AMENDMENT OF ENVIRONMENTAL ASSESSMENT OF EXPLORATION SEISMIC SURVEYS FOR EXPLORATION LICENCES 1097, 1098, 1103, AND 1104 WESTERN NEWFOUNDLAND

Prepared For:

Canada-Newfoundland and Labrador Offshore Petroleum Board on behalf of Geophysical Service Inc.

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1.0 INTRODUCTION

This report is an amendment to the environmental assessment (EA) report originally prepared for NWest Energy Inc. (CRA March 2008) in response to a schedule change by the current Operator, Geophysical Service Incorporated (GSI).

The project schedule for the original EA covered the months of April to December. Since submission of the EA report, the spatial and temporal boundaries were modified. Environmental assessment of the spatial changes was addressed in a separate document submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). The survey has been extended to February; therefore, this amendment addresses effects of the Project in January and February.

This amendment addresses sections in the original EA report and the Addendum (CRA July 2008) Report which are affected by the change in temporal boundaries.

1.1 Project Description Changes

GSI proposed to undertake an exploration seismic 2-D and 3-D seismic survey program on NWest's landholdings on the west coast of Newfoundland and Labrador commencing in the third quarter of 2008. There was also the potential for 2-D surveys on the licenses and geohazard surveys in areas of interest. Due to vessel availability that incurred significant schedule delay, GSI will be using a single-streamer vessel, the MV GSI Pacific, instead of a multi-streamer vessel and will be undertaking a 2-D seismic survey program only. The marine seismic air source array has been changed to a volume of 2940 cubic inches from 2620 cubic inches; however, the sound pressure emitted is the same. The program will take 90days to complete.

The survey program changed spatially from a single survey area to three areas. This change in spatial boundary was addressed by GSI to the C-NLOPB. The Project Area was not changed as a result of that Project modification.

2.0 PROJECT DESCRIPTION

2.1 Project Temporal Boundaries

The temporal boundary of the environmental impact assessment (EIA) is eight years, *i.e.*, it assesses potential impacts that could result from the Project occurring between 2008 and 2015. The EIA report assessed potential effects of geophysical operations from May to December. This assessment remains for 2009 to 2015, but the first survey beginning in 2008 has been extended to February 2009. Beyond the first survey, now scheduled for October 2008 to February 2009, subsequent surveys will be determined annually in consultation with stakeholders. The first survey will be completed in 90 days, and is currently underway.

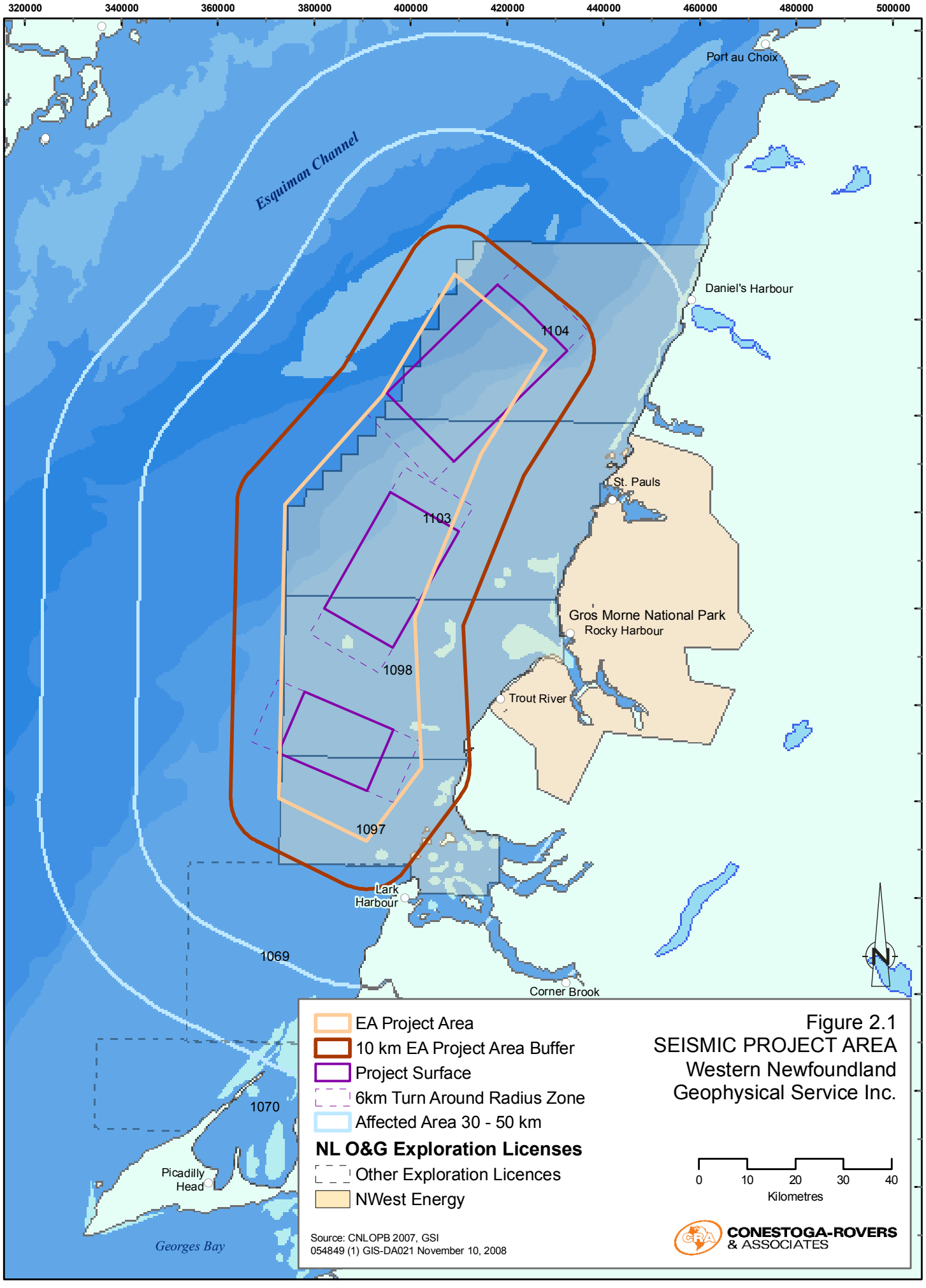
2.2 Project Spatial Boundaries

GSI has modified portions of its 2008 marine seismic survey program. Table 2.1 shows the corner coordinates of the proposed amendments to the survey areas, which are shown in Figure 2.1.

Table 2.1: Corner Coordinates of Revised Survey Area

North Block		**Centre Block**		**South Block**	
UTM E Z21	**UTM N Z21**	**UTM E Z21**	**UTM N Z21**	**UTM E Z21**	**UTM N Z21**
NAD 83	**NAD 83**	**NAD 83**	**NAD 83**	**NAD 83**	**NAD 83**
417992	5567182	395777	5524190	377978	5482871
432428	5553545	410030	5516082	396380	5474876
408917	5530575	396322	5491947	390930	5462208
395008	5544792	382044	5500106	372570	5470149

The spatial boundaries of the modified survey area are shown in Figure 2.1 with the boundaries of the Project Area, Affected Area and the Regional Area.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Esquiman Channel
Port au Choix
Daniel's Harbour
1104
St. Pauls
1103
Gros Morne National Park
Rocky Harbour
1098
Trout River
1097
Lark Harbour
1069
Corner Brook
1070
Picadilly Head
Georges Bay
N
EA Project Area
10 km EA Project Area Buffer
Project Surface
6km Turn Around Radius Zone
Affected Area 30 - 50 km
NL O&G Exploration Licenses
Other Exploration Licences
NWest Energy
Source: CNLOPB 2007, GSI
054849 (1) GIS-DA021 November 10, 2008
Figure 2.1
SEISMIC PROJECT AREA
Western Newfoundland
Geophysical Service Inc.
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES

3.0 ALTERNATIVE TO THE PROJECT & ALTERNATIVES FOR THE PROJECT

There are no changes to this section.

4.0 ENVIRONMENTAL ASSESSMENT METHODLOGY

4.1 Boundaries

Boundaries provide a meaningful and manageable focus for an environmental assessment. They also aid in determining the most effective use of available study resources. Boundaries are described generally below, and in further detail as part of the effects analysis sections for each of the VECs.

4.1.1 Temporal Boundaries

This amendment to the EIA report assesses potential effects of geophysical operations in January and February. The 2-D surveys will take 90 days to complete. Beyond the first survey scheduled for October 2008, subsequent surveys will be determined annually in consultation with stakeholders.

Temporal ecological boundaries consider the relevant characteristics of environmental components or populations, including the natural variation of a population or ecological component, response and recovery times to effects, and any sensitive or critical periods of a VEC's life cycle (*e.g.*, spawning, migration), where applicable.

4.2 Cumulative Effects

With freeze up approaching, January and February will likely see a considerable reduction in shipping through the Project Area. No information is available from Transport Canada to describe shipping frequencies.

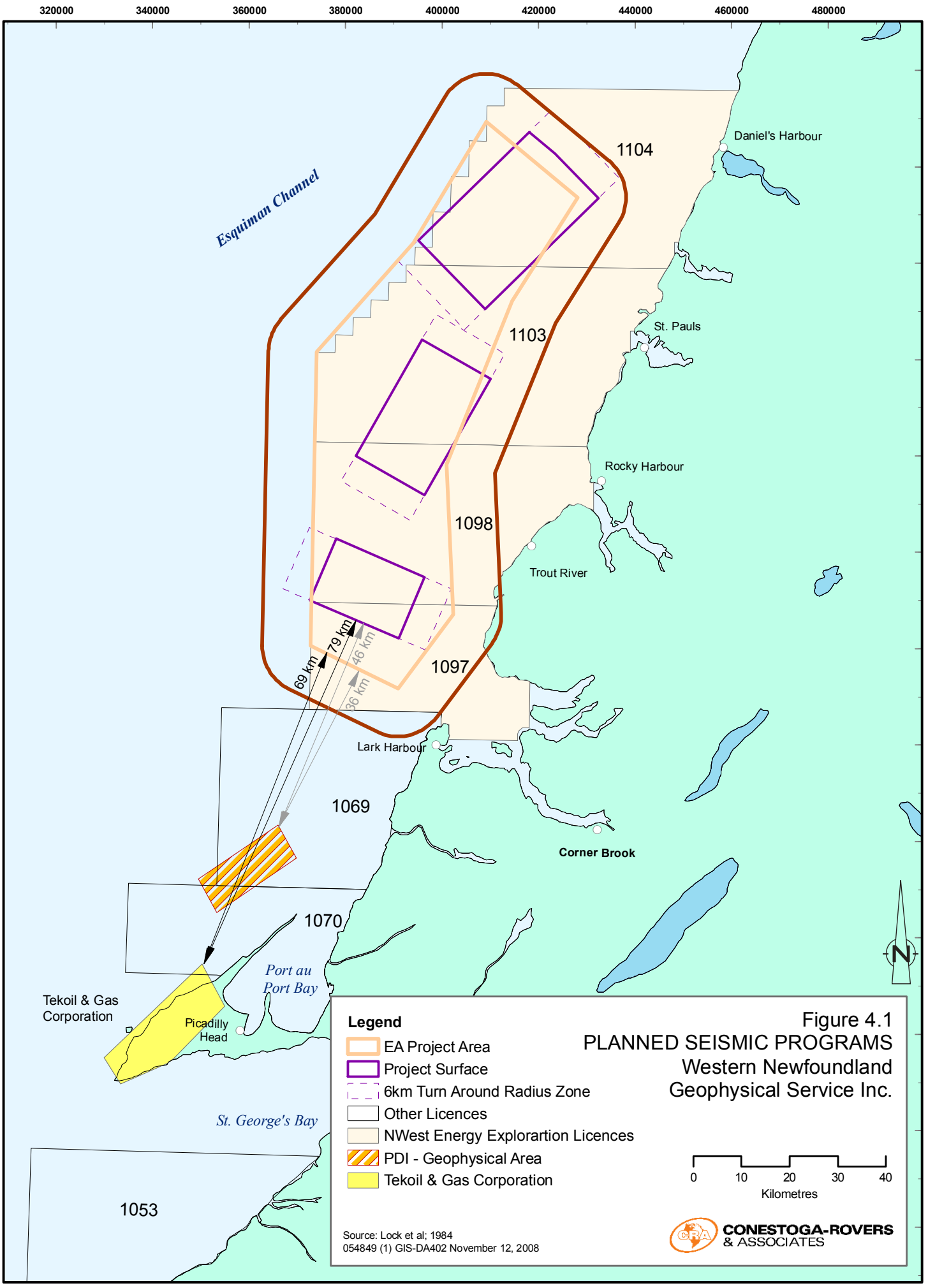
Fish harvesting is not pursued in January and February. Government research vessels are not in the Project Area in January or February.

There are two C-NLOPB approved seismic exploration projects in the Port au Port area. These two surveys are in the same location and are now 70 km south of the most southern boundary of the Project Area and 46 km from the southern boundary of the south block of the seismic survey area (Figure 4.1).

PDI Production Inc. (PDI) submitted a screening level EA as defined by the *Canadian Environmental Assessment Act* (*CEAA*) for a multiyear (2009-2014) ocean bottom cable (OBC) seismic/vertical seismic profiling (VSP) program proposed for marine areas near

the Port-au-Port Peninsula, Newfoundland and Labrador. Initially, PDI was planning a 3-D seismic survey over the Garden Hill South (GHS) area and a 2-D seismic survey over the Shoal Point area. Both proposed marine seismic operations will tie into land-based seismic components on the Port-au-Port Peninsula.

Tekoil and Gas Corp. stated in their EA that they were to commence their seismic survey from October 2008 to April 2009.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Daniel's Harbour
St. Pauls
Rocky Harbour
Trout River
Lark Harbour
Corner Brook
69 km
79 km
46 km
36 km
Port au Port Bay
St. George's Bay
Tekoil & Gas Corporation
Picadilly Head
N
Legend
EA Project Area
Project Surface
6km Turn Around Radius Zone
Other Licences
NWest Energy Explorartion Licences
PDI - Geophysical Area
Tekoil & Gas Corporation
Source: Lock et al; 1984
054849 (1) GIS-DA402 November 12, 2008
Figure 4.1
PLANNED SEISMIC PROGRAMS
Western Newfoundland
Geophysical Service Inc.
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS & ASSOCIATES

5.0 ENVIRONMENTAL BASELINE

5.1 Marine Physical Setting

5.1.1 Chemical and Physical Oceanography Setting

5.1.1.1 Ice

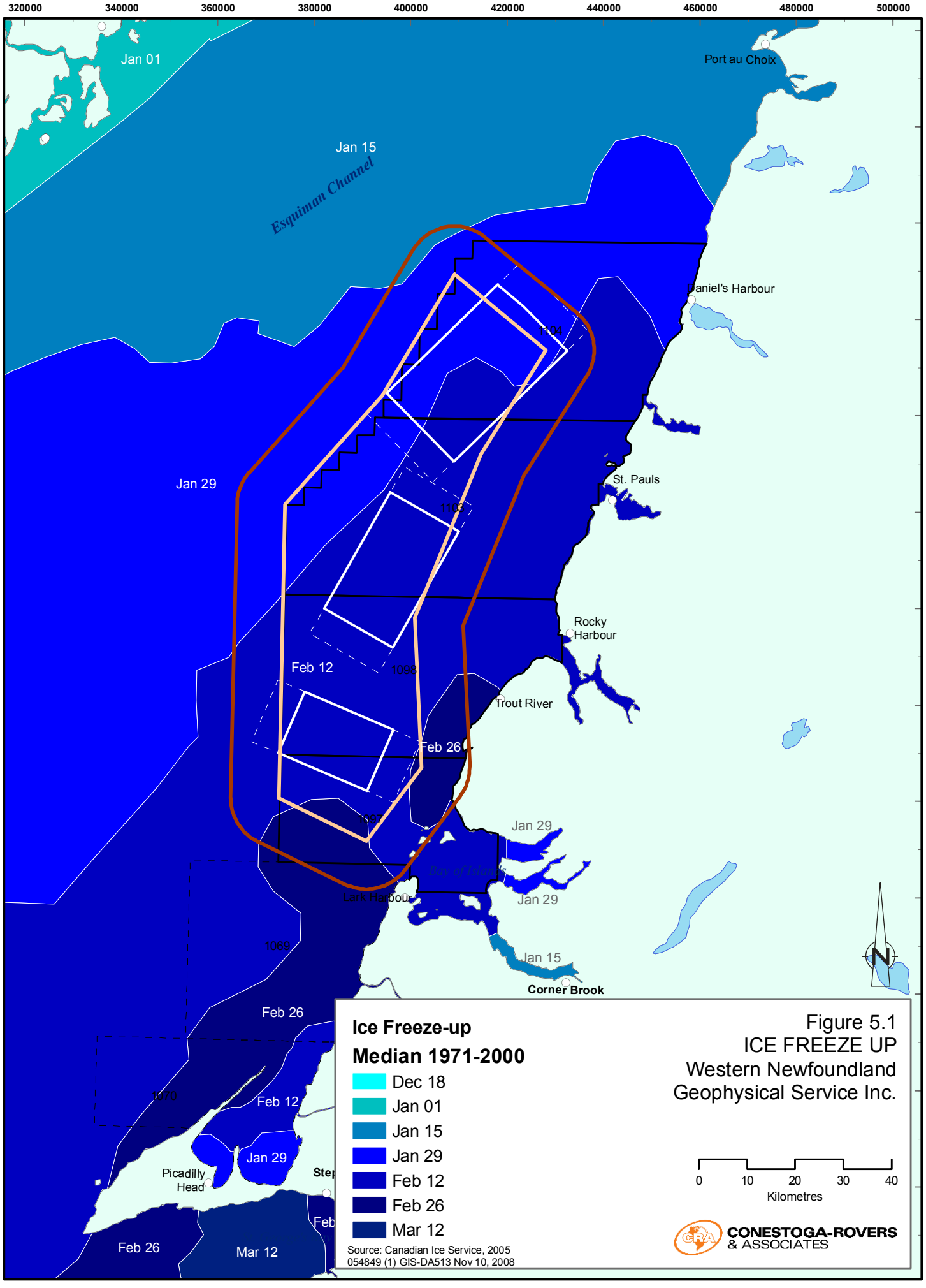
Floating ice is present in two forms in the marine environment: sea ice and icebergs. Both types pose a potential hazard to vessels. Seismic surveys conducted in this area between January 1 and April 30 have the potential of encountering ice.
Ice comes from three sources:

- Labrador ice from the north drifting through the Strait of Belle Isle;
- Ice from the St. Lawrence River and Estuary; and
- Ice formed in the Gulf of St. Lawrence.

The severity of ice varies relatively, depending on the strength and the vector of direction of the wind and the coldness from the air. Over the Gulf, the greatest average ice thickness is 16 cm in February and can vary up to one metre in the Esquiman Channel. In a common year, sea ice enters the Strait of Belle Isle by the start of January. The ice edge usually reaches Notre Dame Bay by the end of the month and Cape Freels in the middle of February. The ice edge is at its maximum southern extent by mid March, and fills the several bays and coves. By April, the rate of melting overtakes the southward ice drift and the pack slowly recedes. Usually by mid-April, navigation via the Strait of Belle Isle is possible, though in extreme years, ice can linger south of Belle Isle after Canada Day.

The freeze-up times discussed herein are based on a 30 year median, 1971 to 2000 (Figure 5.1). A review of weekly ice data for January and February 1970 through 2007 has shown that ice generally makes its first appearance in the northernmost portion of the Project Area by the middle of January. By the end of January, the most northerly and westerly third of the Project Area is ice covered. Usually by February 12, the majority of the Project Area, with the exception of some small near shore areas in the south, is ice-covered. The entire Project Area is generally ice covered by the end of February (Environment Canada 2005).

The ice concentration is the ratio expressed in tenths describing the area of the water surface covered by ice as a fraction of the whole area. Based on the 30-year median, there is generally less than 1/10 ice concentration in the Project Area on January 29. By February 6, the Project Area varies from 4-6/10 ice concentration in nearshore waters to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Jan 01
Port au Choix
Jan 15
Esquiman Channel
Daniel's Harbour
1104
Jan 29
St. Pauls
1103
Rocky Harbour
Feb 12
1098
Trout River
Feb 26
1097
Jan 29
Bay of Islands
Lark Harbour
Jan 29
1069
Jan 15
Corner Brook
Feb 26
1070
Feb 12
Jan 29
Picadilly Head
Feb 26
Mar 12
Ice Freeze-up
Median 1971-2000
Dec 18
Jan 01
Jan 15
Jan 29
Feb 12
Feb 26
Mar 12
Source: Canadian Ice Service, 2005
054849 (1) GIS-DA513 Nov 10, 2008
Figure 5.1
ICE FREEZE UP
Western Newfoundland
Geophysical Service Inc.
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES

over 9/10 ice concentration in deeper waters. In late February, the Project Area is 10/10 ice concentration, based on the 30-year median.

Ice coverage in the Gulf of Saint Lawrence as a whole was lower than average in the 2005-2006 season, and considerably lower than average in the 2006-2007 season (Environment Canada 2006, 2007). (Data are not yet available for the 2007-2008 season). It is possible a similar situation may occur in the 2008-2009 season. Environment Canada's annual report entitled *Seasonal Outlook for Gulf of St. Lawrence and East Newfoundland Waters* for the 2008-2009 season should be available in early December 2008 and will provide further details on predicted ice coverage in the Project Area during the proposed survey timeframe.

Most icebergs enter the coastal and offshore waters of eastern Newfoundland. During late winter and early spring icebergs may occasionally enter the Gulf of St. Lawrence through old ice floes entering the Gulf from the Labrador Sea. About 10% enter the Strait of Belle Isle and drift into the Gulf of St. Lawrence towards Anticosti Island (Woodworth-Lynas *et al*. 1992).

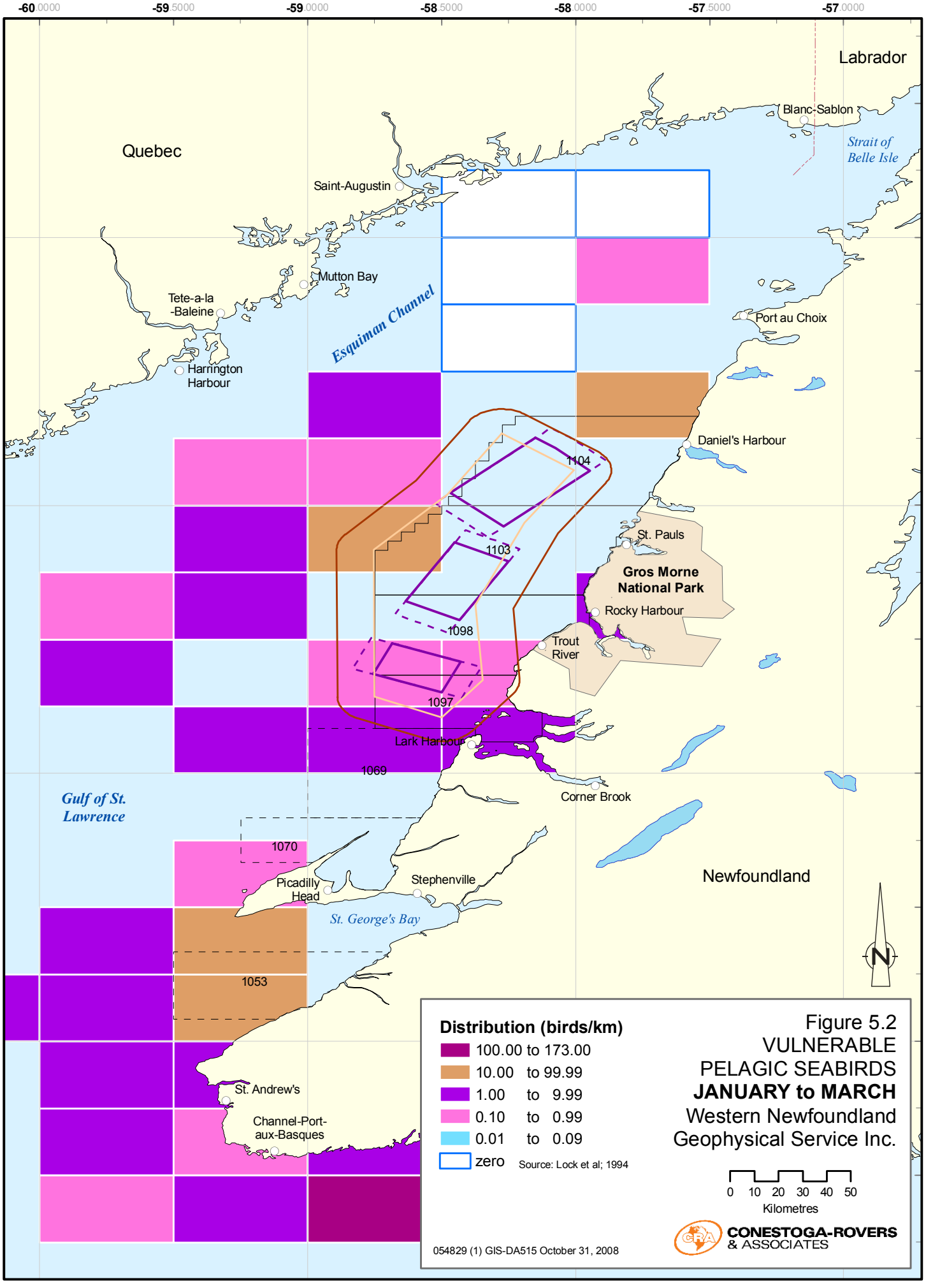
5.2 Marine Resources

5.2.1 Marine and Migratory Birds

Figure 5.2 shows the distribution of vulnerable pelagic seabirds over the year. The period between January and March is zero to moderate in vulnerability to oil pollution (in terms of concentrations) for seabirds in the Affected Area. Most of the Project Area shows that no seabird surveys were undertaken and that may have been due to ice conditions. The highest abundance of seabirds, less than one bird per kilometre, occurs between January and March in the southern part of the Affected Area, particularly in the vicinity of EL 1097. An area of between 10 and 100 birds/km were present on the periphery of ELs 1103 and 1104 during this same period.

5.2.2 Marine Fish and Shellfish

Information on fish and shellfish is the same as provided in the original EA report. Based on the Strategic Environmental Assessment for Western Newfoundland and Labrador Offshore Area (LGL Ltd. 2005), halibut are the only fish spawning in the winter in the Gulf of St. Lawrence.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Labrador
Quebec
Blanc-Sablon
Strait of Belle Isle
Saint-Augustin
Mutton Bay
Tete-a-la -Baleine
Esquiman Channel
Harrington Harbour
Port au Choix
Daniel's Harbour
1104
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St. Pauls
Gros Morne National Park
Rocky Harbour
1098
Trout River
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Lark Harbour
1069
Corner Brook
Gulf of St. Lawrence
1070
Picadilly Head
Stephenville
St. George's Bay
Newfoundland
1053
St. Andrew's
Channel-Port-aux-Basques
N
Distribution (birds/km)
100.00 to 173.00
10.00 to 99.99
1.00 to 9.99
0.10 to 0.99
0.01 to 0.09
zero
Source: Lock et al; 1994
Figure 5.2
VULNERABLE
PELAGIC SEABIRDS
JANUARY to MARCH
Western Newfoundland
Geophysical Service Inc.
0 10 20 30 40 50
Kilometres
CONESTOGA-ROVERS & ASSOCIATES
054829 (1) GIS-DA515 October 31, 2008

Greenland halibut (turbot) (*Reinhardtius hippoglossoides*) is a deepwater flatfish species that occurs in water temperatures ranging between –0.5 to 6.0°C but appears to have a preference for temperatures of 0 to 4.5°C. In the northwest Atlantic off northeastern Newfoundland and southern Labrador, these fish are normally caught at depths exceeding 450 m. Reported depths of capture range from 90 to 1,600 m.

These halibut are believed to spawn in Davis Strait during the winter and early spring at depths ranging from 650 to 1,000 m. They are also thought to spawn in the Laurentian Channel and the Gulf of St. Lawrence during the winter. The large fertilized eggs of this species (4 to 5 mm diameter) are benthic but the hatched young move upwards in the water column and remain at about 30 m below surface until they attain an approximate length of 70 mm. As they grow, the young fish move downward in the water column and are transported by the currents in the Davis Strait southward to the continental shelf and slopes of Labrador and Newfoundland (Scott and Scott 1988).

Atlantic halibut (*Hippoglossus hippoglossus*) in the northern Gulf of St. Lawrence are most abundant in the Esquiman, Laurentian and Anticosti Channels at depths >200 m. Based on observations made during scientific trawl surveys, these halibut are able to spawn in January and May (timing of surveys). Tagging studies have indicated that Atlantic halibut of this stock do not move far from their home range (DFO 2005). Most of the Atlantic halibut caught within the Study Area and landed at Newfoundland ports in 2004 were taken in the offshore areas of 4Rb, primarily beyond the 200 m isobath.

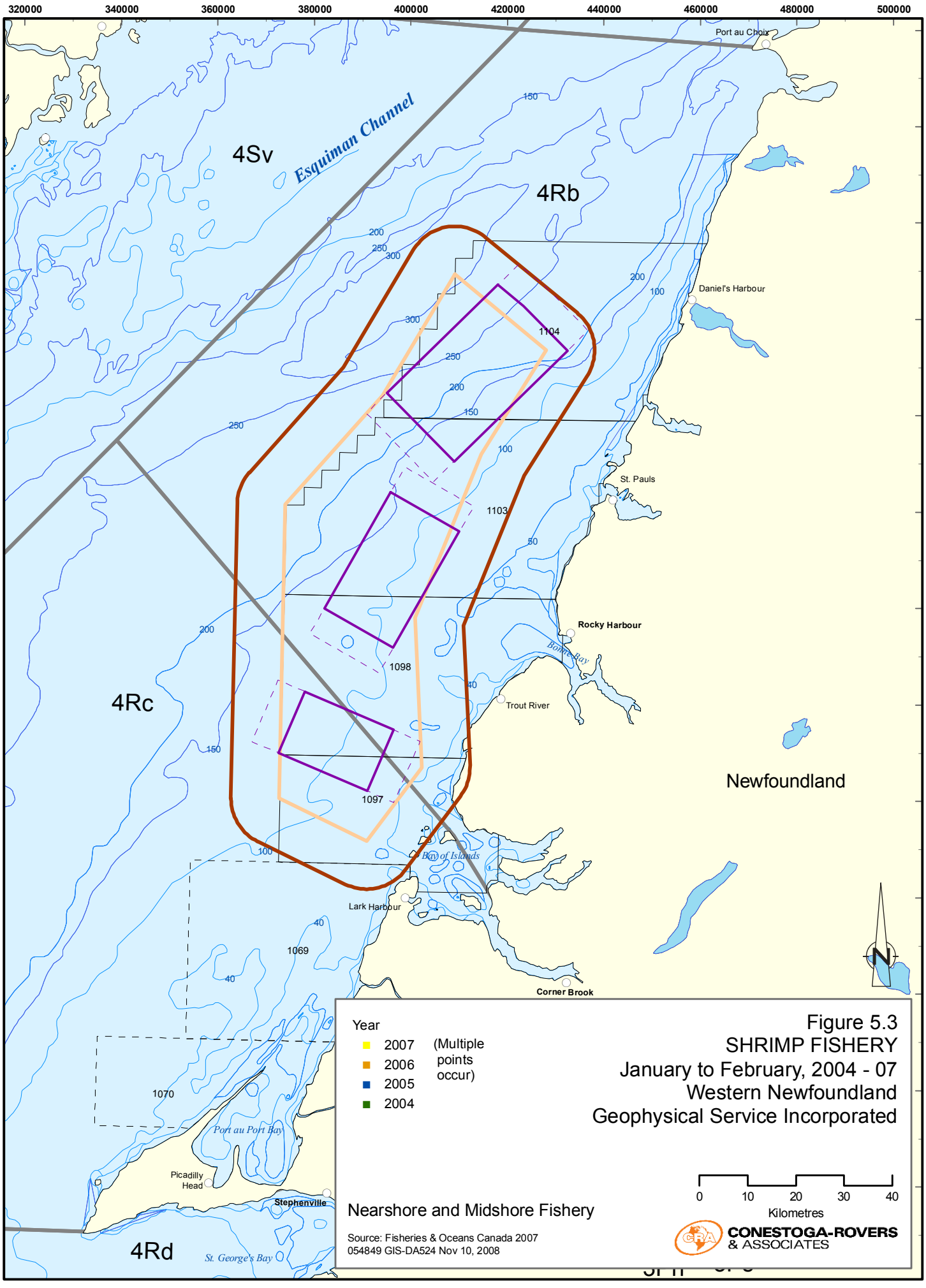
5.3 Other Ocean Users

5.3.1 Commercial Fisheries

Project Area Fisheries (4Rb, c)

Table 5.6 of the original EA showed the landed weight of domestic harvest within NAFO UA 4Rb, c within the entire Project Area and within the single Survey Area. Based on the Fisheries and Oceans Canada database, there were no landed catches in January and February 2004 to 2007 within the three new Survey Areas or within the Project Area (including the 10 km buffer).

Figure 5.3 shows shrimp fishing areas from January to February from 2004 to 2007. No shrimp fishing occurred in the Project Area during these months.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Daniel's Harbour
St. Pauls
Rocky Harbour
Bonne Bay
Trout River
Newfoundland
Bay of Islands
Lark Harbour
Corner Brook
Port au Port Bay
Picadilly Head
Stephenville
St. George's Bay
1104
1103
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150
200
250
300
100
50
40
Year
2007
2006
2005
2004
(Multiple points occur)
Figure 5.3
SHRIMP FISHERY
January to February, 2004 - 07
Western Newfoundland
Geophysical Service Incorporated
Nearshore and Midshore Fishery
Source: Fisheries & Oceans Canada 2007
054849 GIS-DA524 Nov 10, 2008
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES

There was no snow crab harvest during January to February from 2004 to 2007 in the Project Area (Figure 5.4).

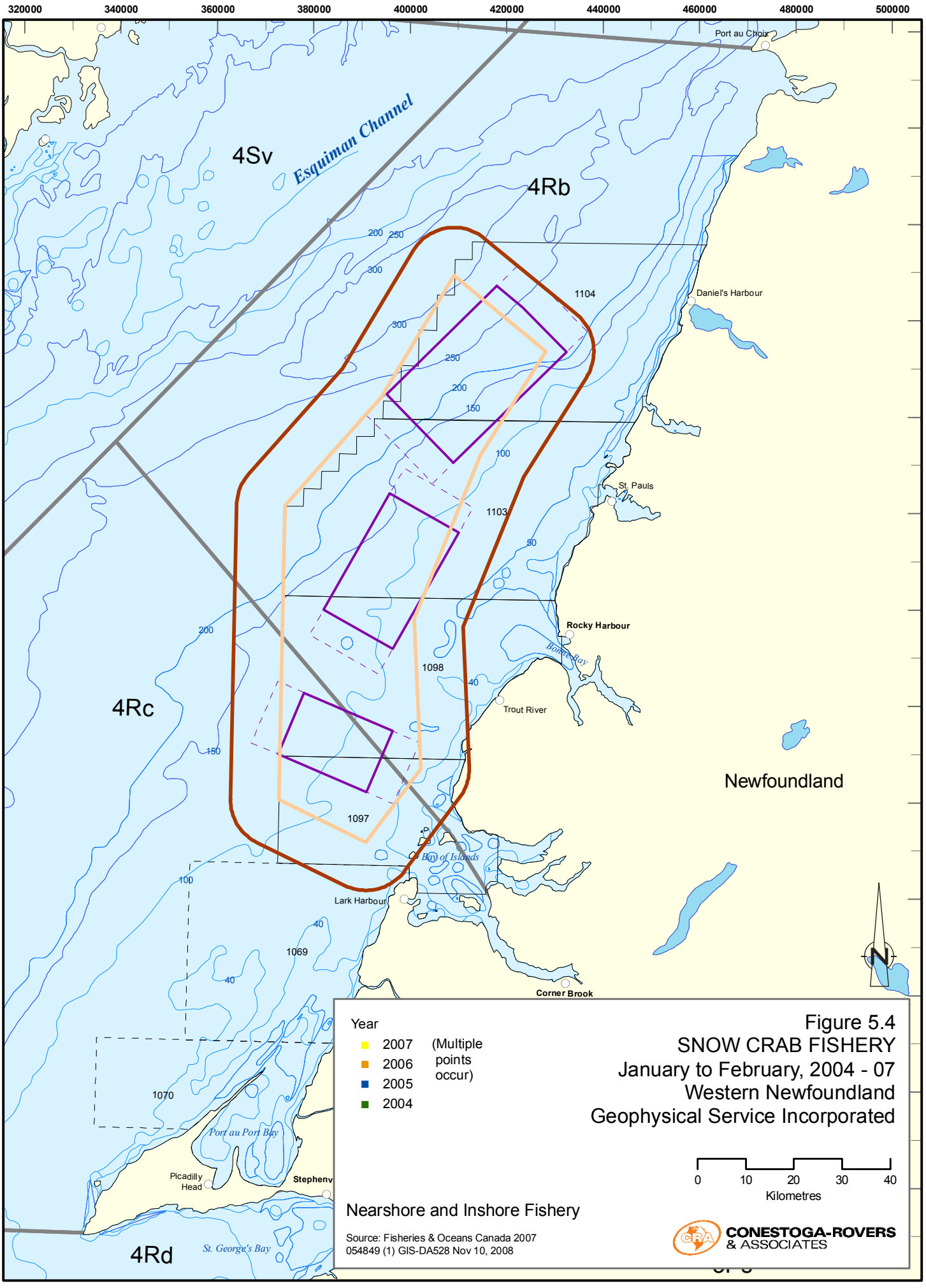
Figures 5.5 and 5.6 show a lack of seine fishing for mackerel, herring or capelin during January and February from 2004 to 2007. Seine fishing did not occur in the Project Area during these months.

Gillnet fishing for plaice, cod, halibut, redfish, skate or turbot was not undertaken in the Project Area between January and February from 2004 to 2007 (Figure 5.7).

There was no longline fishery in the Project Area during January and February from 2004 to 2007 (Figure 5.8).

5.3.2 Research Vessel Surveys

Figure 5.9 shows the locations of DFO research vessel surveys conducted in January and February, based on the DFO databases. Discussions with DFO representatives stated that the majority of stock surveys are undertaken in the summer months. None of the research surveys are within the Project Area over those winter months.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Year
2007
2006
2005
2004
(Multiple points occur)
Figure 5.4
SNOW CRAB FISHERY
January to February, 2004 - 07
Western Newfoundland
Geophysical Service Incorporated
0
10
20
30
40
Kilometres
Nearshore and Inshore Fishery
Source: Fisheries & Oceans Canada 2007
054849 (1) GIS-DA528 Nov 10, 2008
CONESTOGA-ROVERS
& ASSOCIATES

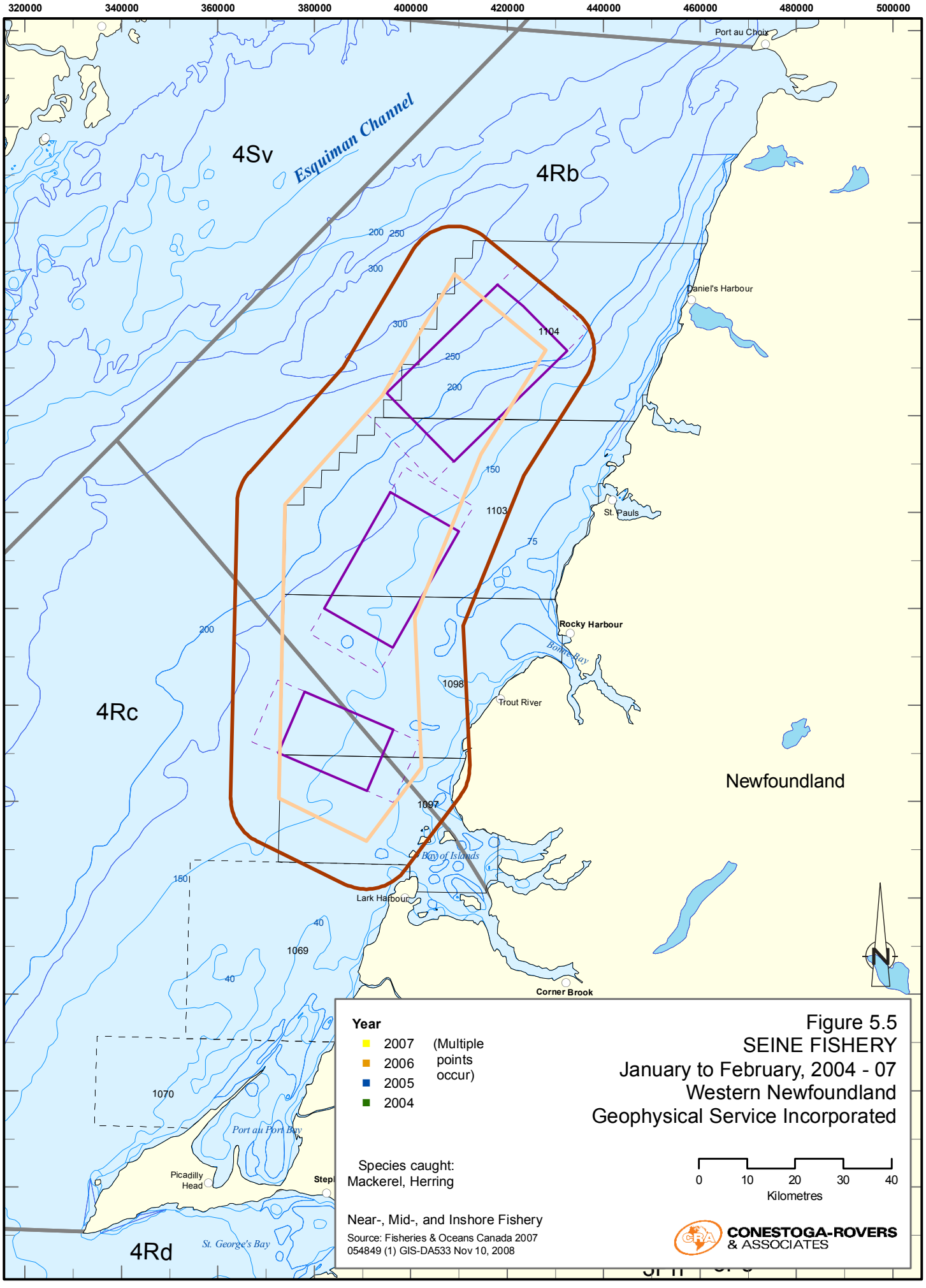
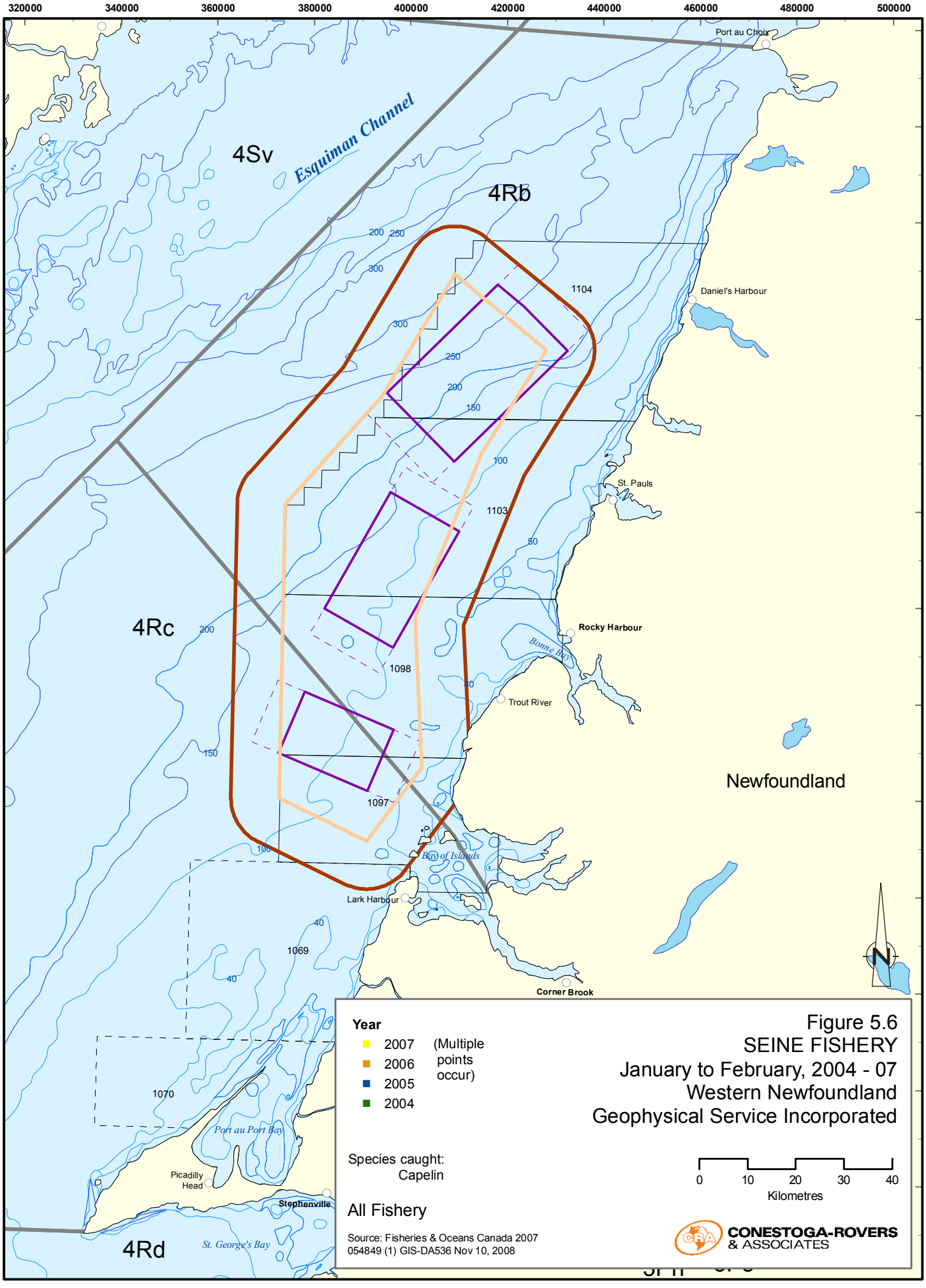


Figure 5.5
SEINE FISHERY
January to February, 2004 - 07
Western Newfoundland
Geophysical Service Incorporated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4Rd
Port au Choix
Daniel's Harbour
St. Pauls
Rocky Harbour
Bonne Bay
Trout River
Newfoundland
Bay of Islands
Lark Harbour
Corner Brook
Port au Port Bay
Picadilly Head
Stephenville
St. George's Bay
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Year
2007
2006
2005
2004
(Multiple points occur)
Species caught:
Capelin
All Fishery
Source: Fisheries & Oceans Canada 2007
054849 (1) GIS-DA536 Nov 10, 2008
Figure 5.6
SEINE FISHERY
January to February, 2004 - 07
Western Newfoundland
Geophysical Service Incorporated
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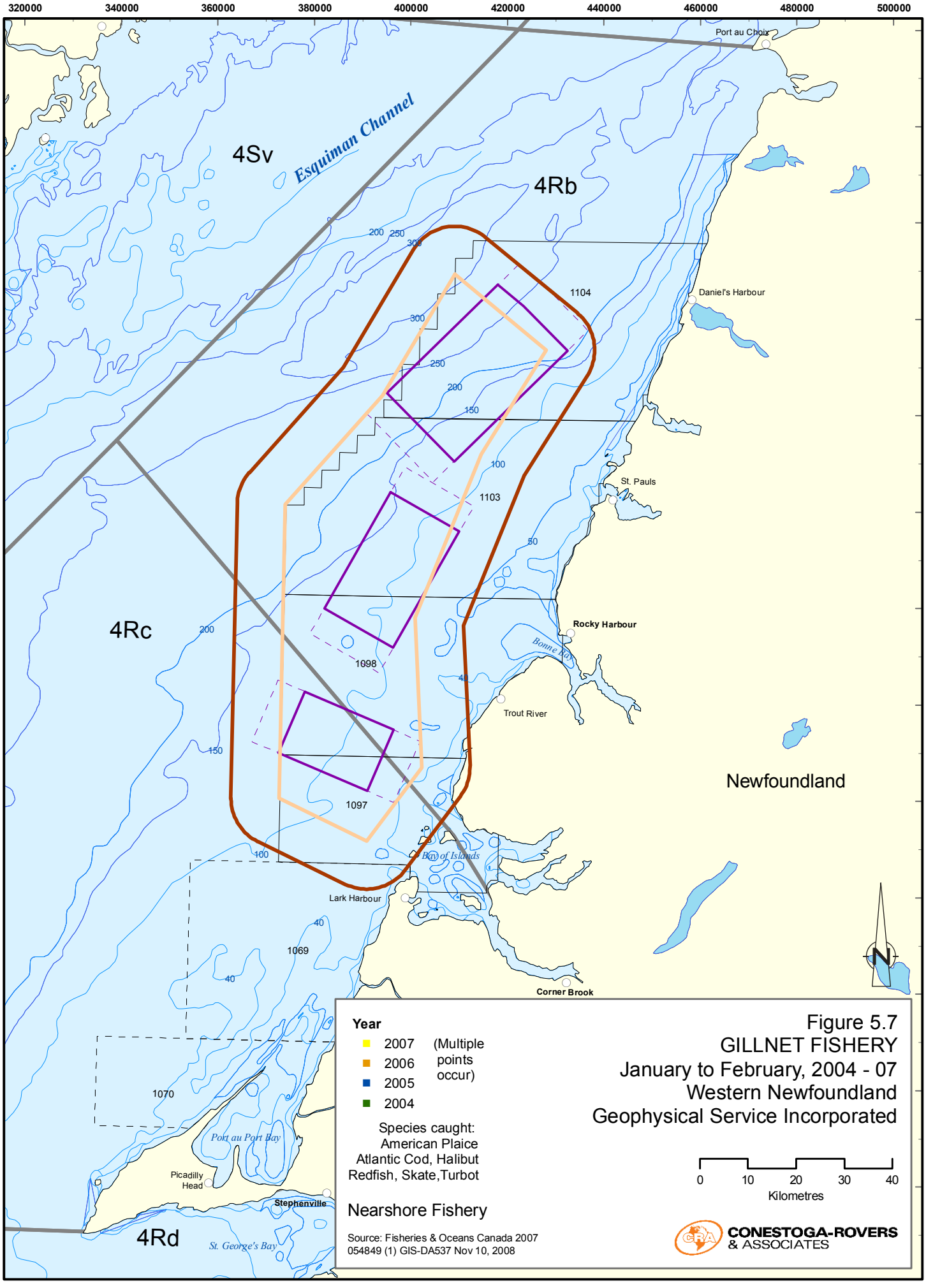
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES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Year
2007
2006
2005
2004
(Multiple points occur)
Species caught:
American Plaice
Atlantic Cod, Halibut
Redfish, Skate,Turbot
Nearshore Fishery
Source: Fisheries & Oceans Canada 2007
054849 (1) GIS-DA537 Nov 10, 2008
Figure 5.7
GILLNET FISHERY
January to February, 2004 - 07
Western Newfoundland
Geophysical Service Incorporated
0
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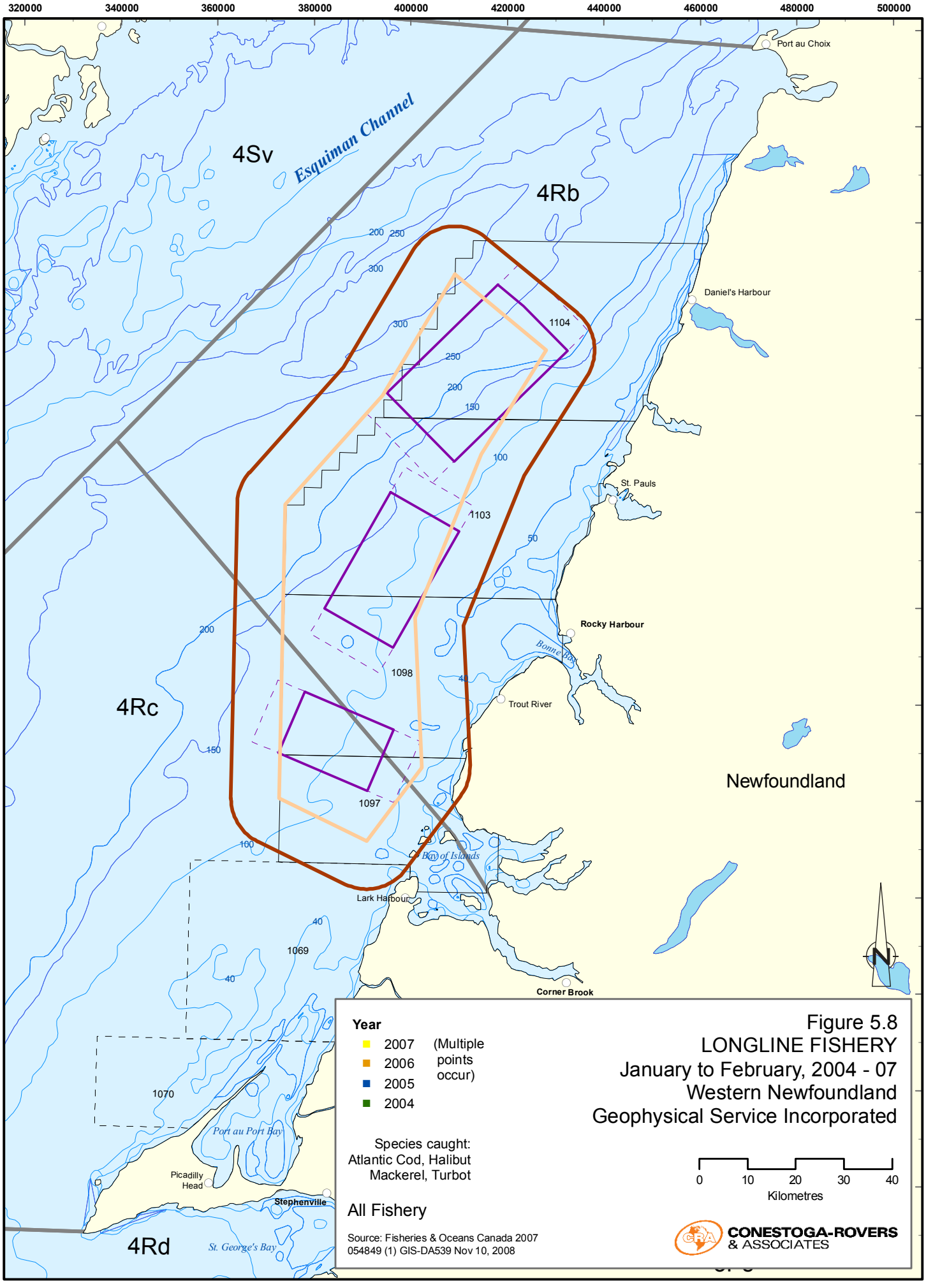
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES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4Rc
4Rd
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Daniel's Harbour
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Rocky Harbour
Bonne Bay
Trout River
Newfoundland
Bay of Islands
Lark Harbour
Corner Brook
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Picadilly Head
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200
250
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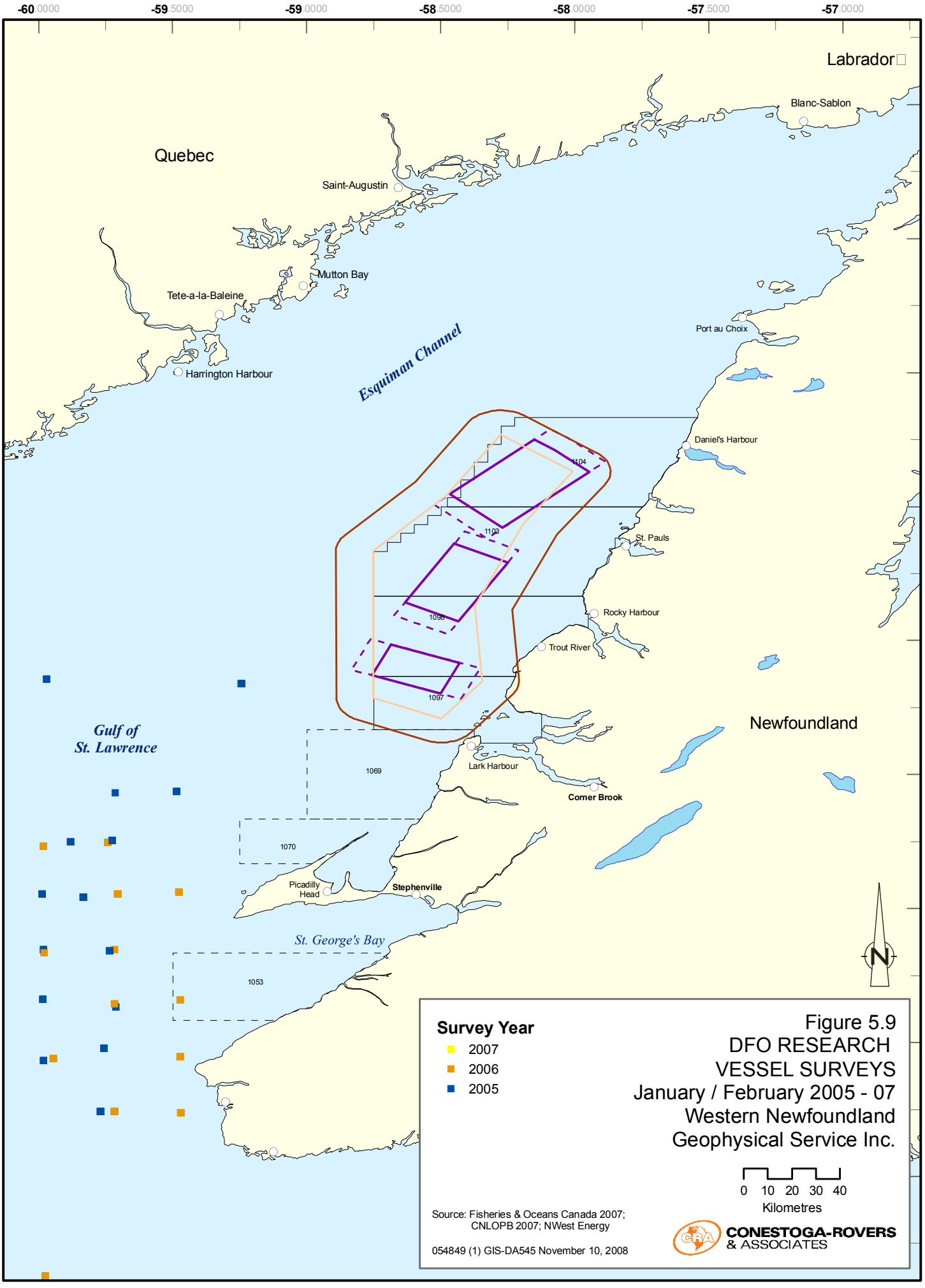
100
50
40
Year
2007
2006
2005
2004
(Multiple points occur)
Species caught:
Atlantic Cod, Halibut
Mackerel, Turbot
All Fishery
Source: Fisheries & Oceans Canada 2007
054849 (1) GIS-DA539 Nov 10, 2008
Figure 5.8
LONGLINE FISHERY
January to February, 2004 - 07
Western Newfoundland
Geophysical Service Incorporated
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES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Gulf of
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1069
Lark Harbour
Corner Brook
1070
Picadilly
Head
Stephenville
St. George's Bay
1053
N
Survey Year
2007
2006
2005
Figure 5.9
DFO RESEARCH
VESSEL SURVEYS
January / February 2005 - 07
Western Newfoundland
Geophysical Service Inc.
0 10 20 30 40
Kilometres
Source: Fisheries & Oceans Canada 2007;
CNLOPB 2007; NWest Energy
054849 (1) GIS-DA545 November 10, 2008
CONESTOGA-ROVERS
& ASSOCIATES

6.0 ENVIRONMENTAL EFFECTS OF PROJECT ACTIVITIES

6.1 Marine and Migratory Birds

The Gulf of St. Lawrence is occupied by numerous seabird species throughout the ice-free period and as expected, there is low abundance in the frozen ice period. Bird populations that may occur from January to February include Northern Fulmars, Black-legged Kittiwakes, Dovekies and murres. Harlequin Ducks and Common Eiders will be over-wintering along the coast (Figure 6.1).

6.1.1 Boundaries

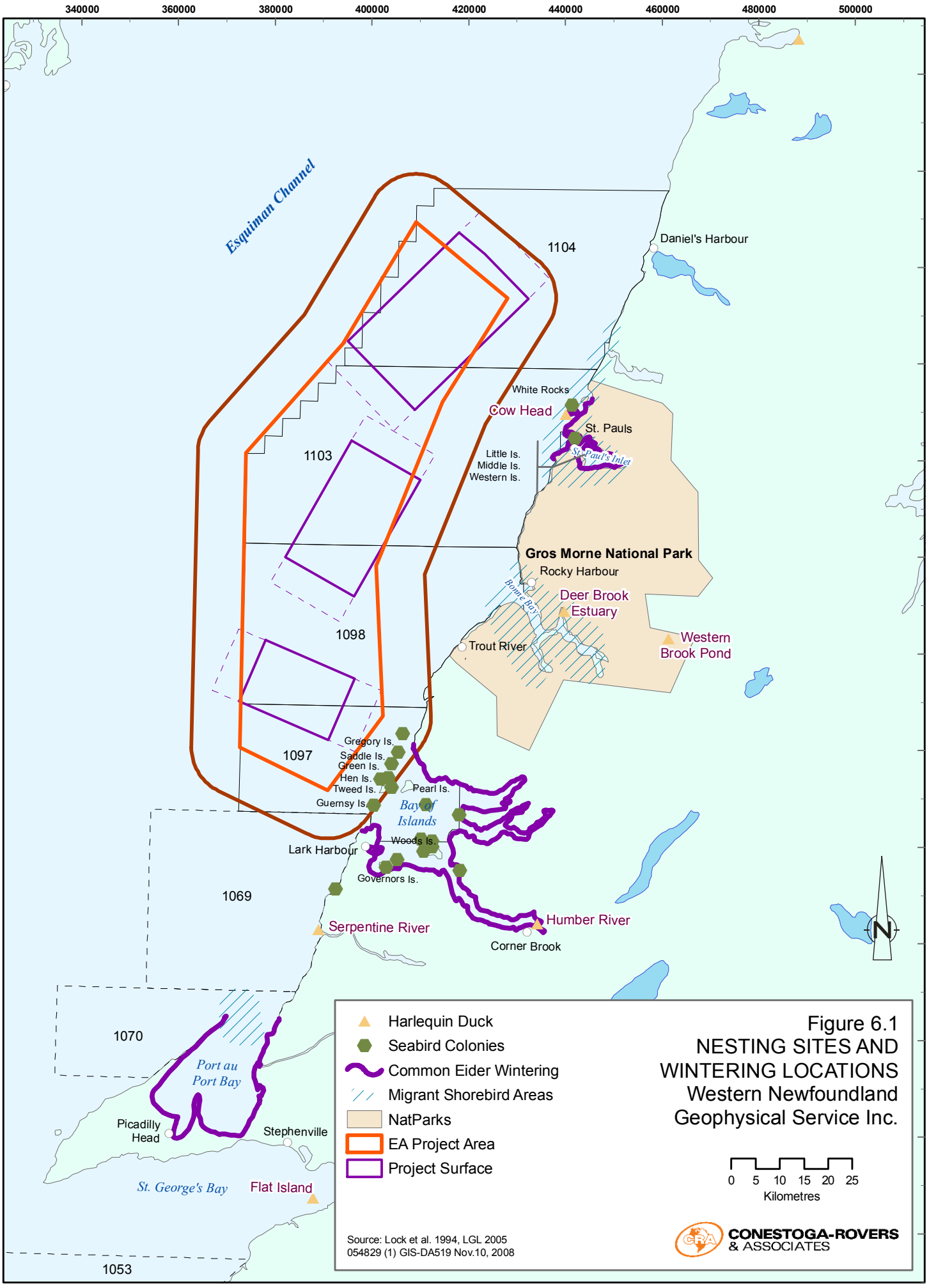
With respect to temporal boundaries, the potential interactions of concern are those related to the seismic activities that could occur in January and February in 2009 for the first seismic survey. The ecological spatial boundary for marine bird species includes only foraging habitats.

6.1.2 Potential Interactions and Issues

There are no data suggesting that seismic surveys have adverse impacts on birds (MMS 2004). Potential impact mechanisms are noise impacts from seismic surveys and disturbance from vessels. Noise produced from these geophysical surveys might only impacts those offshore bird species that spend a considerable amount of time underwater, swimming or plunge diving for food. Noise from the surveys could adversely affect surface-feeding and diving seabirds near the air source array. A possible mechanism for indirect effects is alteration of prey concentration. However, persistent and widespread alterations in abundance of fishes are not expected.

Regulators have expressed concern on effects from attraction of birds to vessel lighting.

Coastal and marine birds could be affected by a spill due to an accident involving the survey vessel.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White Rocks
Cow Head
St. Pauls
St. Paul's Inlet
Little Is.
Middle Is.
Western Is.
Gros Morne National Park
Rocky Harbour
Bonne Bay
Deer Brook Estuary
Western Brook Pond
Trout River
Gregory Is.
Saddle Is.
Green Is.
Hen Is.
Tweed Is.
Guernsy Is.
Pearl Is.
Bay of Islands
Woods Is.
Lark Harbour
Governors Is.
Serpentine River
Humber River
Corner Brook
Port au Port Bay
Picadilly Head
Stephenville
St. George's Bay
Flat Island
N
Harlequin Duck
Seabird Colonies
Common Eider Wintering
Migrant Shorebird Areas
NatParks
EA Project Area
Project Surface
Figure 6.1
NESTING SITES AND WINTERING LOCATIONS
Western Newfoundland
Geophysical Service Inc.
0 5 10 15 20 25
Kilometres
Source: Lock et al. 1994, LGL 2005
054829 (1) GIS-DA519 Nov.10, 2008
CONESTOGA-ROVERS & ASSOCIATES

6.1.3 Significance Criteria and Evaluation

A significant adverse effect on coastal, marine and migratory birds is one likely to cause:

- A death or life-threatening injury of one or more individual of a listed species; and or
- Death or life-threatening injury of non-listed species in sufficient numbers to affect the population adversely; and or
- Long-term or permanent displacement of any species from preferred feeding, breeding or nursery habitats; and or
- Destruction or adverse effects of critical habitat for any listed species.

6.1.4 Effects Assessment and Mitigation

6.1.4.1 Seismic Source Emission

Many species of marine birds utilize habitats within the Affected Area; however, little information on the effects of seismic exploration surveys on these species exists in the scientific literature. Davis *et al.* (1998) suggested the lack of data regarding seabirds and seismic surveys reflects the minimal evidence that any effects occur.

Stemp (1985) found no evidence of seismic effects on marine bird mortality or distributional effects in Davis Strait and Parsons (in Stemp 1985) reported shearwaters did not respond to seismic sources when in close proximity (30 m) to high frequency sounds. Additionally, Turnpenny and Nedwell (1994) found no ill effects of air source seismic surveys on guillemots, fulmars, and kittiwakes. Research in the Irish Sea also indicated no evidence seabirds were attracted or repelled by seismic activity (Evans *et al.* 1993).

Because seismic pulses are directed downward and highly attenuated at the surface, near surface feeding and diving marine birds would not likely be exposed to sound levels that would result in significant adverse effects on hearing or be life threatening. Above the water, the sound from the air source array is reduced to a muffled shot that should have little or no effect on birds that have their heads above water or are in flight. It is possible birds on the water at close range would be startled by the sound; however, the presence of the vessel and associated gear dragging in the water should have already warned the bird of unnatural visual and auditory stimuli.

Stemp (1985) found no evidence that a seismic program in the Davis Strait area had resulted in distributional effects on marine birds. Evans *et al.* (1993) noted that there was no evidence to suggest that seabirds were either attracted to or repelled by seismic testing in the Irish Sea. Turnpenny and Nedwell (1994) refer to data in which trained observers reported no behavioural effects on guillemot, fulmar and kittiwake species that were monitored during air source seismic surveys. Thus, behavioural changes will likely not be evident for the bird species at risk in the Affected Area.

6.1.4.2 Vessel Presence

Seismic survey vessel traffic will be limited to routes to the Survey Areas and within the Survey Areas, including the turn around area.

Avifauna species that occupy the Affected Area will likely not be disturbed by vessel activity due to its transitory nature. The area of interest for seismic surveys is offshore and, therefore, is not expected to impact coastal breeding colonies as birds in this region are not breeding in January and February.

Birds attracted to vessel lighting at night may experience some disorientation and fly into vessel lights and other equipment. There is one extreme case of bird attraction where lights on a fishing vessel attracted 1.5 tonnes (6,000 birds) of crested auklets which endangered the vessel stability. The presence of the seismic vessel is a negligible addition of night lighting compared to fishing vessels and commercial traffic which transit through in the Project Activity Area year round. Collisions of migrating seabirds (*e.g.,* shearwaters, dovekies, murres and Leach's storm-petrel) is more of an issue with erect structures such as lighthouses, broadcast and communication towers, illuminated office buildings, and offshore platforms and light-induced fisheries (Gauthreaux and Belser 2006, Montevecchi 2006). Lighting is required for nighttime vessel activities; therefore navigation, deck lights and interior lights must be left on for safety. However, effort will be made to minimise operations that require high-intensity work lights. Such lighting may be turned off in inclement weather (low cloud cover, overcast skies, fog and drizzle conditions), if not required. Under foggy conditions, coastal lighting is more of an influence as birds fly closer to land (Chaffey 2003, Weir 1976, Blomquist and Peterz 1984). Other light mitigation measures could include shielding upward projecting lights, turning off unneeded interior and exterior lighting and covering windows at night. Routine checks for and records of bird collisions and stranded birds will be reported and appropriate release of birds affected by light in the Project Area will be conducted.

Procedures for handling stranded birds will follow those outlined in the Storm Petrel Mitigation Program developed by Williams and Chardine (1999) for the Terra Nova Offshore Oil Development (Appendix A). An Environmental Observer will be assigned on the vessel during seismic surveys. All marine observations will be reported and information will be given to appropriate organizations to provide valuable information on the distribution of marine birds off the west coast of Newfoundland. A Live Seabird Salvage permit from CWS may be required for this Project (Appendix B)

6.1.4.3 Vessel Discharge and Accidental Events

Accidental releases of hydrocarbons can expose birds to oil by breathing contaminated air, through skin contact, through eating contaminated prey items (Davies and Bell 1984), or by ingesting contaminants while preening contaminated plumage (Stout 1993). Exposure to hydrocarbons may result in a loss of waterproofing, thermoregulatory capability (hypothermia), and buoyancy (drowning) due to the matting of feathers (Wiese 1999; MMS 2004). Oil ingestion, even in small amounts, may result in lethal and sublethal effects, including starvation due to increased energy needs to compensate for heat loss (MMS 2004). Potential impacts are expected to be limited due to the high volatility and relatively small volume of the spilled oil (diesel or kerosene). If a spill occurred and marine birds were impacted, the Williams and Chardine protocol (entitled "The Leach's Storm Petrel: General Information and Handling Instructions") or protocols recommended by the C-NLOPB for handling oiled or standard birds would be followed. No significant adverse effects are likely to occur as a result of an accidental event associated with this Project.

The impacts of oil on birds have been well documented (*e.g.,* Hartung 1995); however, there will be limited amounts of marine fuel and lube oil onboard that could potentially be spilled into the ocean. No oil from discharge is expected to occur and thus, should not have any severe adverse effects on avifauna. Discharge from vessels will be standard for any marine vessel and will follow Offshore Waste Treatment Guidelines (OWTG) (NEB *et al.* 2002). Potential oil spillage may occur from ballast and bilge water discharge, however, if oil is suspected to be in the water, it will be tested and if necessary, treated using an oil/water separator to ensure that oil concentrations in the discharge do not exceed 15 mg/L as required by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1972, and the Protocol of 1978 related thereto), International Maritime Organization and OWTG.

Coastal and marine birds could also be affected by a spill from any vessel (fishing, commercial and DFO research) at sea. The single seismic vessel does not increase the risk to coastal and seabird populations as discussed in the original EA report.

GSI will use non-solid streamers with an Isopar-M fluid. This fluid is kerosene and is used as a dispersant on crude oil spills. GSI has increased the thickness of the streamer skin to further reduce the possibility of a leak or spill, with a wall thickness 12% thicker that that of the original manufacturer. The vessel is required to carry a "Shipboard Oil Pollution Emergency Plan" pursuant to MARPOL 73/78. The Plan contains a description of procedures and checklists, which govern operations involving hydrocarbons. Adherence to this plan should prevent unintended operational releases. Effects due to accidental spills associated with the proposed operation are considered to be detectable if they occur, but to likely have negligible results on fish populations. The streamer will be fluid-filled. Fluids used in streamers (can be light oils or kerosene) are used for floatation purposes only. There are no records of streamer spills in the C-NLOPB files which have been kept since 1997. There were five incidents of streamer spills off Nova Scotia, all in 2003. All spills of streamer fluid were less than 1 m^3 and ranged from 0.02 to 0.57 m^3.

6.1.5 Cumulative Effects

The cumulative effects of anthropogenic disturbance such as seismic surveys, oil and gas exploration, commercial fishing and shipping, along with natural process such as weather and food availability, have potential to change predator and prey abundances inside and outside the Affected Area, thus causing adverse effects on avifauna. However, the minimal increase in vessel traffic from this Project will be minor compared with existing vessel traffic in the area and should not significantly increase disruption to avifauna. Due to the potential for ice coverage in February, marine traffic is likely to be considerably reduced.

PDI and Tekoil stated in their respective EA documents that their surveys could commence in the fall of 2008 and into 2009. These surveys have not commenced; therefore, there will not be any spatial or temporal overlap with other seismic surveys in January and February 2009.

Routine discharges from marine vessels containing petroleum hydrocarbons could cumulatively influence avifauna. The seismic vessel used for this Project will comply with discharge regulations established by OWTG and thus, should not significantly add to short-term or long-term effects of oil spillage on marine avifauna.

Overall, there are no cumulative effects of this seismic exploration Project expected to occur on the distribution, abundance, breeding status and general well-being of marine avifauna inside and outside the Project Area.

6.1.6 Monitoring and Follow-Up

The Fisheries Liaison Observers also act as Environmental Observers onboard to record marine bird (and marine mammal) sightings during the program. The protocol will follow CWS's Standardized Protocols For Pelagic Seabirds Surveys From Moving and Stationary Platforms for the Hydrocarbon Industry: Interim Protocol – June 2006 (Appendix C).

GSI will ensure that CWS is provided field data collection with respect to marine birds at the completion of the seismic survey. These marine bird data reports will be provided following this survey and any other subsequent seismic surveys.

6.1.7 Summary

Table 6.1 provides a summary of the potential for interaction, impact analysis, mitigations and cumulative and residual effects for marine and migratory birds.

Table 6.1 Summary of Environmental Assessment for Marine and Migratory Birds

Interactions and Issues ▪ Direct physical effects associated with seismic noise (*e.g.*, auditory damage) ▪ Decline in prey availability ▪ Disturbance from vessel noise and lights ▪ Accidental spills causing oiling of birds	
Impact Analysis There are no documented adverse effects directly on seabirds as reported by offshore observers. Effects associated with vessel presence and lights will be similar to what marine birds are exposed to now with the considerable commercial and fishing vessel traffic. Harlequin Ducks will not interact with the Project activities spatially, and are only at risk to a spill which would dissipate well within the distance of the Project Area to the coastline. Environmental effects including cumulative effects on marine and migratory birds are considered non-significant.	
Mitigation ▪ A dedicated observer will be on board the seismic vessel to record marine birds and incidents of collisions and strandings ▪ Vessel compliant with audit prior to survey ▪ Maintenance of streamer equipment and responsible management of such equipment ▪ Compliance with OWTG (NEB *et al.* 2002) and MARPOL for all discharges ▪ Avoidance of Gros Morne National Park estuaries by vessel	
Significance	
Likelihood of occurrence	Likely for survey Unlikely for spills
Geographic extent	Immediate, local to vessel
Frequency of occurrence	Intermittent for 90 days for 2-D program

Table 6.1 Summary of Environmental Assessment for Marine and Migratory Birds

Duration of impact	Immediate
Magnitude of impact	Negligible for seismic Low for spills
Reversibility	Reversible
Significance of Effects	Not adversely significant
Confidence • High level of confidence based on previous seismic surveys and research.	

6.2 Marine Fish and Shellfish

This analysis considers Project interactions with commercial pelagic and demersal fish and invertebrates, including egg, larval, juvenile and adult life stages. Fish spawning is of critical importance as survivability of fish at early life stages may be a major limiting factor on adult populations.

6.2.1 Boundaries

With respect to temporal boundaries, the potential interactions of concern are those related to the seismic activities that could occur in January to February in 2009 for the three Survey Areas.

The technical boundaries and the information available for this study rely on existing information with regard to marine fish/shellfish distribution, migration and spawning areas. There is a lack of precise spatial information on spawning grounds, particularly as related to non-commercial species. Other uncertainties surround some demersal fish species, which continue to decline despite moratoriums and controls on fishing effort. There are also few specific studies on the physical effects of seismic studies on fish spawning specific to the Affected and Regional Areas.

6.2.2 Potential Interactions and Issues

Potential interactions between the Project and marine fish and shellfish relate primarily to direct physical injury and detrimental behavioural effects as a result of noise from seismic activities. Physical injury may include failure to reach the next development stage, hearing injury and death to:

- fish eggs and larvae;
- juvenile and adult finfish; and

- invertebrates.

Behavioural effects may include:

- avoidance behaviour;
- increased swimming speeds;
- disruption of migration patterns; and
- disruption of reproductive behaviour and success.

Acoustic behaviour and uses of sound by fish are less documented than the physiology of sound detection by fishes. The effects of intense and potential harmful sound on fish hearing and behaviour are poorly understood. Such noise may disturb fish and may produce temporary or permanent hearing impairment in some individuals, but is unlikely to cause death or life-threatening injury.

6.2.3 Significance Criteria and Evaluation

A significant adverse environmental effect is one that is likely to cause one or more of the following:

- mortality or life-threatening injury to individuals of a species at risk;
- the abundance of one or more non-listed species is reduced to a level from which recovery of the population is uncertain;
- long-term or permanent displacement of any species from spawning habitat; or
- destruction or adverse changes to critical or essential fish habitats.

To be considered significant, Project-related mortality would exceed the range of natural mortality by two standard deviations.

A non-significant adverse environmental effect is one that is likely to cause one or more of the following:

- mortality or life-threatening injury of individuals (other than listed species) in small numbers that would not adversely effect the population or the ecological functioning of the fish community; and / or
- short term displacement of individuals from preferred feeding, spawning, nursery grounds or migratory routes (including critical habitat for listed species and essential fish habitat).

6.2.4 Effects Assessment and Mitigation

Effects to fish and shellfish were discussed in detail in the original EA report and those conclusions are summarized in this section. Recognising that the fishers are not actively harvesting in the January to February period and behavioural effects on catch are not an issue, the fish and shellfish are still there and may be affected.

6.2.4.1 Physical Effects

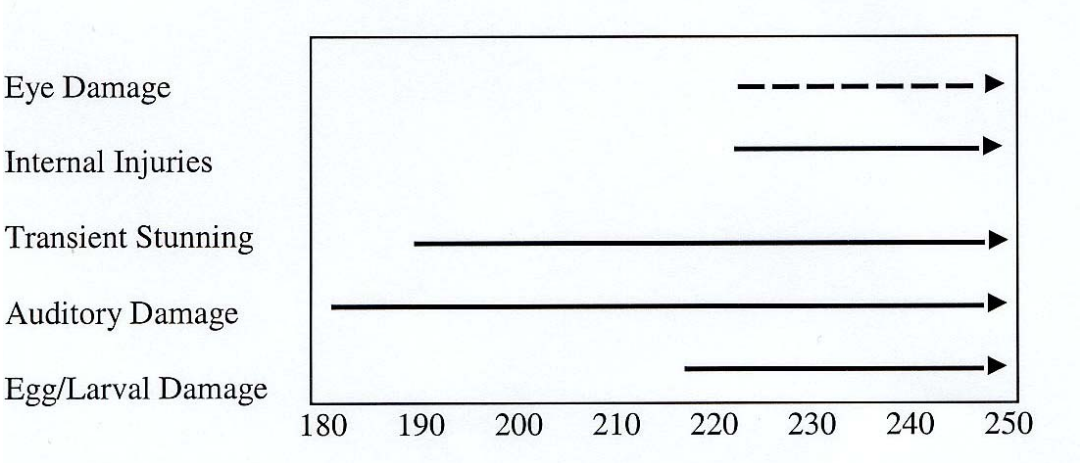
Most studies on the biological effects of seismic sound energy have concentrated on marine mammals and fish, groups which have sensitive hearing organs and which, in many cases, incorporate sound as part of social behaviour. Therefore, this section will discuss effects on physical and anatomical effects, and on spawning fish and eggs and larvae.

Mortality of fish has not occurred in research studies. Rise times are too slow and peak pressures too low to cause serious injury, except perhaps to fish that are within a few metres of an air sleeve at the time of discharge (Turnpenny and Nedwell 1994). DFO (2004) concludes that there are no documented cases of fish mortality upon exposure to seismic sound under field conditions and that exposure to seismic sound is unlikely to result in direct fish mortality. Therefore, spawning fish are not likely to be mortally impacted by the air source array from this Project.

Invertebrates lack swim bladders and hearing organs, two anatomical features where physical damage most likely occurs in aquatic organisms. The Royal Society of Canada (2004) suggests that seismic surveys will have no effect on the marine benthos provided the water depth is greater than 20 m. Kosheleva (1992) reports no obvious physiological effects beyond 1 m from a source of 220 to 240 dB re 1 µPa. He tested external damage and reported no visible signs of damage on crabs exposed to an air source element at 0.5 m.

Hastings (1990) reports the lethal threshold for fish beginning at 229 dB re 1 µPa and a stunning effect in the 192 to 198 dB re 1 µPa range. Turnpenny and Nedwell (1994) deduce that blindness can be caused in fish exposed to air sleeve emissions on the order of 214 dB re 1 µPa, auditory damage starts at 180 dB, transient stunning at 192 dB re 1 µPa and internal injuries at 220 dB re 1 µPa (Figure 6.2).

Figure 6.2 Sound Pressure Threshold (dB re 1 μPa) for the Onset of Fish Injuries



Source: adapted from Turnpenny and Nedwell 1994.
Note: Dotted line indicates an assumed sound level.

Most fish exposed to an air source array at a distance of a few metres could suffer inner ear damage at a source range of 210 and 240 dB. For this Project 2-D array, this sound level is 1 metre or less from the array, depending on angle of emission. The probability of hearing impairment decreases with increased distance between the fish and an air source array as sound attenuates.

Increased stress as a response to external factors is generally difficult to measure in invertebrates. However, changes in relative movement when exposed to a sound field may be a good indicator of stress. Christian *et al.* (2004) discuss the startle responses observed by snow crabs held in a DFO tank and exposed to sounds produced by the clanging of metal bars. Snow crabs were observed immediately drawing in their legs and proceeding to escape the region of the imposing sound. When exposed to a 200-cu. in. array located at a distance of 50 m, caged as well as tagged snow crab demonstrated little to no movement; they did not draw in their legs, and they remained in their original position (Christian *et al.* 2004). Thus, seismic sound fields are not anticipated to cause adverse effects by increasing stress on snow crabs.

In response to concerns for seismic surveys in shallow water on the west coast of Newfoundland, Payne *et al.* (2007) were funded to conduct laboratory and field experimentations on lobsters subject to seismic sources. Over a period of days to several months, there were no effects of delayed mortality or damage to mechanosensory systems associated with animal equilibrium and posture. There was no evidence of leg loss or other appendages. Sublethal effects were observed with feeding (minor) and serum biochemistry and organ stress was apparent in the hepatopancreas.

No significant adverse effects of seismic noise on the behaviour or physiology of fish and shellfish are anticipated from the GSI 2-D seismic surveys.

6.2.4.2 Eggs and Larvae Development

Based on the Strategic Environmental Assessment for Western Newfoundland, the only commercial fish species spawning in the winter are Greenland and Atlantic halibut. These species appear to spawn outside of the Project Area for the most part. There may be spawning of Atlantic halibut in the northern Survey Area which covers water depths >200 m.

While it is recognized that fish eggs, zooplankton (including ichthyoplankton) and larvae could be killed or damaged at distances up to or less than five metres from a large array, various studies have indicated that the impact would be indistinguishable from natural mortality, given the extent of exposure and the numbers of organisms involved.

Reporting on a workshop of oil industry, DFO and fisheries participants from Nova Scotia and Newfoundland sponsored by ESRF in Halifax in 2000, LGL-Griffiths Muecke (Thomson *et al.* 2001) noted that, in light of such information, "The workshop participants concurred that studies of seismic effects on fish eggs and larvae were of low priority and were not considered further" (p. vii).

No significant adverse effects on fish, lobsters, snow crab or eggs and larvae are anticipated as a result of GSI's 2-D seismic program. No specific mitigation is proposed during routine seismic activities.

6.2.4.3 Accidental Events

Oil or kerosene spills may affect water quality, which in turn may affect the health and survival of plankton, fish eggs, and larvae, juvenile and adult fish in the immediate vicinity of the vessel. While risk to adult fish and shellfish is low, pelagic fish eggs and larvae may be affected to different degrees by an accidental spill of hydrocarbons in the water. The nature and degree of such an interaction depends on the severity, timing, and location of the spill. The risk of such vessel accidents is low, and the volumes potentially released are limited. The probability of spills and the research undertaken in spill events to show low effects was discussed in detail in the original EA report.

Therefore, incidents involving survey vessels are not likely to result in significant effects on fish.

6.3 Cumulative Effects

The main projects and activities that may interact cumulatively with fish spawning include oil and gas exploration and production activities, other seismic projects, commercial shipping traffic, commercial fishing, and commercial fishing traffic. Two seismic exploration projects were to be active in the vicinity of the Project Area. PDI Productions Inc. was commencing work in the fall of 2008 in the Port au Port area (EL 1070) but if the Project undergoes unavoidable delays, the seismic work could be undertaken anytime in the next three years. Tekoil and Gas Corp. may be conducting seismic work over part of, and adjacent to, the Port au Port Peninsula (EL 1071) during a six-week period from October 2008 to April 2009. The PDI survey area is 46 km from the GSI southern survey area and Tekoil is 79 km away. Neither survey is being undertaken in January and February 2009, thus there will be no spatial or temporal overlap between these projects and the GSI Project.

In addition to these human activities, marine fish populations in the Affected Area may be affected by natural factors, such as changes in prey and predator populations in areas within their natural range that may occur outside the Affected Area. Certain populations of marine fish are more vulnerable to changes in their environment. This is especially true of species at risk. This seismic program is not changing critical or preferred habitats of marine fish, nor resulting in mass removal of these species. The distribution of most fish species varies seasonally in response to physical or chemical changes in the surrounding environment (*e.g.*, depth, substrate, salinity, temperature) and as a result of seasonal habitat requirements (*e.g.*, spawning, feeding).

Long annual migrations are undertaken by most pelagic species, such as herring and mackerel, and groundfish species, such as cod. The Project will not change the physical or chemical requirements that dictate fish presence, and their ability to reproduce.

Although non-significant, the residual effects of the Project components on fish spawning that may be cumulative with the effects of other human activities in the region are expected to be very limited, consisting primarily of short-term avoidance behaviour. Commercial fishing is not being undertaken in January and February. Seismic surveys produce repetitive, localised and short-term increases in ambient noise levels, with the period between potential exposures ranging from hours to days. Within the near field of an array, about 300 m, received noise levels may reach or exceed 180 dB re 1 µPa.

Beyond this distance, sound from a seismic survey is similar to commercial vessels (MMS 2004).

If another seismic survey was being conducted on the western shelf within the proposed timeframe, a significant distance between surveys will be necessary to prevent both operational conflict and acoustical interference. For instance, most survey operators indicate that they aim to maintain a minimum distance of 40 to 50 km from any other survey vessels, and separation for concurrent surveys is typically greater than 50 km. In the normal course of survey operations, seismic vessel operators, working in a similar geographical area, will plan operations to maximize separation and thereby reduce or avoid seismic interference. This will reduce or eliminate the likelihood that the sound levels from two surveys will be additive in a particular area, and reduce the potential for cumulative effects on marine fish and shellfish.

Considering the significance criteria provided for fish and given that impacts from cumulative vessel traffic, individual projects and other activities in the Affected Area are not likely to contribute to significant adverse effects. The Project components are predicted to have minimal interaction with species at risk; the 2-D seismic survey is not anticipated to result in significant cumulative adverse effects to marine fish and shellfish. Seismic surveys (2-D) have been undertaken in the Regional Area in the past with no apparent effects to fish or fisheries success.

6.3.1 Monitoring

Follow-up and monitoring are not recommended for fish and shellfish for routine seismic activities.

6.3.2 Summary

Table 6.3 provides a summary of the potential for interaction, impact analysis, mitigations and cumulative and residual effects for marine fish and shellfish.

Table 6.3 Summary of Environmental Assessment for Marine Fish and Shellfish

Interactions and Issues
▪ Behavioural changes ▪ Physiological changes ▪ Masking of sound ▪ Hearing impairment ▪ Mortality

Table 6.3 Summary of Environmental Assessment for Marine Fish and Shellfish

Impact Analysis Noise levels from geophysical activities and vessel traffic for this Project are predicted to be less than the limits that cause physical effects on fish. Turnpenny and Nedwell (1994) summarized the following physical effects of noise on fish (worse case within 10 m of a 255 db re 1 µPa source): ▪ transient stunning of marine fish occurs at noise levels above 192 dB re 1µPa; ▪ internal injuries at 200 dB re 1µPa; ▪ egg/larval damage due to noise occurs at 220 dB re 1 µPa; and ▪ fish mortality at 230-240 db re 1µPa. McCauley *et al.* (2000a, b) conducted trials with captive fish and found that increases in swimming behaviour occurred when seismic sound levels reached 156 dB re 1 µPa. In the survey proposed by GSI, sound is estimated to attenuate to 156 dB re 1 µPa @ 1 m at a distance of 32 m-500 m at 0° below horizon and 812 m-32 km at 45° emission angle in 40 m of water. In 150 m water depth, the distance to the same attenuation is 32 m-128 m at 0°, 32 m at 10°, and 2-32 km at 45° emission angles. Noise levels should attenuate to ambient levels 30 to 50 km from the survey vessel. To minimise sudden changes in noise levels, GSI will implement a ramp-up procedure. The various components and activities associated with the proposed Project are not predicted to result in significant environmental effects on fish and shellfish because the effects are reversible, of limited duration, magnitude, and geographic extent (Table 5.2). Although there are few studies on the effects of seismic surveys on specific fish species in the Gulf of St. Lawrence, research studies show that mortality or serious injury is unlikely beyond a distance of approximately 2 m from the sound source. Effects of the Project on marine fish and shellfish in the Affected Area are predicted to be non-significant.	
Mitigation ▪ Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment*, to the extent reasonably practical. ▪ To minimize sudden changes in noise levels, a 30 minute ramp up procedure will be implemented. ▪ Avoidance of known spawning areas at times when fish are known to be spawning, where appropriate. ▪ Compliance with OWTG (NEB *et al.* 2002) for all discharges.	
Significance evaluation	
Likelihood of occurrence	Low for shellfish and finfish physical effects.
Geographic extent	Immediate to the air source array for physical effects
Frequency of occurrence	Intermittent during 2-D data acquisition (90 days)
Duration of impact	Immediate
Magnitude of impact	Low
Permanence/reversibility	Reversible
Significance of effect	Not adversely significant
Confidence	
▪ Understanding the use of sound by fishes is very poor with few relevant published papers. ▪ Lack of specific knowledge about critical fish areas in the Gulf of St. Lawrence.	

6.4 Marine Mammals

Marine mammals are considered a VEC due to their significant role in the offshore ecosystem and because of regulatory protection, and scientific and public concern. This analysis considers cetaceans and pinnipeds that may live and/or migrate through the Project Area.

6.4.1 Boundaries

Temporal boundaries for this analysis are defined by the extended Project schedule into January and February 2009. Temporal ecological boundaries for cetaceans and pinnipeds vary according to species. Most cetaceans are migratory and occur in the Gulf of St. Lawrence predominantly during the summer and fall months (Lesage *et al.* 2007).

Therefore, it is expected that marine mammal presence will range from limited to zero in the Project Area in January and February 2009, and thus not considered further. Mitigation is provided below. The original EA addressed effects on marine mammals for the remaining year.

6.4.3 Mitigation

The Statement of Canadian Practice for Mitigation of Seismic Noise in the Marine Environment (DFO 2008) will also provide guidance to the seismic program. The Statement of Canadian Practice aims to formalise and standardise the mitigation measures used in Canada with respect to the conduct of seismic surveys in the marine environment. It is based on a DFO-sponsored peer review by Canadian and international experts. The following points outline the mitigation measures described in the Statement of Canadian Practice:

- Avoid death, harm, or harassment of individuals of marine mammals and sea turtles listed as endangered or threatened on SARA; and population-level effects for all other marine species.
- Avoid, to the extent reasonably practical, causing a dispersion of an aggregation of spawning finfish.
- from a known spawning area; a displacement of a group of breeding, feeding or nursing, or migrating, marine mammals, if it is known there are no alternate areas available to those marine mammals for those activities.
- Avoid, to the extent reasonably practical, displacing an individual marine mammal listed as endangered or threatened on SARA from breeding, feeding or nursing, or migrating, if it is known there are no alternate areas for those activities that the individual could be expected to use.
- Establish a safety zone of 500 metres from the centre of the seismic source array or arrays.
- Conduct regular on-going visual monitoring of the safety zone by a qualified Environmental Observer, including continuous visual monitoring during a period of at least 30 minutes prior to start-up of the seismic array.
- Delay start up if a whale, other than a dolphin or a porpoise, is seen within the safety zone during the 30 minute visual survey until the sea turtle or whale has not been observed for at least 30 minutes within the safety zone or has been observed leaving the safety zone.
- Shut down seismic array immediately when a whale is observed to be in the safety zone if that whale is listed as endangered or threatened on SARA or is

listed as a species of special concern for which there could be significant adverse effects.

- Operations may re-commence, using ramp-up/soft-start measures if the array has been shut down for more than 30 minutes. This includes commencing the ramp-up by firing a single source, preferably the smallest source in terms of energy output and volume; and continually activating additional sources in ascending order of size over a 20 to 40 minute period until desired operating level is attained.
- Shut down seismic source array(s) or reduce to a single energy source for line changes. If shut down occurs, ramp-up/soft-start procedures will not be required as alternative measures to maintain the safety zone will be used.
- During periods of low visibility and if the seismic program is in an area known to be an area where a vocalizing whale, other than a dolphin, that is listed as endangered or threatened on SARA, is reasonably expected to be encountered, a ramp-up / soft-start will only commence.

GSI will conduct a marine mammal monitoring program for whale species at risk during survey data acquisition. The reporting of marine mammal observations will use the forms developed under the Joint Nature Conservation Committee (JNCC) Guidelines for Minimising Acoustic Disturbance to Marine Mammals from Seismic Surveys (April 2004). A trained Environmental Observer will watch for marine mammals from the bridge, forward and aft, of the seismic vessel throughout the survey. GSI will establish a 500 m safety zone for the program and will delay start up of the air source array if a turtle or whale is observed within the safety zone and will shut down the seismic array if a *SARA* listed whale or turtle is observed within the safety zone. Prior to arriving at the start of a line, the air source array will be slowly brought up to maximum power, a procedure referred to as a "soft start" or "ramping up". An approved ramp-up procedure will be followed when air source operations begin or after every shutdown. Vessels towing streamers have limited maneuverability when the equipment is deployed. GSI is including a 10 km vessel turn-around perimeter around the survey area, during which time the array will be powered down to a single air source (likely the smallest) to warn marine mammals of the presence of the seismic vessel. If the air sources are completely shut down due to maintenance or other purposes, the arrays will be ramped up according to C-NLOPB guidelines, regulations or conditions of authorization.

The potential effects from vessels on marine mammals include strikes, temporary behavioural (aversion or attraction) effects, and effects from vessel noise. The physical presence of the vessel during seismic surveys does not typically result in significant adverse effects regarding collisions. Marine species, in particular marine mammals, are

expected to easily avoid the vessel during seismic surveys due to exhibited avoidance behaviour to noise and the slow speed of the ship. The survey vessel will likely travel at an average speed of 4.5 knots when the survey gear is deployed and will increase to approximately 10 knots while in transit. These speeds are within operational activities of fishing and commercial marine traffic. While the potential for collision exists, collision events are predicted to be unlikely. Collision with an endangered species would be considered significant; however, since there are no records of collision between the listed species at risk and seismic vessels, the probability of occurrence is considered low. Bow wave riding delphinids is considered an attraction behaviour response and unavoidable, and is not considered an adverse effect.

6.4.4 Accidental Events

Spilled oil may affect marine mammals through dermal contact, inhalation, ingestion and/or fouling of baleen plates. Potential impacts will be short-lived due to the high volatility and relatively small volume of the spilled oil (diesel or kerosene) and confinement to surface water. No significant adverse effects are anticipated for marine mammals as a result of small volume accidental spills.

6.4.5 Cumulative Effects

In general, because the sounds generated by seismic surveys are transient and do not "accumulate" in the environment, the most likely cumulative effects will be associated with other concurrent activities (*e.g.*, cargo ships, tankers, oil and gas exploration and production activities, other seismic surveys, fishing vessels). Studies in the Gulf of Mexico showed that seismic surveys produce a relatively minor contribution to the overall underwater noise environment (MMS 2004). The cumulative effect is short term, intermittent and localised, and therefore, not significant with respect to effects on species at risk.

Two seismic exploration projects may be active in the vicinity of the Project Area. PDI Productions Inc. was to commence work in the fall of 2008 in the Port au Port area (EL 1070) but if the Project undergoes unavoidable delays, the seismic work could be undertaken anytime in the next three years. Tekoil and Gas Corp. was to conduct seismic work over part of, and adjacent to, the Port au Port Peninsula (EL 1071) during a six-week period from October 2008 to April 2009. It appears that neither survey is being undertaken in January and February 2009, therefore there is no temporal overlap. In the event of other seismic surveys being conducted on the Western Shelf within the

proposed timeframe, a significant distance between surveys will be necessary to prevent both operational conflict and acoustical interference. This will reduce or eliminate the likelihood that the sound levels from two surveys will be additive in a particular area, and reduce the potential for cumulative effects on species at risk.

In general, the seismic survey vessel activity and noise will constitute a minor percentage contribution to the overall noise generated by other such sources and space-user conflict, and will be of short duration in local areas. Based on current knowledge, and especially with the proposed mitigation procedures in place, the proposed Project is not expected to result in, or contribute to, any significant cumulative impacts on species at risk.

6.4.6 Monitoring and Follow-Up

The Fisheries Liaison Observer acts as the Environmental Observer onboard the seismic vessel. That individual will record sightings of marine mammals on a daily basis, weather permitting. If a concentration of marine mammals is observed in a particular area, the survey can shift to another part of the survey area until the concentration has moved away. This, along with a 30-minute ramp-up procedure will ensure that whale species at risk in the Affected Area are not significantly affected in an adverse manner.

GSI will conduct a periodic review of the EA report to determine the validity of species at risk assessment and acknowledges that additional mitigation may be necessary should new species be added to Schedule 1 over the life of the Project.

6.4.7 Summary

Table 6.4 summarises the environmental effects on marine mammals from the GSI geophysical surveys.

Table 6.4 Summary of Environmental Assessment for Marine Mammals

Interactions and Issues
• Disturbance of marine mammals caused by the presence of vessels, particularly with regard to collisions with species at risk. • Noise from seismic activities leading to masking of cetacean vocalisation; behavioural changes; temporary threshold shift or hearing impairment; or • physical injury.
Impact Analysis
There is lack of published information regarding avoidance thresholds in odontocete whales, however, baleen whales exhibit clear avoidance behaviours at threshold levels of approximately 160 to 170 dB re 1µPa (rms) (Davis *et al*, 1998). NMFS policy regarding exposure of marine mammals to high-level sounds is that whales should not be exposed to impulse sounds exceeding 180 dB re 1µPa (rms), although behavioural

Table 6.4 Summary of Environmental Assessment for Marine Mammals

changes are apparent at 160 dB re 1µPa (rms) (NMFS 2000). Therefore, using 170 dB re 1µPa (rms) (≈160 dB re 1µPa (SEL)) as a received sound level boundary, the minimum and maximum distance from a 242 dB re 1µPa$_{(rms)}$ at 1m broadband source to an attenuation of 170 dB re 1µPa $_{(rms)}$ is 32 km at 0° from horizon and 2 km at 45° in 150 m water depth. Effects from seismic activities may result in physical injury and auditory impairment in cetaceans that are in close proximity to the firing air source array, a distance that should be avoided by marine mammals through ramping-up or when they hear the approaching seismic vessel. Auditory damage and mortality as a result of seismic activities and/or vessel traffic is not considered to be a major concern with respect to the proposed Project. The proposed Project may result in behavioural effects on marine mammals; however, most studies indicate that such behavioural disturbances are likely to be transitory with normal behaviour resuming within an hour or two after vessel passage. Mortality, serious injury or displacement from behavioural patterns that disrupt the ecological functioning of a species are not expected as there is no evidence nor expectation that seismic activities will result in these effects (MMS 2004).	
Mitigation • Collision avoidance practices, including constant speed and course maintained by seismic and support vessels. • Trained observer on the seismic vessel to ensure that air source s are shut down if endangered or threatened cetaceans are present within 500 m of the seismic vessel. • Ramp-up procedure will be implemented, prior to start. Ramp-up will be delayed if a marine mammal is present within 500 m of the seismic vessel.	
Significance evaluation	
Likelihood of occurrence	Medium
Geographic extent	Immediate to Regional for disturbance effects
Frequency of occurrence	Intermittent during 2-D data acquisition (90 days)
Duration of impact	Immediate
Magnitude of impact	Low
Permanence/reversibility	Reversible, immediate recovery after Project activities cease
Significance of Effect	Not adversely significant
Confidence	
• High level of confidence related to significance rating given international and local industry experience.	

6.5 Sea Turtles

Sea turtles are tropical and sub-tropical animals and will have migrated out of the Gulf of St. Lawrence and are not considered further for this seasonal amendment report.

6.6 Species at Risk

6.6.1 Boundaries

The spatial boundaries of interaction between species at risk and the Project are primarily related to the zone of influence as predicted by modelling of noise attenuation from the seismic array.

Ecological spatial boundaries vary between the various species at risk although it is recognised that most species at risk range beyond the Project Area:

- There are no known spawning areas for fish species at risk within the Regional Area in January and February.

- The ecological temporal boundary for marine bird species at risk includes the overwintering habitat of Harlequin Ducks. This species uses the nearshore coastal waters and watercourses in Gros Morne National Park and has limited potential for interaction with this Project. There are no known nesting grounds for the Ivory Gull in the Affected Area, and any presence in the area is expected to be incidental.
- Data on winter occurrence is poor to non-existent on the four species of marine mammals at risk to occur in the Gulf of St. Lawrence (Lesage *et al.* 2007). They may occur in the Affected Area and can be potentially affected by Project activities.

6.6.2 Potential Issues and Interactions

Potential interactions between routine Project activities and species at risk relate primarily to behavioural and physiological effects associated with air source operations. These disturbances may lead to the following effects:

- direct physical effects associated with seismic noise;
- behavioural effects associated with seismic noise; and
- auditory and communication masking by seismic noise in fish and mammals.

There are also likely interactions associated with operation of the seismic vessel and vessel traffic, particularly for bird species (*e.g.*, attraction noise and lights), and marine mammals (*e.g.*, collisions with vessels).

6.6.3 Significance Criteria and Evaluation

A significant, adverse environmental effect is one that, after application of all feasible mitigation and consideration of all reasonable Project alternatives:

- will prevent the achievement of self-sustaining population objectives or recovery goals;
- will result in exceedance of applicable allowable harm assessments; and or
- for which an incidental harm permit would not likely be issued. Due to the sensitive nature of species at risk, residual adverse effects on one individual may be considered significant.

A non-significant, adverse environmental effect is one that, after application of all feasible mitigation and consideration of all reasonable Project alternatives:

- results in threats to individuals, residences or critical habitat of listed species that does not jeopardize the survival or recovery of the species;
- does not result in exceedance of applicable allowable harm assessments; and or
- for which an incidental harm permit would likely be issued.

6.6.4 Effects Assessment and Mitigation

Potential effects on species at risk are discussed in Section 6.1.4 for marine and migratory birds, and Section 6.3.4 for marine mammals.

Recovery plans for the species at risk that may or do occur in the Affected Area are discussed below with respect to mitigation measures applied to the Project. Recovery plans for blue whales is pending and will be considered over the course of the eight year period, if they become available.

6.6.4.1 Marine and Migratory Bird Species At Risk

Harlequin Ducks

Potential impacts of vessel traffic on Harlequin Ducks have been identified in the 'Management Plan for the Harlequin Duck (*Histrionicus histrionicus*) Eastern Population, in Atlantic Canada and Quebec' (Environment Canada 2007). Vessel traffic will be well offshore and out of range of any direct impact with Harlequin Ducks; however, in the unlikely event of disturbance, mitigation measures are addressed below.

Harlequin Ducks are potentially impacted by vessel activity mainly during the moulting and wintering period. One of the most significant threats to North American moulting and wintering population of Harlequin Ducks is potential for oil contamination. Minimal amounts of oil will be aboard the seismic vessel. Potential oil spillage may occur from ballast and bilge water discharge but will be regulated to ensure that oil concentrations in the discharge do not exceed 15 mg/L as required by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1972, and the Protocol of 1978 related thereto), International Maritime Organization and OWTG. Any accidental spills will be reported to the C-NLOPB immediately.

6.6.4.2 Marine Mammal Species at Risk

North Atlantic Right Whale Recovery Plans

Several potential impacts of vessel traffic on North Atlantic right whales have been identified in the 'Canadian North Atlantic Right Whale Recovery Plan' (Fisheries and Oceans Canada 2000. Areas of concern related to vessel traffic and mitigation measures are addressed below.

Vessel collisions, noise disturbance and habitat degradation have been identified as three of the main threats to North Atlantic right whale. To mitigate these potential risks, vessels will gradually increase the intensity of the air source discharge to allow time for whales and turtles to avoid the sound. In addition, a qualified offshore Environmental Observer from the vessel will be assigned to look for evidence of North Atlantic right whales (*i.e.,* whale footprints, surfacing) in the vicinity of the vessel. In the event of whale species presence, the vessel will cease seismic activity and take appropriate measures to avoid collision. Vessel operations will only commence when North Atlantic right whales are outside a 500 m safety radius of the seismic activity.

Petroleum spills are a major threat to North Atlantic right whale recovery. Minimal amounts of oil will be aboard the seismic vessel. Potential oil spillage may occur from ballast and bilge water discharge but will be regulated to ensure that oil concentrations in the discharge do not exceed 15 mg/L as required by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1972, and the Protocol of 1978 related thereto), International Maritime Organization and OWTG. GSI will contract a seismic vessel equipped with solid-streamer technology, as this type of streamer is not reliant on floatation fluid to achieve a neutral ballast state, thus reducing the risk of accidental spill. Any accidental spills will be reported to the C-NLOPB immediately.

Marine noise is a highly emotive issue as it affects cetaceans (large marine mammals, such as whales, dolphins and porpoises). Initial studies have established that noise generated from offshore operations present a low risk to marine life, but due to a lack of data for sensitive species, this statement cannot be adequately defined in all cases. There are no documented cases of marine mammal mortality from exposure to seismic sounds and DFO (2004) considers it unlikely that mammal mortality would be caused by seismic sound exposure.

A dedicated Environmental Observer will be onboard the seismic vessel. If a concentration of marine mammals is observed in a particular area, the survey can shift to another part of the survey area until the concentration has moved away. This, along with a 30-minute ramp-up procedure will ensure that whale species at risk in the Affected Area are not significantly affected.

The potential effects from vessels on marine mammals include strikes, temporary behavioural (aversion or attraction) effects, and effects from vessel noise. The physical presence of the vessel during seismic surveys does not typically result in significant adverse effects. Marine species, in particular marine mammals, are expected to easily avoid the vessel during seismic surveys due to exhibited avoidance behaviour to noise and the slow speed of the ship. The survey vessel will likely travel at an average speed of 4.5 kn when the survey gear is deployed and will increase to approximately 10 kn while in transit. While the potential for collision exists, collision events are predicted to be unlikely. Collision with an endangered species would be considered significant; however, since there are no records of collision between the listed species at risk and seismic vessels, the probability of occurrence is considered low.

Physical harm is expected to be mitigated by using ramp-up or soft-start procedures which will encourage whales to move from the area prior to physical effects occurring. The *Statement of Canadian Practice for Mitigation of Seismic Noise in the Marine Environment* (DFO 2008) for ramp-up and shut down of the air sleeves will be closely followed to avoid death, harm or harassment of individuals of marine mammals listed under *SARA*. Specifically, the ramp-up of the air sleeve to seismic survey capacity will occur over a 20- to 40-minute period to initiate a behavioural avoidance response in marine mammals whereby they will leave the Project Affected Area prior to experiencing hearing damage.

GSI will make the necessary arrangements to ensure that a qualified Environmental Observer will be on board the survey vessel at all times during the survey period. The observer will conduct continuous monitoring for marine mammals for 30 minutes prior to start-up of the seismic array.

6.6.5 Follow Up and Monitoring

Monitoring of species at risk is the same as for unlisted species discussed in the appropriate VEC sections above and in the original EA report.

6.6.6 Cumulative Effects

Seismic vessel activity is a minor component of total marine transportation. Two other geophysical surveys are anticipated on the west coast of Newfoundland during Fall 2008 and Winter 2009, compared with the multitude of commercial tanker, cargo ships, in the vicinity of the western coast of Newfoundland. The additional vessel activity from the survey is negligible compared to the other vessels and cumulative impacts on species at risk are not significant.

In general, because the sounds generated by seismic surveys are transient and do not "accumulate" in the environment, the most likely cumulative effects will be associated with other concurrent activities (*e.g.*, cargo ships, tankers, oil and gas exploration and production activities, other seismic surveys, fishing vessels). Studies in the Gulf of Mexico showed that seismic surveys produce a relatively minor contribution to the overall underwater noise environment (MMS 2004). The cumulative effect is short term, intermittent and localised, and therefore, not significant with respect to affects on species at risk.

Two seismic exploration projects may be active in the vicinity of the Project Area. PDI Productions Inc. was to commence work in the fall of 2008 in the Port au Port area (EL 1070) but if the Project undergoes unavoidable delays, the seismic work could be undertaken anytime in the next three years. Tekoil and Gas Corp. was to conduct seismic work over part of, and adjacent to, the Port au Port Peninsula (EL 1071) during a six-week period from October 2008 to April 2009. It appears that neither survey is to be undertaken in January and February 2009; thus there will be no temporal overlap. If these other seismic surveys being conducted on the west coast within the proposed timeframe, a significant distance between surveys will be necessary to prevent both operational conflict and acoustical interference. This will reduce or eliminate the likelihood that the sound levels from two surveys will be additive in a particular area, and reduce the potential for cumulative effects on species at risk. The Tekoil survey area is 79 km away from the GSI southern survey area, and PDI is 46 km away.

In general, the seismic survey vessel activity and noise will constitute a minor percentage contribution to the overall noise generated by other such sources and space-user conflict, and will be of short duration in local areas. Based on current knowledge, and especially with the proposed mitigation procedures in place, the proposed Project is not expected to result in or contribute to any significant cumulative impacts on species at risk.

6.6.7 Summary

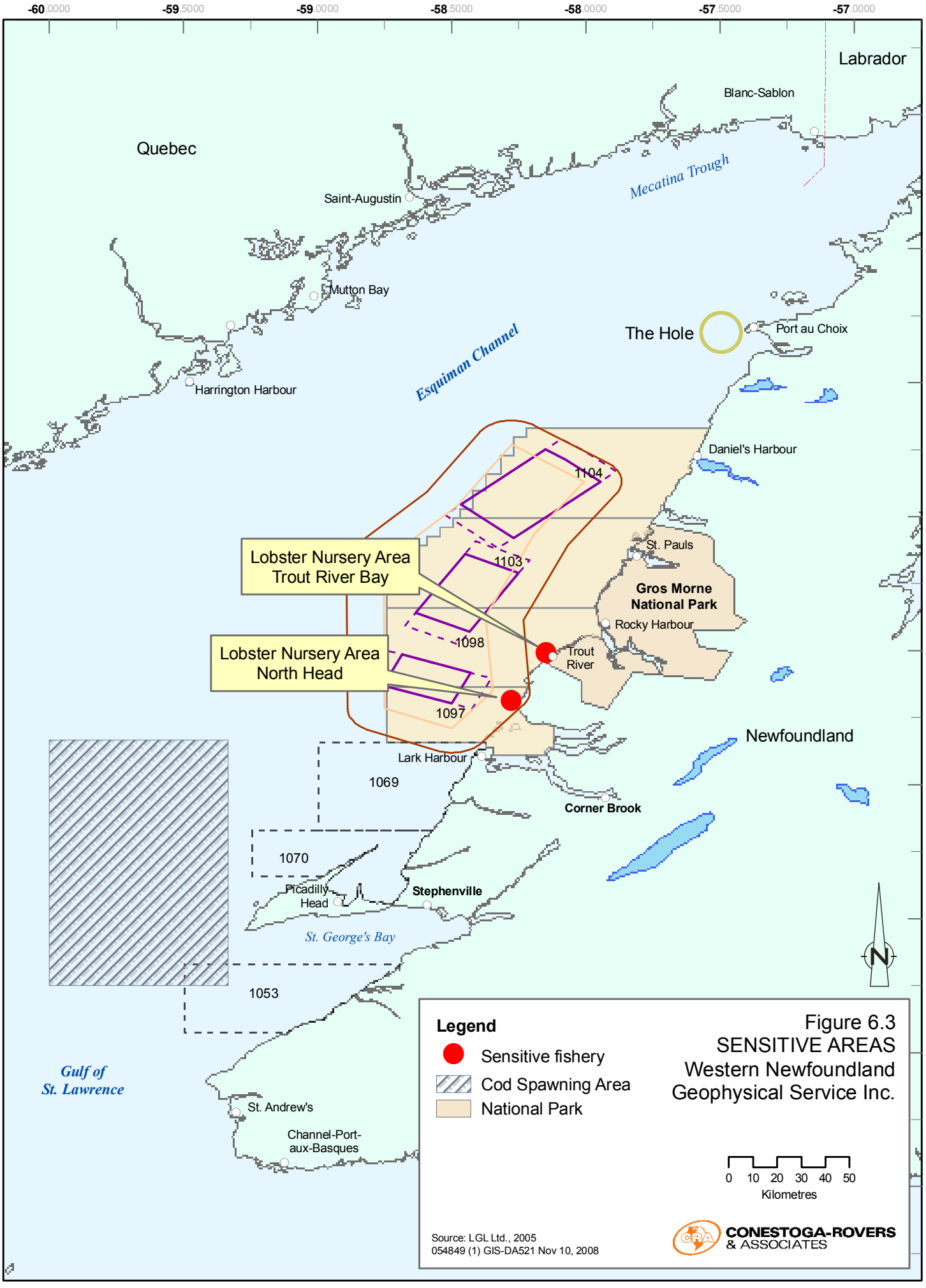
A summary of potential interactions, environmental effects, mitigation, and cumulative and residual environmental effects are provided in Table 6.6.

Table 6.6 Summary of Environmental Assessment for Species at Risk

Interactions ▪ Direct physical effects associated with seismic noise (*e.g.*, auditory damage). ▪ Behavioural effects associated with seismic noise (*e.g.*, avoidance, changes in migration, and feeding). ▪ Communication masking by seismic noise in fish and mammals (*e.g.*, during feeding). ▪ Disturbance from vessel noise and lights.	
Impact Analysis Potential adverse environmental effects on species at risk will be unlikely because of planned monitoring and mitigation measures. In addition, species at risk are expected to show some avoidance of the areas of highest received levels of seismic sounds. Therefore, there is not likely to be a significant adverse environment effect on species at risk.	
Mitigation ▪ Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment* to the extent reasonably practical. ▪ A 500 m safety zone monitoring program for whale species at risk during survey data acquisition will be implemented. ▪ A dedicated Environmental Observer will be onboard the seismic vessel. If a concentration of marine mammals is observed in a particular area, the survey can shift to another part of the survey area until the concentration has moved away. ▪ To minimize sudden changes in noise levels, a ramp up procedure will be implemented. ▪ Collision avoidance practices, including constant speed and course maintained by seismic vessels. ▪ Compliance with OWTG (NEB *et al.* 2002) for all discharges. ▪ Avoidance of bird nearshore overwintering Harlequin Ducks in Gros Morne National Park	
Significance	
Likelihood of occurrence	Medium
Geographic extent	Local to Regional for disturbance effects.
Frequency of occurrence	Intermittent for the 2-D program (90 days)
Duration of impact	Immediate
Magnitude of impact	Low
Permanence/reversibility	Reversible, immediate recovery after Project activities cease.
Significance of Effects	Not adversely significant
Confidence	
High level of confidence based on previous seismic surveys.	

6.7 Sensitive Areas

Special Areas include "sensitive areas" such as important or critical habitat that may be affected by the Project, or areas that have special conservation status by law. There are four sensitive areas within and in close proximity to the Project Area: Gros Morne National Park, two lobster nursery areas and the cod spawning area (Figure 6.3). Details of these sites are provided in Section 5.2.8 of the original EA report.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Saint-Augustin
Mutton Bay
The Hole
Port au Choix
Esquiman Channel
Harrington Harbour
Daniel's Harbour
1104
Lobster Nursery Area
Trout River Bay
1103
St. Pauls
Gros Morne
National Park
Rocky Harbour
1098
Lobster Nursery Area
North Head
Trout
River
1097
Newfoundland
Lark Harbour
1069
Corner Brook
1070
Stephenville
Picadilly
Head
St. George's Bay
1053
Gulf of
St. Lawrence
St. Andrew's
Channel-Port-
aux-Basques
N
Legend
Sensitive fishery
Cod Spawning Area
National Park
Figure 6.3
SENSITIVE AREAS
Western Newfoundland
Geophysical Service Inc.
0 10 20 30 40 50
Kilometres
Source: LGL Ltd., 2005
054849 (1) GIS-DA521 Nov 10, 2008
CONESTOGA-ROVERS
& ASSOCIATES

There will be no incursion of the vessel into the cod spawning area and navigation of the seismic vessel for turning purposes will be a minimum of 35 km distance. The Project Area is located 30 km offshore of Gros Morne National Park and will not interact with Harlequin Ducks.

With respect to temporal boundaries, the potential interactions of concern are those related to the seismic activities that could occur in January and February 2009 for the first seismic survey. Surveys between May and December within the next seven-year (2009 to 2015) time period were addressed in the original EA report. There are no anticipated potential interactions between Project activities and sensitive areas because there are no direct effects to lobster larvae nursery areas and cod spawning areas by noise and accidental spill events in January or February as lobster larvae are settled on the seafloor and cod are not spawning; and there are no anticipated direct effects to the coastal environment and ecosystem of Gros Morne National Park from accidental events.

6.8 Commercial Fisheries

Commercial fisheries are important to the economy of Newfoundland and considered a VEC for this assessment due to potential interactions between the seismic vessel and fishing gear and vessels. There is no commercial fish harvesting being undertaken in January or February; therefore, there is no interaction between the GSI Survey over these two months and fish harvesting. This VEC Is not considered further.

7.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

7.1 Meteorology and Oceanography

Extreme conditions may affect schedule and program operations. Seismic surveys (data quality) are limited by waves in excess of three metres. Meteorological and oceanographic monitoring through weather forecasting services will be undertaken to anticipate severe weather conditions. Degradation of data quality due to poor weather conditions is a determinating factor for operations.

7.2 Sea Ice and Icebergs

Icebergs of Newfoundland and Labrador typically do not extend into the Gulf of St; Lawrence as far south as the Affected Area. The seismic surveys will extend into a month where freeze up occurs in the Project Area. GSI will only work with very thin surface ice if it occurs as the vessel is capable of break it up and it would be of no consequence to the vessel. The cables are towed at eight metres below surface and well below any surface ice. If ice conditions were of a thickness to damage the cables, the data collection conditions would be unsuitable. GSI will watch for ice flows and where there is any risk to the vessel or equipment they will avoid the ice flows or cease operations.

8.0 SUMMARIES AND CONCLUSIONS

8.1 Summary of Mitigation and Follow-Up

Table 8.1 summarises mitigating measures and follow-up procedures that are recommended in this Amendment Report.

Table 8.1 VEC-Specific Mitigative Measures and Follow-Up

VEC	Mitigation Measures	Follow up and Monitoring
Marine and Migratory Birds	Compliance with NWest WMP, *Canada Shipping Act,* OWTG and MARPOL for all discharges. A fuel transfer plan will be developed and implemented. Any handling of stranded birds will follow CWS and industry protocols. A dedicated Environmental Observer will be on board the seismic vessel to record marine birds. Vessel compliant with audit prior to survey. Maintenance of streamer equipment and responsible management of such equipment. Avoidance of overwintering Harlequin Ducks in Gros Morne National Park by vessel.	Sightings data for seabirds will be summarised in a monitoring report which will be submitted to C-NLOPB and CWS. Records of bird strandings will be provided to the C-NLOPB for distribution to interested parties. DFO will be contacted on the sighting of dead and or injured seabirds. DFO will be notified if GSI is responsible for the harm to seabirds.
Marine Fish and Shellfish	Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment,* to the extent reasonably practical. To minimize sudden changes in noise levels, a 30 minute ramp up procedure will be implemented.	No follow up or monitoring required for routine activities
Marine Mammals	Before start of the operations, a meeting will be held with GSI representatives and seismic company representatives to review sail lines, scheduling, anticipated fishing vessels and gear types, mitigating measures, expectations of all parties and Emergency Response Plans. An Environmental Observer will be onboard the vessel throughout the duration of the survey. The Fisheries Liaison Observer and Environmental Observer will record sightings of marine mammals on a daily basis as per protocol. A 20 to 40 minute ramp-up procedure will be undertaken. Ramping up will be delayed if a marine mammal is observed in the 500 m safety zone. Air sources will be shut down or reduced to a smaller air source while the vessel is doing turns between survey lines. The Environmental Observer will ensure the delay or shut down of seismic operations if endangered or	A trained observer will record marine mammal and seabird observations. All spills will be reported. DFO will be contacted on the sighting of dead and or injured marine mammals. DFO will be notified if GSI is responsible for the harm to marine mammals.

Table 8.1 VEC-Specific Mitigative Measures and Follow-Up

VEC	Mitigation Measures	Follow up and Monitoring
	threatened whales are present within 500 m. Any re-start of the air source array will follow the ramping up procedure. Collision avoidance practices, including constant speed and course maintained by seismic and support vessels. Vessels will maintain a steady course and speed, and use existing travel routes, where possible.	
Species at Risk	Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment* to the extent reasonably practical. Same as above for marine birds and marine mammals	A trained observer will record marine mammal, sea turtles and seabird observations. All spills will be reported.
Sensitive Areas	Dedicated Environmental Observer will be on board the seismic vessel to record marine birds and marine mammals. Vessel compliant with audit prior to survey. Maintenance of streamer equipment and responsible management of such equipment. Compliance with OWTG (NEB *et al.* 2002) for all discharges. Avoidance of overwintering Harlequin Ducks in Gros Morne National Park by vessel.	No follow up or monitoring required for routine activities All spills will be reported.
Commercial Fisheries	A Notice to Mariners on the location and scheduling of seismic activities will be issued. Communication mechanisms will be developed with the fishing industry and DFO research surveys. Environmental Observers on the vessel will monitor fishing activity in the vicinity of the seismic vessel and serve as a liaison between the fishing vessels and the seismic vessel; GSI will comply with C-NLOPB's compensation guidelines.	No follow up or monitoring required for routine activities

8.2 Conclusions

The Project Area is not known to be an important feeding, rearing or mating area for any of the listed species that could occur in the area. Commercial fishing will not occur in January and February. With the use of appropriate mitigation, all Project effects have been rated as not adversely significant. Most of the species that could occur in the Project Area are more vulnerable to direct and indirect fishing activities; entanglement in fishing gear; collisions with ships; and/or pollution. As described in this report, all appropriate mitigation measures and response planning will be in place to limit pollution as a result of the Project; vessel activity will generally be restricted to the immediate Project Area; and noise levels associated with the Project are not predicted to

result in physical harm to marine birds, marine fish/shellfish, or marine mammals. Previous 2-D seismic surveys conducted in this area have not resulted in claims of significant adverse effects to biological or socio-economic VECs of the area. Based on the above, no harm to listed species or their critical habitat is anticipated to occur as a result of the Project in January or February. This is consistent with the recent review by the Mineral Management Service (2004) on environmental effects of seismic activities in the Gulf of Mexico, which have shown that adverse significant effects from a much larger number of seismic programs are not apparent beyond the immediate localised project areas.

The significance of residual environmental effects (*i.e.*, after mitigation has been applied), including cumulative effects, is predicted not likely to be significantly adverse for all VECs. In conclusion, this environmental assessment predicts that GSI's proposed 2-D seismic program surveys can be conducted with no likely significant adverse effects on the biological and socio-economic resources of the west coast of Newfoundland.

9.0 REFERENCES

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APPENDIX A

The Leach's Storm-Petrel: General Information and Handling Instructions

The Leach's Storm-Petrel:
General information and handling instructions

Urban Williams (Petro-Canada)
&
John Chardine (Canadian Wildlife Service)

The Grand Banks is an area that is frequented by large numbers of seabirds, representing a variety of species. Large populations are found in this area in both summer and winter, and come from the Arctic, northern Europe, and the south Atlantic, as well as from colonies along the Newfoundland Coast. One of the species found in the area of the Terra Nova Field is the Leach's Storm-Petrel (*Oceanodroma leucorhoa*).


Photo : Gilles Chapdelaine

The Bird:

Leach's Storm-Petrels are small seabirds, not much bigger than a Robin. They have relatively long wings and are excellent fliers. Leach's Storm-Petrels are dark brown in colour and show a conspicuous white patch at the base of the tail. In the hand, you can easily notice a small tube at the top of their bill, and you will also notice that the birds have a peculiar, not unpleasant smell (although some Newfoundlanders call these birds "Stink Birds"). Storm-Petrels are easy prey for gulls and other predators, and so to protect themselves from predation, Leach's Storm-Petrels are only active at night when on land at the breeding colonies.

Nesting Habitat:

Leach's Storm-Petrels are distributed widely in the northern hemisphere, however, their major centres of distribution are Alaska and Newfoundland. The bird breeds on offshore islands, often in colonies numbering tens or hundreds of thousands of pairs, even millions at one colony in Newfoundland. The nest is a chamber, sometimes lined with a some grass, located at the end of a narrow tunnel dug in the topsoil.. Depending on the colony, burrows may be under conifer or raspberry thickets or open grassland.

Reproduction:

In Newfoundland, Leach's Storm-Petrels lay their single egg in May and June. The egg is incubated by both parents alternately, sometimes for stretches exceeding 48 hours. The egg is incubated for 41-42 days, which is a long time for such a small egg. The peak hatching period is in the last half of July. The young petrel remains in the tunnel for about 63-70 days. Once breeding is over in late-August or early September, the birds disperse from the colonies and migrate to their wintering grounds in the Atlantic. September is the most important period for migration of Storm-Petrels to the offshore areas such as near the Terra Nova field.

Populations:

Canada alone supports more than 5 million pairs of Leach's Storm-Petrels. Most of them are found in Newfoundland. The Leach's Storm-Petrel colony located on Baccalieu Island is the largest known colony of this species.

Nesting sites for Leach's Storm-Petrels are found along the southeast coast of Newfoundland. These are - i) Witless Bay Islands (780,00 nesting pairs), ii) Iron Island (10,000 nesting pairs), iii) Corbin Island (100,000 nesting pairs), iv) Middle Lawn Island (26,000 nesting pairs), v) Baccalieu Island (3,336,000 nesting pairs), vi) Green Island (72,000 nesting pairs), and vii) St. Pierre Grand Columbier (100,000 nesting pairs).

Feeding Habits:

Leach's Storm-Petrels feed at the sea surface, seizing prey in flight. Prey usually consists of myctophid fish and amphipods. The chick is fed planktonic crustaceans, drops of stomach oil from the adult bird, and small fish taken far out at sea. Storm-Petrels feed far out from the colony and it would be reasonable to assume that birds nesting in eastern Newfoundland can be found feeding around the Terra Nova site.

The Problem:

As identified in the C-NOPB Decision 97-02, seabirds such as Leach's Storm-Petrels are attracted to lights on offshore platforms and vessels. Experience has shown that Storm-Petrels may be confused by lights from ships and oil rigs, particularly on foggy nights, and will crash into lighted areas such as decks and portholes. Fortunately, this type of accident does not often result in mortality, however, once on deck the bird will sometimes seek a dark corner in which to hide, and can become fouled with oil or other contaminants on deck.

Period of Concern:

Leach's Storm-Petrels are in the Terra Nova area from about May until October and birds could be attracted to lights at any time throughout this period. The period of greatest risk of attraction to lights on vessels appears to be at the end of the breeding season when adults and newly fledged chicks are dispersing from the colonies and migrating to their offshore wintering grounds. September is the most important period for migration of storm-petrels to the offshore areas. Past experience suggests that any foggy night in September could be problematic and may result in hundreds or even thousands of birds colliding with the vessel.

The Mitigation:

On nights when storm-petrels are colliding with the vessel, the following steps should be taken to ensure that as many birds as possible are safely returned to their natural habitat.

- All decks of the vessel should be patrolled as often as is needed to ensure that birds are picked up and boxed (see below) as soon as possible after they have collided with the vessel. After collision, birds will often "freeze" below lights on deck or seek dark areas underneath machinery and the like.
- Birds should be collected by hand and gently placed in small cardboard boxes. Care should be taken not to overcrowd the birds and a maximum of 10-15 birds should be placed in each box, depending upon its size. The birds are very easy to pick up as they are poor walkers and will not fly up off the deck so long as the area is well-lit. They will make a squealing sound as they are picked up- this is of no concern and is a natural reaction to be handled (the birds probably think they have been captured to be eaten!).
- When the birds are placed in the box the cover should be put in place and the birds left to recover in a dark, cool, quiet place for about 5-10 minutes. The birds initially will be quite active in the box but will soon settle down.
- Following the recovery period, the box containing the birds should be brought to the bow of the boat or to some other area of the vessel that has minimal (if any) lighting. The cover should be opened and each bird individually removed by hand. The release is usually accomplished by letting the bird drop over the side of the vessel. There is no need to throw the bird up in the air at release time. If the birds are released at a well-lit part of the vessel they usually fly back towards the vessel and collide again.
- If any of the birds are wet when they are captured (i.e. they drop into water on the deck) then they should be placed in a cardboard box and let dry. Once the bird is dry it can be released as per the previous instruction. Also, temporarily injured birds should be left for longer to recover in the cardboard box before release.
- Any birds contaminated with oil should be kept in a separate box and not mixed with clean birds. Contact Canadian Wildlife Service at (709) 772-5585 for instructions on how to deal with contaminated birds.
- In the event that some birds are captured near dawn and are not fully recovered before daylight, they should be kept until the next night for release. Storm-Petrels should not be released in

daylight as at this time they are very vulnerable to predation by gulls. Birds should be kept in the cardboard box in a cool, quiet place for the day, and do not need to be fed.

- Someone should be given the responsibility of maintaining a tally of birds that have been captured and released, and those that were found dead on deck. These notes should be kept with other information about the conditions on the night of the incident (moonlight, fog, weather), date, time, etc). THIS IS A VERY IMPORTANT PART OF THE EXERCISE AS IT IS THE ONLY WAY WE CAN LEARN MORE ABOUT THESE EVENTS.

Handling Instructions:

- Leach's Storm-Petrels are small, gentle birds and should be handled with care at all times.
- It is recommended that the person handling the birds should wear thin rubber gloves or clean, cotton work gloves. The purpose of the gloves is to protect both the Storm-Petrel and the worker.
- As mentioned Storm-Petrel's have a strong odor that will stick to the handler's hands. Washing with soap and water will remove most of the smell.
- Handling Leach's Storm-Petrels does not pose a health hazard to the worker, however some birds may have parasites on their feathers, such as feather lice. These parasites do not present any risk to humans, however, as a precaution we recommend wearing cotton work gloves or thin rubber gloves while handling birds and washing of hands afterwards.

Wilson's Storm Petrels:

A relative of the Leach's Storm-Petrel is the Wilson's Storm-Petrel. They breed in the south Atlantic and Antarctica and migrate north in our spring to spend the summer in Newfoundland waters. This species is very numerous on the Grand Banks in the summer, and shares the same nocturnal habits as the Leach's Storm-Petrel. Thus it is possible that Wilson's Storm-Petrels may also be attracted to the lights of a vessel at night. The two species are very similar and should be handled in the same way as described above for our Leach's Storm-Petrel.

Permits:

A permit to handle storm-petrels issued by the Canadian Wildlife Service will be held on board the vessel to cover personnel involved in bird collision incidents.

APPENDIX B

Report Of Migratory Birds Salvaged

REPORT OF MIGRATORY BIRDS SALVAGED UNDER THE AUTHORITY OF A FEDERAL MIGRATORY BIRD PERMIT

In compliance with the provisions of the Migratory Birds Convention Act and Regulations, I am submitting below a complete report of the number of specimens of each species of migratory bird salvaged during the year of 200____ under the authority of Permit # _____, issued under Section 4(1) of the Act.

NAME OF PERMIT HOLDER _____ TELEPHONE_____
(PLEASE PRINT)
ADDRESS _____ POSTAL CODE _____

_____

SIGNATURE _____ DATE _____

Return to: Permit Section, Atlantic Region
Canadian Wildlife Service
P.O. Box 6227
Sackville, New Brunswick
E4L 1G6

I wish to renew my permit Yes ___ No ___ (attach any changes needed)

Specimens Salvaged and released

Common Name	Date	Number Collected			Number and Date Released
		Live	Dead		

March 2003

Canadian Wildlife Service – Permit Application

Salvage of Live Seabirds for Release

Name

Tel:
Fax:

e-mail address

Organization

Address

Project Title

Project Description

Purpose of Project :

Project Status: ☐ new ☐ ongoing

Project duration (years) _____

Summary Description:

Area of Activities:

Date of Activities:

Species expected to be salvaged for release:

Methods or protocol followed for handling and release:

Proposed disposition of dead birds: Other Participants (nominees) -

Signature of Applicant:	Date:

Please attach:

1. Two referrals/testimonials of support for the project (for **new proposals only**)

Send completed form to:

e-mail address: donna.johnson@ec.gc.ca

mailing address: Canadian Wildlife Service/Service canadien de la faune
Environment Canada/Environnement Canada
17 Waterfowl Lane, P.O. Box 6227
Sackville, N.B. E4L 1G6

Phone: (506) 364-5044
Fax: (506) 364-5062

APPENDIX C

Standardized Protocols For Pelagic Seabird Surveys From Moving Platforms

STANDARDIZED PROTOCOLS FOR PELAGIC SEABIRD SURVEYS FROM MOVING AND STATIONARY PLATFORMS

(Experienced Observers)

VERSION 1.2 – JULY 2006

Canadian Wildlife Service
Environment Canada – Atlantic Region
Dartmouth, Nova Scotia

Version 1.2

6 July 2006

Environment Canada Environnement Canada
Atlantic Region Région de l'Atlantique

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LIST OF APPENDICES

1. INTRODUCTION

Protocol objectives. The main objective of this protocol is to ensure that observers conducting surveys at sea are recording data in a consistent, unbiased fashion that permit subsequent conversion into seabird densities. Such data are important for the monitoring of seabird abundance and species composition over space and time, which in turn help support future environmental assessments, and assess potential impacts of the hydrocarbon industry, as well as chronic ship-based oil pollution. This protocol is tailored after current methods used elsewhere in the world, making these data comparable to datasets of other geographic areas. Two protocols are presented here for surveys conducted from two types of observation platforms: moving (e.g., fishing fleet, seismic vessel) and stationary (e.g., oil production rig, supply vessel on stand-by).

Observer requirements. These survey protocols should be used by observers with some level of experience conducting pelagic seabird surveys to ensure that appropriate information is collected in a consistent fashion for maximum value. Observers should have adequate training in seabird identification, and in methods for conducting and recording observations in a standardized way. Observers should also be dedicated to conducting surveys at sea while on the platform, and should not have other potentially conflicting duties. Less experienced observers, and those tasked with multiple duties who might have limited time to conduct seabird observations, are encouraged to follow the modified version of this protocol that requires less experience and focussed attention *(Standardized Protocols for Seabird Surveys from Moving and Stationary Platforms for the Hydrocarbon Industry*, CWS publication).

2. SEABIRD SURVEY PROTOCOL FROM MOVING PLATFORMS

2.1. General methodology

Observer position. Whenever possible, conduct observations at a high location near the front of the platform. A high position facing the bow of the vessel (e.g., on the bridge) increases the detection rates of birds, especially species that dive to escape, such as auks. If weather permits, observations can be conducted from a position outdoors.

The transect method. Conduct surveys while looking forward from the moving platform, scanning at a 90° angle from either the port or starboard side, limiting observations to a transect band 300m wide from the side of the platform (Appendix I). This band is referred to as the area "in transect".

Estimating transect width. Estimate the width of the 300m transect prior to beginning observations. This can be done by practicing with a buoy towed on a 300m rope behind a moving platform, using a range finder on a stationary object (e.g., a buoy) while the platform is docked, or using a slide calliper (Appendix III).

Ten-minute periods. A survey consists of a series of ten-minute observation periods, which are exclusively dedicated to detecting birds at sea. Only take breaks at the end of a ten-minute period. Conduct as many consecutive ten-minute observation periods as possible, regardless if birds are present or not, and try to ensure consistent coverage throughout the day.

Continuous counts of birds. Scan the transect continuously by eye, to count and identify birds present in air or on water. Use binoculars to confirm the species identification, and other details, such as age, moult, carrying fish, etc. Scan ahead regularly (e.g., every minute) to detect birds that may dive as the platform approaches. If large concentrations of birds in the transect fly off as the moving platform approaches, use binoculars to help count individuals, and record these as being on water.

Birds on water. Continuously record all birds observed on the sea surface throughout the ten-minute period, and estimate their distance perpendicular from the mid-line of the platform (see Appendix VII for distance categories). Leach's Storm-petrels observed tapping the surface of the water with feet and bill, and Northern Gannets diving into the sea, should be recorded as being on water with the behaviour code that indicates feeding (Appendix X).

Birds in flight. Flying birds are not recorded continuously throughout the 10-minute period, as this would overestimate bird density. Instead, record flying birds using instantaneous counts, or "snapshots", at regular intervals throughout the observation period. The number of snapshots conducted will depend on the speed of the platform (see Appendix IV for time intervals between snapshots). For example, if the platform is moving at a speed of 10 knots, snapshots will occur every minute for the 10-minute observation period. During each snapshot, record flying birds as "in transect" only if they are above the 300m strip transect AND observed when the snapshot is being done. If possible, estimate the distance of the flying bird *when it was first observed* (see Appendix VII for distance categories). Record all other flying birds that are seen outside of the transect or between snapshot intervals as "not in transect", and estimate their distance at the time they were first observed. See Appendix XI for an example of how to record data for birds on water and in flight.

Minimum requirements. Only conduct observations when the platform is travelling at a minimum speed of 4 knots (7.4 km/h) and a maximum of 19 knots (35.2 km/h).

Poor visibility. When a scheduled observation cannot be conducted because visibility is poor due to rain or fog (i.e., when the entire width of the 300m transect is not visible), fill in the Observation Period Information, and write in the notes section why the observation was not conducted.

Null observation periods. Record "No birds observed" when no birds were detected during a ten-minute period, as this type of information is also important.

2.2. Recording information related to each observation period

Observation period information. It is important to fill in all the fields under the heading "Observation period information" of the data sheet at the beginning of every ten-minute observation period. **See Appendix V for detailed notes on filling in each field.**

Bird information. Use appropriate codes to record the following information (in this order of priority) for all birds observed during the period, whether within or outside the transect:

1) Species (see Appendix VIII for list of species code)
2) Number of individuals
3) Flying (***F***) or on the water (***W***)
4) In transect? ***Y*** or ***N***
5) Distance from vessel using categories (see Appendix VII for distance codes)
6) Association (see Appendix X for association codes)
7) Behaviour (see Appendix X for behaviour codes)
8) Compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***) in which birds in flight are heading, if they are not associated with platform.
8) Age (***J***, ***I***, or ***A***)
9) Plumage of adults (***B***, ***NB***, and/or ***M***)
10) Sex (***M*** or ***F***)

See Appendix VII for detailed notes on filling in each field.

Grouping observations. Record groups of birds in the same data row, if they behave as a group and have the same morphological and behavioural characteristics (e.g., all adults in breeding plumage flying in the same direction; see example in Appendix XI). Record other individuals from the group that have different characteristics (e.g., juveniles) in the next row, and associate this record with the previous one by drawing a line that links the two rows (see example in Appendix XI.3f).

3. SEABIRD SURVEY PROTOCOL FOR STATIONARY PLATFORMS

3.1. General methodology

The scan method. Observations from stationary platforms are conducted using instantaneous counts, or "snapshots" of birds within an area that is scanned at regular intervals throughout the day. The length of the survey will depend on the number of birds present at the time of the scan, and may last only a few seconds if no birds are present.

Observer position. Whenever possible, conduct scans from a position outdoors, as close to the edge of the platform as permitted. A position near the edge will increase the detection rates of birds, especially for individuals that use the waters at the base of the platform. Conduct scans at the same location each time, and ensure that other observers use the same location.

Delineated survey area. Conduct surveys by scanning at a 180° angle, limiting observations to a semi-circle around the observer, with a radius of 300m from the edge of the platform (see Appendix II). Sweep the area only once per scan, from one side to the other, and systematically record all birds on water and in flight within the area at that time.

Estimating "in observation" area. Estimate the 300m distance prior to beginning observations. You can base your estimate on the known width of the platform or fixed structure, or by using a slide calliper (see Appendix III).

Frequency of scans. Scan the same area once every 2 hours from morning to evening, regardless if birds are present or not.

Snapshot counts of birds. Scan the area once per survey. If the stationary platform is high (e.g., an oil production platform), use binoculars to count and identify birds present in the air or on the water. Use a telescope to confirm species identification and other details, such as moult, age, carrying fish, etc. If the stationary platform is relatively low (e.g., a supply vessel on stand-by), scan the area by eye to count and identify birds, and confirm details using binoculars.

Birds on water and in flight. Estimate the distance that observed birds are from the base of the platform (see Appendix VII for distance categories).

Poor visibility. When a scheduled scan cannot be conducted because visibility is poor due to rain or fog (i.e., when the entire width of the 300m semi-circle is not visible), fill in the Observation Period Information, and write in the notes why the scan was not conducted.

Null observation periods. Record "No birds observed" when no birds were detected during a scan, as this type of information is also important.

3.2. Recording information related to each scan

Scan information. It is important to fill in all the fields under the heading "Scan Information" of the data sheet at the beginning of each scan. **See Appendix VI for detailed notes on completing each field.**

Bird information. Use appropriate codes to record the following information (in this order of priority) for all birds observed during the period, whether within or outside the semi-circle:

1) Species (see Appendix VIII for list of species code)
2) Number of individuals
3) Flying (***F***) or on the water (***W***)
4) In semi-circle? ***Y*** or ***N***
5) Distance from platform using categories (see Appendix VII for distance categories)
6) Association (see Appendix X for association codes)
7) Behaviour (see Appendix X for behaviour codes)

8) Compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***) in which birds in flight are heading, if not associated with platform.
8) Age (***J***, ***I***, or ***A***)
9) Plumage of adults (***B***, ***NB***, and/or ***M***)
10) Sex (***M*** or ***F***)

See Appendix VII for detailed notes on completing each field.

Grouping observations. Record groups of birds in the same data row if they behave as a group and have the same morphological and behavioural characteristics (e.g., all adults in breeding plumage flying in the same direction; see example in Appendix XII). Record other individuals from the group that have different characteristics (e.g., juveniles) in the next row, and associate this record with the previous one by drawing a line that links the two rows (see example in Appendix XII).

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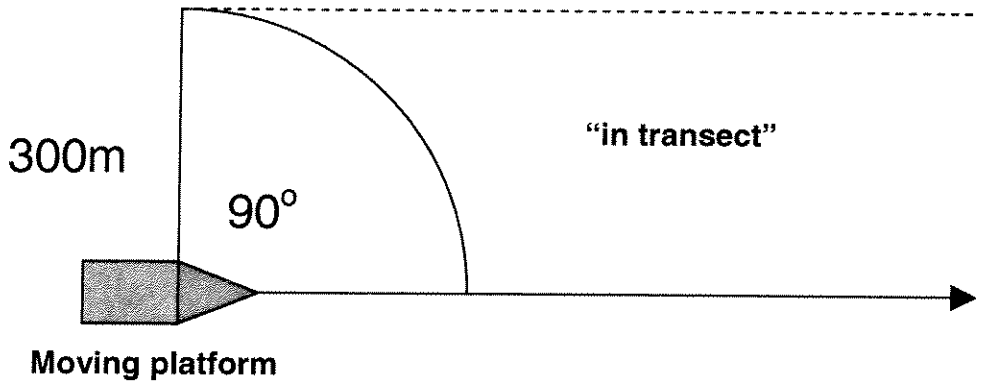
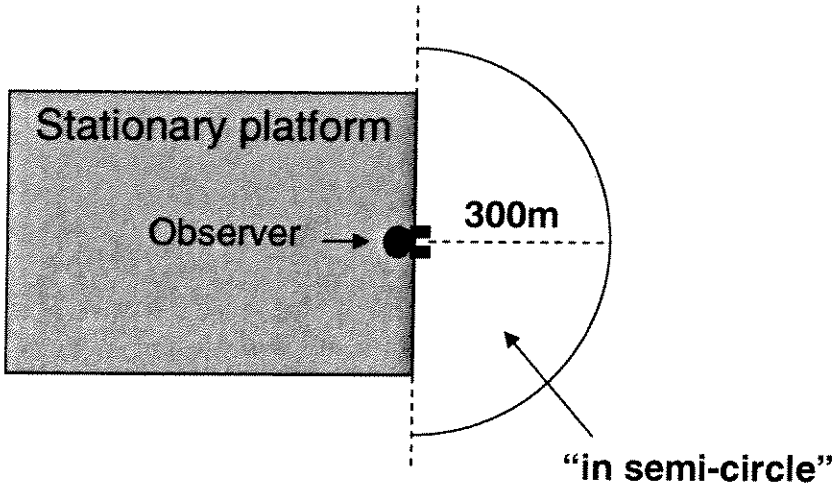
Tasker, M.L., Hope Jones, P., Blake, B.F., Dixon, T.J., and Wallis, A.W. 1986. Seabirds associated with oil production platforms in the North Sea. Ringing and Migration 7: 7-14.

Appendix I. Example of survey using a 90° scan, covering a 300m transect from a moving platform. Record birds that are observed within this transect, whether flying or on the water, as a priority. Record all birds seen outside the transect, if this does not affect observations within the transect, and note them as "not in transect".



Appendix II. Example of survey using a 180° scan, covering a semi-circle of 300m radius from a stationary platform. Record birds observed within this area, whether flying or on the water, as a priority. Record all birds seen outside the 300m semi-circle as well, but note them as "not in semi-circle".



Appendix III. Estimating a 300m distance at sea using a slide calliper (formula derived by J. Chardine, based on Heinemann 1981).

The 300m distance from the observation point can be estimated using a slide calliper and the following equation:

$$d_h = 1000\frac{(ah3838\sqrt{h}) - ahd}{h^2 + 3838d\sqrt{h}}$$

e.g. if $a = 0.714$ m, $h = 15$ m, and $d = 300$ m

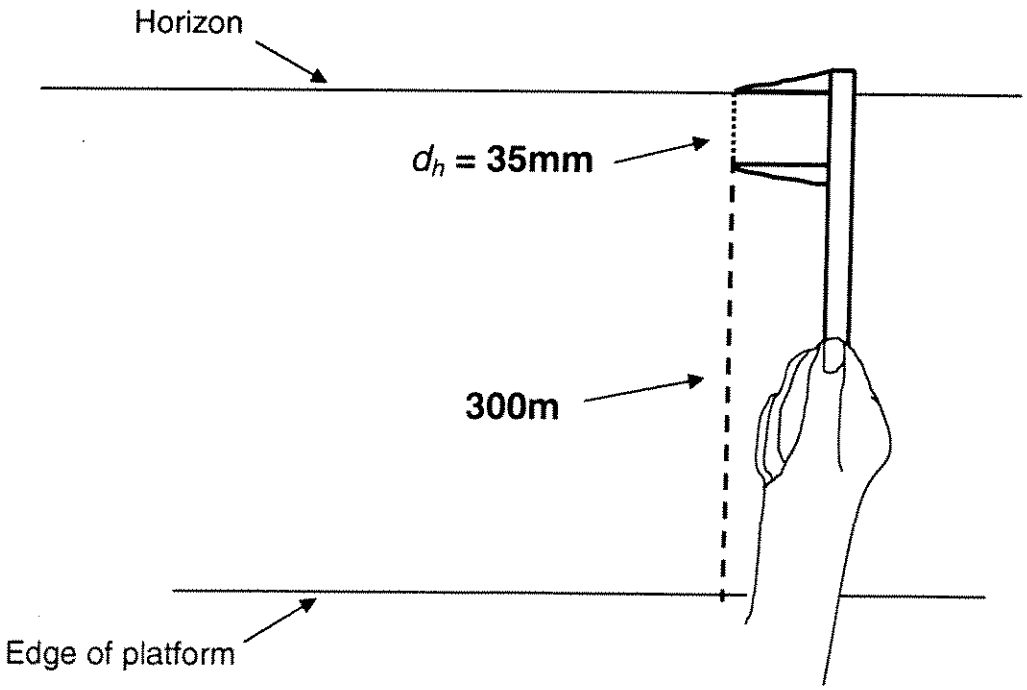
then $d_h = 35.0$ mm

where:

d_h = distance down from horizon down (mm)
a = distance between the observer's eye and the calliper when observer's arm is fully out-stretched (m)
h = height of the observer's eye above the water at the observation point (m)
d = distance to be estimated (m; in this case, the width of the transect or semi-circle, or 300m)

First, calculate d_h to obtain the amount that the calliper should be opened at for a 300m transect or semi-circle. Once this amount is known, hold the calliper vertically at arm's length, opened to the appropriate interval, with the tip of the upper jaw in line to the horizon. The tip of the lower jaw of the calliper is now in line with a distance 300m from the platform, marking the far side of the transect or semi-circle.

Visual illustration of example above:



Appendix IV. Intervals at which instantaneous or "snapshot" counts of flying birds should be conducted within a ten-minute observation period, within a 300m transect from a moving platform.

Platform's speed (knots)	Interval between counts (minutes)
4	2.5
5	2.0
6-8	1.5
9-12	1.0
13-19	0.5

Appendix V. Notes on completing Observation Period Information for a moving platform.

Platform name, agency and type: Agency may include company (e.g., Shell, CN Marine, etc.), or government agency (e.g., DND, DFO, GGC). Type may include seismic ship, supply vessel, fishing boat, research ship, ferry, destroyer, etc.

Date: Date that the observation period occurred (use format 20 July 2004 to avoid ambiguity).

Time start / Time end: Time (using 24 hour notation) at the start and end of the ten-minute observation period. Use local (L) or Universal Time (UTC) and indicate which was used by circling appropriate letter or writing in appropriate space. If local, record as AST, EDT, etc., to avoid ambiguity.

Latitude and longitude at start of observation period: Indicate position of platform in either decimal degrees or degrees minutes seconds.

Activity of moving platform: Activity may include steaming, on patrol, fishing, conducting research, seismic array active or inactive, etc.

Visibility: Estimate visibility in km from 0.3 (which is 300m) to 20km; estimates should also be made on foggy days.

Sea state code: Use Sea state code from Appendix IX.

Swell height: Estimate the height of the swell, as this may also influence the detectability of the birds.

Wind speed or force: Indicate the speed of the wind in knots if recorded on the platform, or use Beaufort code from Appendix IX. If using the wind speed recorded from a moving platform, be sure to record the TRUE speed, as this takes into account the 'apparent' wind generated from the forward momentum of the vessel.

Note on wind speed, sea state and Beaufort codes: Although there is often a direct relationship among these three variables (i.e., when sea state is a 2, Beaufort is a 3, and wind speed is between 7 and 10 knots), this is not always the case. For example, it may take some time for the state of the sea to reflect an increase in the wind speed. When possible, record the wind speed in knots and note the sea state using the descriptions in Appendix IX.

Wind direction: Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***) of the wind. If using the wind direction recorded from a moving platform, be sure to record the TRUE direction, as this takes into account the 'apparent' wind generated from the forward momentum of the vessel.

Platform speed (knots): If speed changes during observation period, indicate new speed and time at which change occurred.

Platform direction: Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); if this changes during observation period, indicate new direction and time at which change occurred.

Observation side: Circle ***Starboard*** or ***Port***.

Observer height (meters): Indicate height of observer's eye above water from observation point in meters.

Outdoors or Indoors: Circle ***Out*** when conducting observations from a position outdoors and ***In*** for indoor observations.

With snapshot? Indicate if snapshot method for birds in flight is being used by circling ***Y*** or ***N***.

Appendix VI. Notes on completing Scan Information for a stationary platform.

Platform name, agency and type: Agency may include company (e.g., Shell, CN Marine, etc.), or government agency (e.g., DND, DFO, CCG). Type may include drilling rig, FPSO, supply vessel, seismic vessel, fishing boat, research ship, ferry, destroyer, etc.

Date: Date that the observation period occurred (use format 20 July 2004 to avoid ambiguity).

Time start / Time end: Time (using 24 hour notation) at the start and end of the ten-minute observation period. Use local (L) or Universal Time (UTC) and indicate which was used by circling appropriate letter or writing in appropriate space. If local, record as AST, EDT, etc., to avoid ambiguity.

Latitude and longitude at start of scan: Indicate position of platform in either decimal degrees or degrees minutes seconds.

Platform activity: Activity may include drilling, off-loading, etc.

Scan type: Indicate at which angle the scan is being conducted (recommended is 180°).

Scan direction: Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***) when looking straight ahead, at center of semi-circle.

Visibility: Estimate visibility in km from 0.3 (which is 30m) to 20km; estimates should also be made on foggy days.

Sea state code: Use Sea State code from Appendix IX.

Swell height: Estimate the height of the swell, as this may also influence bird detectability.

Wind speed or force: Indicate the speed of the wind in knots if recorded on the platform, or use Beaufort code from Appendix IX. If using the wind speed recorded from a moving platform, be sure to record the TRUE speed, as this takes into account the 'apparent' wind generated from the forward momentum of the vessel.

Note on wind speed, sea state and Beaufort codes: Although there is often a direct relationship among these three variables (i.e., when sea state is a 2, Beaufort is a 3, and wind speed is between 7 and 10 knots), this is not always the case. For example, it may take some time for the state of the sea to reflect an increase in the wind speed. When possible, record the wind speed in knots and note the sea state using the descriptions in Appendix IX.

Wind direction: Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***) of the wind. If using the wind direction recorded from a moving platform, be sure to record the TRUE direction, as this takes into account the 'apparent' wind generated from the forward momentum of the vessel

Observer height (meters): Indicate height of observer's eye above water from observation point in meters.

Outdoors or Indoors: Circle ***Out*** when conducting observations from a position outdoors and ***In*** for indoor observations.

Appendix VII. Notes on completing Bird Information.

Species: Identify each individual bird seen to species. If this is not possible for various reasons (e.g., because of brief viewing opportunity, poor lighting condition, etc.), identify to genus or family. Record all unknowns, even if they are identified only as "gull" or "bird".

In transect or semi-circle?: Indicate if bird observed is in (***Y***) or out (***N***) of the transect (moving) or semi-circle (stationary). Give priority to birds that are in the transect or semi-circle; record birds seen outside of the observation area if this does not affect "in-transect or semi-circle" observations.

For moving platform, when are birds "in transect"? Birds on the surface of the water within 300m from the mid-line of the platform are considered in transect. When visibility is good, birds on the water may be seen up ahead of the platform, perhaps as far as 400m or 500m ahead, but still within the 300m strip. Because these individuals may dive or fly away as a result of the approaching vessel, these should be counted as in transect and their perpendicular distance from the mid-line of the platform estimated. Flying birds, however, that are observed during a snapshot more than 300m ahead of the approaching platform are considered NOT in transect. In other words, count flying birds as in transect only if they are observed during a snapshot AND are within 300m perpendicular distance from the mid-line of the vessel and no farther than 300m ahead of the platform (see Appendix XI).

Association and Behaviour: Record one or more association and/or behaviour codes with each bird when appropriate (see Appendix X for association and behaviour codes, and refer to Camphuysen and Garthe (2004) for further information).

Distance: For birds observed on water, estimate the perpendicular distance between the bird(s) and the vessel within the following distance categories: ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, and ***E*** = > 300m, ***3*** = within 300m but no distance recorded. Indicate when birds are in flight, and estimate their distance from the time they were first detected.

Flight direction: Indicate which compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***) birds in flight are heading if they are not associated with the platform. Ensure that a magnetic compass has been corrected for local declination.

Age: Age is based on plumage, where ***J***(uvenile) = first coat of true feathers acquired before leaving nest and ***I***(mmature) = the first fall or winter plumage that replaces the juvenile plumage and may continue in a series that includes first-spring plumage, but is not the complete ***A***(dult) plumage.

Plumage: Adult plumage can be further categorized, where ***B***(reeding) = spring and summer plumage, ***NB*** (non-breeding) = fall and winter plumage, and ***M***(oult) = transitional phase between these two plumages, often with some flight feathers are missing.

Notes: Space is provided to record other pertinent information, such as the presence of fishing vessels in the survey area, if a particular bird was carrying fish, etc.

Appendix VIII. List of species code for seabirds seen within the Atlantic Waters of Canada's Exclusive Economic Zone (EEZ).

Common name	Species code	**Latin name**
COMMON, REGULAR OR FREQUENTLY SEEN SPECIES		
Northern Fulmar	NOFU	*Fulmarus glacialis*
Greater Shearwater	GRSH	*Puffinus gravis*
Manx Shearwater	MASH	*Puffinus puffinus*
Sooty Shearwater	SOSH	*Puffinus griseus*
Wilson's Storm-Petrel	WISP	*Oceanites oceanicus*
Leach's Storm-Petrel	LHSP	*Oceanodroma leucorhoa*
Great Cormorant	GRCO	*Phalacrocorax carbo*
Double-crested Cormorant	DCCO	*Phalacrocorax auritus*
Northern Gannet	NOGA	*Morus bassanus*
Common Eider	COEI	*Somateria mollissima*
Red-breasted Merganzer	RBME	*Mergus serrator*
Surf Scoter	SUSC	*Melanitta perspicillata*
Black Scoter	BLSC	*Melanitta nigra*
White-winged Scoter	WWSC	*Melanitta fusca*
Long-tailed Jaeger	LTJA	*Stercorarius longicaudis*
Parasitic Jaeger	PAJA	*Stercorarius parasiticus*
Pomarine Jaeger	POJA	*Stercorarius pomarinus*
Great Skua	GRSK	*Stercorarius skua*
Herring Gull	HERG	*Larus argentatus*
Iceland Gull	ICGU	*Larus glaucoides*
Glaucous Gull	GLGU	*Larus hyperboreus*
Great Black-backed Gull	GBBG	*Larus marinus*
Black-legged Kittiwake	BLKI	*Rissa tridactyla*
Common Murre	COMU	*Uria aalge*
Thick-billed Murre	TBMU	*Uria lomvia*
Razorbill	RAZO	*Alca torda*
Dovekie	DOVE	*Alle alle*
Atlantic Puffin	ATPU	*Fratercula arctica*
CODES FOR BIRDS IDENTIFIED TO FAMILY OR GENUS ONLY		
Unknown	UNKN	
Unknown Shearwater	UNSH	
Unknown Storm-Petrel	UNSP	
Unknown Jaeger	UNJA	
Unknown Gull	UNGU	
Unknown Tern	UNTE	
Unknown Alcid	ALCI	
Unknown Murre	UNMU	

INFREQUENTLY OR RARELY SEEN BIRDS

Cory's Shearwater	COSH	*Calonectus diomedea*
Audubon's Shearwater	AUSH	*Puffinus lherminieri*
King Eider	KIEI	*Somateria mollissima*
Harlequin Duck	HARD	*Histrionicus histrionicus*
Long-tailed Duck	LTDU	*Clangula hyemalis*
Red Phalarope	REPH	*Phalaropus fulicaria*
Red-necked Phalarope	RNPH	*Phalaropus lobatus*
South Polar Skua	SPSK	*Catharacta maccormicki*
Ivory Gull	IVGU	*Pagophila eburnea*
Black-headed Gull	BHGU	*Larus ribindus*
Laughing Gull	LAGU	*Larus articilla*
Ring-billed Gull	RBGU	*Larus delawarensis*
Lesser Black-backed Gull	LBBG	*Larus fuscus*
Sabine's Gull	SAGU	*Xema sabini*
Common Tern	COTE	*Sterna hirundo*
Black Guillemot	BLGU	*Cepphus grylle*

Appendix IX. Codes for sea state and Beaufort wind force.

Wind Speed (knots)	Sea state code and description	Beaufort wind force scale code and description
0	0 Calm, mirror-like	0 calm
01 – 03	0 Ripples with appearance of scales but crests do not foam	1 light air
04 – 06	1 Small wavelets, short but pronounced; crests do not break	2 light breeze
07 – 10	2 Large wavelets, crests begin to break; foam of glassy appearance; perhaps scattered white caps	3 gentle breeze
11 – 16	3 Small waves, becoming longer; fairly frequent white caps	4 moderate breeze
17 – 21	4 Moderate waves with more pronounced form; many white caps; chance of some spray	5 fresh breeze
22 – 27	5 Large waves formed; white foam crests more extensive; probably some spray	6 strong breeze
28 – 33	6 Sea heaps up; white foam from breaking waves blows in streaks in direction of wind	7 near gale
34 – 40	6 Moderately high long waves; edge crests break into spindrift; foam blown in well-marked streaks in direction of wind	8 gale
41 – 47	6 High waves; dense streaks of foam in direction of wind; crests of waves topple and roll over; spray may affect visibility	9 strong gale
48 – 55	7 Very high waves with long overhanging crests; dense foam streaks blown in direction of wind; surface of sea has a white appearance; tumbling of sea is heavy; visibility affected	10 storm
56 - 63	8 Exceptionally high waves; sea is completely covered with white patches of foam blown in direction of wind; edges blown into froth; visibility affected	11 violent storm
64 +	9 Air filled with foam and spray; sea completely white with driving spray; visibility seriously affected	12 hurricane

APPENDIX X. Codes for associations and behaviours of seabirds recorded during surveys at sea. Choose one or more as applicable. Refer to Camphuysen and Garthe (2004) for further information.

Associations

Associations

10 Associated with fish shoal
11 Associated with cetaceans
13 Associated with line in sea
14 Sitting on or near floating wood
15 Associated with floating litter
16 Associated with oil slick
18 Associated with observation platform
20 Approaching observation platform
21 Associated with other vessel
23 Associated with offshore platform
26 Associated with fishing vessel
27 Associated with or on sea ice
28 Associated with land (e.g., colony)
50 Associated with other species feeding in same location

Behaviours

Foraging behaviour

30 Holding fish
31 Without fish
32 Feeding young at sea
33 Feeding
40 Scavenging
41 Scavenging at fishing vessel
49 Actively searching

General behaviour

60 Resting or apparently sleeping
64 Carrying nest material
65 Guarding chick
66 Preening or bathing

Distress or mortality

90 Under attack by kleptoparasite
96 Entangled in fishing gear or rope
97 Oiled
99 Dead

Appendix XI. Example of a 10-min survey from a moving platform.

XI.1. Scenario (see associated Figure Pg. 23 and datasheet Pg. 24): We are travelling at 10 knots, so in 10 minutes we will travel a distance of about 3km (3.13km to be exact). Based on the speed of the vessel, we will count flying birds every minute (see Appendix IV). This means that the length of the 3km transect will be divided into 10 snapshot "boxes", each 300m long and 300m wide – i.e., the width of the transect. At the start of each minute, we will record all birds flying within the current 300m x 300m snapshot box as "in transect". Remember, we are continuously counting the birds we see on the water. Visibility is excellent, and we can likely detect the larger species at distances of about 500m.

a) We begin the observation period at 08:00 with a count of the birds we see on the water, as well as a snapshot of the flying birds. At this point, we can see 2 birds on the water to the port side of the vessel, at distances C and D (see Appendix VII). We can also see 2 birds together on the water, more than 300m in front of the vessel. We will also count these as "in transect", although we will be careful not to count them again as we get closer. We see a total of 2 flying birds within the 300m transect, although we will only count one as "in transect", as the other is more than 300m in front of the vessel.

b) Now we are about 30 seconds into the 10 min observation period, **in between** snapshot counts. We have already counted 4 of the birds on the water (shown in the figure as open circles), but another has appeared at distance D, and we add this to our list as "in transect". Despite the appearance of a new flying bird within 300m of the vessel, we do not count it as "in transect", as we are in between snapshots. We may add the new bird to our list, but indicate that it is NOT in transect.

c) At minute 1, we take another instantaneous count of flying birds within 300m of the ship. A flock of 3 birds is seen at distance B traveling NW. We also see one new bird on the water at distance B, and one outside 300m (distance category E). These are all "in transect" except for the bird at distance E.

d) At minute 2, we count one flying bird in transect at distance D, travelling SW. Because the density of birds observed is relatively low, and we have the time to record, we note the flock of 4 birds flying south ahead of the vessel, but do NOT count them as "in transect", as they are beyond 300m in front of the ship. Because the birds are spread out across several distance categories when they were first observed (but clearly flying together), we note the distance as "3". We see no new birds on water over the next minute.

e) At minute 3, no new birds are observed, so nothing new is written on our data sheet.

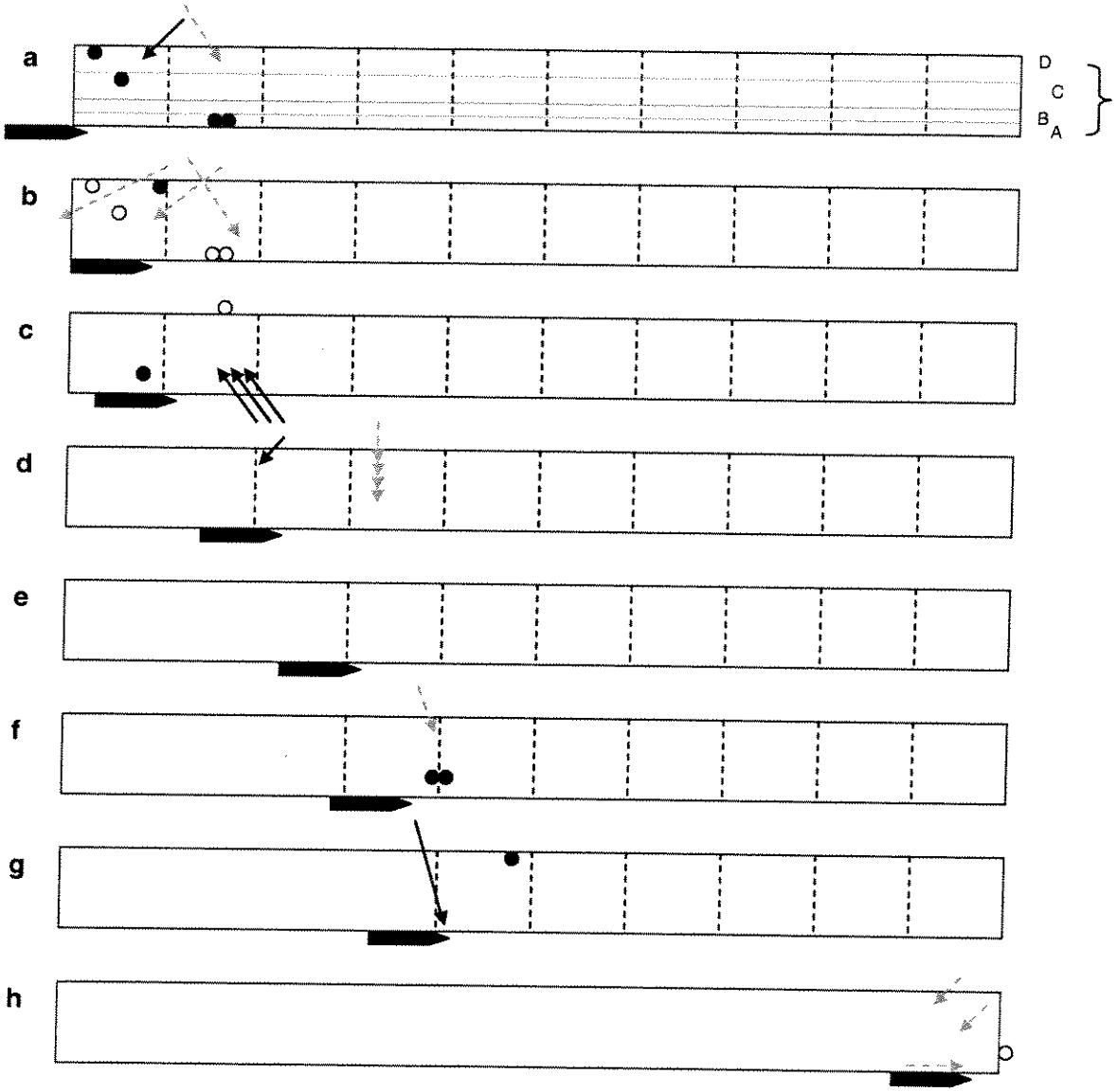
f) As we continue, we DO NOT count the new flying bird we see as "in-transect" because we are now in between snapshots, but if time permits, we will record it as NOT in transect. We will record the 2 birds feeding up ahead on the water, both "in transect". Since one is a juvenile and one is an adult, we enter them on the datasheet in two rows, linking the two with a line in the left margin.

g) At minute 4, our next 'snapshot' takes place, and we see that the bird we saw earlier (see frame f) can now be recorded as "in transect", as it is within 300m of the vessel AND observed during the snapshot. We record the flying distance as D, as that is the distance that we first saw the bird. If we know for certain that this is the same individual we previously recorded as NOT in transect (frame f), we can cross the previous observation out. If we are not certain that this is the same individual we do not cross anything out. There is also a new bird on the water at distance D.

This procedure continues throughout the 10 min period, counting birds observed on the water continuously, and counting flying birds during 1 min snapshots. Recording birds on the water outside of the 300m wide transect, and flying birds in between snapshots can be done if it does not affect observations within the transect.

h) As we approach the end of the 10 min observation period, we note the bird at distance A that has been following us. Remember, you must record ship-followers as "associated with platform" (code 18). And we do not include the bird we can see about 350m ahead of the vessel, because by the time we reach it, the 10 min observation period will be over, and the bird will be counted in the next period.

***XI.2. Scenario Figure* (adapted from Tasker et al. 1984).** An example of a 10 min observation period with birds shown on the water (points) and flying (arrows). Open points and arrows with dashed lines are meant to show those birds that are not to be counted as "in transect". Based on the speed of the vessel, instantaneous counts (snapshots) will be made for flying birds at 1-min intervals, represented here by the vertical dashed lines. The horizontal lines shown in '**a**' represent the bands for distance categories.



XI.3. Datasheet Ten-minute period record sheet for a moving platform

Observation Period Information:

Company/agency	**DFO**	Sea state code	**3**
Platform name and type	**Teleost, DFO Research**	Swell height (m)	**2**
Observer (s)	**Carina Gjerdrum**	Wind speed (knots) **OR** Beaufort code	**17 knots**
Date (Day Month Year)	**15 May 2006**	Wind direction	**SSE**
Time at start (UTC or L)	**0800 L (NLT)**	Platform speed (knots)	**10**
Time at end (UTC or L)	**0810 L**	Platform direction	**E**
Latitude at start	**45° 02.535**	Observation side	**Starboard** (Port)
Longitude at start	**45° 33.751**	Observer's height (meters)	**12**
Platform activity	**steaming**	Outdoors or Indoors	Out or **In**
Visibility (kilometres)	**15 km**	Snapshot Used?	**Yes** or No

Notes:

Crab fishing activity in area

Bird Information:

*this field must be completed for each record

* Species	* Count	* Fly or Water?	* In transect ?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments
a)	1	W	Y	C							
	1	W	Y	D							
	2	W	Y	A							
	1	F	Y	D			SW				
	1	F	N	D			SE				
b)	1	W	Y	D							
	1	F	N	C			SW				
c)	3	F	Y	B			NW				
	1	W	Y	B							
	1	W	N	E							
d)	1	F	Y	D			SW				
	4	F	N	3			S				
f)	1	F	N	D			SE				
	1	W	Y	B		33		I			
	1							A			
g)	1	F	Y	D							
	1	W	Y	D							
h)	1	F	N	A	18						

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance.
[2] Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction
[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult)
[4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)

Appendix XII. Example of completed record sheet for a stationary platform.

Record sheet for a stationary platform

Scan Information:

Company/agency	Canadian Superior	Scan type	180° or other (specify:)
Platform name and type	Drill Rig RG-5	Scan direction	SW
Observer (s)	Jason Snipe	Visibility (kilometres)	1
Date (Day Month Year)	15 August 2005	Sea state code	4
Time at start (UTC or L)	12:50 UTC	Swell height (m)	1
Time at end (UTC or L)	12:54 UTC	Wind speed (knots) **OR** Beaufort code	5 (Beaufort scale)
Latitude at start	43° 54.086N	Wind direction	NW
Longitude at start	63° 26.391W	Observer's height (meters)	15
Platform activity	Not drilling	Outdoors or Indoors	Out or In

Notes:

Bird Information:

*this field must be completed for each record

* Species	* Count	* Fly or Water?	* In semi-circle?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments
HERG	1	F	N	E			NW				
HERG	6	F	Y	C	18		ND	I			
BLKI	3	W	Y	C		60		A	B		
BLKI	1							J			
COMU	1	W	Y	A		65		A	B		
COMU	1							J	B		
GBBG	9	F	N	B	50	41	ND	A	B		
GBBG	5							I			
NOFU	4							A	B		light morph
ALCI	1	W	Y	W				A	B		

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance.
[2] Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction
[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult)
[4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)

Appendix XIII. Check-list of materials required while conducting seabird surveys.

- ☐ Multiple pens or sharp pencils **(required)**
- ☐ Multiple copies of blank recording sheets **(required)**
- ☐ Binoculars **(required)**
- ☐ Hand-held Global Positioning System (GPS) to determine platform position, vessel speed and vessel direction **(required)**
- ☐ Watch or clock **(required) -** with countdown timer that can beep on snapshot intervals would be preferred
- ☐ Compass or GPS to determine flight direction of birds **(required)**
- ☐ Copy of protocol (recommended)
- ☐ Spotting telescope (recommended)
- ☐ Seabird identification guide (recommended)
- ☐ Slide calliper or range finder (recommended)
- ☐ Warm and waterproof clothing (recommended)
- ☐ Calculator if using slide calliper to determine 300m observation distance (recommended)

Appendix XIV

Blank record sheets for moving and stationary platforms

Ten-minute period record sheet for a moving platform

Observation Period Information:

Company/agency		Sea state code	
Platform name and type		Swell height (m)	
Observer (s)		Wind speed (knots) **OR** Beaufort code	
Date (Day Month Year)		Wind direction	
Time at start (UTC or L)		Platform speed (knots)	
Time at end (UTC or L)		Platform direction	
Latitude at start		Observation side	Starboard Port
Longitude at start		Observer's height (m)	
Platform activity		Outdoors or Indoors	Out or In
Visibility (kilometres)		Snapshot Used?	Yes or No

Notes:

Bird Information:

*this field must be completed for each record

* Species	* Count	* Fly or Water?	* In transect?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance.
[2] Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction
[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult)
[4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)

Record sheet for a stationary platform

Scan Information:

Company/agency		Scan type	180° or other (specify:)
Platform name and type		Scan direction	
Observer (s)		Visibility (kilometres)	
Date (Day Month Year)		Sea state code	
Time at start (UTC or L)		Swell height (m)	
Time at end (UTC or L)		Wind speed (knots) **OR** Beaufort code	
Latitude at start		Wind direction	
Longitude at start		Observer's height (meters)	
Platform activity		Outdoors or Indoors	Out or In

Notes:

Bird Information:

*this field must be completed for each record

* Species	* Count	* Fly or Water?	* In semi-circle?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance.
[2] Indicate compass direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction
[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult)
[4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)