Labrador – Island Transmission Link

Marine Mammals, Sea Turtles and Seabirds in the Strait of Belle Isle: Supplementary Information Review and Compilation

Prepared for:

Nalcor Energy
Hydro Place, 500 Columbus Drive, PO Box 12800
St. John's, Newfoundland and Labrador
Canada A1B 0C9

Contract # LC EV 035

Prepared by:

Sikumiut Environmental Management Ltd.
175 Hamlyn Road, PO Box 39089
St. John's, Newfoundland and Labrador
Canada A1E 5Y7

Project # 021-014

November 29, 2010

EXECUTIVE SUMMARY

Nalcor Energy is proposing to develop the *Labrador – Island Transmission Link* (the Project), a High Voltage Direct Current (HVdc) transmission system extending from Central Labrador to the Island of Newfoundland's Avalon Peninsula. In preparation for, and support of, the Project's environmental assessment, this *Marine Mammals, Sea Turtles and Seabirds: Supplementary Information Review and Compilation* has been completed with the objective to gather, summarize and present existing and available information on marine mammals, sea turtles and seabirds in the Strait of Belle Isle. This study complements information gathered during Project-related surveys of marine mammals and seabirds in the Strait of Belle Isle, and the literature review which accompanied this survey (JWEL 2000), as well as other associated studies by Nalcor Energy.

The Study Area was regional in nature, comprising the Strait of Belle Isle from Port au Choix on the west coast of Newfoundland to the tip of the Northern Peninsula and from Baie Jacques Cartier, Quebec to Chateau Bay, Labrador, encompassing an area of approximately 10,000 km^2.

A major source of information for this study was Fisheries and Oceans Canada (DFO). Additional organizations consulted included Environment Canada, the Bedford Institute of Oceanography, Woods Hole Oceanography Centre, Atlantic Canada Conservation Data Centre, Duke University, North Atlantic Right Whale Consortium, and the University of Rhode Island. An annotated bibliography including relevant papers, reports, data sources and personal communications is included as an appendix to this report.

Information on marine mammals, including whales (cetaceans) and seals (pinnipeds) in the Study Area was identified, compiled and reviewed. Recent information collected on marine mammals since 2000 is largely anecdotal in nature; however some systematic land-based, aerial and shipboard surveys do exist. Both anecdotal records and scientific studies and surveys were reviewed, and included information from the DFO historical sightings database, the Trans North Atlantic Sightings Survey, as well as from the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations database, and the Community Coastal Resource Inventory database. A review of information on sea turtles in the Study Area revealed that only a few records of sea turtle sightings exist in the Gulf of St. Lawrence, which likely indicates that sea turtles do not frequent this area.

A review of seabirds in the Study Area included information on migration patterns, nesting and important bird areas and nesting areas of both seabirds and shorebirds. The information contained in the Eastern Canadian Seabirds At Sea database and the historical equivalent Programme Intégré de Reserches sur les Oiseaux Pelagiques database (both maintained by the Canadian Wildlife Service) were examined in order to determine timescale trends in relative seabird abundance within the Study Area, including a seasonal and decadal comparison of relative abundance.

Species listed under the *Species At Risk Act* and/or the provincial *Endangered Species Act*, and those that have been designated by the Committee on the Status of Endangered Wildlife in Canada, are identified and discussed as species of special conservation concern.

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

Nalcor Energy is proposing to develop the *Labrador – Island Transmission Link* (the Project), a High Voltage Direct Current (HVdc) transmission system extending from Central Labrador to the Island of Newfoundland's Avalon Peninsula.

The environmental assessment (EA) process for the Project was initiated in January 2009 and is in progress. An Environmental Impact Statement (EIS) is being prepared by Nalcor Energy, which will be submitted for review by governments, Aboriginal and stakeholder groups and the public.

In preparation for, and support of the EA of the Project, this Marine Mammals, Sea Turtles and Seabirds Study has been completed with the objective to gather, summarize and present existing and available information on these marine wildlife in the Strait of Belle Isle area. This information is intended to supplement that collected through marine surveys conducted in the Strait of Belle Isle by Nalcor Energy and reported elsewhere.

1.1 Project Overview

The proposed Project involves the construction and operation of transmission infrastructure within and between Labrador and the Island of Newfoundland. The Project will include the installation and operation of submarine power cables across the Strait of Belle Isle between Labrador and insular Newfoundland.

The proposed transmission system, as currently planned, will include the following key components:

- an ac-dc converter station in Central Labrador, on the lower Churchill River adjacent to the Lower Churchill Hydroelectric Generation Project;
- an HVdc transmission line extending across Southeastern Labrador to the Strait of Belle Isle. This overhead transmission line will be approximately 400 km in length with a cleared right-of-way averaging approximately 60 m wide, and will consist of single galvanized steel lattice towers;
- cable crossings of the Strait of Belle Isle with associated infrastructure, including cables placed under the seafloor through various means to provide the required cable protection;
- an HVdc transmission line (similar to that described above) extending from the Strait of Belle Isle across the Island of Newfoundland to the Avalon Peninsula, for a distance of approximately 700 km;
- a dc-ac converter station at Soldiers Pond on the Island of Newfoundland's Avalon Peninsula; and
- electrodes in Labrador and on the Island, with overhead lines connecting them to their respective converter stations.

Project planning and design are currently at a stage of having identified a 2 km wide corridor for the on-land portions of the proposed HVdc transmission line and 500 m wide corridors for the proposed Strait of Belle Isle cable crossings, as well as various alternative corridor segments in particular areas (Figure 1.1). Potential (alternative) on-land corridors and study areas have also been identified for the proposed electrodes, although the nature, type and location of these electrodes are the subject of ongoing analysis and engineering.

In terms of the proposed Strait of Belle Isle cable crossings, the HVdc transmission line will extend from Central Labrador to a crossing point on the Labrador side of the Strait of Belle Isle. From there, cables will extend under and across the Strait and make landfall on the northwestern side of the Island of Newfoundland's Northern Peninsula. A number of methods will likely be used to protect the cables across the Strait of Belle Isle. Primarily, the currently identified corridors (Figure 1.1) make use of natural sea-bed features to shelter the cables in valleys and trenches to minimize the possibility of iceberg contact or interaction with fishing activity. In order to access these natural deep valleys and to provide further required protection, various cable protection techniques are under consideration, including tunnelling and rock trenching, rock placement and the laying of concrete mattresses over the cables.

Engineering analyses are ongoing to assess these and other potential approaches and techniques for the protection of the subsea cables. The eventual selection of particular approaches and methods for the submarine cable crossings is the subject of on-going analysis, and will be based on water depths, terrain and seabed geology, substrate characteristics, risk exposure, and overall technical and economic viability.

It is these proposed transmission corridors and components that were the subject of Nalcor Energy's environmental baseline study program. Project planning is in progress, and it is anticipated that the Project description will continue to evolve as engineering and design work continue. The EA of the Project will also identify and evaluate alternative means of carrying out the Project that are technically and economically feasible. In conjunction and concurrent with the EA process, Nalcor Energy will be continuing with its technical and environmental analyses of the corridors, in order to identify and select a specific routing for the Project. The eventual transmission routes and locations will be selected with consideration of technical, environmental and socioeconomic factors.

1.2 Study Purpose and Objectives

The objective of this study is to compile and review existing and available information on marine mammals, sea turtles and seabirds in the general area of the proposed submarine cable crossings of the Strait of Belle Isle associated with the *Labrador – Island Transmission Link*. This information will be used in support of the EIS for the proposed Project. The study further supplements the information gathered in the 1998 marine mammal and seabird surveys within the Strait of Belle Isle (and reported separately by JWEL 2000) and other studies by Nalcor Energy.

nalcor energy

FIGURE 1.1

Strait of Belle Isle Study Area: Potential Landing Sites and Corridors

2.0 APPROACH AND METHODS

This study provides regional and Project area environmental baseline information for marine mammals, sea turtles and seabirds in the Strait of Belle Isle by compiling and reviewing existing and available information from the literature as well as data from relevant government and non-governmental agencies. Experts were consulted throughout this process to provide the study team with information and data relevant to the Study Area, and to supplement the information existing in the published literature and elsewhere.

2.1 Study Area

The Study Area for this information review and compilation exercise was regional in nature, and generally comprised the Strait of Belle Isle, from Port au Choix on the west coast of Newfoundland to the tip of the Northern Peninsula and from Baie Jacques Cartier, Quebec to Chateau Bay, Labrador, thereby encompassing an area of approximately 10,000 km^2. The Study Area is presented in Figure 2.1.

Although the primary focus of the analysis and eventual EA is on the area of the proposed Strait of Belle Isle cable crossings themselves, this Study Area encompasses a larger, regional area comprising much of the Strait of Belle Isle, in recognition of the larger marine environment and ecological systems, as well as to provide appropriate regional context.

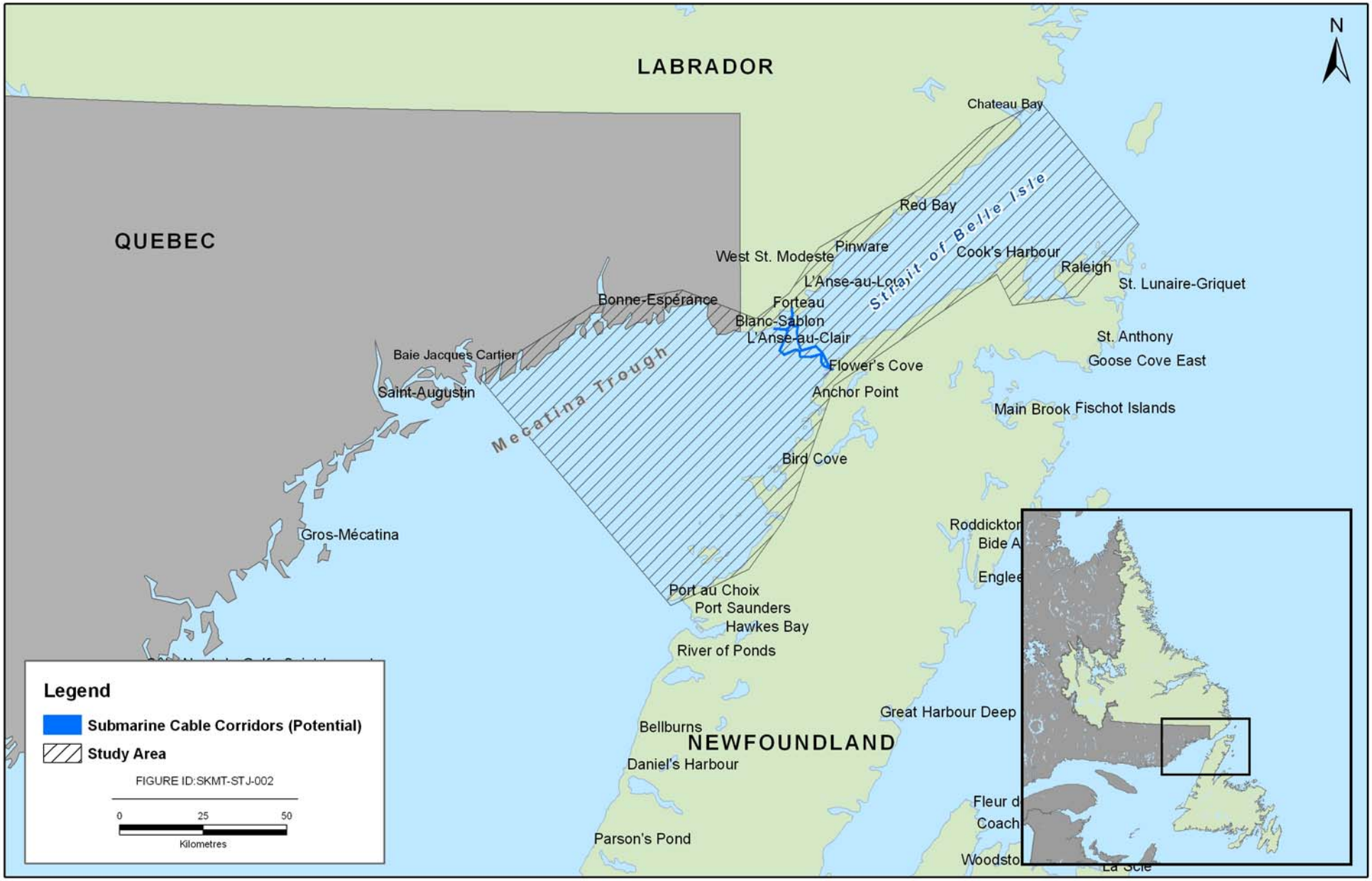
The marine habitat features which are most influential for the distribution of marine mammals, sea turtles and seabirds are described in the ensuing sections. Further details on the marine habitat of the Strait of Belle Isle Study Area, are provided in other reports prepared for Nalcor Energy and reported elsewhere (e.g., AMEC Earth and Environmental 2010; Sikumiut 2010).

2.1.1 **Physical Oceanography**

Physical factors in the ocean, such as currents, tidal mixing and upwelling can significantly influence biological processes. For example, upwelling and vertical mixing in the ocean can create a vertical flux of nutrients, creating areas that are highly productive biologically. The area in the vicinity of the Strait of Belle Isle and coast of the Quebec Lower North Shore has been identified as important for productivity (Savenkoff et al. 2007). High nutrient levels from the Labrador shelf waters enter through the Strait of Belle Isle, as well as tidal mixing and upwelling in the region bring nutrients to the surface (Savenkoff et al. 2007). These processes have resulted in the Strait of Belle Isle and the Mecatina Trough being identified as important feeding areas for pelagic fish species (e.g., capelin and herring), as well as large cetaceans (Savenkoff et al. 2007).

The freshwater outflow from the St. Lawrence River into the estuary is a dominant feature in the oceanography of the Gulf of St. Lawrence, including the Strait. This outflow continues along the north coast of the Gaspé Peninsula. This 'Gaspé Current' is sustained by subsurface upwelling of ocean water and circulates in a counter clockwise flow with most water exiting the Gulf through the Cabot Strait.

The tidal pulse from the Atlantic Ocean enters the Gulf from two directions; through the Cabot Strait and Strait of Belle Isle and tidal energies flow in a counter clockwise fashion increasing in height from a low of 0.6 m (Magdalen Islands) to 5.0 m (Quebec City) (Farquaharson 1970).



nalcor energy

FIGURE 2.1

Strait of Belle Isle Study Area

In relation to stratification, the Strait of Belle Isle is a two-layer system in summer and a homogeneous layer in fall and winter. In summer, the surface layer is 50 to 60 m below the surface with average temperatures reaching between 10 and 11˚C, and average salinities between 30.6 and 32 practical salinity units (psu). Below 60 m, the bottom layer average temperatures range between -0.4 and 3.5˚C, and salinity averages between 31.5 and 32 psu. Conditions in the fall and winter are colder and saltier, with one homogeneous layer beginning to form in October. Average temperatures range from 2.73˚C in November to -1.8˚C in April and the average salinities range from 31.6 psu in November to 33.1 psu in April after which the stratification begins to occur (BIO 2010).

2.1.2 **Sea Ice**

Sea ice located in the Strait of Belle Isle is usually from one of two sources: locally formed sea ice; and pack ice which has drifted from the Labrador Sea or Arctic region. Ice that is formed solely from thermal effects is usually less than 1 metre thick, however sea ice in this region is often formed from collisions of individual floes, creating sea ice several meters thick (Hatch Mott McDonald 2004). Generally, local ice first begins to form in mid to late December, and coverage can last up to 7 to 9 months. Labrador pack ice drifts into the area by late January, and most of the area is generally covered. Ice moves with the wind and currents, and only small portions of it move into the Gulf of St. Lawrence (Hatch Mott McDonald 2004).

2.1.3 **Coastal Zone**

Shoreline habitats at the various potential landing sites for the proposed submarine cable crossing (Forteau Point, L'Anse Amour, Mistaken Cove and Yankee Point) were characterized by AMEC Earth and Environmental (2010). At the Forteau Point site, substrate in the intertidal zone consists of bedrock, bedrock with sand deposits, and boulders, while the backshore consists of grasses, lichens, mosses, shrubs and trees, terminating at the base of cliffs. At the L'Anse Amour site, substrate in the intertidal zone is a beach changing from mostly sand to mostly gravel/cobble while the backshore has three distinct areas: (i) grasses; (ii) grasses with shrubs; and (iii) grasses; shrubs and trees, also terminating at the base of a cliff. The intertidal zone at the Mistaken Cove site consisted of largely exposed bedrock and sand/gravel beaches. The backshore consisted of two distinct vegetation types: (i) grasses and (ii) trees and tuckamore. The Yankee Point intertidal zone was divided into two distinct areas, having (i) bedrock with gravel/pebbles or (ii) gravel. The backshore at Yankee Point consisted of areas with grass and patches of tuckamore located immediately behind the survey area.

The shorelines of discrete reaches of coastline in the Strait of Belle Isle have been classified from aerial video reconnaissance and six shoreline types were delineated: (i) Bedrock cliff; (ii) Bedrock Tidal Flats; (iii) Boulder Tidal Flats; (iv) Gravel Beaches; (v) Sandy Beaches; and (vi) Tidal Mud Flats.

2.2 Methods

The study team has identified, acquired, compiled, reviewed and presented available and existing information on marine mammals, sea turtles and seabirds in the Strait of Belle Isle. The study initially involved conducting a thorough inventory of available information related to the Strait of Belle Isle. The following section presents the approach used in the review and synthesis of relevant information, key sources of information and data, agencies, organizations and persons contacted to acquire the information/data.

2.2.1 **Information Sources**

It was initially determined that a major source of relevant information was Fisheries and Oceans Canada (DFO). Efforts were concentrated on obtaining more recent and relevant information on the Study Area, to supplement a literature review for the same area completed in JWEL (2000). The Strait of Belle Isle Study Area included geographical areas that are the responsibility of two DFO Regions: Newfoundland and Labrador; and Quebec.

The various information/data sources that were examined through discussions with DFO, and through resources available on a variety of associated websites, included:

- DFO Oceans, Habitat Management, and Species at Risk Branch – Newfoundland and Labrador Region;
- DFO Science Branch - Newfoundland and Labrador Region and Quebec Region;
- DFO Science Advisory Reports of the Canadian Science Advisory Secretariat (CSAS) regarding the Large Ocean Management Areas (e.g., GOSLIM);
- DFO Canadian Science Advisory Secretariat (CSAS) Publications including: Science Advisory Reports (SARs), Research Documents, Science Responses, Proceedings of Meetings and Workshops, Stock Status Reports, Ecosystem Status Reports, and Habitat Status Reports (available through the CSAS web site);
- DFO Canadian Technical Report Series of the Journal of Fisheries and Aquatic Sciences;
- DFO Marine Environmental Data Service (MEDS) including the Integrated Science Data Management (ISDM) Databases;
- DFO Atlantic Zone Monitoring Program Database (AZMP);
- DFO Community-based Coastal Resource Inventory (CCRI) Database;
- DFO Gulf of St. Lawrence Integrated Management (GOSLIM) Ecosystem Overview Report (EOR) and associated databases; and
- DFO Libraries and WAVES Database (database of holdings of DFO libraries).

In addition to the above information sources, the study team has also communicated with a variety of DFO Staff to determine the availability of, and acquire access to, additional relevant information and data. A detailed

listing of Personal Communications are provided in Section 5.0, and in general, the following responsible personnel within DFO were contacted:

- Scientists and species experts - Newfoundland and Labrador Region and Quebec Region;
- Section Heads with Science Branch - Newfoundland and Labrador Region;
- Area Habitat Biologist (Western Newfoundland - Newfoundland and Labrador Region);
- Oceans Biologist/GOSLIM Coordinator (Western Newfoundland - Newfoundland and Labrador Region);
- Species at Risk Coordinator - Newfoundland and Labrador Region;
- Biologist, Large Projects Office - Newfoundland and Labrador Region;
- Biologist - Coastal Resource Inventory Program - Newfoundland and Labrador Region; and
- CSAS Coordinator - Newfoundland and Labrador Region.

Government of Newfoundland and Labrador:

- Department of Environment and Conservation;
- Department of Fisheries and Aquaculture; and
- Department of Labrador and Aboriginal Affairs.

Universities, Institutions, and other Organizations:

- Memorial University of Newfoundland (MUN), including the Marine Institute and the Oceans Sciences Centre;
- Bedford Institute of Oceanography;
- Woods Hole Oceanographic Centre;
- University of Rhode Island;
- Duke University – Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP);
- North Atlantic Right Whale Consortium;
- Atlantic Canada Conservation Data Centre (ACCDC); and
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status reports.

In addition to identifying and exploring the various information sources available directly from government agencies, universities, and institutions, the study team conducted both a physical and computerized search of published literature available through Memorial University of Newfoundland. This included the following sources and databases:

- Aquatic Sciences and Fisheries Abstracts (ASFA);
- GEOSCAN;
- Newfoundland and Labrador Archives; and
- Google Scholar.

Other information sources that were examined but subsequently determined to have limited or no relevant information included:

- Offshore Labrador Biological Studies (OLABS) program reports (circa 1978-1982) – Mostly offshore studies;
- National Oceanic and Atmospheric Administration (NOAA) Strategic Environmental Assessment (SEA) of the Atlantic Coast – Limited information for the Study Area;
- Canada Newfoundland Labrador Offshore Petroleum Board's (C-NLOPB) Strategic Environmental Assessment (SEA) of the Labrador Shelf Offshore Area – Mostly offshore but some relevant literature sources were identified;
- Studies conducted by Hydro Quebec for the Romaine River Hydro Development EIS – Not relevant to the Study Area; and
- International Council for Exploration of the Sea Reports and publications – Publications restricted to offshore areas.

2.2.2 **Data Compilation and Analysis**

Information and data were compiled for the Study Area and reviewed for relevancy. An annotated bibliography (Appendix A) was produced and includes relevant papers, reports, data sources and personal communications. Information sources that are relevant to the Study Area are included in the annotated bibliography, but were not necessarily used and cited directly in the report. Information sources used in the report to provide general information about species biology were not included in the annotated bibliography, since the annotated bibliography provides only relevant information on the Study Area.

2.3 Study Team

The study team was led by Larry LeDrew, Project Manager, with senior advice provided by Leroy Metcalfe and Dr. Thomas Smith. Suzanne Thompson conducted the literature review and participated in report preparation for marine mammals and sea turtles, and Dr. Bill Montevecchi conducted the literature review and report preparation for seabirds and Grant Vivian prepared the maps and figures (Table 2.1). Appendix B provides a more detailed biography of team members.

Table 2.1 Study Team Roles and Responsibilities

Name	Role	Responsibilities
Larry LeDrew, M. Sc.	Project Manager	Project management, client liaison, report review
Leroy Metcalfe, B.Sc.	Advisor	Report review
Thomas Smith Ph.D	Senior Advisor	Senior review
Bill Montevecchi, Ph.D	Researcher	Report preparation
Suzanne Thompson, B. Sc.	Biologist – Researcher	Data compilation, analyses, interpretation and report preparation
Grant Vivian, B. Tech.	Geomatics Specialist	Geomatics and mapping support

3.0 RESULTS AND DISCUSSION

This section provides an overview of the results of the information review and compilation, including an outline of the major sources of information used for this study. A thorough description and discussion of the marine mammals, sea turtles and seabirds which are present in the Study Area is provided.

3.1 Major Information Sources

The Gulf of St. Lawrence (including the Strait of Belle Isle) has been designated as a Large Ocean Management Area (LOMA) by DFO. LOMAs are delineated on an ecosystem basis and are established to advance collaborative management through an Integrated Management approach. A considerable amount of the information used in the preparation of this report was compiled and reviewed by the Gulf of St. Lawrence Integrated Management (GOSLIM) project (DFO 2006, 2007; Savenkoff et al. 2007).

During the establishment of GOSLIM, a zonal workshop was undertaken in 2006 (DFO 2006) to identify Ecologically and Biologically Significant Areas (EBSAs) within the GOSLIM. This process required the identification of important areas in terms of the ecological functions they fulfill and/or their structural properties. Three criteria are used to determine ecological and biological significance: (i) uniqueness, (ii) aggregation, and (iii) fitness consequences (Savenkoff et al. 2007).

Eight thematic layers were identified, examined separately and then combined to determine EBSAs within the GOSLIM region:

- topography and physical processes;
- primary production;
- secondary production;
- meroplankton (fish and invertebrate larvae);
- benthic invertebrates (e.g., molluscs, crustaceans, anthozoa);
- pelagic fish;
- demersal fish; and
- pinnipeds and cetaceans.

During this exercise, the Strait of Belle Isle was identified as an Important Area (IA) for the following four thematic layers:

- *primary production* - important for Labrador Shelf waters entering through the Strait, tidal mixing and upwelling;
- *benthic invertebrates* - high abundance of limited species (Circumpolar Eualid - *Eualus gaimardii* and Greenland lebbeid –*Lebbeus groenlandicus*);

- *pelagic fish* - high concentration of capelin, and high feeding concentration of spiny dogfish (*Squalus acanthias)*, Atlantic herring (*Clupea harengus*), and sandlance (*Ammodytes* sp.)*,* as well as spawning for herring; and
- *pinnipeds and cetaceans* - high biomass and aggregation of piscivorous marine mammals and feeding area for large cetaceans (Savenkoff et al. 2007).

Information on marine mammals including whales and seals in the Gulf of St. Lawrence was reviewed in Lesage et al. (2007) in support of this initiative, and includes a detailed summary of information and a comprehensive literature review for the Gulf of St. Lawrence, including the Strait of Belle Isle. This report was used extensively in identifying information sources for marine mammals, as well as relevant details regarding the Study Area. The other thematic layers referenced above, are described in Sikumiut (2010).

Information on seabirds in the Study Area was compiled primarily by Dr. Bill Montevecchi, a regional expert in seabird ecology. Other sources include sightings and information from Canadian Wildlife Service (CWS), including the Eastern Canadian Seabirds At Sea (ECSAS) database, and the historical equivalent Programme Intégré de Reserches sur les Oiseaux Pelagiques (PIROP) database.

3.2 Marine Mammals

In the ensuing sections, recent information sources for marine mammals in the Strait of Belle Isle are discussed in detail, and selected species are examined. This includes information regarding cetaceans (whales) both baleen whales (Mysticeti) and toothed whales (Odontoceti), and pinnipeds (seals). Species of special conservation concern are discussed in further detail in Section 3.5.

Information collected on marine mammals in the Strait of Belle Isle since the publication of JWEL (2000) has been relatively anecdotal in nature; however some systematic land-based, aerial and shipboard survey data does exist (Lawson et al. 2007; Lesage et al. 2007; Lawson and Gosselin 2009; Stenson et al. 2010; Hammill and Stenson 2010). Both anecdotal records and scientific studies and surveys are discussed.

3.2.1 **Scientific Studies and Systematic Surveys**

Marine mammals, including whales and seals, have been observed using the Strait of Belle Isle area for migratory, feeding and reproduction purposes. Due to the high cost of dedicated surveys, the frequency and geographical coverage are often limited for a particular area of interest. It should also be noted that caution should be used when interpreting information collected from surveys since many of these rely on “at surface” sightings (Lesage et al. 2007). This type of information can be biased toward species with higher detectabilities (i.e., larger species, and those with aggregative behaviour, or spend more time at the surface). Seasonal changes in the area can affect sightings of mammals due to seasonal migrations, and therefore interpretation of information collected from surveys conducted in the area depend on season, especially for seal species (Sjare, 2010, pers. comm.).

DFO conducted a large-scale aerial survey of marine megafauna in the northwest Atlantic during the summer of 2007 as part of the Trans North Atlantic Sightings Survey (TNASS), which extends from northeastern United States to the United Kingdom (Lawson and Gosselin 2009). This was the first systematic effort to provide

coverage for much of the Canadian seaboard, and the first in more than two decades to survey the continental shelf along the Labrador and Newfoundland coasts for marine mammals, sea turtles and other species (Lawson and Gosselin 2009). The TNASS study objectives included an effort to estimate the abundance and distribution of marine megafauna in Atlantic Canadian waters. Where sufficient data existed, abundance and distribution was estimated for species of marine mammals (11 whale species) and the leatherback turtle.

During the TNASS survey, eight species of marine mammals were identified in the Strait of Belle Isle Study Area: beluga (*Delphinapterus leucas*); blue whale (*Balaenoptera musculus*); fin whale (*Balaenoptera physalus*); harbour porpoise (*Phocoena phocoena*); humpback whale (*Megaptera novaeangliae*); minke whale (*Balaenoptera acutorostrata*); Atlantic white-beaked dolphin (*Lagenorhynchus albirostris*); and white-sided dolphin (*Lagenorhynchus acutus*). Groupings of humpback whales were sighted more often in the Study Area than other species, while higher numbers of individual white-beaked dolphins were sighted during the survey in the Strait of Belle Isle than other species in the area, and had higher numbers in that area than other areas surveyed.

As discussed previously, during the identification and characterization of EBSAs for the GOSLIM, Lesage et al. (2007) identified important areas for marine mammals. Data were compiled from three aerial surveys: one in each of 1995 and 1996, as previously reported in Kingsley and Reeves (1998), and one in 2002. As well, data from telemetry studies in the Gulf of St. Lawrence for grey seals (*Halicoerus grypus*) and hooded seals (*Cystophora cristata*) for home range analysis were used (Lesage et al. 2007). For the area of the Strait of Belle Isle, including the Mecatina Plateau, at least 14 species of marine mammals were identified: grey seal; harbour seal (*Phoca vitulina)*; hooded seal; harp seal (*Pagophilus groenlandicus*); minke whale; blue whale; fin whale; humpback whale; killer whale; harbour porpoise; Atlantic white-sided dolphin; white-beaked dolphin; short-beaked common dolphin (*Delphinus delphis*); and long-finned pilot whale (*Globicephala melas*). With the exception of hooded seal, all of these species occur within the Strait of Belle Isle and the Mecatina Plateau with some regularity between May to December. Harp seals, hooded seals, and possibly fin whales occur regularly between December and May (Lesage et al. 2007). This data compilation study identified the Strait of Belle Isle as having a feeding function for diverse and high biomasses of megafauna; migration function during spring and fall and a reproduction function during winter for seals. Unique bathymetric characteristics result in persistent zooplankton aggregation in the Study Area (Sourisseau et al. 2006), resulting in the area supporting high biomasses of diverse megafauna (especially humpback whales) during certain periods of the year.

Richard Sears of the Mingan Island Cetacean Study (MICS), a not-for-profit organization, occasionally conducts surveys of marine mammals from St. Augustine to Blanc Sablon (Sears, 2010, pers. comm.). Data collected by Mr. Sears contains mostly boat-based surveys, although he has conducted coastal surveys in the Gulf of St. Lawrence in the 1980s (Sears and Williamson 1982). The last survey was conducted in 2006. Although an abundance of data have been collected, very few publications have been prepared (Sears, 2010, pers. comm.). Mr. Sears does have a photographic catalogue of certain species (e.g., blue whale). Details about Mr. Sears and the MICS can be found online (MICS 2010).

3.2.2 **Anecdotal Information**

Information sources for marine mammals in the Strait of Belle Isle are for the most part anecdotal in nature, and depend on sightings from fishers, tourists, as well as records of entrapments in fishing gear and strandings. The existing historical databases were previously reviewed in JWEL (2000), which did not include the

Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) and associated datasets. This is a spatially referenced online database for marine mammal, seabird and sea turtle data from around the world (OBIS-SEAMAP 2010). This database contains sightings data from various sources and data providers in the Strait of Belle Isle and was used to map species distributions/sightings in the Strait of Belle Isle region. Several datasets include sightings in the Strait of Belle Isle Study Area:

- The University of Rhode Island, Bureau of Land Management, Cetacean and Turtle Assessment Program (CETAP) includes opportunistic sightings of whales, dolphins and sea turtles, and population surveys conducted from 1978 to 1982;
- The Allied Humpback Whale Catalog by the College of the Atlantic, Allied Whale includes sightings of humpback whales between 1976 and 2003; and
- Years of the North Atlantic Humpback Whale (YoNAH) Encounter, which is a collaboration led by Peter Stevick, University of Southern Maine, includes humpback whale sightings, plus photos, genetic sampling and behaviour data from 1992 to 1993.

Data were also provided by Dr. Jack Lawson at DFO (DFO 2010b). Dr. Lawson maintains a sightings database of marine mammals, and includes mostly anecdotal sightings of marine mammals, with most data gathered from platforms of opportunity that were vessel-based. The quality of the data is unknown, and depends on factors such as the observer experience, sighting effort, platform limitations, and sea state. These factors and the inherent problem of cetacean negative or positive reactions to the approach of such vessels have not been factored into the data. True species density or areal abundance cannot be estimated, since sighting effort has not been quantified in most cases. For completeness, these data represent an amalgamation of sightings from a variety of years and seasons. Hence they may obscure temporal or areal patterns in distribution (e.g., the number of pilot whales sighted in nearshore Newfoundland appears to have declined since the 1980s, even though the total number sighted in the overall database suggest they are relatively common). These data are undergoing a continuing process of error-checking. Sighting data are continually being received and entered, so the present dataset is incomplete, although new data will represent a small portion of the total (Lawson, 2010, pers. comm.). For these reasons, the sightings database is mapped for illustration purposes only, to give an indication of the sightings of various species in the Study Area.

Another source of information for this study has been the DFO led CCRI. There are three inventories for the Study Area including:

- Northern Peninsula East Coastal Resource Inventory
- Northern Peninsula West Coastal Resource Inventory
- Labrador Straits Coastal Resource Inventory

These data compilations were intended as a tool to support integrated coastal zone management, environmental assessment, sensitivity mapping, sustainable economic development planning and other potential resource developments. These inventories were compiled in partnership between government agencies (primarily DFO, Environment Canada, Newfoundland and Labrador Department of Fisheries and Aquaculture) and local development associations. A review of the CCRI information determined that it was

of considerable relevance to the study, including a collection of marine mammal sightings. It is important to highlight that much of the data contained in these inventories are local ecological knowledge based, collected through interviews, and therefore are considered anecdotal in nature.

Sightings of marine mammals in this database included whales, seals, walruses (*Odobenus rosmarus*) and polar bears (*Ursus martimus*). Due to the inconsistencies in species identifications, whales were placed in one category, while seals were placed in a separate category. Sightings information is presented in Figure 3.1. The database included two sightings of polar bears, one walrus sighting, and one sea turtle sighting in the Strait of Belle Isle Study Area.

3.2.3 **Whales (Cetaceans)**

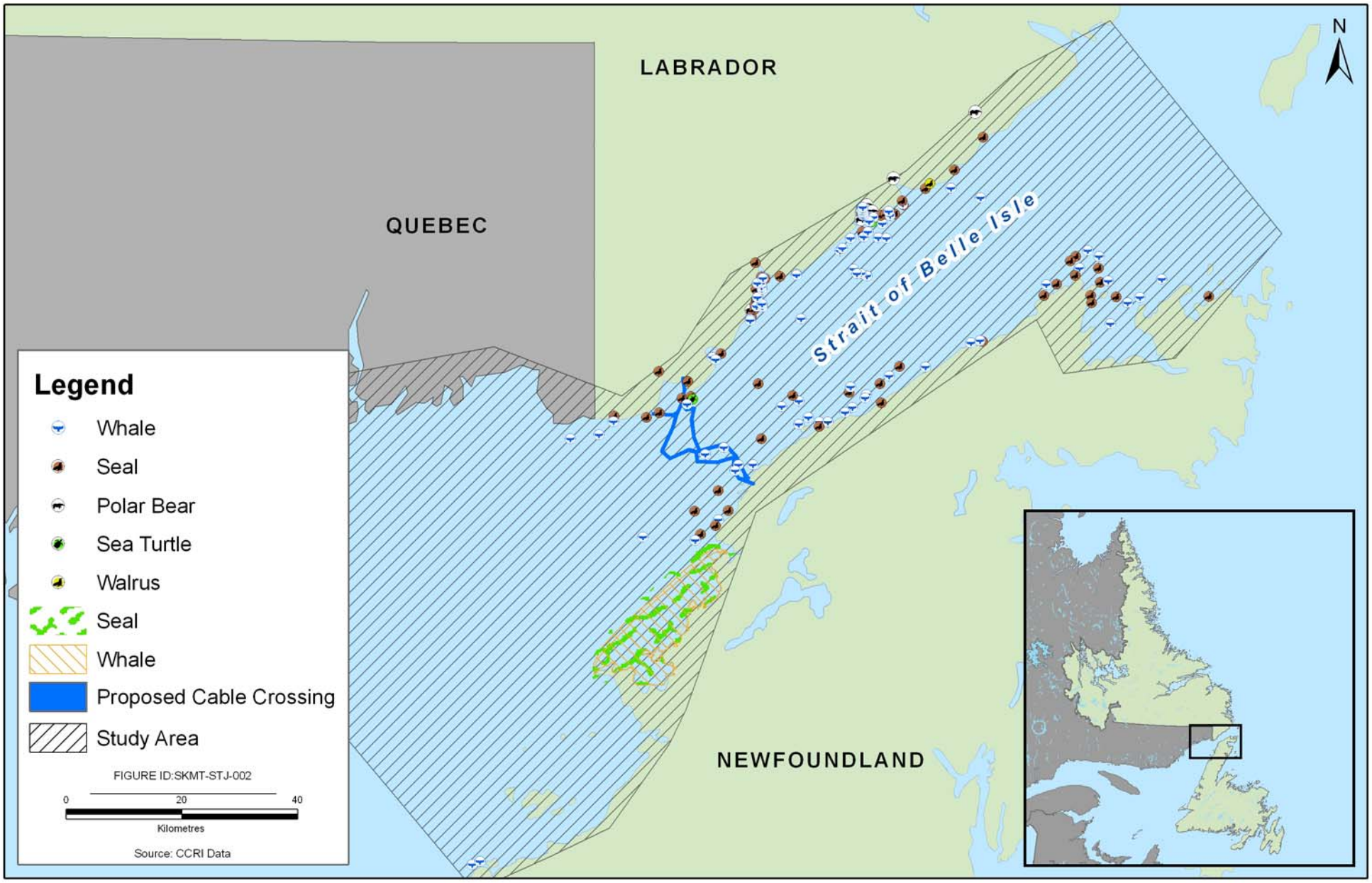
Both baleen and toothed whales have been known to occur in the Study Area. As previously noted, the Strait of Belle Isle has been identified as an important area for marine mammals in the Gulf of St. Lawrence (DFO 2006, 2007; Lesage et al. 2007). Lawson and Gosselin (2009) provide the most recent estimates of the distribution and abundance of several marine mammals in Atlantic Canada, including in the Gulf of St. Lawrence. Several of these species are considered under the *Species At Risk Act* (*SARA*) or by COSEWIC, and are therefore discussed in further detail in Section 3.5. Historically bowhead whales (*Balaena mysticetus*) were also captured by Basque whalers in the Strait of Belle Isle, however, there are no modern reports of these animals in this area (Barkham 1984; Rastogi et al. 2004). North Atlantic right whale (*Eubalaena glacialis*) were also thought to be captured in this area, although recent genetic studies suggest that this is likely not true (Rastogi et al. 2004).

3.2.3.1 **Baleen Whales (Mysticetes)**

Baleen whales identified as frequently using the Strait of Belle Isle include: humpback whale; blue whale; fin whale (*Balaenoptera physalus*); and minke whale. Sei whale (*Balaenoptera borealis*) have also been identified in historical data, although these sightings are rare. Historical sightings of baleen whales in relation to the Study Area are presented in Figure 3.2, as taken from the OBIS-SEAMAP database, and data provided by DFO (2010b).

Humpback Whale

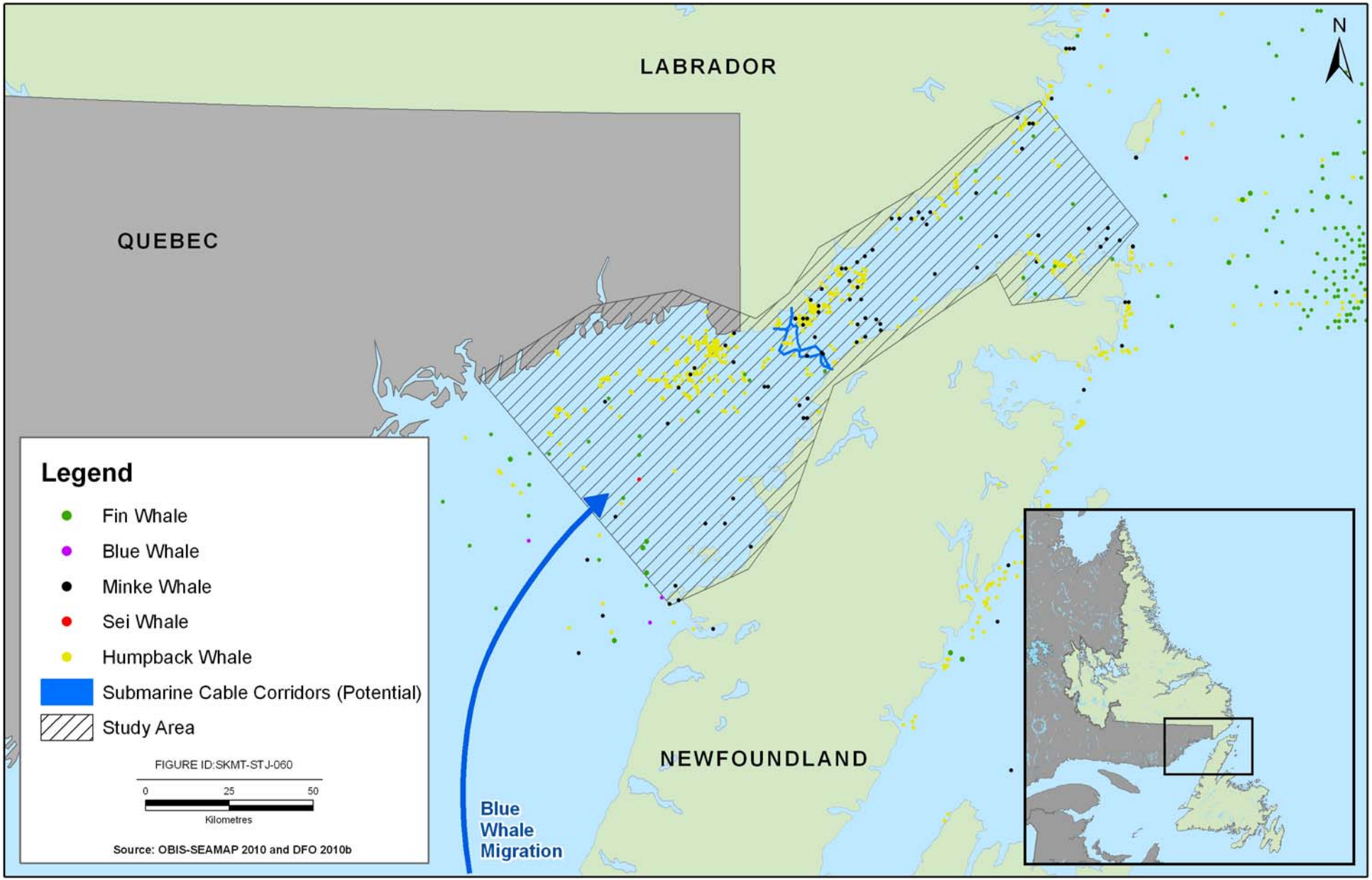
Humpback whales sightings in the Strait of Belle Isle are quite common, as cited by several studies (Lesage et al. 2007; Lawson and Gosselin 2009). They are regular visitors in the Gulf of St. Lawrence during the ice-free period (Lesage et al. 2007) and are known to breed and overwinter in southern climes. In the Gulf of St. Lawrence, humpback whale sightings appear to be in concentrations in the northern Gulf sectors including the Strait of Belle Isle/Mecatina Plateau (Lesage et al. 2007). Winter occurrence in the Gulf of St. Lawrence has been largely undocumented, and only anecdotal reports suggest that they are present at least through to mid to late January, with most sighted off Gaspé (Lesage et al. 2007). It is not known how large the population is in the Gulf of St. Lawrence, however, there are an estimated 2,500 individuals in Canada (Conestoga-Rovers & Associates 2008). The humpback whale is listed under Schedule 3 of the *SARA* as 'Special Concern', and is therefore not officially protected.



nalcor energy

FIGURE 3.1

Anecdotal Sightings of Marine Mammals and Sea Turtles



nalcor energy

FIGURE 3.2

Historical Baleen Whale Sightings

Blue Whale

In spring, summer and fall, the blue whale population in Canada is distributed along the north shore of the Gulf of St. Lawrence, from the St. Lawrence River estuary to the Strait of Belle Isle, and off eastern Nova Scotia. In the winter they are concentrated off the south coast of Newfoundland. They are also known to summer in the Davis Strait (Waring et al. 1999). Distributional data for blue whales in the Gulf of St. Lawrence are scarce; however they have been detected historically in the Strait of Belle Isle area (Lesage et al. 2007). There are an estimated 50 to 105 individuals in the Gulf of St. Lawrence each year (Conestoga-Rovers & Associates 2008). Only six blue whales were detected in the Gulf during the TNASS surveys conducted in the summer of 2007 (Lawson et al. 2007). Although only infrequently sighted, blue whales have been also spotted near Blanc Sablon during the spring (Sears, 2010, pers. comm.). Blue whales are considered 'Endangered' under the *SARA* (Schedule 1).

Fin Whale

Fin whales regularly visit the Gulf of St. Lawrence, and historical records indicate their presence between Pointe-des-Monts and Sept-Îles to the west of Anticosti, and in the Jacques-Cartier Strait, associated with thermal fronts (Lesage et al. 2007). Estimates of population are not certain, however the population in the Gulf of St. Lawrence is in the low 100s (Conestoga-Rovers & Associates 2008). Studies described in Lesage et al. (2007) observed fin whales exclusively in the northern and northeastern Gulf of St. Lawrence, although this distribution may be due to low survey effort, both spatially and temporally (Lesage et al. 2007). In the Gulf of St. Lawrence, only six fin whales were detected during the TNASS surveys conducted in the summer of 2007 (Lawson and Gosselin 2009). Fin whales are also known to occur in the St. Lawrence Estuary during the ice-free period, until at least January (Lesage et al. 2007). They are also known to be present in the northern Gulf during the ice-covered period (Lesage et al. 2007). This is substantiated by ice-entrapment reports in historical literature (Sergeant et al. 1970). Fin whales are listed as 'Special Concern' under *SARA* (Schedule 1) and are therefore officially protected.

Minke Whale

Like humpback whales, minke whales are also very commonly sighted in the Strait of Belle Isle (Lesage et al. 2007). Unlike most rorqual species, they do not prefer thermal fronts, but are found on sandy bottom substrates (Lesage et al. 2007). There is no reliable estimate of population in the Gulf of St. Lawrence, although it is thought to be 1000 plus individuals (Conestoga-Rovers & Associates 2008). Minkes have not been assessed by COSEWIC, however their populations appear to be much healthier than those of other baleen whale species (Conestoga-Rovers & Associates 2008).

3.2.3.2 **Toothed Whales (Odontocetes)**

Toothed whales which have been sighted in the Strait of Belle Isle Study Area include; killer whale; long-finned pilot whale; harbour porpoise; Atlantic white-sided dolphin; white-beaked dolphin; and short-beaked dolphin. Historical sightings of toothed whales in relation to the Study Area are presented in Figure 3.3, according to the OBIS-SEAMAP database and data provided by DFO (2010b).

Killer Whale

Killer whales have been sighted in Atlantic Canada, although relatively little is known about this species. Their nomadic way of life makes them difficult to observe and study, and therefore anecdotal information is the largest source of information about this species in the Gulf of St. Lawrence (Whales Online 2010). In the Gulf of St. Lawrence, they are mostly sighted in the Mingan Island area and the Strait of Belle Isle (Lawson et al. 2007; Lesage et al. 2007). They have been sighted in the Study Area ambushing prey such as Atlantic salmon (Sears, 2010, pers. comm.).

Opportunistic sightings data from 1864 to 2007 and a multi-year photographic catalogue of killer whales in Atlantic Canada were examined to determine the status of killer whales by Lawson et al. (2007). Most of the sightings took place between June to September, within the last seven years. These data were used to compile groups of killer whales frequenting waters in Newfoundland and Labrador. No estimates of population in the Northwest Atlantic have been made, however a photographic catalogue of at least 64 individuals found off Newfoundland and Labrador exists (Lawson et al. 2007). The results from this research suggested that the waters off St. Anthony and the Strait of Belle Isle may be important for these whales.

Long-finned Pilot Whale

Long-finned pilot whales have been sighted in the Strait of Belle Isle (Figure 3.3). There is possibly only a few thousand individuals present in the Gulf of St. Lawrence, and there does not appear to be a north to south seasonal migration, although some seasonally migrate between inshore and offshore areas (Conestoga-Rovers & Associates 2008).

Harbour Porpoise

Harbour porpoise have been long observed in the Strait of Belle Isle region (Lesage et al. 2007). Recently there have been particularly high catches of harbour porpoises as by-catch in fishing gear in the Strait of Belle Isle (Lawson et al. 2004; Lesage et al. 2006). This is often evidence of regular occurrence of this species. However, there has not been any evidence of harbour porpoise occurring in the Gulf of St. Lawrence during the winter months (Lesage et al. 2007). The population of harbour porpoises in the Gulf of St. Lawrence is estimated to be somewhere between 36,000 and 125,000, and their migration is not well understood (Conestoga-Rovers & Associates 2008).

Dolphin Species

Three species of dolphins have been sighted in the Strait of Belle Isle Study Area: Atlantic white-sided dolphin; white-beaked dolphin; and short-beaked dolphin. All three are often present in the summer months, where they can be found feeding.

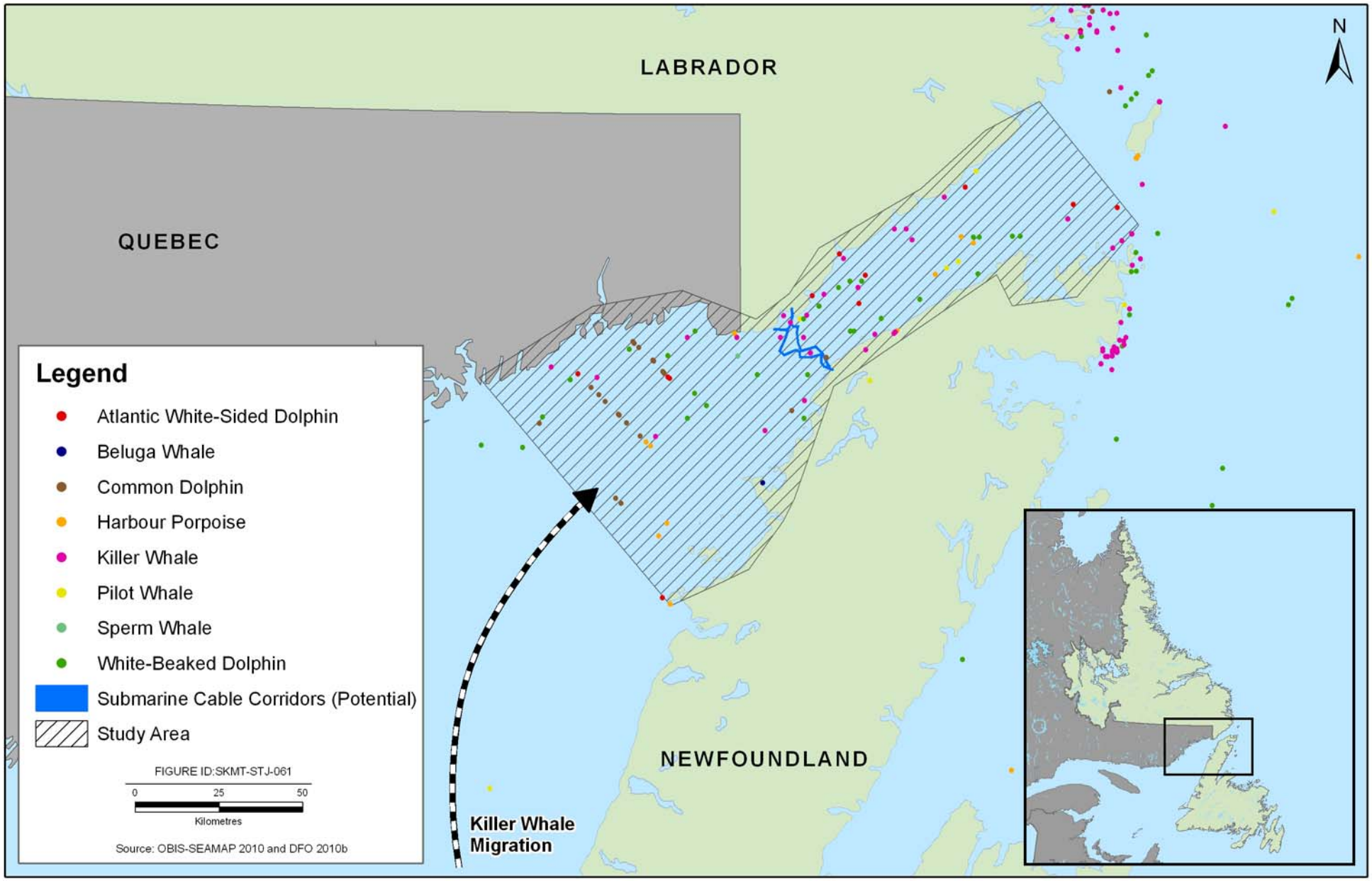
During aerial surveys conducted in 1995, 1996 and 2002, Atlantic white-sided dolphin were generally found in deeper waters in the Gulf of St. Lawrence. They were, however, also found in the shallower waters of the Strait of Belle Isle (Lesage et al. 2007). No reliable estimates of populations exist, although there appears to be 500 to 12,000 individuals in the Gulf of St. Lawrence (Conestoga-Rovers & Associates 2008). They are sporadically found in the Gulf of St. Lawrence, however their migration routes within the area are unknown.

White-beaked dolphin were almost exclusively found in the northeastern Gulf of St. Lawrence, including the Strait of Belle Isle, during aerial surveys conducted during the summers of 1995, 1996 and 2002 (Lesage et al. 2007). According to studies conducted in 1995 and 1996, the population of white-beaked dolphins is approximately 2,500 in the Gulf of St. Lawrence.

The first documented sightings in the Strait of Belle Isle area of short-beaked dolphin were from data compiled and discussed by Lesage et al. (2007). This also applies to the Gulf of St. Lawrence as a whole, where a total of 243 individuals were sighted (Lesage et al. 2007). Their migration routes in the Gulf of St. Lawrence are therefore unknown.

Other Species

Beluga whales have also been sighted in the Strait of Belle Isle area (e.g., one sighting in the region in 2007 surveys reported in Lawson and Gosselin (2009). Beluga whales are commonly a cold water / Arctic species, however have historically been recorded in the St. Lawrence Estuary, particularly at the mouth of the Saguenay River which has the oceanographic characteristics of an arctic fjord. Although populations have declined (Hammill et al. 2007), beluga whales were the second most commonly sighted cetacean in the Gulf and Scotian Shelf strata during the TNASS Surveys conducted in the summer of 2007 (Lawson and Gosselin 2009). One sperm whale (*Physeter macrocephalus*) was also sighted in the Strait of Belle Isle Study Area in 1993 (DFO 2010b; Figure 3.3).



nalcor energy

FIGURE 3.3

Historical Toothed Whale Sightings

3.2.4 **Pinnipeds (Seals)**

Surveys for pinnipeds (seals) usually take place when a high abundance of different species can be expected to be observed in a specific area (Robillard et al. 2005). Recent surveys conducted in the Gulf of St. Lawrence captured seals in areas further south than they might have been normally expected during that specific time of year (Sjare, 2010, pers. comm.). Species of seals that use the Strait of Belle Isle area include: harp seal; grey seal; harbour seal; and hooded seal. Bearded seals (*Rignathus barbatus*) have also been spotted breeding as far south as Belle Isle, north of the Study Area, and even further south according to anecdotal information (Sjare, 2010, pers. comm.). In general, the Strait of Belle Isle Study Area is used for both migratory purposes and for whelping areas for these species of seals.

Harp Seal

Being the most abundant seal in the Gulf of St. Lawrence, harp seals have an estimated total population of 5.8 million, with approximately one third of that population within the Gulf of St. Lawrence (Lesage et al. 2007). They are known to occur in the Gulf of St. Lawrence between January through April and May, where they are normally hunted (Lesage et al. 2007). Along with hooded seals, they are known to be present in the Strait of Belle Isle between December and May (Stenson et al. 2003).

As part of ongoing resource status assessments, aerial surveys for harp seals are commonly conducted in the Gulf of St. Lawrence, including the Strait of Belle Isle, with recent results of pup production estimates reported in Stenson et al. (2002; 2003; 2005; and 2010). The last harp seal aerial survey within the Study Area was conducted in 2008, with results reported on abundance in Hammill and Stenson (2010), and on pup production in Stenson et al. (2010). Harp seals are known to use the pack ice within the Strait of Belle Isle for whelping (Sjare, 2010, pers. comm.). After the conclusion of whelping, the pups that do not continue with the ice down through the Gulf leaving via the Cabot Strait may migrate through the Strait of Belle Isle in June (Lesage et al. 2007). Knowledge of harp seal distribution and behaviour outside of the ice-free season is mostly through by-catch in various fisheries. The lumpfish fishery, which occurs between April to July, has captured harp seals in the Gulf of St. Lawrence (Sjare et al. 2005), thus substantiating the idea that harp seals may remain in the region during the summer season. Figure 3.4, which was reproduced from DFO (2010a), demonstrates the range, migratory patterns and important whelping areas for harp seals in the Gulf of St. Lawrence.

nalcor energy

FIGURE 3.4

Migratory Patterns and Whelping Concentrations of harp Seals

Grey Seal

Grey seals inhabit continental shelf waters including the Gulf of St. Lawrence and estuary. They are found there seasonally for moulting, feeding and breeding purposes (Conestoga-Rovers & Associates 2008). Grey seals normally enter the estuary of the Gulf in April and May to moult (Lesage et al. 2007). Studies from 1994 to 2001 in the Gulf of St. Lawrence and estuary investigated the distribution and abundance of grey seals (Robillard et al. 2005). These studies also observed haul out habitat for grey seals in the Gulf of St. Lawrence, which included mostly exposed reefs, as well as isolated rocks, sand banks, and reefs connected to land. Pinnipeds usually haul out of the water to areas of ice or land, between periods of foraging for different reasons, including breeding or predator avoidance. Grey seals were also observed on rocky ledges on shore near steep cliffs (Robillard et al. 2005).

Grey seals represent the second most abundant seal species in the Gulf of St. Lawrence, with an estimated 52,000 individuals entering the Gulf to reproduce in 2004, or approximately 20 percent of the total population of the Northwest Atlantic based on pup counts in whelping areas (Hammill and Gosselin 2005; Trzcinski et al. 2006; Bowen et al. 2007). Grey seals have been noted hauling out in sites in the Strait of Belle Isle, and are therefore known to occur there at least during the ice-free period between May to December (Lesage et al. 2007).

Hooded Seal

Hooded seals are said to be a single population in the Atlantic Ocean, and are highly migratory, solitary individuals. For this reason, they may be difficult to detect, although they have been observed in the Strait of Belle Isle during post-breeding migration (Bajzak et al. 2009). Females leave the whelping patch once the pups are weaned, usually in March, move to the northern slope of the Laurentian channel and remain there until early May, at which point they begin their migration to Greenland (Bajzak et al. 2009). Males may also migrate to Greenland this way, but they leave the whelping area at the end of March when breeding ceases and, move to the northern slope of the Laurentian channel for four weeks before beginning their migration (Lesage et al. 2007).

Like harp seals, hooded seals have been known to use the pack ice in the Strait of Belle Isle region (Sjare, 2010, pers. comm.), and may be present in the Study Area between December and May (Stenson et al. 2003). Bajzak et al. (2009) noted that results from tagging studies in the Gulf of St. Lawrence indicated that all of the 23 tagged hooded seals (11 females, 12 males) migrated toward Greenland, most through the Cabot Strait (8 females, 9 males), whereas the others migrated through the Strait of Belle Isle (3 females, 3 males). Figure 3.5, adapted from Bajzak et al. (2009), demonstrates three distinctive and typical migratory tracks for postbreeding hooded seals, through the Gulf of St. Lawrence to Greenland including the Strait of Belle Isle, and the Cabot Strait. Hooded seals spend their summers in the Arctic (Lesage et al. 2007).

FIGURE 3.5

Details of Three Distinctive (Typical) Migratory Routes from the Gulf of St. Lawrence to Greenland for Postbreeding Hooded Seals

Harbour Seal

Harbour seals use the coastal environment and are relatively sedentary throughout most of the year. Atlantic Canada estimates of harbour seals are largely undocumented, and it is considered the least abundant of seal species, having approximately 10,000 to 15,000 individuals, with approximately 4,000 to 5,000 in the Gulf of St. Lawrence (Lesage et al. 2007). Recent information on harbour seal distribution and abundance is scarce, and is lacking for the Quebec Lower North Shore and Western Newfoundland, although older data suggested that this area is used during ice-free period (Robillard et al. 2005; Lesage et al. 2007). Studies in 1994 to 2001 in the Gulf of St. Lawrence and estuary looked at distribution and abundance of harbour seals (Robillard et al. 2005). These studies also observed haul out habitat for harbour seals in the Gulf of St. Lawrence, which included mostly isolated rock substrates, as well as exposed reefs, sand banks, and reefs connected to land. Harbour seals were also observed on rocky ledges on shore near steep cliffs (Robillard et al. 2005). These surveys were conducted throughout the Gulf of St. Lawrence, estuary and the Saguenay River, however little information was collected in the Study Area.

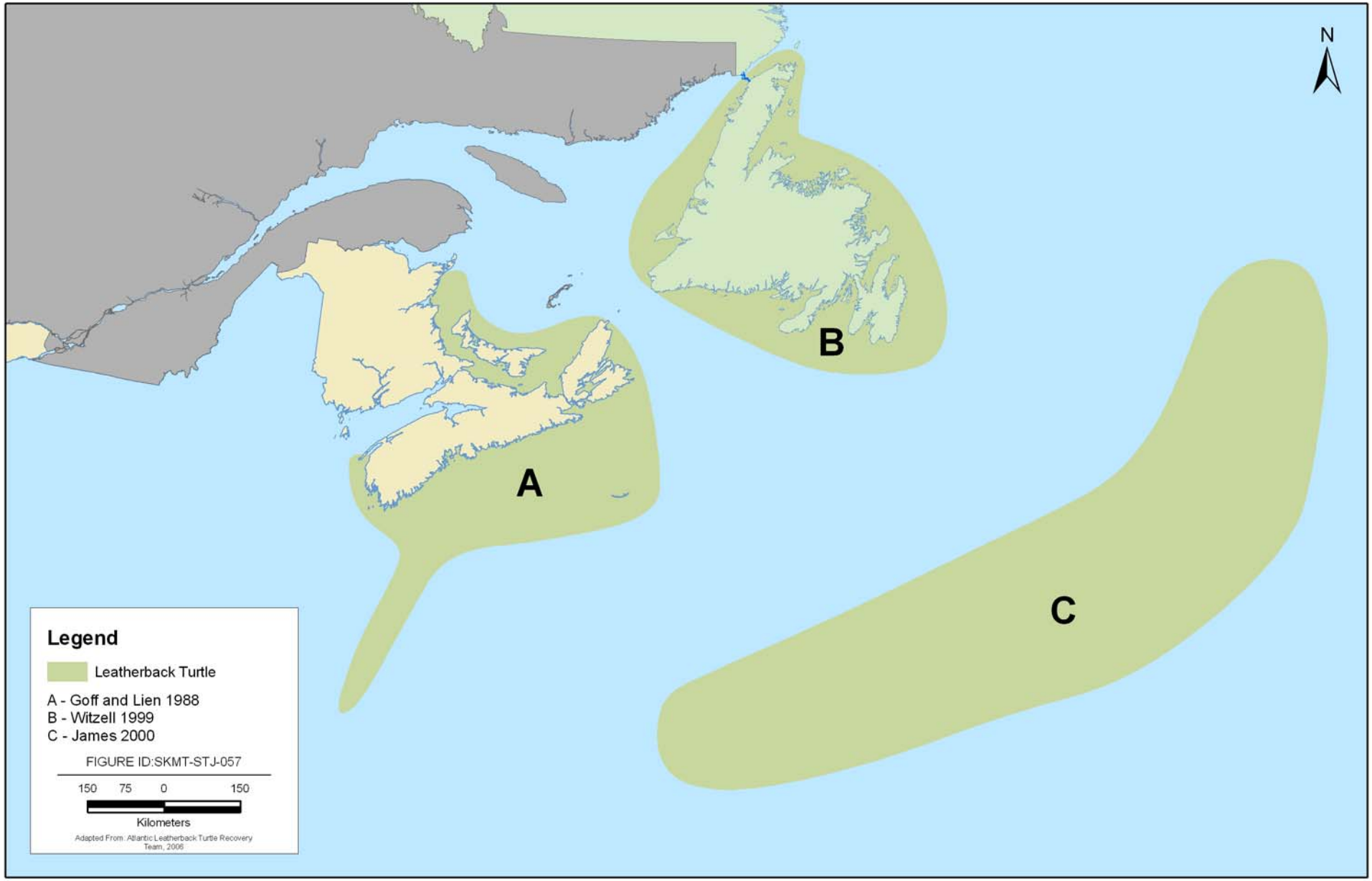
3.3 Sea Turtles

The few records of sea turtle sightings in the Gulf of St. Lawrence indicates that sea turtles are not common in the Study Area (O'Boyle 2001). Two species of sea turtle that could potentially occur in the Strait of Belle Isle are the leatherback turtle (*Dermochelys coriacea*) and the loggerhead turtle (*Caretta caretta*). These are found in the waters off Newfoundland during the summer and fall (Goff and Lien 1988; Marquez 1990; Witzell 1999). The loggerhead turtle is more common off the Atlantic coast, but is found in greater numbers offshore (O'Boyle 2001). The Kemp's ridley turtle (*Lepidochelys kempii*) may also occur in eastern Canada, although little is known about their distribution (Conestoga-Rovers & Associates 2008).

Leatherback Turtle

Leatherbacks can be found in the tropical, temperate and boreal waters of the Atlantic, Pacific and Indian Oceans. The northern most recorded latitude of a leatherback is 71°N and the southernmost is approximately 27°S (Atlantic Leatherback Turtle Recovery Team 2006). These animals appear to mainly use northern waters to forage during the summer and fall, before undertaking a southward migration (Atlantic Leatherback Turtle Recovery Team 2006). This northern distribution encompasses Canadian waters, having a broad seasonal distribution that includes slope waters east of the Fundian Channel, Georges Bank, south coast of Newfoundland, Sydney Bight and the southern Gulf of St. Lawrence (DFO 2004). Few records for the Gulf of St. Lawrence exist, including the Strait of Belle Isle, although one tagged animal entered the Gulf in 2000 (O'Boyle 2001). Leatherback turtles have also been reported off the coast of Labrador (Threlfall 1978). Shoop and Kenney (1992) state that the availability of appropriate food and suitable nesting beaches are probably the two more important factors affecting distribution and abundance of leatherback turtles. Leatherback turtles are listed as 'Endangered' under Schedule 1 of *SARA*, which gives them legal protection and mandatory recovery requirements (Atlantic Leatherback Turtle Recovery Team 2006).

The overall range of leatherback turtles in Atlantic Canada is presented in Figure 3.6. The shaded areas in the figure depict the different concentrations of observations originally compiled and presented by the Atlantic Leatherback Turtle Recovery Team (2006), and presents data from Goff and Lien (1988), from Witzell (1999) and from James (2000).



nalcor energy

FIGURE 3.6

Distribution of Leatherback Turtle in Atlantic Canada

Leatherback turtles have been occasionally spotted in the Gulf of St. Lawrence. During the collection of data for the 2007 TNASS study, sea turtles were one of the targeted species (Lawson and Gosselin 2009).

The status of the leatherback turtle population in the Atlantic Ocean is difficult to assess because of their widespread distribution and limited accessibility (i.e., minimal on-land use by females during nesting only). Because only nesting females are accessible, counts of females or their nests provide the best, and currently the only, index of leatherback turtle population size (DFO 2004).

Loggerhead Turtle

The distribution of the loggerhead turtle is constrained by temperature and the species is not generally observed in waters below 15˚C (O'Boyle 2001). Loggerhead turtles are present in Atlantic Canada waters during the summer season and may stay later in the season than leatherback turtles (O'Boyle 2001). Loggerhead turtles have been designated by COSEWIC as 'Endangered", however they are not listed under *SARA*. It appears that loggerhead populations are stable or declining slowly in the North Atlantic. Although available trend data are insufficient to make a clear determination, populations are thought to be much reduced from historical levels (Brazner et al. 2006 in O'Boyle 2006). It has been suggested that foraging in Atlantic Canada occurs in the areas of the Georges Banks and Grand Banks, due to high catches in the Canadian Pelagic Longline Fishery since 1999 (Brazner et al. 2006 in O'Boyle 2006). Although they may possibly occur in the general vicinity of the Strait of Belle Isle, their presence is likely rare within the Study Area.

3.4 Seabirds

Over 30 species of seabirds and marine ducks occur in, and/or migrate through the Strait of Belle Isle during the year. There are a number breeding colonies within the Strait of Belle Isle, along the coasts of Labrador and the island of Newfoundland as well as on islands along both coasts.

3.4.1 **Seabird Migrations**

Large numbers of seabirds and waterfowl migrate through the Strait of Belle Isle, and many are known to congregate on rounded headlands (e.g., Point Amour and Forteau Point) as they migrate along the coast (Russell and Fifield 2001). To take the first evidence from human activity, remains of more than 28 species of birds have been uncovered at the Maritime Archaic site in Port au Choix, Newfoundland (Tuck 1976). The most common of these were the now extinct Great Auks (*Penguinis impennis*), gulls, Red-breasted Mergansers (*Mergus serrator*), swans, loons, geese, Bald Eagles (*Haliaeetus leucocephalus*), murres and cormorants. The Great Auks were migrating from colonies on the Bird Rocks of the Isles de Madeleine and from Funk Island on the northeast coast of Newfoundland; gannets, murres and other seabirds from these colonies currently move through the Strait.

During summer, warm water flows out of the Gulf of St. Lawrence on the Newfoundland (southern) side of the Strait. This warm water mass interfaces and contrasts sharply with the cold inflowing Labrador Current on the Labrador (northern) side of the Strait. The interface between the water masses appears to be a productive site for pelagic seabirds (LeGrow 1999).

Consistent with breeding colony distributions (below), it is expected that during summer diving species (auks, marine ducks) will be more abundant in the cold northern waters of the Strait and that surface-feeding gulls and terns will dominate in the warmer southern waters on the Newfoundland side of the Strait. Concentrations of pelagic seabirds are expected in the interface between the water masses in the mid-Strait region.

Marine birds that move through the Strait of Belle Isle throughout the year (although most commonly during fall, spring and summer) are presented in Table 3.1.

Table 3.1 Marine Birds that Commonly Move Through the Strait of Belle Isle (Rees 1963; Brown 1986)

Common Name	Scientific Name
Common Loon	*Gavia immer*
Northern Fulmar	*Fulmarus glacialis*
Greater Shearwater	*Puffinus gravis*
Sooty Shearwater	*Puffinus griseus*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*
Northern Gannet	*Morus bassanus*
Double-crested Cormorant	*Phalacrocorax auritus*
Great Cormorant	*Phalacrocorax carbo*
Phalaropes	*Phalaropus spp.*
Jaegers	*Stercorarius spp.*
Ring-billed Gull	*Larus delawarensis*
Herring Gull	*Larus argentatus*
Iceland Gull	*Larus glaucoides*
Glaucous Gull	*Larus hyperboreus*
Great Black-backed Gull	*Larus marinus*
Black-legged Kittiwake	*Rissa tridactyla*
Caspian Tern	*Sterna caspia*
Common Tern	*Sterna hirundo*
Arctic Tern	*Sterna paradisaea*
Dovekies	*Alle alle*
Common Murre	*Uria aalge*
Thick-billed Murre	*Uria lomvia*
Razorbill	*Alca torda*
Atlantic Puffin	*Fratercula arctica*
Black Guillemots	*Cepphus grille*

Marine ducks that move in significant numbers through the Strait of Belle Isle are listed in Table 3.2.

Table 3.2 Marine Ducks that Move Through the Strait of Belle Isle (LeGrow 1999)

Common Name	Scientific Name
Common Eider	*Somateria mollissima*
Harlequin Duck	*Histrionicus histrionicus*
Long-tailed Duck	*Clangula hyemalis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Black Scoter	*Melanitta nigra*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Red-breasted Mergansers	*Mergus serrator*

Major movements of loons, seabirds and marine ducks have been observed from Point Amour during spring (S. Gilliland, pers. comm.; see LeGrow 1999). In summer, capelin and other small fishes aggregate in the Pinware River estuary which is an important feeding site for both sea ducks and seabirds.

Endangered Ivory Gulls (*Pagophila eburnea*) occur in winter and spring in association with Arctic pack ice and especially with whelping harp seals (*Phoca groenlandica*).

3.4.2 Seabird Density and Abundance

Systematic counts of seabirds from vessels have been carried out in the waters of Newfoundland and Labrador since the 1960s (Rees 1963; Brown et al. 1975; Lock et al. 1994; LeGrow 1999). Almost all of this effort was standardized and organized by the CWS (Brown et al. 1975). The PIROP Program (Brown et al. 1975) was conducted from 1966-1992. A newer program was initiated by the CWS in 2005 (ECSAS), which follows standardized methods outlined by Buckland et al. (2001), and referred to as the distance sampling method (Wilhelm et al. 2010). Further information on and from these databases is found in Appendix C.

Density estimates for seabirds in the Strait of Belle Isle region were calculated and mapped by the CWS (Wilhelm et al. 2010); however this information has not yet been published. Density estimates (birds per km^2) for seabird species in the Study Area as provided by the CWS are included in Table 3.3. The Strait of Belle Isle was only surveyed in the summer months (May-August), and therefore density estimates are only available for that season.

The ACCDC in Sackville, New Brunswick has some records of birds in Newfoundland and Labrador and in the region of the Strait of Belle Isle, but this is mostly taken from CWS sources (Kiers, 2010, pers. comm.).

Table 3.3 Density Estimates for Seabirds in the Strait of Belle Isle During Summer from the ECSAS Database

Common Name	Density (birds per km^2)	± Standard Deviation
All Waterbirds	9.61	3.84
Northern Fulmar	0.41	0.28
Shearwaters	0.87	0.51
Northern Gannet	1.37	0.63
Large Gulls	1.45	0.94
Black-legged Kittiwakes	2.34	1.66
Dovekie	0.25	0.24
Murres	0.65	0.73
Other Alcids	0.59	0.44

Both the ECSAS and PIROP databases were examined to determine marine bird occurrences within the Study Area, and to make seasonal and decadal comparisons of relative abundances. This report is found in Appendix C, with the results summarized in this section. PIROP survey data for the Study Area were available for 14 years spanning the period from 1969 to 1987. ECSAS data for the area were available for 5 years, from 2005 to 2009. No survey data was available for the Strait of Belle Isle for the 1990s.

Twenty-eight species of marine birds were recorded in the Study Area from 1969 to 2009 (PIROP and ECSAS data combined). Table 3.4 summarizes all the species observed (as well as those not identified to species) according to relative abundance (percent RA) and frequency of occurrence (percent FO).

Greater and Sooty Shearwaters were the most abundant species, accounting for 19.2 and 11.6 percent relative abundance respectively. They were followed by Black-legged Kittiwake (6.8 percent RA) and other gull species, including Thayer's Gull, Iceland Gull and Glaucous Gull, that accounted for a major proportion (16.8 percent RA) of the total number of species observed. Black-legged Kittiwake was the most frequently observed species (12.2 percent FO) and was followed by Northern Fulmar and Greater Shearwater (11.9 and 11.1 percent FO, respectively). The correlation between the relative abundance and frequency of occurrence scores is quite robust ($r = 0.60$, $df = 36$, $P = 0.0001$).

Table 3.4 Percent Relative Abundance and Percent Frequency of Occurrence of All Seabird Species and Species Groups Observed During PIROP and ECSAS Surveys

Species	Relative Abundance (%)	Frequency Occurrence (%)
Greater Shearwater	19.2	11.1
Sooty Shearwater	11.6	8.2
Black-legged Kittiwake	6.8	12.2
Thayer's Gull	6.5	0.1
Northern Fulmar	5.5	11.9
Iceland Gull	5.3	1.2
Glaucous Gull	5	1.2
Red Phalarope	4.7	0.5
Red-necked Phalarope	3.4	0.1
Great Black-backed Gull	3.1	8.2
Herring Gull	2.9	9.9
Dovekie	2.8	2.8
Leach's Storm-Petrel	2	1.5
Common Murre	1.4	4.3
Atlantic Puffin	0.9	4.4
Thick-billed Murre	0.8	0.7
Common Tern	0.8	0.3
Northern Gannet	0.7	3.9
Razorbill	0.7	1
Pomarine Jaeger	0.6	1.5
Parasitic Jaeger	0.6	0.4
Black Guillemot	0.6	1
Long-tailed Jaeger	0.6	0.3

Table 3.4 (Cont'd) Percent Relative Abundance and Percent Frequency of Occurrence of All Seabird Species and Species Groups Observed During PIROP and ECSAS Surveys

Species	Relative Abundance (%)	Frequency Occurrence (%)
Wilsons Storm Petrel	0.6	0.6
Manx Shearwater	0.4	0.1
Arctic Tern	0.3	0.5
Great Skua	0.3	0.2
Ring-billed Gull	0.2	0
Seabirds Not Identified to Species		
Phalaropes	5.2	0.6
Gulls	1.7	1.1
Shearwaters	1.3	0.8
Auks	1.1	1.9
Murres	1	5
Jaegers	0.5	1.5
Terns	0.5	0.7
Storm-Petrels	0.4	0.4

3.4.2.1 **Decadal Trends**

Table 3.5 summarizes the percent relative abundance (percent RA) and percent frequency of occurrence (percent FO) scores for seabirds according to taxonomic groups during PIROP and ECSAS surveys. Shearwaters (including three species) were the most abundant taxonomic group (20.1 percent RA), followed by Northern Fulmar (7.2 percent RA), phalaropes (two species; 6.4 percent RA) and gulls (six species; 5.8 percent RA). Gulls were the most frequently observed group during surveys (30.9 percent FO), followed by auks (19.3 percent FO), shearwaters (18.3 percent FO) and Northern Fulmar (10.8 percent FO). Storm-petrels, gannets, jaegers and terns were observed less frequently.

Table 3.5 Ranking of Species Groups in All Decades According to Percent Relative Abundance (Expressed as Percentages) Using PIROP (1960s Through 1980s) and ECSAS (2000s) Methods

Species Group	Relative Abundance (%)	Frequency Occurrence (%)
Shearwaters	20.1	18.4
Fulmar[1]	7.2	10.8
Phalaropes	6.4	1.1
Gulls	5.8	30.9
Storm-Petrels	1.9	2.2
Auks	1.7	19.3
Gannet[2]	1.0	3.5
Jaegers	0.8	3.6
Terns	0.7	1.4

Note: [1] category contains only one species (Northern Fulmar)
[2] category contains only one species (Northern Gannet)

Table 3.6 presents a direct comparison of the percent relative abundance of species groups from the PIROP and ECSAS datasets. This analysis shows major changes in the abundances of some seabird species groups in the Strait of Belle Isle over the last 5 decades. Most striking is the decline in the abundance of shearwaters observed during PIROP surveys (37.6 percent RA) relative to the ECSAS surveys (1.2 percent RA), but overall there is a declining trend in the abundance of all the major species groups. These estimates (percent RA) are broken down by decade in Table 3.7 and Figure 3.7 and show a similar pattern of decline.

Table 3.6 Relative Abundance (% RA) of Seabird Species Groups Recorded During Systematic Vessel Surveys in the Strait of Belle Isle Using PIROP (1960s Through 1980s) and ECSAS (2000s) Methods

Species Group	PIROP (1960s-1980s)	ECSAS (2000s)
Shearwaters	37.6	1.2
Fulmars[1]	14.4	2.4
Phalaropes	11.8	0.0
Gulls	11.6	1.3
Storm-Petrels	3.6	1.8
Auks	3.3	2.1
Gannets[2]	2.0	1.1
Jaegers	1.4	1.6
Terns	1.1	1.7

Note: [1] category contains only one species (Northern Fulmar)
[2] category contains only one species (Northern Gannet)

Shearwaters, fulmars and auks were most abundant in the 1970s, whereas phalaropes, gulls, jaegers and terns were most abundant during the 1960s. Gannets were most abundant during the 1980s. Fulmars (Figure 3.7) and auks were the most abundant species groups during the 2000s, but their numbers were lower than during previous decades.

Table 3.7 Relative Abundances (Expressed as Percentages) of Seabird Species Groups During Systematic Vessel Surveys in the Strait of Belle Isle Using PIROP (1960s Through 1980s) and ECSAS (2000s) Recording Methods

Species Group	1960s	1970s	1980s	2000s
Shearwaters	4.2	19.1	3.3	0.5
Fulmar[1]	1.9	7.0	3.3	1.1
Phalaropes	7.3	4.1	6.7	0.0
Gulls	7.9	4.7	7.0	0.6
Storm-Petrels	1.0	1.1	3.3	0.8
Auks	0.8	1.5	0.7	1.0
Gannet[2]	0.5	0.4	1.9	0.5
Jaegers	1.1	0.5	1.0	0.7
Terns	2.6	0.4	0.5	0.7

Note: [1] category contains only one species (Northern Fulmar)
[2] category contains only one species (Northern Gannet)

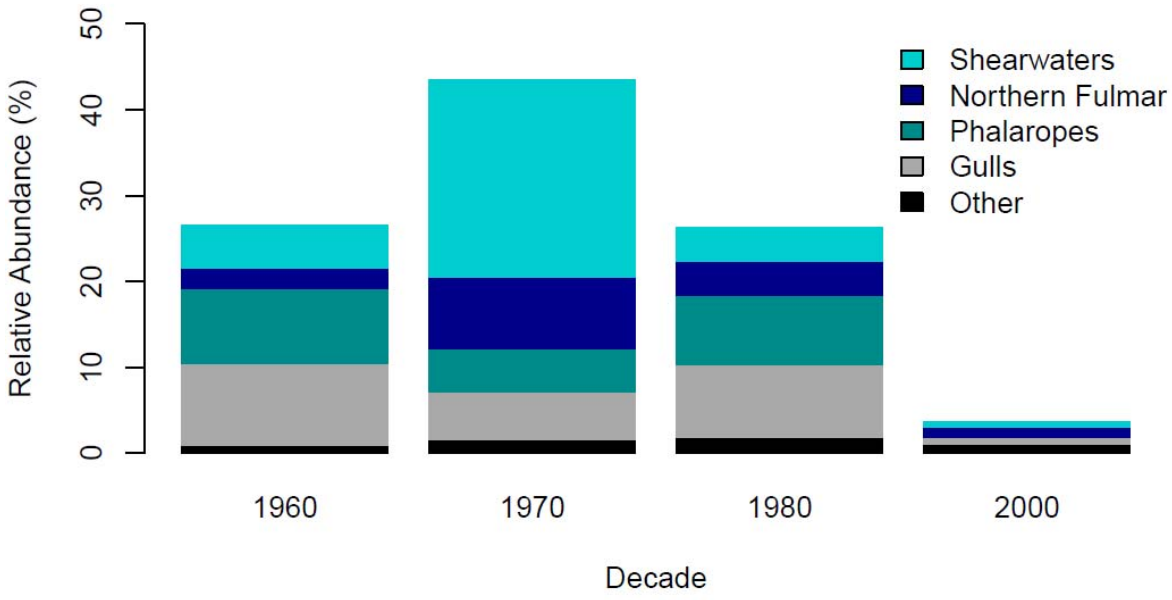


Figure 3.7 Decadal Relative Abundances (Expressed as Percentages) of Different Species Groups Recorded During Systematic Vessel Surveys in the Strait of Belle Isle by PIROP (1960s – 1980s) and by ECSAS (2000s)

Findings of declines in the relative abundances of seabirds during the current decade are supported by Gjerdrum et al. (2010) who show a striking southerly shift in the distribution of shearwaters and an offshore movement of gulls away from the Strait of Belle Isle in the current decade.

It seems likely that at least some of this long-term decrease in seabird numbers and biodiversity in the Strait of Belle Isle is related to ocean climate change. Changing oceanographic conditions likely influence these trends in marine avifauna abundance and diversity. Informative investigations could involve relating changes in the temperature and salinity of the southerly flowing Arctic water being moved into the Gulf of St. Lawrence through the northern Strait by the Labrador Current. As well, changes in the warmer water flowing out through the southern part of the Strait could influence marine productivity and the occurrences and distributions of prey species that in turn drive changing distributional patterns of top seabird predators.

3.4.2.2 **Seasonal Trends**

The monthly occurrences of the most abundant seabird groups are shown in Table 3.8 and Figure 3.8. Most birds were recorded during autumn migratory movements, with shearwaters dominating counts in October and Northern Fulmars being the most abundant seabird during counts in November. Lesser numbers were observed during summer, with very few being observed during winter and spring when the Strait of Belle Isle is usually ice-covered, preventing vessel traffic.

Table 3.8 Relative Abundance (% RA) of the Most Abundant Species Groups Observed During Systematic Vessel Surveys in the Strait of Belle Isle Using PIROP (1960s Through 1980s) and ECSAS (2000s) Methods

Species Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Shearwaters	0.0	0.0	0.0	0.0	0.0	2.6	1.6	1.6	1.7	37.7	0.1	0.0
Fulmar	0.0	0.3	0.0	0.0	0.2	0.6	1.5	2.1	0.5	3.8	15.0	0.0
Phalaropes	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	3.8	1.1	0.0	0.0
Gulls	0.1	0.8	0.5	0.0	0.2	0.7	0.7	2.3	0.8	2.3	7.9	0.2
Other	1.2	0.2	0.2	0.0	0.4	0.3	0.4	0.6	0.2	0.6	0.7	0.1

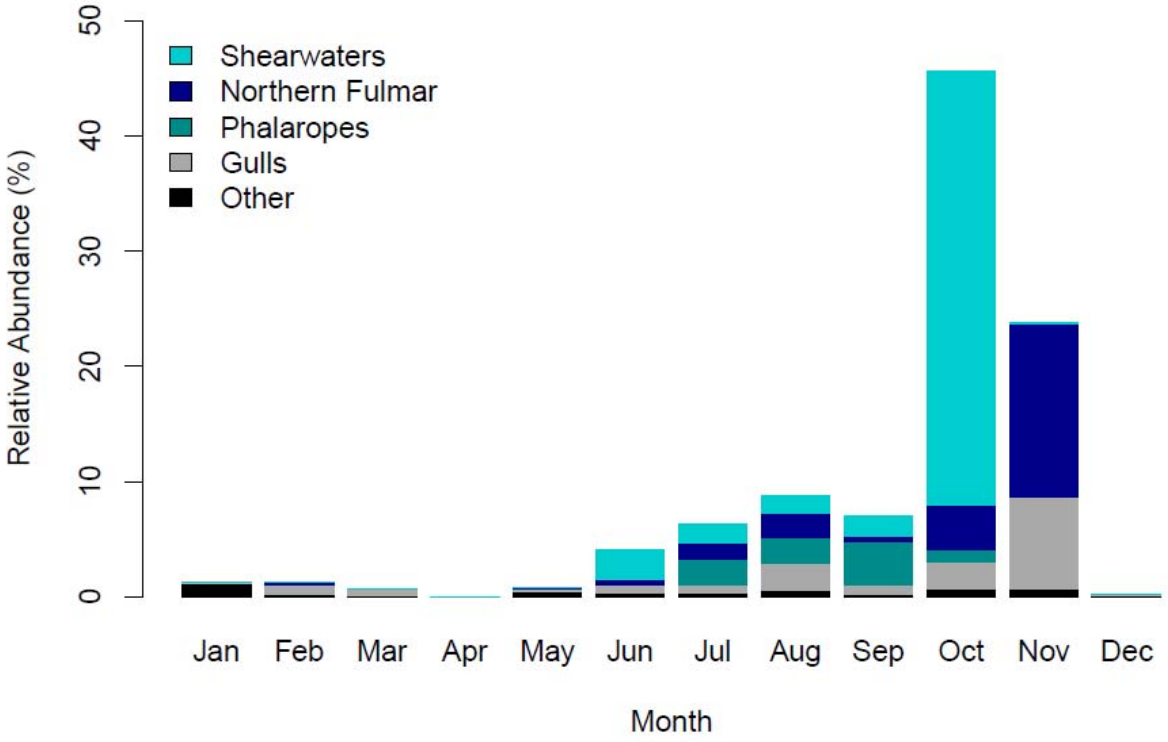


Figure 3.8 Monthly Relative Abundances (% RA) of the Most Abundant Species Groups Recorded During All PIROP and ECSAS Surveys Combined

It is evident from the monthly analysis of seabird data that the number and diversity of birds detected is a function of survey effort (see also LeGrow 1999). Figure 3.9 clarifies this relationship in a direct comparison of seabird occurrences and vessel survey effort. The conclusion is straight-forward, more surveys result in the detection of more birds and more species diversity.

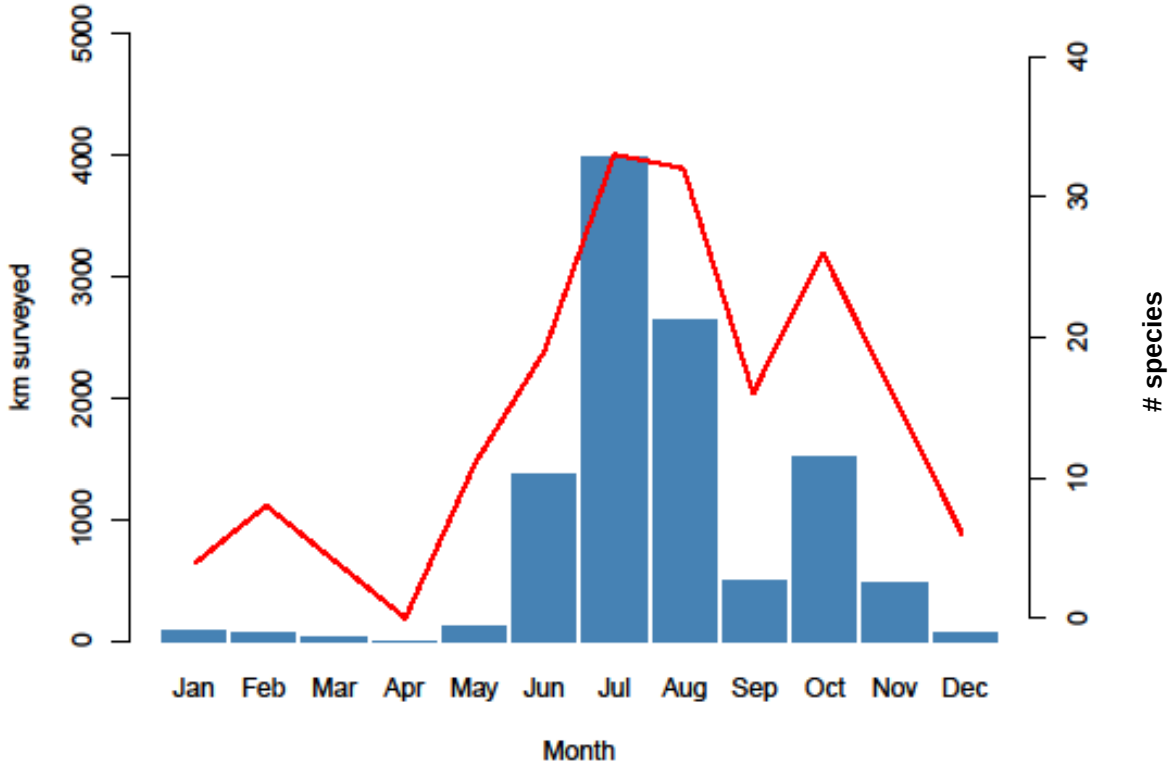
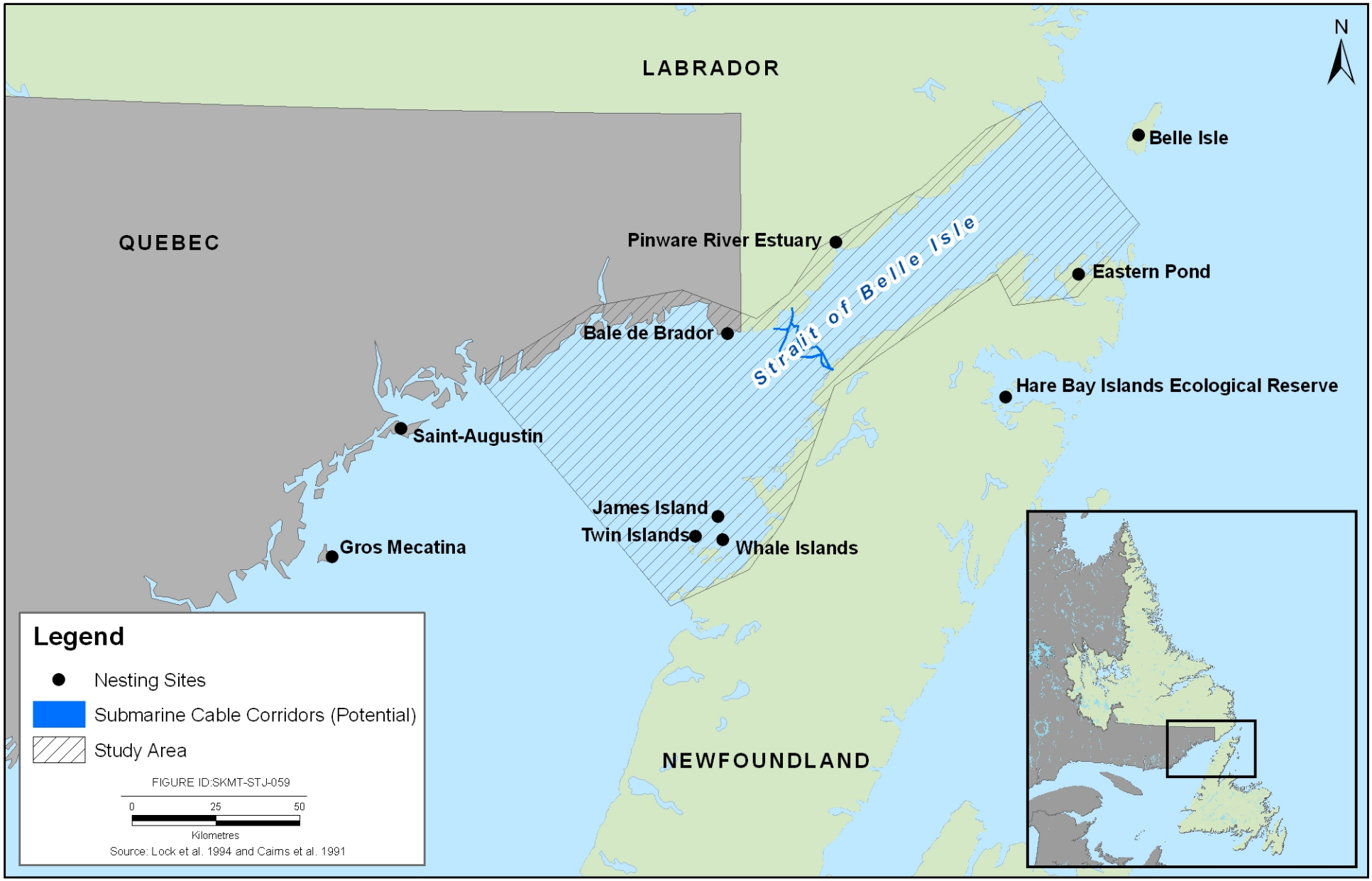


Figure 3.9 Monthly Diversity (Number of Species; Blue Bars) and Survey Effort (Red Line) Recorded During All PIROP and ECSAS Surveys Combined

3.4.3 Seabird Breeding Colonies

During summer, globally significant populations of seabirds breed in colonies along the Labrador coast and Quebec North Shore. Although outside the Study Area, the Gannet Islands Ecological Reserve off Cartwright and Groswater Bay is the site of the largest North American population of Razorbills. The Gannet Islands is also home to significant populations of Thick-billed and Common Murres, and is the site where the breeding ranges of the more northerly distributed Thick-billed Murre and the more southerly distributed Common Murre meet. About 40,000 pairs of Atlantic Puffins nest on the Gannet Islands. The Mingan and St. Mary's Islands along the North Shore of Quebec have substantial important colonies of marine birds, including Common Eiders that also nest on the islands in Groswater Bay near Cartwright, Labrador and in the Hare Bay Ecological Reserve, located near the eastern tip of the Northern Peninsula (Figure 3.10). Large colonies of Common and Arctic Terns occur at sites on the west coast of the Northern Peninsula along the southern side of the Strait. Important seabird nesting sites in the immediate vicinity of the Strait of Belle Isle are illustrated in Figure 3.10.

Generally and associated with the Arctic inflow and capelin, colonies of diving species like auks (murres, puffins, Razorbills) are more common along the northern side of the Strait and the North Shore of Quebec, whereas colonies of surface-feeding birds such as gulls and terns are more common on the southern side of the Strait along the west coast of Newfoundland (Cairns et al. 1991).



nalcor energy

FIGURE 3.10

Important Seabird Nesting Locations

3.4.4 **Shorebirds**

Numerous species of shorebirds occur at coastal headlands and beaches in the Strait of Belle Isle and along Newfoundland's west coast. Shorebird numbers peak in the region during fall migration (August, September, October). Key feeding, roosting and stopover sites include Shoal Cove East, Shoal Cove West, Eddies Cove East, L'anse au Loup, Pines Cove, Port Saunders and L'Anse aux Meadows.

The Canadian Wildlife Service in St. John's conducts surveys and collects records of shorebird occurrences in the province. Shorebird numbers peak in the region during fall migration (August, September, October). Based on the Canadian Wildlife Service shorebird survey database (CWS, Unpublished Data, 2010), the most common shorebirds that stop in the Strait during fall migration are White-rumped Sandpipers (*Calidris fuscicollis*), Greater Yellowlegs (*Tringa melanoleuca*), Semi-palmated Sandpipers (*Calidris pusilla*), Ruddy Turnstones (*Arenaria interpres*), Semi-palmated Plovers (*Charadrius semipalmatus*), and Dunlin (*Calidris alpina*). Table 3.9 lists the ten most common shorebirds that occur in the region during autumn.

Table 3.9 Ten Most Common Shorebird Species that Stop in the Strait of Belle Isle During Fall Migration Listed in Order of Abundance Based on CWS Shorebird Survey Database (CWS, Unpublished Data, 2010)

Common Name	**Scientific Name**
White-rumped Sandpiper	*Calidris fuscicollis*
Greater Yellowlegs	*Tringa melanoleuca*
Semi-plamated Sandpiper	*Calidris pusilla*
Ruddy Turnstone	*Arenaria interpres*
Semi-palmated Plover	*Charadrius semipalmatus*
Dunlin	*Calidris alpine*
Sanderling	*Calidris alba*
Least Sandpiper	*Calidris minutilla*
Black-bellied Plover	*Pluvialis squatarola*
Lesser Yellowlegs	*Tringa flavipes*

3.5 Species of Special Conservation Concern

Several of the marine mammal and seabird species, and two sea turtle species that occur within the Strait of Belle Isle are designated as being of special conservation concern and are discussed in this section. Some of these species have either been designated under the federal *Species at Risk Act* (*SARA*) and/or the *Newfoundland and Labrador Endangered Species Act (NL ESA*). Of the species discussed in this report, only the seabirds are considered under both legislations, as marine mammals and sea turtles are considered under federal legislation only. Other species discussed in this section are marine mammal and sea turtle species assessed and designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

COSEWIC is a committee of experts which is responsible for the assessment and classification of species as being either 'Extinct', 'Extirpated', 'Endangered', 'Threatened', of 'Special Concern', 'Data Deficient', or 'Not at Risk'. COSEWIC provides recommendations to the federal government, whose officials then review the assessments and decide which species are added to the official list of protected species (Schedule 1 under *SARA*). Only species listed under Schedule 1 of *SARA* are legally protected under the Act, and measures are developed to protect these species and their critical habitat. Recovery strategies are required for those species designated as 'Endangered', 'Threatened' or 'Extirpated', while management plans are required for species designated as 'Special Concern'.

As *SARA* designation and COSEWIC designation are very different in terms of legal protection, the following sections have been sub-divided to reflect these differences. The section includes a discussion of *SARA* designated marine mammal and sea turtle species, followed by *SARA* and *NL ESA* designated seabird species. In addition, marine mammal and a sea turtle species designated by COSEWIC (including species that are on Schedule 2 and Schedule 3 of *SARA* and therefore not legally protected) that are known to occur in the Study Area are also discussed.

3.5.1 ***SARA* Designated Marine Mammal and Sea Turtle Species**

Marine mammal and sea turtle species of special conservation concern that occur within the Strait of Belle Isle, and that are legally protected under Schedule 1 of *SARA*, are outlined in Table 3.10 and include the blue whale, fin whale and the leatherback turtle.

A discussion of these three species follows Table 3.10 including reasons for their designations.

Table 3.10 Marine Mammals and Sea Turtles that are Listed Under the *Species At Risk Act (Schedule 1)*

Species	***SARA* Designation**
Blue whale (*Balaenoptera musculus*) Atlantic population	Endangered Schedule 1
Fin whale (*Balaenoptera physalus*) Atlantic Ocean population	Special Concern Schedule 1
Leatherback turtle (*Dermochelys coriacea*) Atlantic Ocean population	Endangered Schedule 1

Blue Whale

The blue whale, a large baleen whale, is listed under *SARA* as 'Endangered' and was last assessed by COSEWIC in May 2002 (COSEWIC 2010). Whaling reduced the original population. There are now fewer than 250 mature individuals, and strong indications of a low calving rate and a low recruitment rate to the studied population. Today, the biggest threats for this species come from ship strikes, disturbance from increasing whale watching activity, entanglement in fishing gear, and pollution. They may also be vulnerable to long-term changes in climate, which could affect the abundance of their prey (COSEWIC 2010).

Fin Whale

The fin whale, the second largest of baleen whales, is listed under *SARA* as 'Special Concern' and was last assessed by COSEWIC in May 2005 (COSEWIC 2010). During much of the 20th Century, the size of this population was reduced by whaling. Sightings remain relatively common off Atlantic Canada and they have not been hunted since 1971. There is some uncertainty regarding the current abundance and level of depletion relative to pre-whaling numbers. Threats to the fin whale include ship strikes and entanglement in fishing gear, although none are thought to seriously threaten the population (COSEWIC 2010).

Leatherback Turtle

The leatherback turtle is listed as 'Endangered' under Schedule 1 of *SARA,* and is protected under the Act. A Recovery Team has been formed to develop a recovery strategy (Atlantic Leatherback Turtle Recovery Team 2006). The species is undergoing a severe global decline (greater than 70 percent in 15 years). In Canadian waters incidental capture in fishing gear is a major cause of mortality. A long lifespan, very high rates of egg and hatching mortality, and a late age of maturity makes this species unusually vulnerable to even a small increase in rates of mortality of adults and older juveniles (COSEWIC 2010).

3.5.2 *SARA* and *NL ESA* Designated Seabird Species

Seabird species of special conservation concern status that occur in the Strait of Belle Isle include Ivory Gull, Harlequin Duck, Barrow's Goldeneye and Red Knot. Listed species that may potentially occur include Piping Plover and Eskimo Curlew. Most of these seabirds are considered uncommon or rare within the Study Area. These species are designated under the federal (*SARA*) and/or provincial (*NL ESA*) legislation (Table 3.11). Recovery strategies have been developed for both the Piping Plover (Environment Canada 2006) and the Eskimo Curlew (Environment Canada 2007); they are posted on the *SARA* Registry.

A discussion of these six species follows Table 3.11 including their likely occurrence in the Study Area, and reasons for their designations.

Table 3.11 Coastal and Marine Bird Species that are Listed by the Newfoundland and Labrador *Endangered Species Act* and/or *Species at Risk Act*

Species	***NL ESA* Status**	***SARA* Designation**
Ivory Gull *(Pagophila eburnea)*	Endangered (October 2006)	Endangered – Schedule 1
Harlequin Duck *(Histrionicus histrionicus)*	Vulnerable (May 2001)	Special Concern – Schedule 1
Barrow's Goldeneye *(Bucephala islandica)*	Vulnerable (November 2000)	Special Concern – Schedule 1
Red Knot *(Calidris canutus rufa)*	Endangered (April 2007)	No Status, No Schedule
Eskimo Curlew *(Numenius borealis)*	Endangered (May 2000)	Endangered – Schedule 1
Piping Plover *(Charadrius melodus melodus)*	Endangered (May 2000)	Endangered – Schedule 1

Ivory Gull

The Ivory Gull winters among the pack ice of the Davis Strait, Labrador Sea, and Gulf of St. Lawrence, including the Strait of Belle Isle (Stenhouse 2004). The species occurs at times in the Strait, usually in association with Arctic sea ice. It has been occasionally observed along the coast of the Northern Peninsula (Stenhouse 2004; Warkentin and Newton 2009). Generally speaking, records of Ivory Gull are rare and irregular (Stantec 2010). It is listed under both *SARA* and the *NL ESA* as 'Endangered'. It was last assessed by COSEWIC in April 2006 (COSEWIC 2010). Aboriginal traditional knowledge and recent intensive breeding colony surveys indicate that the Canadian breeding population of this seabird has declined by 80 percent over the last 20 years. Threats include contaminants in the food chain, continued hunting in Greenland, possible disturbance by mineral exploration at some breeding locations and degradation of ice-related foraging habitats as a result of climate change (COSEWIC 2010).

Harlequin Duck

Harlequin Duck is listed under *SARA* as 'Special Concern' and by *NL ESA* as 'Vulnerable'. The COSEWIC designation was previously 'Endangered', however it was last assessed by COSEWIC in May 2001 and placed in a lower risk category (COSEWIC 2010). The population size of this sea duck is substantially larger than previously thought, though it is relatively small. Harlequin Ducks are known to use the Torrent River on the Northern Peninsula as a breeding site (Thomas 2008) and to migrate through the Strait of Belle Isle. However, during the 1996 monitoring at the Point Amour IBA, only seven Harlequin Ducks were observed (Russell and Fifield 2001). Therefore, occurrence of this species in the Study Area is probably not common. The Harlequin Duck congregates in fairly large groups when moulting and wintering, and therefore is vulnerable to environmental and other catastrophic events such as oil spills (COSEWIC 2010).

Barrow's Goldeneye

The Barrow's Goldeneye is known to migrate through the Strait of Belle Isle, however the majority of the population winters in the St. Lawrence estuary, with small numbers seen throughout Atlantic Canada and Maine (Schmelzer 2006; COSEWIC 2010). Schmelzer (2006) further states that if breeding does occur in Newfoundland it is probably sporadic and/or infrequent. During 1996 waterfowl surveys conducted from Point Amour only one sighting of Barrow's Goldeneye was recorded (CWS, Unpublished Data, 1996). This species is listed under both *SARA* as 'Special Concern' and by *NL ESA* as 'Vulnerable'. It was last assessed by COSEWIC in November 2000 (COSEWIC 2010). Reasons for designation include the small numbers of individuals in this eastern population. Limited habitat availability and oil spill potential are both potential threats to this population, although none is currently at a scale that would negatively impact the population (COSEWIC 2010).

Red Knot

The Red Knot, a medium-sized shorebird, has been observed at Eddies Cove East, and is listed under the *NL ESA* as 'Endangered'. It has no status or schedule under *SARA*, and was last assessed by COSEWIC in April 2007 (COSEWIC 2010). Yet the *rufa* subspecies that breeds in the eastern Canadian Arctic has experienced population declines of about 70 percent over the past three generations (15 years; Baker et al. 2004). The Red Knot breeds in Arctic Canada, and the *rufa* subspecies migrates between Arctic breeding grounds to its wintering areas at the tip of South America, and passes along Newfoundland and Labrador during migration. The most important areas for this subspecies during migration are along the north shore of the St. Lawrence, and there are no important areas identified for Red Knot in Labrador or Newfoundland (COSEWIC 2010), therefore occurrence in the Study Area would be considered uncommon; previous observations have been made at Eddies Cove East, St. Paul's Inlet and Stephenville Crossing. Threats to the *rufa* subspecies include a depletion of horseshoe crab eggs in Chesapeake Bay, a critical source used during migration. There is no potential for rescue from other populations (COSEWIC 2010).

Eskimo Curlew

The Eskimo Curlew is a species of shorebird, which is listed under *SARA* as 'Endangered'. The last assessment by COSEWIC was in November 2009 (COSEWIC 2010). The Eskimo Curlew has 100 percent of its known breeding range in Arctic Canada. The population collapsed in the late 1800s, primarily owing to uncontrolled market hunting and dramatic losses in the amount and quality of spring stopover habitat (native grasslands). The population has never recovered and there have been no confirmed breeding records for over 100 years, or any confirmed records of birds (photographs/specimens) since 1963. Recent sight records suggest the possibility of a small population (fewer than 50 mature individuals) may still persist in remote Arctic landscapes. The occurrence of this species in the Study Area is therefore considered to be very unlikely. Factors affecting recovery include very low population size, no known chance of rescue from outside populations, and the historic and ongoing conversion of native grasslands on its spring staging areas in Canada and the U.S. and on its wintering grounds in Argentina (COSEWIC 2010).

Piping Plover

The Piping Plover, a shorebird, nests on some of the sandy beaches on Newfoundland's west coast (e.g., Cowhead in Gros Morne National Park) which is well outside the Study Area. It is included in this section despite the low probability of it occurring in the Study Area. It is listed under the *NL ESA* as 'Endangered' (May 2001)

and under *SARA* as 'Endangered'. The Piping Plover was last assessed by COSEWIC in May 2001 (COSEWIC 2010). Reasons for its designation include a small number of individuals which are breeding in Canada, and a decreasing quality, loss and destruction of nesting habitat. Predation, ATV habitat degradation and other disturbances are interfering with reproductive success. Strong conservation initiatives have failed to result in any significant increase in numbers of breeding pairs (COSEWIC 2010).

3.5.3 COSEWIC Designated Marine Mammal and Sea Turtle Species

Marine mammal species of special conservation concern that have been designated by COSEWIC that are known to occur in the Study Area include harbour porpoise, killer whale and beluga whale. Sea turtle species designated by COSEWIC include the loggerhead turtle. These species do not have the legal protection that species listed on Schedule 1 of *SARA* are provided. These species and their COSEWIC designation, including where applicable their Schedule 2 status under *SARA*, are outlined in Table 3.12.

A discussion of these four species follows Table 3.12 including reasons for their recommendation in the COSEWIC assessment.

Table 3.12 Marine Mammal and Sea Turtle Species that have COSEWIC Designations or are Listed Under Schedule 2 or 3 of *SARA*

Species	**COSEWIC Designation**	***SARA* Designation**
Harbour porpoise (*Phocoena phocoena*) Northwest Atlantic population	Special Concern (April 2006)	Threatened Schedule 2
Killer whale (*Orcinas orca*) Northwest Atlantic/Eastern Arctic population	Special Concern (November 2008)	No Status
Beluga whale (*Delphinapterus leucas*) Ungava Bay population	Endangered (May 2004)	No Status
Beluga whale (*Delphinapterus leucas*) St. Lawrence estuary population	Threatened (May 2004)	No Status
Loggerhead turtle (*Caretta caretta*) Atlantic Ocean population	Endangered (April 2010)	No Status

Harbour Porpoise

The harbour porpoise is designated by COSEWIC as 'Special Concern', and under Schedule 2 of *SARA* as 'Threatened', but is not legally protected under *SARA*. It was last assessed by COSEWIC in April 2006 (COSEWIC 2010). Harbour porpoise is widely distributed in eastern Canadian marine waters. Population of this species remains abundant, although a major threat to the harbour porpoise is incidental catch in fishing gear, especially

gillnets. Management measures in the Bay of Fundy and Gulf of Maine have shown to reduce bycatch rates in gillnets in these areas, though these measures have not been implemented in much of the species range, including the Gulf of St. Lawrence and Newfoundland and Labrador. There is also concern that acoustic harassment devices associated with aquaculture may exclude some porpoises from their habitat in the Bay of Fundy, and possibly other areas. Lack of good abundance information and lack of monitoring and mitigation in many relevant fisheries are reasons for concern (COSEWIC 2010).

Killer Whale

The killer whale population in the Northwest Atlantic/Eastern Arctic was designated by COSEWIC as 'Special Concern' in November 2008, but has no designation under *SARA*, and is therefore not legally protected. Threats to this population include hunting in Greenland, acoustical and physical disturbance and contaminants. Acoustical and physical disturbance is increasing and will become greater as shipping traffic increases in the Arctic. This population's small size (fewer than 1000 mature individuals and likely less than 250) and the species' life history and social attributes justify designation as 'Special Concern' (COSEWIC 2010).

Beluga Whale

Canadian beluga whales have been divided into seven populations based on disjunct summer distributions and genetic differences (COSEWIC 2010). For this report, the two populations in closest proximity to the Study Area are discussed. In May 2004, the Ungava Bay population and the St. Lawrence estuary population were designated by COSEWIC as 'Endangered' and 'Threatened' respectively. The summer distribution of both these populations does not extend into, or near the Study Area, however their occurrence does include the Atlantic Ocean for both of these populations (COSEWIC 2010), and sightings have been reported in the Strait of Belle Isle (Lawson and Gosselin 2009). The Ungava Bay population is very low, and has potentially been extirpated. Hunting has caused the population decline and continues in Ungava Bay. The St. Lawrence estuary population, designated as 'Threatened', was severely reduced by hunting which continued until 1979. Current threats include contaminants, vessel traffic and industrialization of the St. Lawrence watershed (COSEWIC 2010).

Loggerhead Sea Turtle

The loggerhead sea turtle was designated as 'Endangered' by COSEWIC in April 2010. This species has experienced global decline, including the Northwest Atlantic population. Juveniles for the Northwest Atlantic population are known to feed in Atlantic Canadian waters. Threats to the Canadian population include commercial fishery, and loss of nesting sites in the U.S. and the Caribbean (COSEWIC 2010). Although they may possibly occur in the Strait of Belle Isle, their presence is likely rare.

4.0 SUMMARY

This study has assembled recent baseline information for marine mammals, sea turtles and seabirds in the Strait of Belle Isle by compiling and reviewing existing and available information from the literature as well as data from relevant government and non-governmental agencies. Experts were consulted during the process to provide the study team with information and data relevant to the study and to supplement information existing in the literature.

4.1 Marine Mammals

Recent information on marine mammals including whales (cetaceans) and seals (pinnipeds) in the Study Area was identified, compiled and reviewed. In support of the GOSLIM, a detailed summary of information and a comprehensive literature review for the Gulf of St. Lawrence, including the Strait of Belle Isle was compiled in 2007. This report was used extensively in identifying recent information sources, as well as relevant details regarding the Study Area. Information collected on marine mammals in the Strait of Belle Isle since 2000 is largely anecdotal in nature; however some systematic land-based, aerial and shipboard surveys have occurred. Both anecdotal records and scientific studies and surveys were reviewed.

Scientific reports included systematic aerial surveys in 1995, 1996, and 2002. Studies of movement and diving behaviour using satellite telemetry on hooded and grey seals in the Gulf of St. Lawrence were also conducted. The results of these surveys were reviewed in relation to the GOSLIM initiative, along with other relevant information sources. It was determined that at least 14 species of marine mammals may occur in the Study Area including: grey seal; harbor seal; hooded seal; harp seal; minke whale; blue whale; fin whale; humpback whale; killer whale; harbour porpoise; Atlantic white-sided dolphin; white-beaked dolphin; shortbeaked common dolphin; and long-finned pilot whale.

During the summer of 2007, a survey was conducted by DFO as part of the Trans North Atlantic Sightings Survey that identified eight species of marine mammals in the Strait of Belle Isle Study Area: beluga; blue whale; fin whale; harbour porpoise; humpback whale; minke whale; white-beaked dolphin; and the Atlantic white-sided dolphin. Aggregations of humpback whales were sighted more often in the Study Area than other species, while higher numbers of individual white-beaked dolphins were sighted during the survey in the Strait of Belle Isle than other species in the area, and had higher numbers in that area than other areas surveyed. Boat-based surveys have also been conducted in the area.

Historical sightings data which have not been previously presented in earlier Project reports were also examined. This includes information (sightings) from anecdotal sources and surveys, and compiled by the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations. Another source of information for marine mammals is the DFO historical sightings database. Both of these sightings databases were compiled and mapped to illustrate distributions of marine mammal sightings; however any type of analysis to determine abundance, density or any other type of estimation would not be feasible due to the nature of the data. Another source of information for marine mammals within the Study Area was anecdotal information from the Community Coastal Resource Inventory (CCRI) database.

Most of the species listed (with the exception of hooded seal) occur in the Study Area between May and December, whereas harp seals, fin whales and hooded seals regularly occur there between December and May. The Strait of Belle Isle serves as a feeding area for diverse and high biomasses of megafauna and serves as a migration path during spring and fall and as a breeding and pupping area during winter for seals.

4.2 Sea Turtles

Only a few records of sea turtle sightings exist in the Gulf of St. Lawrence, which indicates that sea turtles do not frequent this area. The species of sea turtles that could potentially occur in the Strait of Belle Isle include the leatherback turtle (*Dermochelys coriacea*) and the loggerhead turtle (*Caretta caretta*). Both species are relatively common in the waters off Newfoundland during the summer and fall. The loggerhead turtle is more common off the Atlantic coast, and is found in greater numbers offshore.

4.3 Seabirds

Large numbers of seabirds and marine ducks migrate through the Strait's narrow waterway. Consistent with the location of breeding colonies, it is expected that during the summer, diving species (auks, marine ducks) will be more abundant in the cold northern waters of the Strait and that surface-feeding gulls and terns will dominate in the warmer southern waters on the Newfoundland side. Concentrations of pelagic seabirds are expected in the inter-face between the water masses in the mid-Strait region.

There are 25 marine bird species, and 9 marine duck species that move through the Strait of Belle Isle throughout much of the year though primarily during fall, spring and summer. Available data from seabird surveys in the Strait of Belle Isle from the PIROP database (1960s to 1980s) and the ECSAS database (2000s) were integrated and compared using the density of birds observed per square kilometer. These databases were examined to determine relative abundance and frequency of occurrence of different species and groups of seabirds to identify decadal and seasonal trends.

Shearwaters, fulmars, kittiwakes and gulls are the most commonly sighted seabirds in the Strait of Belle Isle. Auks, storm-petrels, gannets, jaegers and terns are also frequently observed. Significant decadal changes in seabird abundances and species diversity have occurred in the Strait of Belle Isle from the 1960s through 2010. Shearwaters, fulmars and auks were most abundant in the 1970s, whereas phalaropes, gulls, jaegers and terns were most abundant during the 1960s. Gannets were most abundant during the 1980s. Fulmars and auks were the most abundant species groups during the 2000s.

Peak numbers of birds and species were recorded during the 1970s, and the lowest numbers of birds and species have been obtained during the current decade. Ocean basin scale shifts in seabird distributions are associated with recent changes in the Strait of Belle Isle.

Seabirds are most abundant in the Strait of Belle Isle during autumn migratory movements. Shearwaters dominate counts in October and Northern Fulmar are the most abundant bird during November. Juvenile gulls are also most abundant at the end of summer and during early autumn. During the winter, the Strait of Belle Isle is usually ice-covered and vessel traffic is precluded, therefore very few seabirds have been recorded during winter and spring in the Study Area. Vessel survey effort contributes strongly to the number and diversity of birds detected.

Numerous species of shorebirds occur at coastal headlands and beaches in the Strait of Belle Isle and along Newfoundland's west coast. Shorebird numbers peak in the region during the fall migration (August, September, October). Key feeding, roosting and stopover sites in the vicinity of the Study Area include Shoal Cove East, Shoal Cove West, Eddies Cove East, L'Anse au Loup, Pines Cove, Port Saunders and L'Anse aux Meadows.

4.4 Species of Special Conservation Concern

There are a number of species of special conservation concern occurring within the Strait of Belle Isle. These species have either been designated under *SARA* or have been designated by the COSEWIC. Those species listed under Schedule 1 of *SARA* are legally protected under the *Act*, and measures are developed to protect these species and their critical habitat. Some species of seabirds and shorebirds which may occur in the Study Area are also protected under the *NL ESA*.

Marine mammal species of special conservation concern that are known to or may occur within the Study Area which have legal protection under Schedule 1 of *SARA* include the blue whale and fin whale which are listed under the *SARA* Schedule 1 as 'Endangered' and 'Special Concern', respectively. The leatherback turtle is designated as 'Endangered' under Schedule 1 of *SARA*, and may occur in the Study Area.

Seabird species of special conservation concern status that occur in the Strait of Belle Isle area include Ivory Gull, Harlequin Duck, Barrow's Goldeneye and Red Knot. Listed species that may potentially occur include Piping Plover and Eskimo Curlew. Most of these species are considered uncommon or rare within the Study Area. Piping Plover, Eskimo Curlew and Ivory Gull have all been designated as 'Endangered' by the *NL ESA* and *SARA*, and the Red Knot has also been listed as 'Endangered' by the *NL ESA* only. Barrow's Goldeneye and Harlequin Duck have both been designated as 'Special Concern' by *SARA* and 'Vulnerable' under the *NL ESA*.

The COSEWIC has designated marine mammal and sea turtle species that may potentially occur within the Study Area. Marine mammal species potentially occurring in the Study Area include harbour porpoise, killer whale, and beluga whale. The harbour porpoise has been designated as a species of 'Special Concern' by COSEWIC, and is listed under Schedule 2 of the *SARA.* Killer whales, which have been observed in the Strait of Belle Isle region, have been given the designation of 'Special Concern' by COSEWIC. Observations of beluga whales have also been recorded in the Strait of Belle Isle and nearby populations have been designated by COSEWIC as 'Endangered' (Ungava Bay population) and 'Threatened' (St. Lawrence estuary population). The loggerhead sea turtle has also been designated as 'Endangered' by COSEWIC, however its presence in the Study Area is likely rare. These species have been designated by COSEWIC, but are not legally protected under *SARA.*

5.0 REFERENCES AND PERSONAL COMMUNICATIONS

AMEC Earth and Environmental. 2010. Labrador – Island Transmission Link: Marine Flora, Fauna and Habitat Survey – Strait of Belle Isle Subsea Cable Crossing Corridors. Report prepared for Nalcor Energy, February 2010.

Atlantic Leatherback Turtle Recovery Team 2006. Recovery Strategy for Leatherback Turtle (*Dermochelys coriacea*) in Atlantic Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa, vi + 45 pp.

Bajzak, C.E., S.D. Côte, M.O. Hammill, and G. Stenson. 2009. Intersexual differences in the postbreeding foraging behaviour of the Northwest Atlantic hooded seal. Mar. Ecol. Prog. Ser. 385: 285-294.

Baker, A.J., P.M. Gonzalez, T. Perisma, L.J. Niles, L. J. I de LS do Nascimento, P.W. Atkinson, N.A. Clark, C.D.T. Minton, M. Peck and G. Aarts. 2004. Rapid population decline in Red Knots: Fitness consequences of decreased refuelling rates and late arrival in Delaware Bay. Proceedings of the Royal Society of London, Series B 271: 875-882.

Barkham, S.H. 1984. The Basque whaling establishments in Labrador 1536-1632 – A summary. Arctic 37: 515-519.

Bajzak, C.E., S.D. Côte, M.O. Hammill, and G. Stenson. 2009. Intersexual differences in the postbreeding foraging behaviour of the Northwest Atlantic hooded seal. Mar. Ecol. Prog. Ser. 385: 285-294.

Beauchamp, J., H. Bouchard, P. de Margerie, N. Otis, J.-Y., Savarial. 2009. Recovery Strategy for the blue whale (*Balaenoptera musculus*), Northwest Atlantic population, in Canada [FINAL]. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. 62 pp.

BIO 2010. Hydrographic database and ocean data inventory database. Available at: http://www.mar.dfo-mpo.gc.ca/science/ocean/database/data_query_f.html/. Accessed July 2010.

Bowen, W.D., J.I. McMillan, and W. Blanchard. 2007. Reduced population growth of gray seals at Sable Island: evidence from pup production and age of primiparity. Marine Mammal Science 23: 48-64.

Brazner, J., J. McMillan, L. Marks, and S. Campana. 2006. Recovery Potential Assessment Report for Loggerhead Turtles in NAFO Areas 3 – 6. RAP Working Paper 2006/28. In O'Boyle, R. 2006. Proceedings of the Maritime Provinces Recovery Potential Assessment of Atlantic Shortfin Mako, White Shark, and Loggerhead Turtle, 28-30 November 2006. BIO. DFO. Can. Sci. Advis. Sec. Proc. Ser. 2006/039.

Brown R.G.B. 1986. Revised Atlas of Eastern Canadian Seabirds. Supply and Services Canada, Ottawa.

Brown, R.G.B., D.N. Nettleship, P. Germain, C.E. Tull, and T. Davis. 1975. Atlas of Eastern Canadian Seabirds. Canadian Wildlife Service, Ottawa.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford University Press. Oxford, UK.

Cairns, D.K., G. Chapdelaine, W.A. Montevecchi. 1991. Prey harvest by seabirds in the Gulf of St. Lawrence. Pages 277-291 in: J. Therriault (Editor) Gulf of St. Lawrence: Small Ocean or Big Estuary? Canadian Special Publication of Fisheries and Aquatic Science. 113.

Committee On The Status of Endangered Wildlife In Canada (COSEWIC). 2010. Wildlife Species Search. Available at: http://www.cosewic.gc.ca/eng/sct1/index_e.cfm. Accessed April 2010.

Conestoga-Rovers & Associates. 2008. Environmental Assessment of Geophysical Surveys for Exploration Licenses 1097, 1098, 1103 and 1104 Western Newfoundland. Prepared for NWest Energy Inc. 221 p + App.

CWS (Canadian Wildlife Service). 1996. Unpublished data. Data provided by the Canadian Wildlife Service collected during the 1996 waterfowl surveys at Point Amour, Labrador.

CWS (Canadian Wildlife Service). 2010. Unpublished Data. CWS Shorebird Database.

DFO (Fisheries and Oceans Canada). 2004. Allowable Harm Assessment for Leatherback Turtle in Atlantic Canadian Waters. DFO Science Stock Status Report 2004/035

DFO (Fisheries and Oceans Canada). 2006. Proceedings of the Zonal Workshop on the Identification of Ecologically and Biological Significant Areas (EBSA) within the Gulf of St. Lawrence and Estuary. DFO Can. Sci. Advis. Sec. Proceedings Series. 2006/011.

DFO (Fisheries and Oceans Canada). 2007. Ecologically and Biologically Significant Areas (EBSA) in the Estuary and Gulf of St. Lawrence: Identification and Characterization. DFO Can. Sci. Advis. Sec., Sci. Adv. Rep. 2007/016.

DFO (Fisheries and Oceans Canada). 2010a. Current Status of Northwest Atlantic Harp Seals, *Pagophilus groenlandicus*. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/074.

DFO (Fisheries and Oceans Canada). 2010b. Marine Megafauna Sightings and Strandings Database. Data provided by Dr. J. Lawson.

Environment Canada. 2006. Recovery Strategy for the Piping Plover (*Charadrius melodus circumcinctus*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vi + 30 pp.

Environment Canada. 2007. Recovery Strategy for the Eskimo Curlew (*Numenius borealis*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. v + 10 pp.

Farquaharson, W.I. 1970. Tides, tidal streams, and currents in the Gulf of St. Lawrence. Second Edition, Part 1, Tides and Tidal Streams, AOL Report 170-5. Atlantic Oceanographic Laboratory, Bedford Institute, Dartmouth, NS.

Gjerdrum C., D.A. Fifield and M. Mahoney. 2010. Changes in the pelagic distribution of seabirds in Atlantic Canada over a 44-year period. Poster – First World Seabird Conference. Victoria, British Columbia.

Goff, G.P. and J. Lien. 1988. Atlantic leatherback turtles, *Dermochelys coriacea*, in cold water off Newfoundland and Labrador. Canadian Field-Naturalist 102(1):1-5

Hammill, M.O. and J.-F. Gosselin. 2005. Pup production of non-Sable Island grey seals, in 2004. FO Can. Sci. Advis. Sec. Res. Doc. 2005/033:1-20.

Hammill, M.O., L.N. Measures, J.-F. Gosselin, and V. Lesage. 2007. Lack of recovery in St. Lawrence Estuary beluga. DFO. Can. Sci. Advis. Sec. Res. Doc. 2007/026.

Hammill, M. O. and G.B. Stenson. 2010. Abundance of Northwest Atlantic harp seals (1952-2010). DFO Can. Sci. Advis. Sec. Res. Doc. 2009/114. iv + 12 p.

Hatch Mott McDonald. 2004. Fixed link between Labrador and Newfoundland. Pre-feasibility study final report. Available at: http://www.gov.nf.ca/publicat/fixedlink/. Accessed March 2010.

James, M.C. 2000. Distribution of the leatherback turtle (*Dermochelys coriacea*) in Atlantic Canada: Evidence from an observer program, aerial surveys, and a volunteer network of fish harvesters. M.Sc. Thesis. Biology Department. Acadia University, Wolfville, Nova Scotia, 71pp.

JWEL (Jacques Whitford Environment Limited). 2000. Marine Mammals and Seabirds in the Strait of Belle Isle. LHP 98-12. Prepared for Labrador Hydro Project.

Kiers, J. 2010. Personal Communication. Associate Data Manager. Atlantic Canada Conservation Data Centre (ACCDC). Corner Brook, NL. Email. April 6th, 2010.

Kingsley, M.C.S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76: 1529-1550

Lawson, J. 2010. Personal Communication. Research Scientist. Department of Fisheries and Oceans. St. John's, NL. Email. September 27th,2010.

Lawson, J., S. Benjamins, and G. Stenson. 2004. Harbour porpoise bycatch estimates for Newfoundland's 2002 nearshore cod fishery. Can. Sci. Advis. Sec. Res. Doc. 2004/066: 1-29.

Lawson. J.W., and J.-F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's marine megafauna survey - A component of the 2007 TNASS. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/031. vi + 28 p.

Lawson, J.W., T. Stevens, and D. Snow. 2007. Killer whales of Atlantic Canada, with particular reference to the Newfoundland and Labrador Region. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/062.

LeGrow, K. H. 1999. Distributions of marine birds in relation to water masses and fronts in the Strait of Belle Isle in the northwestern Atlantic. M.Sc. thesis. Memorial University of Newfoundland, St. John's.

Lesage, V., J. Keays, S. Turgeon, and S. Hurtubise. 2006. Bycatch of harbour porpoises (*Phocoena phocoena*) in gillnet fisheries of the Estuary and Gulf of St. Lawrence, Canada, 2002-02. Journal of Cetacean Research and Management 8: 67-78.

Lesage, V., J.-F. Gosselin, M. Hammill, M.C.S Kingsley, and J. Lawson. 2007. Ecologically and Biologically Significant Areas (EBSAs) in the Estuary and Gulf of St. Lawrence – A marine mammal perspective. DFO Can. Sci. Advis. Secr. Res. Doc. 2007/046.

Lock, A.R., R.G.B. Brown, and S.H. Gerriets. 1994. Gazetteer of Marine Birds in Atlantic Canada. An Atlas of Seabird Vulnerability to Oil Pollution. Canadian Wildlife Service. Sackville, New Brunswick.

Marquez, R. 1990. FAO Species Catalogue. Vol. 11. Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date. FAO Fisheries Symposium No 125 vol. 11. 81 pp.

MICS (Mingan Island Cetacean Study). 2010. Mingan Island Cetacean Study Website. Available At: http://www.rorqual.com/englisch/index.html. Accessed April 2010.

O'Boyle, R. 2001. Meeting on Turtle By-Catch in Canadian Atlantic Fisheries: Hayes Boardroom, BIO. 20 March 2001. DFO. Can. Sci. Advis. Sec. Proc. Ser. 2001/017.

OBIS-SEAMAP. 2010. Ocean Biogeographic Information System – System Spatial Ecological Analysis of Megavertebrate Populations. Duke University. Available At: http://seamap.env.duke.edu/. Accessed April 2010.

Rastogi, T., M.W. Brown, B.A. McLeod, T.R. Frasier, R. Grenier, S.L. Cumbaa, J. Nadarajah, and B.N. White. 2004. Genetic analysis of 16th-century whale bones prompts a revision of the impact of Basque whaling on right and bowhead whales in the western North Atlantic. Canadian Journal of Zoology 82: 1647-1654.

Rees, E. I. S. 1963. Marine birds in the Gulf of St. Lawrence and Strait of Belle Isle during November. Canadian Field Naturalist. 77: 98-107.

Robillard, A., V. Lesage, and M.O. Hammill. 2005. Distribution and abundance of harbor seals (*Phoca vitulina concolor*) and grey seals (*Halichoerus grypus*) in the Estuary and Gulf of St. Lawrence, 1994–2001. Can. Tech. Rep. Fish. Aquat. Sci. 2613: 152 pp.

Russell J. and D. Fifield 2001. Marine Bird Important Bird Areas near the Strait of Belle Isle and Northern Peninsula: Conservation Concerns and Potential Strategies. Can. Nature Fed., Bird Studies Can., Natural History Society of Newfoundland and Labrador, 140pp.

Savenkoff, C., M.-N. Bourassa, D. Baril, and H.P. Benoît. 2007. Identification of Ecologically and Biologically Significant Areas for the Estuary and Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/015.

Schmelzer, I. 2006. A Management Plan for Barrow's Goldeneye *Bucephala islandica*; Eastern Population in Newfoundland. Available online: http://www.env.gov.nl.ca/env/wildlife/wildatrisk/BAGO_24July.pdf

Sears, R. 2010. Personal Communication. Founder. Mingan Island Cetacean Society. St. Lambert, QC. Telephone Call. April 7th, 2010.

Sears, R. and J.M. Williamson. 1982. A preliminary aerial survey of marine mammals for the Gulf of St. Lawrence to determine their distribution and relative abundance. Mingan Island Cetacean Survey – Station de Recherches des Iles Mingans (MICS), Malmouth, Mass., and Sept

Sergeant, D. E., Mansfield, A. W., and Beck, B. 1970. In shore records of Cetacea for eastern Canada. Journal of the Fisheries Research Board of Canada 27: 1903-1915.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal distributions and abundances of loggerhead and leatherback sea turtles in waters of the North Eastern United States. Herpetological Monographs 6: 43–67.

Sikumiut 2010. Marine Fish and Fish Habitat in the Strait of Belle Isle: Information Review and Compilation. Prepared for Nalcor Energy.

Sjare, B. 2010. Personal Communication. Marine Mammal Research Scientist. Department of Fisheries and Oceans. St. John's, NL. Meeting, April 19th, 2010.

Sjare, B., D. Walsh, G.B. Stenson and S. Benjamins. 2005. An update on harp seal (*Pagophilus groenlandicus*) by-catch estimates in the Newfoundland lumpfish fishery. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/049.

Sourisseau, M., Y. Simard, and F.J. Saucier. 2006. Krill aggregation in the St. Lawrence system, and supply of krill to the whale feeding grounds in the estuary from the gulf. Mar. Ecol. Prog. Ser. 314: 257-270.

Stantec Consulting Limited. 2010. Avifauna. Report prepared for Nalcor Energy.

Stenhouse, I.J. 2004. Canadian Management Plan for the Ivory Gull (*Pagophila eburnea*). Canadian Wildlife Service, St. John's, Newfoundland and Labrador. 18 pp. + Appendices. Available online: http://www.env.gov.nl.ca/env/wildlife/wildatrisk/ivgu%20canadian_mgmnt_plan.pdf

Stenson, G.B., M.O. Hammill and J.W. Lawson. 2010. Estimating pup production of Northwest Atlantic Harp Seals, *Pagophilus groenlandicus*: Results of the 2008 surveys. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/103. iv + 39 p.

Stenson, G. B., M.O. Hammill, M.C.S. Kingsley, B. Sjare, W.G. Warren and R.A. Myers. 2002. Is there evidence of increased pup production in northwest Atlantic harp seals, *Pagophilus groenlandicus*? ICES J. Mar. Sci. 59:81-92.

Stenson, G.B., M.O. Hammill, J.W. Lawson, J.-F. Gosselin, and T. Haug. 2005. 2004 pup production of harp seals (*Pagophilus groenlandicus*) in the Northwest Atlantic. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/037.

Stenson, G.B., L.-P. Rivest, M.O. Hammill, J.-F. Gosselin and B. Sjare. 2003. Estimating Pup Production of Harp Seals, Pagophilus groenlandicus, in the Northwest Atlantic. Mar. Mammal. Sci. 19:141-160.

Thomas, P. 2008. Harlequin Ducks in Newfoundland. Waterbirds 31 (Special Publication 2): 44-49

Threlfall, W. 1978. First Record of the Atlantic Leatherback Turtle (*Dermochelys coriacea*) from Labrador. Canadian Field Naturalist. 92(3): 287.

Trimper, P.G., P. Thomas and T.E. Chubbs. 2008. Harlequin Ducks in Labrador. Waterbirds 31 (Special Publication 2): 32-43.

Trzcinski, M.K., R. Mohn, and W.D. Bowen. 2006. Continued decline of an Atlantic cod population: How important is grey seal predation. Ecological Applications 16: 2276-2292.

Tuck, J.A. 1976. Newfoundland and Labrador Prehistory. Van Nostrand Rheinhold, Toronto.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, K.D. Bisack, and L. J. Hansen. 1999. U.S. Atlantic Marine Mammal Stock Assessments – 1998. NOAA Technical Memorandum NMFS-NE-116.

Warkentin, I. and S. Newton. 2009. Birds of Newfoundland Field Guide. Boulder Publications. Portugal Cove - St. Phillip's, NL.

Whales Online. 2010. Whale Species. Available At: http://www.whales-online.net/ . Accessed May 2010.

Wilhelm S., C. Gjerdum and D. A. Fifield. 2010. Standardized protocol for pelagic seabird surveys in eastern Canada from moving and stationary platforms. Canadian Wildlife Service Technical Report Series: in press.

Witzell, W.N. 1999. Distribution and relative abundance of sea turtles caught incidentally by the US pelagic longline fleet in the western North Atlantic Ocean. 1992-1995. Fisheries Bulletin 97:200-211.

APPENDIX A

Annotated Bibliography

Marine Mammals, Sea Turtles and Seabirds in the Strait of Belle Isle:

Information Compilation and Review

Annotated Bibliography

(Google Earth, 2010)

Prepared By:
Sikumiut Environmental Management Ltd.
175 Hamlyn Road, P.O. Box 39089
St. John's, NL
A1E 5Y7

Prepared For:
Nalcor Energy
Hydro Place, 500 Columbus Drive
P.O. Box 12800, St. John's, NL
A1B 0C9

November 2010

Atlantic Leatherback Turtle Recovery Team. 2006. Recovery Strategy for Leatherback Turtle (Dermochelys coriacea) in Atlantic Canada. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa, vi + 45 pp.

Recovery strategy for the leatherback turtle in Atlantic Canada.

Bajzak, C.E., S.D. Cote, M.O. Hammill, and G. Stenson. 2009. Intersexual differences in the postbreeding foraging behaviour of the Northwest Atlantic hooded seal. Mar. Ecol. Prog. Ser. 385: 285-294.

A study looking at differences in reproductive strategies of hooded seals captured in the Gulf of St. Lawrence. This report outlines the seals moving through the Strait of Belle Isle during some periods.

Baker, A.J., P.M. Gonzalez, T. Perisma, L.J. Niles, L. J. I de LS do Nascimento, P.W. Atkinson, N.A. Clark, C.D.T. Minton, M. Peck and G. Aarts. 2004. Rapid population decline in Red Knots: Fitness consequences of decreased refuelling rates and late arrival in Delaware Bay. Proceedings of the Royal Society of London, Series B 271: 875-882.

This study provided information about the Red Knot, including population and estimations of declines.

Beauchamp, J., Bouchard, H., de Margerie, P., Otis, N., Savaria, J.-Y., 2009. Recovery Strategy for the blue whale (Balaenoptera musculus), Northwest Atlantic population, in Canada [FINAL]. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. 62 pp.

This is the recovery strategy for the Blue Whale in the Northwest Atlantic, which was recently released and posted on the SARA registry.

Brown R. G. B. 1986. Revised Atlas of Eastern Canadian Seabirds. Supply and Services Canada, Ottawa.

This atlas provides distributions of birds at sea assessed from vessel surveys. The data in this atlas is now decades old. More recent information from surveys from the Strait of Belle Isle ferry can be found in LeGrow (1999) and more recent data from vessel surveys can be extracted from the Eastern Canadian Seabirds at Sea Data Base (See Wilhelm et al. 2010).

Cairns, D. K., G. Chapdelaine, W. A. Montevecchi. 1991. Prey harvest by seabirds in the Gulf of St. Lawrence. Pages 277-291 in: J. Therriault (Editor) Gulf of St. Lawrence: Small Ocean or Big Estuary? Canadian Special Publication of Fisheries and Aquatic Science. 113.

This study contains an analysis of fish consumption by breeding seabirds throughout the Gulf of St. Lawrence including Strait of Belle region. This is useful for visualizing the breeding distribution of seabird in Strait area and throughout the Gulf.

Cairns D. K., W. A. Montevecchi and W. Threlfall. 1989. Researcher's guide to Newfoundland seabird colonies. Memorial University of Newfoundland Occasional Papers in Biology. 14.

A compendium of the breeding seabird populations (colonies) of Newfoundland (not Labrador). The data is now decades old but some colonies do not have more recent surveys. More current data can be found on the

Canadian Wildlife Service website, at the Atlantic Conservation Data Centre, and in Montevecchi 2010 for the Gannet Islands and Hare Bay Ecological Reserves.

Chapdelaine, G. 1995. Fourteenth census of seabird populations in the sanctuaries of the North Shore of the Gulf of St. Lawrence. Canadian Field-Naturalist. 109: 220-226.

Census of seabird colonies along the North Shore of the Gulf of St. Lawrence, the region influenced by the inflowing Labrador Current.

Conestoga-Rovers & Associates. 2008. Environmental Assessment of Geophysical Surveys for Exploration Licenses 1097, 1098, 1103 and 1104 Western Newfoundland. Prepared for NWest Energy Inc. 221 p + App.

An Environmental Assessment (EA) prepared in support of seismic activity in Western Newfoundland. This EA has some relevant information on marine mammals that may be present in the Strait of Belle Isle Study Area, with most of the data sources taken from Lesage et al. 2007.

CWS (Canadian Wildlife Service). 1996. Unpublished data. Data provided by the Canadian Wildlife Service collected during the 1996 waterfowl surveys at Point Amour, Labrador.

Waterfowl surveys conducted in the Strait of Belle Isle in 1996, specifically at Point Amour, Labrador. This data indicated that the Barrow's Goldeneye was observed only once in the Study Area during this survey.

DFO (Fisheries and Oceans), 2005. The Gulf of St. Lawrence. A Unique Ecosystem, Oceans and Science Branch, Fisheries and Oceans Canada, © Her Majesty the Queen in Right of Canada, 2005. Cat. No. FS 104-2/2005, ISBN 0-662-69499-6

This article is an active document and provides an overview of the Gulf of St. Lawrence area, including the Strait of Belle Isle study area. It includes a great deal of information on the studies that have taken place, and physical and biological aspects of the region.

DFO (Fisheries and Oceans), 2006. Proceedings of the Zonal Workshop on the Identification of Ecologically and Biologically Significant Areas (EBSA) within the Gulf of St. Lawrence and Estuary. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2006/011.

An overview of discussion topics in the workshop surrounding Ecologically and Biologically Significant Areas (EBSA) in the estuary and Gulf of St. Lawrence. The discussion identified knowledge and data gaps in the Strait of Belle Isle area. It also outlines the importance of the Strait of Belle Isle area in terms of physical aspects, areas important to fish, macroinvertebrates, and maps areas of importance for feeding, reproduction and aggregation of marine mammals

DFO (Fisheries and Oceans), 2007. Ecologically and Biologically Significant Areas (EBSA) in the Estuary and Gulf of St. Lawrence: identification and characterization. DFO Can. Sci. Advis. Sec., Sci. Adv. Rep. 2007/016.

This report does not include a great deal of information on the Strait of Belle Isle area, but does provide an overview of the physical and biological environment, and its importance to marine mammals.

DFO (Fisheries and Oceans). 2010. Current Status of Northwest Atlantic Harp Seals, Pagophilus groenlandicus. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2009/074.

A status report on Harp Seals in the Northwest Atlantic. The resource status is estimated based on surveys and incorporates estimates of pup production, reproductive rates, and total population size. The report gives an indication of the range of the stock, which includes the Strait of Belle Isle area, the migratory routes and whelping locations. This resource status report indicates the importance of the Strait of Belle Isle as a migratory route and has an important whelping area north and just in the southern strait.

Environment Canada. 2006. Recovery Strategy for the Piping Plover (Charadrius melodus circumcinctus) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vi + 30 pp.

Recovery strategy for the piping plover.

Environment Canada. 2007. Recovery Strategy for the Eskimo Curlew (Numenius borealis) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. v + 10 pp.

Recovery strategy for the Eskimo Curlew.

Hammill, M.O., L.N. Measures, J.-F. Gosselin, and V. Lesage. 2007. Lack of recovery in St. Lawrence Estuary beluga. DFO. Can. Sci. Advis. Sec. Res. Doc. 2007/026

This report looks at populations of beluga in the St. Lawrence Estuary, and does not have any relevant information for the Strait of Belle Isle Study Area, however demonstrates the presence of beluga in the St. Lawrence Estuary.

Hammill, M. O. and Stenson, G. B. 2010. Abundance of Northwest Atlantic harp seals (1952-2010). DFO Can. Sci. Advis. Sec. Res. Doc. 2009/114. iv + 12 p

A report detailing the results of a population model study of harp seals from 1952 to 2009. The study was conducted to determine abundance in the Northwest Atlantic. This does not include detailed information about the Strait of Belle Isle area; however it does give an overview of the abundance estimates for the harp seals that frequent this area.

Howes, L. A. and W. A. Montevecchi. 1993. Population trends of gulls and terns in Gros Morne National Park, Newfoundland. Canadian Journal of Zoology. 71: 1516-1520.

Documents changes in the breeding populations of gulls and terns and their interactions in Gros Morne National Park, 1970s – early 1990s. More recent surveys have been conducted by Parks staff (see Montevecchi and Anderson 1998) and should be available through the staff ecologist.

Ingstad, A.S. 1977. The Discovery of a Norse Settlement in America. Universitetsforlaget, Oslo.

A historic overview of the Norse Greenlanders' occupation at L'Anse aux Meadows. Saga of Karlsefarni indicates abundant nesting concentrations of eiders in the area.

Kingsley, M. C. S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76: 1529-1550.

Aerial line-transect surveys of cetaceans were flown in the Gulf of St. Lawrence in late August and early September of 1995 and in late July and early August of 1996. Part of these aerial surveys were conducted in the Strait of Belle Isle study area.

L**awson, J., Benjamins, S., and Stenson, G. 2004. Harbour porpoise bycatch estimates for Newfoundland's 2002 nearshore cod fishery. Can. Sci. Advis. Sec. Res. Doc. 2004/066: 1-29.**

Provides estimates of bycatch of harbour porpoise in nearshore cod fishery for Newfoundland, and includes the area of 4Ra, which encompasses the area of the Strait of Belle. Shows relatively high bycatch rates in the area.

Lawson, J.W., T. Stevens, and D. Snow. 2007. Killer whales of Atlantic Canada, with particular reference to the Newfoundland and Labrador Region. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/062.

A report which was compiled through research results of sightings data and a multi-year photographic catalogue of killer whales in Atlantic Canada. The report provides a depiction of the migration routes of different pods and groups. The multi-year photographic catalogue includes data between 1864 to 2007, with most of the sightings recorded in the last seven years, between June to Sept in the NL region.

Lawson. J.W., and Gosselin, J.-F. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's marine megafauna survey - A component of the 2007 TNASS. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/031. vi + 28 p.

A report on the results of surveys conducted in 2007 for marine mammals, sea turtles and other mega-fauna, as part of the Trans North Atlantic Sightings Survey (TNASS), which encompasses the North Eastern USA, Canada to the United Kingdom. The main goal of these surveys was to determine abundance and distribution estimates for marine mammals. The report indicates sightings within the Strait of Belle Isle study area.

LeGrow, K. H. 1999. Distributions of marine birds in relation to water masses and fronts in the Strait of Belle Isle in the northwestern Atlantic. M.Sc. thesis. Memorial University of Newfoundland, St. John's.

Data from vessel transects aboard the Newfoundland – Labrador ferry and from land-based counts of marine birds were collected and analyzed to assess bird distributions and movements in association with oceanographic features (water masses, fronts) and wind conditions in the Strait.

Specifically, research assessed marine bird distributions during summer when the warm out-flowing current on the southern (Newfoundland) side of the Strait contrasts sharply with the cold inflowing Labrador Current on the northern (Labrador) side of the Strait. It was anticipated that consistent with colony distributions that the cold water mass associated with the Labrador Current diving species (auks, marine ducks) would be more common on the northern side of the Strait and that surface-feeding gulls would dominate seabird numbers on the south side of the Strait. The interface between the water masses was expected to be a productive site for pelagic seabirds.

Descriptions of the common marine bird species at different times of year are presented.

The vessel surveys were not able to systematically detect these trends likely owing to small sample sizes, though a more robust survey design could do so.

A simulation model for the number of transects needed to have adequate analytical power to capture seabird x environmental associations in the face of hyper-variability was produced.

Lesage, V., Keays, J., Turgeon, S., and Hurtubise, S. 2006. Bycatch of harbour porpoises (Phocoene phocoena) in gillnet fisheries of the Estuary and Gulf of St. Lawrence, Canada, 2002-02. Journal of Cetacean Research and Management 8: 67-78.

Provides estimates of harbour porpoise bycatches in gillnet fisheries within the Gulf of St. Lawrence, including the Strait of Belle Isle.

Lesage, V., J.-F. Gosselin, M. Hammill, M. C. S Kingsley, and J. Lawson. 2007. Ecologically and Biologically Significant Areas (EBSAs) in the Estuary and Gulf of St. Lawrence – A marine mammal perspective. DFO Can. Sci. Advis. Secr. Res. Doc. 2007/046.

This study evaluates various locations in and surrounding the Gulf of St. Lawrence that may be likely candidate areas for marine mammal Ecologically and Biologically Significant Areas (EBSAs). Important factors are observed, such as available food, habitat available (i.e., ice conditions) as well as the likely functions for each area. Information on surveys in the study areas are also reviewed, including marine mammal spotting, as well as biomass and population estimates.

Lock, A. R., R. G. B. Brown and S. H. Gerriets. 1994. Gazetteer of marine birds in Atlantic Canada. An Atlas of Seabird Vulnerability to Oil Pollution. Canadian Wildlife Service, Sackville, New Brunswick.

Documents colonies of seabirds in the North Gulf Shelf Region (see Montevecchi (1996) in Appendix A). Also gives the oil pollution vulnerabilities of seabirds at different times of year in different areas, including the Strait of Belle Isle and Gulf of St. Lawrence regions.

McKinnon, J., G. Gilchrist and D. A. Fifield. 2009. A pelagic seabird survey of Arctic and sub-Arctic Canadian waters during fall. Marine Ornithology. 37: 77-84.

Vessel surveys of seabirds along east coast of Baffin Island, Hudson Bay, Labrador coast and Strait of Belle Isle during September and October 2005. Highest densities encountered off the Labrador coast, mostly Northern Fulmars and Dovekies.

Meltzer Research and Consulting. 1996. Draft Regional Study Analysis: Identification of National Marine Conservation Areas in the Laurentian Channel Marine Region 7. Halifax, Nova Scotia.

Parks Canada Marine Conservation Plan for Atlantic Ocean Conservation Region 4 (North Gulf Shelf including the Strait of Belle Isle) and Region 7 (Laurentian Channel).

Montevecchi, W. A. 1996. Seabird colonies in the North Gulf Shelf Region 4 and in the Laurentian Channel Region 7. (Unpublished – Appendix A).

Overviews and lists seabird colonies in the North Gulf Shelf Region that includes the Strait of Belle Isle.

Montevecchi, W. A. 2010 under review. Seabird Capitals: The Ecological Seabird Reserves of Newfoundland and Labrador. Flanker Press, St. John's.

New book soon to be published on the Ecological Seabird Reserves of Newfoundland and Labrador. The most relevant of these for seabird considerations in the Strait of Belle Isle are 1) the Gannet Islands Ecological Reserve north of the Strait and through which the breeding seabirds pass during migration before and after breeding, and 2) the Hare Bay Ecological Reserve just south of the Strait on the east coast of the Northern Peninsula. Hare Bay has been important nesting site for Common Eiders and gulls and terns.

Montevecchi, W. A. and S. Anderson. 1998. Long-term population trends of seabirds in Gros Morne National Park. In. D. Anions and T. Berger (Editors). Ecosystem Monitoring in Gros Morne National Park. Parks Canada Report. Rocky harbor, Newfoundland.

This report documents the breeding population trends of terns and gulls in Gros Morne National Park primarily in the Cowhead area. These surveys have been maintained by Parks personnel, and current population information should be available through Parks staff.

Montevecchi, W. A., D. K. Cairns, A. E. Burger, R. D. Elliot and J. Wells. 1987. Status of Black-headed Gulls in Newfoundland and Labrador. American Birds. 41: 197-203.

Document the known breeding records and sites of the Black-headed Gull. Nests and frequently seen in Stephenville area on the west coast of Newfoundland.

Montevecchi W. A. and L. M. Tuck. 1987. Newfoundland Birds: Exploitation, Study, Conservation. Nuttall Ornithological Club, Cambridge, Massachusetts.

Historical compilation of knowledge about birds on the Island of Newfoundland. Overview of seabird colonies and of bird records compiled from archaeological sites in the Strait of Belle Isle region.

Petrie, B., B. Toulany and C. Garret. 1988. The transport of water, heat and salt through the Strait of Belle Isle. Atmosphere-Ocean. 26: 234-251.

Physical oceanography of the Strait of Belle Isle.

Rees, E. I. S. 1963. Marine birds in the Gulf of St. Lawrence and Strait of Belle Isle during November. Canadian Field Naturalist. 77: 98-107.

Interesting survey of the birds located in and near the Strait of Belle Isle during November 1962. Low densities reported and some interesting seabirds (e.g. Greater Shearwaters).

Robillard, A., V. Lesage, and M.O. Hammill. 2005. Distribution and abundance of harbor seals (Phoca vitulina concolor) and grey seals (Halichoerus grypus) in the Estuary and Gulf of St. Lawrence, 1994–2001. Can. Tech. Rep. Fish. Aquat. Sci. 2613: 152 pp.

This report has no real information on the Strait of Belle Isle area, but has a description of surveys conducted further in the Gulf of St. Lawrence and estuary on harbor and grey seals. It demonstrates the effort that has been conducted further south.

Savenkoff, C., Castonguay, M., Méthot, R., Chabot, D., and Hammill, M. O. 2005. Input data and parameter estimates for ecosystem models of the northern Gulf of St. Lawrence (2000– 2002). Can. Tech. Rep. Fish. Aquat. Sci. 2588.

This report provides an outline of the available data in the northern Gulf of St. Lawrence that was used to develop an ecosystem model. It includes information on whales, fish, primary/secondary productivity, and benthic invertebrates to name a few. Where data doesn't exist for the region of the Gulf of St. Lawrence, input parameters were used from other ecosystems, or other data sources. This report needs to be assessed in terms of relevant data on marine mammals.

Schmelzer, I. 2006. A Management Plan for Barrow's Goldeneye *Bucephala islandica*; Eastern Population in Newfoundland. Available online: http://www.env.gov.nl.ca/env/wildlife/wildatrisk/BAGO_24July.pdf

A management plan for the Barrow's Goldeneye.

Schneider, D. C. 1990. Seabirds and fronts: A brief overview. Polar Research. 8: 17-21.

Useful paper in the study of seabirds at fronts, such as that created at the interface of the southern warm current outflow and the northern cold current inflow in the Strait of Belle Isle.

Sears, R. and Williamson, J.M. 1982. A preliminary aerial survey of marine mammals for the Gulf of St. Lawrence to determine their distribution and relative abundance. Mingan Island Cetacean Survey – Station de Recherches des Iles Mingans (MICS), Malmouth, Mass., and Sept.

Reports on the results of a preliminary aerial survey in the Gulf of St. Lawrence in the 1980's, and includes areas in the Study Area.

Sergeant, D. E., Mansfield, A. W., and Beck, B. 1970. In shore records of Cetacea for eastern Canada. Journal of the fisheries Research Board of Canada 27: 1903-1915.

This report provides evidence of historical records of fin whales in the Strait of Belle Isle, through entrapment in ice.

Sjare, B., D. Walsh, G.B. Stenson and S. Benjamins. 2005. An update on harp seal (Pagophilus groenlandicus) by-catch estimates in the Newfoundland lumpfish fishery. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/049.

Report on by-catch estimates of harp seals in the Lumpfish Fishery, which occurs in the Gulf of St. Lawrence, including the Strait of Belle Isle. This report substantiates the idea that some harp seals may stick around in the Gulf of St. Lawrence during the ice-free period.

Sjare, B., and Stenson, G. B. 2010. Changes in the reproductive parameters of female harp seals (Pagophilus groenlandicus) in the Northwest Atlantic. ICES Journal of Marine Science. 67: 304–315.

Report focuses mostly on the reproductive changes for Harp Seals (female) in the Northwest Atlantic, however does point out some important whelping, and moulting areas. Moulting areas exist for this species in the Strait of Belle Isle.

Sourisseau, M., Y. Simard, and F.J. Saucier. 2006. Krill aggregation in the St. Lawrence system, and supply of krill to the whale feeding grounds in the estuary from the gulf. Mar. Ecol. Prog. Ser. 314: 257-270.

This report outlines the results of a simulation of krill aggregations in the St. Lawrence system, in relation to currents and other oceanographic information. Gives indication of important whale feeding grounds in the region.

Stantec Consulting Limited. 2010. Avifauna. Report prepared for Nalcor Energy.

A report prepared for the Labrador-Island Transmission Link Environmental Impact Statement. Provides an overview of all bird species located in the Study Area.

Stenhouse, I.J. 2004. Canadian Management Plan for the Ivory Gull (*Pagophila eburnea*). Canadian Wildlife Service, St. John's, Newfoundland and Labrador. 18 pp. + Appendices. Available online: http://www.env.gov.nl.ca/env/wildlife/wildatrisk/ivgu%20canadian_mgmnt_plan.pdf

Management plan for the Ivory Gull.

Stenson, G. B., M.O. Hammill, M.C.S. Kingsley, B. Sjare, W.G. Warren and R.A. Myers. 2002. Is there evidence of increased pup production in northwest Atlantic harp seals, Pagophilus groenlandicus? ICES J. Mar. Sci. 59:81-92.

A report on harp seal pup production in the Northwest Atlantic, including the area of the Strait of Belle Isle.

Stenson, G.B., M.O. Hammill, J. Lawson, J.F. Gosselin, and T. Haug. 2005. 2004 Pup production of Harp Seals Pagophilus groenlandicus, in the Northwest Atlantic. DFO Can. Sci. Advis. Secr. Res. Doc. 2005/037.

This report provides results of a study conducted in 2004 to determine pup production of Harp Seals off Newfoundland and Labrador, as well as the Gulf of St. Lawrence. The survey was a combination of photographic and aerial surveys of whelping areas, and included part of the Strait of Belle Isle study area.

Stenson, G.B., Hammill, M.O. and Lawson, J.W. 2010. Estimating pup production of Northwest Atlantic Harp Seals, Pagophilus groenlandicus: Results of the 2008 surveys. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/103. iv + 39 p.

A report documenting results from aerial surveys for North West Atlantic Harp Seals in 2008. The survey covers the area from the Front to the northern Gulf of St. Lawrence. This survey was used to estimate the production of harp seals in the area. This report identifies the Strait of Belle Isle area as being important for seal whelping. Seal pups also travel from the Front to the northern Gulf of St. Lawrence through the Strait of Belle Isle on ice. The report documents the amount of sea ice in the area during the survey period (March of 2008).

Stenson, G. B., Rivest, J.-P., Hammill, M. O., Gosselin, J.-F., and Sjare, B. 2003. Estimating pup production of harp seals, Pagophilus groenlandicus, in the Northwest Atlantic. Marine Mammal Science19: 141-160.

An estimation of pup production of harp seals based on aerial surveys for the Northwest Atlantic. Gives an indication of timing of pupping and locations.

Thomas, P. 2008. Harlequin Ducks in Newfoundland. Waterbirds 31 (Special Publication 2): 44-49

Provides an overview of Harlequin Ducks in Newfoundland. Harlequin Ducks are known to use the Torrent River on the Northern Peninsula as a breeding site.

Toulany, B., B. Petrie and C. Garrett. 1987. The frequency-dependent structure and dynamics of flow fluctuations in the Strait of Belle Isle. Journal of Physical Oceanography. 17: 185-196.

Useful paper about fluctuating oceanographic conditions that could influence marine animal activities in the Strait of Belle Isle.

Tuck, J. A. 1975. Ancient People of Port au Choix. Memorial University, St. John's, Newfoundland.

Details the marine birds and mammals found in the archaeological sites used by the Maritime Archaic People.

Tuck, J. A. 1976. Newfoundland and Labrador Prehistory. Van Nostrand Rheinhold, Toronto.

Details the marine birds and mammals found in the archaeological sites throughout the Strait of Belle Isle.

Tuck, J. A. and R. Grenier. 1989. Red Bay Labrador – World Whaling Capital A.D. 1550-1600. Atlantic Archaeology, St, John's, Newfoundland.

Documents the Basque whaling station and activities in Red Bay.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, K.D. Bisack, and L. J. Hansen. 1999. U.S. Atlantic Marine Mammal Stock Assessments – 1998. NOAA Technical Memorandum NMFS-NE-116.

This report is a stock assessment for various marine mammals in the U.S. Atlantic. These marine mammals are the same that frequent waters in the Gulf of St. Lawrence, and Strait of Belle Isle area. The stock assessment for the Blue whale mentions the Strait of Belle Isle as being an important region during spring and summer. Newfoundland and Labrador areas are also mentioned in the geographic range for various other marine mammals.

Warkentin, I. and S. Newton. 2009. Birds of Newfoundland Field Guide. Boulder Publications. Portugal Cove - St. Phillip's, NL.

A field guide to birds found in Newfoundland.

Whales Online. 2010. Whales Species. Available At: http://www.whales-online.net/. Accessed May 2010.

This website provides information on whales that can be found in the Gulf of St. Lawrence, as well as research that is being conducted in the area.

Wilhelm S., C. Gjerdum and D. A. Fifield. 2010. Standardized protocol for pelagic seabird surveys in eastern Canada from moving and stationary platforms. Canadian Wildlife Service Technical Report Series: in press.

Procedures and methods for conducting vessel surveys of birds at sea.

Personal Communications

Richard Sears – Mingan Islands Cetacean Society

Becky Sjare – DFO Marine Mammals

Jack Lawson – DFO Marine Mammals

Garry Stenson – DFO Marine Mammals

Robert Kenney – University of Rhode Island

Michael Moore – Woods Hole Oceanographic Institution

Heather Pettis – North Atlantic Right Whale Consortium

Mike Hammill – DFO Quebec

Veronique Lesage – DFO Quebec

Peter Stevick – Year of the North Atlantic Humpback Whale - YoNaH

APPENDIX B

Study Team Profiles

Study Team Profiles

Larry LeDrew M. Sc., Senior Scientist – Project Manager. Larry has over 30 years experience in the science and environmental field. Mr. LeDrew has conducted fisheries research for government (DFO) and has been responsible for environmental assessment and research for over 20 years with Newfoundland and Labrador Hydro (Nalcor). Larry has had extensive involvement in the management of environmental issues associated with electricity generation and transmission and most recently, prior to his retirement from Nalcor in July, 2008, was the environmental assessment Lead for the Lower Churchill Hydroelectric Generation Project. In this position Larry was also responsible for the development, and implementation, of the transmission line route and corridor selection process employed for the Project. For this study Larry was Project Manager responsible for client relations and team coordination.

Leroy Metcalfe B. Sc Project Lead – Marine Mammals and Seabirds. Leroy is an Inuk from Nain currently residing in St. John's. He has nearly 20 years of experience in environmental consulting, project management and resource management. He has participated in and led various component studies related to environmental assessments and monitoring for activities such as the Voisey's Bay Project and the Lower Churchill environmental assessment. His field survey experience includes extensive fisheries sampling for Lower Churchill Project, waterfowl surveys for various clients, marine mammal surveys, and application of GIS systems to data compilation and display. As part of these various works, he conducted literature reviews related to seal biology and survey methods; fish biology and methyl mercury in fish; and for materials related to the Torngat Mountains National Park. For this Project, Leroy was the Project Lead responsible for overseeing the project and final report preparation.

Dr. Tom Smith, Associate (sub-consultant), Advisor - Marine Mammals. Tom has been involved in research on marine and other mammals for 35 years. He worked as a research scientist with Fisheries and Oceans Canada for 23 years. For the past 15 years he has operated his consulting firm, EcoMarine Corporation (E.M.C.) which conducts environmental impact studies in Polar Regions. Tom has published over 200 scientific papers and reports and is known as a world authority on the Arctic Ringed seal and the Beluga whale both of which are keystone species in the arctic marine ecosystem. For this Project, Tom provided advice on literature sources and was responsible for senior review of the report on marine mammals.

Dr. Bill Montevecchi, Associate (sub-consultant), Advisor – Seabirds. Bill is a University Research Professor in Psychology, Biology and Ocean Sciences at Memorial University. Dr. Montevecchi is an internationally recognized expert in the study of birds as indicators of environmental conditions and ecosystem health. His long-term research program focuses on the roles of birds as environmental indicators in the Low Arctic terrestrial and marine ecosystems of Newfoundland and Labrador with an emphasis on conservation and sustainable ecological and economic development. Bill Montevecchi was responsible for the literature review on seabirds, as well as final report preparation.

Suzanne Thompson, B. Sc. M.E.S. Candidate, Biologist – Research, Data Compilation, Analysis and Report Preparation. Suzanne has a Bachelor of Science in Biology, and is currently completing a Masters in Environmental Science. Her course work has been focused in aquatic sciences, with interests in Fisheries Resource Management, Ecology, Environmental Risk Assessment, and Environmental Policy and Regulations. Suzanne has practical field experience in both freshwater and marine environments and has contributed to the collection and analysis of environmental baseline data, as well as environmental effects monitoring, including

water and sediment quality, fish population surveys, stream habitat surveys, littoral zone habitat mapping in lacustrine environments. Suzanne has also contributed to the analysis of socioeconomic data, assisting in the preparation of reports, and Environmental Protection Plans. She is fully familiar and has experience with habitat quantification approaches in freshwater (fluvial and lacustrine) and marine habitats and is knowledgeable in the requirements for evaluating habitat alteration, disruption, and destruction (HADDs). Suzanne conducted the review of the literature and compiled the available datasets. In association with the study leads, she conducted the analysis and summarized data, prepared the draft report and the annotated bibliography.

Grant Vivian, B. Tech., Dipl. Geomatics, Geomatics Lead. As Geomatics Lead of Sikumiut, Grant's primary responsibilities include traditional resource development, environmental field work, strategic planning, GIS design and analysis, report writing, and project management. Grant became an integral part of Sikumiut's environmental team upon arrival where he has completed several large baseline projects including winter lake mapping using Ground Penetrating Radar, a science new to the region of Labrador. His previous work experience relates directly to the northern regions where he used satellite technology to process high resolution river ice charts and iceberg maps off the coast of Newfoundland and Labrador. Grant has valuable international experience working independently in surveying and GIS technology where he gained extensive knowledge in dimensional control concepts for structural design. His technical expertise spans a broad spectrum of Geomatics including cartographic map analysis, satellite image processing, underwater acoustical systems, surveying and GIS technologies, and computer aided drafting (CAD). Grant was responsible for geo-referencing and GIS support.

APPENDIX C

Marine Bird Occurrences in the Strait of Belle Isle:
Seasonal and Decadal Comparisons of Relative Abundance

Marine Bird Occurrences in the Strait of Belle Isle
Seasonal and Decadal Comparisons of Relative Abundances

W. A. Montevecchi

Memorial University of Newfoundland

(mont@mun.ca**)**

Greater Shearwater, a Southern Hemisphere breeder, that is abundant in the waters of Newfoundland and Labrador during summer (austral winter) and the most abundant species recorded from vessel surveys in the Strait of Belle Isle. (photo: W. A. Montevecchi)

Background

Systematic counts of seabirds from vessels have been carried out in the waters of Newfoundland and Labrador since the1960s (Rees 1963, Brown et al. 1975, Brown 1986, Lock, Brown and Gerriets 1994, LeGrow 1999). Almost all of this effort was standardized and organized by the Canadian Wildlife Service (Brown et al. 1975). Counts were based on 10-minute observation periods from moving vessels where all observed birds were recorded, as well as aspects of their behavior (e.g. flying, sitting on water) and plumage. Observations of birds were coded with date, time, ship position and speed, weather and sea state conditions, and at times with oceanographic variables, such as sea surface temperature. From 1984 onward, following a review of pelagic survey methods by Tasker et al. (1984), counts were restricted to 300 meter wide fixed transects, which permitted the calculation of densities (number of birds per square km). This method and database referred to as the PIROP (Programme Intégré de recherches sur les oiseaux pélagiques) Program (Brown et al. 1975) was executed from 1966 – 1992. All data are archived and maintained by the Canadian Wildlife Service office at the Bedford Oceanographic Institute in Dartmouth, Nova Scotia (Carina.Gjerdrum@EC.GC.CA).

Following a 13-year hiatus, the Canadian Wildlife Service initiated a new system of counts in 2005. The new program makes estimates of the distances of observed birds from the observer on the vessel, referred to as the distance sampling method (Buckland et al. 2001) that allows for corrections of detection misses by the observer. The new observation procedures and database are referred to as ECSAS (Eastern Canadian Seabirds at Sea) Program (Wilhelm, Gjerdrum and Fifield 2010). As with the PIROP data, ECSAS files are archived and maintained by the Canadian Wildlife Service office at the Bedford Oceanographic Institute in Dartmouth, Nova Scotia (Carina.Gjerdrum@EC.GC.CA).

In the Strait of Belle Isle, the longer duration PIROP records have more survey coverage and effort than the more systematic and recent ECSAS data. While it needs to be emphasized that the PIROP and ECSAS observers recorded birds using different methodologies for similar but distinct purposes, there are many compelling reasons for both combining and drawing comparisons between the two data sets in terms of the numbers of birds observed per kilometer. Such an approach maximizes use of the available information and permits long-term decadal assessments of historical changes in seabird species diversity and

abundance in the Strait of Belle Isle. Recently, the PIROP and ECSAS datasets have been compared for the entire Atlantic Canada region (Gjerdrum, Fifield and Mahoney 2010).

In the present exercise, we integrate, compare and interrogate all the available information on numbers of birds observed per kilometer from the PIROP and ECSAS databases, which provides a comparable measure of seabird abundances and occurrences. We more fully examine species occurrences, their relative abundances and diversity and their seasonal and decadal fluctuations in the Strait of Belle Isle from the 1960s to the present. We draw conclusions about what is known and about existing information gaps.

Methods

Information on seabird abundances and occurrences in the Strait of Belle Isle were extracted from systematic counts of seabirds from the PIROP and ECSAS survey programs. PIROP survey data for the Strait of Belle Isle were available for 14 years spanning the period from 1969 to 1987. There were no survey data available for the Strait of Belle Isle during the 1990s. ECSAS data for the area were available for 5 years from 2005 – 2009. A total of 10,792.4 km was surveyed in the Strait of Belle during these two programs, including 9584.9 km from PIROP and 1207.5 km ECSAS.

Estimates of seabird abundance were generated using information on the total number of birds (according to species and taxonomic groups) as a function of effort (total # kilometers surveyed) expressed as # birds per kilometer. Differences in the survey methods over time do not permit a comparison of densities (# birds/km^2). Information on decadal trends of seabirds in the Strait of Belle Isle are presented as percent relative abundance and percent frequency of occurrence for all seabird species and taxonomic groups. This presentation of the data provides information on changes in the numbers and composition of species occurring in the Strait of Belle Isle over the past five decades. Information on seasonal patterns in the region are presented as the percent relative abundance of seabird taxonomic groups and species diversity (total number of species) by month (includes PIROP and ECSAS data). Survey data were processed, tabulated, graphed and analyzed using R 2.10.1, a statistical and graphical programming language (R development core team 2010).

Results and Discussion

Twenty-eight species of marine were recorded in the Strait of Belle Isle from 1969 to 2009 (PIROP and ECSAS data combined). Table 1 summarizes all the species observed (as well as those not identified to species) according to relative abundance (% RA) and frequency of occurrence (% FO). Greater and Sooty Shearwaters were the most abundant species accounting for 19.2 and 11.6 % relative abundance respectively. They were followed by Black-legged Kittiwake (6.8 % RA; Figure 1) and other gull species, including Thayer's Gull, Iceland Gull and Glaucous Gull, that accounted for a major proportion (16.8 % RA) of the total number of species observed. Black-legged Kittiwake was the most frequently observed species (12.2 % FO) and was followed by Northern Fulmar and Greater Shearwater (11.9, and 11.1 % FO, respectively). The correlation between the relative abundance and frequency of occurrence scores is quite robust. ($r = 0.60$, $df = 36$, $P = 0.0001$).

Table 1 – Percent relative abundance and percent frequency of occurrence of all seabird species and species groups observed during PIROP and ECSAS surveys. Species are listed from highest to lowest according to percent relative abundance.

Species	Relative Abundance (%)	Frequency Occurrence (%)
Greater Shearwater	19.2	11.1
Sooty Shearwater	11.6	8.2
Black-legged Kittiwake	6.8	12.2
Thayers Gull	6.5	0.1
Northern Fulmar	5.5	11.9
Iceland Gull	5.3	1.2
Glaucous Gull	5	1.2
Red Phalarope	4.7	0.5
Red-necked Phalarope	3.4	0.1
Great Black-backed Gull	3.1	8.2
Herring Gull	2.9	9.9
Dovekie	2.8	2.8
Leach's Storm-Petrel	2	1.5
Common Murre	1.4	4.3
Atlantic Puffin	0.9	4.4
Thick-billed Murre	0.8	0.7

Common Tern	0.8	0.3
Northern Gannet	0.7	3.9
Razorbill	0.7	1
Pomarine Jaeger	0.6	1.5
Parasitic Jaeger	0.6	0.4
Black Guillemot	0.6	1
Long-tailed Jaeger	0.6	0.3
Wilsons Storm Petrel	0.6	0.6
Manx Shearwater	0.4	0.1
Arctic Tern	0.3	0.5
Great Skua	0.3	0.2
Ring-billed Gull	0.2	0
Seabirds Not Identified to Species		
Phalaropes	5.2	0.6
Gulls	1.7	1.1
Shearwaters	1.3	0.8
Auks	1.1	1.9
Murres	1	5
Jaegers	0.5	1.5
Terns	0.5	0.7
Storm-Petrels	0.4	0.4

Figure 1 *– Black-legged Kittiwake, the third most abundant seabird species during systematic vessel surveys in the Strait of Belle Isle. (photo: W. A. Montevecchi).*

Decadal Trends

Table 2 summarizes the percent relative abundance (% RA) and percent frequency of occurrence (% FO) scores for seabirds according to taxonomic groups during PIROP and ECSAS surveys. Shearwaters (including three species) were the most abundant taxonomic group (20.1 % RA), followed by Northern Fulmar (7.2 % RA), phalaropes (two species; 6.4 % RA) and gulls (six species; 5.8 % RA). Gulls were the most frequently observed group during surveys (30.9 % FO), followed by auks (19.3 % FO), shearwaters (18.3 % FO) and Northern Fulmar (10.8 % FO). Storm-petrels, gannets, jaegers and terns were observed less frequently.

Table 2 - Ranking of species groups in all decades according to percent relative abundance (expressed as percentages) using PIROP (1960s through 1980s) and ECSAS (2000s) methods.

.Species Group	Relative Abundance (%)	Frequency Occurrence (%)
Shearwaters	20.1	18.4
Fulmar[1]	7.2	10.8
Phalaropes	6.4	1.1
Gulls	5.8	30.9
Storm-Petrels	1.9	2.2
Auks	1.7	19.3
Gannet[2]	1.0	3.5
Jaegers	0.8	3.6
Terns	0.7	1.4

[1] category contains only one species (Northern Fulmar)

[2] category contains only one species (Northern Gannet)

Table 3 presents a direct comparison of the percent relative abundance of species groups from the PIROP and ECSAS datasets. This analysis shows major changes in the abundances of some seabird species groups in the Strait of Belle Isle over the last 5 decades. Most striking is the decline in the abundance of shearwaters observed during ECSAS surveys (37.6 % RA) relative to the PIROP surveys (1.2 % RA), but overall there is a declining trend in the

abundance of all the major species groups. These estimates (% RA) are broken down by decade in Table 4 and Figure 2 and show a similar pattern of decline.

Table 3 - Relative abundance (% RA) ofseabird species groups recorded during systematic vessel surveys in the Strait of Belle Isle using PIROP (1960s through 1980s) and ECSAS (2000s) methods.

Species Group	PIROP	ECSAS
Shearwaters	37.6	1.2
Fulmars[1]	14.4	2.4
Phalaropes	11.8	0.0
Gulls	11.6	1.3
Storm-Petrels	3.6	1.8
Auks	3.3	2.1
Gannets[2]	2.0	1.1
Jaegers	1.4	1.6
Terns	1.1	1.7

[1] category contains only one species (Northern Fulmar)

[2] category contains only one species (Northern Gannet)

Table 4 and Figure 2 present decadal comparisons of the percent relative abundances of different species groups in the Strait of Belle Isle (PIROP and ECSAS data combined). Shearwaters, fulmars and auks were most abundant in the 1970s, whereas phalaropes, gulls, jaegers and terns were most abundant during the 1960s. Gannets were most abundant during the 1980s. Fulmars (Figure 3) and auks were the most abundant species groups during the 2000s, but their numbers were lower than during previous decades.

Table 4 – Relative abundances (expressed as percentages) of seabird species groups during systematic vessel surveys in the Strait of Belle Isle using PIROP (1960s through 1980s) and ECSAS (2000s) recording methods.

Species Group	1960s	1970s	1980s	2000s
Shearwaters	4.2	19.1	3.3	0.5
Fulmar[1]	1.9	7.0	3.3	1.1
Phalaropes	7.3	4.1	6.7	0.0
Gulls	7.9	4.7	7.0	0.6
Storm-Petrels	1.0	1.1	3.3	0.8
Auks	0.8	1.5	0.7	1.0
Gannet[2]	0.5	0.4	1.9	0.5
Jaegers	1.1	0.5	1.0	0.7
Terns	2.6	0.4	0.5	0.7

[1] category contains only one species (Northern Fulmar)

[2] category contains only one species (Northern Gannet)

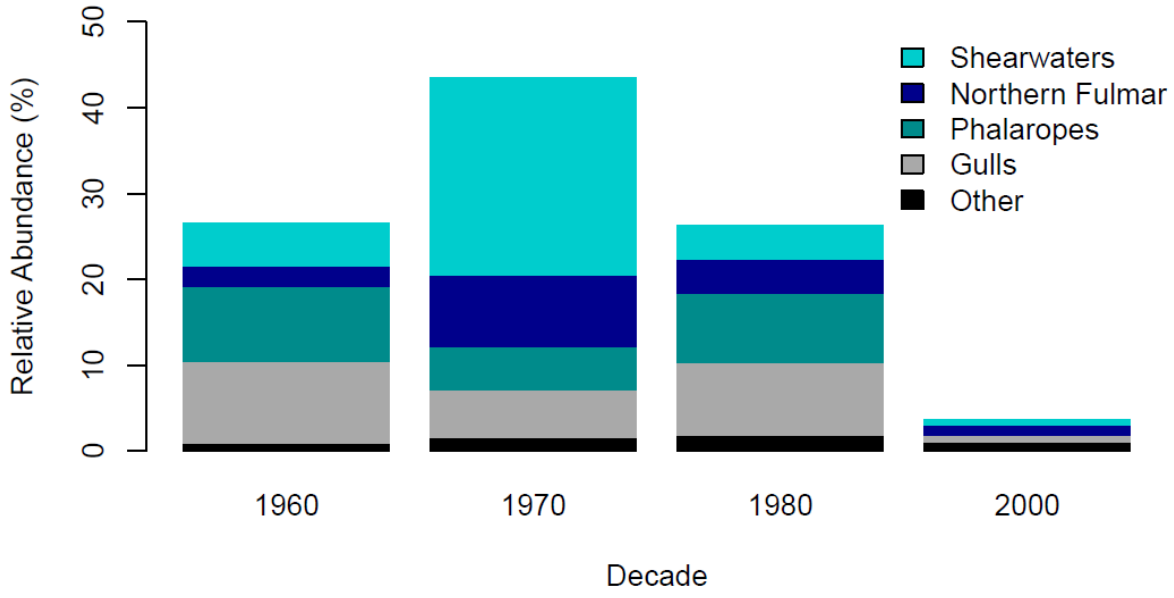


Figure 2 *– Decadal relative abundances (expressed as percentages) of different species groups recorded during systematic vessel surveys in the Strait of Belle Isle by PIROP (1960s – 1980s) and by ECSAS (2000s).*

Figure 3*. Northern Fulmar, an abundant seabird species in the Strait of Belle Isle. (photo: W. A. Montevecchi)*

Our finding of declines in the relative abundances of seabirds during the current decade are supported by Gjerdrum, Fifield and Mahoney (2010) who show a striking southerly shift in the distribution of shearwaters and an offshore movement of gulls away from the Strait of Belle Isle in the current decade.

It seems likely that at least some of this long-term decrease in seabird numbers and biodiversity in the Strait of Belle Isle is related to ocean climate change. Changing oceanographic conditions likely influence these trends in marine avifauna abundance and diversity. Informative investigations could involve relating changes in the temperature and salinity of the southerly flowing arctic water being moved into the Gulf of St. Lawrence through the northern Strait by the Labrador Current. As well, changes in the warmer water flowing out through the southern part of the Strait could influence marine productivity and the occurrences and distributions of prey species that in turn drive changing distributional patterns of top seabird predators.

Seasonal Trends

The monthly occurrences of the most abundant seabird groups are shown in Table 5 and Figure 4. Most birds were recorded during autumn migratory movements, with shearwaters dominating counts in October and Northern

Fulmars being the most abundant seabird during counts in November. Numbers of birds were recorded during summer, with very few being observed during winter and spring when the Strait of Belle Isle is usually ice-covered, preventing vessel traffic.

Table 5 - Relative abundance (% RA) of the most abundant species groups observed during systematic vessel surveys in the Strait of Belle Isle using PIROP (1960s through 1980s) and ECSAS (2000s) methods.

Species Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Shearwaters	0.0	0.0	0.0	0.0	0.0	2.6	1.6	1.6	1.7	37.7	0.1	0.0
Fulmar	0.0	0.3	0.0	0.0	0.2	0.6	1.5	2.1	0.5	3.8	15.0	0.0
Phalaropes	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	3.8	1.1	0.0	0.0
Gulls	0.1	0.8	0.5	0.0	0.2	0.7	0.7	2.3	0.8	2.3	7.9	0.2
Other	1.2	0.2	0.2	0.0	0.4	0.3	0.4	0.6	0.2	0.6	0.7	0.1

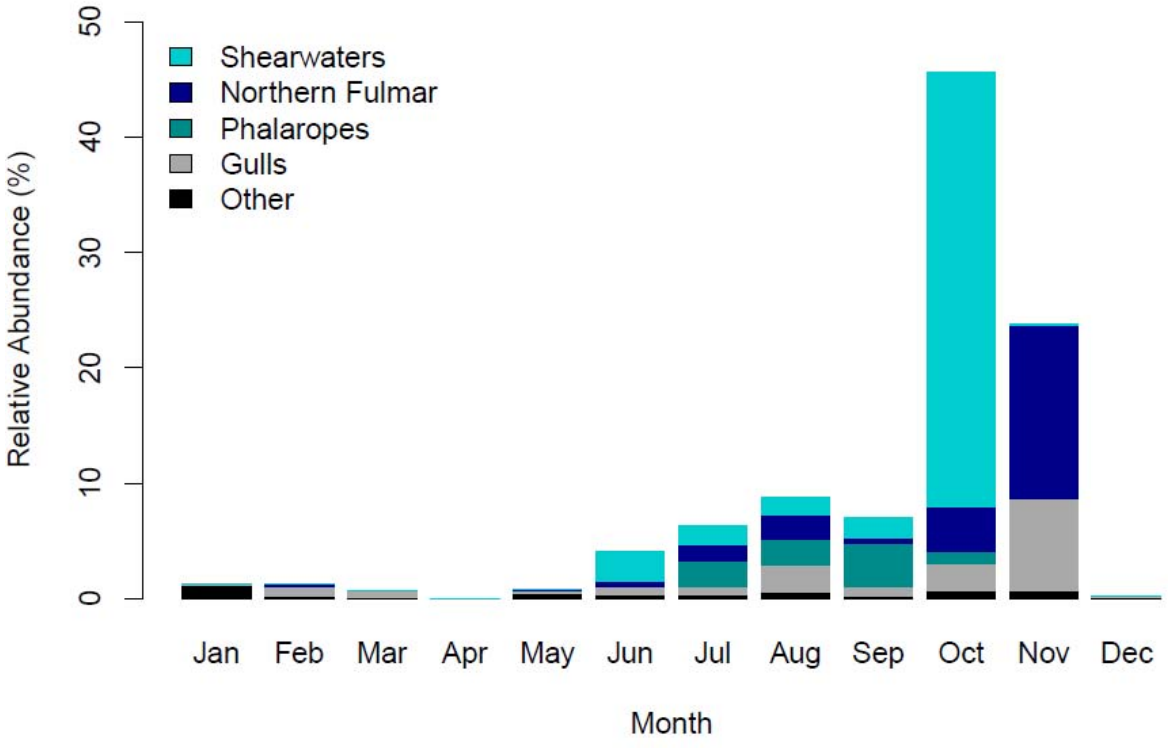


Figure 4 – *Monthly relative abundances (% RA) of the most abundant species groups recorded during all PIROP and ECSAS surveys combined.*

It is evident from the monthly analysis of seabird data that the number and diversity of birds detected is a function of survey effort (see also LeGrow 1999). Figure 5 clarifies this relationship in a direct comparison of seabird occurrences and vessel survey effort. The conclusion is straight-forward, i.e. more surveys result in the detection of more birds and more species diversity.

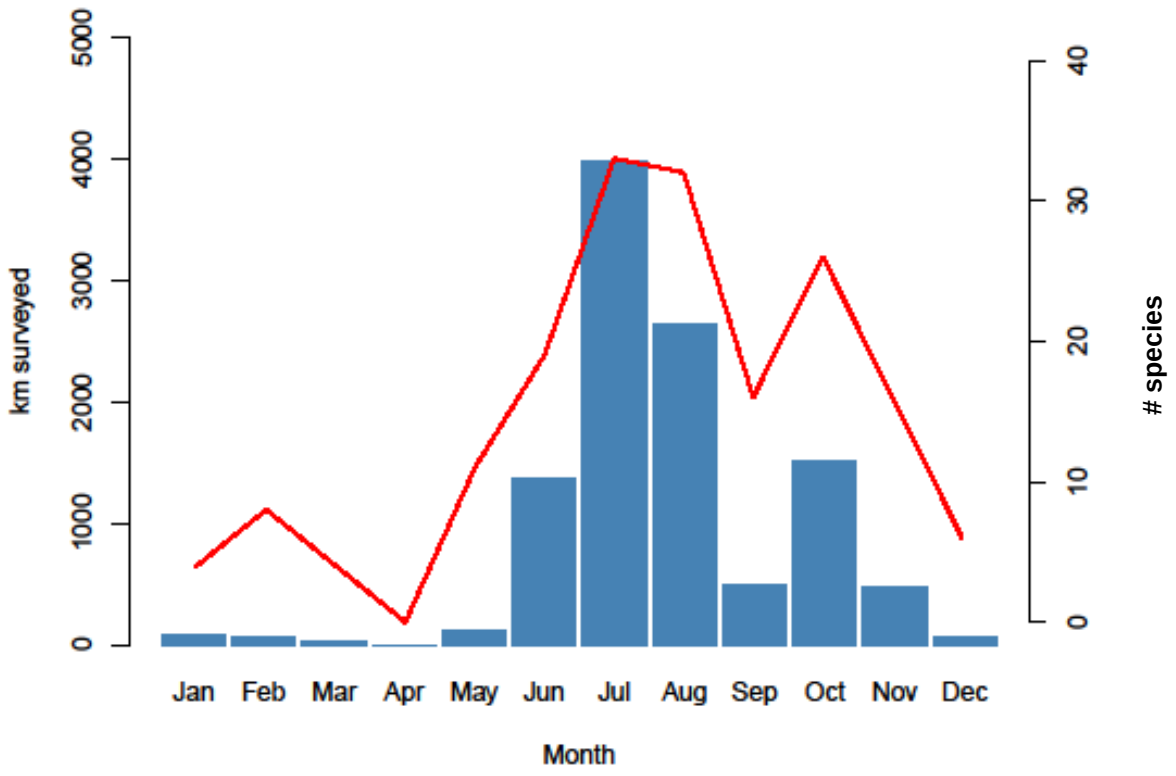


Figure 5 *– Monthly diversity (number of species; blue bars) and survey effort (red line) recorded during all PIROP and ECSAS surveys combined.*

Conclusions

- It is informative to maximize use of all available data from seabird surveys in the Strait of Belle Isle from the 1960s through 2010 by both integrating and comparing the numbers of birds observed per kilometer from the PIROP and ECSAS datasets.
- Shearwaters, fulmars, kittiwakes and gulls are the most commonly sighted seabirds in the Strait of Belle Isle. Auks, storm-petrels, gannets, jaegers and terns are also frequently observed.

- Significant decadal changes in seabird abundances and species diversity have occurred in the Strait of Belle Isle from the 1960s through 2010.
- Peak numbers of birds and species were recorded during the 1970s, and the lowest numbers of birds and species have been obtained during the current decade.
- Ocean basin scale shifts in seabird distributions are associated with recent changes in the Strait of Belle Isle.
- Seabirds are most abundant in the Strait of Belle Isle during autumn migratory movements. Shearwaters dominate counts in October and Northern Fulmar are the most abundant bird during November. Juvenile gulls are also most abundant at the end of summer and during early autumn.
- Very few seabirds have beenrecorded during winter and spring when the Strait of Belle Isle is usually ice-covered and vessel traffic is precluded.
- Vessel survey effort determines the number and diversity of birds detected. More surveys will improve information about seabird occurrences and species diversity.
- More surveys would be particularly useful at present, because little survey effort has been made since 1990, and seabird distributions have shifted markedly since then.

Literature Cited

Brown, R. G. B., Nettleship, D. N., Germain, P., Tull, C. E., and Davis, T. 1975. *Atlas of Eastern Canadian Seabirds*. Canadian Wildlife Service, Ottawa.

Brown, R. G. B. (1986) *Revised Atlas of Eastern Canadian Seabirds*. Supply and Services Canada, Ottawa.

Buckland, S. T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borchers, D. L. and L. Thomas (2001) *Introduction to Distance Sampling: Estimating Abundance of Biological Populations*. Oxford University Press. Oxford, UK.

Gjerdrum C., D. A. Fifield and M. Mahoney (2010) Changes in the pelagic distribution of seabirds in Atlantic Canada over a 44-year period. Poster – First World Seabird Conference, Victoria, British Columbia.

Lock, A. R., R. G. B. Brown and S. H. Gerriets (1994) *Gazetteer of marine birds in Atlantic Canada. An Atlas of Seabird Vulnerability to Oil Pollution*. Canadian Wildlife Service, Sackville, New Brunswick.

LeGrow, K. H. (1999) Distributions of Marine Birds in Relation to Water Masses and Fronts in the Strait of Belle Isle in the Northwestern Atlantic. M.Sc. thesis. Memorial University of Newfoundland, St. John's.

R Development Core Team (2008) R: a language and environment for statistical computing. R Foundation for Statistical Computing, ISSN/ISBN 3-900051-07-0, available at www.r-project.org

Rees, E. I. S. (1963) Marine birds in the Gulf of St. Lawrence and Strait of Belle Isle during November. *Canadian Field Naturalist* 77, 98-107.

Tasker, M. L., Hope-Jones, P., Dixon, T. J. and Blake, B. F. (1984) Counting seabirds at sea from ships: A review of methods employed and a suggestion for a standardized approach. *Auk* 101: 567–579

Wilhelm S., C. Gjerdum and D. A. Fifield (2010) Standardized protocol for pelagic seabird surveys in eastern Canada from moving and stationary platforms. *Candian Wildlife Service Technical Report Series*: in press.