Environmental Assessment Update of WesternGeco's Eastern Newfoundland Offshore Seismic Program, 2015–2024

Prepared by

Prepared for

WesternGeco
200, 125-9th Avenue
SE Calgary, AB T2G 0P6

March 2016
LGL Project No. FA0084

Environmental Assessment Update of WesternGeco's Eastern Newfoundland Offshore Seismic Program, 2015–2024

Prepared by

LGL Limited, environmental research associates
P.O. Box 13248, Stn. A
St. John's, NL A1B 4A5
Tel: 709-754-1992
jchristian@lgl.com

Prepared for

WesternGeco
200, 125-9th Avenue
SE Calgary, AB T2G 0P6

March 2016
LGL Project No. FA0084

Suggested format for citation:

LGL Limited. 2016. Environmental Assessment Update of WesternGeco's Eastern Newfoundland Offshore Seismic Program, 2015–2024. LGL Rep. FA0084. Rep. by LGL Limited, St. John's, NL for WesternGeco (Division of Schlumberger Canada Limited), Calgary, AB. 29 p. + appendices.

Table of Contents

Page

List of Figures

Page

List of Tables

Page

1.0 Introduction

This document is an Update of the Environmental Assessment (EA; LGL 2015[1]) of WesternGeco's 2015–2024 2-Dimensional (2D), 3-Dimensional (3D) and/or 4-Dimensional (4D) seismic program in the eastern Newfoundland offshore area, and its associated Addendum (LGL 2016[2]). In 2016, WesternGeco is proposing to conduct 3D seismic surveys in its Project Area (see Figure 2.1 in § 2.0). This EA Update document addresses the validity of the EA (Table 1.1) as it pertains to WesternGeco's proposed seismic survey activities in 2016. The EA Update is intended to assist the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) in its regulatory review process by demonstrating that both the scope of the assessment and the mitigation measures to which WesternGeco previously committed remain technically valid for proposed seismic survey operations in 2016.

Table 1.1 Environmental Assessment Documents for the WesternGeco Eastern Newfoundland Offshore Seismic Program, 2015–2024.

Screening Determination Reference	Temporal Scope	EA Document Title
C-NLOPB File No. 30006-020-001	1 May to 30 November 2015–2024	Environmental Assessment of WesternGeco's Eastern Newfoundland Offshore Seismic Program, 2015–2024 (LGL 2015[a], 2016[b])

Notes:
[a] On 21 March 2016 the C-NLOPB made a positive determination on this document.
[b] EA Addendum posted to C-NLOPB website 29 January 2016.

The following sections provide the information necessary to confirm the validity of the EA and its associated Addendum (see Table 1.1), including assessment of the potential effects of 2D, 3D and 4D seismic survey activities within the defined Project Area (see Figure 2.1 below) on the following Valued Environmental Components (VECs): Fish and Fish Habitat; Fisheries; Seabirds; Marine Mammals and Sea Turtles; Species at Risk; and Sensitive Areas. This Update also includes new relevant information not included in the EA and its associated documents.

2.0 Project Description

2.1 Vessels and Equipment

In addition to the seismic vessel, 2D, 3D and 4D seismic surveys require two support vessels: (1) a picket vessel tasked with communicating with other vessels (primarily fishing vessels) that may be operating in the area, and scouting ahead for any other hazards such as floating debris; and (2) a supply vessel tasked with re-supply, refuelling and personnel transfer.

[1] http://www.cnlopb.ca/assessments/westgecoeast3.php
[2] http://www.cnlopb.ca/pdfs/westgecoeast/reveaadd.pdf

For 2D surveys, the seismic ship will tow a single solid seismic hydrophone cable (streamer) that is 8,000–12,000 m long, deployed near the ocean surface within a depth range of 10–45 m. This is a passive listening device, which will receive the sound waves reflected from structures underneath the ocean floor and transfer the data to an on-board recording and processing system. For 3D seismic surveys, the seismic ship will tow multiple streamers. Streamers will be solid, 8,000–12,000 m in length, depending on survey design, and deployed at depths ranging from 10–45 m. As many as 16 streamers may be towed during a 3D seismic survey.

The 2D and 3D survey sound sources will consist of one or more airgun arrays with a total discharge volume of 3,000–6,000 in^3, operating at tow depth of 6–15 m. If two airgun arrays are used, they will be operated in a 'flip-flop' arrangement. The airguns will be operated with compressed air at a pressure of 2,000 psi and produce approximate peak-to-peak pressures of 104–141 bar-m. The airguns in the array are strategically arranged to direct most of the energy vertically downward rather than sideways. The shot interval will be one shot every 19–25 s, and the survey speed will be around 4.5 knots (8.3 km/h).

The seismic vessel is also equipped with an echosounder. The downward-facing echosounder operates at a frequency of 50 kHz or 200 kHz and will be used to collect water depth information. For this Project, sound velocity profiles will also be acquired in the water column at various locations in the survey area. This is a routine practice during seismic programs. Sound velocity profiles allow for more accurate interpretation of the acoustic data (i.e., seismic pulses) recorded by the seismic streamer. These data are acquired with a small, passive device that will be operated from either the picket vessel or from a small boat deployed from the seismic vessel. The device measures pressure, temperature, and salinity, from which the speed of sound can be calculated.

2.2 Spatial Scope

The Project and Study areas defined in the EA (LGL 2015) remain unchanged and are presented in Figure 2.1. The Project Area, in which all survey activities will occur, is encompassed by the Study Area. The boundary of the Study Area is 25 km outside of that for the Project Area. The 25 km wide area is intended to account for the propagation of sound being generated in the Project Area that could potentially affect marine biota.

2.3 Temporal Scope

The temporal scope defined in the EA (LGL 2015) as 1 May–30 November during each year of the 2015–2024 period remains unchanged.

2.4 Seismic Survey Activities Planned for 2016

In 2016, WesternGeco plans to conduct about 10,000 km^2 of 3D seismic surveying in the Project Area, specifically in the northern Flemish Pass/southern Orphan Basin area (see Figure 2.1). The average line length will be ~141 km and the line direction will be north-south. Surveying will commence in the eastern part of the acquisition area and move westwards.

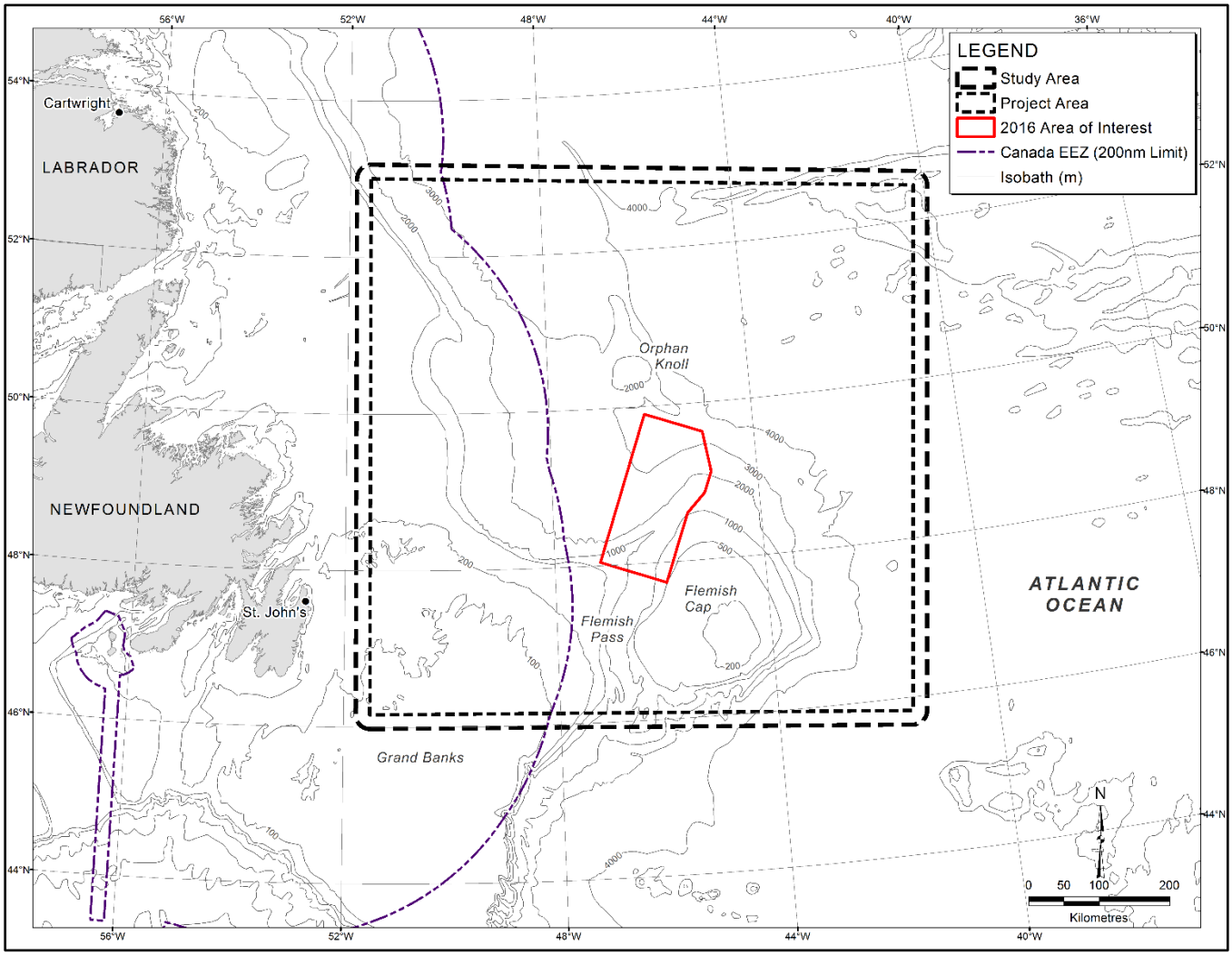


Figure 2.1 Locations of the Project Area, Study Area, and 2016 AOI for WesternGeco's Eastern Newfoundland Offshore Seismic Program, 2015–2024.

The MV *Amazon Conqueror* (Figure 2.2) will most likely be the seismic vessel conducting the 3D seismic surveying in 2016. This vessel was built in Flensburg, Germany in 2014 and is registered in Panama. The MV *Amazon Conqueror* is 126.0 m long, 28.0 m wide and has a mean draft of 7.3 m. The vessel is equipped with four Wartsila auxiliary engines and has a maximum cruising speed of 16.7 knots. It is also equipped with a helideck.

Two airgun arrays will used during the 3D survey, operated in a flip-flop arrangement. Each array will have a volume of 5,085 in^3 and an operating pressure of 2,000 psi. The arrays will be towed at a depth range of 6–9 m. The source sound level of each array will be 120 bar-m $_{p\text{-}p}$ (~262 dB re 1 µPa $_{p\text{-}p}$). Fourteen solid streamers will be used during the 3D surveying, each one 8,000 m in length. Separation between adjacent streamers will be 100 m at the front and 125 m at the tail. The streamers will be towed at a depth range of 13–19 m.

Figure 2.2 MV *Amazon Conqueror.*

All other project details presented in § 2.0 of the EA apply to WesternGeco's seismic survey activities in 2016.

2.5 Mitigation Measures

Mitigation measures implemented during seismic surveys carried out under this Project will follow those described in the EA and Addendum (LGL 2015, 2016) and defined in Appendix 2 of *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (CNLOPB 2012). These include ramp-up (i.e., soft start) of the airgun arrays, the use of qualified and experienced, dedicated Marine Mammal Observer(s) (MMOs) to monitor marine mammals and sea turtles and implement shut downs/ramp up delays of the airgun array when appropriate, and the use of a Fisheries Liaison Officer (FLO) and communication procedures to avoid conflicts with fisheries. Seabird observations and monitoring/mitigation for stranded birds will also be carried out by qualified/experienced personnel according to established Canadian Wildlife Service (CWS) protocols.

3.0 Physical Environment

WesternGeco provided a summary description of the existing physical environment in the Project Area in its EA (LGL 2015). Section 3.0 of the EA on the Physical Environment was based primarily on information provided in the Eastern Newfoundland Strategic Environmental Assessment (SEA) (C-NLOPB 2014) and relevant project-specific EAs (Suncor 2013; LGL 2014).

4.0 Biological Environment

Background biological environment information not previously included in the two documents associated with this Project (see Table 1.1) is included in this section.

4.1 Fish and Fish Habitat

The new information presented in this subsection does not change the effects predictions made in the EA (LGL 2015).

New information is included for key points concerning the relationship between planktonic communities and oceanic conditions of the northeast Newfoundland Slope and northern Grand Banks, as well as for snow crab (*Chionoecetes opilio*), northern shrimp (*Pandalus borealis*), Atlantic cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides*), and capelin (*Mallotus villosus*).

4.1.1 Plankton

The Atlantic Zone Monitoring Program (AZMP) was implemented by the Department of Fisheries and Oceans (DFO) in 1998 in an attempt to better understand, describe and forecast the state of the marine ecosystem. A critical element of the AZMP is an observation program designed to assess the variability in nutrients, phytoplankton and zooplankton (DFO 2015a). The AZMP findings in relation to oceanographic conditions in the Study Area for 2014 are summarized below.

- Copepod abundance throughout much of the Atlantic zone has increased consistently relative to levels observed in 2013, with the exception of the northeast Newfoundland Shelf (NAFO Div. 2J3K) where a notable decline has occurred.
- Chlorophyll anomalies have been below normal on the Newfoundland and Labrador Shelf since 2010 and have demonstrated interannual variability on the Grand Banks in recent years.
- In 2014, the annual-mean transport index for the Labrador Current was near normal over the Labrador and northeastern Newfoundland Slope.
- For the past decade, ice volumes on the Newfoundland and Labrador Shelf have generally been lower than normal.

4.1.2 Snow Crab

Snow crab landings in NAFO Div. 2HJ were at their lowest level in two decades in 2013 but increased by 25% to 1,740 t in 2014. Offshore landings in NAFO Div. 3K declined by 50% from 2008–2011 and has since changed little, remaining near historically low levels. Offshore landings in NAFO Div. 3LNO have remained near their highest level (~26,000 t) in the past 3 years (DFO 2015b).

4.1.3 Northern Shrimp

The northern shrimp fishable biomass index in Shrimp Fishing Area (SFA) 6 (NAFO Div. 2J3K) declined from 421,000 t in 2011 to 216,000 t in 2013, the lowest in the time series, and increased slightly to 233,000 t in 2014. The fishable biomass index in SFA 5 (NAFO Div. 2HJ) has been relatively stable since 2010 (e.g., ~116,000 t in 2014) (DFO 2015c). The catches and estimated biomass of shrimp in NAFO Div. 3NO have decreased considerably during the last eight years. In 2015, the biomass in Div. 3NO had decreased by 22% compared to 2014, and it represents the lowest value in the

survey time series (2001–2015). Most of the biomass (>95%) in NAFO Div. 3L was observed in areas where depths were <60 m, a recently developing pattern (shrimp in Div. 3LNO historically have been distributed along the entire edge of the Grand Banks where water depths typically range from 93–550 m) (Casas et al. 2015). In NAFO Div. 3M, analyses of stratified random bottom trawl surveys completed on the Flemish Cap in 2015 show that total biomass and female biomass indices increased from 2014 (70% and 117%, respectively) but still remain at relatively low levels. The total and female biomasses in 2015 were estimated to be 1,527 and 1,057 t, respectively (Casas 2015).

4.1.4 Atlantic Cod

According to recent assessments, all Atlantic cod stocks remain at a very low level although spawning biomass has increased in recent years. In 2010, after a decade-long moratorium, a cod fishery on the Flemish Cap (Div. 3M) was re-opened; however the moratoria on directed fisheries continue for Div. 3NO and Div. 3L. (NAFO 2014). Recently, the highest estimated biomass of Atlantic cod has been observed in the shallow strata (93–274 m) (Román et al. 2015). A recent publication by Rose and Rowe (2015) suggests that the Atlantic cod stock in Div. 2J3KL has been making a comeback over the last decade. Using both acoustic and trawl surveys, they say that cod in this stock have increased from tens of thousands of tonnes in the 1990s to >200,000 t.

4.1.5 Greenland Halibut

The annual Canadian research vessel fall survey of Div. 2J3K shows an increasing biomass index for Greenland halibut from 2010–2014, reaching the highest levels of the 1978–2014 time series. The abundance index from the fall survey increased from 2012–2014, yet it remains below the series average. By comparison, the biomass and abundance indices for the Canadian research vessel spring survey of Div. 3LNO have been declining and remain at low levels (Morgan 2015). In terms of catch depth, the biomass levels varied by location of the survey. Most of the Greenland halibut biomass was observed in the 200–750 m depth range in NAFO Div. 2J, the 300–500 m depth range in NAFO Div. 3K, the 275–731 m depth range in NAFO Div. 3L, the 367–731 m depth range in NAFO Div. 3N, and the 93–274 m and 550–731 m depth ranges in NAFO Div. 3O (Morgan 2015).

4.1.6 Capelin

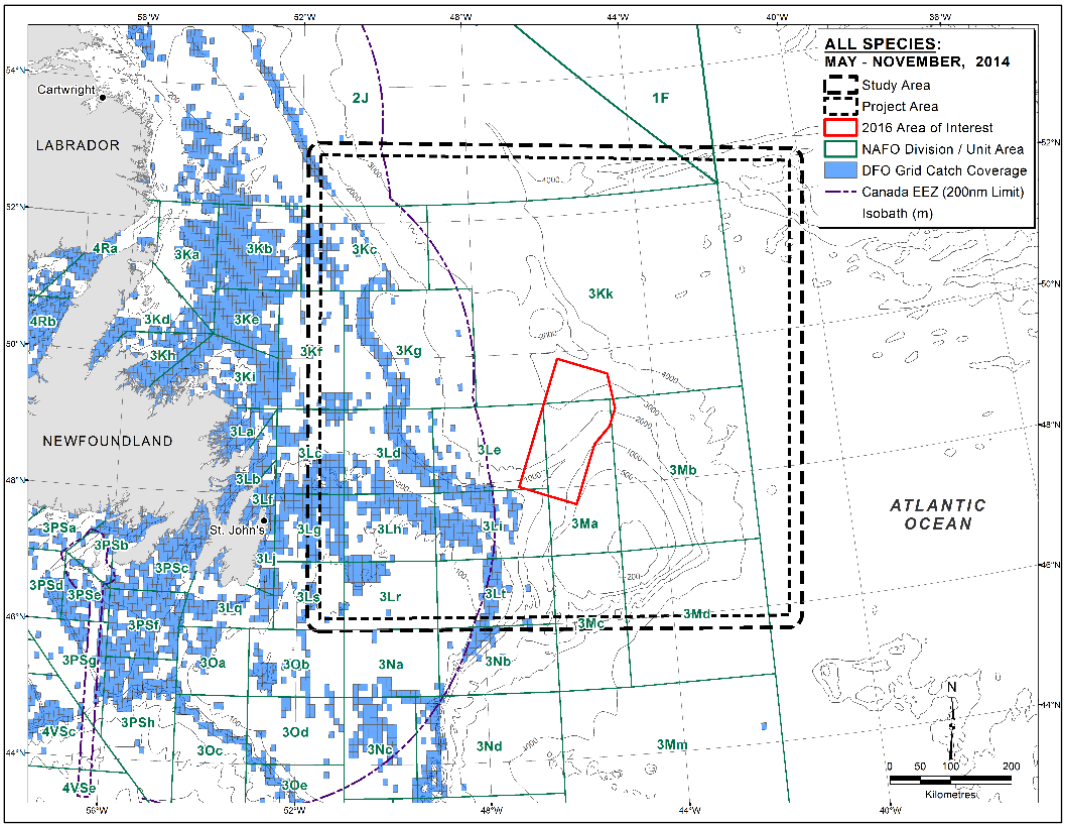
Abundance indices from the 2013 and 2014 spring acoustic surveys in NAFO Div. 2J3KL indicate a large increase in abundance of capelin, some of the highest values seen since 1990. Mean lengths and weights of capelin observed during 2013 and 2014 were also some of the highest seen since 1990 (DFO 2015d).

4.2 Fisheries

The new information presented in this subsection does not change the effects predictions made in the EA (LGL 2015).

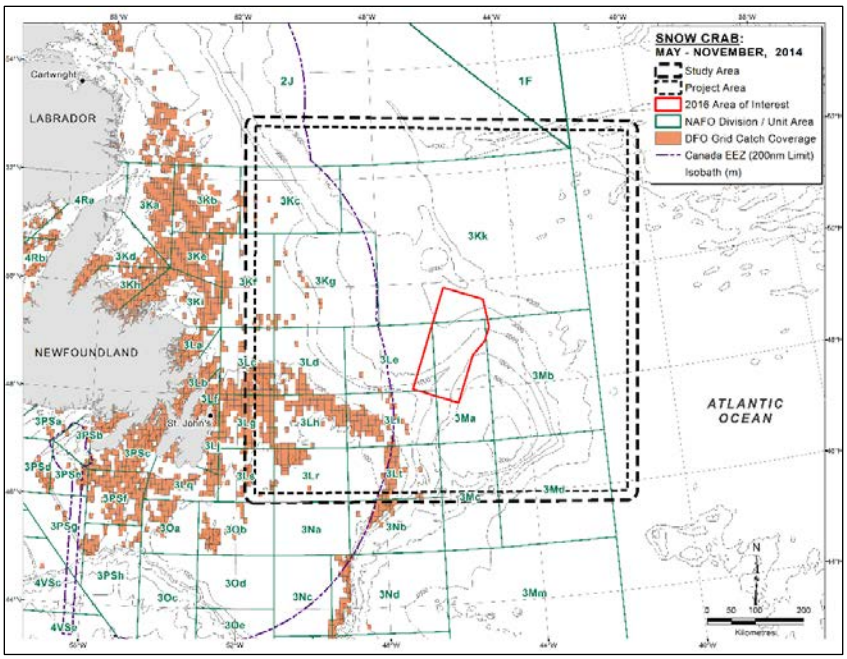
4.2.1 Commercial Fisheries

Analyses of the 2014 commercial fisheries landings data did not indicate any major differences in distribution of harvest locations during May–November 2014 (Figures 4.1–4.4) compared to the distributions during May–November 2005–2013 (see Figures 4.5–4.8 *in* LGL 2015). Figures 4.1–4.4 show the distributions of May–November 2014 harvest locations for all species, snow crab, Greenland halibut and northern shrimp, respectively. The majority of harvesting occurred in areas where water depths were <1,000 m. As in previous years (see Tables 4.2–4.5 *in* LGL 2015), snow crab (54% of total catch in the Study Area in terms of total catch weight quartile code counts), Greenland halibut (19%) and northern shrimp (12%) dominated the catches in the Study Area during May–November 2014. Other notable species caught during that time period include redfish (*Sebastes* sp.) (5%), Atlantic halibut (*Hippoglossus hippoglossus*) (4%), roughhead grenadier (*Macrourus berglax*) (2%), witch flounder (*Glyptocephalus cynoglossus*) (2%), Atlantic cod (1%) and argentine (*Argentina silus*) (1%).



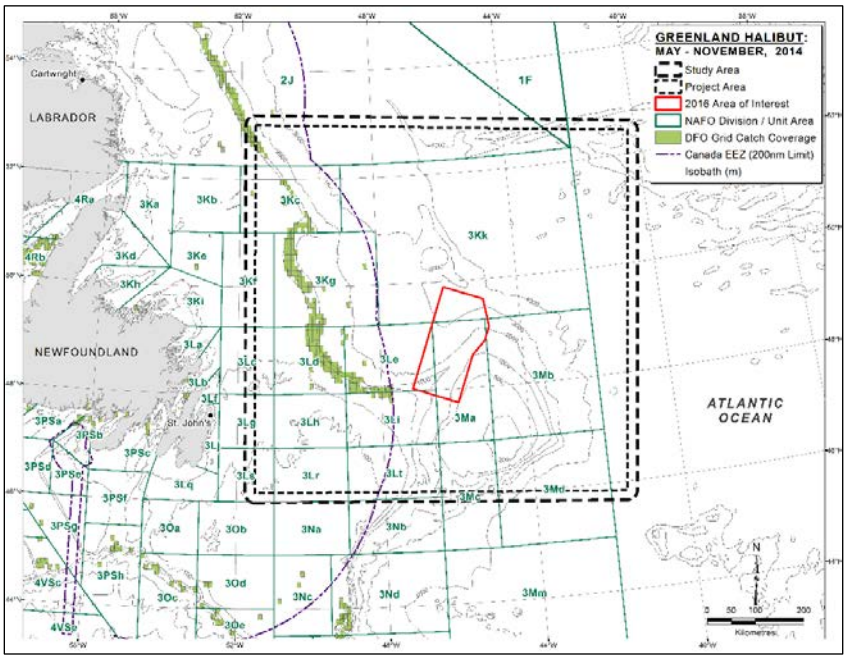
Source: DFO commercial landings database, 2014.

Figure 4.1 Distribution of Commercial Fishery Harvest Locations, All Species, May–November 2014.



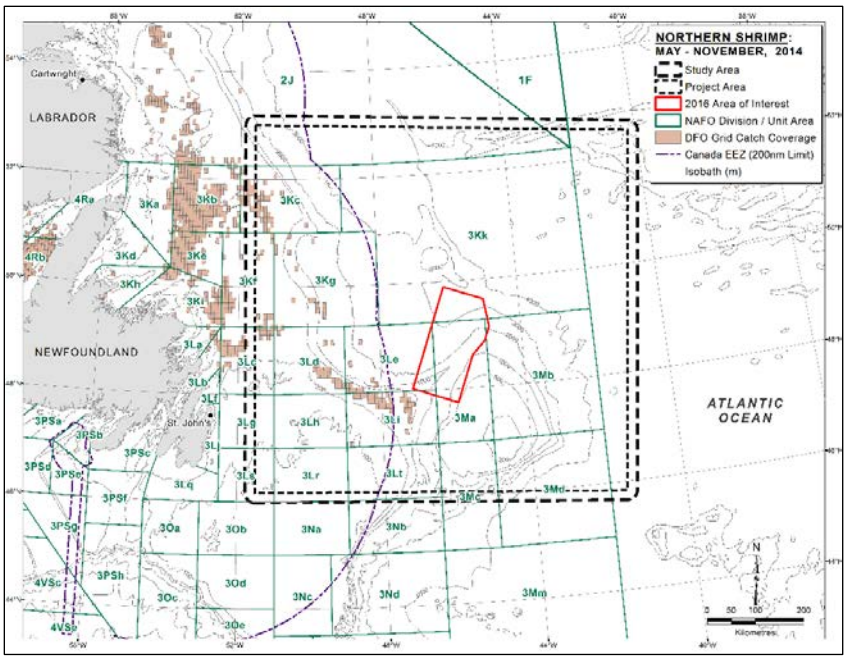
Source: DFO commercial landings database, 2014.

Figure 4.2 Distribution of Commercial Fishery Harvest Locations, Snow Crab, May–November 2014.



Source: DFO commercial landings database, 2014.

Figure 4.3 Distribution of Commercial Fishery Harvest Locations, Greenland Halibut, May–November 2014.



Source: DFO commercial landings database, 2014.

Figure 4.4 Distribution of Commercial Fishery Harvest Locations, Northern Shrimp, May–November 2014.

Catch weight and value quartile counts, months of effort, and gear types for species harvested in the Study Area are shown in Table 4.1. There were no reported catches in the 2016 Area of Interest (AOI) during May–November 2014.

4.2.1.1 Snow Crab

During May–November 2014, the general distribution of harvest locations for snow crab in the Study Area was consistent with that observed during May–November 2005–2013 (see Figures 4.21–4.24 *in* LGL 2015). Most of the snow crab was caught in the west-southwest portion of the Study Area in water depths <200 m (see Figure 4.2). As noted in the EA (see § 4.3.3.2 *in* LGL 2015), snow crab replaced northern shrimp as the predominant species caught in 2013, and has since remained the primary commercial species harvested in the Study Area during May–November (see Table 4.1). The total allowable catch (TAC) for snow crab in NAFO Div. 2J, 3K and 3LNO has been quite consistent during recent years, remaining at 1,765 mt in 2J from 2013–2015, decreasing from 7,980 mt to 7,294 mt in 3K between 2014–2015, and increasing from 35,193 mt to 35,698 mt in 3LNO between 2014 and 2015 (DFO 2015e).

Table 4.1 Commercial Catch Weights and Values in the Study Area, May–November 2014 (Values indicate the frequency of catch weight quartile codes [i.e., 1–4] attributed to each species. Gear types and months of effort are also indicated).

Species	Catch Weight Quartile Code Counts [a]				Catch Value Quartile Code Counts [b]				Total Counts [c]	Month Caught	Gear Type	
	1	2	3	4	1	2	3	4			Fixed	Mobile
Snow Crab	83	233	414	169	59	176	364	300	899	May–Aug	Pot	-
Greenland Halibut	39	112	127	36	54	113	108	39	314	Jun–Sep	Gillnet	Trawl
Northern Shrimp	87	64	42	6	108	57	30	4	199	May–Nov	-	Trawl
Redfish	12	22	24	24	17	24	22	19	82	Jun–Sep	Gillnet	Trawl
Atlantic Halibut	6	12	21	25	10	13	16	25	64	Jun–Sep	Gillnet	Trawl
Roughhead Grenadier	2	13	10	8	2	16	11	4	33	Jun–Aug	Gillnet	Trawl
Witch Flounder	2	5	7	13	3	3	7	14	27	Jun–Sep	Gillnet	Trawl
Atlantic Cod	3	8	3	9	4	9	7	3	23	May–Sep	Gillnet	Trawl
Argentine	2	10	4	4	3	12	4	1	20	Aug	-	Trawl
American Plaice (*Hippoglossoides platessoides*)	0	2	2	0	1	1	2	0	4	May; Jul	Gillnet	Trawl
Skate (Raja sp.)	1	0	0	2	1	0	0	2	3	Jul	Gillnet	-
Yellowtail Flounder (*Pleuronectes ferruginea*)	0	2	0	0	1	1	0	0	2	May; Jul	-	Trawl
Atlantic Mackerel (*Scomber scombrus*)	0	0	1	0	0	1	0	0	1	Oct	-	Seine
Total	**237**	**483**	**655**	**296**	**263**	**426**	**571**	**411**	**1,671**	-	-	-

Source: DFO commercial landings database, 2014.

Notes:

[a] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch weights in a given year, all species combined). 2014 quartile ranges: 1 = 0 – 2,421 kg, 2 = 2,422 – 10,786 kg, 3 = 10,787 – 42,872 kg, 4 = ≥ 42,873 kg.

[b] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch values in a given year, all species combined). 2014 quartile ranges: 1 = $0 – $8,851, 2 = $8,852 – $38,076, 3 = $38,077 – $140,695, 4 = ≥ $140,696.

[c] Total counts of the number of catch records per species; the total quartile code counts for catch weight and catch value are equal.

4.2.1.2 Greenland Halibut

During May–November 2014, the general distribution of harvest locations for Greenland halibut in the Study Area was consistent with that observed during May–November 2005–2013 (see Figures 4.27–4.30 *in* LGL 2015). Most Greenland halibut harvesting occurred in the western portion of the Study Area in areas where water depths ranged between 500 and 1,000 m (see Figure 4.3). Harvesting did not extend either further south or east in the Study Area during 2014 as it did during 2011–2013. As in previous years, Greenland halibut was the predominant groundfish species harvested during May–November in the Study Area. The TAC for Greenland halibut in Div. 3LMNO decreased from 11,543 mt in 2014 to 10,966 mt in 2016 (NAFO 2016).

4.2.1.3 Northern Shrimp

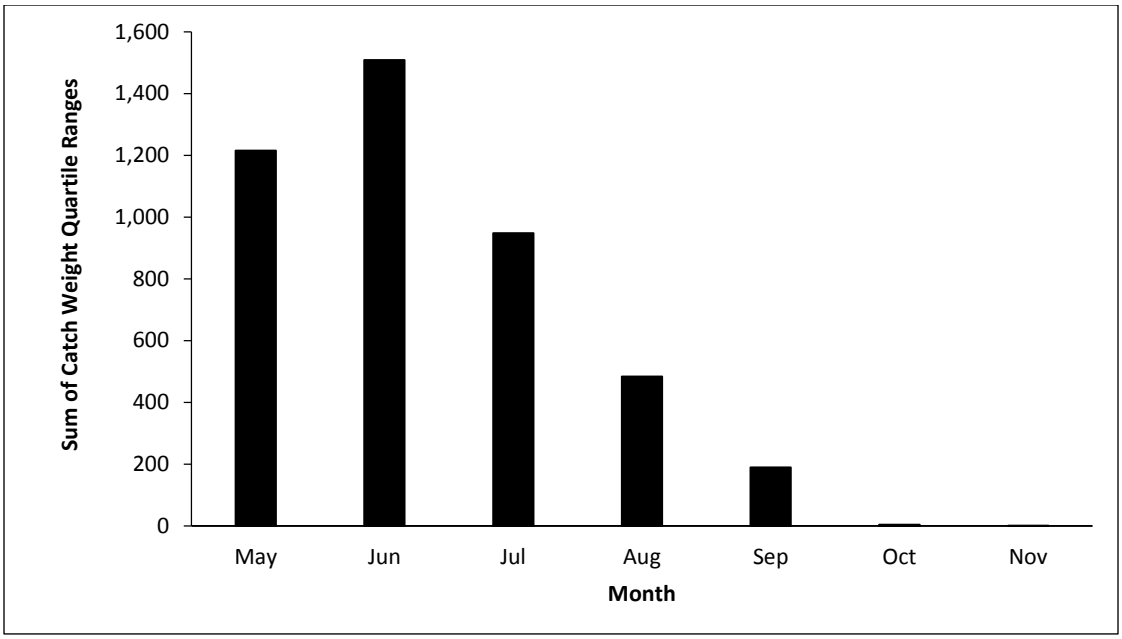
As noted in the EA (see Figure 4.14 *in* LGL 2015), northern shrimp harvesting in the Study Area has declined considerably during recent years. The shrimp fishery closed in NAFO Div. 3L in 2015 and will remain closed in 2016. The moratorium on this fishery in Div. 3M was implemented 2010 and remains in effect (DFO 2015e; NAFO 2015a). The TAC for northern shrimp in SFA 6 (i.e., Div. 3K and a portion of 2J) has decreased during recent years (from 60,245 mt in 2013 to 48,196 mt in 2014 and 2015) (DFO 2015e). Similar to previous years, northern shrimp harvesting in the Study Area during May–November 2014 occurred primarily in the western portion of the Study Area in areas where water depths ranged from 200–500 m (see Figure 4.4).

4.2.1.4 Other Fishes

Redfishes, Atlantic halibut, Atlantic cod, American plaice (*Hippoglossoides platessoides*), and yellowtail flounder (*Pleuronectes ferruginea*) have also been identified as important commercial species in the Study Area (see Table 4.1 above, and Tables 4.2–4.5 *in* LGL 2015). These species are predominantly harvested in areas where water depths <500 m. Atlantic halibut are managed by DFO, while NAFO sets annual TAC values for the remaining four species. The 2015 TAC levels for Atlantic halibut in NAFO Div. 3NOPs4VWX+5 increased from 2,563 mt in 2015 to 2,738 mt in 2016 (DFO 2015e). With relatively high recruitment levels since the mid-2000s, the Atlantic cod and redfish stocks on the Flemish Cap in NAFO Div. 3M appear healthy, and are projected to support an increase in harvesting in 2016 and 2017 (NAFO 2015a,b). The TAC for Atlantic cod in Div. 3M increased from 13,795 mt in 2015 to 13,931 mt in 2016 (NAFO 2016). Redfish TAC in Div. 3LN remained at 10,400 mt in 2015 and 2016, increased from 6,700 mt in 2015 to 7,000 mt in 2016 in Div. 3M, and remained at 20,000 mt in 2015 and 2016 in Div. 3O (NAFO 2016). The TAC for yellowtail flounder in Div. 3LNO remained steady at 17,000 mt in 2015 and 2016 (NAFO 2016). Fishing for Atlantic cod in Div. 3LNO is banned, while fishing for American plaice is banned in Div. 3LNO, 3M and 3Ps (DFO 2015e; NAFO 2015a).

4.2.1.5 Timing and Gear Types of Commercial Fisheries

Similar to previous years, most of the harvesting in the Study Area during the May–November 2014 period occurred during the May–July period (see Figure 4.5 below, and Figure 4.13 *in* LGL 2015). Gear types used in 2014 were typical of those used in the Study Area commercial fisheries during recent years (see Table 4.1 above, and § 4.3.3.2 *in* LGL 2015). The 2014 harvest locations using fixed and mobile gears are shown in Figure 4.6.



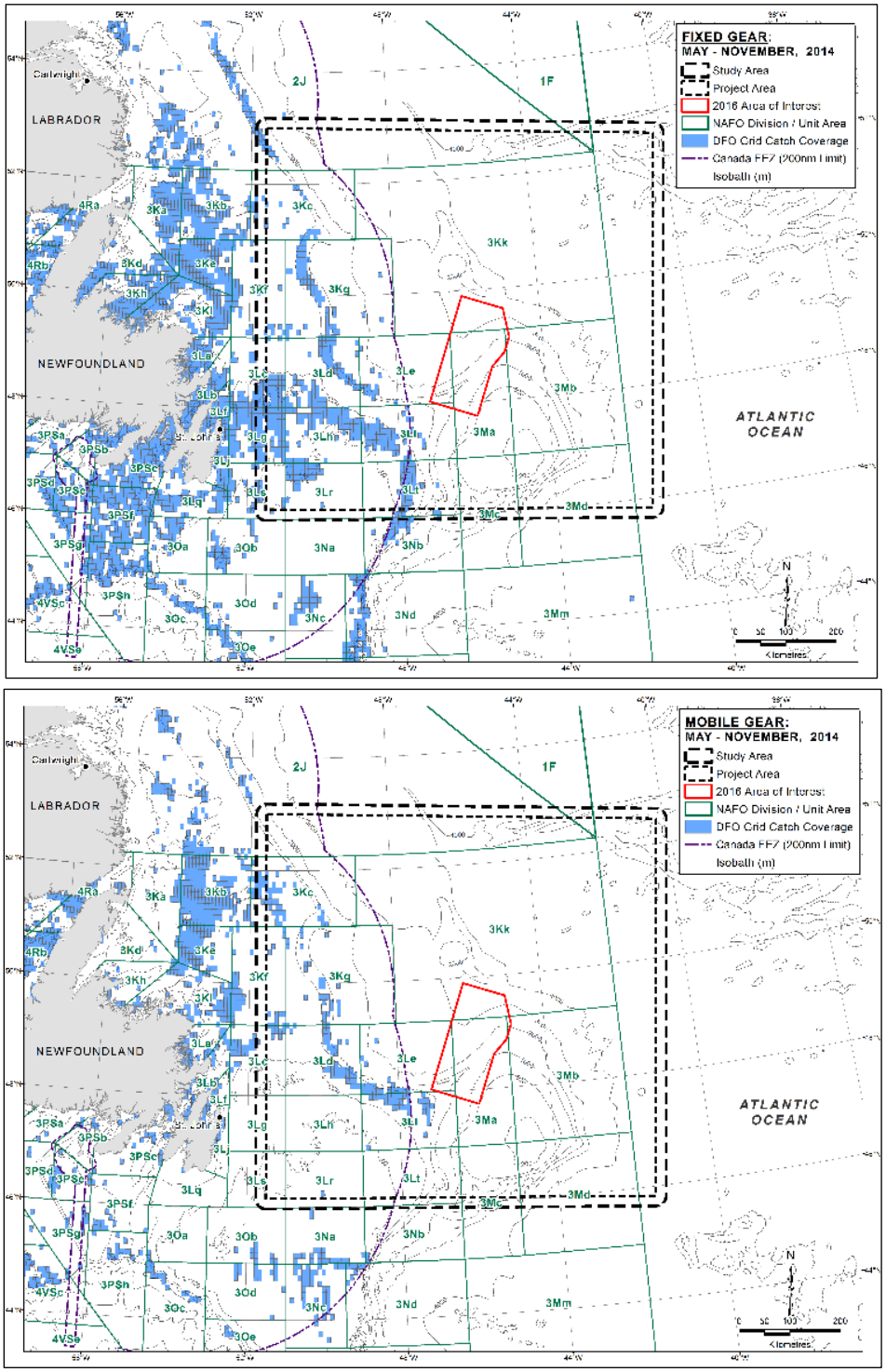
Source: DFO commercial landings database, 2014.
Notes: Sum of catch weight quartile codes is the summation of quartile codes (i.e., 1–4) for all catch records for all species; the greater the sum of quartile code counts, the greater the catch weight for a given month.

Figure 4.5 Monthly Sums of Catch Weight Quartile Codes in the Study Area, All Species, May–November 2014.

4.2.2 Traditional and Aboriginal Fisheries

Several communal commercial fisheries licences (CCFL) are held by Aboriginal groups in the Study Area. The Innu Nation of Labrador holds a CCFL for fixed gear groundfish fishing in NAFO Div. 2J, 3LMNO, 2GH (north of the Study Area) and 3Ps (southwest of the Study Area). This licence also permits access to shrimp in SFAs 6 and 7 (D. Ball and D. Tobin, DFO, Resource Management and Aboriginal Affairs, pers. comm. 3 December 2015). The Qalipu First Nation Band holds CCFLs for snow crab and groundfish in Div. 3K, and for shrimp in SFA 6 (D. Ball and D. Tobin, DFO, Resource Management and Aboriginal Affairs, pers. comm. 3 December 2015). There is potential for the Mi'kmaq Alsumk Mowimsikik Koqoey Association (MAMKA) to expand from the inshore into Div. 3KL, depending on future management measures for northern cod (D. Ball and D. Tobin, DFO, Resource Management and Aboriginal Affairs, pers. comm. 3 December 2015). The Nunatsiavut Government holds a Communal Snow Crab licence and allocation in NAFO Div. 2GHJ, north of 54º40' N (north of the Study Area) (DFO 2010).

According to the Southern and Eastern Newfoundland SEAs (C-NLOPB 2010, 2014), there are no other Aboriginal fisheries that occur in the Study Area.



Source: DFO commercial landings database, 2014.

Figure 4.6 Harvest Locations using Fixed (top) and Mobile (bottom) Gears in the Study Area, All Species, May–November 2014.

4.2.3 Recreational Fisheries

Recreational fisheries in Newfoundland and Labrador are described in § 4.3.5 of the EA (LGL 2015) and § 3.3.3 of the Southern Newfoundland SEA (C-NLOPB 2010). In 2015, the recreational groundfish fishery occurred in all NAFO areas around Newfoundland and Labrador, including NAFO Div. 2GH, 2J3KL, 3Ps, 3Pn and 4R, with the exception of the Eastport (northeast Newfoundland) and Gilbert Bay (southeast Labrador) Marine Protected Areas (MPAs) (DFO 2015e). This fishery, conducted primarily in coastal and inshore waters (C-NLOPB 2014), was open for three weeks in the summer (commenced 18 July 2015), and for nine days in the fall (commenced 19 September 2015) (DFO 2015e). Information for the 2016 recreational fishery season is not yet available on the DFO website; however, dates for these summer and fall recreational fisheries are relatively consistent from year to year.

Given where the recreational fishery typically occurs, it is highly unlikely that any recreational fisheries will be conducted in the Study Area.

4.2.4 Aquaculture

As indicated in the Southern Newfoundland SEA (see § 3.3.2 *in* C-NLOPB 2010), the Eastern Newfoundland SEA (see § 4.3.4.3 *in* C-NLOPB 2014), and the EA (see § 4.3.6 *in* LGL 2015), there are no approved aquaculture sites in the Study Area. All current aquaculture sites in Newfoundland and Labrador are located on the coast, west of the Study Area (see § 4.3.4.3 and Figure 4.150 *in* C-NLOPB 2014; DFA 2015).

4.2.5 DFO and Industry Science Surveys

DFO Research Vessel (RV) data collected during annual multi-species trawl surveys between 2008–2012 were presented in the EA (see § 4.3.7 *in* LGL 2015). Analysis results of the 2013 data for spring (May–June) and fall (September–December) RV surveys in the Study Area do not indicate any major differences in either the predominant species caught or the harvest locations compared to previous survey years (see Table 4.8 and Figure 4.32 *in* LGL 2015). Contrary to previous years, there were no RV survey data collected in the Study Area during March but there were in September (LGL 2015). During 2013, there was one RV harvest location in the southwestern portion of the 2016 AOI where water depths are <1,000 m.

Fisheries research surveys conducted by DFO and the fishing industry were described in § 4.3.8 of the EA (LGL 2015). The tentative schedule of the 2016 DFO multispecies science surveys is presented in Table 4.2 (G. Sheppard, Technician, DFO, pers. comm. 27 January 2016). Spring RV surveys are set to begin at the end of March and continue into early-June, with surveys potentially occurring in the Study Area during late-April to early-June. DFO fall RV surveys will begin in mid-September and end in early-December, and may occur in the Study Area throughout this period.

Table 4.2 Tentative Schedule of DFO RV Surveys in 2016.

NAFO Division	Start Date	End Date	Vessel
3P	29 Mar	12 Apr	*Needler*
3L	5 Apr	26 Apr	*Teleost*
3P	12 Apr	26 Apr	*Needler*
3L	26 Apr	2 May	*Vladykov* [a]
3P + 3KLMNO	27 Apr	2 May	*Teleost*
3P + 3O	27 Apr	10 May	*Needler*
3KL	3 May	21 May	*Teleost*
3O + 3N	10 May	21 May	*Needler*
3L + 3N	24 May	10 Jun	*Needler*
3K	6 Jul	18 Jul	*Vladykov*
3K	20 Jul	24 Jul	*Vladykov*
3L	15 Aug	21 Aug	*Vladykov*
3K	23 Aug	25 Aug	*Vladykov*
3O	14 Sep	27 Sep	*Needler*
3L	17 Sep	24 Sep	*Vladykov*
3O + 3N	27 Sep	8 Oct	*Needler*
2H	4 Oct	8 Oct	*Teleost*
3N + 3L	11 Oct	25 Oct	*Needler*
2H + 2J	11 Oct	25 Oct	*Teleost*
3L	17 Oct	26 Oct	*Vladykov*
3L	25 Oct	8 Nov	*Needler*
2J + 3K	25 Oct	8 Nov	*Teleost*
3K + 3L	9 Nov	19 Nov	*Needler*
3K	9 Nov	22 Nov	*Teleost*
3K + 3L Deep	22 Nov	6 Dec	*Teleost*

Notes:

[a] The *Vladykov* will be partaking in science surveys (e.g., cod tagging, Trinity Bay Ecosystem), but not in the spring or fall NL RV surveys.

Start/end dates subject to change as trip plans are finalized (G. Sheppard, Technician, DFO, pers. comm. 27 January 2016).

As indicated in Figure 4.7, numerous DFO-Industry Collaborative Post-season Snow Crab Trap Survey stations are located in the western and southwestern portions of the Study Area (see Figure 4.42 *in* LGL 2015); none occur in WesternGeco's 2016 AOI. It is anticipated that sampling at these stations will occur during the September–November period in 2016.

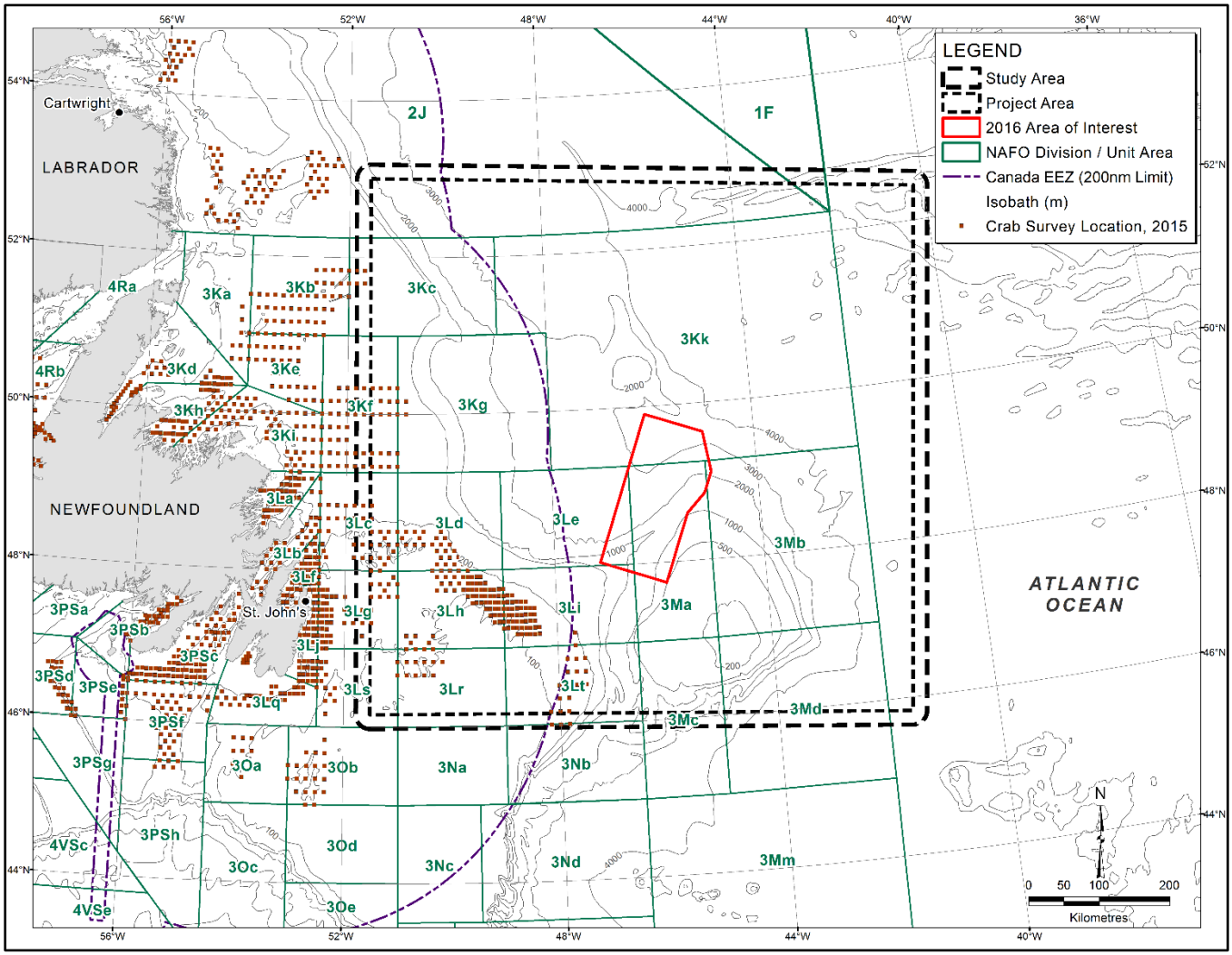


Figure 4.7 Distribution of DFO-Industry Collaborative Post-season Snow Crab Trap Survey Stations Relative to WesternGeco's 2016 AOI.

4.3 Seabirds

The new information presented in this subsection does not change the effects predictions made in the EA (LGL 2015).

4.3.1 Breeding Seabirds in Eastern Newfoundland

Just over 3.6 million pairs of seabirds nest on the southeast coast of Labrador and the east coast of Newfoundland. These include 2.3 million pairs of Leach's Storm-Petrels and 792,000 pairs of Common Murres (Table 4.3). The seabird breeding colonies on Funk Island, Baccalieu Island, the Witless Bay Islands and Cape St. Mary's are among the largest in Atlantic Canada. More than 3.4 million pairs nest at these three locations alone (Table 4.3). These include the largest Atlantic Canadian colonies of Leach's Storm-petrel (2,022,000 pairs on Baccalieu Island), Common Murre (470,000 pairs on Funk

Island), Black-legged Kittiwake (13,950 pairs on Witless Bay Islands), Thick-billed Murre (1,000 pairs at Cape St. Mary's), and Atlantic Puffin (302,030 pairs on Witless Bay Islands). Many of these breeding birds may use the western edge of the Study Area during the breeding season. After the nesting season, breeding seabirds disperse over a large area of the Newfoundland and Labrador offshore area, including the Project's Study Area.

4.3.2 Hydrobatidae (Storm-petrels)

Leach's Storm-Petrel is common and widespread in offshore waters of Newfoundland from April to early-November. More than two million pairs of Leach's Storm-Petrel nest on the Avalon Peninsula (see Table 4.3). Evidence suggests the population of Newfoundland Leach's Storm-Petrels is experiencing a considerable decline. Preliminary results from a 2013 survey of nesting Leach's Storm-Petrel on Baccalieu Island, the largest breeding colony of this species in the world, provide an estimate of just over 2 million pairs, a decline of ~40% from the previous survey in 1984 (EC-CWS unpublished). The results of surveys of nesting Leach's Storm-Petrels on Gull Island in the Witless Bay Ecological Reserve indicated a decrease from 352,000 breeding pairs in 2001 to 180,000 pairs in 2012 (~51% decline) (EC-CWS unpublished).

There have been recent studies of the movements of Leach's Storm-Petrel using telemetry. A bird outfitted with a geolocator in the Gull Island, Newfoundland colony migrated to Cape Verde Islands off the west coast of Africa in early-December, averaging 420 km/day during the 12-day migration. The Leach's Storm-Petrel appears to have remained in this area for at least five weeks, at which time the transmitter stopped functioning. A Leach's Storm-Petrel tagged in Nova Scotia followed a similar southward track, departing Nova Scotia in mid-October. It staged for several weeks near the Cape Verde Islands before continuing on to the eastern tip of Brazil where it spent the rest of the winter. It migrated north again in early-April (Pollet et al. 2014a).

Leach's Storm-Petrels outfitted with geolocators travelled up to 1,015±238 km during foraging trips from nesting colonies in Nova Scotia (Pollet et al. 2014b). Newfoundland breeders can be expected to travel a similar distance from their breeding colonies, if required, putting most of the Study Area off eastern and southern insular Newfoundland within reach.

4.3.3 Alcidae (Dovekie, Murres, Black Guillemot, Razorbill and Atlantic Puffin)

There are ~403,000 pairs of Atlantic Puffin nesting in eastern Newfoundland, and ~47,000 pairs nesting in southeast Labrador (see Table 4.3).

Table 4.3 Number of Pairs of Seabirds Nesting at Colonies in Eastern Newfoundland and Southeast Labrador.

Species	Gannet Islands	Bird Island	Northern Groais Island	Wadham Islands	Cape Freels and Cabot Island	Funk Island	Baccalieu Island	Witless Bay Islands	Mistaken Point	Cape St. Mary's
Northern Fulmar	16[a]					13[a]		13[a]		Present[c]
Leach's Storm-Petrel	20[a]	Present[b]		6,000[a]	250[c]		2,022,000[a]	314,020[a,d]		
Northern Gannet						6,075[a]	2,564			14,789[a]
Herring Gull						150[a]	46	2,045[e]		Present[c]
Great Black-backed Gull	120[a]	20[b]				75[a]	2	15[e]		Present[c]
Black-legged Kittiwake	72[a]		2,400[c]			100[a]	5,096	13,950[a]	4,750[f]	10,000[c]
Common and Arctic Tern				376[c]	250[c]					
Common Murre	31,170[a]	3,100[b]			2,600[c]	470,000[a]	1,440	268,660[a]	100[f]	15,484[a]
Thick-billed Murre	1,846[a]	Present[b]				250[a]	73	240[s]		1,000[c]
Razorbill	14,801[a]	1,530[b]		30[a]	25[c]	200[a]	406	846[a]	Present[f]	100[c]
Black Guillemot	110[a]			25[a]			113	20[c]	Present[f]	Present[c]
Atlantic Puffin	38,666[a]	8,070[b]		7,140[a]	20[c]	2,000[a]	45,300	302,020[a,]	50[f]	
Total	86,821	12,720	2,400	13,571	3,145	478,863	2,077,040	901,829	4,900	41,373

Sources: [a] EC-CWS, unpubl.data; [b] Important Bird Areas of Canada (www.ibacanada.ca); [c] Cairns et al. (1989); [d] Wilhelm et al. submitted; [e] Bond et al. in press; [f] Parks and Natural Areas (unpubl. data)

4.3.4 Mitigation Methods for Stranded Seabirds

A newly available draft document for handling stranded birds replaces Williams and Chardine (n.d.) protocol cited in previous EAs. The Canadian Wildlife Service (CWS) draft document is entitled "Best Practices for Stranded Birds Encountered Offshore - Atlantic Canada" (EC 2015). The final version of the document is still being prepared.

4.4 Marine Mammals and Sea Turtles

The new information presented in this subsection does not change the effects predictions made in the EA (LGL 2015).

4.4.1 Updated COSEWIC Designations

There is only one COSEWIC status update (COSEWIC 2016) for marine mammals and sea turtles included in Table 4.14 of the WesternGeco EA (LGL 2015). This change in status does not affect the effects assessment or requirement for mitigation measures.

- Harp seal (*Pagophilus groenlandicus*) (Atlantic) – changed from *high-priority candidate* species in the EA (LGL 2015) to *low-priority candidate* species.

4.4.2 Updated Population/Abundance Estimates

The update of the marine mammal and sea turtle population/abundance estimates included in the EA (LGL 2015) is as follows:

- Fin whale (*Balaenoptera physalus*) – the current estimate for the western North Atlantic stock is 1,618 individuals (CV = 0.33; Waring et al. 2015).

4.4.3 Additional References

McCordic et al. (2014), using images from the North Atlantic Humpback Whale Catalogue (NAHWC), examined humpback whale (*Megaptera novaengliae*) flukes for the presence of rake marks from killer whales (*Orcinus orca*). They found that humpbacks in the western North Atlantic (including Newfoundland and Labrador region and the Quebec shore of the Gulf of St. Lawrence) have a scarring rate that is almost twice that of either the Gulf of Maine or West Greenland. According to the authors, this suggests that the Canadian population of killer whales may prey preferentially on marine mammals.

Matthews and Ferguson (2014) analyzed stable isotopes in the tooth collagen of killer whales from the Eastern Canadian Arctic (ECA) and the northwest Atlantic (NWA) (samples from Newfoundland). Significant differences in stable nitrogen isotope values between killer whales from the two areas support the hypothesis that ECA and NWA killer whales are from largely non-overlapping populations.

Despite these inter-area differences, ECA and NWA killer whales were found to forage at similar trophic levels.

4.5 Species at Risk

The new information presented in this subsection does not change the effects predictions made in the EA (LGL 2015).

Table 4.4 includes the species/populations at risk that could potentially occur in the Study Area, based on available information at the websites for *SARA* and COSEWIC as of March 2016. Changes in species status since preparation of the 2015 EA Update are described below and noted in red font and light grey shading in Table 4.4.

- Leatherback sea turtle (*Dermochelys coriacea*) has been given two separate listings under *SARA*. The leatherback sea turtle, in general, has an *endangered* status under Schedule 1 of *SARA* but no status under COSEWIC. The Atlantic population of this sea turtle has an *endangered* status under COSEWIC but no status under *SARA*.

As of March 2016, no other species/populations that could potentially occur in the Study Area have been added to Schedule 1 of *SARA*.

There are no new or updated recovery strategies for species/populations that potentially occur in the Study Area and have either *endangered* or *threatened* status under Schedule 1 of *SARA* since the preparation of the EA (LGL 2015) and its Addendum (LGL 2016). Final recovery strategies exist for the blue whale, northern bottlenose whale, North Atlantic right whale, leatherback sea turtle, spotted wolffish, northern wolfish, and Ivory Gull. A management plan has also been prepared for the Atlantic wolfish which currently has *special concern* status under Schedule 1 of *SARA*.

WesternGeco will monitor *SARA* issues through the law gazettes, the Internet, and communication with DFO and Environment Canada, and will adaptively manage any issues that may arise in the future. WesternGeco will comply with relevant regulations pertaining to *SARA* Recovery Strategies and Action Plans, and continue to exercise due caution to minimize impacts on species at risk during all of its operations. WesternGeco also understands that other species/populations may be given either *endangered* or *threatened* status under Schedule 1 of *SARA* during the course of the Project, and will continue to monitor for any status changes.

Table 4.4 *SARA*-Listed and COSEWIC-Assessed Marine Species that Potentially Occur in the Study Area.

SPECIES		*SARA*[a]			COSEWIC[b]		
Common Name	**Scientific Name**	**Endangered**	**Threatened**	**Special Concern**	**Endangered**	**Threatened**	**Special Concern**
Marine Mammals							
Blue Whale (Atlantic population)	*Balaenoptera musculus*	Schedule 1			X		
North Atlantic Right Whale	*Eubalaena glacialis*	Schedule 1			X		
Northern Bottlenose Whale (Scotian Shelf population)	*Hyperoodon ampullatus*	Schedule 1			X		
Fin Whale (Atlantic population)	*Balaenoptera physalus*			Schedule 1			X
Sowerby's Beaked Whale	*Mesoplodon bidens*			Schedule 1			X
Northern Bottlenose Whale (Davis Strait-Baffin Bay-Labrador Sea population)	*Hyperoodon ampullatus*						X
Killer Whale (Northwest Atlantic/ Eastern Arctic population)	*Orcinus orca*						X
Sea Turtles							
Leatherback Sea Turtle	*Dermochelys coriacea*	Schedule 1					
Leatherback Sea Turtle (Atlantic population)	*Dermochelys coriacea*				X		
Loggerhead Sea Turtle	*Caretta caretta*				X		
Fishes							
White Shark (Atlantic population)	*Carcharodon carcharias*	Schedule 1			X		
Northern Wolffish	*Anarhichas denticulatus*		Schedule 1			X	
Spotted Wolffish	*Anarhichas minor*		Schedule 1			X	
Atlantic Wolffish	*Anarhichas lupus*			Schedule 1			X
Atlantic Cod (Newfoundland and Labrador population)	*Gadus morhua*				X		
Atlantic Bluefin Tuna	*Thunnus thynnus*				X		
Porbeagle Shark	*Lamna nasus*				X		
Roundnose Grenadier	*Coryphaenoides rupestris*				X		
Cusk	*Brosme brosme*				X		
Smooth Skate (Funk Island	*Malacoraja senta*				X		

SPECIES		*SARA*[a]			COSEWIC[b]		
Common Name	**Scientific Name**	**Endangered**	**Threatened**	**Special Concern**	**Endangered**	**Threatened**	**Special Concern**
Deep population)							
Atlantic Salmon (South Newfoundland population)	*Salmo salar*					X	
American Eel	*Anguilla rostrata*					X	
Shortfin Mako Shark (Atlantic population)	*Isurus oxyrinchus*					X	
American Plaice (Newfoundland and Labrador population)	*Hippoglossoides platessoides*					X	
Acadian Redfish (Atlantic population)	*Sebastes fasciatus*					X	
Deepwater Redfish (Northern population)	*Sebastes mentella*					X	
White Hake (Atlantic and Northern Gulf of St. Lawrence population)	*Urophycis tenuis*					X	
Blue Shark (Atlantic population)	*Prionace glauca*						X
Basking Shark (Atlantic population)	*Cetorhinus maximus*						X
Spiny Dogfish (Atlantic population)	*Squalus acanthias*						X
Roughhead Grenadier	*Macrourus berglax*						X
Thorny Skate	*Amblyraja radiata*						X
Birds							
Ivory Gull	*Pagophila eburnea*	Schedule 1			X		

Sources: [a] *SARA* website (http://www.sararegistry.gc.ca/species/default_e.cfm), accessed March 2016; [b] COSEWIC website (http://www.cosewic.gc.ca/index.htm); accessed March 2016. COSEWIC candidate species not included.

4.6 Sensitive Areas

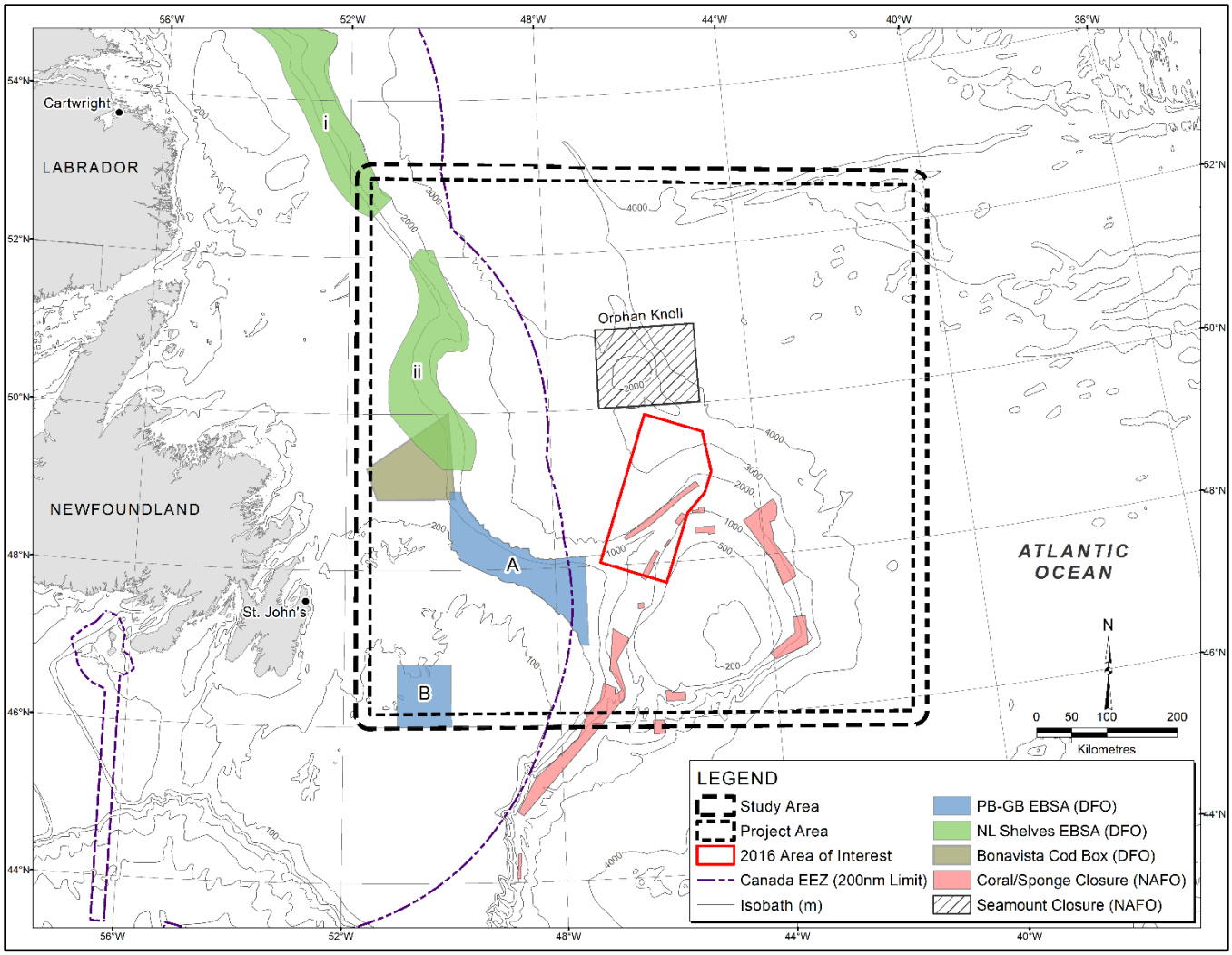
The new information presented in this subsection does not change the effects predictions made in the EA (LGL 2015).

There have not been any new designations or modifications of Coral/Sponge Closure Areas by the Northwest Atlantic Fisheries Organization (NAFO) Scientific Council since the EA was prepared (LGL 2015; NAFO 2015c). Figure 4.8 shows 12 of the total 13 Coral/Sponge Closure Areas overlapping with the Study Area, and four overlapping with the 2016 AOI. These Coral/Sponge Closure Areas are closed to all bottom fishing activities until at least 31 December 2020 (NAFO 2015c). A recent Terms of Reference released by DFO detailed an upcoming national peer review in March 2016 in Halifax, NS. The review will address the needs of DFO Ecosystems and Fisheries Management in developing clear guidance on how to use location data of coral and sponge concentrations in Canadian waters in the delineation of Ecologically and Biologically Significant Areas (EBSAs), and relate these concentrations to the NAFO fishing footprint of bottom contact fisheries (DFO 2016a).

No additional EBSAs have been designated in either the Placentia Bay–Grand Banks Large Ocean Management Area (PG-GB LOMA) or the Newfoundland and Labrador Shelves Bioregion since the EA was prepared (LGL 2015). The two PB-GB LOMA EBSAs (Northeast Shelf and Slope and Virgin Rocks) and two NL Shelf Bioregion EBSAs (Orphan Spur and Labrador Slope) that overlap with the Study Area are shown in Figure 4.8. The key attributes of these EBSAs were presented in § 4.7.1.1 and 4.7.1.2 of the WesternGeco EA (LGL 2015). A Terms of Reference was released by DFO for 29 January 2016 in relation to Canada's agreement to the Convention on Biological Diversity Aichi Target 11, which includes the goal of conserving 10% of coastal and marine areas by 2020 (DFO 2016b). Specifically, the Oceans Program aims to identify and/or clarify particular sub areas for each EBSA in the NL Bioregion; to this end, DFO Oceans has requested that DFO Science provide detailed descriptions of sub-components of the EBSAs designated in the PB-GB LOMA, and geospatially-referenced data layers for sub-components of the PB-GB LOMA and NL Shelves Bioregion EBSAs (DFO 2016b).

No NAFO Conservation and Enforcement Areas, including Seamount Closure Areas, have been newly designated or modified since the WesternGeco EA was prepared (see Figure 4.47 and § 4.7 of LGL (2015); NAFO (2015c)). The single Seamount Closure Area which occurs in the Study Area, Orphan Knoll, is presented in Figure 4.8 and briefly described in § 4.7.3 of LGL (2015).

Protection of the Bonavista Cod Box from commercial fisheries (excluding snow crab fishery) and other invasive activities was recommended by the *Fisheries Resource Conservation Council* (FRCC). This level of protection was never applied. As indicated in its description in § 4.7.4 of LGL (2015), the Bonavista Cod Box is an important area for cod spawning and juvenile cod. The entirety of the Bonavista Cod Box overlaps the Study Area (see Figure 4.8).



Notes: PB-GB LOMA EBSAs: (A) Northeast Shelf and Slope; (B) Virgin Rocks NL; Shelves Bioregion EBSAs: (i) Labrador Slope; (ii) Orphan Spur.

Figure 4.8 Sensitive Areas that Overlap the Study Area.

5.0 Consultations

The document One Ocean Protocol for Consultation Meetings: Recommendations for the Fishing and Petroleum Industries in Newfoundland and Labrador (One Ocean 2013a) outlines recommendations for preparing, convening and following up on consultation meetings.

On 1 March 2016, WesternGeco distributed information to various stakeholders and agencies (consultees), describing the seismic activities planned for 2016. The distributed information package is provided in Appendix 1. Recipients of the information are as follow:

- Fisheries and Oceans Canada (DFO);
- Environment Canada (EC);
- One Ocean;

- Fish, Food and Allied Workers Union (FFAW/Unifor);
- Nature Newfoundland and Labrador (NNL);
- Association of Seafood Producers (ASP);
- Ocean Choice International (OCI);
- Groundfish Enterprise Allocation Council (GEAC);
- Canadian Association of Prawn Producers (CAPP);
- Newfound Resources Ltd.;
- Clearwater Seafoods; and
- Icewater Seafoods.

As of 18 March 2016, WesternGeco had received replies from three of the consultees: (1) DFO; (2) One Ocean; and (3) OCI. DFO indicated that it would await submission of the EA Update and provide comment then, One Ocean acknowledged receipt of the information, and OCI asked for clarification on coordinates presented in the information package. Emails were sent to all consultees again on March 18 as a reminder that the deadline to comment on the information regarding 2016 activities was drawing near. Environment Canada responded to the second email, saying it had no comment on the information package. Appendix 2 contains a summary table of WesternGeco's consultation regarding the 2016 seismic survey activities, including the individuals contacted for each group.

6.0 Environmental Assessment

6.1 Mitigation Measures

The mitigation measures described in the EA (LGL 2015) and the associated Addendum (LGL 2016) remain applicable to WesternGeco's seismic survey activities planned for 2016.

In 2011, One Ocean reviewed fishing and petroleum industry processes and practices for offshore seismic survey operations in Newfoundland and Labrador with the intention of identifying opportunities to better understand and improve operational processes that would mutually benefit both industries. Results of the review are outlined in the document One Ocean Protocol for Seismic Survey Programs in Newfoundland and Labrador (One Ocean 2013b).

6.2 Validity of Significance Determination

Based on careful consideration of newly available information presented in §4.0 and results of consultations with stakeholders, the determinations of significance of the residual effects of seismic surveying activities on VECs presented in the EA (LGL 2015) remain valid for the seismic survey activities planned by WesternGeco in 2016.

7.0 Concluding Statement

The seismic survey activities that WesternGeco plans to conduct in 2016 have been reviewed and determined to be within the scope of the EA (LGL 2015) and its Addendum (LGL 2016). The environmental effects predicted in the EA and its Addendum remain valid. WesternGeco reaffirms its commitment to implement the mitigation measures proposed in these assessment documents and in the Screening Decisions made by the C-NLOPB.

8.0 References

Bond, A.L., S.I. Wilhelm, G.J. Robertson, and S. Avery-Gomm. Differential declines among nesting habitats of breeding gulls in Witless Bay, Newfoundland and Labrador. Waterbirds, *in press*.

Cairns, D.K., W.A. Montevecchi, and W. Threlfall. 1989. Researcher's guide to Newfoundland seabird colonies. Second edition. Memorial University of Newfoundland Occasional Papers in Biology, No. 14. 43 p.

Casas, J.M. 2015. Northern shrimp (*Pandalus borealis*) on Flemish Cap surveys, 2015. NAFO SCR Doc. 15/047.

Casas, J.M., E. Román, and J. Teruel. 2015. Northern shrimp (*Pandalus borealis*, Krøyer) from EU-Spain bottom trawl survey 2015 in NAFO Div. 3LNO. NAFO SCR Doc. 15/048.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2010. Southern Newfoundland strategic environmental assessment. LGL Rep. SA1037. Rep. by LGL Limited, St. John's, NL, Oceans Limited, St. John's, NL, Canning & Pitt Associates, Inc., St. John's, NL, and PAL Environmental Services, St. John's, NL, for Canada-Newfoundland and Labrador Offshore Petroleum Board, St. John's, NL. 333 p. + appendices.

C-NLOPB. 2012. Canada-Newfoundland and Labrador Offshore Petroleum Board: Geophysical, Geological, Environmental and Geotechnical Program Guidelines, January 2012.

C-NLOPB. 2014. Eastern Newfoundland strategic environmental assessment. Rep. by AMEC Environment & Infrastructure, St. John's, NL, for the C-NLOPB, St. John's, NL. 527 p. + appendices.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) website. 2016. Available at http://www.cosewic.gc.ca/eng/sct5/index_e.cfm

DFA (Department of Fisheries and Aquaculture). 2015. Seafood industry year in review 2014. Fisheries and Aquaculture, Government of Newfoundland and Labrador. 38 p. Available at http://www.fishaq.gov.nl.ca/.

DFO (Fisheries and Oceans Canada). 2010. Snow crab (*Chionoecetes opilio*) – Newfoundland and Labrador – 2009-2011. Government of Canada. Available at http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/snow-crab-neige/snow-crab-neiges2009-eng.htm.

DFO. 2015a. Oceanographic conditions in the Atlantic zone in 2014. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/030.

DFO. 2015b. Assessment of Newfoundland and Labrador snow crab. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/029.

DFO. 2015c. Assessment of northern shrimp (*Pandalus borealis*) in Shrimp Fishing Areas 4-6 (NAFO Divisions 2G-3K) and of striped shrimp (*Pandalus montagui*) in Shrimp Fishing Area 4 (NAFO Division 2G). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/018.

DFO. 2015d. Assessment of capelin in Subarea 2 and Divisions 3KL in 2015. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/036.

DFO. 2015e. Decisions for Atlantic Canada, Quebec and the Arctic – 2015. Government of Canada. Available at http://www.dfo-mpo.gc.ca/decisions/fm-2015-gp/index-atl-eng.htm.

DFO. 2016a. Terms of Reference. Delineation of significant areas of cold water corals and sponge-dominated communities in Canada's Atlantic and Eastern Arctic marine waters. National Peer Review – National Capital Region. March 8-10, 2016, Halifax, NS. Available at http://www.dfo-mpo.gc.ca/csas-sccs/Schedule-Horraire/2016/03_08-10-eng.html.

DFO. 2016b. Terms of Reference. Refinement of information relating to Ecologically and Biologically Significant Areas (EBSAs) identified in the Newfoundland and Labrador (NL) Bioregion. Regional Science Response Process – Newfoundland and Labrador Region. January 29, 2016, St. John's, NL. Available at http://www.dfo-mpo.gc.ca/csas-sccs/Schedule-Horraire/2016/01_29b-eng.html.

EC (Environment Canada). 2015. Best practices for stranded birds encountered offshore Atlantic Canada, Draft 2 - April 17 2015. Environment Canada. 12 p. + appendices.

EC-CWS (Environment Canada-Canadian Wildlife Service). Unpublished data.

LGL (LGL Limited). 2014. Environmental Assessment East Canada CSEM Survey, 2014-2018. LGL Rep. SA1248. Rep. by LGL Limited, St. John's, NL for Electromagnetic Geoservices Canada (Operator) (EMGS), Vancouver, BC. 192 p. + Appendices

LGL. 2015. Environmental Assessment of WesternGeco's Eastern Newfoundland Offshore Seismic Program, 2015-2024. LGL Rep. FA0035. Prepared by LGL Limited in association with Canning & Pitt Associates Inc., St. John's, NL for WesternGeco (Division of Schlumberger Canada Limited), Calgary, AB. 255 p. + appendices.

LGL. 2016. Environmental Assessment of WesternGeco's Eastern Newfoundland Offshore Seismic Program, 2015-2024 Addendum. LGL Rep. FA0035. Prepared by LGL Limited in association with Canning & Pitt Associates Inc., St. John's, NL for WesternGeco (Division of Schlumberger Canada Limited), Calgary, AB. 11 p.

Matthews, C.J. and S.H. Ferguson. 2014. Spatial segregation and similar trophic-level diet among eastern Canadian Arctic/north-west Atlantic killer whales inferred from bulk and compound specific isotopic analysis. J. Mar. Biol. Assoc. U.K. 94(6): 1343–1355.

McCordic, J.A., S.K. Todd, and P.T. Stevick. 2014. Differential rates of killer whale attacks on humpback whales in the North Atlantic as determined by scarification. J. Mar. Biol. Assoc. U.K. 94(6): 1311–1315.

Morgan, M.J. 2015. Greenland halibut *(Reinhardtius hippoglossoides)* in NAFO Subarea 2 and Divisions 3KLMNO: Stock trends based on annual Canadian research vessel survey results. NAFO SR Doc. 15/041.

NAFO (Northwest Atlantic Fisheries Organization). 2014. Report of Scientific Council Meeting, 31 May - 12 June 2014.

NAFO. 2015a. NAFO making waves: Bans on bottom fishing. Press Release. Available at http://www.nafo.int/fisheries/frames/fishery.html.

NAFO. 2015b. NAFO regulated stocks. Available at http://www.nafo.int/science/nafo-stocks.html.

NAFO. 2015c. Northwest Atlantic Fisheries Organization conservation and enforcement measures. NAFO/FC Doc. 15/01. Serial No. N6409.

NAFO. 2016. NAFO quota tables. Available at http://www.nafo.int/fisheries/frames/fishery.html.

One Ocean. 2013a. One Ocean Protocol for Consultation Meetings: Recommendations for the Fishing and Petroleum Industries in Newfoundland and Labrador. 7 p + appendix.

One Ocean. 2013b. One Ocean Protocol for Seismic Survey Programs in Newfoundland and Labrador. 17 p + appendix.

Parks and Natural Areas. Department of Environment and Conservation, Government of Newfoundland and Labrador. Unpublished data.

Pollet, I.L, A. Hedd, P.D. Taylor, W.A. Montevecchi and D. Shutler. 2014a. Migratory movements and wintering areas of Leach's Storm-Petrels tracked using geolocators. Journal of Field Ornithology. 85: 321-328, 2014.

Pollet, I.L., R.A. Ronconi, I.D. Jonsen, M.L. Leonard, P.D. Taylor and D. Shutler. 2014b. Foraging movements of Leach's storm-petrels *Oceanodroma leucorhoa* during incubation. Journal of Avian Biology 45: 001-010, 2014.

Román, E., Á. Armesto and D. González-Troncoso. 2015. Results for the Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish of the Spanish Survey in the NAFO Div. 3L for the period 2003-2014. NAFO SCR Doc. 15/020.

Rose, G.A. and S. Rowe. 2015. Northern cod comeback. Can. J. Fish. Aquat. Sci. 72: 1789–1798.

SARA (*Species at Risk Act*) website. 2016. Available at http://www.sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

Suncor (Suncor Energy). 2013. Environmental Assessment of Suncor Energy's Eastern Newfoundland Offshore Area 2D/3D/4D Seismic Program, 2014-2024. LGL Rep. SA1233. Rep. by LGL Limited, St. John's, NL for Suncor Energy, St. John's, NL. 210 p. + appendices.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2015. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2014. NOAA Tech Memo NMFS NE 231: 361 p. doi: 10.7289/V5TQ5ZH0.

Wilhelm, S.I., J. Mailhiot, J. Arany, J.W. Chardine, G.J. Robertson, and P.C. Ryan. Incorporating the use of geographic information system to monitor seabird colonies: Implications for population trends. Marine Ornithology, *submitted*.

Personal Communications

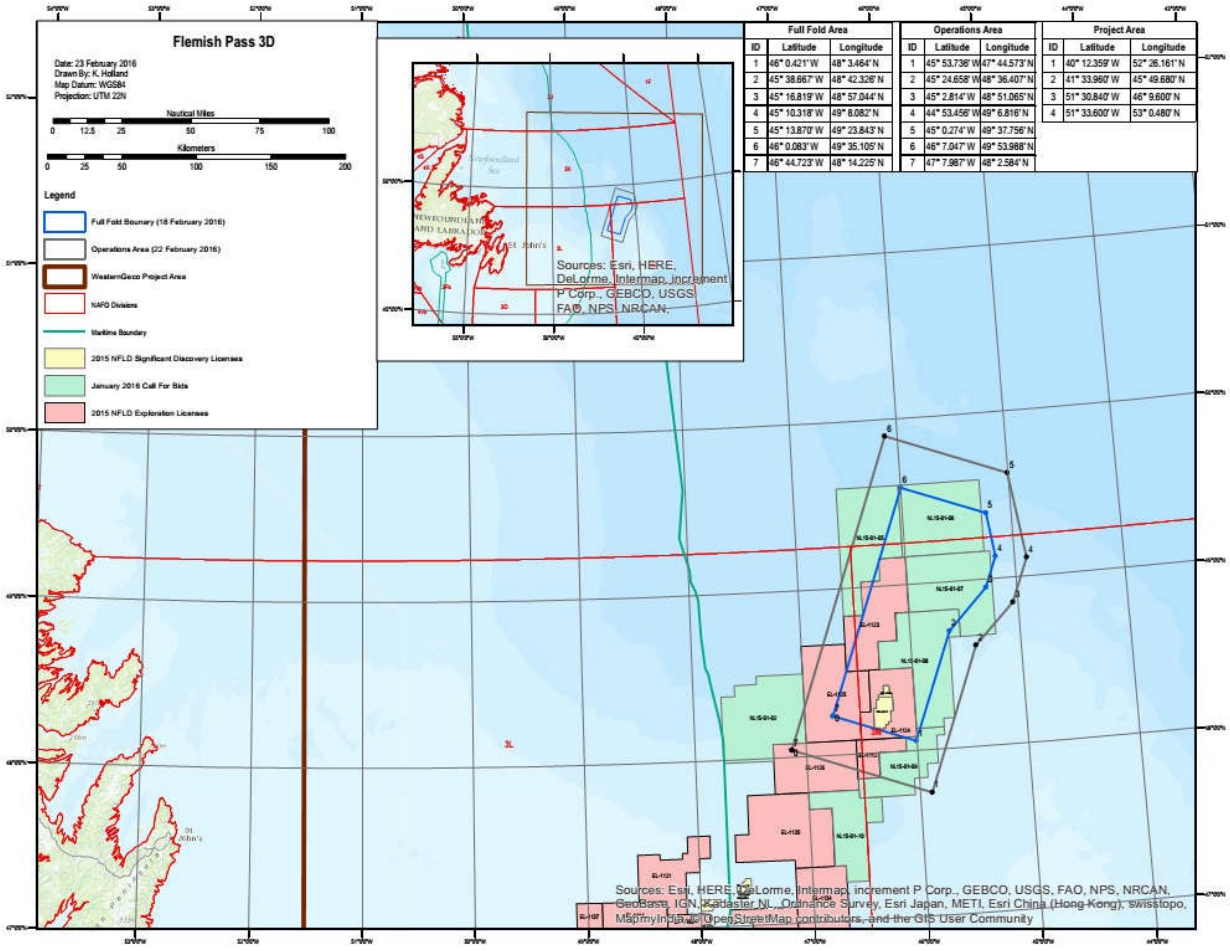
Ball, D. Resource Management and Aboriginal Affairs, DFO. 3 December 2015.
Sheppard, G. Technician, DFO. 27 January 2016
Tobin, D. Resource Management and Aboriginal Affairs, DFO. 3 December 2015.

List of Appendices

Appendix 1 – Information Regarding 2016 Activities Distributed to Consultees

WesternGeco Canada plans to conduct a 3D seismic program during the May to November 2016 period. The program will cover an approximate area of 9,000km^2 situated in the Flemish Pass Basin area.

The planned program is situated outside of the 200 nautical mile limit and overlaps parts of NAFO Div. 3K, 3L and 3M. The program will commence late May on the eastern most side of the survey area and will be shot in a north/south direction.



WesternGeco will be utilizing the seismic vessel M/V Amazon Conqueror to conduct the survey. The Amazon Conqueror was built in Flensburg, Germany in 2014 and is registered in Panama. The vessel is 126.0 m long, 28.0 m wide and has a mean draft of 7.3 m.

The vessel will use 14 towed streamers, 8,000 metres in length and deployed at a depth of 13-19 metres. The solid streamers will be separated by 100 metres and will be filled with polyurethane foam to minimize any potential of environmental impact from flotation fluid leaks due to breaks or tears.

The survey sound source will consist of two air source arrays, with sufficient volume to output ~120 bar-meters peak-to-peak (~261 dB re 1 µPa $_{p\text{-}p}$). The air source will operate at a towed depth of about ~6-9 metres and a pressure of 2000 psi.

During the 2016 program there will be two (2) support vessels in the field along with the seismic vessel at any given time: one (1) full time guard vessel and one (1) full time supply vessel. WesternGeco will also employ two (2) Marine Mammal Observers and one (1) Fisheries Liaison Officer for the duration of the program. Communication between the seismic vessel and stakeholders in the area will continue throughout the survey using Notices to Shipping, Notices to Mariners and radio broadcasts.

All Project mitigations detailed in our Environmental Assessment *(Environmental Assessment – WesternGeco Eastern NL Offshore Seismic Program, 2015-2024)* follow the guidelines outlined in the *Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine*

Environment as well as the recommended environmental planning, mitigation and reporting measures for marine seismic surveys in the NL offshore area in Appendix 2 of the "*Geophysical, Geological, Environmental and Geotechnical Program Guidelines*". All policies, practices, recommendations and procedures referred to in the EA will be implemented and maintained for the duration of the program.

If you should have any further questions on this 2016 survey or require any additional details on our plans, we would be happy to meet with you either in person, via teleconference or through email communication at any time. I will touch base with you again in about two weeks to see if there are any additional things you wish to discuss prior to the submission of our annual EA Update (anticipated to be submitted to the C-NLOPB mid-March 2016).

Thank you,

Lesa Tanner WesternGeco
Canada Project Operations
33 Thornhill Drive
Dartmouth, NS B3B1R9
Email: LTanner@slb.com
Office: 902-481-6427

Appendix 2 – Summary of WesternGeco Consultations Regarding 2016 Activities

Stakeholders Notified March 1, 2016:	Responses as of March 18th:	Follow Up Communication March 18, 2016:	Responses as of March 22nd:
Fisheries and Oceans Canada – Distribution Email Address	Darrin Sooley replied on March 2nd that he would await submission of the EA Update and subsequent formal request to review same from the CNLOPB and will provide comments to CNLOPB accordingly.	Email not sent to DFO based on previous comments received that they would wait for formal submission of the EA update.	N/A
Environment Canada – Glenn Troke	No response received to date.	Sent to Glenn Troke	Mr. Troke replied on March 21st indicating that they have no questions at this time.
Nature Newfoundland & Labrador – Len Zedel	No response received to date.	Sent to Len Zedel	No response received to date.
One Ocean – Maureen Murphy Rustad	Maureen replied March 3rd acknowledging receipt of the update.	Sent to Maureen Murphy Rustad	No further responses received.
Fish, Food and Allied Workers Union (FFAW/Unifor) – Dwan Street and Johan Joensen	No response received to date.	Sent to Dwan Street and Johan Joensen	No response received to date.
Association of Seafood Producers – Derek Butler	No response received to date.	Sent to Derek Butler	No response received to date.
Ocean Choice International (OCI) – Rick Ellis and Greg Viscount	Note from OCI Spatial Analyst on March 7th to clarify a question on coordinates.	Sent to Rick Ellis and Greg Viscount	No further responses received.
Groundfish Enterprise Allocation Council (GEAC) – Kris Vascotto	No response received to date.	Sent to Kris Vascotto	No response received to date.
Canadian Association of Prawn Producers – Bruce Chapman	No response received to date.	Email to Bruce Chapman bounced back stating that mailbox was full.	No response received to date.
Clearwater Seafoods – Catherine Boyd	No response received to date.	Sent to Catherine Boyd	No response received to date.
Icewater Seafoods – Alberto Wareham	No response received to date.	Sent to Alberto Wareham	No response received to date.
Newfound Resources Ltd. – Brian McNamara	No response received to date.	Sent to Brian McNamara	No response received to date.