JWEL PROJECT NO. 1203

MARINE MAMMALS AND SEABIRDS IN THE STRAIT OF BELLE ISLE

LHP 98-12

PREPARED FOR

NEWFOUNDLAND AND LABRADOR HYDRO
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November 8, 2000

With Updated *Executive Summary and Introduction*
by Nalcor Energy – November 2009

EXECUTIVE SUMMARY
Updated by Nalcor Energy – November 2009

The proposed *Labrador-Island Transmission Link* includes the installation of a submarine cable across the Strait of Belle Isle. Construction activity in and adjacent to the marine environment associated with cable installation has the potential to interact with marine mammals and seabirds in the project area.

The primary objective of the 1998 marine mammal and seabird survey in the Strait of Belle Isle was to estimate the relative abundance of marine mammals and seabirds in the Strait and surrounding area during the ice-free season. These baseline data will contribute to the requirements for a future environmental assessment and any follow-up monitoring, if required. Aerial and boat-based surveys were conducted approximately every three weeks from July to December, 1998. The aerial survey covered the entire Strait of Belle Isle and the northeast Gulf of St. Lawrence, an area of approximately 5,400 km^2. The boat-based survey covered an area of approximately 725 km^2 in the general area of the proposed cable crossing corridors.

Nine species of whales and dolphins and two species of seals were sighted during the 1998 marine mammal survey of the Strait of Belle Isle. Marine mammals in the Strait of Belle Isle were most abundant in August, with harbour porpoise, white-sided dolphin, and humpback, fin and the minke whales at their peak relative abundance. The relative abundance of most species, except the white-sided and white-beaked dolphins, declined after August.

The most common baleen whale, the humpback, appears to be most frequent near Belle Isle and along transects running southeast to the Northern Peninsula from L'Anse au Loup to L'Anse au Clair. The harbour porpoise, the most abundant species during the survey, was most frequent near the western end of the study area, along the transects running northwest to Labrador from Castor's River to Eddie's Cove West and along transects running southeast to the Northern Peninsula from L'Anse au Clair to Blanc Sablon. Overall, there appeared to be a preference for the Labrador side of the Strait by most marine mammals.

A dedicated observer conducted seabird surveys during four of the boat-based mammal surveys between August and October. A total of 29 seabird species were seen during the surveys between August and October. When considering all surveys together, there were just 10 species that comprise the five most abundant species during each survey. The total number of species seen for each of the surveys was consistent. However, species composition and abundance varied greatly between surveys. Species that breed in the area in relatively large numbers (Greater Black-backed Gulls, Herring Gulls, Atlantic Puffin, and Common Murre) were most abundant in the August survey.

The results of the 1998 marine mammal and seabird survey and literature review reported herein will be used in the Project's Environmental Impact Statement (EIS), along with any additional information and literature that has become available since that time, in order to describe the existing (baseline) conditions in the Strait of Belle Isle area which could potentially interact with Project works and activities.

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1.0 INTRODUCTION

This Section Updated by Nalcor Energy - November 2009

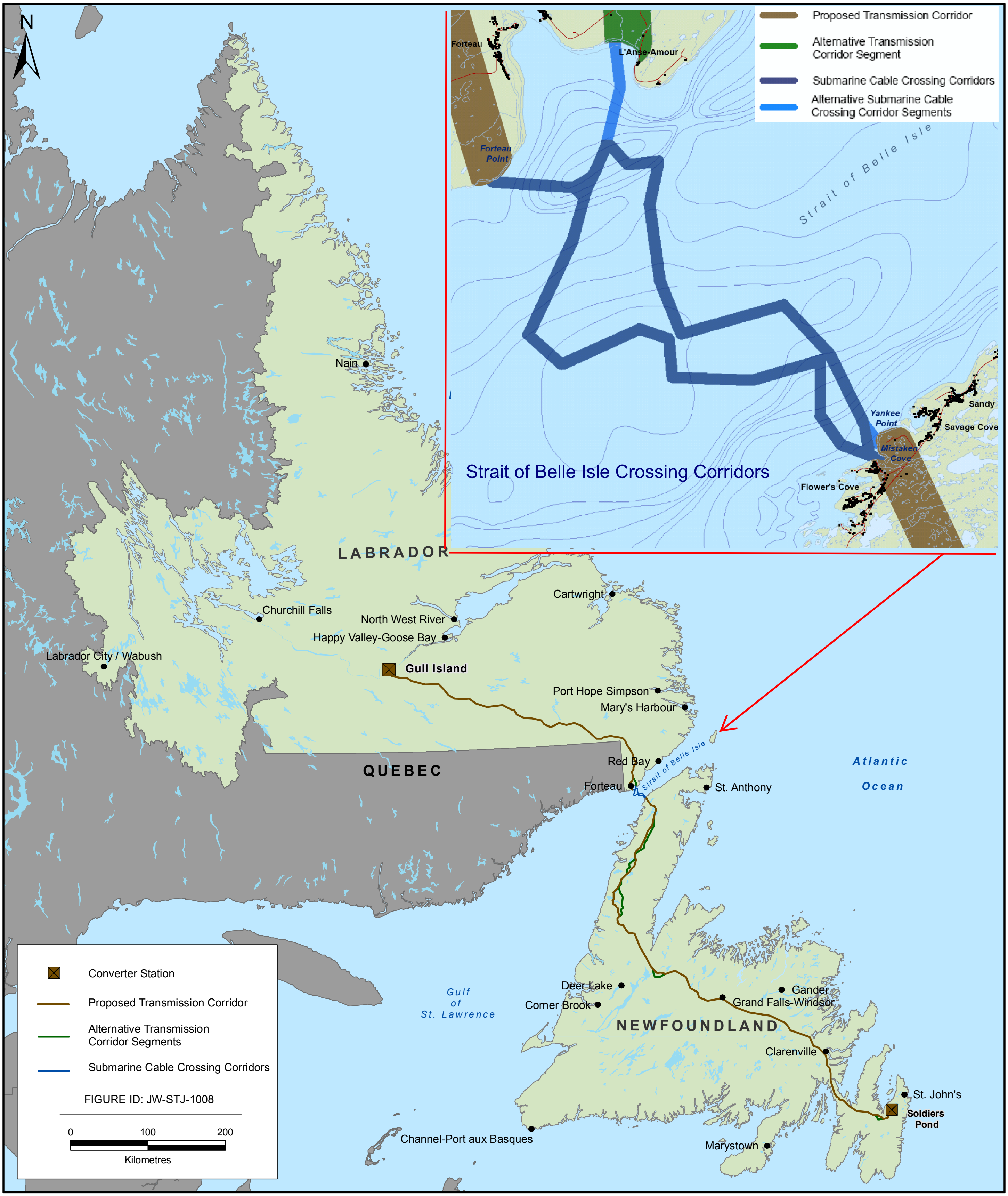
1.1 Project Overview

The proposed *Labrador – Island Transmission Link* (the Project) involves the construction and operation of transmission infrastructure within and between Labrador and the Island of Newfoundland. Nalcor Energy is proposing to establish a High Voltage Direct Current (HVdc) transmission system extending from Central Labrador to Soldiers Pond on the Island's Avalon Peninsula. The Project will include the installation and operation of submarine power cables across the Strait of Belle Isle between Labrador and the Island of Newfoundland.

The proposed transmission system, as currently planned, will include the following key components (Figure 1.1):

- an ac-dc converter station 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 60 m wide, and consist of single galvanized steel lattice towers;
- cable crossings of the Strait of Belle Isle with associated infrastructure (Figure 1.1 - Inset), which may involve placing three to five cables within identified corridors across the Strait 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 of Newfoundland 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 transmission line and 500 m wide corridors for the proposed Strait of Belle Isle cable crossings. 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.



nalcor energy

FIGURE 1.1

Labrador - Island Transmission Link

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. Two alternative cable landing sites have been identified and are being considered on the Labrador side - Forteau Point and L'Anse Amour. On the Newfoundland side, two options are also being considered - Mistaken Cove and nearby Yankee Point.

Two proposed submarine cable corridors have also been identified for these cable crossings, which extend from these potential landing sites and across the Strait. These cable corridors are approximately 25 – 35 km in length, depending upon the specific landing site alternatives involved. Construction of the submarine crossings would include the placement of three to five cables within two separate corridors across the Strait (two to four cables to carry the power and one to be used as a spare). Both cable crossing corridors would therefore be used, minus the inshore segments connecting the alternative landing site options that are not eventually selected for development. The eventual selection of specific cable routes within the two currently identified 500 m wide corridors is the subject of ongoing engineering analysis. A number of methods will likely be used to protect the cables across the Strait of Belle Isle. Primarily, the currently identified corridors 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 ocean bed contours 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 are also being evaluated for specific areas.

Engineering analyses are ongoing to assess these and other potential approaches and techniques for protection of the subsea cables. The eventual selection of particular approaches and methods for cable protection along the route and specific portions of it 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.

1.2 Marine Mammal and Seabird Survey: Study Purpose and Rationale

The purpose of this study was to conduct a marine mammal and seabird survey in the Strait of Belle Isle, in order to understand the presence, abundance and distribution of marine mammals and seabirds in the general vicinity of the proposed submarine cable crossings through the collection of additional, primary data. The study area for the marine mammal and seabird survey encompasses the northern Gulf of St. Lawrence and the Strait of Belle Isle, delineated by longitudes 58°00'W and 55°30'W (Figure 1.2).[1]

The field survey was intended to collect and present additional information on marine mammals and seabirds in this area, in order to supplement the existing and available literature. The results of the 1998 survey and literature review reported herein will be used in the Project's Environmental Impact Statement (EIS), along with any additional information and literature that has become available since that time, in order to describe the existing (baseline) conditions in the Strait of Belle Isle area which could potentially interact with the Project works and activities.

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1 Please note that references to the COSEWIC (Committee on the Status of Endangered Wildlife in Canada) designations of various species outlined in this report were current as of the time the survey was completed (1998), but in some cases have since been revised.

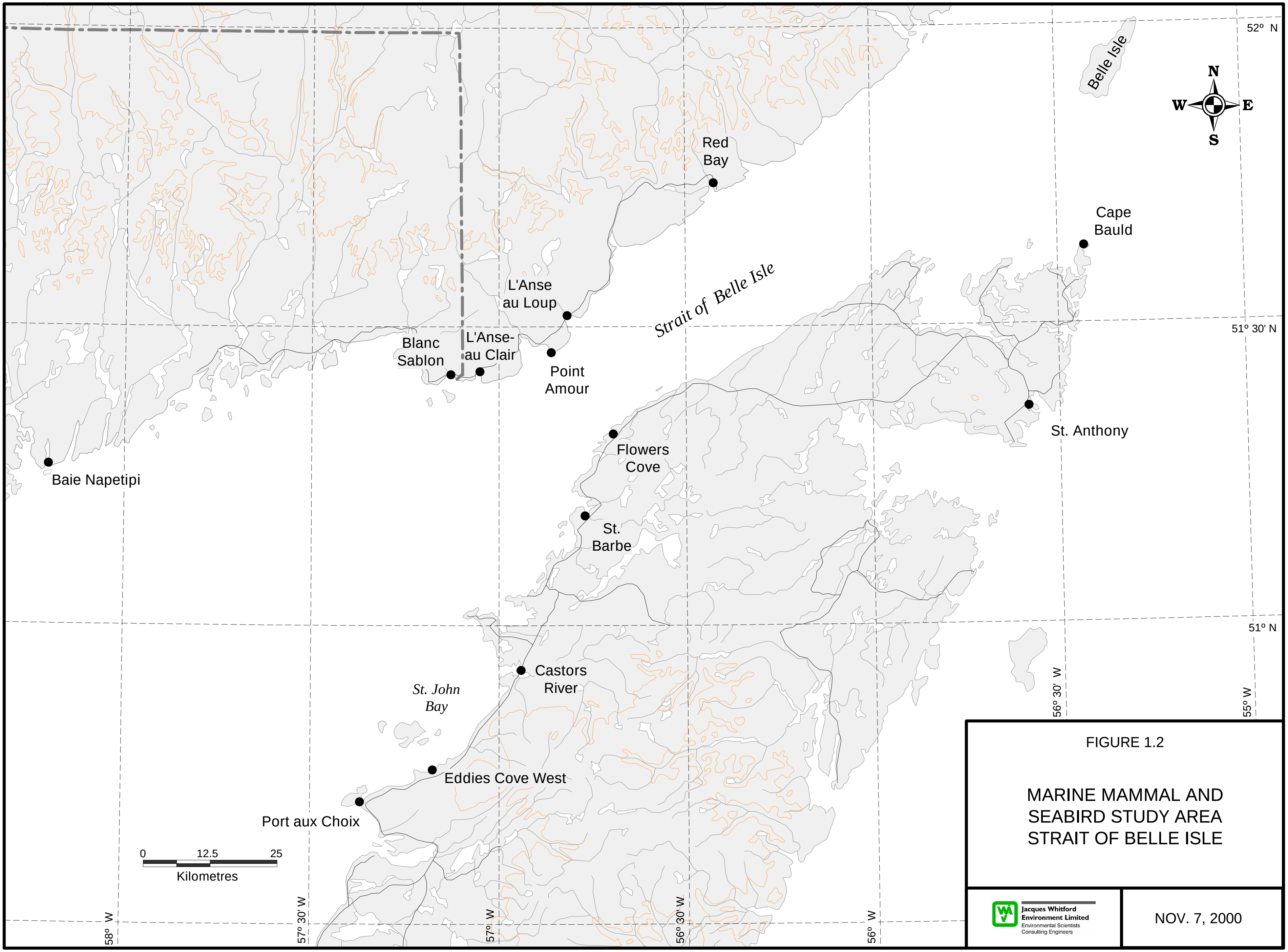

FIGURE 1.2

MARINE MAMMAL AND
SEABIRD STUDY AREA
STRAIT OF BELLE ISLE

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2.0 DESCRIPTION OF STUDY TEAM

The marine mammal and seabird study was conducted by Jacques Whitford Environment Limited (JWEL). The 1998 marine mammal and seabird study team included a scientific authority, field crew leaders, navigators, observers, and data management personnel (Table 2.1). All team members have in-depth knowledge and experience in their fields. The proportion of team members residing in Newfoundland and Labrador is approximately 89%. Brief biographical statements, highlighting project roles and responsibilities and relevant education and employment experience, are provided below.

Table 2.1 Study Team - Marine Mammals and Seabirds in the Strait of Belle Isle

Participant	Role	Affiliation
David Pinsent	Project Manager/ Field Crew Leader - Plane	JWEL – St. John's
Michael Kingsley	Scientific Authority	Independent
Holly Hogan	Field Crew Leader - Boat	JWEL – St. John's
Stephen Bettles	Navigator - Plane	JWEL – St. John's
Natasha Smith	Navigator/Observer - Boat	JWEL – St. John's
Malindi Shinkle	Observer - Boat	JWEL – St. John's
Stephanie Barnes	Observer - Boat	JWEL - St. John's
Richard Neville	Observer - Plane	JWEL – Goose Bay
Bruce Mactavish	Seabird Observer - Boat	JWEL - St. John's

David Pinsent, M.Sc. (**Memorial University of Newfoundland**), is a marine biologist with JWEL in St. John's. Mr. Pinsent served as Project Manager for the marine mammal survey as well as Field Crew Leader for the aerial surveys. He was responsible for the overall execution of the field programs, report production, and budget management.

Mr. Pinsent has more than 14 years experience in the study and application of marine science. He has spent several years studying the abundance and distribution of plankton, fish and marine mammals in coastal and offshore waters. Mr. Pinsent designed, conducted and authored the marine resources, ringed seal and marine mammal surveys during the Voisey's Bay Mine/Mill Environmental Assessment. Mr. Pinsent has also been involved in the design, sampling and reporting for the Terra Nova EEM Baseline Program, as well as the marine component studies for the Newfoundland Transshipment Terminal and the Argentia Nickel Smelter/Refinery projects. He was also a senior author of the environmental assessment documents for the Voisey's Bay Mine/Mill, the Argentia Nickel Smelter/Refinery and the Newfoundland Transshipment Terminal projects. During the mid-1980s, Mr. Pinsent was employed with the Whale Research Group of Memorial University as a biologist and observer to conduct marine mammal surveys along the coast of Newfoundland and Labrador.

Michael C.S. Kingsley, M.A. acted as the scientific authority for the mammal survey. He designed the survey program and conducted the data analysis.

Mr. Kingsley has 25 years experience in wildlife and marine mammal research and management. Mr. Kingsley's experience was founded on expertise in mathematics and statistics, and developed into fields of population estimation and assessment and related areas of biological study. His scientific activities have remained strongly oriented toward population estimation by survey and other means, population dynamics (including mathematical modelling), and population analysis and assessment. This emphasis has led to frequent involvement in environmental impact assessment and environmental monitoring activities. Most recently, Mr. Kingsley controlled the research program of the region on the St. Lawrence beluga whale under the St. Lawrence Action Plan, and maintained research into other (cetacean) species for the Department of Fisheries and Oceans. Mr. Kingsley has a great deal of experience in conducting aerial surveys of marine mammals, and much of his surveying experience was within the St. Lawrence region. Among Mr. Kingsley's numerous publications, several in particular which demonstrate this knowledge and experience, of aerial surveys of marine mammals within the St. Lawrence region.

Holly Hogan, M.Sc., is a wildlife biologist with JWEL in St. John's. She acted as the Field Crew Leader for the boat-based marine mammal surveys and also assisted in data compilation, analysis and report writing.

Ms. Hogan has been involved in designing and implementing studies relating to marine and terrestrial ecology for 14 years and has had extensive field experience. She conducted daily marine mammal surveys in the Witless Bay Seabird Ecological Reserve for a five-month period and was employed with the Whale Research Group to release entrapped whales as well as to conduct whale identification workshops. Ms. Hogan has conducted several ship-board marine mammal surveys in the offshore waters of Newfoundland and Alaska.

Stephen Bettles, M.Sc., is a marine biologist with JWEL in St. John's. He was the data recorder/navigator during the aerial surveys, assisting the pilot to maintain course and recording the GPS position, time, altitude and survey conditions of each mammal sighting. Mr. Bettles assisted in data collection, analysis and report preparation.

Mr. Bettles has prepared Environmental Quality Assessments for two Atlantic Coastal Action Program Sites in Prince Edward Island. He has also performed intertidal habitat assessments and juvenile fish population surveys with the Department of Fisheries and Oceans. Having over eight years experience in marine biology and six years in aquaculture, he has used many sampling techniques for both marine and freshwater studies and has conducted aquaculture site assessments in Placentia Bay and St. Mary's Bay. Mr. Bettles also worked with the Island Nature Trust in Prince Edward Island and conducted many intensive botanical surveys. He is also an advanced SCUBA diver and has much experience with scientific diving as well as small boat safety.

Natasha J. Smith, Graduate Diploma - Environmental Technology, is an Environmental Technician with JWEL in St. John's. Ms. Smith was the data recorder/navigator as well as an additional observer during the boat-based portion of the marine mammal survey. She recorded GPS position, time, direction, distance from vessel and survey conditions for each mammal sighting. Ms. Smith also assisted in the data compilation and report preparation.

Ms. Smith assists in the coordination of project tasks at JWEL and collects environmental data and samples. Prior to joining JWEL, Ms. Smith was an Environmental Effects Officer with Environment Canada where she reviewed and provided technical advice on aquatic EEM programs for 19 pulp and paper mills in Atlantic Canada; prepared technical reports on the results of the programs and participated in the amendment of several requirements and guidance documents for Cycle 2 of the Pulp and Paper EEM program. Ms. Smith has experience with fish surveys, benthic invertebrate surveys, effluent sampling, sediment sampling and marine mammal surveys and is an open water SCUBA diver.

Malindi A. Shinkle, B.Sc., is a junior biologist and data manager with JWEL in St. John's. She was an observer during the boat-based survey and assisted in data management and report preparation.

Ms. Shinkle has been associated with the company since the completion of her Bachelors degree in April, 1998. She has considerable experience using Windows-based programs and is responsible for data management (data entry and storage, data QA/QC, data summary and reduction, etc.) for numerous JWEL projects including: environmental impact assessments, baseline data collection and environmental effects monitoring programs. Ms. Shinkle's field experience includes: marine and freshwater habitat assessment, air quality monitoring techniques, water quality testing, benthos sampling, and marine mammal identification.

Stephanie Barnes, MES, is an Environmental Scientist with JWEL in St. John's. She was an alternate during the boat-based survey and assisted in the research and report writing.

Ms. Barnes has a strong academic background in natural resource planning with a focus on marine conservation and public participation. She has considerable field and laboratory experience including: freshwater and marine habitat assessment, water quality testing, benthos and sediment sampling, and marine mammal identification. Ms. Barnes has held term employment with the Department of Environment and Labour as Project Coordinator for an insecticide monitoring program as well as with the Newfoundland and Labrador Conservation Corps as Regional Supervisor of environmental projects.

Richard Neville is a junior environmental technician with JWEL in the Goose Bay office. Mr. Neville served as an observer during the aerial surveys.

Mr. Neville is a Labrador resident and a recent graduate of the Environmental Field Assistant Program at the College of the North Atlantic. Mr. Neville has a general knowledge of marine and freshwater environments throughout Atlantic Canada. Prior to this program, his mammal identification training has been gained through years spent as a commercial fisher on the south Labrador coast. Additional field experience includes participation in field studies to monitor eider populations and habitat in Eagle River. Mr. Neville's safety and emergency training includes First Aid, Restricted Radio Operators certification, Helicopter Safety Training, Canadian Firearms and Small Craft Survival/Flat Water Canoe Level I Certification.

Bruce Mactavish is a widely recognized authority on bird distribution and identification in eastern Canada. He was responsible for the design and execution of the boat-based seabird surveys.

Mr. Mactavish has been a field consultant on numerous avifauna-related projects in Newfoundland and Labrador over the past 25 years. These include: research associated with the original avifauna surveys of Gros Morne National Park and L'Anse-aux-Meadows National Historic Park; three seasons of conducting a series of 18 Breeding Bird Surveys across Newfoundland for Memorial University; four seasons of intensive songbird biodiversity studies in old growth and second growth balsam fir forest in western Newfoundland for Forestry Canada; aerial and ground surveys throughout Northern Labrador for National Defence; and numerous site surveys of avifauna and other wildlife in support of environmental assessments for JWEL and others.

3.0 SUMMARY OF STUDY OBJECTIVES

3.1 Marine Mammals Surveys

The objectives of the marine mammals survey in the Strait of Belle Isle study were to: 1) conduct a literature/data review of the marine mammal sightings within and near the Strait of Belle Isle; 2) summarize the possible project-related interactions and effects on these species; and 3) estimate the relative abundance of marine mammals in the Strait and the surrounding area during the ice-free season.

3.2 Seabird Surveys

The Strait of Belle Isle has rich and diverse seabird populations. These populations are highly variable, both temporally and spatially. Species abundance and composition is affected not only by season, but also by local weather conditions. The objective of the seabird monitoring program was to gain a general overview of seabird species diversity and abundance found during the late summer and fall in the area of the proposed submarine cables in the Strait of Belle Isle.

4.0 DESCRIPTION OF THE STUDY AREA

4.1 Study Area

The Strait of Belle Isle separates the northern part of Newfoundland from the southeastern coast of Labrador. It extends for approximately 118 km in a northeast-southwest direction. The narrowest part, near Point Amour at the southern end, is approximately 15 km wide. At the northern end of the Strait, is Belle Isle, located in the centre of the channel approximately 20 km from the islands off the coast of Labrador and about 22 km from Cape Bauld (Figure 1.2).

4.2 Coastal Geomorphology

The bedrock in the Strait of Belle Isle is composed of Precambrian and Cambrian sedimentary rocks with northeast-southwest to east-west structural trends (Woodward-Clyde Consultants 1980). The coast of Labrador along the Strait is steep granite which rises to flat-topped ridges and summits ranging from 300 to 390 m above sea-level (asl). The Newfoundland coast is low, with shorelines rising to only approximately 30 m. The greatest water depths in the Strait are on the Labrador side and the range varies from 30 to 146 m. Centre Bank, in the middle of the southern part of the Strait, has depths ranging from 43 to 55 m. The shallowest part, having a depth of about 29 m, is in the northern end of the Strait near Fairway Bank (Cooper 1960).

4.3 Oceanography

The inshore branch of the Labrador current flows southwesterly into the Strait and along the north side of the Labrador Coast before entering the Gulf of St. Lawrence. Warmer and less saline water from the Gulf flows northeasterly into the Strait along the coast of Newfoundland. The turbulence created by the mixing of the cold Labrador current with warmer water from the Gulf of St. Lawrence creates a front of nutrient-rich water and an area of increased productivity. Water temperatures recorded from July to October during a 1981 field program (Lower Churchill Development Corporation 1984) found that the average water temperatures were highest on the Newfoundland side, followed by the Labrador side and coldest in the centre of the Strait. Water temperatures varied from 0^{o}C to 12^{o}C during the period, with a mean of 4°C. The average salinity was found to be in the order of 32 parts per thousand (ppt).

Water movement through the Strait is predominately tidal; the water regularly turns and runs both eastward and westward with equal strength while under the control of the tide alone. This is complicated by a frequent tendency for a “dominant flow” to be greater in one direction than the other. The dominant flow may last several days to a week or more. A mixed semi-diurnal tide occurs in the Strait of Belle Isle, with considerable variation occurring between the height of the two high tides and the two low tides each day. The normal tidal range in the Strait is approximately 1 m for mean tides and 1.5 m for spring tides. The average period of the tides is half a lunar day (Lower Churchill Development Corporation 1984).

4.4 Meteorology

During the winter months, the average atmospheric pressure decreases from southwestward to northeastward. Depressions are numerous and these regions are often stormy, with gale force winds that may suddenly change in direction and force. The Strait of Belle Isle is often in the cold air of a depression, with winds from the northwest. The average pressure gradient is less pronounced in the spring and winds become more variable with northeasterly winds more frequent (Cooper 1960). Most winds are westerly and southwesterly during the summer months. Winds speeds are the lowest in June, July and August and then increase through to December (Lower Churchill Development Corporation 1984). In late summer and autumn, the wind in the Strait of Belle Isle tends to blow along the length of the Strait in a northeasterly or southwesterly direction.

The mean daily air temperatures for Daniel’s Harbour (approximately 60 km south of study area), measured from 1946 to 1990 by Atmospheric Environment stations (AES) in the area (Environment Canada 1998), are considered a representative source due to the proximity of the town to the proposed cable crossing area. Air temperatures measured during the winter months, December to March, ranged from -4.1 to -8.6^{o}C and during the summer months, June to August, ranged from 9.7 to 14.4^{o}C.

4.5 Ice Conditions

The period of open navigation in the Strait of Belle Isle varies from year to year but is generally from July to October (Cooper 1960). Open water conditions may prevail through December but usually by January new ice forms and covers most of the Strait. However, in recent years, including 1999, January has been virtually ice free. A substantial amount of ice can develop in the Strait during a severe winter; February and March have the heaviest ice conditions and often the Strait is congested with only occasional zones of open water (Lower Churchill Development Corporation 1984). Under the effect of prevailing westerly winds, a lane of open water follows the north side of the Strait as far west as Forteau Bay. By early April, the amount of ice decreases and open water zones are more frequent, however, easterly winds often drive first-year ice into the Strait from the Labrador Sea. Navigation through the Strait is usually possible by late May or early June.

Icebergs are numerous in the Strait from April until September or October. They are relatively small and enter mainly under the combined pressure of strong easterly winds and ice fields off the southern Labrador coast (Cooper 1960). Otherwise, the Strait is often clear of icebergs, which are moved out of the area passing under the influence of westerly winds between Belle Isle and Cape Bauld.

5.0 METHODS

5.1 Aerial Survey

5.1.1 Aerial Survey Design

The total marine mammal survey area is approximately 5,400 km^2. It extends from the northeastern tip of the Northern Peninsula of Newfoundland, southwestward to a line approximately from Port au Choix to the Baie Napetipi in Quebec. To cover this area, an aerial transect pattern was laid out on headings of 320 and 140 degrees true, at a spacing of 7.4 km (4 nautical miles) (Figure 5.1). A spacing further apart would risk mammals being missed and a closer spacing would risk duplicating mammal observations. This northwest-southeast orientation provided good coverage of various habitat types and water depths throughout the Strait. Twenty-five transects, for a total estimated length of 1,200 km (648 nautical miles), were flown during the aerial surveys. This survey design permitted thorough coverage of the study area within a single day, thereby reducing temporal sampling error. The study area was surveyed twice over two consecutive days when weather permitted. Consecutive surveys act as study area duplicates and give greater statistical power to the data, thus providing population estimates with better confidence limits.

Line-transect methods are used in surveys where targets are rare so that all sightings may be useful and in cases where targets become less visible with distance from the platform, but at an unknown rate. In such cases, strip-transect surveys may incur bias by using too wide a strip and useful off-transect sightings may be inconsistently recorded. Line-transect methods have become standard for shipboard surveys for cetaceans in the open sea. Aerial line-transect surveys for both marine and terrestrial species are increasingly replacing strip-transect methods. Field methods for line-transect survey consist of recording all targets detected together with a best measure of their distances from the platform or from the transect line. The recorded sightings distances are then analyzed to estimate the decline of visibility with distance. The resulting estimated “relative detection curve” is then applied to the recorded sightings to estimate density and numbers. Line-transect methodology was used during this survey.

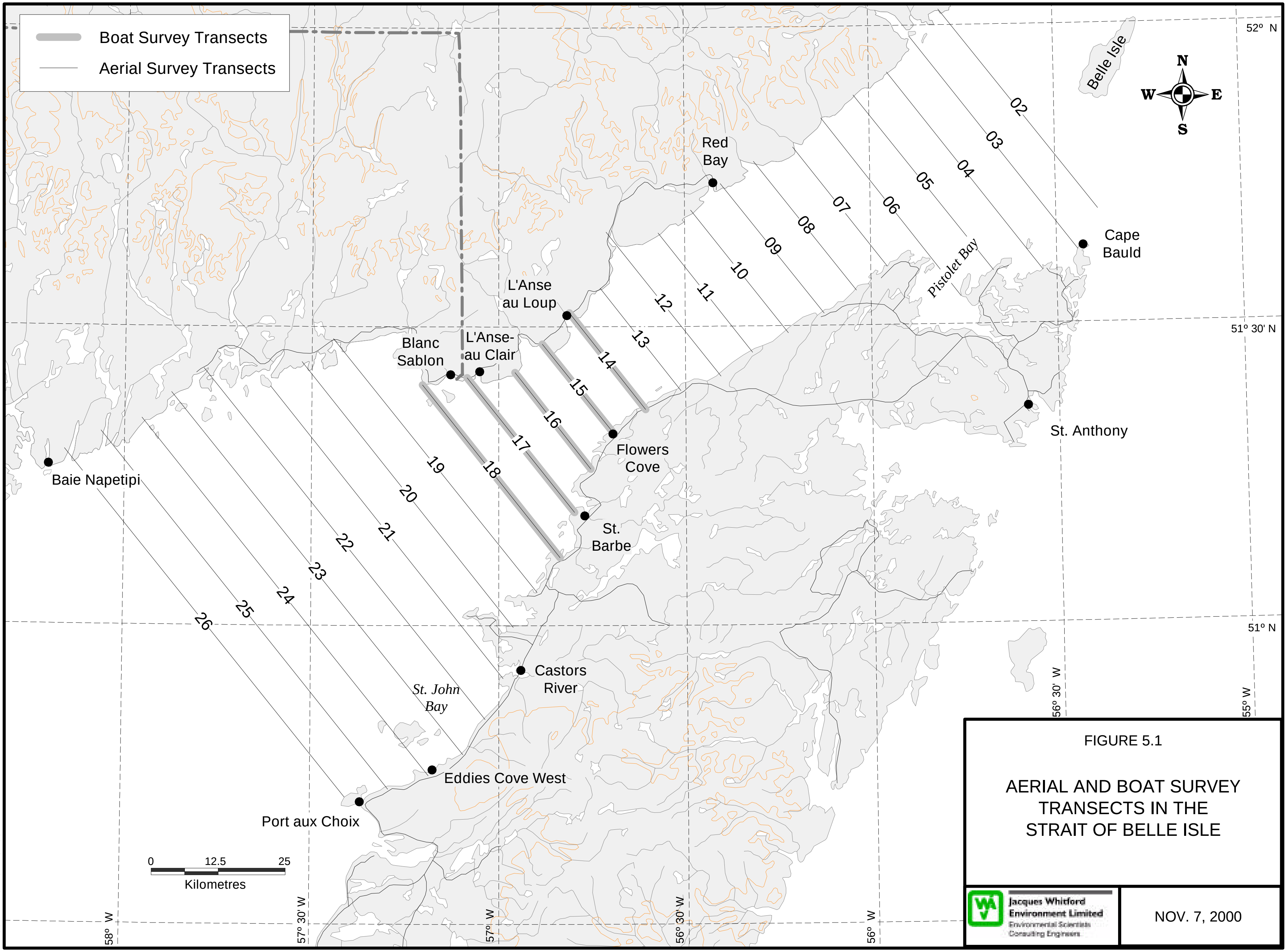

FIGURE 5.1

AERIAL AND BOAT SURVEY TRANSECTS IN THE STRAIT OF BELLE ISLE

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5.1.2 Aerial Survey Execution

Marine mammal surveys were conducted only on days when wind speeds were forecasted less than 15 knots, with a Beaufort scale wind force of 3 or less, visible from land. There were occasions, however, when conditions exceeded these limits due to the patchiness of wind and wave conditions across the Strait. This patchiness is primarily due to the variation in fetch and current direction in the Strait. Aerial surveys were flown in a Partenavia P68C twin-engine, fixed-wing aircraft at a target ground speed of 100 knots. Surveys were flown at 210 to 220 m altitude. The aerial surveys were flown approximately every three weeks but varied due to weather conditions.

Mammal counts were recorded by an observer sitting in the rear, on each side of the aircraft. Mammal observations were recorded to species only when there was a positive identification, otherwise sightings were recorded as accurately as possible (i.e., dolphin species). The entire field of view was continuously scanned to the side and slightly ahead of the aircraft's path. There was a blind spot under the aircraft approximately 300 m wide. Clinometer readings of each observation were recorded to estimate the distance of the mammal from the track or transect line. Each time a mammal was spotted, the navigator would mark the position with the Global Positioning System (GPS), thus giving it a waypoint (see data sheet in Appendix A). The navigator was also responsible for assisting the pilot to stay on the predetermined transect line.

5.2 Boat-Based Survey

5.2.1 Marine Mammals

Boat surveys were conducted at three-week intervals to coincide as closely as possible with aerial surveys. The vessels used to conduct the surveys were Canadian Coast Guard-certified longliners. During the first two survey periods (August 5 to 8 and August 29 to 30), 16.8 m (55-foot) longliners were used. All subsequent surveys were conducted aboard the "Cabot Brothers", a 13.7 m (45-foot) vessel. Aerial transect lines 14 to 18 were surveyed by boat (see Figure 5.1), covering transect distance of over 110 km (60 nautical miles) at a cruising speed of 7 to 9 knots. Each transect was surveyed twice per survey period, except during the October 7 survey (Survey 4), when all lines were surveyed only once. Following Survey 4, transect line 18 was no longer surveyed due to weather and daylight limitations. The survey team consisted of one data recorder/navigator and two observers, one observer scanning 90 degrees to the starboard side and the other scanning 90 degrees to the port side. The recorder/navigator was responsible for providing headings and GPS data and recording marine mammal data, and also scanning when possible. The observers were positioned on the top of the wheel house, 5 m from the waterline. Observers recorded the sighting angle of the whales as well as the group size and an estimate of distance from the transect. For each transect the following data were recorded (see also Appendix A):

- At the start and end of each transect, the heading and a position reading were taken from the GPS. Transect start and end time were also recorded.
- Weather conditions were recorded at the start of each survey, including wind direction/speed, sea state (Beaufort scale), visibility and cloud cover. Surveys were not conducted in wind conditions exceeding 15 knots.

- The surface of the water was scanned constantly while travelling on the transect using a combination of binoculars and the naked eye.
- Each time a marine mammal was spotted, a separate observation entry was made in the data sheet. Each observation was assigned an identifying letter. Repeat sightings of the same individual were assigned the same identifying letter. Sightings at times other than during dedicated surveys were entered as "incidental".
- For each sighting, the species was recorded, the time and UTM coordinates of the boat, as well as the distance and the relative position (in degrees) of the marine mammal from the boat using a sighting board. Comments regarding behaviour or identification attributes were recorded when appropriate.

5.2.2 Seabirds

Seabird surveys were conducted concurrently with four of the boat-based marine mammal surveys by a dedicated seabird observer. The seabird survey team consisted of one observer/recorder. Headings and GPS data were provided by the marine mammal survey recorder/navigator. The seabird observer was also positioned on top of the wheel house, 5 m from the waterline, and scanned 90 degrees to starboard and port (for a total of 180 degrees) to a distance of 50 m from the boat.

For each transect the following data were recorded (see also Appendix A):

- At the start and end of each transect, the heading and a position reading were taken from the GPS. Start and end time were also recorded.
- Weather conditions were recorded at the start of each survey, including wind direction/speed, sea state (Beaufort scale), visibility and cloud cover. Surveys were not conducted in wind conditions exceeding 15 knots.
- Each transect was divided into 10-minute intervals. The time and UTM coordinates were recorded at the start of each interval.
- The surface of the water was scanned constantly while travelling on the transect, using a combination of binoculars and the naked eye.
- During each 10-minute interval, all birds seen within the 50 m radius were identified and counted. Any noteworthy comments or observations were recorded where appropriate.

5.3 Mammal Survey Data Analysis

The survey data were analyzed using line-transect methods. In line-transect analysis, all sightings are recorded with an estimate or a measure of their distance from the trackline. The strip width that can be effectively scanned by the observers (the Effective Strip Width, or ESW) is subsequently estimated by analyzing the distribution of recorded distances between the trackline and the sightings. Line-transect methods avoid the problem of sightings being missed at the outer edge of an over-ambitious fixed-width survey strip (Burnham et al. 1980; Buckland et al. 1993). To collect line-transect data, the sighting angle to all marine mammals sighted was measured with hand-held clinometers in percentage grade, and later converted to a lateral distance of the sighting from the trackline.

The survey program was designed on a three week repeat period. Every three weeks, an aerial and a boat survey was to be conducted, each twice. It was considered desirable to carry out the surveys only in winds of less than 15 knots, but such good weather was difficult to obtain in the study area. Most of the aerial survey mileage was flown in sea states recorded as Beaufort 2 (47%) and 3 (35%) (i.e., in winds of 7 to 10 knots).

The first aerial survey took place in weather that was somewhat windier than desirable, and there was no coincident boat survey owing to delay in finding and equipping a suitable vessel. After that, the three-weekly schedule of surveys was adhered to with only slight adjustments for weather. However, operational arrangements sometimes prevented the two surveys from taking place on the same days (Table 5.1).

The mean sea state for each transect for the entire survey program was calculated. It appeared that transects 2-13 on average tended to be windier than the transects further south-west. The mean Beaufort sea state was calculated for each transect. There appeared to be a tendency for rougher seas east of approximately transect 14, compared with calmer seas south-west of transect 15 (Figure 5.2).

Table 5.1 Progress of Aerial and Boat-Based Mammal Survey

Survey		Dates	Transect Coverage / Survey			Distance (km) in Bft				
			Once	Twice	3x or more	1	2	3	4+	Total
Aerial	**1**	9–10 Jul	14–26	2–13	-	-	83.9	577.8	784.7	1446.4
	2	4–5 Aug	26	2–14; 18–25	15–17	-	1517.7	866.1	114.8	2498.6
	3	29 Aug – 1 Sep	8–13; 22–26	14–21	-	468	628	177.4	-	1273.4
	4	19-Sep	3–13; 19–21	14–18	-	-	608	259.1	-	867.1
	5	5–7/10	3–1; 20–21	12–13, 19	14–17	-	22.8	965.8	275.9	1264.5
	6	24–25 Oct	8–11; 18–25	Dec-13	14–17	-	503.1	602.6	-	1105.7
	7	20–21 Nov	7–13; 21–24	19–20	14–18	348.5	594.4	297.8	30.9	1271.6
	8	7–9 Dec	7–13; 19–23	14–16	17–18	59.2	791	73.6	-	923.8
Boat	**2**	5–8 Aug	-	14–18	-	75.8	30.6	63.9	50.5	220.8
	3	29–30 Aug.	-	14–18	-	-	76.3	79.8	64.7	220.8
	4	15–18 Sept.	-	14–18	-	16.4	34.1	97.1	73.2	220.8
	5	7 Oct.	14–18	-	-	-	-	61.6	48.8	110.4
	6	27–29 Oct.	14–15	16–17	-	-	27.5	18.2	76.2	122
	7	18–20 Nov.	14	15–17	-	-	-	59.9	76.3	136.2
	8	7–9 Dec.	15–18	-	-	-	34.1	-	59.9	94

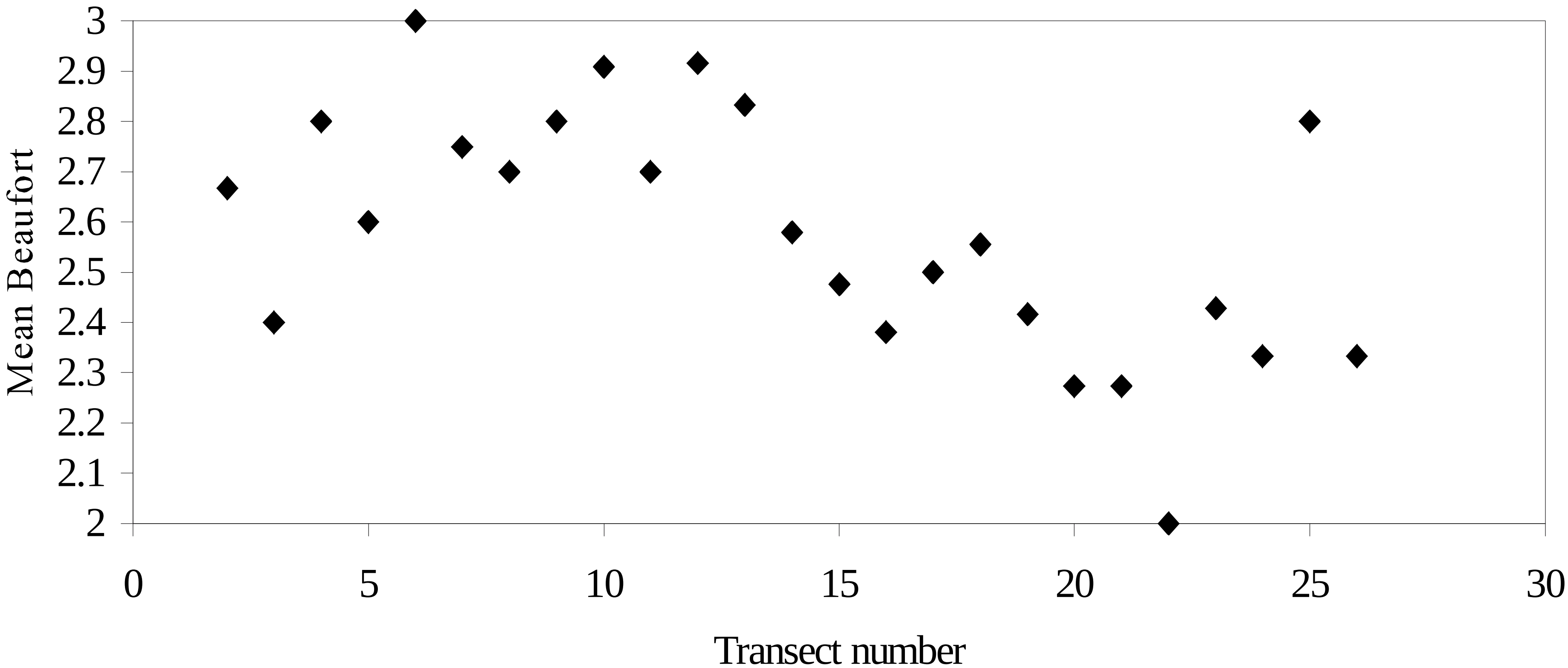

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FIGURE 5.2

MEAN BEAUFORT SEA STATE DURING AERIAL SURVEY TRANSECTS

5.3.1 Line-Transect Analysis of Boat Survey Sightings

Boat survey sightings were analyzed using line-transect analysis. A single sighting curve was calculated for all surveys pooled. A cut-off Beaufort sea state was subjectively assigned to reject observations in sea states with apparently low encounter rates, provided that not too high a proportion of sightings would be lost. The distance and bearing data was converted to a lateral distance off the transect line. A 3-parameter hazard-rate sighting curve was fitted to the off-transect distances, assuming that all species could be seen on the track-line as well as, or better than, at any distance off track. The data was censored at a distance that gave a sighting rate of about 7–8% of the maximum (assumed to occur at distance 0). The ESW was calculated by integrating the censored sighting curve.

Four common species harbour porpoise, white-beaked dolphin, minke whale, and humpback whale had enough sightings (Table 5.2) to fit reasonable sighting curves and to obtain good estimates of the ESWs and their standard errors (Table 5.3). Cetacean species seen more rarely such as sei whale, fin whale, and pilot whale as well as all seals, could not be analyzed by line-transect methods, because there were not enough sightings.

Table 5.2 Gross Encounter Rates by Beaufort Sea State for Common Species of Cetacean for Boat Surveys in the Belle Isle Strait Narrows, Summer 1998

Species	Overall Average Encounter Rate (/100 km) in Beaufort			
	1	2	3	4+
Harbour porpoise	54.2	22	12.1	2.67
White-beaked dolphin	22.78	9.87	9.20	6.34
Minke whale	14	5.9	2.9	2.67
Humpback whale	1.08	4.44	4.47	3.11

Table 5.3 Effective Strip Widths for Boat Surveys for the Commonest Species of Cetaceans in Belle Isle Strait, August - December 1998

	Harbour Porpoise	White-beaked Dolphin	Minke Whale	Humpback Whale
Effective number of sightings*	41.1	12.9	34.4	25.8
Censoring distance (m)	300	350	500	1500
One-sided ESW (m) (est. SE)	101 (19)	99.5 (20.6)	132 (25)	728 (120)

Limit Beaufort sea states for line-transect analysis: harbour porpoise 3; white-beaked dolphin 3; minke whale 4; humpback whale 4.

* effective number of sightings: number of animals seen divided by CHM** of animals per sighting

**CHM (contraharmonic mean) – the size of the group containing the average animal. It is calculated as the sum of squares of the group size divided by the sum of the group sizes (total number of animals seen).

The ESWs for all these species were smaller than expected. For the three small species, harbour porpoise, white-beaked dolphins, and minke whales, the ESWs were of the order of only 100 m. These species are all expected to be hard to see, but larger ESWs may be obtained (*cf* Kingsley and Reeves 1998). The small ESWs in this survey are probably due to the less than ideal weather conditions and to the height of the observers above the water surface. However, the small ESWs imply large survey expansion factors and the necessity of inferring large populations in the study area from a relatively small number of sightings. The ESW for humpback whales was difficult to estimate owing to a relatively high proportion of sightings recorded right on the trackline; it was necessary to assume that humpbacks were equally visible at all distances out to at least 250 m to get a sensible answer.

5.3.2 Line-Transect Analysis of Aerial Survey Sightings

Three species, harbour porpoise, minke whale, and humpback whale, had enough observations to permit quantitative line-transect analysis. Preliminary analyses were carried out to determine the incidence of variable weather conditions and their effect on the visibility of these species.

It is expected that Beaufort sea state will affect the visibility of most marine mammals, particularly the smaller species. For porpoises and minke whale observations in this study, there was a decrease in the gross encounter rate with increasing Beaufort sea state (Table 5.4). This was especially marked for harbour porpoises, where 88% of individuals were sighted in the 8.2% of the flown mileage that was in Beaufort 1. Furthermore, the observations made in Beaufort 2 conditions were distributed differently, much closer to the trackline than those made in Beaufort 1. Therefore, for quantitative analyses of harbour porpoise observations on aerial survey, only the observations made in sea state 1 were used.

Table 5.4 Overall Encounter Rates (Individuals per 100 km) of Common Cetaceans in Aerial Survey of the Belle Isle Strait

	Estimated one-sided ESW* (m)	**Overall Encounter Rate (/100 km) in Beaufort Sea State**			
		1	**2**	**3**	**4**
Harbour Porpoise	174	15.530	0.232	0.183	0
Minke Whale	242	0.571	0.274	0.079	0.091
Humpback Whale	552	0.685	0.421	0.707	0.637
Dolphins (all)		1.256	0.747	0.314	0
* Limited Beaufort sea state for line transect analysis was 1 for harbour porpoise, 2 for minke whale, and 3 for humpback whale					

For minke whales, the encounter rate recorded for Beaufort 2 was half that for Beaufort 1 and for Beaufort sea state 3 was almost four times smaller again. However, the distance flown over sea states 2 and 3 was so large that to have rejected that data would have unacceptably reduced the available number of sightings. Analyses for minke whale were based on aerial survey effort in sea states 1 or 2.

Conversely, for humpback whales, sea state did not appear greatly to affect the recorded encounter rate (Table 5.4). From Beaufort 1 all the way up to Beaufort 4 or 5, the encounter rate appeared to stay about the same. The cue for humpback whales appeared, from the results of the line transect analysis, to be the blow rather than the body, and this is less apt to be obscured by rough water. However, distribution may be confounded with sea state, in that humpbacks may have a preference (for other reasons, such as food availability) for the part of the study area where seas were often rougher, the higher density in that area being thus offset in the observation records by a reduced visibility. For humpback whales, analyses were based on observations made in sea states 1 to 3.

Line-transect analysis for porpoises was based on effort and observations in Beaufort sea state 1. Few observations were made in higher sea states, so omitting them lost little information, and the encounter rate at higher sea states was so different that it was impossible to combine the data. The few observations in sea state 2 were all within 250 m of the trackline, much closer than those made in sea state 1, which were distributed out to 750 m. The data and the sighting curve were censored at 610 m (2,500 ft), corresponding to a relative visibility of 10.5%. No observations were recorded at any greater distance. Aerial observations of porpoises were curious, in that most of them were made in good conditions on Survey 3, but on that survey there were rather few aerial observations of anything else.

For minke whales, analyses were based on observations in sea states 1 and 2. Although the recorded encounter rates were different, most of the observations would have been rejected if sea state 2 had been excluded from the analyses because most of the flying was in those conditions. Sighting data was censored at 610 m.

For both porpoises and minke whales, the closest sightings were at a sighting angle of about 52° below the horizon, which is normal for aerial surveys in flat-windowed aircraft (Kingsley and Reeves 1998) This corresponded to a distance of approximately 165 m (540 ft) from the trackline. Observations of humpback whales began further out, at approximately 235 m (540 ft) out from the trackline. It is not obvious why this should be so, except perhaps that the longer dive times of humpbacks may make them hard to detect close to the aircraft, where each spot on the surface is only in view for a short time.

All observations of humpback whales up to Beaufort 3 were included in line transect analysis, as the encounter rate did not decrease much with sea state and as many observations were made in sea state 3 as in sea state 2. Few humpbacks were recorded in Beaufort sea state 1, possibly because the species is usually found in waters that are seldom so calm. As noted above, there were few observations of species other than harbour porpoise on the only survey that encountered such Beaufort 1 conditions. Sighting distances in sea state 2 were distributed relatively evenly between 400 and 1400 m from the trackline, but those in sea state 3 were concentrated between 700 and 800 m. The ESW for humpback whales in aerial survey was surprisingly small at 552 m, largely because sightings did not start until well out from the trackline.

5.3.3 Comparison of Boat Survey with Aerial Survey Sighting Rates

To compare sighting rates, aerial survey observations were screened on the basis of the sea state and censoring cut-off distance, and encounter rates were calculated by transect, and by survey. Boat survey observations were screened to remove resightings of animals already seen. Encounter rates (animals per 100 km) were tabulated by transect and by survey for the transects covered by both the aerial and boat-based surveys.

5.4 Quality Assurance/Quality Control

Data management involves a number of systematic processes and protocols that are designed to provide a framework for providing quality environmental data with a high degree of credibility (CCME 1993). The major components of the data management system used for the LHP environmental studies include:

- data documentation (computer programs, and statistical, normalization and error control procedures);
- data recording (field notebooks, field maps and auxiliary data records);
- data custody and transfer (chain of custody records, QA/QC procedures for authorizing changes to data, QA/QC documentation of transfer formats, data recording forms, and data verification and validation);
- data validation (data identification, transmittal errors, flagged or rejected data, data comparability, and data review and evaluation);
- data verification (sample results reported and checked for transmission errors, data review, flagging and screening);
- data presentation (tables, graphs and figures); and
- data storage (digital format and hard copy).

JWEL developed and implemented a QA/QC procedure for data management. The following description provides a brief overview of the procedures that JWEL established and how they were carried out by JWEL's field crews.

Field data were recorded in field log books and then entered into electronic format (Microsoft Excel, Version 5.0) by the field crews. Electronic files containing field data were then verified against field records to eliminate transcription errors due to manual data entry. Daily log books, field note books, field records and electronic files were forwarded to JWEL's data coordinator in St. John's. All data and related information were stored in duplicate form.

6.0 RESULTS

6.1 Literature Review of Historical Marine Mammal Data

Literature reviews were conducted at JWEL, Memorial University of Newfoundland and the Department of Fisheries and Oceans libraries. Literature searches summarized published marine mammal sighting and stranding data in the Strait of Belle Isle area. A separate literature review summarized the potential effects of underwater construction and blasting on marine mammal species.

6.1.1 Whales

There is a limited body of existing literature on marine mammal distribution in the Strait of Belle Isle. There are few scientific surveys but several anecdotal records (Table 6.1; see Appendix B for list of references). Interpretation of marine mammal distribution based on historical records is imprecise due to some inherent biases. Since some of the records are from systematic surveys, while other sources are anecdotal, coverage and precision of mammal identifications vary widely. For anecdotal records, populated areas like headlands with lighthouses, and the ferry route between St. Barbe and Blanc Sablon would receive greater coverage than would remote locations. In addition, large conspicuous species would be observed and reported more frequently than dolphins and porpoises, which could easily be missed or considered less remarkable. Even with these limitations, the historical records provide valuable information. These records provide species absence/presence and relative abundance information (when interpreted carefully) and suggest areas of greater concentration as well as temporal distribution.

The historical literature indicates that the Strait of Belle Isle is an important area for several whale species (Figure 6.1). Abundances are particularly high between the months of May to August and when all whale species are considered together, distribution patterns emerge. Taking into account the unequal observation effort, there appear to be “hot spots” where reports of whale observations frequently recur (Figure 6.1). The area off the coast of Labrador between L’anse au Clair and L’anse au Loup, and the area around Red Bay, appear to be areas of high relative density in the Strait. The Port au Choix area also has many whale records, but these records are comprised almost entirely of dead or entrapped whales. The headland near Port au Choix juts out into the Gulf and may be the first land mass that an animal travelling in the Gulf current would encounter, as the Gulf of St. Lawrence narrows toward the Strait of Belle Isle.

Table 6.1 Summary of Historical Marine Mammal Sightings in the Strait of Belle Isle

Species	Number	Date	Location	Circumstances	Source
Beluga whale	1	13 June, 1990	St. Lunaire, NF	Dead in lumpnet	16
Beluga whale	1	28 June, 1993	L'Anse au Loup, Lab.	Stranded - alive	18
Beluga whale	1	18 June, 1985	L'Anse au Loup, Lab.	Entrapped in gillnet - released alive	11
Beluga whale (probably)	1	early 1968	Goose Cove, St. Anthony district (51° 18'N, 55° 38'W)	Dead (caught in a seal net)	2
Beluga whale or Pothead whale	1	24 July, 1993	Red Bay, Lab.	Stranded - dead; disappeared	18
Blue whale	1	27 July, 1982	St. Anthony, NF	Dead at sea, reported by Coast Guard	8
Blue whale	1	22 July, 1988	Eddie's Cove, NF	Dead (?), examined by DFO	14
Blue whale	1	15 Nov., 1988	Port aux Choix, NF	Very old, decomposed	14
Blue whale	1	late August - early Sept. 1995	near Blanc Sablon	Aerial survey	22
Dolphins (likely were white beaked)	2	25 July, 1986	Camp Islands, Lab.	Caught in salmon nets - dead.	12
Fin whale	8	21 July - 12 Aug., 1981	Cape Bauld, NF	Shore and shipboard watches	1
Fin whale	2 or same individual twice	10 Aug., 1981	Strait of Belle Isle	During each of two ferry crossings	1
Fin whale	1	30 June- 7 July, 1975	51°-52°N, 56°-58°W	Boat based survey	3
Fin whale	1	9 & 16-21 July, 1975	51°-52°N, 54°-56°W	Boat based survey	3
Fin whale	1	22 Sept., 1981	Reefs Harbour, NF	Caught in a herring net - dead	5 (J. Lien data)
Fin whale	1	7 Sept., 1982	L'Anse au Loup, Lab.	Stranded	8
Fin whale	1	3 Aug., 1979	Castor River South, St. Barbe District	Entrapped in gillnet - whale released self	20
Fin whale	1	4 Aug., 1980	St. John's Bay, Castor River South	Entrapped in herring net - dead	20
Fin whale or Blue whale (?)	1	3 Aug., 1987	SE St. Anthony, NF	Stranded	13
Harbour porpoise	1	3-10 Sept., 1981	Eastern side of the Strait of Belle Isle	Aerial survey	1
Harbour porpoise	1	18 Sept., 1981	Eastern side of the Strait of Belle Isle	Aerial survey	1
Harbour porpoise	4	18 Sept., 1981	Western side of the Strait of Belle Isle	Aerial survey	1
Harbour porpoise	9	late Aug. - early Sept., 1995	Strait of Belle Isle	Aerial survey	22
Harbour seal	2	9 Sept., 1981	Western side of the Strait of Belle Isle	Aerial survey	1
Harbour seal	1	18-19 Sept., 1981	Eastern side of the Strait of Belle Isle	Aerial survey	1
Harp Seal	aprx. 1600	29 April, 1981	In the Strait of Belle Isle	Aerial survey	1
Harp Seal	2	1 June, 1981	In the Strait of Belle Isle	Aerial survey	1
Harp Seal	140	April, 1982	In the Strait of Belle Isle	Aerial survey	1
Hooded Seal	1	15-16 April, 1982	In the Strait of Belle Isle	Aerial survey	1

Species	Number	Date	Location	Circumstances	Source
Humpback whale	7	29 April, 1981	East of St. Anthony	Aerial survey	1
Humpback whale	39	19 May and 1 June, 1981	In or near the Strait of Belle Isle	Aerial survey	1
Humpback whale	1	13 June and 26 June, 1981	In or near the Strait of Belle Isle	Aerial survey	1
Humpback whale	14	12 July, 1981	Most seen in the middle of the Strait of Belle Isle	Aerial survey	1
Humpback whale	1	10 Aug., 1981	In the Strait of Belle Isle	Shipboard watch from the MV Northern Cruiser	1
Humpback whale	1	30 June, 1981	Port aux Choix, NF	Caught in cod trap - alive (released)	5 (J. Lien data)
Humpback whale	1	5 June, 1981	Battle Harbour, Lab.	Caught in salmon net - alive	5 (J. Lien data)
Humpback whale	1	16 June, 1981	Brig Bay, NF	Caught in cod trap - alive	5 (J. Lien data)
Humpback whale	1	30 June, 1981	Port aux Choix, NF	Caught in cod trap - alive	5 (J. Lien data)
Humpback whale	1	30 July, 1981	Fox Harbour, Lab.	Caught in a cod trap - dead	5 (J. Lien data)
Humpback whale	1	30 July, 1981	St. Lewis, Lab.	Caught in a cod trap - dead	5 (J. Lien data)
Humpback whale	10 or 15	23 June, 1980	Pointe Amour, Lab.	Boat or shore based sighting	6
Humpback whale	10 or 15	24 June, 1980	Pointe Amour, Lab.	Boat or shore based sighting	6
Humpback whale	10 or 15	25 June, 1980	Pointe Amour, Lab.	Boat or shore based sighting	6
Humpback whale	1	16 July, 1980	Near Flower's Cove, Strait of Belle Isle	Boat or shore based sighting	6
Humpback whale	plentiful	15-21 June, 1980	Red Bay, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	few	25-30 May, 1980	Pointe Amour, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	few	8-14 June, 1980	Pointe Amour, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	few	15-21 June, 1980	Pointe Amour, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	plentiful	22-28 June, 1980	Pointe Amour, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	few	29 June-5 July, 1980	Pointe Amour, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	few	11-17 Aug., 1980	Pointe Amour, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	few	24-31 Aug., 1980	Pointe Amour, Lab.	Shore based sighting (lighthouse keeper)	6
Humpback whale	1	16 July, 1979	52°18' N, 55°30' W	Aerial or boat based survey	7
Humpback whale	6 or 8	17 July, 1979	52°21' N, 55°31' W	Aerial or boat based survey	7
Humpback whale	1	18 June, 1983	L'Anse au Loup, Lab.	Entrapped in codtrap - alive	9
Humpback whale	1	29 June, 1983	Indian Cove, Lab.	Entrapped in salmon net - dead	9
Humpback whale	1	30 June, 1983	Petty Harbour, Lab.	Entrapped in codtrap - alive	9
Humpback whale	1	13 July, 1984	St. Anthony, NF	Entrapped in gillnet -	10

Species	Number	Date	Location	Circumstances	Source
				released alive	
Humpback whale	1	9 July, 1985	Quirpon, NF	Entrapped in codtrap - released alive	11
Humpback whale	1	16 July, 1985	Petty Harbour, Lab.	Entrapped in salmon net - live release	11
Humpback whale	1	30 Aug., 1985	Camp Islands, Lab.	Entrapped in codtrap - dead	11
Humpback whale	1	1 July, 1986	Cook's Harbour, NF	Whale towed nets off. Later (4 July) caught in Noddy Bay	12
Humpback whale	1	4 July, 1986	Noddy Bay, NF	Whale towing gillnets. By the time it was released it had caught aprx. 50 nets	12
Humpback whale	1	9 Sept., 1986	Camp Islands, Lab.	Entrapped in gillnet(s), whale observed towing gear off	12
Humpback whale	1	1 Sept., 1986	Camp Islands, Lab.	Floating dead - verified by Coast Guard	12
Humpback whale	1	12 May, 1987	Port Saunders, NF	Entrapped in lobster pots and gillnets - released alive	13
Humpback whale	1	21 May, 1987	Port Saunders, NF	Entrapped in gillnets - released alive	13
Humpback whale	1	22 June, 1987	Eddie's Cove, NF	Entrapped in lumpnets - released alive	13
Humpback whale	1	30 June, 1987	Green Island Cove, NF	Entrapped in codtrap - released alive	13
Humpback whale	1	3 July, 1987	St. Anthony, NF	Entrapped in gillnet - whale towed gear off	13
Humpback whale	1	4 Aug., 1987	Battle Harbour, Lab.	Entrapped in salmon net - released alive	13
Humpback whale	1	28 Aug., 1987	Strait of Belle Isle	Entrapped in gillnet - released alive	13
Humpback whale	1	15 July, 1988	Flower's Cove, NF	Entrapped in codtrap - dead	14
Humpback whale	1	19 July, 1988	Eddie's Cove, NF	Floating dead (?) - evidence of gear entrapment	14
Humpback whale	1	19 July, 1988	Griquet, NF	Entrapped in codtrap - self release	14
Humpback whale	1	20 July, 1988	Battle Harbour, Lab.	Entrapped in codtrap - self release	14
Humpback whale	1	20 July, 1988	Battle Harbour, Lab.	Entrapped in codtrap - released alive	14
Humpback whale	1	20 July, 1988	Battle Harbour, Lab.	Entrapped in gillnets - towed gear off	14
Humpback whale	1	20 July, 1988	Battle Harbour, Lab.	Entrapped in gillnets - towed gear off	14
Humpback whale	1	25 July, 1988	St. Anthony, NF	Entrapped in gillnets - towed gear off	14
Humpback whale	1	28 July, 1989	Murray Harbour, Lab.	Entrapped in codtrap - released alive	15
Humpback whale	1	28 July, 1990	St. Anthony, NF	Entrapped in codtrap - dead	16

Species	Number	Date	Location	Circumstances	Source
Humpback whale	1	30 July, 1990	St. Anthony, NF	Entrapped in salmon net - released alive	16
Humpback whale	1	27 June, 1992	L'Anse Amour, Lab.	Entrapped in salmon net - self release	17
Humpback whale	1	15 July, 1992	Fox Harbour, Lab.	Entrapped in gillnet - released alive	17
Humpback whale	1	24 July, 1992	St. Anthony, NF	Entrapped in salmon - towed gear off	17
Humpback whale	1	25 July, 1992	Main Brook, NF	Entrapped in gillnet - released alive	17
Humpback whale	1	5 Sept., 1992	L'Anse au Loup, Lab.	Entrapped in fishing gear - whale towing gear	17
Humpback whale	1	22 June, 1993	Bird Cove, NF	Entrapped in codtrap - dead, sunk with gear.	18
Humpback whale	1	2 July, 1993	Boat Harbour, Cape Norman, NF	Entrapped in codtrap - dead, part of fluke taken.	18
Humpback whale	1	15 Sept., 1993	Blanc Sablon, Que.	Entrapped in fishing gear - whale towing gear	18
Humpback whale	1	15 Oct., 1993	Red Bay, Lab.	Entrapped in fishing gear - towed gear off	19
Humpback whale	many	6 Jan., 1993	St. Lunaires/Griquet, NF	Unusual sighting - capelin spawning on beach, many humpbacks feeding near beach	19
Humpback whale	1	21 June, 1980	Deadmans Cove, St. Barbe	Entrapped in gillnet - alive	20
Humpback whale	1	18 July, 1980	Eddies Cove East, NF	Entrapped in fishing gear - dead	20
Humpback whale	1	15 Aug., 1980	St. John's Bay, St. Barbe	Entrapped in gillnet - dead	20
Killer whale	4	1 June, 1981	Cape Bauld, NF		23
Killer whale	2	13 June, 1981	Southeast entrance of the Strait of Belle Isle	Aerial survey	1
Killer whale	1	13 June, 1981	Northwest entrance of the Strait of Belle Isle	Aerial survey	1
Killer whale	4	8 July, 1981	20 naut. Miles off Ferolle Pt.		23
Killer whale	3	22 July, 1981	Cape Bauld, NF	Shore watch	1
Killer whale	1	late February 1960	Green Island Cove, Strait of Belle Isle of Belle Isle (51° 22'N, 56° 34'W)	Dead	2
Killer whale	6	2 May, 1953	ca. 51° 30'N, 57° 00' W	Swimming north along edge of icefield	4 (H.D. Fisher)
Killer whale	1	26 June, 1951	50° 40'N, 57° 20' W		4 (M.S. Gordon)
Killer whale	1	19 June, 1951	51° 35'N, 55° 25' W		4 (M.S. Gordon)
Killer whale	3	3 July, 1951	52°13'-53°00' N, 55°50'-55°55' W		4 (M.S. Gordon)
Killer whale	1	17 July, 1953	51°09' N, 57°11' W	Scavenging around longlining vessel	4 (F.K. Spencer)
Killer whale	1	14 Aug., 1951	53°15' N, 56°00' W		4 (M.S. Gordon)
Minke whale	3	21 July, 1981	Cape Bauld, NF	Shore watch	1

Species	Number	Date	Location	Circumstances	Source
Minke whale	1	25 Aug., 1981	Cape Bauld, NF	Shore watch	1
Minke whale	1	26 Aug., 1981	Cape Bauld, NF	Shore watch	1
Minke whale	2	25-26 June, 1981	In the Strait of Belle Isle	Aerial survey	1
Minke whale	1	12-13 July, 1981	In the middle northern section of the Strait of Belle Isle	Aerial survey	1
Minke whale	1	20-21 Aug., 1981	Western end of the Strait of Belle Isle	Aerial survey	1
Minke whale	4 seen singly, 2 pairs and 2 groups of 3-5 individuals	30 June - 7 July, 1975	51°-52°N, 56°-58°W	Boat based survey	3
Minke whale	7 seen singly, 2 pairs and 1 group of 3-5 individuals	9 & 16-21 July, 1975	51°-52°N, 54°-56°W	Boat based survey	3
Minke whale	1	17 July, 1980	Near Flower's Cove, Strait of Belle Isle	Boat or shore based sighting	6
Minke whale	1	11 Aug., 1980	Near Red Bay, Lab.	Boat based sighting	6
Minke whale	few	15-21 June, 1980	Red Bay, Lab.	Shore based sighting (lighthouse keeper)	6
Minke whale	1	4 July, 1984	Belle Isle, NF	Entrapped in codtrap - released alive	10
Minke whale	1	19 June, 1987	North Boat Harbour, NF	Entrapped in lumpnets - whale towed nets off	13
Minke whale	1	20 July, 1988	Battle Harbour, Lab.	Entrapped in salmon net - dead (?)	14
Minke whale	1	20 July, 1988	Battle Harbour, Lab.	Entrapped in salmon net - dead (?)	14
Minke whale	1	22 July, 1988	Labrador Ferry	Decomposed, floating	14
Minke whale	1	late Aug-early Sept., 1995	Strait of Belle Isle	Aerial Survey	22
Minke whale	2	late Aug-early Sept., 1995	near L'anse au Clair	Aerial Survey	22
Minke whale	1	late Aug-early Sept., 1995	near Blanc Sablon	Aerial Survey	22
Minke whale	1	late Aug-early Sept., 1995	St. John Bay	Aerial Survey	22
Pilot whale	very large herd	12 Aug., 1953	Ingornachoix Bay, NF	Mixed with tuna *Thunnus thynnus* L.	4 (F.K. Spencer)
Pilot whale	2 or 3	24 June, 1980	Pointe Barque, Quebec	Boat or shore based sighting	6
Pilot whale	4	14 Dec., 1990	St. Anthony, NF	Dead; old	16
Pothead whale	3	13 July - 27 Oct., 1981	In the Strait of Belle Isle	Aerial survey	1
Pothead whale	1	30 Nov., 1980	L'Anse aux Meadows, NF	Dead	20
Rorqual (probably a Fin whale)	1	28 March, 1968	Port aux Choix (50° 42'N, 57° 25'W)	Dead (caught in ice), found floating in the water, identified by Fishery Officer	2
Rorqual (probably a Fin	4	before 22 April, 1968	Forteau and Fox Cove, Labrador (51° 23'N, 57°	Dead (caught in ice)	2

Species	Number	Date	Location	Circumstances	Source
whale)			00'W)		
Rorqual (probably a Fin whale)	3	before 22 April, 1968	Hawke Bay (50° 40'N, 57° 20'W)	Dead (caught in ice)	2
Sperm whale	1	14 Oct., 1981	Reefs Harbour, NF	Remained alive in small estuary for 1 week, then beached and died	5 (J. Lien data)
Unidentified dolphins	63 (from six different groups)	29 June - 18 Aug., 1981	In the Strait of Belle Isle	Ship and shore watches	1
Unidentified whale	1	16 July, 1979	52°20' N, 55°31' W	Aerial or boat based survey	7
Unidentified whale	1	16 July, 1979	52°21' N, 55°31' W	Aerial or boat based survey	7
Unidentified whales	4	16 July, 1979	52°21' N, 55°31' W	Aerial or boat based survey	7
Unidentified whales	2	late Aug-early Sept., 1995	Strait of Belle Isle	Aerial survey	22
Unidentified whales	3	late Aug-early Sept., 1995	southwest Strait of Belle Isle	Aerial survey	22
Unidentified whales	1	late Aug-early Sept., 1995	St. John Bay	Aerial survey	22
Unknown whale	2	13 Aug., 1980	Port Saunders, NF	Boat based sighting	6
Unknown whale	1	20 June, 1983	L'Anse au Loup, Lab.	Entrapped in codtrap - alive	9
Unknown whale	1	1 July, 1983	Port aux Choix, NF	Entrapped in codtrap - alive	9
White beaked dolphins	28	24 July and 9 Sept., 1981	North coast of the Strait of Belle Isle	Aerial survey	1
White beaked dolphins	49 (from 5 different groups)	22 July - 14 Aug., 1981	South coast of the Strait of Belle Isle	Shore watches	1
White beaked dolphins	2 or 3	16 July, 1979	52°21' N, 55°31' W	Aerial or boat based survey	7
White beaked dolphins	3 or 4	17 July, 1979	52°21' N, 55°31' W	Aerial or boat based survey	7
White beaked dolphins	6	late Aug-early Sept., 1995	northeast Strait of Belle Isle	Aerial survey	22
White beaked dolphins	3	late Aug-early Sept., 1995	Strait of Belle Isle	Aerial survey	22
White beaked dolphins	22	late Aug-early Sept., 1995	Strait of Belle Isle	Aerial survey	22
White beaked dolphins	25	late Aug-early Sept., 1995	Strait of Belle Isle	Aerial survey	22
White beaked dolphins	7	late Aug-early Sept., 1995	Strait of Belle Isle	Aerial survey	22
White beaked dolphins	3	late Aug-early Sept., 1995	southwest Strait of Belle Isle	Aerial survey	22
White sided dolphins	total of 14 in nearshore waters	14 June - 19 Dec., 1981	In the Strait of Belle Isle or in Notre Dame Bay	Aerial surveys	1
White sided dolphins	13	5 Sept., 1981	East of St. Anthony	Incidental sighting (seen with 9 plunge-diving	1

Species	Number	Date	Location	Circumstances	Source
				gannets)	
White sided dolphins	19	late Aug-early Sept., 1995	Brador Bay	Aerial survey	22
White sided dolphins	20-25	21 Aug., 1954	20 miles north of St. Lewis Sound, Lab.	Sight record from M.S. Gordon	4

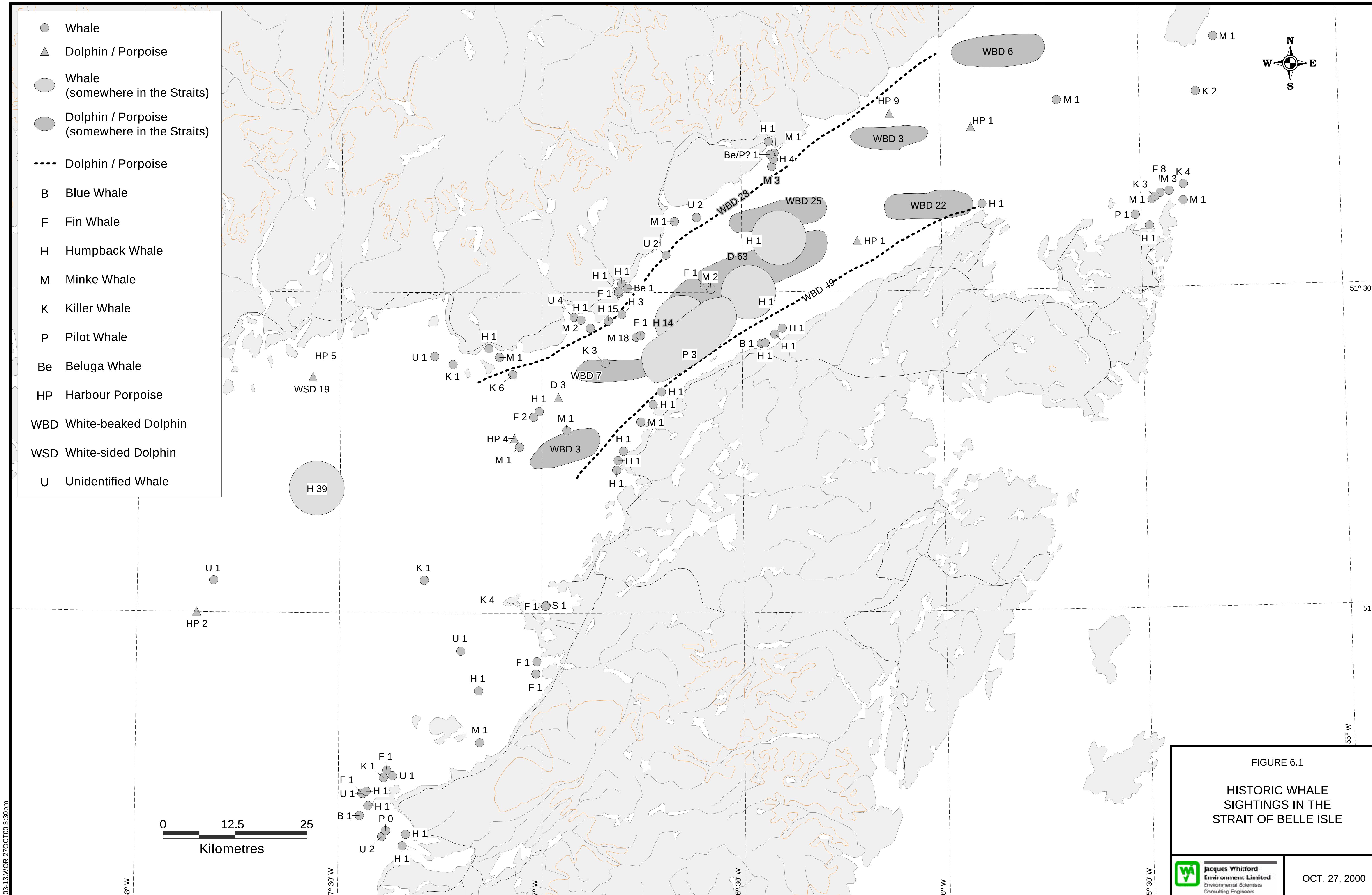

FIGURE 6.1

HISTORIC WHALE SIGHTINGS IN THE STRAIT OF BELLE ISLE

Fin (*Balaenoptera physalus*) and blue (*Balaenoptera musculus*) whales are infrequently reported. Only two records of blue whales occurring near the Strait of Belle Isle were found in the literature, and both of these were dead animals that washed ashore. Although these species are highly conspicuous, they are not as widely known as humpbacks (*Megaptera novaeangliae*) and minkes (*Balaenoptera acutorostrata*), and would be less likely to be correctly identified. The cluster of stranded fin and blue whale records for Port au Choix (Figure 6.2), likely died elsewhere in the Gulf of St. Lawrence and were carried by the Gulf current, where they hung up on the headland at Port au Choix. Similarly, all fin whale records for the western side of the Northern Peninsula (St. John and St. Margaret Bays) are dead animals. Their positions along the southwestern side of the Strait of Belle Isle are most likely a result of passive drift with the Gulf current. Other records of fin whales appear to be randomly distributed throughout the Strait. The large number near Cape Bauld (Figure 6.2) is an artifact of a concentrated survey effort there from July 21 to August 12, 1981 (Table 6.1).

Humpback whales appear to be common in the Strait from May to August (Figure 6.3), with greatest numbers recorded in June and July. This species is the most frequently reported and abundant of the large whales. Most reports refer generally to “The Strait of Belle Isle”. However, references to specific locations indicate that the area between Point Amour and L’anse au Loup is a preferred area. This record is probably not biased, as observation efforts here are likely no different from any other community in the Strait. The cluster of observations in the Port au Choix area represent entrapments in fishing gear. It is difficult to determine whether these whales were attracted to the area to feed, or if they simply encountered fishing gear in this area en route to other feeding areas, due to the local physiography.

Minke whales also seem common in the Strait of Belle Isle from May to August, with the majority of minke sightings occurring during the months of July and August (Figure 6.4). Minkes were also reported more frequently in September than humpbacks. Minkes are less conspicuous than humpbacks, with blows that are smaller and more diffuse, and sometimes near impossible to see. These data suggest that minkes are more common than humpbacks in September. Minkes have been sighted throughout the Strait of Belle Isle and it is difficult to ascertain areas of concentration. However, they do appear to have been sighted more often on the northern (Labrador) side of the Strait (Figure 6.4). The minke records for the Cape Bauld area result from shore-based observations on three occasions in July and August of 1981.

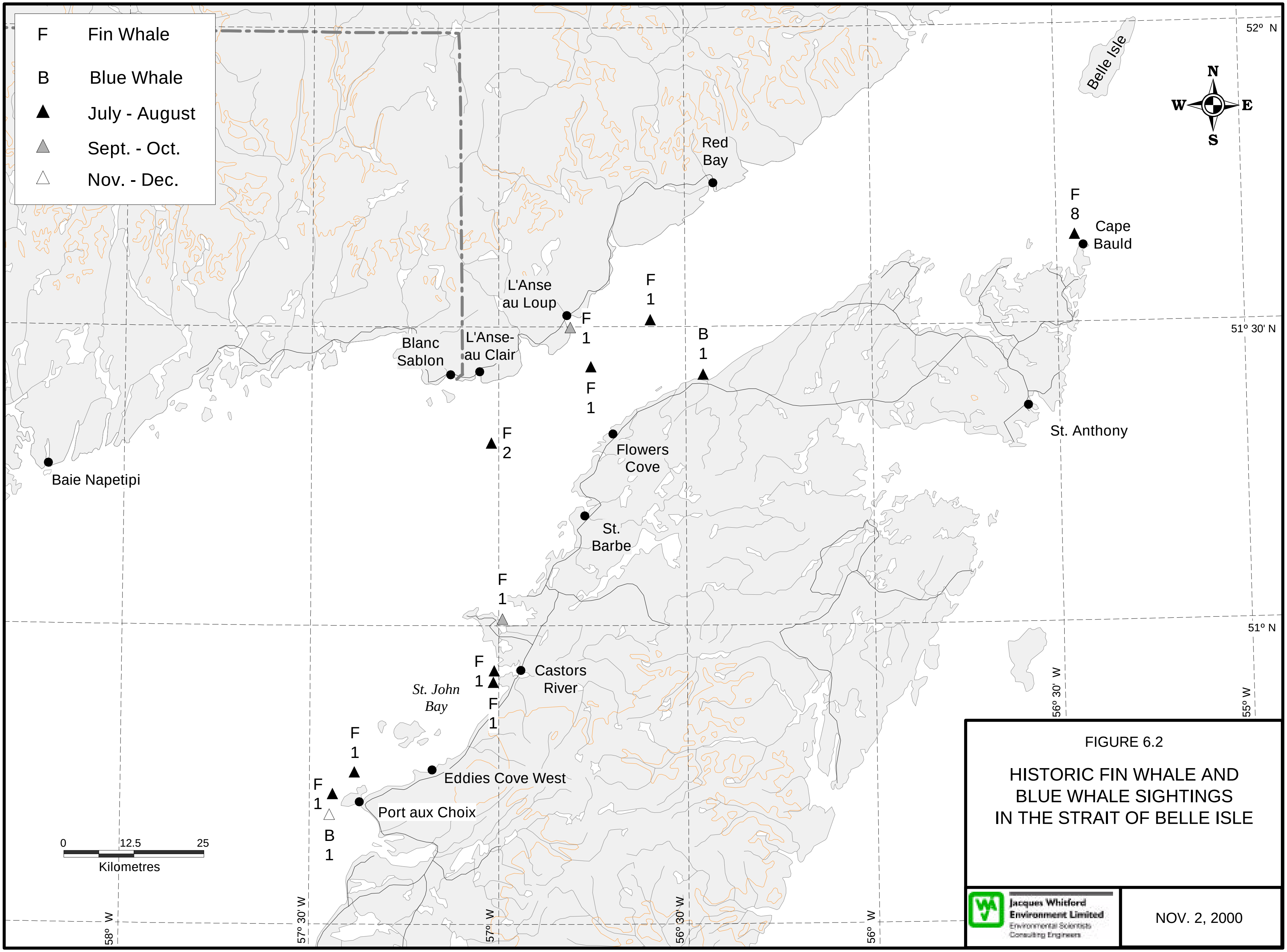

FIGURE 6.2

HISTORIC FIN WHALE AND BLUE WHALE SIGHTINGS IN THE STRAIT OF BELLE ISLE

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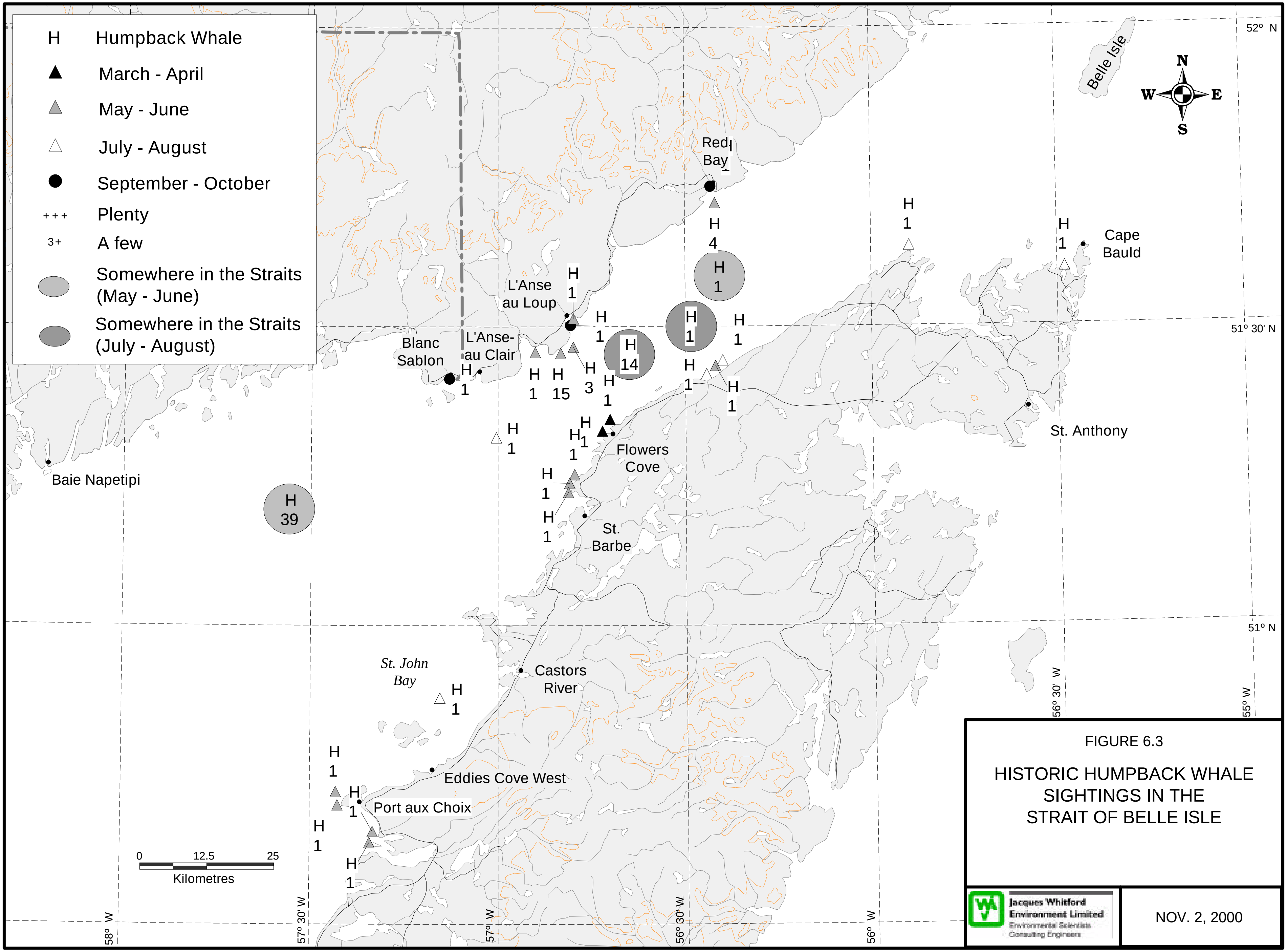

FIGURE 6.3

HISTORIC HUMPBACK WHALE SIGHTINGS IN THE STRAIT OF BELLE ISLE

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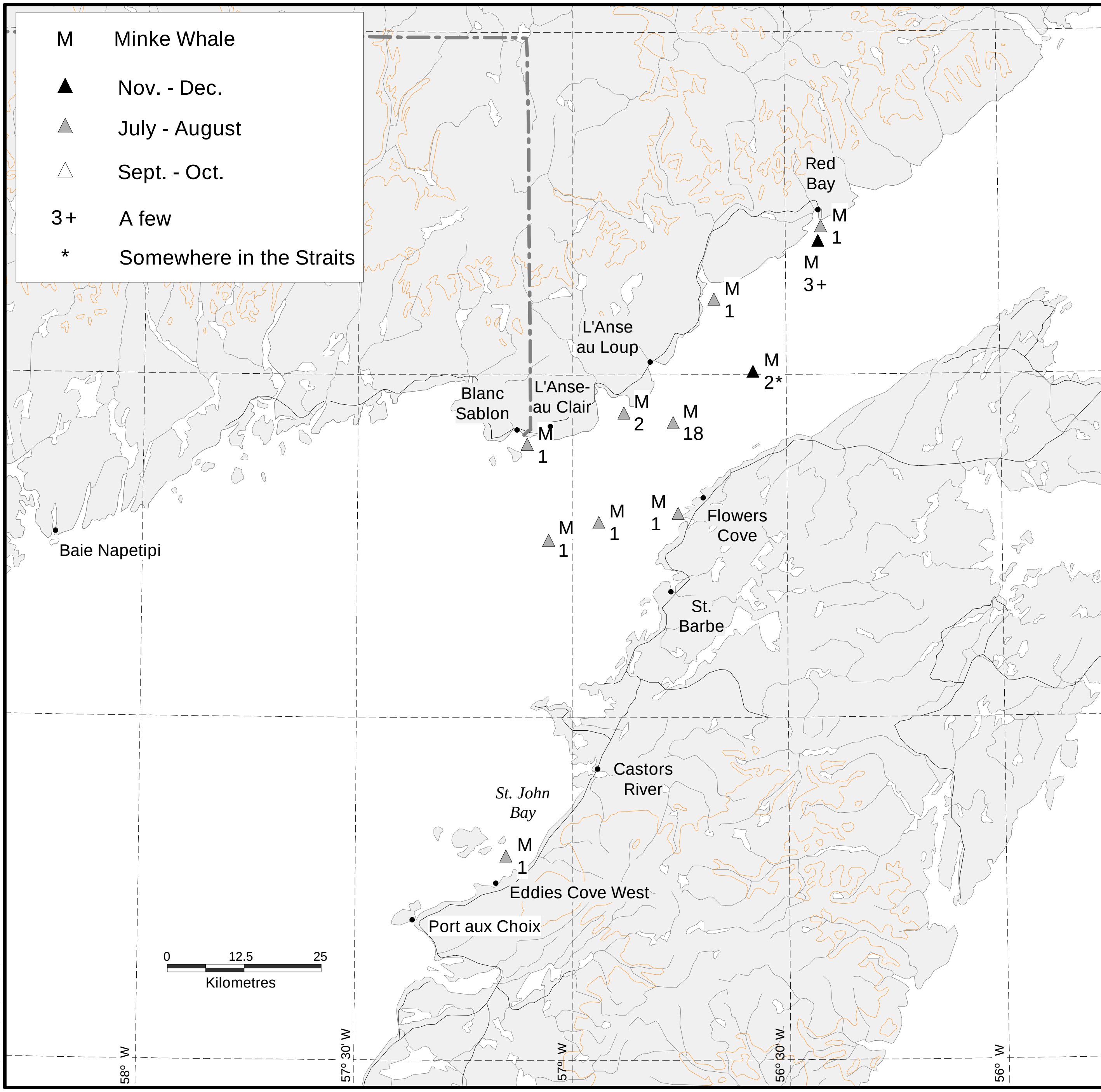

FIGURE 6.4

HISTORIC MINKE WHALE SIGHTINGS IN THE STRAIT OF BELLE ISLE

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White-beaked dolphins (*Lagenorhynchus albirostris*) are also very commonly reported throughout the Strait of Belle Isle (Figure 6.5). Reported observations cite coastal Newfoundland and Labrador, as well as many general references to the "Strait of Belle Isle". This species, though small, is fairly conspicuous when demonstrating certain behaviours. Locally known as "jumpers", white-beaked dolphins travel in small groups and often jump out of the water while swimming. Like many other dolphins, they will also ride a vessel's bow wave. Atlantic white-sided dolphins (*Lagenorhynchus acutus*) have been reported only once near the Quebec north shore (Figure 6.5).

Records for live harbour porpoise (*Phocoena phocoena*) are scarce (Figure 6.5). Harbour porpoises are small and inconspicuous, with a dorsal fin that is easily confused with small waves. This species is visible at close range, and only under very calm sea states; conditions which are not common in the Strait of Belle Isle. However, a large incidental catch of harbour porpoise has been documented in the northern Gulf of St. Lawrence, largely resulting from entrapment of these animals in groundfish gill nets while foraging for capelin and herring. The impact of by-catch on the harbour porpoise population in this region is unknown due to insufficient information on the population size (Fontaine et al. 1994). A reported 1,900 porpoises were taken in 1989/1990 in fishing gear in the northern Gulf, western Gulf and St. Lawrence estuary regions (Palka et al. 1996). One of the highest by-catch rates, as determined from a 1992 survey, was the northeastern Gulf region. A reported four to five harbour porpoises were taken per ton of fish landed. However, the absence of a measure of total fishing effort precluded estimation of the total by-catch (Palka et al. 1996).

Killer whales (*Orcinus orca*) have been seen occasionally in the Strait (Figure 6.6). Sightings are infrequent but recurring, having been reported at different times between 1951 to 1981 (Table 6.1). There is no obvious pattern of abundance to suggest preferred areas. They likely enter the Straits on their migration along the Labrador coast each year.

Pilot whales (*Globicephala melanena*) have been reported very infrequently, and are not likely common to the area (Figure 6.7). One large herd was reported in Ingornachoix Bay in August, 1953 (Table. 6.1). There is only one record of a beluga whale (*Delphinapterus leucas*), seen stranded in L'anse au Loup in July 1993 (Figure 6.7; Table 6.1). An undetermined beluga or pilot whale was seen dead a month later in Red Bay. It is quite likely the same animal; a vagrant from the St. Lawrence Beluga population, possibly.

There is only one sperm whale (*Physeter macrocephalus*) record for the Strait of Belle Isle. This rare species was seen in Reefs Harbour (Figure 6.8; Table 6.1) in October 1981, and later died.

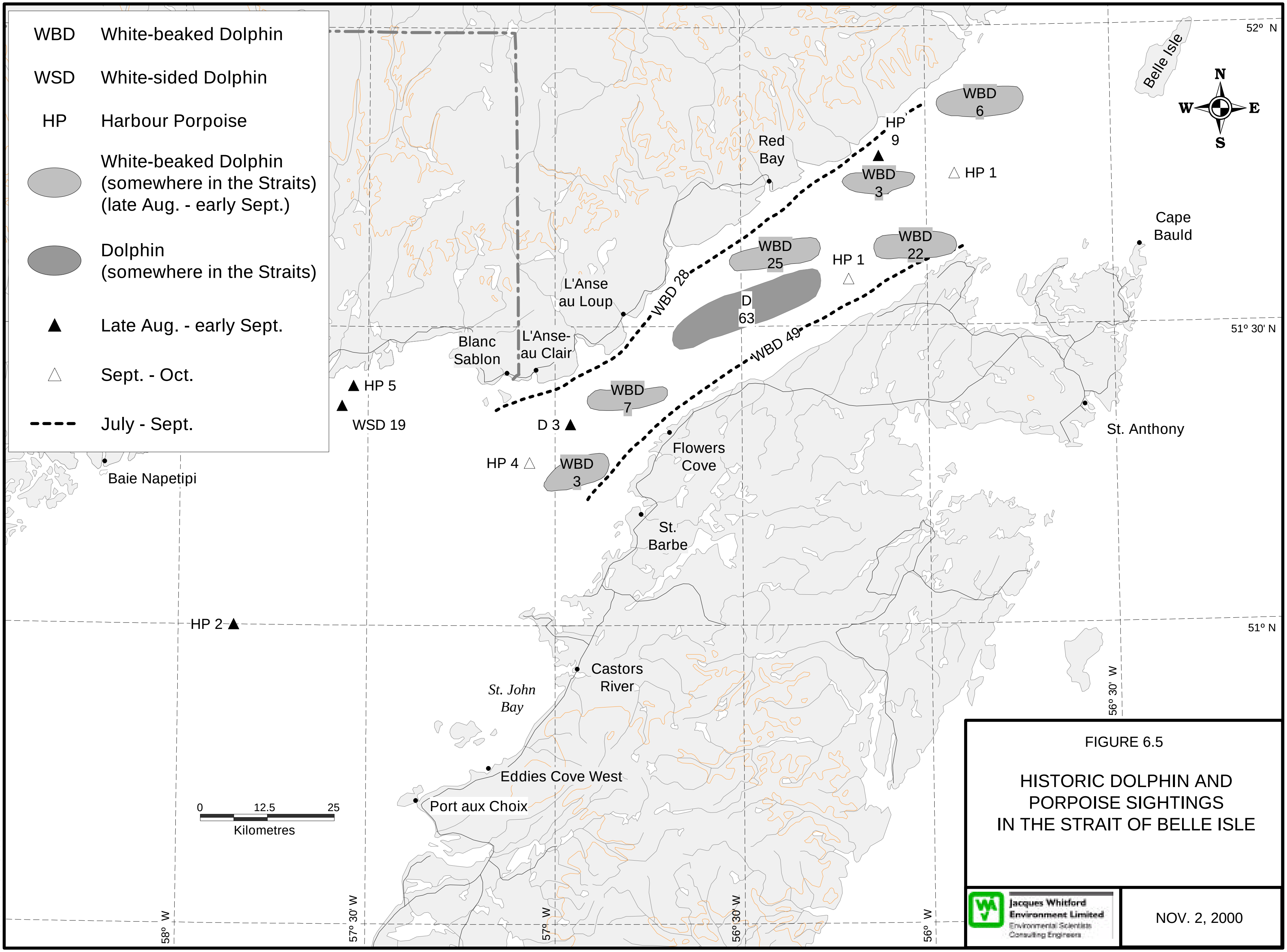

FIGURE 6.5

HISTORIC DOLPHIN AND PORPOISE SIGHTINGS IN THE STRAIT OF BELLE ISLE

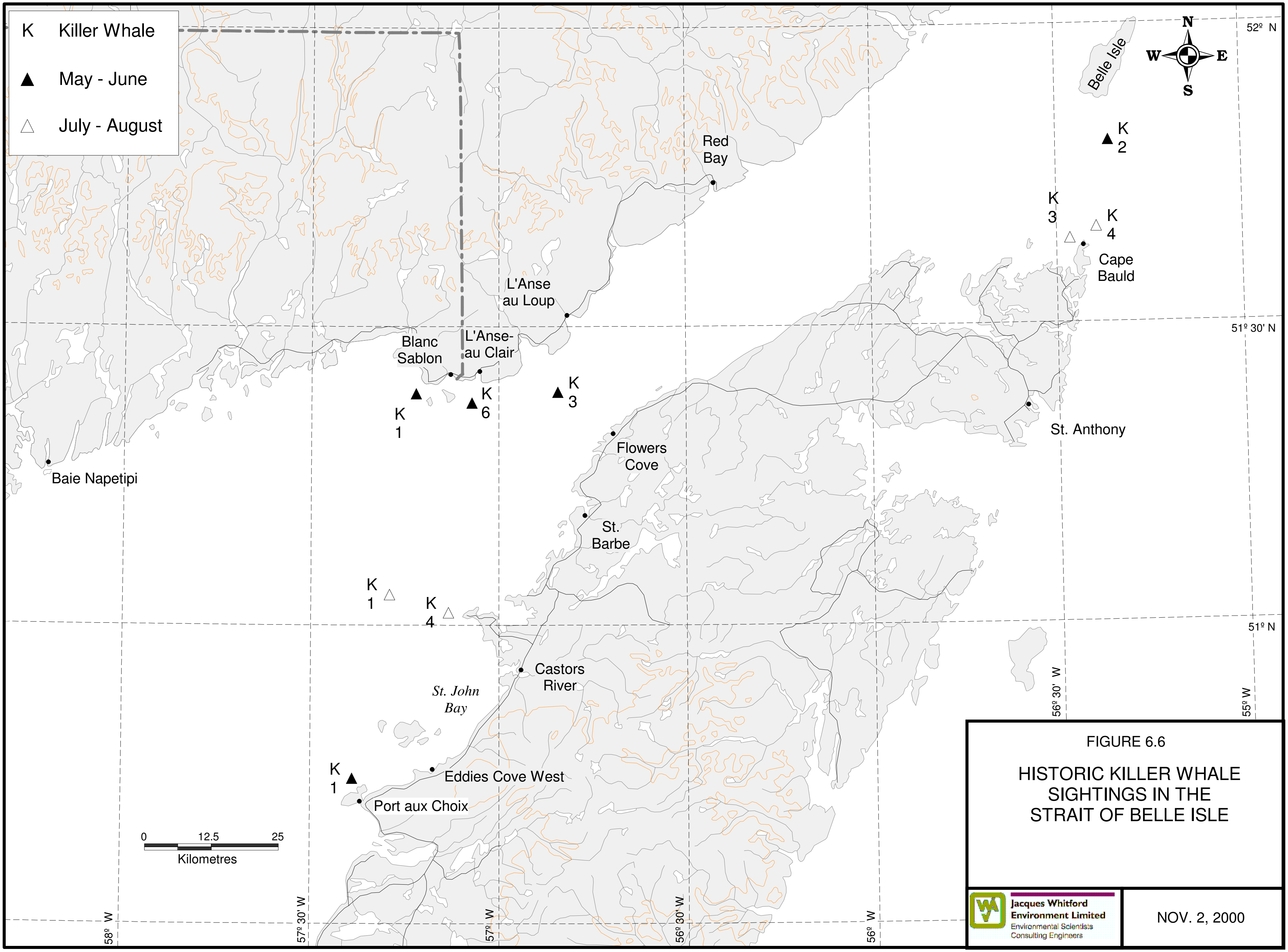

FIGURE 6.6

HISTORIC KILLER WHALE SIGHTINGS IN THE STRAIT OF BELLE ISLE

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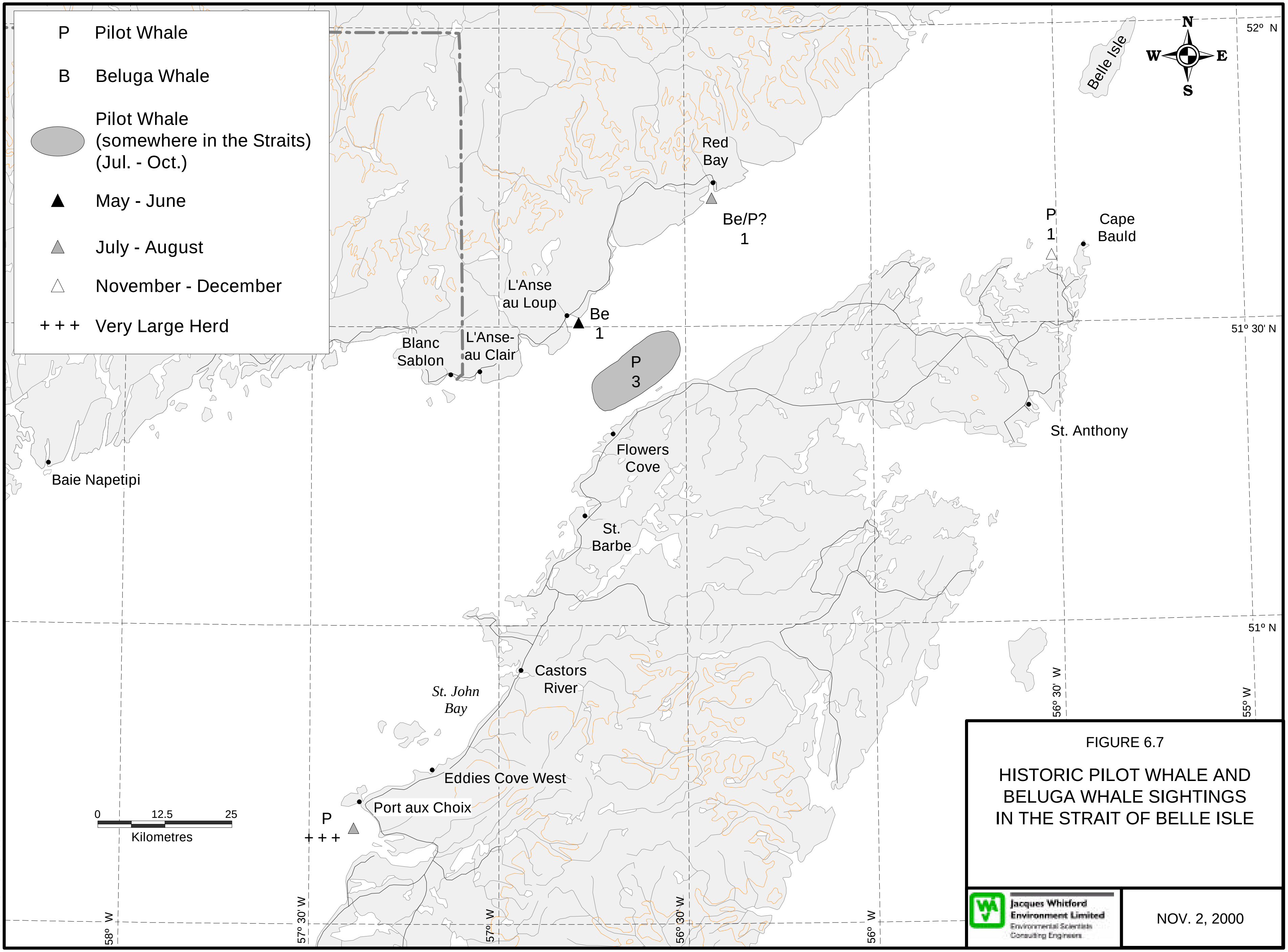

FIGURE 6.7

HISTORIC PILOT WHALE AND BELUGA WHALE SIGHTINGS IN THE STRAIT OF BELLE ISLE

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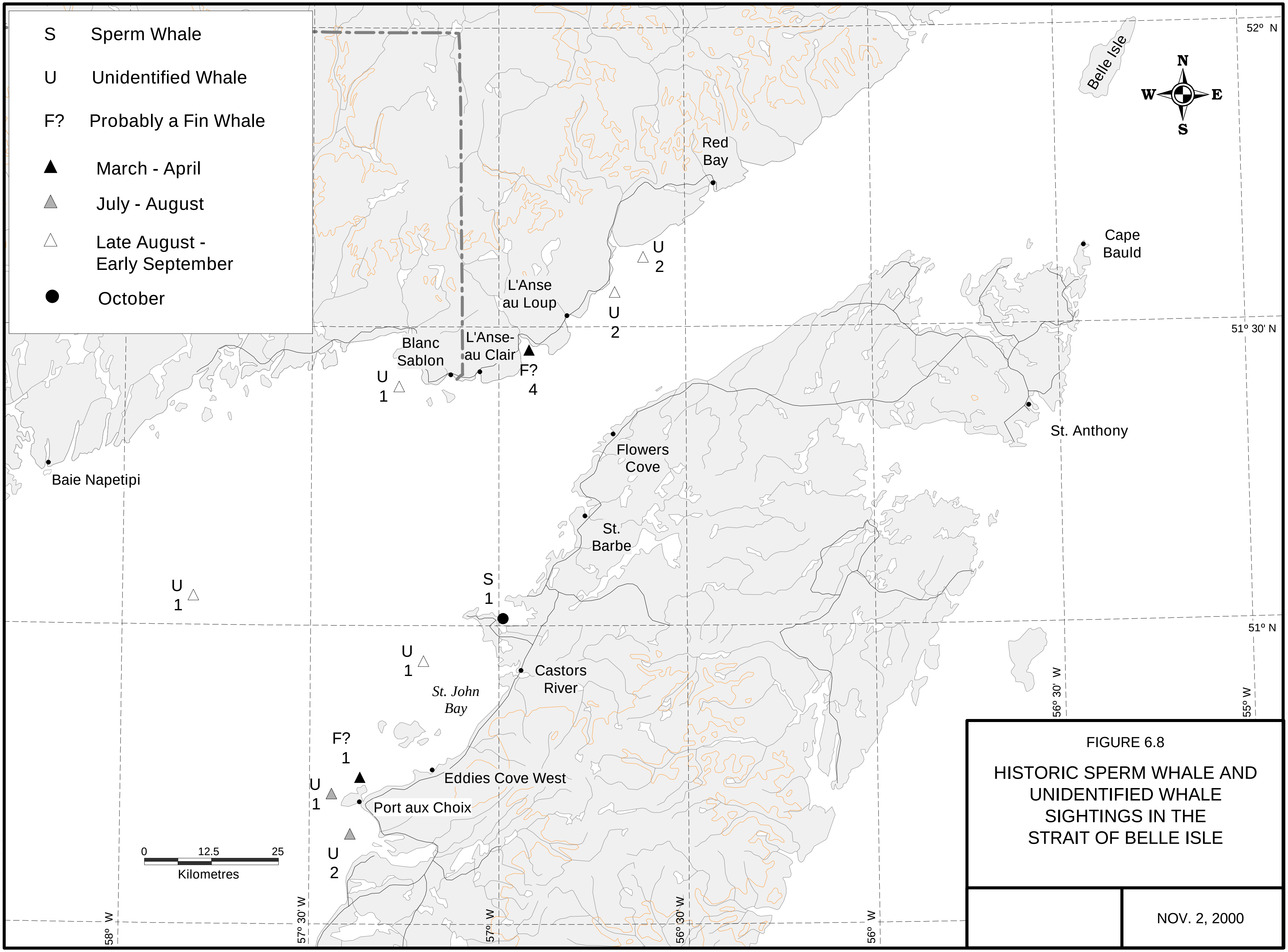

FIGURE 6.8

HISTORIC SPERM WHALE AND UNIDENTIFIED WHALE SIGHTINGS IN THE STRAIT OF BELLE ISLE

NOV. 2, 2000

Sightings of unidentified whales are also presented in Figure 6.8. The distribution of unidentified whales is primarily near-shore, and is a result of entrapment or stranding. Reports were probably made because of the unusual circumstances, thus biasing the data for near-shore observations. Also, it is not possible to determine whether the whales were actively feeding in the area, or if they were caught in gear en route to another destination. These records therefore offer little in terms of interpreting natural distributions.

6.1.2 Seals

The only reference to seal populations are from aerial surveys conducted in 1981 and 1982 (Figure 6.9, Table 6.1). These surveys indicated that harp seal (*Phoca groenlandica*) herds are present in early spring, in association with pack ice. The only historical hooded seal (*Cystophora cristata*) record is an individual animal seen in April, 1981. There are two records of harbour seal (*Phoca vitulina*), seen in September, 1981. Harp and hooded seals are known to migrate through the Strait of Belle Isle during winter, on their way to their breeding grounds near the Magdalen Islands and during the spring on their way to feeding grounds along the Labrador and Greenland coasts.

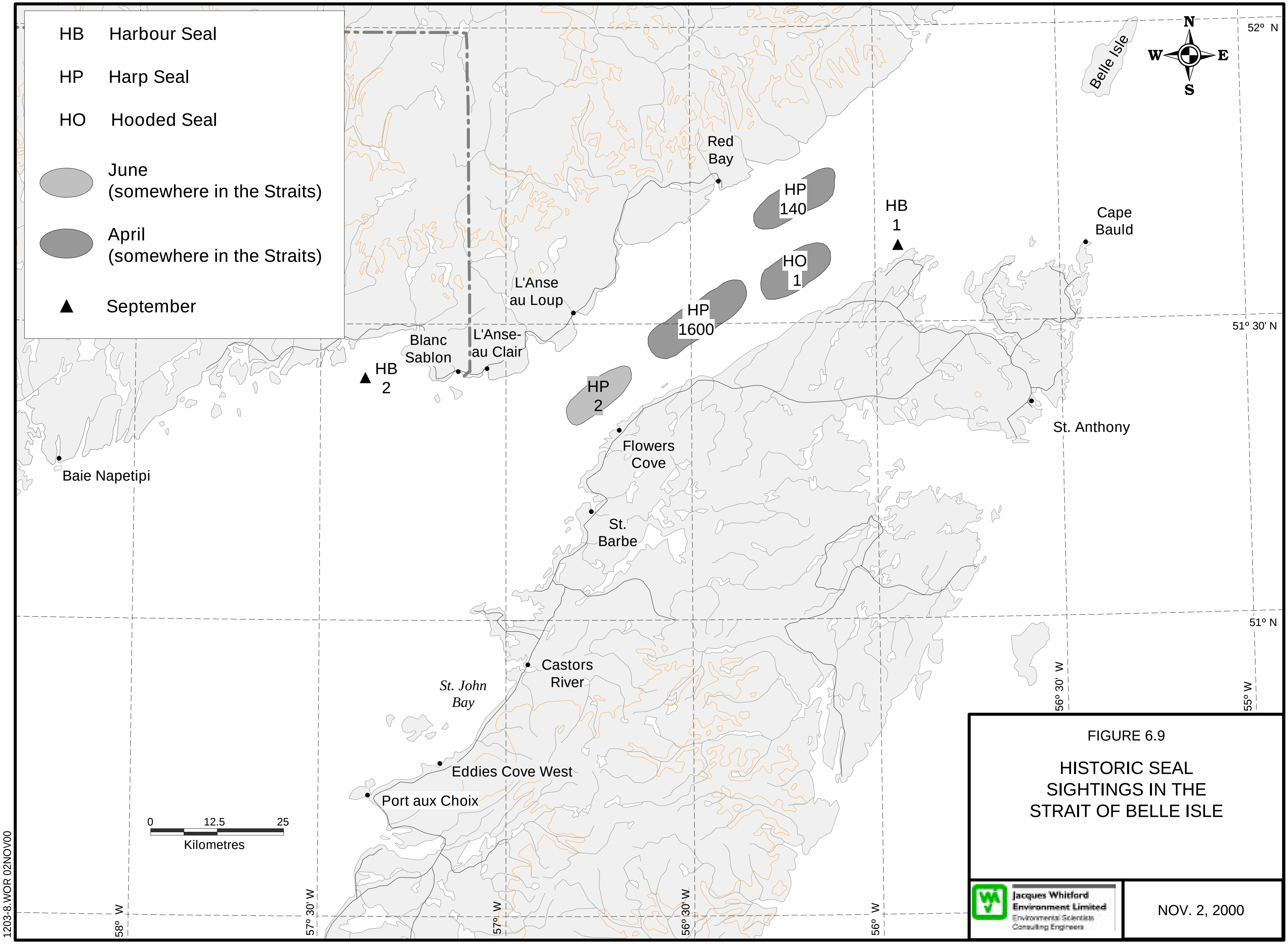

FIGURE 6.9

HISTORIC SEAL SIGHTINGS IN THE STRAIT OF BELLE ISLE

6.2 Effects of Construction on Marine Mammals

The following is a synopsis of a literature search on the effects of underwater construction noise, a project-related effect that could interact with marine mammals. Other relevant references are provided in Section 8.2.

Sound travels efficiently through water and there is concern regarding deleterious effects of man-made noise on marine mammals. This could happen through interference with the mammal's ability to detect calls from others, echolocation pulses, or other important natural sounds (Richardson et al. 1995). It has been documented in the literature that blasting and underwater construction can have behavioural, physiological and psychological effects on marine mammals (e.g., Wright 1981; Myrberg 1990; Ketten 1995; Lien 1995).

Blasting is the strongest point source of sound in the ocean, with the possible exception of strong earthquakes and volcanic eruptions. Pressure pulses, caused by marine explosions, are known to cause injury and death in marine mammals (Richardson et al. 1995). One of the physiological effects of blasting on marine mammals is injury causing temporary or permanent reductions in hearing sensitivity. Since marine mammals rely heavily on acoustic cues for communication and navigation, the effects of acoustic trauma have been well studied.

Ketten (1995) examined the physical parameters of two underwater detonations of Class A explosives (TNT derivatives with fast rise-time waveforms), for their potential to induce blast injury and acoustic trauma in marine mammals. Ketten (1995) also examined differences in the structure of the ear in marine versus land mammals, and how these anatomical differences may affect the incidence and severity of acoustic trauma. The concepts of temporary versus permanent threshold shifts are summarized.

The results of an in-air auditory testing study on a harbour seal (Kastak and Schusterman 1996) indicated that exposure to broadband construction noise for six days, averaging 6 to 7 hours of intermittent exposure per day, resulted in a temporary threshold shift (TTS) of 8 dB at 100 Hz. In addition, the animal's false alarm rate increased from 7% in the pre-exposure session to 30% in the post-exposure test session. Following one week of recovery, the seal's threshold was within 2 dB of its original level, and the false alarm rate was less than 10%. The data suggest that TTS can be induced in seals, and that the seal may have suffered from tinnitus, resulting in a reduced ability to distinguish signal-present from signal-absent trials.

In a discussion paper on the effects of explosives in fish and marine mammals in the waters of the Northwest Territories, Wright (1981) noted that underwater shock waves resulting from the detonation of high velocity chemical explosives have been demonstrated to be lethal to marine mammals, and sublethal damage to their auditory systems could occur at considerable distances from explosions. Seismic exploration surveys in seal pupping areas may result in an abandonment of prime habitat and may weaken the mother-pup bonding response, resulting in decreased survival of the pups.

Wright (1981) also reviewed the methods that have been developed to predict the damage zone for underwater explosions. These include peak pressure (P_{max}), energy flux density (E_f) and impulse (I). Wright (1981) concluded that the impulse model is the best of these in predicting lethal and safe ranges and has been chosen by the Department of Fisheries and Oceans to predict the zone of damage to fish and marine mammals.

Lien and Borggaard (1995) compared the behavioural and physiological manifestations of marine blasting that occurred at the Bull Arm site, Trinity Bay, Newfoundland. Blasting was required for infrastructure construction and subsequent towing of the platform to deeper water. The blasting program coincided with peak abundance of humpback whales which were feeding in the area. Observations of fishermen indicated that whale collisions with their fishing gear increased during blasting. A monitoring program was undertaken to identify individual whales and track their movements and behavior. Initial results indicated no measurable effects of blasting on whale abundance or movements. However, the incidence of collisions with fishing gear were higher during the period of most frequent blasting and highest whale abundance (in 1992-93) compared with long term rates of such events documented in the study area.

Whales orient to objects by echolocation. A shift in threshold, or damage to hearing could result from exposure to intense underwater noise, and affect their ability to detect and avoid fishing gear. Dead whales removed from fishing gear near the site of the construction and from non-industrial areas were autopsied and their ears examined. Ears from whales that died near the construction site showed damage. By examining orientation performance, and with the opportunity to examine ears of dead whales, this study provided new data regarding the impact of explosions on cetaceans that has not been previously available. Results suggest that avoidance behavior alone, the primary data used to evaluate the impact of explosions on whales, is not adequate and that evaluations of hearing and orientation abilities is required, as the effects may be more pronounced than previously believed.

In a study of the possible effects of offshore oil and gas development on marine mammals, Geraci and St. Aubin (1979) investigated the possible physiological, behavioral and psychological effects of offshore oil development activities on marine mammals. These activities include shock waves from explosions. It was determined that shock waves with high peak pressures and rapid rates of pressure can result in damage and death in living organisms. The authors also determined that impact noise, such as explosions, evoke a startle reflex on marine mammals. Some respond to impact noise by sounding, aggregating, or dispersing and subsequently regrouping the social structure.

Low-frequency sound may also affect marine mammal behavior. In a review of the effect of low-frequency sound on marine mammals (NRC 1994), it was concluded that human-made noise affects the ability of marine mammals to communicate and to receive information about their environment. High levels of human-made sound can cause disruptions in marine mammals, such as frightening, annoying or distracting the animals, which can lead to physiological and behavioural disturbances.

The National Research Council reviewed current literature on the effect of low frequency sound on marine mammals (NRC 1994), and provided an objective overview of the current state of knowledge. The report recommended changes in the U.S. regulatory structure for reducing regulatory barriers and facilitating valuable research, and recommended further research that would provide some of the missing information on the effect of low-frequency sound on marine mammals. The authors concluded that human-made noise can be assumed to affect the ability of marine mammals to communicate and receive information about their environment.

Another review of the effects of man-made noise on the behavior of marine animals (Myrberg 1990) reports similar findings. Field studies have shown aversion by various whales to the noise accompanying offshore petroleum exploration and production. Variation in response involves level of source-noise, on-going activity at the time of exposure and, to an uncertain degree, the species involved.

One such field study assessed the effects of industrial activity on humpback whales, minke whales, and harbor porpoise, at Bull Arm, Trinity Bay, Newfoundland, in association with the construction of the gravity-based structure (Bohggard 1996). Tracking individual animals provided some evidence of the short-term effects from industrial activity. In 1994, when dredging was the predominant activity, humpback whales were less likely to be resighted near the industrial activity and exhibited movement away from the site; no such changes were observed during blasting in 1992 (Todd et al. 1996) or during vessel activity in 1995. Humpback resightings and residency were comparatively higher in 1995 than in other years. Furthermore, minke whale resightings occurred in an area of heavy vessel activity in 1995. Reactions by individual cetaceans appeared to depend on the type of industrial activity.

Resightings of individually identified animals between years suggested long-term effects of industrial activity on cetaceans. Humpback whales photo-identified in Trinity Bay in 1992 were observed less frequently in Newfoundland in 1993 than were whales identified in other inshore bays. In addition, a lower proportion of humpback whales identified in Trinity Bay in 1992 were resighted in Newfoundland in 1993, compared with animals identified in an undisturbed area. Individual minke whales were resighted in the industrial area in a subsequent year. Individually identified whales, monitored for several years, were a more sensitive indicator of long term impacts of anthropogenic than abundance, distribution, and respiration measures.

Richardson and Green (1990) conducted a study to determine reactions of bowhead whales (*Balaena mysticetus*), to drilling and dredging noise in the Canadian Beaufort Sea. Bowheads were monitored for their behavioral response to seven 30 to 40 minute underwater playbacks of recorded drillship and dredge noise. Some bowheads oriented away when received noise levels and spectral characteristics were comparable to those several kilometers from actual drillships and dredges. During some playback tests, call rates decreased, feeding ceased, and cycles of surfacing, respiration and diving may have changed. Sensitivity of various whales to noise differed. Roughly half responded when the received level of noise was about 115 dB re 1 mu-Pa on a broadband basis, or about 110 dB in one 1/3-octave band (20 to 30 dB above ambient). Such levels occurred 3 to 11 km from a drillship and dredge in the Canadian Beaufort Sea. Bowheads occasionally were seen less than 5 km from actual drillships and dredges, where received noise levels were at least as high as during our brief playbacks. Thus, some bowheads may habituate to prolonged noise exposure. Alternatively, only the less sensitive individual whales may occur less than 5 km from drillships and dredges.

6.3 Survey Results

6.3.1 Marine Mammals

Estimated total visible numbers for each species are presented in Table 6.2. These estimates are of visible numbers, and no corrections have been applied either for the diving behavior of the animals, the possible variability in observer acuity or the effects of weather, all of which may prevent available animals from being detected. Total numbers, especially of species with long dive times, may be several times the tabulated estimates. These biases do not prevent making definite statements about the seasonal presence of different species, their distributions, or although with a little less confidence, species composition.

6.3.1.1 Blue Whale

Three blue whales were spotted during the 1998 surveys (Figure 6.10). The three were spotted together on August 29 near some fishing vessels on Transect 18, a few kilometres from Blanc-Sablon. The blue whale is designated as vulnerable by COSEWIC in 1998 and is not numerous in the Gulf. It is a regular summer visitor in some areas, including areas off the Mingan Island in the northern Gulf, Pointe des Monts in the north-western Gulf, and Les-Escoumins–Forestville in the St. Lawrence estuary. No previous reports would have led to an expectation of numerous blue whales in the Strait of Belle Isle.

6.3.1.2 Minke Whale

The aerial survey estimate of minke whale numbers is small relative to the boat survey (Tables 6.2 and 6.3); this species is not easy to see from any platform but especially difficult from a moving aircraft. Kingsley and Reeves (1998) estimated about 700 visible on an aerial survey for the whole northern Gulf, and this species is ubiquitous. If observers on the boat survey tended to underestimate distances, the line-transect ESW would be underestimated, and numbers overestimated, in the same proportion. However, minke whales are not too hard to detect close to a boat, as they surface quite frequently.

Table 6.2 Estimated Average Visible Numbers of Common Cetaceans During the Boat (Transects 14-18) and Aerial Surveys

Species	Dates	Beaufort	Estimated Numbers	
			Boat†	Aerial‡
Harbour porpoise	04/08–01/09	1		5580*
Harbour porpoise	05/08–07/10	1–3	840	
White-beaked dolphin	29/08–29/10	1–3	940	
Minke whale	04/08–19/09	1–2		90
Minke whale	05/08–18/09	1–4	200	
Humpback whale	09/07–01/09	1–3		60
Humpback whale	05/08–18/09	1–4	40	

† Estimated numbers are those mammals visible on or near the trackline, in the given Beaufort sea states, averaged over the survey dates given.

‡ Estimated numbers visible at the optimal distance to airborne observers (700 feet in a flat-windowed aircraft), in the given Beaufort sea states, averaged over the survey dates given

* This estimate of harbour porpoise numbers assumes that densities measured on transects in Beaufort sea state 1 can be extended to parts of the study area where such sea states were never obtained. If this assumption is erroneous, this estimate of numbers would be too high, possible by a factor of about 2.

Figure 6.10 Mean Number of Sightings of Marine Mammals in the Strait of Belle Isle (Boat Survey)

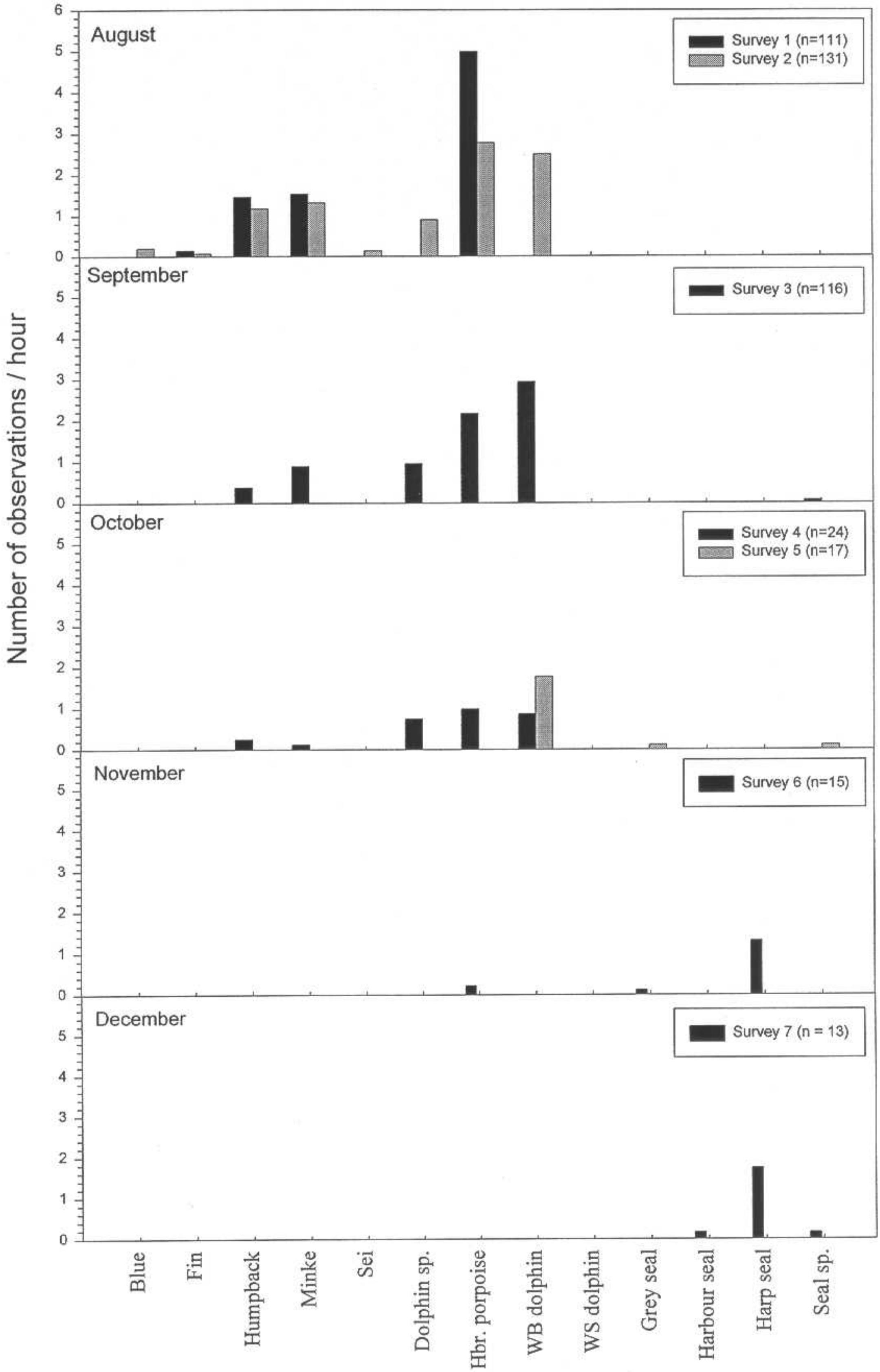

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Table 6.3 Encounter Rates (per 100 Km) for Minke Whales in Aerial and Boat Surveys of the Belle Isle Strait Narrows

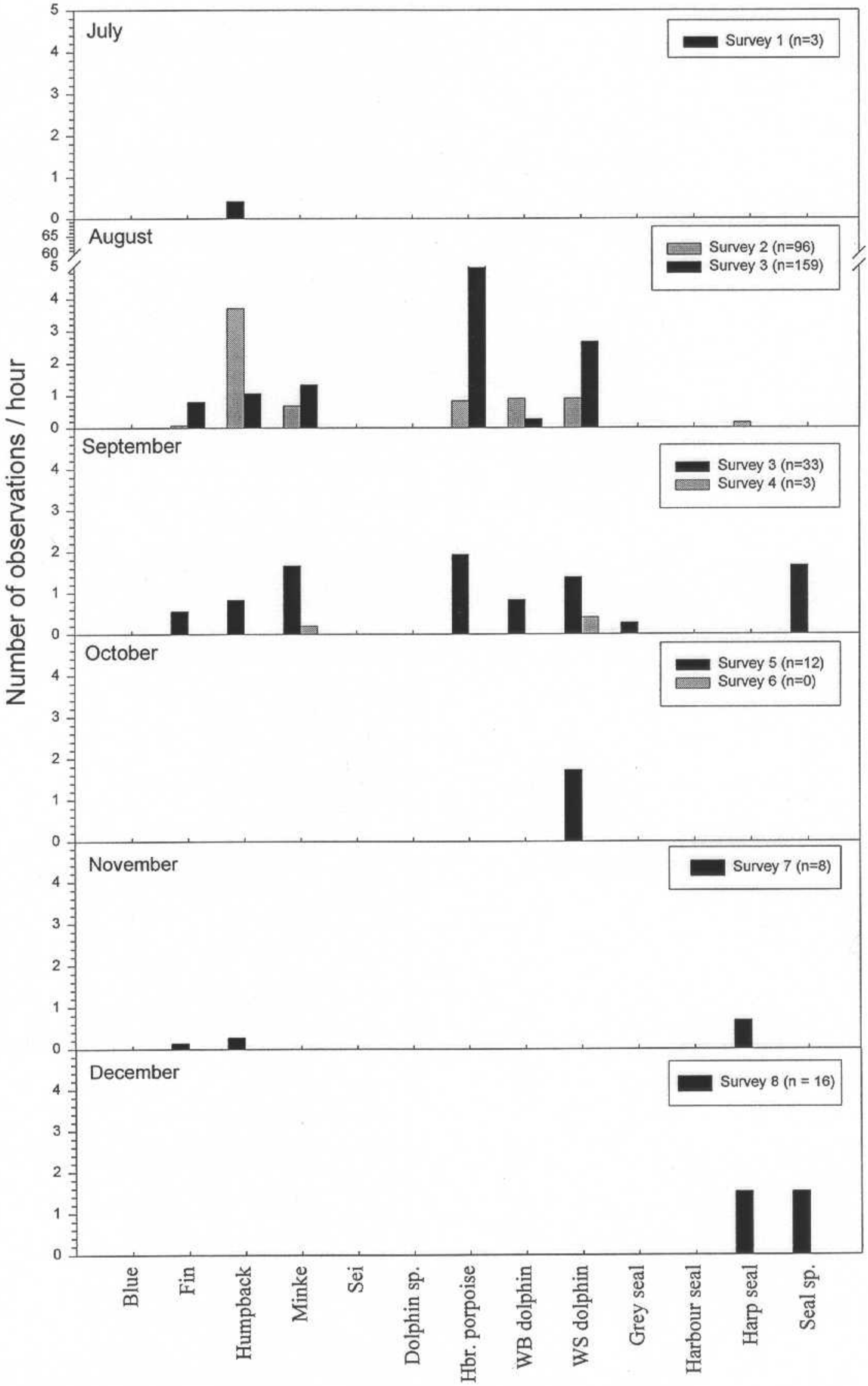
Transect	Boat Survey (all weather)			Aerial Survey (Beaufort 1 & 2)		
	2	3	4	2	3	4
14	0	3.05	9.15	0	0	0
15	0	7.04	10.6	0	0	0
16	2.75	16.5	13.7	0	2.19	0
17	9.09	3.64	1.82	0	3.12	0
18	11.7	0	2.93	--	0	0

Minkes are most abundant during August and September, encompassing over 98% of total observations. Just a single sighting was recorded after September (Figure 6.11). These data correspond well with historical observations (Section 6.1.1), which suggests that minkes were common from May to August, with greatest numbers in July and August. The historical records also show that minkes were more common than humpbacks in September, which also agrees with our data from 1998. Peak abundance likely corresponds to the arrival of capelin to the area.

It appears as if the aerial observers saw overall far fewer minke whales than the boat observers. Of the transects covered by the boat in surveys 2, 3, and 4, the boat saw minke whales on 12 of 15 combinations of transect and survey, the aerial survey saw minkes on only 2 (Table 6.3). This result is not surprising, as the short, discrete surfacing of minke whales makes them a poor subject for aerial surveys. The visible number estimates attained from the boat survey are therefore likely more accurate.

The distribution of all minke observations during the baseline survey in 1998 is illustrated in Figure 6.12. There appear to be more minkes on the Labrador side of the Strait, which supports the apparent historical trend (Figure 6.4). Also, minkes seem to be concentrated in the most narrow section of the Strait, between L'Anse Amour and Blanc Sablon, on the Labrador/Quebec side.

Figure 6.11 Mean Number of Sightings of Marine Mammals in the Strait of Belle Isle (Aerial Survey)



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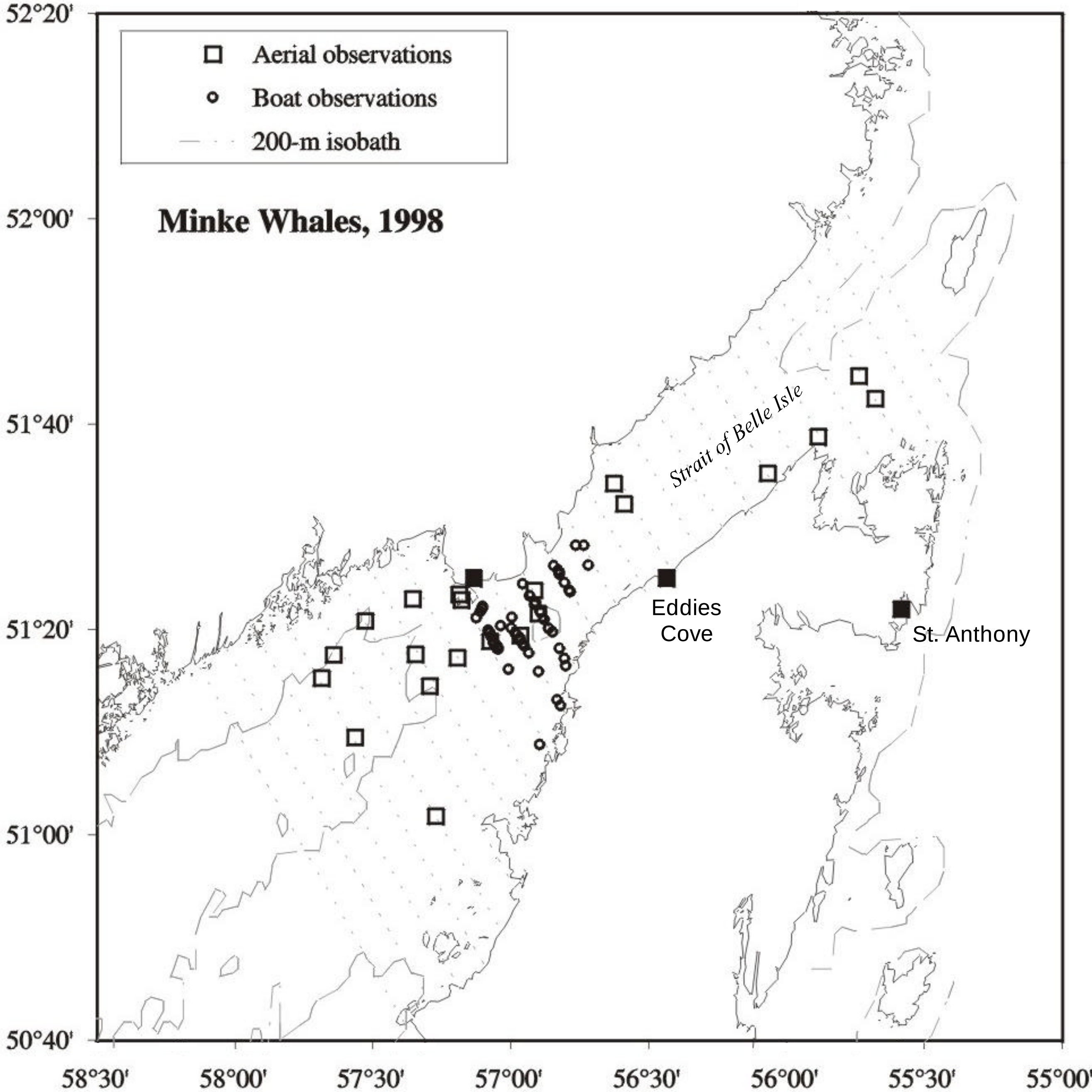

FIGURE 6.12

DISTRIBUTION OF MINKE WHALE OBSERVATIONS

6.3.1.3 Fin Whale

The distribution of fin whale sightings was mostly in the northeastern Gulf, apparently associated with the 200 m depth contour, but one sighting was also made near Cape Bauld. In the Strait, fin whales were relatively infrequent during our surveys, as the historical observations indicate. They were most abundant in August (Figures 6.10 and 6.11), near the west end of the 1998 study area (Figure 6.13). During the summers of 1995 and 1996, the fin whale was the most abundant of the large whales on the north shore of the Gulf (Kingsley and Reeves 1998). The fin whale is designated as vulnerable by COSEWIC (1998).

6.3.1.4 Long-Finned Pilot (Pothead) Whale

The pilot whale is common in Newfoundland waters during the summer and may remain up to late autumn (Sergeant and Fisher 1957). The distribution of pilot whales is closely correlated with that of the squid (*Illex illecebrosus*), the primary prey of the pilot whale. The times of arrival and disappearance of the squid appear to be determined mainly by water temperatures (preferred range being 5 to 15^{o}C) and hence the distribution of the pilot whale is related to hydrographical conditions (Sergeant and Fisher 1957). Pilot whales are known to summer in the coastal waters of southern Labrador and in the Gulf of St. Lawrence; they move offshore outside the Continental Shelf in winter (Sergeant and Fisher 1957).

The only sightings of pilot whales during the 1998 surveys were incidental, or between transects. There were five pilot whales spotted by the boat crew between transects 17 and 18 on August 5.

6.3.1.5 Humpback Whale

For humpback whales, the aerial survey observers recorded encounter rates of the same order of magnitude as the boat survey during Survey 2, but surprisingly saw very few in Survey 3, despite favorable wind conditions. It seemed for both platforms as though relatively rough seas were not much of a barrier to seeing humpback whales (Table 6.4). Forty to sixty humpbacks in the area during the summer seems reasonable (Figure 6.2). There is evidence that significant numbers of humpbacks are in this area during the summer. Marine mammal observers on the research vessel *Alfred Needler* once had over 70 humpbacks in sight at one time in the Strait of Belle Isle.

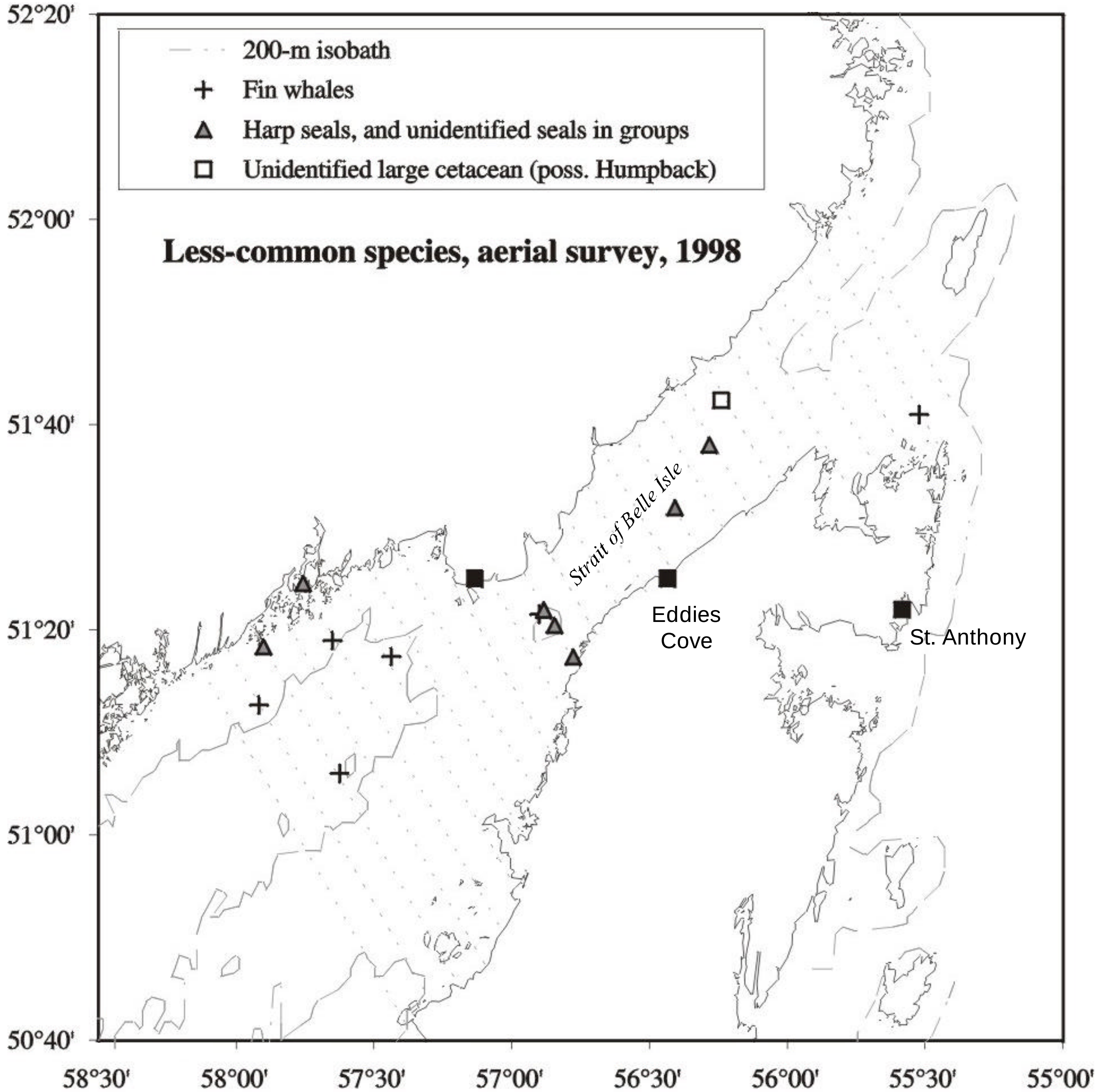

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FIGURE 6.13

DISTRIBUTION OF LESS COMMON SPECIES OBSERVATIONS

Table 6.4 Encounter Rates (per 100 Km) for Humpback Whales in Aerial and Boat Surveys of the Belle Isle Strait Narrows

Transect	Boat Survey (all weather)			Aerial Survey (Beaufort 1 & 2)		
	2	3	4	2	3	4
14	6.1	6.1	0	8.73	6.55	0
15	3.52	7.04	0	4.65	0	0
16	24.7	24.7	8.24	5.48	0	0
17	5.45	1.82	1.82	2.34	0	0
18	4.4	2.93	2.93	--	0	0

One-sided ESW for boat survey was estimated at 7.28 m, for aerial survey 552 m.

From July to November, humpbacks were most abundant in August, when 85% of our humpback observations were recorded. Relative abundances sharply decreased after September (Figures 6.10 and 6.11). Historically however, humpbacks appear to be common from May to August, with greatest numbers observed from June to July (Table 6.1). There appear to be two areas of particular importance for humpbacks, east of Cape Onion toward Belle Isle, and from Pinware to Blanc Sablon (Figure 6.14).

6.3.1.6 Harbour Porpoise

There were almost no data to compare sighting rates for harbour porpoise between the two platforms, as only the Beaufort 1 aerial survey data were used, and only one of the aerial transects covered by the boat survey was flown in sea state 1. This was Transect 18 in Survey 3, and the encounter rate for porpoises during the aerial survey was 12 and for the boat survey, 2.93 per 100 km (Figure 6.15). As the aerial ESW (173 m) was about twice the boat ESW (93.3 m), the aerial density estimate ended up about twice that for the boat survey (Table 6.2).

Results from the boat survey indicate that harbour porpoise disappear at the beginning of October. Large by-catches of this species have been observed in the north-eastern Gulf in mid-September, and it is hypothesised that porpoises move eastward along the north shore in late summer in preparation for leaving the Gulf.

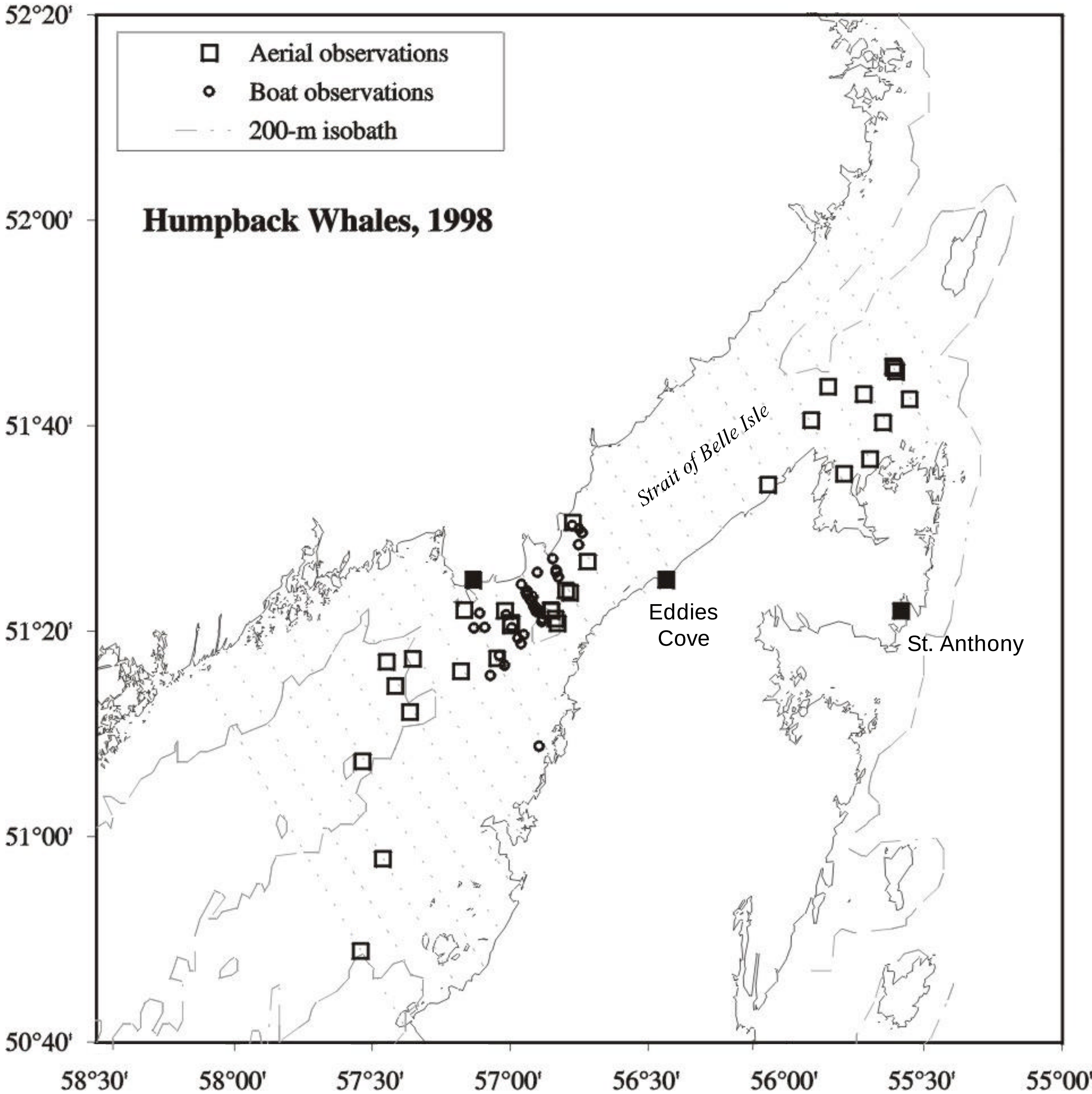

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FIGURE 6.14

DISTRIBUTION OF HUMPBACK WHALE OBSERVATIONS

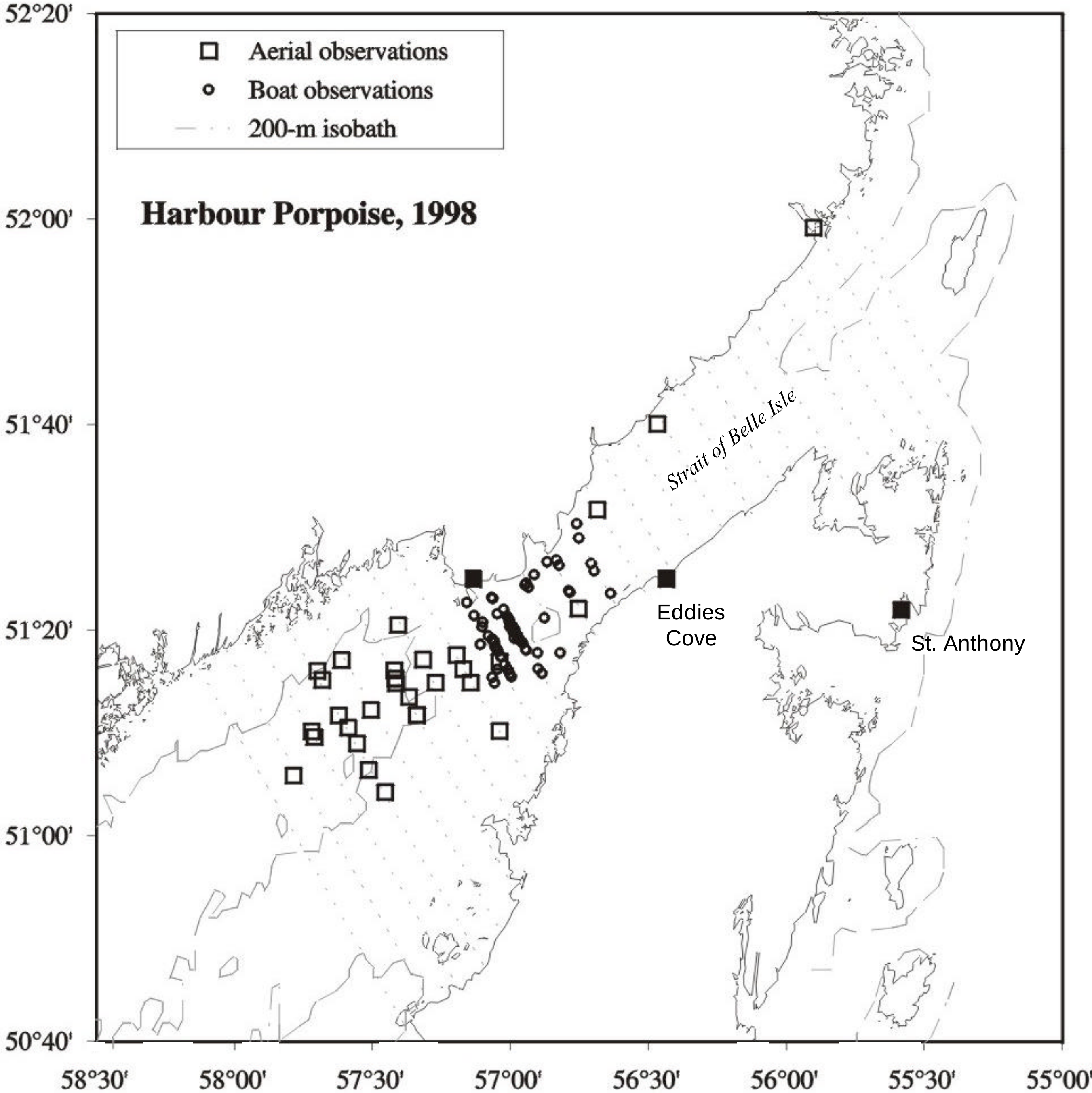

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FIGURE 6.15

DISTRIBUTION OF HARBOR PORPOISE OBSERVATIONS

The estimated numbers of harbour porpoise on aerial survey seem large (Table 6.2), compared with estimates for only 12,000 to 25,000 visible for the entire Gulf (Kingsley and Reeves 1998). However, this estimate assumes that densities measured in sea state 1 are applied to parts of the study area where these conditions never occurred. If porpoise densities are lower in areas that usually have rougher water, the estimate is too high. If this density estimate were applied only to the north-eastern Gulf (i.e., the south-western part of the study area), up to and including transect 17, the estimate of visible numbers would be only about 3,200. High rates of by-catch have been observed in the north-east Gulf during the fall, indicating that there may be high densities at that time.

6.3.1.7 Atlantic White-sided Dolphin

There is evidence to suggest that numbers of white-sided dolphin can vary widely from year to year. Estimates on the Gulf of St. Lawrence population from 1995 were approximately 12,000 animals, in 1996 only about 500 animals (Kingsley and Reeves, 1998). The white-sided dolphin was observed during the aerial surveys in August, September and October, with peak abundance in August (Figures 6.10 and 6.11). There were too few observations to determine any pattern of distribution (Figure 6.16). The Atlantic white-sided dolphin is designated as not at risk under COSEWIC (1998).

6.3.1.8 White-beaked Dolphin

A population estimate for white-beaked dolphins off the Labrador coast is about 3,500 (Alling and Whitehead 1987). This species was designated as not at risk by COSEWIC (1998). The white-beaked dolphin was the second most abundant species during the boat surveys, after the harbour porpoise, in August, September and October (Figure 6.10). Their pattern of distribution, like most other mammal species, seems to favour the Labrador side of the Strait (Figure 6.16).

Mean visible numbers of white-beaked dolphins in the boat survey area are just below 1,000 (Table 6.2). Kingsley and Reeves (1998) estimated an average of about 2,500 in the entire northern Gulf, but observed that this species was mostly seen in the extreme north-east and in the Strait of Belle Isle. White-beaked dolphins are conspicuous in being abundant as late as the end of October.

6.3.1.9 Harp Seal

The total population has been estimated in 1996 at 4.9 million (Hammill and Stenson 1997). Pup production in 1994 was estimated for the northern Gulf of St. Lawrence at approximately 58,000, an indication that the harp seal population is growing at approximately 5% per year (Lacoste 1997).

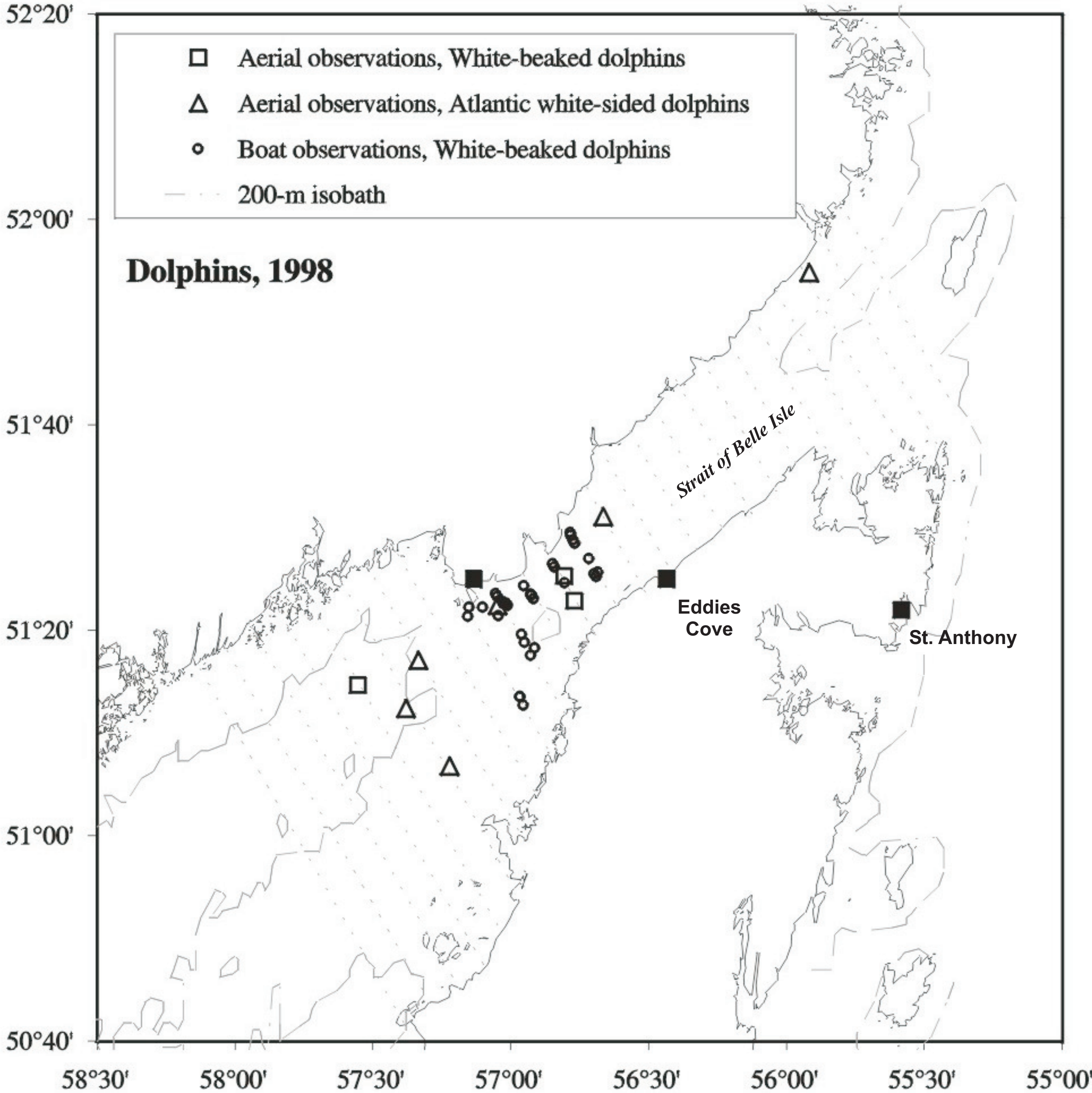

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FIGURE 6.16

DISTRIBUTION OF DOLPHIN OBSERVATIONS

The 1998 surveys identified few harp seals before November, with increasing densities thereafter (Figures 6.10 and 6.11). These individuals are likely the early migrants making their way to the breeding grounds on the Magdalen Islands. Numbers in the Strait would be expected to increase exponentially over the winter.

6.3.1.10 Grey Seal

The population of grey seals (*Halichoerus grypus*)in Atlantic Canada was estimated in 1996 at approximately 184,000. The Gulf component of the population was estimated at about 60,000 and is predicted to be increasing at approximately 6.8% per year (Hammill and Stenson 1997). Grey seals occurred in low numbers in the study area during the September, October and November surveys (Figures 6.10 and 6.11).

6.3.2 Seabirds

The total number of each species seen for each survey is presented in Table 6.5. Survey effort was not the same for all survey periods, so the number of each species seen/hour was calculated, in order to make results comparable across all survey periods. The number of each species seen/hour for each survey period is presented in Table 6.6; and Figure 6.17

A total of 29 seabird species were seen during all the seabird surveys. The total number of species seen for each of the surveys was quite consistent. However, species composition and abundance varied greatly between surveys. The five most abundant species for each survey are presented in Table 6.7. When considering all surveys together, there were a total of 10 species that comprise the top five species for each survey. Herring Gull (*Larus argentatus*) was the only species present in the five most abundant species for all four surveys, indicating a great deal of variability even among the most abundant species. Sooty Shearwater (*Puffinus griseus*) shows the greatest level of variability. It was the most abundant species for the August survey (Survey 1), when its abundance exceeded that of any other species seen on any of the surveys (Table 6.6; Figure 6.17). However, it was not seen at all on the late October survey (Survey 4) (Table 6.5; Figure 6.17). Common Eider (*Somataria mollisima*) was seen in very small numbers on Survey 1 (Table 6.6; Figure 6.17), and was not seen again until the late October survey, when it was the third most abundant species (Table 6.7).

Table 6.5 Total Number for All Species Seen on Each Seabird Survey

Species	Abbr.	Survey 1	Survey 2	Survey 3	Survey 4
		Aug. 29 – 30	**Sept. 15 – 18**	**Oct. 7**	**Oct. 27 - 29**
Common Loon	COLO	3	3	2	
Red-throated Loon	RTLO	3	5	4	3
Northern Fulmar	NOFU	17	291	66	40
Manx Shearwater	MASH	7	1		
Sooty Shearwater	SOSH	2387	53	67	
Leach's Storm Petrel	LSPE	2	2		
Parasitic Jaeger	PAJA	2			
Pomarine Jaeger	POJA	20	17		
Jaeger Sp.	JASP	7	4	2	
Northern Gannet	NOGA	25	84	16	3
Common Eider	COEI	8		5	232
White-winged Scoter	WWSC		1		1
Surf Scoter	SUSC		33		
Scoter Sp.	SRSP		2		
Oldsquaw	OLDS		1	4	4
Greater Black-backed Gull	GBBG	325	74	28	22
Herring Gull	HEGU	903	305	68	44
Iceland Gull	ICGU				5
Black-legged Kittiwake	BLKI	779	3173	842	16
Common Tern	COTE	13			
Arctic Tern	ARTE	13	15		
Tern Sp.	TESP	13	10	2	
Black Guillemot	BLGU		29	5	20
Atlantic Puffin	ATPU	1896	367	36	255
Razorbill	RAZO	26	16	6	128
Razorbill/Murre	RZMU				220
Common Murre*	COMU*	91	65	214	15
Thick-billed Murre*	TBMU*	2		3	26
Murre Sp.*	MUSP*	168	2	22	2
Total Murre Sp.**	TOMU**	261	67	39	43
Dovekie	DOVE			842	489
Red Phallarope	REPH		7	4	
Sanderling	SAND	1			
Greater Yellow Legs	GRYE		2		
Boreal Chickadee	BOCH			62	
Total Number of Species		**24**	**26**	**22**	**19**

*Indicates Murre species
**Summation of Murre species

Table 6.6 Total Number of All Species Seen per Hour on Each Seabird Survey

Species	Abbr.	Survey 1	Survey 2	Survey 3	Survey 4
		Aug. 29 – 30	Sept. 15 – 18	Oct. 7	Oct. 27 - 29
Common Loon	COLO	0.21	0.19	0.25	0.00
Red-throated Loon	RTLO	0.21	0.32	0.49	0.35
Northern Fulmar	NOFU	1.18	18.57	8.11	4.71
Manx Shearwater	MASH	0.49	0.06	0.00	0.00
Sooty Shearwater	SOSH	165.76	3.38	8.24	0.00
Leach's Storm Petrel	LSPE	0.14	0.13	0.00	0.00
Parasitic Jaeger	PAJA	0.14	0.00	0.00	0.00
Pomarine Jaeger	POJA	1.39	1.09	0.00	0.00
Jaeger Sp.	JASP	0.49	0.26	0.25	0.00
Northern Gannet	NOGA	1.74	5.36	1.97	0.35
Common Eider	COEI	0.56	0.00	0.61	27.29
White-winged Scoter	WWSC	0.00	0.06	0.00	0.12
Surf Scoter	SUSC	0.00	2.11	0.00	0.00
Scoter Sp.	SRSP	0.00	0.13	0.00	0.00
Oldsquaw	OLDS	0.00	0.06	0.49	0.47
Greater Black-backed Gull	GBBG	22.57	4.72	3.44	2.59
Herring Gull	HEGU	62.71	19.47	8.36	5.18
Iceland Gull	ICGU	0.00	0.00	0.00	0.59
Black-legged Kittiwake	BLKI	54.10	202.53	103.52	1.88
Common Tern	COTE	0.90	0.00	0.00	0.00
Arctic Tern	ARTE	0.90	0.96	0.00	0.00
Tern Sp.	TESP	0.90	0.64	0.25	0.00
Black Guillemot	BLGU	0.00	1.85	0.61	2.35
Atlantic Puffin	ATPU	131.67	23.43	4.43	30.00
Razorbill	RAZO	1.81	1.02	0.74	15.06
Razorbill/Murre	RZMU	0.00	0.00	0.00	25.88
Common Murre*	COMU*	6.32	4.15	1.72	1.76
Thick-billed Murre*	TBMU*	.14	0.00	0.37	3.06
Murre Sp.*	MUSP*	11.67	0.13	2.70	0.24
Total Murre Sp.**	TOMU**	18.13	4.28	4.80	5.06
Dovekie	DOVE	0.00	0.00	103.52	57.53
Red Phallarope	REPH	0.00	0.45	0.49	0.00
Sanderling	SAND	0.07	0.00	0.00	0.00
Greater Yellow Legs	GRYE	0.00	0.13	0.00	0.00
Boreal Chickadee	BOCH	0.00	0.00	7.62	0.00

*Indicates Murre species
**Summation of Murre species

Figure 6.17 Mean Number of Seabird Sightings in the Strait of Belle Isle (Boat Survey)

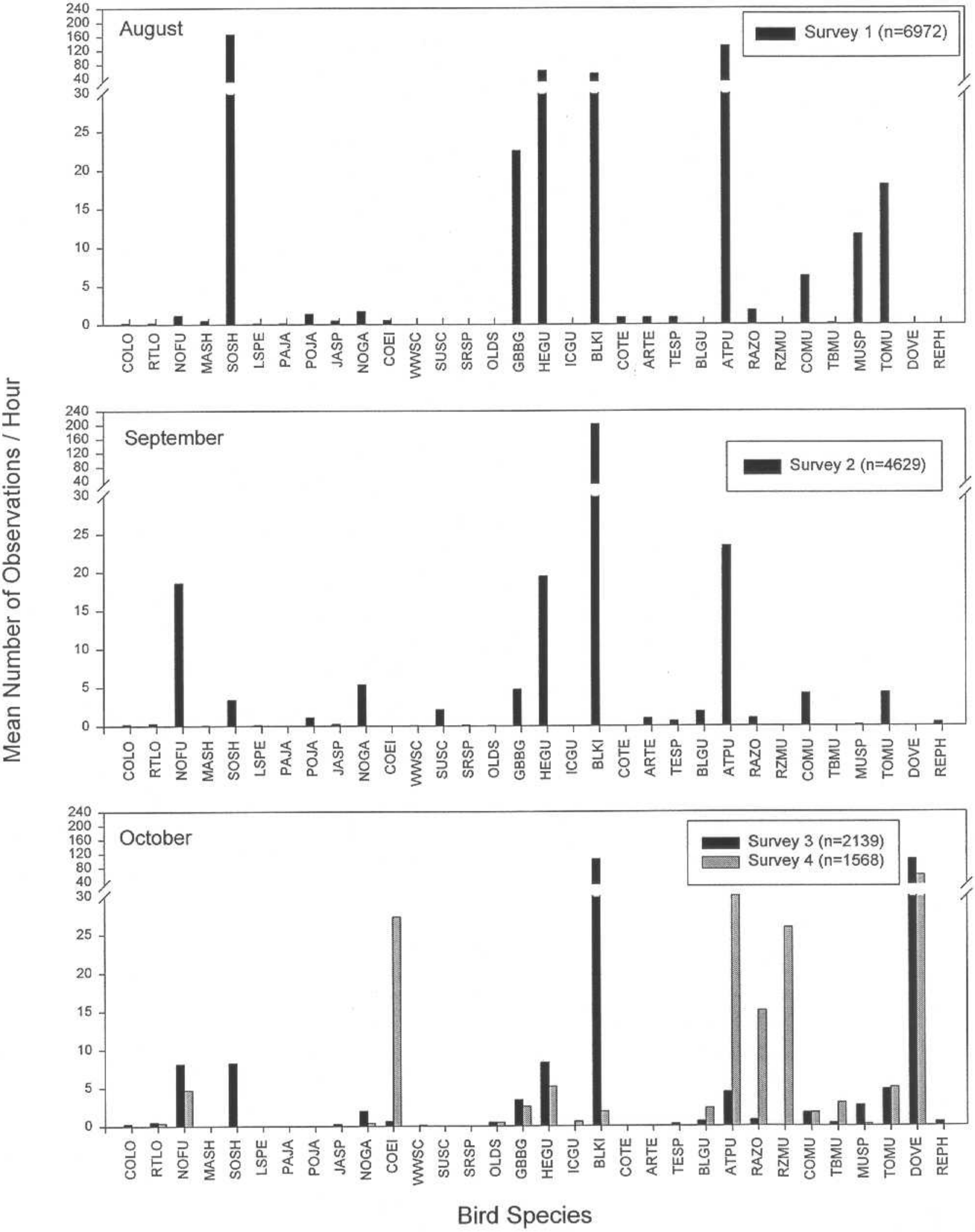

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Table 6.7 The Five Most Abundant Species for Each Seabird Survey, in Order of Decreasing Abundance

Abundance	Survey 1 (Aug 29-30)		Survey 2 (Sept 15 – 18)		Survey 3 (Oct 7)		Survey 4 (Oct 27-29)	
	Species	Obs/hours	Species	Obs/hours	Species	Obs/hours	Species	Obs/hours
1	SOSH	165.76	BLKI	202.53	BLKI	103.52	DOVE	57.53
2	ATPU	131.67	ATPU	23.43	DOVE	103.52	ATPU	30.00
3	HEGU	62.71	HEGU	19.47	HEGU	8.36	COEI	27.29
4	BLKI	54.10	NOFU	18.57	SOSH	8.24	RAZO	15.06
5	GBBG	22.57	NOGA	5.36	NOFU	8.11	HEGU	5.18

As would be expected, species that breed in the area in relatively large numbers (e.g., the Brador Bay Seabird Sanctuary near L'anse au Claire and other parts of southern Labrador and the Quebec north shore) are most abundant in the August survey. These species include Greater Black-backed Gulls (*Larus marinus*), Herring Gulls, Atlantic Puffin (*Fratercula arctica*), and Common Murre (*Uria aalge*). Razorbills (*Alca torda*) also breed in the area in relatively small numbers, and are represented throughout all surveys. Razorbill numbers increase markedly in the late October survey (Survey 4) (Table 6.6; Figure 6.17). Leach's Storm Petrel which has a long breeding season, was present into the September survey.

The following is an account of the most common and/or the most ecologically important seabird species observed during the 1998 surveys.

6.3.2.1 Procellariidae

Northern Fulmar

The Northern Fulmar (*Fulmarus glacialis*) is circumpolar. In the western Atlantic, it breeds in colonies on Ellesmere and Baffin Islands. A few small colonies have been found in south east Labrador and eastern Newfoundland. It is a common bird at sea off Newfoundland year-round. Sub-adult birds summer commonly at sea off Newfoundland (Brown et al. 1975). It is fairly common in the Strait of Belle Isle during all periods of open water. Northern Fulmars feed mostly on zooplankton.

Sooty Shearwater

The Sooty Shearwater (*Puffinus griseus*) breeds in the southern hemisphere during the North American winter. It is highly pelagic and common in the north Atlantic from June to October. It is common in the Strait of Belle Isle from June to September, and less common in October. The Sooty Shearwater feeds on zooplankton and small fish near the surface of the water.

6.3.2.2 Hydrobatidae

Leach's Storm-Petrel

The Leach's Storm-Petrel (*Oceanodroma leucorhoa*) breeds in the north Pacific Ocean and north Atlantic Ocean. In the Atlantic Ocean, it breeds in the British Isles, Iceland, Greenland, Newfoundland and south to Massachusetts (Godfrey 1986). They breed on islands around the coast of Newfoundland and southeast Labrador. The center of population is the Avalon Peninsula, which contains several very large breeding colonies, including the largest in the world, 3,360,000 pairs on Baccalieu Island (Cairns et al. 1986). Leach's Storm-Petrels are highly pelagic. Their diet consists of zooplankton caught at the surface of the water. The winter range is poorly known but is south of Canadian waters. Leach's Storm-Petrels are present in small numbers in the Strait of Belle Isle from June to September.

6.3.2.3 Sulidae

Northern Gannet

The Northern Gannet (*Morus bassanus*) breeds locally in the north Atlantic: British Isles, Iceland, Newfoundland and Quebec (Gulf of St. Lawrence) (Godfrey 1986). The closest colonies to Strait of Belle Isle are Funk Island, Newfoundland and Anticosti Island, Quebec. In the western Atlantic, Northern Gannets winter at sea from Virginia south to Florida.

Northern Gannets are fairly common in the Strait of Belle Isle from June to October. Many of these are sub-adult birds. They feed on fish such as mackerel, herring and capelin by diving from the air into the water.

6.3.2.4 Anatidae

Common Eider

The Common Eider (*Somateria mollissima*) breeds throughout much of coastal North Atlantic. In the western Atlantic, it breeds from Ellesmere Island south to Maine. Large numbers breed on the coast of Labrador. Many northern birds migrate in the autumn to the southern limit of the breeding range. In the Strait of Belle Isle, Common Eider is a common migrant in spring (April and May) and autumn (October to December). Common Eiders dive for mollusks, crustaceans and other invertebrates.

6.3.2.5 Laridae

Pomarine Jaeger

There are three species of jaeger in the world. They breed in the Arctic and subarctic regions of the northern hemisphere and winter at sea roughly at latitude 35^{o} N and southward (Godfrey 1986). All three species migrate through Newfoundland waters in spring and autumn. Pomarine Jaeger *(Stercorarius pomarinus)* was the only species recorded during the surveys.

They migrate southward through Newfoundland waters from August to October. Pomarine Jaegers are kleptoparasitic, (i.e., they rob other birds of their prey). The Black-legged Kittiwake (*Rissa tridactyla*) is the favorite target of Pomarine Jaegers. Generally, jaegers are far less abundant than their prey species.

Black-legged Kittiwake

The Black-legged Kittiwake *(Rissa tridactyla*) is circumpolar. In eastern Canada, it breeds on islands and coastal cliffs in the high Arctic south to the Gulf of St. Lawrence (Godfrey 1986). They winter at sea as far north as there is open water and south to latitude 35^{o}. Kittiwakes are numerous year-round at sea off the Newfoundland and Labrador coast in ice-free conditions (Brown et al. 1975). They feed on a small fish and a large variety of invertebrates near the surface of the water. They are common, feeding and migrating through the Strait of Belle Isle, often congregating where strong tides bring food items to the surface.

6.3.2.6 Alcidae

Dovekie

The Dovekie (*Alle alle*) breeds in Greenland west to Spitsbergen. A small population breeds in Canada in eastern Baffin Island (Nettleship and Birkhead 1985). With an estimated 12,000,000 pairs, mostly in the Thule region of Greenland, it is the most numerous alcid and possibly the most numerous seabird in the Atlantic Ocean. It winters from the low Arctic south to the Scotian Shelf and Gulf of Maine (Nettleship and Birkhead 1985).

They occur in the Strait of Belle Isle as a migrant, remaining until extensive ice coverage forces them farther south. Dovekie is the only Atlantic alcid to feed primarily on zooplankton (Nettleship and Birkhead 1985). They can be very abundant around the coast of Newfoundland in fall and winter.

Common Murre

The Common Murre (*Uria aalge*) has a circumpolar breeding range. In the western Atlantic, 95% of the population breeds in colonies on islands or coastal cliffs from the mid-Labrador coast south to eastern Newfoundland. They winter off shore from Newfoundland south to Georges Bank.

Common Murres are fairly common in the Strait of Belle Isle during summer and fall. There is a breeding colony near Blanc Sablon. The diet is principally small fish which they dive for from the surface of the water.

Thick-billed Murre

The Thick-billed Murre (*Uria lomvia*) is circumpolar. In the western Atlantic, it breeds from the high Arctic (Ellesmere Island) south to Cape St. Mary's, Newfoundland (Godfrey 1986). The eastern Arctic holds 95% of the eastern Canadian breeding population. Small numbers breed in the Gulf of St. Lawrence. They winter at sea from the Arctic south to Nova Scotia and uncommonly to the mid-Atlantic States (Godfrey 1986).

In the Strait of Belle Isle, they are uncommon during the summer months. Thick-billed Murres become numerous in coastal Newfoundland when migrants from the north appear, starting in October. They can be a common winter bird wherever there is open water. This is the bird traditionally referred to as 'turr' by Newfoundlanders. The diet is mainly small fish (Nettleship and Birkhead 1985).

Razorbill

The Razorbill (*Alca torda*) breeds only in the north Atlantic from northern Russia, Iceland, Greenland, Labrador, Newfoundland and south in small numbers to Maine (Godfrey 1986). The total population estimated at 700,000 pairs, with the center of abundance being Iceland. Only 15,000 pairs breed in North America, with 70% of those breeding in eastern Labrador (Nettleship and Birkhead 1985). Small numbers breed near Blanc Sablon, Quebec. In North America, they winter from southern Newfoundland south to North Carolina (Godfrey 1986).

In the Strait of Belle Isle, Razorbills are present in small numbers during the summer. The Labrador breeding birds appear to use the Strait of Belle Isle as a migration corridor to wintering grounds farther south as was indicated by a few hundred flying south on the late October survey. The diet of Razorbills consists of small fish and crustaceans (Nettleship and Birkhead 1985).

Black Guillemot

The breeding range of Black Guillemot (*Cepphus grylle*) is almost circumpolar, centered in the north Atlantic and northern Russia. In eastern North America, it breeds from southern Ellesmere Island to coastal Maine. It breeds in small colonies on exposed rocky coasts and islands. Although relatively ubiquitous throughout its large range, the total north Atlantic breeding population, estimated at 266,000 pairs, makes it the least common Atlantic Ocean alcid (Nettleship and Birkhead 1985). It winters within its breeding range as far north as there is open water. Black Guillemots have a wider range of food items than the other alcids, choosing various small fish and invertebrates (Nettleship andBirkhead 1985). Black Guillemots prefer shallow coastal waters more than the other alcids. In the Strait of Belle Isle, it is fairly common near the shoreline year-round, as long as there is open water.

Atlantic Puffin

The Atlantic Puffin (*Fratercula arctica*) breeding range is from northern Russia west to Iceland, Greenland and North America. In North America, they breed on coastal cliffs and islands from mid-Labrador south to Maine (Godfrey 1986). Most of the Canadian population breeds in southeast Newfoundland. In North America, the Atlantic Puffin winters at sea from southern Newfoundland southward to Massachusetts (Nettleship and Birkhead 1985).

There is a breeding colony of puffins near Blanc Sablon totalling over 7,200 breeding pairs. Puffins are regularly seen in the Strait of Belle Isle from May to November. Numbers are probably enhanced by birds migrating to and from the mid-Labrador coast during spring and autumn. Atlantic Puffins feed primarily on fish that they catch by diving from the surface of the water.

7.0 DISCUSSION AND CONCLUSION

7.1 Marine Mammals

7.1.1 Blue Whale

The blue whale averages between 23 to 32 m in length and weighs 80 to 130 tonnes. They usually travel in small groups of three to four individuals. According to the most recent estimate, the population of blue whales in the western Northwest Atlantic is believed to be between 500 to 1,000 animals (Seton et al. 1992). The blue whale is designated as vulnerable by COSEWIC (1998).

In the summer, their distribution extends from Iceland to the Gulf of St. Lawrence and Newfoundland (Sears et al. 1987). The north shore of the Gulf of St. Lawrence, from the estuary to the Strait of Belle Isle, is recognized as an area of relatively frequent blue whale sightings during the spring, summer and fall (Mansfield 1985). However, blue whales are infrequently reported in the literature, as they were during our survey in 1998. Areas of upwelling and high plankton productivity attract blue whales because they feed exclusively on euphausiids (krill) (Gaskin 1976). During March and April, they frequent the southwest coast of Newfoundland and the Gulf of St. Lawrence to feed on krill. The winter range of the blue whale is not well understood, but it is believed to move south, towards the equator (Mansfield 1985) and perhaps offshore (Seton et al. 1992), but there may be some overwintering in the Gulf of St. Lawrence.

7.1.2 Minke Whale

Minke whales grow to a maximum of 10.2 m long and on average weigh 600 to 900 kg. The global population of minkes is estimated at approximately 300,000 animals. They are commonly spotted nearshore, rarely more than 169 km from land (Fahey 1996). They often enter estuaries, bays and inlets during the summer to feed. They are know to be curious creatures, approaching anchored boats and wharfs. Minkes usually travel singly or in small groups of two to four animals. They show a high degree of site fidelity and residency, and occupy distinct ranges.

Diet analysis conducted in the 1960s, during commercial whaling in Trinity Bay, showed that capelin (*Mallotus villosus*) is the dominant food item for minke whales in Newfoundland waters (Sergeant 1963). Cod was the next most abundant prey item, with salmon, squid, herring and plankton each comprising a small portion of the diet. Minkes were most abundant in August 1998, when the capelin fishery in the area was at its peak. Inshore/offshore movements in response to capelin abundance have been documented (see Marques 1996).

In Newfoundland waters, a migration northward, along the east coast peaks in June and July, with a peak return southward, during October and November (Sergeant 1963). A survey of the Gulf of St. Lawrence in 1995 and 1996 reported approximately 1,000 minkes, of which 75% occurred on the north shore of the Gulf in high densities (Kingsley and Reeves 1998). The 1998 boat survey estimate of 200 minkes in the survey area during August and September is realistic.

7.1.3 Fin Whale

There may be two discrete fin whale populations in the western North Atlantic, one in Nova Scotia and one in Newfoundland/Labrador. Fin whales in the Gulf of St. Lawrence may be a part of the Nova Scotia stock (Mitchell 1974). There are separate population estimates reported for each of these groups. The Newfoundland/Labrador group was estimated at 1,900 animals, the Gulf of St. Lawrence group at 340 animals in the 1960s, and the Nova Scotia group at 430 individuals (see Meredith and Campbell 1988). It has been suggested that the Nova Scotia stock moves south during the winter and the Newfoundland stock moves to an area off Nova Scotia (see Meredith and Campbell 1988). The fin whale was relatively infrequent in 1998, comprising just 1.27 percent of 1998 mammal observations. However, Kingsley and Reeves (1998) report the fin whale as relatively abundant on the north shore of Quebec. The fin whale is designated as vulnerable by COSEWIC (1998).

The fin whale is second only to the blue whale in size, reaching 24 m in length and weighing approximately 45 tonnes. The fin whale is widely distributed in the north Atlantic, in areas of high productivity. Winter distributions of the fin whales as well as their calving and breeding grounds are largely unknown, but they do undergo a seasonal north-south migration. Winter records of fin whales have been reported as far south as North Carolina, Florida and the Gulf of Mexico. They are usually solitary animals, but male, female and calf may travel together. Larger groups have been spotted feeding on schooling fish (Gambell 1985). The fin whale in Newfoundland and Labrador prey mostly on capelin and herring.

7.1.4 Long-Finned Pilot (Pothead) Whale

An aerial survey conducted in the coastal and offshore waters of eastern Newfoundland and southeastern Labrador estimated the pilot whale population at about 13, 200 (Hay 1982). This species is designated as not at risk under COSEWIC (1998).

One group of six pilot whales was seen on the 1998 boat survey, in relatively shallow water close to Blanc Sablon. This is somewhat unexpected, as this species is considered to be strongly associated with the warmer waters in the southeastern Gulf, as well as normally frequently rather deep water. In Newfoundland waters it has been thought to be associated with squid (*Illex illecebrosus*), but off the northeastern coast of the United States it has been found in association with mackerel (*Scomber scombrus*).

7.1.5 Humpback Whale

The humpback whale is a stocky baleen whale that rarely exceeds 15 m in length and 32 tonnes in weight (Hay 1985). Humpback whales are common during the summer months on the southeast shoal of the Grand Banks, off eastern Newfoundland and southern Labrador, on Fyllas Bank off West Greenland and in the southern gulf and estuary of the St. Lawrence. The lower north shore of Quebec and the Strait of Belle Isle are known as areas of relatively high humpback densities during the summer (Kingsley and Reeves, 1998). The survey in 1998 estimated 60 humpbacks in the aerial survey study area during the summer months, whereas the boat survey resulted in an estimate of 40 humpbacks during August and September. This narrow portion of the Strait appears to be of preferred area for humpbacks.

In the summer, the distribution of humpback whales is principally determined by prey distributions; prey includes crustacean zooplankton (i.e., euphausiids), herring (Clupeidae), sand lance (*Ammodytes* sp.), capelin and other small fish and squid (Whitehead 1987). Capelin is the major food for humpbacks off Newfoundland but krill, herring and squid are also taken at various times; preferred summer feeding grounds may change week by week and year by year (Whitehead 1987). Within a particular feeding or breeding ground, individual humpbacks may travel more than 100 km during a season or may stay resident in a certain place for an extended period of time (weeks or months). There is also evidence for humpbacks returning to the same feeding area year after year (see Kingsley and Reeves, 1998). Although other species of whales, such as the fin and minke, use the same prey as the humpback, there is no evidence that the presence of these other species disturb humpback whale feeding (Whitehead 1987).

The North Atlantic population of humpback whales is estimated at about 7,700 whales, with approximately 4,900 males and 2,800 females (Palsbøll et al. 1997). This population is designated as vulnerable by COSEWIC (1998).

7.1.6 Harbour Porpoise

The harbour porpoise is the smallest of the cold-water marine whales and is found along northern temperate coasts. It is generally regarded as a common species but is becoming less common in several major portions of its range (Gaskin 1992a). It is suggested that there are three separate populations of harbour porpoises in eastern Canadian waters, located in: 1) eastern Newfoundland; 2) the Gulf of St. Lawrence; and 3) the Gulf of Maine/Bay of Fundy (Palka et at. 1996). The division between the Newfoundland population and the other two is thought to be the most discrete based on summer distribution patterns. In addition, recent studies of regional differences in organochlorine and heavy metal contaminants revealed significant differences between the three populations, thus supporting the discrete population hypothesis (Palka et al. 1996).

During the spring, the Newfoundland population is distributed in the coastal shelf waters of Labrador and along the eastern and southeastern coast of Newfoundland. In the summer, harbour porpoises occur in Baffin Bay and in the deeper waters of the Labrador Sea. The offshore boundaries of the spring and summer distributions are unknown, as are the wintering grounds (Palka et al. 1996). The habitat of harbour porpoise is generally within waters of about 5 to 16^{o}C and in depths of greater than 10 m. It tends to be found in areas of significant coastal fronts or topographically generated upwellings. In a distributional sense, the harbour porpoise is closely tied to the major pelagic schooling fish which comprise the bulk of its diet. Capelin and herring have been found to be the most important prey items in terms of frequency of occurrence and mass and caloric contribution to the diet (Fontaine et al. 1994). Harbour porpoise also feed on redfish, hake, cod and other small demersal fishes. A large incidental catch of harbour porpoise by commercial fisheries has been documented in the northern Gulf of St. Lawrence but its impact on the population is unknown due to insufficient information available on population size.

The harbour porpoise is designated as threatened by COSEWIC (1998). Recent estimates of between 12,000 and 21,000 harbour porpoises have been reported in the Gulf of St. Lawrence population. This Gulf population is likely the one appearing in our survey from Blanc Sablon westwards, near the end of August (Figures 6.10 and 6.11). In fact, 83% of harbour porpoise observations came from this area in August.

7.1.7 Atlantic White-sided Dolphin

The Atlantic white-sided dolphin, a medium-sized cetacean, is one of two species of dolphins found in the cool waters of the North Atlantic ocean. They usually travel in loosely associated groups of 5 to 25 individuals. This dolphin is generally observed in waters of the inner region of the coastal shelf; the distribution is wide-ranging and includes southeastern Newfoundland and southern Labrador. Young dolphins appear to remain with breeding herds till about two years of age, after which they may lead solitary lives or form into loose groups (Sergeant et al. 1980).

The white-sided dolphin feeds primarily on pelagic schooling fish in the upper part of the euphotic zone and the major prey are sand lance, squid, herring and silver hake. Distribution in the spring and summer appears to be related to the availability of prey species and for this reason, the white-sided dolphin is largely confined to areas of the coastal shelf where abundant schooling fish or squid occur (Gaskin 1992b). The distribution of this dolphin has also been related to areas where water temperatures and salinities are low, although this may be coincidental to environmental factors that concentrate preferred prey (Selzer and Payne 1988).

The white-sided dolphin was too infrequently observed during the 1998 surveys to accurately estimate the population size. Estimates on the Gulf of St. Lawrence population range from 500 to 12,000 animals (Kingsley and Reeves 1998).

7.1.8 White-beaked Dolphin

The white-beaked dolphin is also a common dolphin species in the north Atlantic, occurring in closely associated pods. White-beaked dolphins feed on squid, octopus, cod, herring, capelin and sometimes on benthic crustaceans (Leatherwood et al. 1976). It has a more northerly distribution than does the white-sided dolphin, regularly occurring from Davis Strait to Nova Scotia. The white-beaked dolphin is primarily an offshore migratory species, but is most common in water less than 100 m deep (Kingsley and Reeves 1998). The peak southern migration time for this species off the Labrador coast is August and September (Alling and Whitehead 1987). The peak abundance during the 1998 surveys was during August and September, possibly reflecting this southern migration.

7.1.9 Harp Seal

The harp seal is the most abundant of the four seal species found in Atlantic Canada. The northwest Atlantic population of harp seals is usually subdivided into two components: 1) the Newfoundland component, which breeds off northeast Newfoundland and southern Labrador; and 2) the Gulf component, which breeds in the southern, and occasionally the northern, Gulf of St. Lawrence (Lacoste 1997). Harp seals are highly migratory and these two components of the population overlap in their distribution during the non-breeding season while summering in the Canadian Arctic and/or west Greenland. Seals from both areas move southward along the coast of Labrador during the fall or early winter. Upon reaching the Strait of Belle Isle, one component of the population moves into the Gulf of St. Lawrence while the rest of the seals remain off the east coast of Newfoundland (Hammill and Stenson 1997). In the Gulf, harp seals whelp near the Magdalen Islands and in the northern Gulf in late February or early March. Following mating in late March, the seals disperse and move into the northern Gulf to moult in April and May. After moulting, seals begin a northern migration and return to the Arctic for the summer months (Lacoste 1997). Harp seals were not abundant during the 1998 surveys but their numbers would be expected to increase considerably throughout the winter and again in the spring.

The harp seal has been found to be the most important predator in the northern Gulf region, accounting for 68 to 98% of cod, herring and redfish consumed (Hammill and Stenson 1997). Other prey species include capelin, Greenland halibut, squid, euphausiids and small crustacea (Wallace and Lavigne 1992).

7.1.10 Grey Seal

This species is recognized as the second most important consumer of fishes in the northern Gulf of St. Lawrence, the harp seal being the primary consumer. Important prey of the grey seal include cod, herring, capelin, mackerel, redfish and flounder (Beck 1983; Hammill and Stenson 1997).

The breeding season for the grey seal is from mid-December to early February and the two major breeding grounds in Canada are Northumberland Strait and St. George's Bay. Seals leave the breeding grounds by late February and March. There is no well-defined migration pattern or time but some seals do enter the Gulf of St. Lawrence and take up residence along the Quebec north shore (Beck 1983). Grey seals were infrequent during the 1998 surveys in September, October and November.

7.1.11 Temporal Summary of Mammal Distributions

All species became scarcer in later summer and fall. Both survey platforms showed humpback and minke whales decreasing in mid-September. Both these species may be in the area to feed on capelin, which usually peak in the area in late July or August.

The humpback and minke whales appear to leave the area the earliest, followed by porpoise and then white-beaked dolphins. Porpoises are probably year-round feeders, but have such thin blubber that they may be intolerant of low water temperatures. The white-sided and white-beaked dolphins are probably also year-round feeders and are resident in the north Atlantic. However, their principal prey species, mackerel or other pelagic schooling fishes, have limited tolerance for cold water.

The most interesting feature of the data on other species is the small number of sightings of seals. Most of the seals seen were harp seals, and although a few were encountered in August, they were mostly seen late in the program in November and December, possibly early migrants from the Arctic. There were very few sightings of grey or harbour seals.

7.1.12 Spatial Summary of Mammal Distributions

There were frequent sightings of humpback whales in an area north of Pistolet Bay and the northern tip of the Northern Peninsula, roughly the south-eastern halves of transects 3–6 (See Figure 5.1). A few minke whales were also sighted in this area. Apart from this area, there were few sightings of any marine mammals anywhere east of transect 14. The sea state on average was worse in the eastern part of the study area, which may have contributed to this observed distribution pattern either by reducing visibility of those animals that were in this area, or by inducing smaller species to favour calmer waters. However, it seemed that this trend was also confirmed within the boat-survey study area, where more observations tended to occur on the more south-westerly transects.

There appears to be an area of concentration of marine mammals in the north-eastern Gulf and extending into the Belle Isle Strait narrows as far as about transect 17 or 16. The aerial survey results showed a consistent pattern of sightings for humpback whales, minke whales and porpoises, all of which seemed to be associated with water 200 m deep or deeper in the extreme north-eastern Gulf. There were relatively few sightings south of the 200-m isobath on transects 19–26.

Within the survey area covered by boat and aerial surveys (Transects 14-18), sightings seemed to be more concentrated on the Labrador side. It is not known if this may be due to calmer waters on the Labrador side of the Straits as the sea state data were ordinarily summarized by transect. This area appeared highly productive in that flocks of many species were observed feeding and there was fishing activity in the area throughout the summer and fall.

7.2 Seabirds

Seabird populations are highly variable, both temporally and spatially. The Strait of Belle Isle and surrounding area is used for breeding, feeding and migration by many species throughout the year. Species abundance and composition is affected not only by season, but also by local weather conditions. Storm events can create upwellings that bring benthic prey to the surface, and can create ideal feeding conditions for several days. Prevailing winds also influence the distribution of pelagic species. These variables affect seabird distribution and abundance in the Strait of Belle Isle. Seabird distribution in the study area for each survey are presented in Figure 7.1a-d.

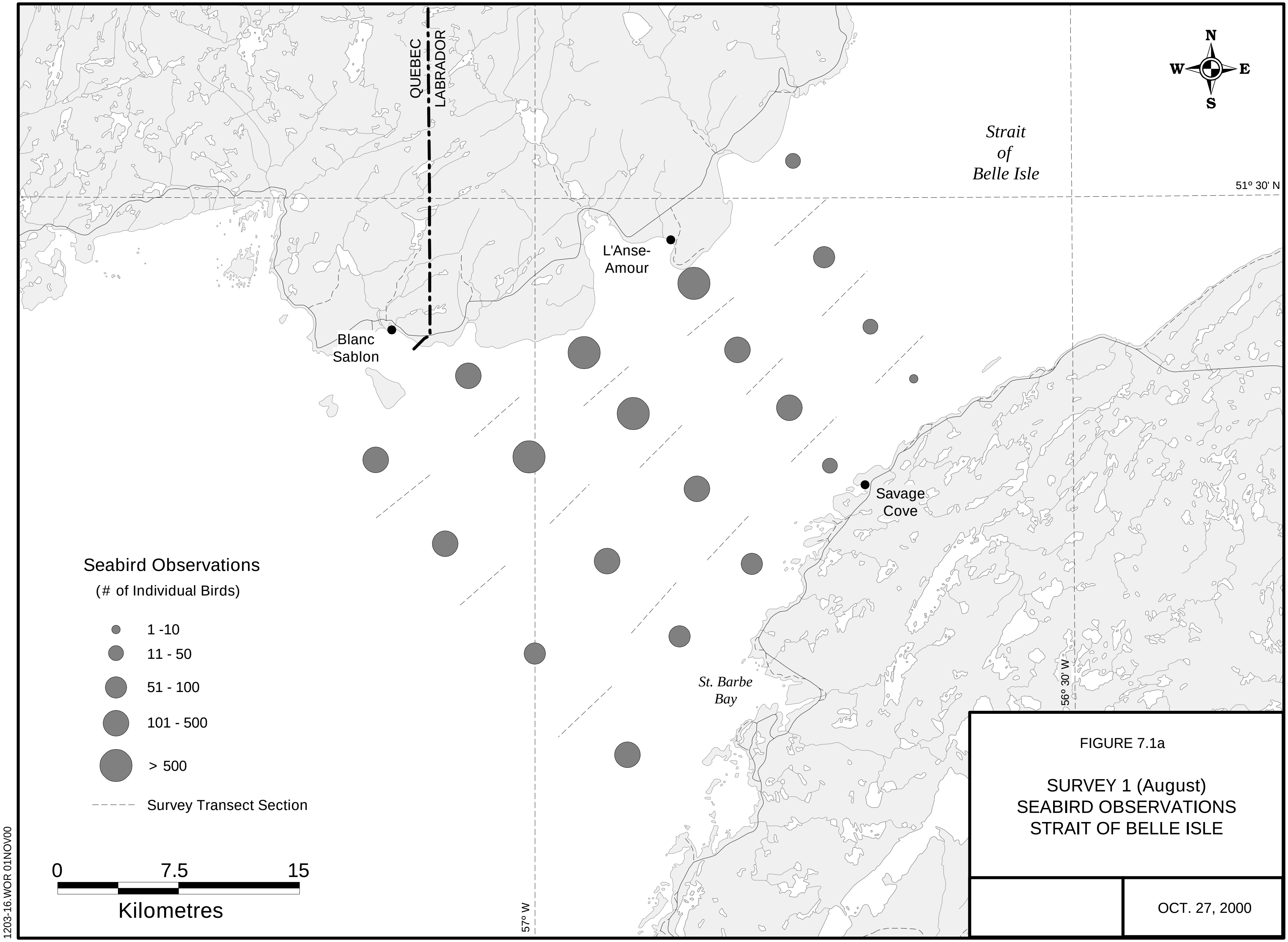

FIGURE 7.1a

SURVEY 1 (August)
SEABIRD OBSERVATIONS
STRAIT OF BELLE ISLE

OCT. 27, 2000

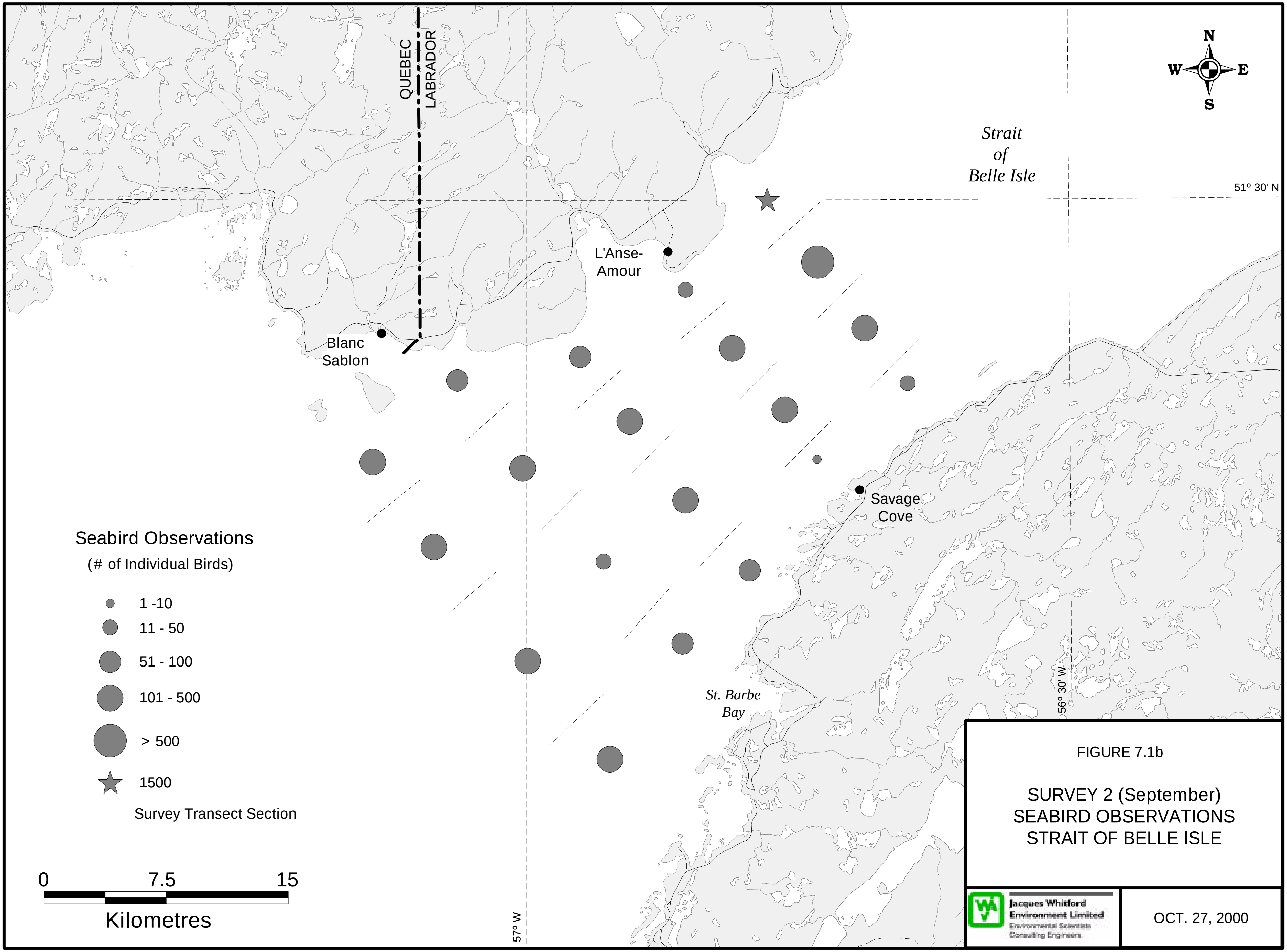

FIGURE 7.1b

SURVEY 2 (September)
SEABIRD OBSERVATIONS
STRAIT OF BELLE ISLE

1203-18.WOR 01NOV00

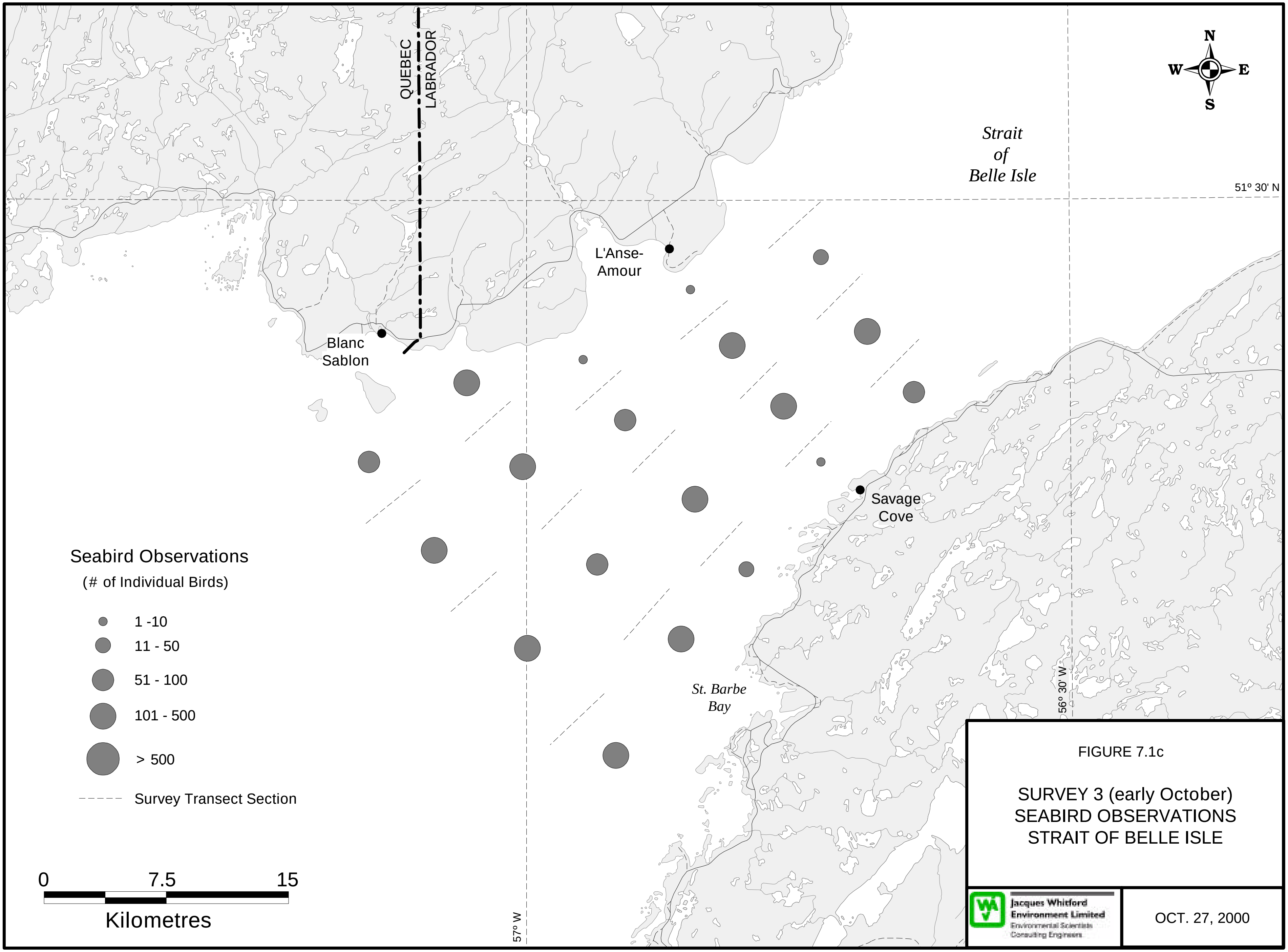

FIGURE 7.1c

SURVEY 3 (early October)
SEABIRD OBSERVATIONS
STRAIT OF BELLE ISLE

1203-17.WOR 01NOV00

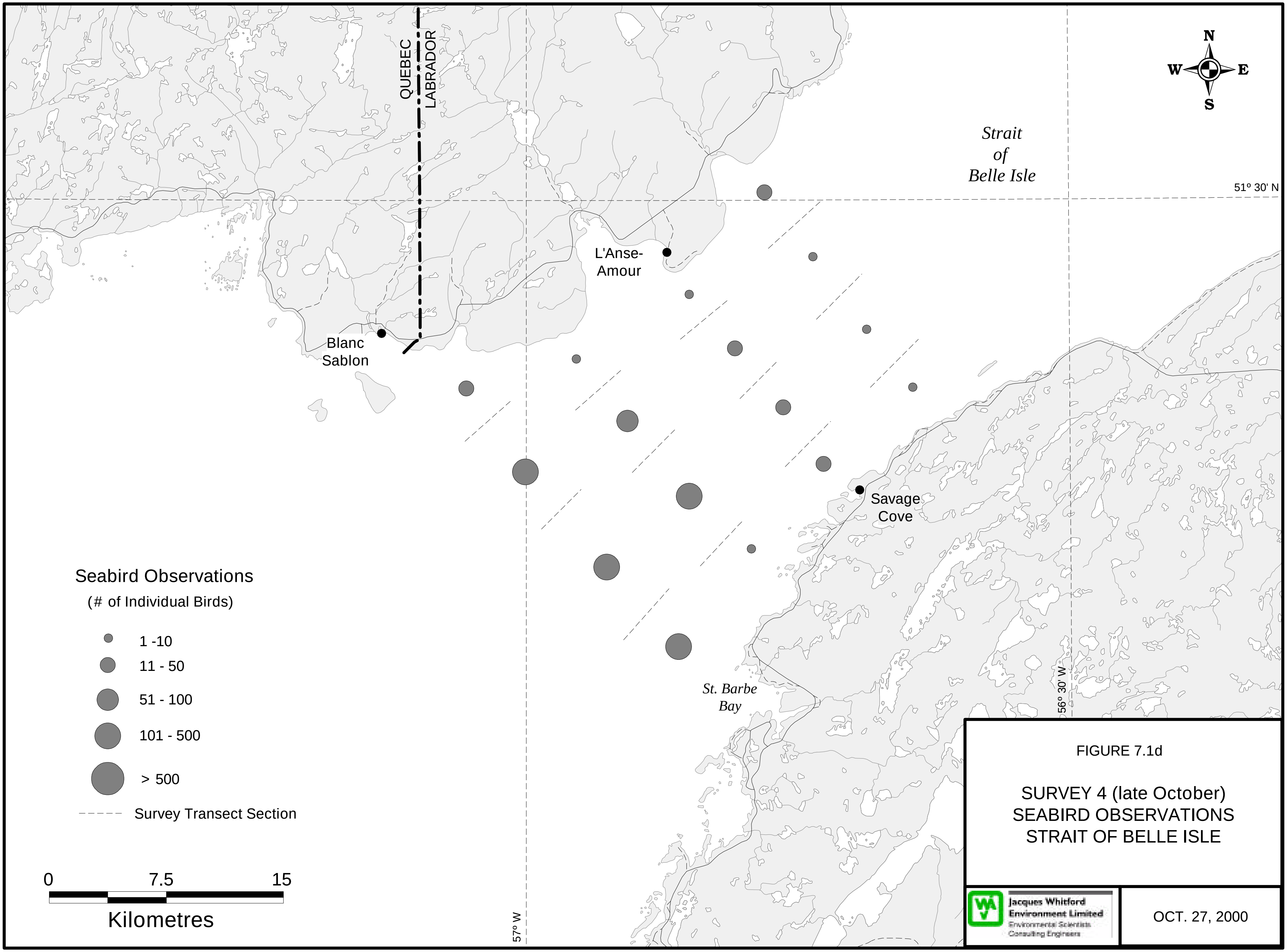

FIGURE 7.1d

SURVEY 4 (late October)
SEABIRD OBSERVATIONS
STRAIT OF BELLE ISLE

1203-19.WOR 01NOV00

7.2.1 Temporal Distribution

The August survey was predominated by locally breeding species: Atlantic Puffin; Herring Gull; Black-legged Kittiwake; and Greater Black-backed Gull. These species, with the exception of Black-legged Kittiwake, all breed in the Brador Bay Seabird Sanctuary, near Blanc Sablon. (G. Chapdelaine, pers. comm.). The Brador Bay Seabird Sanctuary is particularly important for its Atlantic Puffin colony. In late August, this species would still be nesting and rearing young. Other breeding species would have fledged young, and be starting to disperse. All of these species breed in other locations along the Quebec North Shore, and would likely feed in the Strait of Belle Isle. Sooty Shearwater, the most abundant species during the August survey, is the only one that does not breed in the area. It breeds in the southern hemisphere during the North American winter. It is highly pelagic and common in the north Atlantic from June to October. It is common in the Strait of Belle Isle from June to September, and less common in October. It was seen on all but the last survey in August. Sooty Shearwaters seen in the August survey were noted to be flying predominantly east, or feeding in riptides. The distribution of this species is greatly influenced by prevailing or storm winds. It is likely that the large numbers seen on this survey were due to strong westerly winds preceding the survey.

The September survey was dominated by post-breeding Black-legged Kittiwakes that congregated in the Strait of Belle Isle to feed. This would be expected, as they are commonly found feeding and migrating through the Strait of Belle Isle, often congregating where strong tides bring food items to the surface. Kittiwakes are numerous year-round at sea off the Newfoundland and Labrador coast in ice-free conditions (Brown et al. 1975).

Although Northern Fulmars were present in all surveys, they were particularly numerous during the September survey. Fulmars breed in small numbers along southern Labrador. Like Sooty Shearwaters, Fulmars are pelagic, feed primarily on zooplankton, and their distribution is influenced greatly by local weather conditions. The large numbers likely reflect a local weather event.

There was a clear shift in the dominant species in the October surveys. New species have emerged in large numbers, and species that were previously present in small numbers, increased. This represents a shift from the predominance of breeding populations to migrating populations from other breeding grounds.

Dovekies were not present at all in the first two surveys, but were among the most abundant species in the two October surveys. The Dovekies breed in Greenland west to Spitsbergen. A small population breeds in Canada in eastern Baffin Island (Nettleship and Birkhead 1985). With an estimated 12,000,000 pairs, mostly in the Thule region of Greenland, it is the most numerous alcid and possibly the most numerous seabird in the Atlantic Ocean. It winters from the low Arctic south to the Scotian Shelf and Gulf of Maine (Nettleship and Birkhead 1985). They occur in the Strait of Belle Isle as a migrant, remaining until extensive ice coverage forces them farther south.

Razorbills breed at the Brador Bay Seabird Sanctuary, and in other areas of the Quebec North Shore (G. Chapdelaine, pers. comm.), and are present on all surveys in small numbers. However, they are present in large numbers in the final October survey. Large numbers breed at St. Mary’s Island in the Gulf of St. Lawrence. Many of the breeders migrate through the Strait of Belle Isle en route to wintering grounds in the Bay of Fundy and coastal Massachusetts.

Another large colony of Razorbills is located on the Gannet Island, located northeast of Cartwright, Labrador. Migratory birds from this population could also be using the Strait of Belle Isle as a migratory corridor to winter feeding areas.

Common Eider numbers also increase dramatically in the late October survey. Large numbers breed on the coast of Labrador. Many northern breeding eiders migrate in the autumn to the southern limit of the breeding range. It is a common autumn migrant in the Strait of Belle Isle, from October to December.

7.2.2 Spatial Distribution

During the August survey, when breeding species predominate, the greatest concentrations of seabirds occur near the Labrador coast, between L'anse Amour and Blanc Sablon. When raising young, there is a great deal of effort exerted in food procurement for raising young. For this reason, it is likely that the area where the birds are concentrating is an area of high productivity. Possible oceanographic features that would contribute to these conditions are discussed in Section 4.3.

The September and early October surveys show no clear pattern in seabird distribution. This time period includes late puffin breeding activity, migration into the area by some species, as well as short-term influxes of pelagic species from weather events. Feeding is not the primary reason for being in the area for some species. Since several species are present in the Strait of Belle Isle at the same time, but for different reasons, it is not surprising that no clear pattern of distribution emerges.

The late October survey indicates a pattern of distribution, with numbers decreasing away from the Gulf of St. Lawrence end of the Strait. The reason for this pattern is not clear.

7.3 Conclusion

The objectives of the marine mammal and seabird survey in the Strait of Belle Isle were met in that:

1) the relative abundance and distribution of species present during the ice-free season in 1998 was identified;
2) a literature/data review of previous mammal sightings was documented; and
3) a literature search on the effects of underwater construction noise on marine mammals was conducted and summarized.

The data collected and summarized during this survey can therefore contribute to the baseline data requirements of an environmental assessment and future follow-up monitoring, if required.

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APPENDIX A

Data Sheets

AERIAL SURVEY OBSERVATION SHEET

Marine Mammal Survey in the Strait of Belle Isle
JWEL Project 1203

DATE	TRANSECT NO.	OBSERVER	RIGHT/LEFT
START TIME	END TIME	ALTITUDE	
START POSITION	END POSITION	HEADING 320^o; 140^o	

WAY POINT	OBS. TIME	SPECIES	COUNT	OBS. ANGLE	CONDITIONS (IE. WIND, GLARE, SEA STATE)

BOAT-BASED SURVEY OBSERVATION SHEET

Marine Mammal Survey in the Strait of Belle Isle **WIND DIRECTION/SPEED:**

JWEL Project 1203 **BEAUFORT SCALE:** **VISIBILITY:** **SKY:**

DATE	TRANSECT NO.	OBSERVER	RIGHT/LEFT

START TIME	END TIME	ALTITUDE
START POSITION	END POSITION	HEADING 320°; 140°

WAY POINT	SIGHTING BOARD	OBS. TIME	OBS. ANGLE	SPECIES (ad/juv.)	COUNT	COMMENTS

Page ____/____

Straits of Belle Isle Seabirds

Newfoundland and Labrador Hydro - 1203-1531

Date:_________________ **Transect #**:_______ **Bearing**:_______ **Ship Speed** (*knots*) _______

	START	END
Position	N51° . ´,W ° . ´	N51° . ´,W ° . ´
Way Point #		
Time		
Visibility		
Weather	*Sky* *Wind (knots)* *Temp (°C)*	*Sky* *Wind (knots)* *Temp (°C)*
Observer: **Bruce Mactavish**		

Date:______/______/ 98______ Transect: ________________ Bearing: ___________

Start Position: N 51° . ´, W ° . ´			Way Point #:
Species	Number	Comments	

Start Position: N 51° . ´, W ° . ´			Way Point #:
Species	Number	Comments	

APPENDIX B

Historical Data References

Historical Data References

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