983; Balazs 1985; Gramentz 1988; Loehefener et al. 1989; Lutz 1989; Witherington 1994; Bugoni et al. 2001; Torrent et al. 2002). Sea turtles are often found heavily oiled after a spill (e.g., Hall et al. 1983; NMFS 2011). Hall et al. (1983) found hydrocarbon residues in the kidney, liver and muscle tissue of three dead turtles, and prolonged exposure to oil may have disrupted feeding behaviour and weakened the turtles. Gross histologic lesions developed in loggerhead sea turtles experimentally exposed to oil, but most effects were apparently reversed by the tenth day after exposure (Bossart et al. 1995). Similarly, Lutcavage et al. (1995) found that juvenile loggerhead turtles exposed to weathered crude oil exhibited gross and histologic changes in the skin and mucosal surfaces, but that the turtles recovered with 21 days. Oil may also reduce lung diffusion capacity, decrease oxygen consumption or digestion efficiency, or damage nasal and eyelid tissue (Lutz et al. 1989), as well it can have negative effects on the skin, blood, digestive and immune systems and salt glands (Milton et al. 2003). Exposure to oil can also increase egg mortality and cause developmental defects (as summarized by Milton et al. 2003).

Summary

A summary of the potential environmental effects resulting from WREP interactions with at-risk marine mammals and sea turtles, including those of accidental events and past, present, and likely future projects, is provided in Table 12-12.

Table 12-12 Potential White Rose Extension Project-related Interactions: Marine Mammals and Sea Turtles Species at Risk

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Nearshore			
Pre-construction and Installation			
Construction of graving dock (include sheet pile/driving, potential grouting)	x		
Dewater graving dock	x		
Air emissions	x		
Water discharge from The Pond	x		
CGS Construction and Installation			
Marine (Argentia and Deep-water Mating Site)			
Additional nearshore surveys (e.g., geotechnical, geophysical, environmental)	x		
dredging	x		x
CGS solid ballasting (which may include disposal of water containing fine material)	x		
CGS water ballasting and de-ballasting	x		
CGS towing to deep-water mating site	x		
Noise from topsides mating	x		
Air emissions	x		
Additional hook-up and commissioning of topsides	x		
Operation of helicopters, supply, support, standby, mooring and tow vessels/barges/ ROVs	x		x
Offshore			
Wellhead Platform Installation/Commissioning			
Clearance surveys (e.g., sidescan sonar) prior to installation of WHP or pipelines/ flowlines	x		
Tow-out/offshore installation	x		
Operation of helicopters and vessels/barges	x		x
Diving activities/Operation of ROVs	x		
Installation of flowlines and pipelines between WHP, subsea drill centre(s) and existing infrastructure	x		
Potential rock berms for flowline protection	x		
Additional hook-up, production testing and commissioning	x		
Air emissions	x		
Hydrostatic test fluid (flowlines)	x		
Possible use of corrosion inhibitors or biocides (flowlines) [(A)]	x		
Waste generated (domestic waste, construction waste, hazardous waste, sanitary waste)	x		
Drilling-associated seismic (VSPs and wellsite surveys)	x		
Subsea Drill Centre Excavation/Installation (previously assessed by LGL 2007a)			
Dredging and disposal of dredge material	x		
Clearance surveys (e.g., sidescan sonar) prior to installation of pipelines/flowlines	x		
Operation of helicopters and supply, support, standby and tow vessels/barges	x		x
Diving activities / Operation of ROVs	x		

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Air emissions	x		
Installation of subsea equipment, flowlines and tie-in modules to existing subsea infrastructure	x		
Hydrostatic test fluid (flowlines)	x		
Possible use of corrosion inhibitors or biocides (flowlines) [(A)]	x		
Waste generated (domestic waste, construction waste, hazardous waste, sanitary waste)	x		
Drilling-associated seismic (VSPs and wellsite surveys)	x		
Production/Operation and Maintenance			
Presence of structure	x	x	
Noise from drilling from a MODU and WHP	x		
WBM (from either WHP or MODU) and SBM (from MODU only) cuttings [(B)]	x		
Air emissions	x		
Chemical use and management (e.g. BOP fluids, fuel, well treatment fluids, corrosion inhibitors)	x		
Waste generated (domestic waste, construction waste, hazardous, sanitary waste)	x		
Operation of helicopters, supply, support, standby and tow vessels/barges/ROVs	x		x
Surveys (geotechnical, geophysical and environmental)	x		
Oily water treatment [(C)]	x		
Diving activities/Operation of ROVs	x		
Decommissioning and Abandonment			
Removal of WHP	x	x	
Plugging and abandoning Wells	x		
Operation of helicopters	x		
Operation of vessels (supply/support/standby/tow vessels/barges/diving/ROVs)	x		x
Air emissions	x		
Surveys (geotechnical, geophysical and environmental)	x		
Potential Future Activities			
Surveys (e.g., geophysical, geological, geotechnical, environmental, ROV, diving)	x		
Excavation of drill centres (including disposal of dredge spoils)	x		
Noise from drilling operations from MODU at potential future drilling centres	x		
WBM and SBM Cuttings	x		
Hook-up and commissioning of drill centres	x		
Installation of Pipeline(s)/Flowline(s) and Testing from Drill Centres to FPSO, including Flowline Protection	x		
Chemical Use and management (e.g., BOP fluids, fuels, well treatment fluids, corrosion inhibitors)	x		
Accidental Events			
Marine diesel fuel spill from support vessel	x		x
Graving dock breach	x		
SBM whole mud spill	x		
Subsea hydrocarbon blowout	x		x
Hydrocarbon surface spill	x		x
Other spills (e.g., fuel, waste materials)	x		x
Marine vessel incident (including collisions) (i.e., marine diesel fuel spill)	x		x
Cumulative Environmental Effects			
Commercial fisheries (nearshore and offshore)	x		x
Marine traffic (nearshore and offshore)	x		x
White Rose Oilfield Development (including North Amethyst and South White Rose extension drill centre)	x		
Terra Nova Development	x		
Hibernia Oil Development	x		
Hibernia Southern Extension Project	x		
Hebron Oil Development	x		

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Offshore Exploration Seismic Activity	x		
Offshore Exploration Drilling Activity	x		
(A) Husky will evaluate the use of biocides other than chlorine. The discharge from the hypochlorite system will be treated to meet a limit approved by the C-NLOPB's Chief Conservation Officer. (B) Water-based drilling fluids and cuttings will be discharged overboard. Husky will evaluate best available cuttings management technology and practices to identify a waste management strategy for spent non-aqueous fluid and non-aqueous fluid cuttings from the semi-submersible drilling rig. Synthetic-based mud cuttings will be re-injected into a dedicated well from the WHP, pending confirmation of a suitable disposal formation. (C) Water (including from open drains) will be treated prior to being discharged to the sea in accordance with OWTG			

12.5.2 Environmental Effects Analysis and Mitigation Measures

Potential environmental effects of the WREP on non-listed marine mammals and sea turtle species are assessed in detail in Section 11.5. Many of the issues of concern with respect to environmental effects for at-risk species, as well as mitigation measures and management strategies, are similar to those presented for not at-risk species of marine mammals and sea turtles in the Nearshore and Offshore Study Areas. On an ecosystem basis, the at-risk and not at-risk species and their habitats are often highly integrated. The *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment*, appended to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles.

12.5.2.1 Nearshore

The marine mammal and sea turtle species at-risk that are likely to occur in the WREP Nearshore Study Area are the fin whale and the harbour porpoise. The killer whale may occur in small numbers. The blue whale, Sowerby's beaked whale and northern bottlenose whale are considered unlikely to occur in the Nearshore Study Area. Leatherback sea turtles may also occur in the area, but in small numbers. These are the species upon which the following assessment focuses.

Pre-construction and Installation

Change in Habitat Quantity

No change in habitat quantity is expected for at-risk marine mammals or sea turtles during the pre-construction and installation phase of the WREP, as all activities will occur onshore. The Nearshore Study Area has not been identified as critical habitat for any of the at-risk marine mammals or sea turtles considered in this environmental assessment.

Change in Habitat Quality

Changes in habitat quality may result in physical/physiological/behavioural effects on at-risk marine mammals and sea turtles. The activity that is most likely to affect at-risk marine mammals and sea turtles during the pre-construction and installation phase is pile driving, which produces sound levels high enough to cause physical/physiological/ behavioural effects in marine mammals (and sea turtles). Other activities during graving dock construction are expected to have negligible effects on the habitat quality of at-risk marine mammals and sea turtles (see Table 12-12). It is expected that air emissions and water discharges will adhere to regulatory requirements before being released.

There is little risk of hearing impairment from pile driving to marine mammals and sea turtles, given that sound levels typically recorded during impact pile driving activities do not exceed 180 dB re 1 µPa (rms) beyond several hundred metres from the source. There would be even less risk of hearing impairment during the WREP pre-construction and installation phase, as pile driving would occur onshore and the transfer of sound from land to water is expected to be minimal. However, pile driving can produce impulsive sounds with levels high enough to cause behavioural effects in marine mammals and sea turtles, which may result in a change in habitat quality. There is some evidence to suggest that harbour porpoise echolocation activity may decline, at least temporarily, during pile driving (see Section 11.4.1). However, any behavioural disturbance is expected to be short-term and localized. If an at-risk marine mammal or sea turtle did react to pile driving sounds by changing its behaviour or moving a small distance, the effects of the change are unlikely to be critical to the individual, let alone the stock or population. A monitoring protocol may be established by Husky, with guidance from DFO.

Summary

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles. Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from the WHP graving dock pre-construction and installation.

Concrete Gravity Structure Construction

Change in Habitat Quantity

No changes in habitat quantity directly affecting at-risk marine mammals or sea turtles are expected during this phase. Dredging may change the habitat quantity for marine mammal and sea turtle prey items. However, since the at-risk marine mammals and sea turtles occurring in the area do not feed off the bottom, change in habitat quantity due to dredging is expected to have negligible effects on these species.

Change in Habitat Quality

This environmental effect category includes interactions that may result in physical/ physiological/behavioural effects, which occur as a result of a change in habitat quality. The activity that may affect at-risk marine mammals and sea turtles during construction and installation of the CGS is dredging, which could produce sound levels high enough to cause physical/physiological/behavioural effects in at-risk marine mammals and sea turtles. Dredging would also affect the habitat quality by increasing turbidity. Leatherback sea turtles in particular use visual cues to evade vessels and predators, which could be affected by water clarity. However, sediment suspension modelling by AMEC (2012a) showed that suspended sediment levels will not exceed the thresholds for total particular matter given in the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002). In addition, leatherback sea turtles are uncommon in the Nearshore Study Area. Thus, it is expected that increased turbidity associated with dredging would have negligible effects on at-risk marine mammals and sea turtles. Other activities associated with the CGS construction and installation (see Table 12-2) are expected to have negligible effects on the habitat quality of at-risk marine mammals and sea turtles. It is expected that air emissions will be minimized, when possible, and water discharges from CGS ballasting will adhere to regulatory requirements before being released into the marine environment.

It is very unlikely that dredging operations would cause TTS let alone PTS in any at-risk marine mammal or sea turtle species, as sound levels greater or equal to 180 dB re 1 µPa (rms) (un-weighted) were predicted to occur at $R_{95\%}$ distances of 7 m or less. At-risk marine mammals and sea turtles may show behavioural changes from dredging activities. However, cetaceans have been reported to continue using habitats near short-term dredging operations and any behavioural responses are expected to be short-term and localized. Dredging operations during the WREP will be temporary and of limited duration. Proper planning and equipment design will reduce the duration of dredging activities and hence the environmental effect on at-risk marine mammals and sea turtles.

A monitoring protocol for marine mammals will be established by Husky prior to the start of construction activities and was summarized in a previous section. The protocol will be developed in consultation with DFO.

Potential Risk of Mortality

To the best of the study team’s knowledge, there is no evidence that at-risk marine mammals or sea turtles have experienced injury, fatal or otherwise, during dredging activities (Section 11.4).

Summary

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles. Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from construction of the CGS.

Concrete Gravity Structure Tow-out

Change in Habitat Quantity

The tow-out of the CGS to deeper water in Placentia Bay will temporarily reduce the amount of habitat quantity available to at-risk marine mammals or sea turtles. However, the footprint of the CGS is minimal and temporary. Thus, changes in habitat quantity are expected to have negligible effects on at-risk marine mammals and sea turtles. The Nearshore Study Area has not been identified as critical habitat for any of the at-risk marine mammals or sea turtles considered in this assessment.

Change in Habitat Quality

This effect category includes interactions that may result in physical/physiological/ behavioural effects, which occur as a result of a change in habitat quality. Activities that are most likely to affect at-risk marine mammals and sea turtles during tow-out and installation of the CGS at the deep-water mating site are vessel traffic, helicopter overflights and geophysical surveys (i.e., side scan sonar and geohazard surveys), which produce sound levels high enough to cause physical/physiological/behavioural effects in marine mammals and sea turtles. Other activities associated with the CGS tow-out and installation (see Table 12-12) are expected to have negligible effects on the habitat quality of at-risk marine mammals and sea turtles. It is expected that air emissions will be minimized, when possible, and water discharges will adhere to regulatory requirements before being released into the marine environment.

Sound levels from vessel traffic associated with the WREP are not expected to be high enough to cause physical or physiological effects on marine mammals or sea turtles (see Richardson et al. 1995). The potential for TTS and PTS are very low, as sound levels that have the potential to induce hearing impairment in marine mammals and sea turtles have been modelled to occur less than 5 m from a tug (JASCO 2012). However, increased noise levels would result in changes in habitat quality that are likely to elicit behavioural responses by marine mammals and sea turtles and may cause masking (see Section 11.4.1.2). Behavioural responses by fin whales, killer whales, beaked whales and harbour porpoise to vessels are variable and may include approach or avoidance and changes in diving, feeding, or vocalizations (see Section 11.4.1.2). Leatherback sea turtles are uncommon in the Nearshore Study Area and typically only occur there during late summer or early fall. Generally, sea turtles flee or dive when approached closely by a vessel. Vessel traffic is expected to have a short-term and localized effect on marine mammals and sea turtles. WREP activities involving vessel traffic will avoid spatial and temporal concentrations of at-risk marine mammals and sea turtles whenever possible. Additionally, vessels will maintain a steady vessel course and safe speed whenever possible, as abrupt changes in course and speed are known to increase behavioural responses by cetaceans.

Helicopter flights over water will introduce minimal sound to the surrounding marine environment. Nonetheless, some at-risk marine mammals may startle or dive during low-altitude overflights (see Richardson et al. 1995). Baleen whales often react to aircraft overflights by hasty dives, turns, or other changes in behaviour. Odontocetes reacting to aircraft may dive, slap the water with flippers or flukes, or swim away. Thus, helicopter overflights are expected to have short-term and localized effects on at-risk marine mammals. Single or occasional overflights by helicopters would likely only elicit a brief behavioural response by most at-risk marine mammals. Sea turtles are uncommon in the Nearshore Study Area and typically only occur there during late summer or early fall. To avoid disturbance of at-risk marine mammals and sea turtles, the helicopter will avoid flying at low altitudes whenever it is safe to do so. Helicopters will typically only reduce altitude on approach for landing.

The geophysical surveys that may take place along the tow-out route include side scan sonar and geohazard surveys. These surveys produce noise at lower source levels than those of airgun pulses from seismic surveys (described in Section 11.4.2.1). Sounds are also typically emitted in a narrow beam, short duration and sometimes at frequencies outside the range of marine mammal and sea turtle hearing abilities. Therefore, geohazard surveys and side scan sonar are less likely to affect at-risk marine mammals and sea turtles than seismic surveys. However, they may cause short-term, localized avoidance of the area or other brief behavioural responses. If auditory impairment or other non-auditory physical effects would occur from geohazard survey sounds, they would be limited to short distances. Marine mammals that show behavioural avoidance of seismic vessels, including most at-risk baleen whales, and some at-risk odontocetes and sea turtles are unlikely to incur auditory impairment or other physical effects.

Potential Risk of Mortality

The presence of vessels during various WREP activities can also increase the risk of direct mortality via vessel collisions with at-risk marine mammals. Large species of whales and sea turtles that spend extended periods near the surface would be particularly susceptible to ship strikes. The fin whale is the most commonly reported whale to be struck by vessels and is expected to be the at-risk species most susceptible to collisions in the Nearshore Study Area. Although at-risk sea turtles are also at risk of collisions, leatherback sea turtles are uncommon within the Nearshore Study Area, particularly at times other than late summer and early fall.

WREP activities involving vessel traffic will avoid spatial and temporal concentrations of at-risk marine mammals and sea turtles whenever possible, and vessels will maintain a steady course and safe speed, or deviate from their course to avoid potentially fatal collisions. Particularly in the Nearshore Study Area, smaller vessels (less than 80 m long) associated with the WREP will typically be engaged in activities that require a slow speed or maintenance of a stationary position, which will also reduce the risk of a collision.

Summary

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles. Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from tow-out of the CGS.

The environmental effects of WREP nearshore construction and installation activities on at-risk marine mammals and sea turtles are summarized in Table 12-13.

Accidental Events in the Nearshore

The effect of an accidental release of hydrocarbons (i.e., fuel) in the Nearshore Study Area is assessed below. Spills in the Nearshore Study Area would be attributable to vessel malfunctions (i.e., collisions). The type and probability of spills are discussed in Section 3.6. A detailed analysis can be found in SL Ross (2012).

Table 12-13 Environmental Effects Assessment for Marine Mammals and Sea Turtles Species at Risk: Construction and Installation

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(A)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Nearshore										
Bund Wall Construction (e.g., sheet/pile driving)	Change in habitat quality (N)	• Equipment design	M	3	1	3	R	2	NS	H
Dredging of Bund Wall and Tow-out Route	Change in habitat quality (N)	• Planning • Equipment design	M	3	1	3	R	2	NS	H
Air Emissions	Change in habitat quality (N)	• Adhere to NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	N	4	6	3	R	2	NS	H
Water Discharges from The Pond/Dewater Graving Dock	Change in habitat quality (N)	• Compliance monitoring and treatment as required before discharge	L	1	1	3	R	2	NS	H
CGS Solid and/or Water Ballasting/Deballasting	Change in habitat quality (N)		L	1	1	3	R	2	NS	H
Nearshore Geophysical Surveys	Change in habitat quality (N)	• Avoid animal concentration when possible • Maintain steady course and safe speed when possible	L	3	1	3	R	2	NS	H
CGS Tow-out	Change in habitat quality (N)		L	3	1	1	R	2	NS	H
Noise from Topside Mating	Change in habitat quality (N)		L	1	1	1	R	2	NS	H
Additional Hook-up and Commissioning of Topsides	Change in habitat quality (N)		L	1	1	1	R	2	NS	H
Vessel Traffic (e.g., supply, tug, barge)	Change in habitat quality (N) Potential mortality (N)	• Avoid animal concentrations when possible • Maintain steady course and safe speed Deviate course to avoid animals	L	3	6	3	R [(B)]	2	NS	H
Helicopter Overflights	Change in habitat quality (N)	• Avoid low altitudes when possible	L	2	6	3	R	2	NS	H
Offshore										
WHP tow-out and Installation	Change in habitat quality (N)		L	3	1	2	R	2	NS	H
Dredging	Change in habitat quality (N)	• Planning • Equipment design	M	3	1	2	R	2	NS	H
Diving Activities/Operation of ROVs	Change in habitat quality (N)		L	2	1	2	R	2	NS	H
Installation of Flowlines and Pipelines	Change in habitat quality (N)		L	2	1	2	R	2	NS	H
Potential Rock Berms for Flowline Protection	Change in habitat quality (N)		L	2	1	2	R	2	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Additional Hook-up, Production Testing and Commissioning	Change in habitat quality (N)		L	2	1	2	R	2	NS	H
Geophysical Surveys (e.g., VSP, geohazard, sidescan sonar)	Change in habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	3	1	2	R	2	NS	H
Vessel Traffic (e.g., supply, tug, barge)	Change in habitat quality (N) Potential mortality (N)	• Avoid animal concentrations when possible • Maintain steady course and safe speed Deviate course to avoid animals	L	3	6	2	R (B)	2	NS	H
Helicopter Overflights	Change in habitat quality (N)	• Avoid low altitudes when possible	L	3	6	2	R	2	NS	H
Air Emissions	Change in habitat quality (N)	• Adhere to NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	N	5	6	2	R	2	NS	H
Hydrostatic Test Fluid	Change in habitat quality (N)	• Adhere to OWTG	L	1	1	2	R	2	NS	H
Waste Generated	Change in habitat quality (N)	• Adhere to OWTG	L	1	1	2	R	2	NS	H

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.
(B) Reversible at the population level but irreversible at the individual level.

Oil spill response is included as part of the contingency planning undertaken for the WREP and additional information regarding spill response for the Nearshore and Offshore Study Areas can be found in Section 16.9. Chapter 16 describes the WREP overall environmental management process.

Change in Habitat Quantity

No direct changes in habitat quantity are expected during accidental events. However, a change in habitat quality because of a hydrocarbon spill may indirectly reduce the amount of habitat available to an at-risk marine mammal or sea turtle by rendering it unsuitable for foraging and other activities.

Change in Habitat Quality

The accidental release of fuel may affect several physical and internal functions of marine mammals and sea turtles. Hydrocarbons can be inhaled or ingested, and may cause behavioural changes, inflammation of mucous membranes, pneumonia and neurological damage (see Geraci and St. Aubin 1990). However, most marine mammals, particularly baleen whales, are considered to be not directly susceptible to deleterious effects of oil (see Geraci and St. Aubin 1990). A fuel spill in Placentia Bay was estimated to evaporate or disperse within a maximum eight days, limiting the exposure time of at-risk species to the fuel.

Potential Risk of Mortality

At-risk marine mammals are not considered to be at high risk from the effects of oil exposure. However, sea turtle carcasses are often found after a spill, but leatherback sea turtles are uncommon in the Nearshore Study Area, especially outside of summer and fall. At-risk baleen whales appear to be less susceptible to spills than delphinids, as dolphins are often found stranded after an oil spill. Thus, delphinids that occur in the Nearshore Study Area at the time of the spill are most susceptible to fouling. Although effects of the *Exxon Valdez* oil spill were substantial on killer whales, killer whales are uncommon in Placentia Bay, and no population-level effects would be expected.

For at-risk marine mammals and sea turtles, it is probable that only small proportions of populations are at risk at any one time in the Nearshore Study Area. Oil spill prevention measures, along with typical oil spill countermeasures (creating an oil spill response plan, training, preparation, an equipment inventory, and conducting emergency response drills) will serve to reduce the number of animals exposed to hydrocarbons.

Summary

Depending on the time of year, location of animals within the affected area, and type of oil spill or blow-out, the effects of an offshore oil release on the health of cetaceans is predicted to range from negligible to low magnitude over varying geographic extents. Based on present knowledge of Placentia Bay and the modelling exercises, it can be predicted that a hydrocarbon spill associated with the WREP will not result in any significant residual environmental effects to at-risk marine mammals or sea turtles in the Nearshore Study Area (Table 12-14). Mitigation measures will likely reduce effects of potential hydrocarbon spills on at-risk marine mammals and sea turtles in the Nearshore Study Area.

Table 12-14 Environmental Effects Assessment for Marine Mammals and Sea Turtles Species at Risk: Accidental Events in the Nearshore

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [A]: Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance	Significance Rating	Level of Confidence
Graving Dock Breach	Change in habitat quality (N)		L	1	1	1	R	2	NS	H
Nearshore Fuel Spill	Change in habitat quality (N) Potential mortality (N)	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	M	4-5	1	2	R [B]	2	NS	H

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.
(B) Reversible at the population level but irreversible at the individual level.

12.5.2.2 Offshore

In the Offshore Study Area, the fin whale is considered the most likely at-risk species to occur, while the harbour porpoise and killer whale may occur in small numbers. The Sowerby's beaked whale, northern bottlenose whale and blue whale are uncommon in the Offshore Project Area. The leatherback turtle may also regularly occur in small numbers. These are the species upon which the following assessment focuses.

Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from WREP activities.

Wellhead Platform or Subsea Drill Centre Installation/Commissioning

The environmental effects of WREP installation activities on at-risk marine mammals and sea turtles are summarized in Table 12-13.

Change in Habitat Quantity

The footprint of the WHP or subsea drill centre in the Offshore Project Area would occupy a very limited area that may reduce the habitat quantity for pelagic and migratory at-risk marine mammals and sea turtles. However, this reduction in habitat quantity is expected to result in minimal habitat loss for at-risk marine mammals and sea turtles. The Offshore Study Area has not been identified as critical habitat for any of the at-risk marine mammals or sea turtles considered in this assessment.

Change in Habitat Quality

This effect category includes interactions that may result in physical/physiological/ behavioural effects which occur as a result of a change in habitat quality. Activities that are most likely to affect at-risk marine mammals and sea turtles during the WHP installation and commissioning are wellsite and VSP surveys which produce sound levels high enough to cause physical/physiological/behavioural effects in at-risk marine mammals (and sea turtles). However, sounds from dredging, vessel traffic and helicopters could also affect the habitat quality. Dredging may occur over a limited area in the Offshore Study Area that may be used by pelagic and migratory at-risk marine mammals and sea turtles. As the at-risk marine mammal and sea turtles species that occur in the Offshore Study Area are not benthic foragers, they would not likely be affected by a disruption in benthic habitat. Dredging will likely result in minimal effects on prey and habitat quality for at-risk marine mammals and sea turtles.

Other activities associated with the WHP installation and commissioning (see Table 12-13) are expected to have negligible effects on the habitat quality of at-risk marine mammals and sea turtles. It is expected that air emissions will be minimized, when possible. Any waste or fluids to be discharged into the marine environment will adhere to regulatory requirements. The main environmental effect from some other activities is the operation of vessels (described above). Artificial light might attract prey species of at-risk marine mammals and sea turtles, but this potential positive environmental effect is also considered negligible.

Many cetaceans tend to avoid operating airguns, but only slight (if any) avoidance has been shown by sea turtles. However, wellsite and VSP surveys are likely to have fewer effects on at-risk marine mammals and sea turtles over a smaller area than 2-D or 3-D seismic surveys, as most of the sound is focused downward. As summarized in Section 11.4.2.1, data now available imply that TTS is unlikely to occur in various odontocetes (and probably mysticetes as well) unless they are exposed to a sequence of several airgun pulses in which the strongest pulse has a received level substantially exceeding 190 dB re 1 µPa (rms). On the other hand, for the harbour porpoise, TTS may occur upon exposure to one or more airgun pulses whose received level equals the NMFS "do not exceed" value of 190 dB re 1 µPa (rms). That criterion corresponds to a single pulse with a SEL of 175 to 180 dB re 1 $\mu Pa^2 \cdot s$ in typical conditions, whereas TTS is suspected to be possible in harbour porpoises with a cumulative SEL of approximately 164 dB re 1 $\mu Pa^2 \cdot s$. Although the possibility of hearing impairment cannot be entirely excluded, it is unlikely that the WREP would result in any cases of temporary or especially permanent hearing impairment, or any substantial non-auditory physical or physiological effects. Commonly applied monitoring and mitigation measures, including visual monitoring, ramp-ups and power-downs of the airguns when mammals are seen within the "safety radii", are expected to minimize the already-low probability of exposure of marine mammals to sounds strong enough to potentially induce PTS.

Some behavioural disturbance is expected, but this would be localized and short-term. Short term avoidance behaviour does not necessarily provide information about long-term effects, such as reproductive rate or distribution and habitat use in subsequent days or years. Additionally, effects likely vary between species, location and past exposure to airgun sounds. Wellsite and VSP surveys in or near areas where at-risk marine mammals or turtles concentrate are likely to have the greatest effect. However, at-risk marine mammals are expected to be widely distributed throughout the Jeanne d'Arc Basin, the Offshore Study Area is not a breeding area for leatherback sea turtles, and there are no known feeding areas or sensitive areas for at-risk marine mammal or sea turtle species; thus, concentrations of at at-risk species, especially sea turtles, are unlikely.

As indicated in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* C-NLOPB 2012d), mitigation measures will be implemented consistent with those provided in the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment*, including, but not limited to:

- Ramp-up of the airgun array over a minimum of 20 minutes
- Monitoring by a trained marine mammal observer
- Shutdown of the airgun array when a Schedule 1 endangered or threatened marine mammal or sea turtle is sighted within the 500 m safety zone
- Delay of ramp-up if any marine mammal or sea turtle is sighted within the 500 m safety zone.

Considering the seismic survey mitigation measures, there will likely be minimal effects of wellsite and VSP surveys on at-risk marine mammals and sea turtles.

Sound levels from vessel traffic associated with the WREP are not expected to be high enough to cause physical or physiological effects on marine mammals or sea turtles (see Richardson et al. 1995). The potential for TTS and PTS are very low, as sound levels that have the potential to induce hearing impairment in at-risk marine mammals and sea turtles have been modelled to occur less than 5 m from a tug (JASCO 2012). However, increased noise levels would result in changes in habitat quality that are likely to elicit behavioural responses by at-risk marine mammals and sea turtles and may cause masking (see Section 11.4.1.2). Behavioural responses by fin whales, killer whales, beaked whales and harbour porpoise to vessels are variable and may include approach or avoidance and changes in diving, feeding, or vocalizations (see Section 11.4.1.2). Leatherback sea turtles are uncommon in the Offshore Study Area and typically only occur there during late summer or early fall. Generally, sea turtles flee or dive when approached closely by a vessel. Vessel traffic is expected to have a short-term and localized effect on at-risk marine mammals and sea turtles. WREP activities involving vessel traffic will avoid spatial and temporal concentrations of at-risk marine mammals and sea turtles whenever possible. Additionally, vessels will maintain a steady vessel course and safe speed whenever possible, as abrupt changes in course and speed are known to increase behavioural responses by cetaceans.

Helicopter flights over water will introduce minimal sound to the surrounding marine environment. Nonetheless, some at-risk marine mammals may startle or dive during low-altitude overflights (see Richardson et al. 1995). Baleen whales often react to aircraft overflights by hasty dives, turns, or other changes in behaviour. Odontocetes reacting to aircraft may dive, slap the water with flippers or flukes, or swim away. Thus, helicopter overflights are expected to have short-term and localized effects on at-risk marine mammals. Single or occasional overflights by helicopters would likely only elicit a brief behavioural response by most at-risk marine mammals. Sea turtles are uncommon in the Offshore Study Area and typically only occur there during late summer or early fall. To avoid disturbance of at-risk marine mammals and sea turtles, the helicopter will avoid flying at low altitudes whenever it is safe to do so. Helicopters will typically only reduce altitude on approach for landing.

It is very unlikely that dredging operations would cause TTS let alone PTS in any at-risk marine mammal or sea turtle species, as sound levels greater or equal to 180 dB re 1 µPa (rms) (un-weighted) were predicted to occur at $R_{95\%}$ distances of 7 m or less. At-risk marine mammals and sea turtles may show behavioural changes from dredging activities. However, cetaceans have been reported to continue using habitats near short-term dredging operations and any behavioural responses are expected to be short-term and localized. Dredging operations during the WREP will be temporary and of limited duration. Proper planning and equipment design will reduce the duration of dredging activities and hence the environmental effect on at-risk marine mammals and sea turtles.

Potential Risk of Mortality

As discussed for mortality associated with vessel traffic in the Nearshore Study Area, there is a risk of vessel collision with at-risk marine mammals and sea turtles resulting in serious injury or mortality. Large species of whales and sea turtles that spend extended periods near the surface would be particularly susceptible to ship strikes. Fin whales are especially susceptible to collisions, as they are the most commonly reported whale to be struck by vessels and are expected to be common in the Offshore Study Area. However, leatherback sea turtles are uncommon within the Offshore Study Area, particularly at times other than late summer and early fall.

WREP activities involving vessel traffic will avoid spatial and temporal concentrations of marine mammals and sea turtles whenever possible, and vessels will maintain a steady course and safe speed, reduce speed, or deviate from their course in order to avoid potentially fatal collisions with at-risk marine mammals or sea turtles.

Summary

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles. Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from the installation/commissioning of the WHP or subsea drill centre (see Table 12-13).

Operation and Maintenance

The environmental effects of WREP operations and maintenance activities on at-risk marine mammals and sea turtles are listed in Table 12-12.

Change in Habitat Quantity

The footprint of the WHP or subsea drill centre in the Offshore Project Area would occupy a very limited area that may be used by pelagic and migratory at-risk marine mammal and sea turtle species. Thus, the installation of the WHP or subsea drill centre at the offshore site location will result in minimal habitat loss for at-risk marine mammals and sea turtles.

Change in Habitat Quality

As discussed previously, potential changes in habitat quality of the Offshore Study Area may result from wellsite and VSP and other geophysical surveys, vessel traffic, helicopter overflights and drilling. These changes may have physical/physiological/ behavioural effects on at-risk marine mammals and sea turtles. Drilling may occur from the WHP or a MODU, if the subsea drill centre option is selected (and from MODUs at future subsea drill centres). Modelling results by JASCO (2012) showed that sound levels of 160 dB re 1 μPa (rms) or greater occur within 5 m ($R_{95\%}$) of the drilling activity. Thus, there is nearly no risk of TTS or PTS to at-risk marine mammals or sea turtles, and the behavioural disturbance zone around drill operations is very small. Some cetaceans are known to react to drillships and may show slight, but temporary avoidance (reviewed by Richardson et al. 1995).

Other activities associated with production and operations (see Table 12-12) are expected to have negligible effects on the habitat quality of at-risk marine mammals and sea turtles. It is expected that air emissions will comply with regulatory requirements. Any waste or fluids to be discharged into the marine environment will adhere to regulatory requirements. The discharge of any blowout preventer (BOP) fluid from an offshore platform will not affect at-risk marine mammals because glycol-water mixes will be used and the BOP fluid will have a low toxicity. Sanitary and domestic waste water will be discharged during drilling and production operations; all discharges will meet the OWTG. Organic matter from sanitary wastes will be quickly dispersed (after maceration) and degraded by bacteria and food waste may be shipped ashore. The environmental effects on at-risk marine mammals and sea turtles swimming in the receiving waters containing small amounts of organic matter and nutrients will be minimal.

Water-based cuttings and production fluids will be discharged overboard in accordance with the OWTG (NEB et al. 2010). Water-based cuttings will be discharged overboard regardless of development option selected. Synthetic-based cuttings will be re-injected into the subsurface if the WHP option is selected and will be treated and discharged overboard if the subsea drill centre option is selected. Any SBM cuttings will be treated to meet the OWTG before being discharged overboard Drilling activities are unlikely to produce concentrations of heavy metals in muds and cuttings that are harmful to at-risk marine mammals (Neff et al. 1980, in Hinwood et al. 1994). In addition, none of the at-risk marine mammals that regularly occur in the Offshore Study Area are known to feed on benthos in the area. These activities are expected to have minimal environmental effect on at-risk marine mammals and sea turtles

The main environmental effect from some other activities is the operation of vessels (described above). Artificial light might attract prey species of at-risk marine mammals and sea turtles, but this potential positive environmental effect is also considered negligible.

Potential Risk of Mortality

As discussed earlier, there is a risk of vessel collision with at-risk marine mammals and sea turtles resulting in serious injury or mortality. Fin whales are especially susceptible to collisions, as they are the most commonly reported whale to be struck by vessels and are expected to be common in the Offshore Study Area. However, leatherback sea turtles are uncommon within the Offshore Study Area, particularly at times other than late summer and early fall.

WREP activities involving vessel traffic will avoid spatial and temporal concentrations of marine mammals and sea turtles whenever possible, and vessels will maintain a steady course and safe speed, reduce speed, or deviate from their course in order to avoid potentially fatal collisions with at-risk marine mammals or sea turtles.

Summary

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles. Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from the operation and maintenance of the WHP or subsea drill centre (Table 12-15).

Table 12-15 Environmental Effects Assessment for Marine Mammals and Sea Turtles Species at Risk: Operations and Maintenance

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Presence of Structure	Change in habitat quantity (P) Change in habitat quality (N)		L	1	6	5	R	2	NS	H
Noise from Drilling	Change in habitat quality (N)		L	3	6	5	R	2	NS	H
WBM and SBM Cuttings	Change in habitat quality (N)	• Re-use of drill mud	L	2	2	5	R	2	NS	H
Geophysical Surveys (e.g., VSP, geohazard)	Change in habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	2	2	5	R	2	NS	H
Vessel Traffic (e.g., supply, tug, barge)	Change in habitat quality (N) Potential mortality (N)	• Avoid animal concentrations when possible • Maintain steady course and safe speed • Deviate course to avoid animals	L	3	6	5	R (B)	2	NS	H
Helicopter Overflights	Change in habitat quality (N)	• Avoid low altitudes when possible	L	2	6	5	R	2	NS	H
Air Emissions	Change in habitat quality (N)	• NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	N	5	6	5	R	2	NS	H
Chemical Use and Management (BOP fluids, corrosion inhibitors)	Change in habitat quality (N)		L	1	6	5	R	2	NS	H
Waste Generated	Change in habitat quality (N)	• Adhere to regulations	L	1	6	5	R	2	NS	H
Oily Water Treatment	Change in habitat quality (N)	• Adhere to regulations	L	1	6	5	R	2	NS	H
Diving Activities / Operation of ROVs	Change in habitat quality (N)		L	2	3	5	R	2	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.
(B) Reversible at the population level but irreversible at the individual level.

Offshore Decommissioning and Abandonment

The environmental effects of WREP decommissioning and abandonment activities on at-risk marine mammals and sea turtles are listed in Table 12-12.

Change in Habitat Quantity

The removal of structures (WHP) will make minimal habitat available to at-risk marine mammals and sea turtles. This will have negligible effects on at-risk marine mammals and sea turtles in the Offshore Study Area.

Change in Habitat Quality

Environmental effects of removing structures (WHP), vessel traffic, helicopter traffic and geophysical surveys are decommissioning activities which could affect habitat quality. These activities, as well as those that do not produce sound (e.g., air emissions), could affect habitat quality. The potential environmental effects of these activities are expected to be similar to (or less than) those of construction or operation (assessed previously).

Potential Risk of Mortality

As discussed earlier, there is potential for a vessel collision with at-risk marine mammals and sea turtles, resulting in serious injury or mortality. WREP activities involving vessel traffic will avoid spatial and temporal concentrations of at-risk marine mammals and sea turtles whenever possible, and vessels will maintain a steady course and safe speed in order to avoid potentially fatal collisions with at-risk marine mammals and sea turtles. Vessels will reduce speed whenever possible and deviate their course to avoid marine animals.

Summary

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles. Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from decommissioning and abandonment (Table 12-16).

Table 12-16 Environmental Effects Assessment for Marine Mammals and Sea Turtles Species at Risk: Decommissioning and Abandonment

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(A)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Removal of WHP	Change in habitat quantity (P) Change in habitat quality (N)		L	2	1	2	R	2	NS	H
Plugging and abandoning wells	Change in habitat quality (N)		L	2	1	2	R	2	NS	H
Geophysical Surveys (e.g., VPS, geohazard)	Change in habitat quality (N)	• Adherence to the Geophysical, *Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	2	2	3	R	2	NS	H
Vessel Traffic (e.g., supply, tug, barge)	Change in habitat quality (N) Potential mortality (N)	• Avoid animal concentrations when possible • Maintain steady course and safe speed • Deviate course to avoid animals	L	3	6	3	R [(B)]	2	NS	H
Helicopter Overflights	Change in habitat quality (N)	• Avoid low altitudes when possible	L	2	6	3	R	2	NS	H
Air Emissions	Change in habitat quality (N)	• Adhere to NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	N	5	6	3	R	2	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(A)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
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Geographic Extent:
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6 = >10,000 km radius

Frequency:
1 = <11 events/year
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Duration:
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4 = 37 to 72 months
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Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm
(B) Reversible at the population level but irreversible at the individual level

Potential Future Activities

Change in Habitat Quantity

No changes in habitat quantity for marine mammals or sea turtles are expected during potential future activities.

Change in Habitat Quality

Future activities in the Offshore Study Area that could potentially affect habitat quality may include, but are not limited to, geophysical surveys, drilling, vessel traffic and helicopter overflights (see Table 12-12). All of these activities will introduce sound into the water, which may affect at-risk marine mammals and sea turtles. These activities, as well as those that do not produce sound (e.g., chemical use and management, cuttings), could affect habitat quality. The potential environmental effects of these activities are expected to be similar (or less than) those of installation or operation (assessed previously).

Potential Risk of Mortality

There is potential for a vessel collision with at-risk marine mammals and sea turtles resulting in serious injury or mortality. Large species of whales and sea turtles that spend extended periods near the surface would be particularly susceptible to ship strikes. Fin whales are the most susceptible at-risk species in the Offshore Study Area, as they are the most commonly reported whale to be struck by vessels and they are expected to be common in the Offshore Study Area. However, sea turtles are uncommon in the Offshore Study Area, particularly at times other than late summer and early fall. The potential environmental effects of vessel traffic associated with potential future activities are expected to be similar (or less than) those of installation or operation.

Summary

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d) will be followed to minimize environmental effects on at-risk marine mammals and sea turtles. Given that WREP activities are mostly localized, of low to medium magnitude, and reversible at the population level, there are not likely to be significant residual adverse environmental effects on at-risk marine mammals and sea turtles from potential future activities.

Accidental Events

Spills in the Offshore Study Area could be associated with a subsea hydrocarbon blowout, surface oil spills, or fuel spills from vessels. The types and probability of spills are discussed in Section 3.6. A detailed analysis can be found in SL Ross (2012).

Oil spill response is included as part of the contingency planning undertaken for the WREP and additional information regarding spill response for the Offshore Study Area can be found in Section 16.9. Chapter 16 describes the WREP overall environmental management process.

Change in Habitat Quantity

No direct changes in habitat quantity are expected during accidental events. However, a change in habitat quality because of a hydrocarbon spill may indirectly reduce the amount of habitat available to an at-risk marine mammal or sea turtle by rendering it unsuitable for foraging and other activities.

Change in Habitat Quality

The accidental release of hydrocarbons may affect several physical and internal functions of marine mammals and sea turtles. Hydrocarbons can be inhaled or ingested, and may cause behavioural changes, inflammation of mucous membranes, pneumonia and neurological damage (see Geraci and St. Aubin 1990). However, most marine mammals, particularly baleen whales, are considered to be not directly susceptible to deleterious effects of oil (see Geraci and St. Aubin 1990). However, weak or stressed animals may also be vulnerable to oil spills.

Potential Risk of Mortality

At-risk marine mammals are not considered to be at high risk from the effects of oil exposure. Sea turtle carcasses are often found after a spill; however, leatherback sea turtles are uncommon in the Offshore Study Area, especially outside of summer and fall. At-risk baleen whales appear to be less susceptible to spills than delphinids, as dolphins are often found stranded after an oil spill. Thus, delphinids that occur in the Offshore Study Area at the time of the spill are most susceptible to fouling. Although effects of the *Exxon Valdez* oil spill were substantial on killer whales, killer whales are uncommon in the Offshore Study Area, and no population-level effects would be expected.

For at-risk marine mammals and sea turtles, it is probable that only small proportions of populations are at risk at any one time in the Offshore Study Area. Oil spill prevention measures, along with typical oil spill countermeasures (creating an oil spill response plan, training, preparation, an equipment inventory, and conducting emergency response drills) will serve to reduce the number of animals exposed to hydrocarbons.

Summary

Depending on the time of year, location of animals within the affected area, and type of oil spill or blow-out, the effects of an offshore oil release on the health of cetaceans is predicted to range from negligible to low magnitude over varying geographic extents. Based on present knowledge of Jeanne d’Arc Basin and the modelling exercises, it can be predicted that a hydrocarbon spill associated with the WREP will not result in any significant residual environmental effects to at-risk marine mammals or sea turtles in the Offshore Study Area (Table 12-17).

Mitigation measures will likely reduce effects of potential hydrocarbon spills on at-risk marine mammals and sea turtles in the Offshore Study Area.

Table 12-17 Environmental Effects Assessment for Marine Mammals and Sea Turtles Species at Risk: Accidental Events

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [A]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Subsea Blowout, or Crude Oil Surface Spill	Change in habitat quality (N) Potential mortality (N)	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	L	6	1	2	R [B]	2	NS	H
Other Spills (fuel, chemicals)	Change in habitat quality (N) Potential mortality (N)	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	L	1	1	2	R [B]	2	NS	H
SBM Whole Mud Spill	Change in habitat quality (N)		L	2	1	2	R	2	NS	H
Marine Vessel Incident, including collisions (fuel spills)	Change in habitat quality (N) Potential mortality (N)	• Oil spill response plan • Training, preparation, equipment inventory, prevention, and emergency response drills	L	5	1	2	R [B]	2	NS	H

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
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Frequency:
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Duration:
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Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm.
(B) Reversible at the population level but irreversible at the individual level.

12.5.2.3 Cumulative Environmental Effects

Marine exploration, commercial fishery activity, marine transportation and existing and planned production activity (e.g., White Rose, Hibernia, Terra Nova and Hebron) all have the potential to interact with at-risk marine mammals and sea turtles (see Table 12-12). It is very unlikely that routine activities associated with other marine exploration, existing production areas, marine transportation and commercial fisheries have much environmental effect on at-risk marine mammals and sea turtles.

Nearshore

Cumulative environmental effects in the Nearshore Study Area are expected to be of a lower magnitude than those of the Offshore Study Area, as fewer activities have the potential to interact with the WREP (see below).

Offshore

Commercial fishing activities may cause incidental mortalities or disturbance to at-risk marine mammals and sea turtles. It is predicted that the WREP will not cause any mortality to at-risk marine mammals and sea turtles and thus, there will be no or negligible cumulative environmental effect from commercial fishing activities. Major shipping routes pass in proximity to the Offshore Study Area, and additional marine traffic (e.g., cruise ships) typically occur inshore of the Offshore Study Area. Supply vessels and tankers are also associated with other developments in Jeanne d'Arc Basin. As assessed above, the most likely effect of vessel traffic on marine mammals and sea turtles is disturbance. It is predicted that WREP activities are very unlikely to cause any mortality and, thus, the cumulative environmental effects of marine transportation are predicted to be not significant.

Underwater sound associated with WREP activities will likely have the greatest effect on marine mammals and sea turtles, particularly cetaceans. Most species will be able to hear sounds, if they are close enough, and will be able to avoid them if they so choose. Mitigation measures associated with wellsite and VSP surveys are designed to prevent harm to marine mammals or sea turtles. Individuals travelling near one or more of the offshore developments or in proximity to other offshore exploration activities may be subject to cumulative environmental effects. However, these effects would most likely be limited to behavioural effects (i.e., localized avoidance). Cumulative environmental effects of other developments and exploration activities on the Jeanne d'Arc Basin are predicted to be not significant.

A major hydrocarbon spill or blowout in Jeanne d'Arc Basin could affect marine mammals and sea turtles to varying degrees depending upon type, size, location, timing and species and life stages involved. A major spill is statistically very unlikely to coincide among multiple developments in the Jeanne d'Arc Basin. Nonetheless, cumulative environmental effects could occur from chronic discharge of oil bilges at sea by ships transiting the area or from other activities that could affect marine mammals and sea turtles. Overall, the effects of accidental events on marine mammals and sea turtles were predicted to be not significant, and thus, the overall cumulative environmental effects on marine mammals and sea turtles are also likely to be not significant.

12.5.2.4 Determination of Significance

The determination of significance is based on the definition provided in Section 12.2. It considers the magnitude, geographic extent, duration, frequency, reversibility and ecological context of each environmental effect within the Study Areas, and their interactions, as presented in the preceding analysis. Significance is determined at the population level within the Nearshore and Offshore Study Areas.

The significance of potential residual adverse environmental effects, including cumulative environmental effects, resulting from the interaction between WREP-related activities and at-risk marine mammals and sea turtles, after taking into account any proposed mitigation, is summarized in Table 12-18.

Table 12-18 Residual Environmental Effects Summary: Marine Mammals and Sea Turtles Species at Risk

Phase	Residual Adverse Environmental Effect Rating (A)	Level of Confidence	Probability of Occurrence (Likelihood)
Construction (B)	NS	H	N/A (C)
Installation of WHP or Subsea Drill Centre	NS	H	N/A
Operation and Maintenance	NS	H	N/A
Decommissioning and Abandonment (D)	NS	H	N/A
Accidental Events	NS	H	N/A
Cumulative Environmental Effects	NS	H	N/A

Key:

Residual Environmental Effects Rating:
S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Level of Confidence in the Effect Rating:
L = Low level of Confidence
M = Medium Level of Confidence
H = High level of Confidence

Probability of Occurrence of Significant Effect:
L = Low Probability of Occurrence
M = Medium Probability of Occurrence
H = High Probability of Occurrence

NA = Not applicable
(A) As determined in consideration of established residual environmental effects rating criteria
(B) Includes all Argentia activities (engineering, construction, tow-out) of the WHP option only
(C) Effect is not predicted to be significant, therefore the probability of occurrence rating is not required under CEAA
(D) Includes decommissioning and abandonment of the WHP and offshore site

The environmental effects of routine activities associated with the construction, installation, operations/maintenance and decommissioning/abandonment phases of the WREP on at-risk marine mammals and sea turtles are predicted to be not significant (Table 12-18). Given that routine activities associated with the WREP are localized, of low to medium magnitude and reversible, environmental effects on marine mammal and sea turtle Species at Risk are not expected to contravene the prohibitions of SARA (Sections 32(1), 33, 58(1)). The environmental effects associated with accidental events arising from the WREP on at-risk marine mammals and sea turtles are also predicted to be not significant (Table 12-18).

12.5.2.5 Follow-up and Monitoring

The *CEAA* definition of "follow-up program" is "a program for (a) verifying the accuracy of the environmental assessment of a project, and (b) determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project". Follow-up programs serve as the primary means to determine and quantify change from routine operations on the receiving environment. Compliance monitoring on its own, does not satisfy the requirements for a follow-up program. Compliance monitoring is conducted to ensure that a project and its activities are meeting the relevant environmental standards, guidelines and regulations. Compliance monitoring will be conducted for the WREP in accordance with regulatory requirements.

Specific EEM programs to verify the accuracy of assessment predictions and the efficacy of mitigation measures are not planned for at-risk marine mammals and sea turtles.

For wellsite and VSP activities in the Offshore Study Area, Husky will implement a marine mammal and sea turtle observation program. The program will be consistent with the requirements outlined in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d). Data on marine mammal and sea turtle observations will be provided to DFO and the C-NLOPB where applicable.

12.6 Marine Bird Species at Risk

12.6.1 Project-Valued Environmental Component Interactions and Existing Knowledge of Environmental Effects

Potential interactions between the WREP and non-listed marine birds are evaluated in Chapter 10; these are similar to those interactions relevant to the at-risk marine bird species. In the nearshore, the WREP could interact with the Harlequin Duck, Red Knot or Ivory Gull. However, interactions with Piping Plover are unlikely, based on this specie's known distribution and the absence of suitable habitat on Placentia Bay. In the offshore, the Ivory Gull is the only at-risk marine birds expected to occur in the Offshore Study Area.

As discussed in Section 10.4, underwater hearing in birds is poorly understood. However, pile driving and wellsite and VSP surveys may still interact with at-risk marine birds via effects on hearing.

12.6.1.1 Nearshore

As discussed in Section 10.5.1, nearshore WREP activities may affect habitat quantity and habitat quality for at-risk marine birds. Activities most likely to cause disturbance (i.e., change in habitat quality) include pile driving (bund wall construction), vessel traffic and dredging. Artificial lighting during periods of darkness may attract at-risk marine birds; they may strike vessels or infrastructure, leading to injury or strandings. However, Harlequin Duck, Red Knot and Ivory Gull are not known to be attracted to lighting, and the latter two species are more likely to become airborne again after stranding than some non-listed marine birds. Several activities (e.g., dredging, pile driving and vessel traffic) may also lead to temporary disturbance of at-risk marine birds in a localized area.

Direct mortality of at-risk marine birds is not expected to be an environmental effect of most routine activities in the Nearshore Study Area.

Graving Dock Construction

Pile Driving

As discussed in Section 10.4.1.1, onshore pile driving may be audible above water and under water offshore, potentially interacting with at-risk marine birds. The existing knowledge of the effects of underwater noise on marine birds is discussed in Section 10.4.2.1 under the discussion on seismic surveys.

Lighting

As discussed in Section 10.4.1.1, artificial lighting on coastal structures at the construction site may attract nocturnally-active marine birds. Harlequin Duck, Red Knot and Ivory Gull are active primarily during the day, and attraction to artificial lighting associated with stranding or mortality has not been documented in these species.

Air Emissions

Although air emissions could, in theory, affect the health of some resident at-risk marine birds, the effects would likely be minimal because emissions of potentially harmful materials will be small and rapidly disperse to undetectable levels.

Operation of Helicopters and Vessels

As discussed in Section 10.4.1.1, temporary, localized disturbances are possible effects of activities such as operation of helicopters and vessels.

Very little information is available specific to the effects of operation of helicopters or vessels on Harlequin Duck, Ivory Gull, or Red Knot. Response to noise varies among bird species (Ryals et al. 1999) and response to other components of disturbance presumably varies in a similar manner. One study of disturbance effects on birds (Burger et al. 2007) included an assessment of Red Knot disturbance by humans, cars, airplanes and dog presence. The shorebirds that were studied responded most strongly to the presence of dogs and did not return to the location within the 10-minute post-disturbance monitoring period. Red Knot also appeared to be more responsive to humans than to cars or an airplane, showing moderate signs of recovery to pre-disturbance levels within 30 seconds of car or airplane disturbance relative to periods greater than the defined 10 minutes for human disturbance. In the same study, when studying the relative number of estuarine waterbirds as a function of distance to human-made structures, Burton et al. (2002) found that Red Knot numbers were measurably lower in areas where a human footpath was within 150 m.

In the eastern Harlequin Duck, disturbance by low altitude aircraft over-flights have been studied on Labrador breeding grounds. The Harlequin Duck's response to over-flights increased with corresponding increases in sound levels (dose-response association) (Goudie and Jones 2004). This effect intensified above 80 dBA. The greatest responses occurred in response to military jet aircraft because their noise has high sound levels (greater than 100 dBA) and sudden onset, as perceived by a stationary subject. The ducks responded with visible increases in alert behaviour and by becoming inactive or immobile (Goudie 2006). These direct behavioural responses generally lasted for less than 1 minute and were unlikely to affect the amount of time devoted to critical behaviours such as feeding or resting. However, over-flights had other effects. There was a decrease in courtship behaviour lasting up to 1.5 hours after the over-flight. Increased agonistic behaviour (aggressive interaction among Harlequin Duck) was seen for up to 2 hours after the disturbance. Forty-three percent of the variance in behavioural responses was explained by the noise component of the disturbance. The presence of these effects suggests that the ducks experience whole-body stress responses. However, the effects of these whole-body stress responses on Harlequin Duck in the marine environment at the population level are unstudied.

Like many gull species, Ivory Gulls are attracted to vessels rather than being frightened, based on observations during the 24-hour daylight regime of summer in the High Arctic (T. Lang, pers. comm.).

Concrete Gravity Structure Construction

Lighting

As discussed under graving dock construction, artificial lighting on coastal structures at the construction site is not likely to interact with at-risk marine birds in the Nearshore Study Area. The existing knowledge of the effects of light attraction in other marine bird species is discussed in Section 10.4.2.1.

Air Emissions

Although air emissions could, in theory, affect the health of some resident at-risk marine birds, the effects would likely be minimal because emissions of potentially harmful materials will be small and rapidly disperse to undetectable levels.

Operation of Helicopters and Vessels

As discussed above, temporary and localized disturbances to at-risk marine birds are possible with activities such as the operation of helicopters and vessels.

Tow-out and Installation

Lighting

As discussed in Section 12.6.1.1, artificial lighting on coastal structures at the construction site is not likely to interact with at-risk marine birds in the Nearshore Study Area. The existing knowledge of the effects of light attraction in other marine bird species is discussed in Section 10.4.2.1.

12.6.1.2 Offshore

As discussed in Section 10.4.2.1, offshore construction/installation activities have the potential to result in effects on habitat quality and, to a lesser extent, habitat quantity (e.g., placement of the WHP and MODU could potentially obstruct use of a very limited area of habitat). Activities with the greatest potential for disturbance (e.g., effects on habitat quality) include the operation of helicopters, the operation of vessels, wellsite and VSP surveys and dredging activities. Artificial lighting at night is not likely to negatively interact with Ivory Gull. It is not known whether there is hearing impairment to marine birds spending considerable amounts of time below the surface of the water and in close proximity to airgun pulses during seismic surveys (restricted to wellsite surveys and VSP for the WREP).

With the possible exception of collisions with infrastructure, mortality of Ivory Gulls is not expected to be an environmental effect of activities in the Offshore Study Area during the construction/installation phase.

Wellhead Platform and Subsea Drill Centre Installation/Commissioning

Offshore WHP installation/commissioning activities may result in effects on habitat quality. Activities most likely to cause disturbance (e.g., effects on habitat use) include the operation of helicopters, the operation of vessels, wellsite and VSP surveys and dredging activities. Lighting at night throughout the WREP is not likely to cause injury, strandings or mortality to Ivory Gull. The risk of hearing impairment to Ivory Gull from surveys is low because Ivory Gull plunge dive for prey only occasionally and only to shallow depths, thus minimizing its exposure to underwater noise. Several other activities may also lead to temporary disturbance of Ivory Gull in a localized area. Mortality of Ivory Gull is not expected to be an environmental effect of activities in the Offshore Study Area during installation/commissioning.

The potential for interactions between at-risk marine birds and the installation of a subsea drill centre is similar to that of a WHP, and has been previously assessed (LGL 2007a).

Wellsite and Vertical Seismic Profile Surveys

As discussed in Section 10.4.2.1, species that spend most of their foraging efforts without submerging their heads, such as Ivory Gull, are not likely to be at risk of hearing impairment. Even during the occasional plunge-dive, they may not be exposed to high levels of airgun sound because the sound sources used in wellsite and VSP surveys produce much less energy than those used in 2-D and 3-D seismic surveys.

Wellsite and VSP surveys likely have low potential to interact negatively with Ivory Gull. During three summers (2009 to 2011) of monitoring of 2-D seismic exploration in the Greenland Sea, Ivory Gull were attracted daily to vessels and showed only occasional, brief startle reactions to the sound produced by the airgun array (T. Lang, pers. comm.).

The potential physical and physiological effects of seismic programs on marine mammals and sea turtles have recently been reviewed for StatoilHydro's 3-D program in Jeanne d'Arc Basin (LGL 2008), Petro-Canada's 3-D program in Jeanne d'Arc Basin (LGL 2007e) and for Husky's program in northern Jeanne d'Arc Basin (LGL 2005b; Moulton et al. 2006b). Geohazard surveys are less likely to affect marine mammals and sea turtles as reviewed in several environmental assessments for Jeanne d'Arc Basin (LGL 2005a, 2005b, 2005c, 2005d, 2008).

Lighting

As discussed in Section 12.6.1.1, artificial lighting on offshore structures (vessels, MODU, WHP) is not likely to interact negatively with Ivory Gull in the Offshore Study Area. The existing knowledge of the effects of light attraction in other marine bird species is discussed in Section 10.4.2.1.

Operations and Maintenance

Operations/maintenance activities have the potential to result in changes to habitat quality and habitat use for Ivory Gull. Interactions are summarized here:

- Lighting and flaring at night for the duration of the WREP may attract Ivory Gull. These gulls may benefit by feeding on fish or invertebrates attracted to the surface by the lighting or by nutrients from waste disposal.

- The operation of helicopters has potential for disturbance, but the operation of vessels may attract rather than cause escape responses or mortality.

- The discharges of fluids or solids have the potential to foul the plumage of Ivory Gull and possibly lead to ingestion of non-biological substances, which may lead to mortality.

- Hearing impairment to Ivory Gull plunge diving below the surface of the water and in close proximity to airgun pulses during wellsite or VSP surveys may be a possibility. However, as mentioned above, Ivory Gull are not likely to dive deep enough or often enough to come in to close proximity to damaging airgun pulses.

Lighting

As discussed in Section 12.6.1.1, artificial lighting on the installed WHP, MODUs and support and supply vessels is not likely to interact negatively with Ivory Gull, and may instead offer foraging opportunities.

Flaring

As discussed in Section 12.6.1.1, bright light from flaring may attract gulls for foraging opportunities, so this WREP activity may interact with Ivory Gulls However, gulls are not prone to collisions with structures under such conditions or to mortality from the flare itself.

Operational Discharges

As discussed in Section 10.4.2.2, routine WHP or MODU discharges are not expected to produce sheens. Discharges of sewage particles are not expected to be in sufficient quantity to attract marine birds such as Ivory Gull. The discharge near the seafloor will also make any interaction with Ivory Gull unlikely.

Decommissioning and Abandonment

Effects of WREP decommissioning/abandonment activities may affect habitat quality for Ivory Gulls, similarly to those effects experienced during the construction and operations phases. Lighting may attract Ivory Gull, but is not likely to interact negatively Ivory Gull. Operation of helicopters may lead to temporary disturbance in a localized area, but operation of vessels is not likely to result interact negatively with Ivory Gull.

Potential Future Activities

Future activities in the Offshore Project Area may include, but are not limited to, geophysical surveys, drilling from a MODU, vessel traffic and helicopter overflights. Most of these activities involve artificial lighting, noise and presence of structures. These activities, as well as chemical use and management, could affect habitat quality for Ivory Gull. There is low potential for direct mortality of Ivory Gull as a result of collisions with or strandings on artificially-lit structures. The potential environmental effects of geophysical surveys, drilling, vessel traffic and helicopter overflights have been discussed previously within Section 10.4.

12.6.1.3 Accidental Events

The unintentional release of hydrocarbons is the primary accidental event with the potential to affect at-risk marine birds. An oil spill, although unlikely, could occur during the construction, operation and maintenance, and/or decommissioning phases of the WREP. Accidental events could result in a change in habitat quality and/or mortality. A blowout, also unlikely, could occur during the operation and maintenance phase.

As discussed in Section 10.4.3, shorebirds as a group, including Red Knot, may interact with hydrocarbon spills or blowout whose slicks reach shorelines. This may include direct mortality or temporary effects on habitat quality.

Effects of the 1989 *Exxon Valdez* oil spill on Harlequin Duck in Prince William Sound, Alaska, have been studied. Following initial high mortalities, female winter survival was depressed for 20 years after the spill (Esler and Iverson 2010). Population size declined during 1995 to 1997 only in oiled areas (Esler et al. 2002). A biomarker for oil exposure, cytochrome P4501A (found in livers), was present up to 20 years after the spill, indicating ongoing exposure to oil (Esler et al. 2010). It should be noted that this measurement is a biomarker for exposure and not necessarily a deleterious effect per se. Concentrations of PAHs in nearshore waters off oiled shores and in five intertidal prey species were detected up to 21 years after the spill (Neff et al. 2011). Based on modelling, Iverson and Esler (2010) suggested a population recovery time of 24 years for Harlequin Duck after the *Exxon Valdez* spill.

A large spill of SBM has the potential to create a sheen on the water surface that could affect marine birds under certain conditions (e.g., flat calm, no wind). It is unlikely that Ivory Gulls would be affected by an SBM spill since the chances of this rare species encountering the very specific conditions is unlikely, especially since this gull spends relatively little time on the water.

12.6.1.4 Summary

A summary of the potential environmental effects resulting from WREP-marine bird Species at Risk interactions, including those of past, present and likely future projects and accidental events, is provided in Table 12-19. Given the relative rarity of these birds in the Nearshore and Offshore Project and Study Areas and their probable distribution and behaviour relative to WREP routine activities and infrastructure, minimal effects are predicted on these species. However, a large oil or SBM spill could affect them if they came in contact with a slick or sheen.

Table 12-19 Potential White Rose Extension Project-related Interactions: Marine Bird Species at Risk

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Nearshore			
Pre-construction and Installation			
Lighting	x		x
Construction of graving dock (include sheet pile/driving, potential grouting)	x	x	
Air emissions	x		
CGS Construction and Installation			
Onshore (Argentia Construction Site)			
Lighting	x		x
Air emissions	x		
Marine (Argentia and Deep-water Mating Site)			
Additional nearshore surveys (e.g., geotechnical, geophysical, environmental)	x		
Dredging	x		x
Lighting	x		x
Air emissions	x		
Operation of helicopters, supply, support, standby, mooring and tow vessels/barges/ROVs	x		
Offshore			
Wellhead Platform Installation/Commissioning			
Tow-out/offshore installation	x	x	
Operation of helicopters and vessels/barges	x		
Lighting	x		x
Air emissions	x		
Drilling-associated seismic (VSPs and wellsite surveys)	x		
Subsea Drill Centre Excavation/Installation **(Previously assessed; LGL 2007a)**			
Operation of helicopters and supply, support, standby and tow vessels/barges	x		
Lighting	x		x
Air emissions	x		
Drilling-associated seismic (VSPs and wellsite surveys)	x		
Production/Operation and Maintenance			
Presence of structure	x		
Lighting	x		x
Air emissions	x		
Power generation and flaring	x		x
Chemical use and management (e.g. BOP fluids, fuel, well treatment fluids, corrosion inhibitors [(A)])	x		
Waste generated (domestic waste, construction waste, hazardous, sanitary waste)	x		
Operation of helicopters, supply, support, standby and tow vessels/barges/ROVs	x		
Surveys (geotechnical, geophysical and environmental)	x		

Potential WREP Activities, Physical Works, Discharges and Emissions	Change in Habitat Quality	Change in Habitat Quantity	Potential Mortality
Decommissioning and Abandonment			
Removal of WHP	x		
Operation of Helicopters	x		
Operation of Vessels (supply/support/standby/tow vessels/barges/diving/ROVs)	x		
Lighting	x		x
Air emissions	x		
Surveys (geotechnical, geophysical and environmental)	x		
Potential Future Activities			
Surveys (e.g., geophysical, geological, geotechnical, environmental, ROV, diving)	x		
Chemical use and management (e.g., BOP fluids, fuel, well treatment fluids, corrosion inhibitors [A])	x		
Accidental Events			
Marine diesel fuel spill from support vessel	x		x
Graving dock breach	x		
SBM whole mud spill	x		x
Subsea hydrocarbon blowout	x		x
Hydrocarbon surface spill	x		x
Other spills (e.g., fuel, waste materials)	x		x
Marine vessel incident (including collisions) (i.e., marine diesel fuel spill)	x		x
Cumulative Environmental Effects			
Commercial fisheries (nearshore and offshore)	x		x
Marine traffic (nearshore and offshore)	x		x
White Rose Oilfield Development (including North Amethyst and the South White Rose extension drill centre)	x	x	x
Terra Nova Development	x	x	x
Hibernia Oil Development	x	x	x
Hibernia Southern Extension Project	x	x	x
Hebron Oil Development	x	x	x
Offshore Exploration Seismic Activity	x		x
Offshore Exploration Drilling Activity	x	x	x
(A) Husky will evaluate the use of biocides other than chlorine. The discharge from the hypochlorite system will be treated to meet a limit approved by the C-NLOPB's Chief Conservation Officer.			

12.6.2 Environmental Effects Analysis, Monitoring, and Mitigation Measures

As shown in Table 12-19, WREP activities can interact with marine bird species at risk to create the following potential environmental effects:

- Change in Habitat Quantity: includes interactions that limit habitat availability to at-risk marine birds.

- Change in Habitat Quality: includes interactions that may result in physical/ physiological/behavioural effects that occur as a result of a change in habitat quality for at-risk marine birds.

- Potential Mortality: includes interactions that may cause the mortality of at-risk marine birds.

As discussed in Section 12.6.1, the WREP construction and offshore industrial activities with the greatest potential to affect the habitat quality of marine birds are noise, artificial lighting and operation of helicopters and vessels. Habitat quantity has the potential to be affected by construction of the graving dock (bund wall), tow-out and installation of the WHP at the deep-water mating site and installation of the WHP or subsea drill centre in the Offshore Project Area. Flaring, as well as collisions with infrastructure, has the greatest potential for mortality of marine bird species at risk.

12.6.2.1 Nearshore

Pre-construction and Installation

Change in Habitat Quantity

Construction of the bund wall may result in a small reduction of available habitat In the Nearshore Project Area. Although the area does not have known habitat for Harlequin Duck or Red Knot, they could potentially occur in the vicinity of the bund wall site. The bund wall will represent a relatively small physical footprint within an area that has previously been disturbed during construction activities of other projects (i.e., does not represent a loss of important at-risk marine bird habitat).

Change in Habitat Quality

Pile Driving

Pile driving involved in the construction of the bund wall, may produce impulsive sound levels high enough to temporarily disturb at-risk marine birds occurring in close proximity at a localized scale. The environmental effects of pile driving on at-risk marine birds in the Nearshore Study Area are not well known, but these activities will occur in a small area that has been previously disturbed by construction activities associated with other projects. There are no known concentrations of foraging at-risk marine birds that could potentially be affected by pile driving activities.

Lighting

Artificial lighting on coastal structures and vessels has the potential to attract nocturnally-active marine birds, resulting in stranding. However, Harlequin Duck and Red Knot are not known to be attracted to artificial lighting.

Husky will develop protocols for regular searches of birds that may become stranded on all vessels and facilities. Recovered birds will be released in accordance with standard protocols (Williams and Chardine 1999; Husky 2008). A marine bird salvage and release permit under the authority of the Federal Migratory Bird Permit must be applied for and obtained from CWS. Husky will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected.

Air Emissions

The effects of air emissions on at-risk marine birds would likely be minimal because emissions of potentially harmful materials will be small and rapidly disperse to undetectable levels. Air emissions are expected to have a negligible effect on the habitat quality of the marine bird species at risk VEC.

Operation of Helicopters and Vessels

At-risk marine birds may be temporarily disturbed by passing vessels associated with WREP activities, including construction and survey vessels. Such effects would become important if they prevent foraging or nesting activities. Vessels passing known concentrations of foraging Red Knot or Harlequin Duck are of the most concern, but no known concentrations are likely to occur in Nearshore Study Area that potentially may be affected. Whenever possible, vessels associated with the WREP should maintain a steady course and safe speed (the vessel will be operated in a safe manner in accordance with applicable vessel operating regulations).. Concentrations of Harlequin Duck are known to winter in the vicinity of Cape St. Mary's Ecological Reserve. Concentrations of Harlequin Duck and Red Knot, if any occur, should be avoided. WREP effects on Cape St. Mary's Ecological Reserve are discussed in Section 13.3.1.5.

Potential Mortality

Collision with infrastructure is a potential source of mortality, primarily via attraction to artificial lighting, although the at-risk marine bird species in the Nearshore Study Area are not known to be attracted to artificial light.

Summary

The environmental effects of WREP pre-construction and installation activities on marine bird species at risk are summarized in Table 12-20.

Given that WREP activities are mostly localized, of low magnitude, and reversible, there are not likely to be significant adverse environmental effects on marine bird species at risk from pre-construction and installation activities associated with the WREP in the Nearshore Study Area.

Table 12-20 Environmental Effects Assessment for Marine Bird Species at Risk: Construction and Installation

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(A)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Nearshore										
Bund Wall Construction (e.g., sheet / pile driving)	Change in habitat quality (N) Change in habitat quantity (N)	• Equipment design	L	1	1	3	R	2	NS	H
Dredging of Tow-out Route	Change in habitat quality (N)	• Planning • Equipment design	L	2	1	2	R	2	NS	H
Lighting	Change in habitat quality (N) Potential mortality (N)	• Adhere to CWS recovery and release protocol for stranded bird • Evaluate use of shielding and deflectors with directional lighting and incorporate where safe	L	2	6	3	R	2	NS	H
Air Emissions	Change in habitat quality (N)	• Adhere to NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	L	3	6	3	R	2	NS	H
Nearshore Geophysical Surveys	Change in habitat quality (N)	• Avoid animal concentration when possible • Maintain steady course and safe speed when possible	L	1	1	2	R	2	NS	H
Operation of Helicopters and Vessels (e.g., supply, tug, barge)	Change in habitat quality (N)	• Avoid marine bird concentrations when possible • Maintain steady course and safe speed when possible • Deviate course to avoid animals • Minimum altitude of 300 m and lateral distance of 2 km over active colonies, including Cape St. Mary's Ecological Reserve and elsewhere when possible	L	2	6	3	R	2	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Offshore (for WHP or subsea drill centre)										
WHP Tow-out and Installation	Change in habitat quantity (P) Change in habitat quality (N)		L	1	6	2	R	2	NS	H
Geophysical Surveys (e.g., VPS, geohazard, sidescan sonar)	Change in habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	1	1	2	R	2	NS	H
Operation of Helicopters and Vessels (e.g., supply, tug, barge)	Change in habitat quality (N)	• Avoid marine bird concentrations when possible • Maintain steady course and safe speed when possible • Deviate course to avoid animals • Minimum altitude of 300 m and lateral distance of 2 km over active colonies, including Cape St. Mary's Ecological Reserve and elsewhere when possible	L	2	6	3	R	2	NS	H
Lighting	Change in habitat quality (N) Potential mortality (N)	• Adhere to CWS recovery and release protocol for stranded bird • Evaluate use of shielding and deflectors with directional lighting and incorporate where safe	L	2	6	3	R	2	NS	H
Air Emissions	Change in habitat quality (N)	• Adhere to NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	N	3	6	3	R	2	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(A)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

Concrete Gravity Structure Construction

Change in Habitat Quantity

Construction of the CGS is not expected to overlap the marine environment, thus will not have an effect on habitat quantity for marine bird species at risk.

Change in Habitat Quality

Lighting

As discussed above, artificial lighting on coastal structures and vessels has the potential to attract nocturnally-active at-risk marine birds. Husky will implement the mitigation discussed above.

Air Emissions

As discussed above, air emissions are expected to have a negligible effect on the habitat quality of at-risk marine birds.

Operation of Helicopters and Vessels

As discussed above, at-risk marine birds may be temporarily disturbed by passing vessels or helicopters associated with WREP activities. No known concentrations are likely to occur in the Nearshore Study Area that potentially may be affected. Whenever possible, vessels associated with the WREP should maintain a steady course and safe speed. Concentrations of at-risk marine birds, if any occur, will be avoided.

Potential Mortality

As discussed above, collision with infrastructure is a potential source of mortality, although light attraction has not been documented in the species in the marine bird species at-risk VEC.

Summary

The environmental effects of WREP concrete gravity structure construction activities on at-risk marine birds are summarized in Table 12-20.

Given that WREP activities are mostly localized, of low magnitude, and reversible, there are not likely to be significant adverse environmental effects on marine bird species at risk from concrete gravity structure construction activities associated with the WREP in the Nearshore Study Area.

Concrete Gravity Structure Tow-out and Installation

Change in Habitat Quantity

Modelling for the WREP dredging along the tow-out route shows that dredging will have a small geographic extent (AMEC 2012a). Total particulate matter will be well below the thresholds set in *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002). There is no known important habitat for marine bird species at risk in the

Nearshore Project Area, so any dredging taking place along the tow-out route is not expected to have an effect on habitat quantity for the marine bird species at risk VEC.

Change in Habitat Quality

Lighting

As discussed above, artificial lighting on coastal structures and vessels has low potential to attract nocturnally-active at-risk marine birds. Husky will implement the mitigation discussed above.

Air Emissions

As discussed above, air emissions are expected to have a negligible effect on the habitat quality of at-risk marine birds.

Operation of Helicopters and Vessels

As discussed above, marine bird species at risk may be temporarily disturbed by passing vessels or helicopters associated with WREP activities. No known concentrations are likely to occur in the Nearshore Study Area that potentially may be affected. Whenever possible, vessels associated with the WREP should maintain a steady course and safe speed. Concentrations of at-risk marine birds, if any occur, will be avoided.

Potential Mortality

As discussed above, collision with infrastructure is a potential source of mortality although the at-risk marine birds likely to occur are primarily diurnal and are not know to be attracted to artificial light.

Summary

The environmental effects of WREP concrete gravity structure tow-out and installation activities on at-risk marine birds are summarized in Table 12-20.

Given that WREP activities are mostly localized, of low magnitude, and reversible, there are not likely to be significant adverse environmental effects on the marine bird species VEC from concrete gravity structure tow-out and installation activities associated with the WREP in the Nearshore Study Area.

Accidental Events in the Nearshore

The following sections assess the effect of an accidental release of hydrocarbons in the nearshore. Spills in the nearshore would be attributable to vessel malfunctions. Probability and type of spills are summarized in Section 3.6. A detailed analysis is provided in SL Ross (2012).

A graving dock breach would increase suspended sediment and sedimentation in the nearshore and potentially affect seabirds through effects on their food (e.g., benthic invertebrates and fish) and/or their foraging ability (e.g., reduced visibility).

Hydrocarbon spill response is included as part of the contingency planning undertaken for the WREP, and additional information regarding spill response for the Nearshore Study Area can be found in Section 16.9. Chapter 16 describes the WREP overall environmental management process.

Spill modelling of the accidental release of fuel in Placentia Bay predicts that the portion of the 100 m^3 and 350 m^3 spills not reaching shore would evaporate from the surface within approximately 52 and 67 hours, respectively (SL Ross 2012). Slick width was estimated to be up to 440 m, with the loss of the slick at distances of up to 53 km. However, under certain wind conditions and currents a spill in Placentia Bay could reach shore prior to evaporation (SL Ross 2012). When wind conditions were included in the model, a 350 m^3 slick during March-July reached the shore within 2 to 159 hr, but was most likely to do so within 6 to 48 hr (SL Ross 2012). The maximum slick life for a spill that did not reach shore was eight days. Weathering processes (photolysis and biodegradation) would reduce the amount of oil potentially reaching shorelines.

Change in Habitat Quantity

Hydrocarbon spills are not likely to permanently alter at-risk marine bird habitat. Diminishing sublethal effects in Harlequin Ducks affected by the *Exxon Valdez* spill in Alaska suggest Harlequin Duck habitat is recovering. Spill cleanup, weathering and biodegradation would result in eventual recovery of habitat in the Nearshore Study Area.

Change in Habitat Quality

The presence of hydrocarbons may temporarily affect habitat quality of oiled areas for both oiled and un-oiled birds. Prey availability may be reduced or at-risk marine birds may react by avoidance of affected habitat. Sublethal effects of hydrocarbons ingested by at-risk marine birds may affect their reproductive rates or survival rates. Sublethal effects may persist for a number of years, depending upon generation times of affected species and the persistence of any spilled hydrocarbons.

Potential Mortality

Exposure to hydrocarbons has effects on thermal and buoyancy that typically lead to the deaths of affected marine birds. Although some may survive these immediate effects, long-term physiological changes may eventually result in death. Most seabirds are relatively long-lived. Hydrocarbons may be transferred to eggs or nestlings, causing embryo or nestling mortality. However, if fuel spilled in Placentia Bay reached the exposed coast, it would likely not persist long on Newfoundland’s high energy, rocky coastline.

Summary

The environmental effects of WREP accidental events on at-risk marine birds in the nearshore are summarized in Table 12-21.

Table 12-21 Environmental Effects Assessment for Marine Bird Species at Risk: Accidental Events in the Nearshore

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A): Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance	Significance Rating	Level of Confidence
Marine Diesel Fuel Spill from Support Vessel	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Training, Preparation, Equipment Inventory, Prevention and Emergency Response Drills	H	3	1	2	R/I(B)	2	S	H
Graving Dock Breach	Change in habitat quality (N)	• Prevention through Design Standards and Maintenance • Emergency Response Contingency Plan	L	1	1	1	R	3	NS	H

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm
(B) Reversible at the population level but irreversible at the individual level

Adverse environmental effects of accidental events (hydrocarbon spills due to collisions, graving dock breach) in the Nearshore Study Area are predicted to be low to high in magnitude, low to moderate in geographic extent, low to moderate in duration and low in frequency. Although significant at the individual level in most cases (Camphuysen 2011), these environmental effects are predicted to be reversible at the population level. Nevertheless, these environmental effects are predicted to be significant. Smaller scale spills and blowouts in calm conditions may be mitigated via oil spill response measures and marine bird rehabilitation; however, these mitigations are recognized to be limited. Husky will practice prevention using safety and risk management systems, management of change procedures and global standards. There will be an emphasis on accident prevention at all phases of the WREP.

12.6.2.2 Offshore

Wellhead Platform or Subsea Drill Centre Installation/Commissioning

Change in Habitat Quantity

The WHP or subsea drill centre in the Offshore Project Area would occupy a small area that may reduce the habitat quantity for at-risk marine birds (Ivory Gull). However, this reduction in habitat quantity is expected to result in minimal habitat loss for this VEC. Ivory Gull is rarely seen away from sea ice, so the likelihood of it occurring in the vicinity of the WHP is low.

Change in Habitat Quality

Temporary and localized disturbances to at-risk marine birds in the Offshore Study Area may affect bird habitat quality resulting in behavioural changes. WREP activities creating noise, such as wellsite and vertical seismic profiling surveys, light emissions, vessel traffic and helicopter operations are most likely to potentially result in a change in habitat quality.

Wellsite and Vertical Seismic Profiling Surveys

Wellsite and VSP surveys have the potential to affect habitat quality for at-risk marine birds (although Ivory Gull does not often plunge dive when foraging) through disturbance from airgun noise. However, sound levels used in these surveys are unlikely to have more than a very localized, reversible effect.

Lighting

Artificial lighting on vessels and WHPs in the Offshore Study Area at night has the potential to attract nocturnally-active marine birds. However, the Ivory Gull is not known to be attracted to artificial lighting.

Operation of Helicopters and Vessels

As discussed above, at-risk marine birds may be temporarily disturbed by passing vessels or helicopters associated with offshore construction/installation activities. No known concentrations are likely to occur in the Offshore Study Area that potentially may be affected. Whenever possible, vessels associated with the WREP should maintain a steady course and safe speed. Concentrations of at-risk marine birds, if any occur, will be avoided.

Potential Mortality

Collision with infrastructure resulting from attraction to artificial lighting is a potential source of mortality. However, Ivory Gull is not known to strand on vessels or platforms, or to collide with infrastructure at night. Potential mortality from subsequent dehydration and starvation is readily mitigated. Consequently, residual effects from artificial lighting are unlikely.

The effects of wellsite and VSP survey airgun sound are unlikely to result in at-risk marine bird mortality because the small sound sources used in these kinds of surveys produce only a fraction of the sound levels produced by arrays used 2-D and 3-D seismic surveys. Also, in rare instances when disturbance from the source vessel does not cause the dispersal of marine birds, such birds would be unlikely to be within the few metres of the sound source necessary to cause mortality.

Summary

The environmental effects of WREP wellhead platform or subsea drill centre installation/ commissioning activities on at-risk marine birds are summarized in Table 12-20.

Given that WREP activities are mostly localized, of negligible to low magnitude, and reversible, there are not likely to be significant adverse environmental effects on marine bird species at risk from installation/commissioning activities associated with the WREP in the Offshore Study Area.

Production/Operations and Maintenance

Change in Habitat Quantity

None of the WREP activities in the Offshore Study Area during the operations and maintenance phase are predicted to result in changes in habitat quantity for marine bird species at risk.

Change in Habitat Quality

Primary WREP activities that could potentially result in changes in habitat quality for at-risk marine birds include wellsite and VSP surveys, artificial lighting, flaring, operational discharges and operation of helicopters and vessels.

Wellsite and Vertical Seismic Profiling Surveys

As discussed above, wellsite and VSP surveys have the potential to affect habitat quality for marine birds through disturbance from airgun noise. However, sound levels used in these surveys are unlikely to have more than a very localized, reversible effect.

Lighting

As discussed above, artificial lighting on vessels and WHPs at night has the potential to attract or disorient nocturnally-active marine birds. In the offshore Study Area, Ivory Gull are not known to be nocturnally-active or attracted to artificial lighting, at least not to any large extent.

Flaring

As with artificial lighting discussed above, flaring on the WHP may attract or disorient nocturnally-active marine birds. As discussed above, Ivory Gull are not known to be susceptible to this type of effect. As described in this environmental assessment, the need for flaring will be reduced compared with past oil developments in offshore Newfoundland. Release and recovery of any stranded birds would contribute to minimizing effects on habitat quality.

Operational Discharges

As discussed in Section 10.4.2.2, discharges from the WREP are not expected to produce sheens. They will be released at depths below those usually used by marine bird species at risk.

Operation of Helicopters and Vessels

As discussed above, marine bird species at risk may be temporarily disturbed by passing vessels or helicopters such as those associated with offshore operation/ maintenance activities. No known concentrations of Ivory Gulls are likely to occur in the Offshore Study Area that potentially may be affected. Whenever possible, vessels associated with the WREP should maintain a steady course and safe speed. Concentrations of at-risk marine birds, if any occur, will be avoided.

Potential Mortality

Although the potential for flaring to cause marine bird mortality is poorly understood, the heat from noise flares should deter birds from close approach. Even those marine birds induced into circulating around the flare boom and becoming exhausted as a result would not suffer mortality by descending to rest on the sea surface. Those birds stranding on the WHP will be unlikely to suffer mortality because of the mitigation (recovery and release) described above.

Summary

The environmental effects of WREP production/operation and maintenance activities on marine bird species at risk are summarized in Table 12-22.

Given that WREP activities are mostly localized, of negligible to low magnitude, and reversible, there are not likely to be significant adverse environmental effects on marine bird species at risk VEC from the production/operation and maintenance activities associated with the WREP.

Table 12-22 Environmental Effects Assessment for Marine Bird Species at Risk: Production/Operation and Maintenance

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [A]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Presence of Structure	Change in habitat quality (N)	• Decommissioning	L	1	6	5	R	2	NS	H
Lighting	Change in habitat quality (N) Potential mortality (N)	• Adhere to CWS recovery and release protocol for stranded birds • Evaluate use of shielding and deflectors with directional lighting and incorporate where safe	L	2	6	5	R	2	NS	H
Air Emissions	Change in habitat quality (N)	• Adhere to NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	N	3	6	5	R	2	NS	H
Power Generation and Flaring	Change in habitat quality (N) Potential mortality (N)	• Adhere to CWS recovery and release protocol for stranded birds	L	1	6	5	R	2	NS	H
Chemical use and management (e.g. BOP fluids, fuel, well treatment fluids, corrosion inhibitors)	Change in habitat quality (N)		L	1	6	5	R	2	NS	H
Waste generated (domestic, construction, hazardous, sanitary, hydrostatic testing, cooling, firewater)	Change in habitat quality (N)	• Subsurface Discharge	L	2	6	5	R	2	NS	H
Operation of helicopters, supply, support, standby and tow vessels/barges/ROVs	Change in habitat quality (N)	• Avoid marine bird concentrations when possible • Maintain steady course and safe speed when possible • Deviate course to avoid animals • Minimum altitude of 300 m and lateral distance of 2 km over active colonies, including Cape St. Mary's Ecological Reserve and elsewhere when possible	L	3	6	5	R	2	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Wellsite and VSP Surveys	Change in habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	1	1	2	R	2	NS	H

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

Offshore Decommissioning and Abandonment

Habitat Quantity

None of the WREP activities in the Offshore Study Area during the decommissioning and abandonment phase are predicted to result in changes in habitat quantity for marine bird species at risk.

Habitat Quality

Activities associated with the removal of the WHP may induce temporary and localized disturbance of at-risk marine birds. These activities are not expected to occur near any known concentrations of marine bird species at risk. It is expected that bird behaviour would likely return to normal shortly after the completion of these activities (if disturbed at all).

Effects on habitat quality and mitigation associated with lighting, air emissions operation of helicopters and vessels, and wellsite and VSP surveys, have been discussed under the construction/installation and production/operations phases and are applicable to the decommissioning/abandonment phase.

Potential Mortality

The potential risk of mortality and mitigation associated with lighting and wellsite and VSP surveys, have been discussed under the construction/installation and production/ operations phases and are applicable to the decommissioning/abandonment phase. None of these activities are expected to result in potential mortality of marine bird species at risk.

Summary

The potential environmental effects of decommissioning activities are expected to be similar (or less than) those of construction or operation; therefore, no significant adverse environmental effects are predicted.

The environmental effects of WREP decommissioning/abandonment activities on marine bird species at risk are summarized in Table 12-23.

Table 12-23 Environmental Effects Assessment for Marine Bird Species at Risk: Decommissioning and Abandonment

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
Removal of WHP	Change in habitat quality (N)		L	2	1	1	R	2	NS	H
Plugging and Abandoning Wells	Change in habitat quality (N)		L	1	3	2	R	2	NS	H
Lighting	Change in habitat quality (N) Potential mortality (N)	• Adhere to CWS recovery and release protocol for stranded birds • Evaluate use of shielding and deflectors with directional lighting and incorporate where safe	L	2	6	5	• R	2	NS	H
Air Emissions	Change in habitat quality (N)	• Adhere to NL *Air Pollution Control Regulations, 2004* and CEPA *National Ambient Air Quality Objectives*	N	3	6	5	• R	2	NS	H
Operation of helicopters, supply, support, standby and tow vessels/ barges/ROVs	Change in habitat quality (N)	• Avoid marine bird concentrations when possible • Maintain steady course and safe speed when possible • Deviate course to avoid animals • Minimum altitude of 300 m and lateral distance of 2 km over active colonies, including Cape St. Mary's Ecological Reserve and elsewhere when possible	L	3	6	5	R	2	NS	H
Wellsite and VSP Surveys	Change in habitat quality (N)	• Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012d)	L	1	1	2	R	2	NS	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		

Key: Magnitude: N = Negligible (essentially no effect) L = Low: <10 percent of the population or habitat in the Study Area will be affected M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected H = High: >25 percent of the population or habitat in the Study Area will be affected Geographic Extent: 1 = <1 km radius 2 = 1 to 10 km radius 3 = 11 to 100 km radius 4 = 101 to 1,000 km radius 5 = 1,001 to 10,000 km radius 6 = >10,000 km radius	Frequency: 1 = <11 events/year 2 = 11 to 50 events/year 3 = 51 to 100 events/year 4 = 101 to 200 events/year 5 = >200 events/year 6 = continuous Duration: 1 = <1 month 2 = 1 to 12 months 3 = 13 to 36 months 4 = 37 to 72 months 5 = >72 months	Reversibility (population level): R = Reversible I = Irreversible Ecological / Socio-cultural / Economic Significance: 1 = Relatively pristine area not affected by human activity 2 = Evidence of existing adverse activity 3 = High level of existing adverse activity	Significance Rating: S = Significant NS = Not Significant P = Positive Level of Confidence: L = Low level of confidence M = Medium level of confidence H = High level of confidence
(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm			

Potential Future Activities

Future activities in the Offshore Project Area may include, but are not limited to, wellsite and VSP surveys, drilling from a MODU, operation of helicopters and vessels and chemical use and management. These activities involve artificial lighting, noise and disturbance.

Change in Habitat Quantity

None of the potential future WREP activities are expected to cause changes in habitat quantity for marine bird species at risk.

Change in Habitat Quality

Wellsite and VSP surveys, drilling from a MODU, operation of helicopters and vessels activities, as well as chemical use and management, could affect habitat quality for at-risk marine birds; an indirect effect could result if discharges affect seabird food resources (i.e., invertebrates and fish). The potential effects of wellsite and VSP surveys, drilling, operation of helicopters and vessels have been discussed previously within Section 12.6.2.2.

Potential Mortality

There is also some potential for direct mortality as a result of collisions with or strandings on artificially lit structures. As discussed above, the effects of artificial lighting on at-risk marine birds are not expected to cause changes in mortality after the application of mitigation.

Summary

The potential environmental effects of future activities are expected to be similar or less than those of construction or operation; therefore, no significant adverse environmental effects are predicted.

Accidental Events

Spills in the Offshore Study Area could be associated with a subsea hydrocarbon blowout, surface oil spills, or fuel spills from vessels. Oil spill modelling for the WREP in the Offshore Study Area indicates that a diesel fuel spill was estimated to have a slick survival time of 48 hr (SL Ross 2012) and would thus have reduced effects on marine birds compared to a crude oil spill. The different types and probability of spills are discussed in Section 3.6.

Oil spill response is included as part of the contingency planning undertaken for the WREP (and additional information regarding spill response for the Offshore Study Area can be found in Section 16.9. Chapter 16 describes the WREP overall environmental management process.

A crude oil blowout of 3,963 to 6,435 m^3/day over 120 days would have a slick survival time of more than 30 days; a subsea blowout would have a thinner, but wider slick (up to 2.8 km) than a surface blowout (up to 3.4 mm thick and 160 m wide) (SL Ross 2012).

The spill would most likely be dispersed to a southeasterly direction, away from the shore. According to the spill modelling (SL Ross 2012), oil is highly unlikely to reach the shore if a spill occurs in the Offshore Study Area. The probability of a crude oil spill reaching shore was zero for December through February and April through September, and less than 1 percent for March, October and November (SL Ross 2012).

SBM whole mud spills, if they accidentally occur from the WREP, would most likely be released at depths greater than those usually used by marine birds and would not affect birds unless a sheen formed at the surface. The muds used are selected for their low toxicity to organisms. The density of SBMs would favour sinking to the sea bottom. Most spills modelled for the WREP were predicted to cover 1,800 m^2 or less (AMEC 2012b). The SBM will biodegrade within weeks to months depending upon water temperature and other physical factors.

Change in Habitat Quantity

As discussed above, hydrocarbon spills are not likely to permanently alter at-risk marine bird habitat quantity. Spill cleanup, weathering and biodegradation would result in eventual recovery of such habitat. SBM whole mud spills are likely to cover small areas, have reversible effects on benthos and occur at depths not usually used by at-risk marine birds. If sheens formed at the surface, there would be very temporary changes in habitat quantity.

Change in Habitat Quality

As discussed above, the presence of hydrocarbons may temporarily affect habitat quality for both oiled and un-oiled birds. Prey availability may be reduced or marine bird species at risk may react by avoidance of affected habitat. Sublethal effects of hydrocarbons ingested by marine birds may affect their reproductive rates or survival rates. Sublethal effects may persist for a number of years, depending upon generation times of affected species and the persistence of any spilled hydrocarbons.

Accidental release of SBM whole muds are likely to occur at depths below those used by at-risk marine birds, thus are unlikely to change habitat quality for marine birds unless a sheen formed at the surface.

Potential Mortality

As discussed above, exposure to hydrocarbons frequently leads to hypothermia and deaths of affected marine bird species at risk. Although some may survive these immediate effects, long-term physiological changes may eventually result in death. Most seabirds are relatively long-lived. In the remote possibility that hydrocarbons released at the WHP site reached the exposed coast, a slick would likely be rapidly weathered and dispersed on the high energy, rocky coastline.

SBM whole mud spills would not be toxic to at-risk marine birds and therefore would not have the potential for mortality except under very exceptional circumstances such as a large surface spill, flat calm conditions, presence of birds on the water, and presence of a thick enough sheen to affect insulation.

Summary

The environmental effects of WREP accidental events on at-risk marine birds are summarized in Table 12-24.

Adverse environmental effects of accidental events (i.e., hydrocarbon spills due to subsea blowouts, batch spills or marine vessel incidents, SBM whole mud spills) in the Offshore Study Area are predicted to be low to high in magnitude, low to high in geographic extent, low to moderate in duration and low in frequency. Although hydrocarbon spills would be significant at the individual level in most cases (Camphuysen 2011), these environmental effects are predicted to be reversible at the population level. Nevertheless, these environmental effects are predicted to be significant. Smaller scale spills and blowouts in calm conditions may be mitigated via oil spill response measures and marine bird rehabilitation; however, these mitigations are recognized to be limited. Husky will practice prevention using safety and risk management systems, management of change procedures and global standards. There will be an emphasis on accident prevention at all phases of the WREP.

12.6.2.3 Cumulative Environmental Effects

Marine oil and gas exploration, commercial fishery activity, marine transportation and existing and future production activity (e.g., White Rose, Hibernia, Terra Nova and Hebron) all have the potential to interact with marine bird species at risk. Hunting of marine birds occurs in the Nearshore Study Area, but the hunting of at-risk species is prohibited. It is unlikely that routine activities associated with other marine exploration, existing production areas, marine transportation and commercial fisheries have substantive environmental effects on at-risk marine birds. The one exception would be an accidental hydrocarbon spill or blowout in the Offshore Study Area.

Nearshore

Cumulative environmental effects in the Nearshore Study Area are expected to be of a lower magnitude than those of the Offshore Study Area, as fewer activities have the potential to interact with the current WREP (see below for cumulative environmental effects assessment of the Offshore Study Area).

The bycatch of marine birds in commercial fisheries has historically been a known source of marine bird mortality, but bycatch of marine birds in commercial fisheries (e.g., inshore gill netting) has declined sharply since 1992 (Piatt and Nettleship 1987; Benjamins et al. 2008). However, Harlequin Duck, Red Knot and Ivory Gull are not known to have suffered bycatch.

Table 12-24 Environmental Effects Assessment for Marine Bird Species at Risk: Accidental Events

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects [(A)]						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		
SBM Whole Mud Spill	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Training, Preparation, Equipment Inventory, Prevention and Emergency Response Drills	H	3	1	2	R/I[(B)]	2	NS	H
Subsea Blowout	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Training, Preparation, Equipment Inventory, Prevention and Emergency Response Drills	H	3	1	3	R/I[(B)]	2	S	H
Hydrocarbon Surface Spill	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Training, Preparation, Equipment Inventory, Prevention and Emergency Response Drills	H	3	1	2	R/I[(B)]	2	S	H
Other Spills (e.g., Fuel, Waste Materials	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Training, Preparation, Equipment Inventory, Prevention and Emergency Response Drills	H	1	1	2	R/I[(B)]	2	S	H
Marine Vessel Incident (including Collisions) (i.e., Marine Diesel Fuel Spill)	Change in habitat quality (N) Potential mortality (N)	• Oil Spill Response Plan • Training, Preparation, Equipment Inventory, Prevention and Emergency Response Drills	M	2	1	2	R/I[(B)]	2	S	H

WREP Activity	Potential Positive (P) or Negative (N) Environmental Effect	Mitigation Measure	Evaluation Criteria for Assessing Environmental Effects (A)						Significance Rating	Level of Confidence
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological / Socio-cultural / Economic Significance		

Key:

Magnitude:
N = Negligible (essentially no effect)
L = Low: <10 percent of the population or habitat in the Study Area will be affected
M = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected
H = High: >25 percent of the population or habitat in the Study Area will be affected

Geographic Extent:
1 = <1 km radius
2 = 1 to 10 km radius
3 = 11 to 100 km radius
4 = 101 to 1,000 km radius
5 = 1,001 to 10,000 km radius
6 = >10,000 km radius

Frequency:
1 = <11 events/year
2 = 11 to 50 events/year
3 = 51 to 100 events/year
4 = 101 to 200 events/year
5 = >200 events/year
6 = continuous

Duration:
1 = <1 month
2 = 1 to 12 months
3 = 13 to 36 months
4 = 37 to 72 months
5 = >72 months

Reversibility (population level):
R = Reversible
I = Irreversible

Ecological / Socio-cultural / Economic Significance:
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse activity
3 = High level of existing adverse activity

Significance Rating:
S = Significant
NS = Not Significant
P = Positive

Level of Confidence:
L = Low level of confidence
M = Medium level of confidence
H = High level of confidence

(A) Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm
(B) Reversible at the population level but irreversible at the individual level

Offshore

The effects of illumination on structures and vessels, air emissions, discharges, underwater sound, accidental hydrocarbon spills from exploration vessels, existing production drilling platforms and vessels, other exploratory drilling structures and platforms may have cumulative environmental effects with WREP activities and WREP accidental events.

Marine bird species at risk may be attracted to the lights of offshore structures and vessels at night and during periods of poor visibility. As a result, they may strand on offshore platforms, as discussed above, although Ivory Gull is primarily diurnal and is not prone to light attraction. The stranding of birds at offshore platforms is largely mitigated by bird handling and release protocols so that any cumulative environmental effects, if they occur, would be low in magnitude and not significant.

The WREP will create additional emissions to the atmosphere, but air emissions from one drilling operation will be relatively small in scale and within the range of other offshore marine activities such as marine shipping. Emissions will very rapidly dissipate in the windy offshore environment and will not endanger the health of at-risk marine birds since any exposures will be of very low concentrations and durations. Any cumulative environmental effects are considered negligible.

Drill mud and other discharges are regulated by the OWTG and the quantities involved, geographic extents and magnitudes are small. There are few pathways for drill mud/ cuttings discharges to affect marine birds, other than the potential exception of a sheen of SBM from accidental release of whole mud under flat calm conditions. As described for the effects of discharges on at-risk marine birds, any cumulative environmental effect is considered not significant.

As discussed above, bycatch of marine birds in commercial fisheries has declined sharply since 1992 (Piatt and Nettleship 1987; Benjamins et al. 2008). However, Ivory Gull is not known to be susceptible to effects from commercial fishing.

As described in the assessment above, underwater sound has the potential to disturb marine bird species at risk that spend prolonged periods submerged near a loud sound source. Ivory Gull is the only at risk marine birds found in Newfoundland and Labrador offshore waters and rarely dives for long or to more than a few metres below the surface. Avoidance or behavioural disturbance is the most likely effect of underwater sound produced by offshore operations associated with the WREP or other nearby operations, but these effects are expected to be low in magnitude and only affect a small area. Thus, it is predicted that cumulative environmental effects of underwater sound on at-risk marine birds are not significant.

A major spill or blowout on the Grand Banks could affect Ivory Gull, although the pack ice it usually associates with rarely reaches the outer part of the banks. A major spill is statistically very unlikely to coincide among various operations on the Grand Banks. Nevertheless, cumulative environmental effects could occur from chronic discharges of oil bilges at sea by ships transiting the area or from other activities that could affect at-risk marine birds. A major oil spill could significantly affect marine bird species at risk on the Grand Banks and thus result in a significant cumulative environmental effect when considered in addition to other stressors on bird populations (e.g., hunting, bycatch in commercial fishing, or oiling from bilge dumping). However, petroleum hydrocarbons from a deep-water blowout may be considerably reduced when it reaches the surface, and the wind and wave conditions typical of the Grand Banks will further aid in the dispersal of petroleum hydrocarbons. Spill countermeasures and marine bird rehabilitation would additionally reduce potential cumulative environmental effects.

12.6.2.4 Determination of Significance

The determination of significance is based on the definition provided in Section 12.2. It considers the magnitude, geographic extent, duration, frequency, reversibility and ecological context of each environmental effect with the Study Area, and their interactions, as presented in the preceding analysis. Significance is determined at the population level within the Study Area.

Adverse environmental effects of accidental events (i.e., hydrocarbon and other chemical spills due to collisions, failure of lines subsea blowouts, batch spills, marine vessel incidents, graving dock breach, SBM whole mud spills) are predicted to be low to high in magnitude, low to high in geographic extent, low to moderate in duration and low in frequency. Although hydrocarbon spills would likely be significant at the individual level, these environmental effects are predicted to be reversible at the population level. Nevertheless, the environmental effects of hydrocarbon spills are predicted to be significant. Smaller scale spills and blowouts in calm conditions may be mitigated via oil spill response measures and marine bird rehabilitation; however, these mitigations are recognized to be limited. Husky will adhere to safety and risk management systems, management of change procedures, and global standards. There will be an emphasis on accident prevention at all phases of the WREP.

The significance of potential residual environmental effects, including cumulative environmental effects, resulting from the interaction between WREP-related activities and marine birds, after taking into account any proposed mitigation, is summarized in Table 12-25.

Because the adverse environmental effects of routine WREP activities are predicted to be not significant, the adverse environmental effects of the WREP overall is predicted to be not significant. Given that routine activities associated with the WREP are localized, of low to medium magnitude and reversible, environmental effects on marine bird Species at Risk are not expected to contravene the prohibitions of SARA (Sections 32(1), 33, 58(1)).

Table 12-25 Residual Environmental Effects Summary: Marine Bird Species at Risk

Phase	Residual Adverse Environmental Effect Rating (A)	Level of Confidence	Probability of Occurrence (Likelihood)
Construction (B)	NS	H	N/A (C)
Installation of WHP or Subsea Drill Centre	NS	H	N/A
Operation and Maintenance	NS	H	N/A
Decommissioning and Abandonment (D)	NS	H	N/A
Accidental Events	S	H	L
Cumulative Environmental Effects	NS	H	N/A

KEY

Residual Environmental Effects Rating:
S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Level of Confidence in the Effect Rating:
L = Low level of Confidence
M = Medium Level of Confidence
H = High level of Confidence

Probability of Occurrence of Significant Effect:
L = Low Probability of Occurrence
M = Medium Probability of Occurrence
H = High Probability of Occurrence

NA = Not applicable
(A) As determined in consideration of established residual environmental effects rating criteria
(B) Includes all Argentia activities (engineering, construction, tow-out) of the WHP option only
(C) Effect is not predicted to be significant, therefore the probability of occurrence rating is not required under CEAA
(D) Includes decommissioning and abandonment of the WHP and offshore site

12.6.2.5 Follow-up and Monitoring

An EEM program for the nearshore component of the WREP will be developed; the offshore component will be incorporated into the existing EEM for the White Rose field. Chapter 15 of this environmental assessment outlines a proposed process to develop the EEM program. Based on the environmental effects assessment for marine bird species at risk, an at-risk marine bird EEM component is not contemplated at this stage. The nearshore EEM will be developed in consultation with stakeholders, including the public, regulatory agencies and scientific community. The final nearshore EEM design may include at-risk marine bird monitoring; however, that will be determined as the EEM design process progresses.

In the event of a spill, and depending on the nature and size of the spill, marine bird monitoring will be implemented. The details regarding monitoring requirements and protocols will be outlined in the oil spill response plan and will be determined in consultation with the C-NLOPB and Environment Canada.

Husky will continue the current seabird observation program for the White Rose field.