Environmental Assessment Update (2019) of Multiklient Invest Labrador Offshore Seismic Program, 2018–2023

Prepared by

LIMITED
environmental research associates

Prepared for

Multiklient Invest AS

&

TGS-NOPEC Geophysical Company ASA

July 2019
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1.0 Introduction

This document is an Update of the Environmental Assessment (EA) of the Multiklient Invest AS (MKI) Labrador Offshore Seismic Program, 2018–2023 (LGL 2018) and the associated Addendum (LGL 2019). In 2019, MKI is proposing to conduct 2D and 3D seismic surveying in the Labrador Offshore Project Area (Figure 1.1). The EA Update document addresses the validity of the EA (Table 1.1) as it pertains to MKI's proposed seismic survey activities in 2019. 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 MKI previously committed remain technically valid for proposed seismic survey operations in 2019.

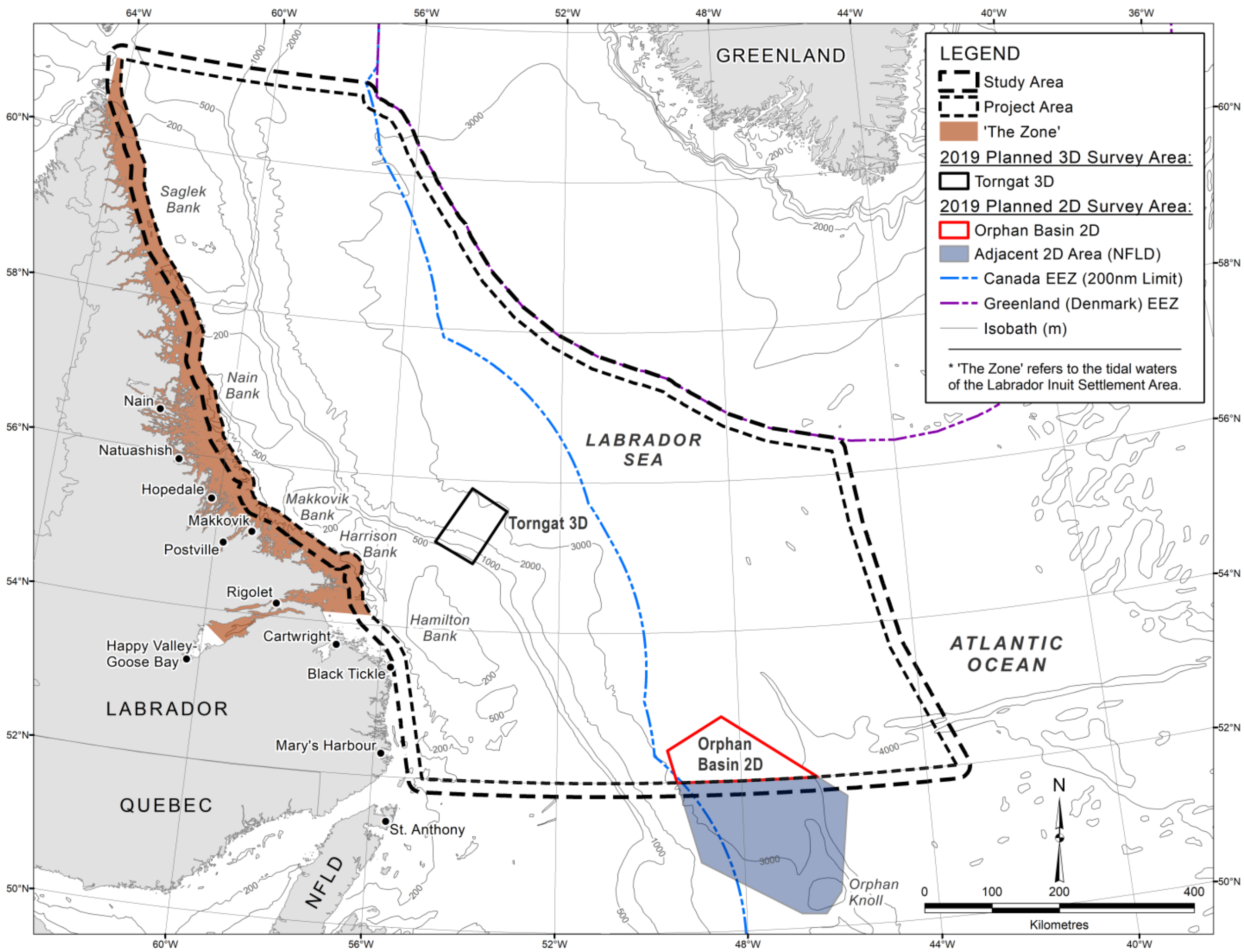


FIGURE 1.1. Locations of the Project Area, Study Area and 2019 Planned 2D and 3D Survey Areas for MKI's Labrador Offshore Seismic Program.

TABLE 1.1. Environmental Assessment documents for the MKI Labrador Offshore Seismic Program, 2018–2023. Screening determination reference number C-NLOPB File No. 45006-020-006.

Temporal Scope	EA Document
May 1 to November 30, 2018–2023	Environmental Assessment of Multiklient Invest Labrador Offshore Seismic Program, 2018–2023 (LGL 2018) and EA Addendum (LGL 2019)[a]

Note:
[a] On 22 May 2019, the C-NLOPB made a positive determination on this EA and EA Addendum.

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

2.0 Project Description

2.1 Vessels and Equipment

The EA assessed a project that included a maximum of four simultaneous seismic surveys within a given year: three 3D surveys and one 2D survey. For 2019, MKI will conduct two simultaneous surveys; a 3D survey with the MV *Ramform Titan* and a 2D survey with the MV *Sanco Atlantic*. All project description parameters described in the EA are applicable to MKI's 2019 activities. However, specific details for 2019 are provided in §2.4.

2.2 Spatial Scope

The Project and Study areas defined in the EA (LGL 2018) remain unchanged (see Figure 1.1).

2.3 Temporal Scope

The temporal scope defined in the EA (LGL 2018) as 1 May to 30 November during each year of the 2018–2023 period remains unchanged.

2.4 Seismic Survey Activities Planned for 2019

In 2019, MKI plans to conduct 2D and 3D seismic surveying in the Project Area. A maximum of two seismic survey vessels will be used in 2019. MKI is proposing to conduct approximately 3,300 km^2 of 3D and 850 km of 2D seismic surveying in the Project Area in 2019 (see Figure 1.1). There is one 3D survey area and one 2D survey area identified in the Project Area for 2019 (see Figure 1.1).

In 2019, MKI will use the MV *Ramform Titan* for the 3D seismic surveying and the MV *Sanco Atlantic* for the 2D seismic surveying. The *Ramform Titan* was built in 2013 and flagged in the Bahamas (Figure 2.1). The *Titan* is 104.2 m long, with a beam of 70 m and a draft of 6.4 m. The vessel will travel at a speed of ~9 km/h (4.9 knots) while conducting the 3D seismic surveying. The MV *Sanco Atlantic* (Figure 2.2) (formerly called the *Atlantic Explorer*) is 91.3 m in length, 17.4 m wide, and has a draft of 8.4 m. The vessel will travel at a speed of ~8.3 km/h (4.5 knots) while conducting the 2D seismic surveying.

FIGURE 2.1. MV *Ramform Titan.*

FIGURE 2.2. MV *Sanco Atlantic.*

All other project details presented in §2.0 of the EA remain applicable to MKI's seismic survey activities in 2019.

2.4.1 Seismic Energy Source Parameters

For 3D seismic surveying MKI will use a 4130 in^3 array, operated at a pressure of 2000 psi, towed at either 7 m or 9 m depth. The shotpoint interval will be one array pulse every 25 m. For 2D seismic surveying MKI will use a 4880 in^3 array, operated at a pressure of 2000 psi, towed at 9 m depth. The shotpoint interval will be one array pulse every 25 m.

2.4.2 Seismic Streamers

The *Ramform Titan* will tow 16 streamers each 8.1 km in length. The streamers will be spaced 100 m apart for a total spread of 12.2 km^2. The *Sanco Atlantic*'s streamer will be 8.1 km in length. Streamers will be towed at depths ranging from 9–25 m.

2.4.3 Support Vessels

The MV *Thor Freyja* will be used as a support vessel. The MV *Strait Hunter* and *Blain M* will perform escort vessel duties. The operational objective is to have one of these vessels available with each seismic vessel and the support vessel will be used to fill in for escort duties when required.

2.4.4 Survey Locations and Timing

The planned timing of MKI's 3D and 2D surveys in the Project Area is summarized in Table 2.1. The maximum number of MKI seismic vessels acquiring data within the Project Area as part of the Project at any given time would be two; this is planned to occur during mid-August. Note that a portion of the Orphan Basin 2D survey area falls outside of the Project Area boundary but the two-week duration shown in Table 2.1 encompasses the entire survey period.

TABLE 2.1. Planned timing of MKI's 2019 seismic survey activities in the Project Area.

	August (week)				September (week)			
Survey Area	1	2	3	4	1	2	3	4
Torngat 3D	■	■	■	■	■	■	■	■
2D Orphan Basin		■	■					

2.5 Mitigation Measures

Mitigation measures to be implemented during seismic surveys carried out for this Project will follow those described in the EA (LGL 2018) and its Addendum (LGL 2019), and defined in

Appendix 2 of *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2018). 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 (Seabird Observers [SBOs]) according to established Canadian Wildlife Service (CWS) protocols aboard each of the seismic vessels.

Passive Acoustic Monitoring (PAM) will be used during the pre-ramp up watch and during periods when visibility is <500 m in order to detect cetacean vocalizations. Further details are provided in Table 6.1.

3.0 Physical Environment

A summary of the physical environment was provided in §3.0 of the EA (LGL 2018). There is no new relevant information available on the physical environment in the Study Area.

4.0 Biological Environment and Fisheries

The EA and associated Addendum (LGL 2018, 2019) were submitted in July 2018 and April 2019, respectively. The Addendum addressed comments and data gaps identified by reviewers of the EA. The following subsections present new information on each of the VECs: Fish and Fish Habitat, Fisheries, Sea-Associated Birds, Marine Mammals and Sea Turtles, Species at Risk, and Sensitive Areas.

4.1 Fish and Fish Habitat

New information regarding invertebrate and fish species that occur within the Study Area is presented in this section. The new information does not change the effects predictions made in the EA (LGL 2018).

4.1.1 Fish

As was the case in the EA, ‘fish’ includes macro-invertebrates that are targeted in the commercial fisheries and all fishes, either targeted in the commercial fisheries or otherwise. The focus is on key commercially- and ecologically-important fishes.

4.1.1.1 Principal Macro-invertebrates and Fishes Commercially Harvested

Macroinvertebrates

Snow Crab

Snow crab landings in Northwest Atlantic Fisheries Organization (NAFO) Divs. 2HJ have remained at 1,700 t since 2014 and fishing effort during that time has been at its lowest in over 20 years (DFO 2018a). Total mortality has increased in recent years and recruitment into the fishery has been remarkably low and is likely to remain that way. The number of old-shelled adult crabs in the population (residual biomass) has been at a low level, which is a concern (DFO 2018a). The Total Allowable Catch (TAC) for Divs. 2GHJ in 2019 is set at 1,865 t, a level that has remained unchanged from previous years (DFO 2019a).

Northern Shrimp

The TAC in shrimp fishing area (SFA) 4 (NAFO Divs. 2HG) was maintained at 14,971 t from 2013/14 fishing season until 2017 when it was increased to 15,725 t (DFO 2019a). The fishable biomass in SFA 4 had increased from 76,600 t in 2005 to 164,000 t in 2012 but decreased to 95,300 t in 2016 (DFO 2017). In SFA 5 (NAFO Divs. 2JH), the TAC for the 2016/17 season was increased to 25,630 t from 20,970 t that was implemented in 2014. The TAC of 25,630 t remains in effect for 2019 (DFO 2019a). There was a decline in the fishable biomass in SFA 5 from 149,000 t in 2015 to 110,000 t in 2016 (DFO 2017).

Fishes

Greenland Halibut (Turbot)

A Harvest Control Rule (HCR) has been used to manage the Greenland halibut fishery in NAFO Divs. 3KL since 2010. The survey-based HCR sets an annual TAC for four years. The TAC set by this rule in 2011 was 17,185 t (NAFO 2011). Landings across Newfoundland and Labrador (NL) were 10,457 t in 2018 (DFO 2019b).

Atlantic Halibut

The Atlantic halibut commercial fishery operates within NAFO Divs. 3NOPs4VWX5Zc. In 2016, landings within NAFO Divs. 3NOPs were 1,071 t and preliminary landings from 2017 were 370 t. Landings within 3NOPs4VWX5Zc in 2017 were 2,324 t, below the TAC of 3,621 t (DFO 2018b). The total landings from NL waters in 2018 were 816 t (DFO 2019a).

Atlantic Cod

Despite northern cod populations in NAFO Divs. 2J3KL remaining low since the 1992 moratorium, abundance estimates show an increase from 227 million (2+ years) in 2005 to 795 million in 2017 (DFO 2018c). Bottom-trawl surveys conducted by DFO in 2017 show that over 80% of the biomass and abundance of cod is in the northern portions of the stock, specifically Divs. 2J and 3K (DFO 2018d). In 2018, a northern cod stewardship fishery management approach was implemented, ensuring that catches did not exceed 9,500 t (i.e., a 25% reduction from the 2017 TAC). The management plan was put in place for one year (DFO 2019a). The total landings in all NAFO divisions in provincial waters was 16,258 t in 2018 (DFO 2019b).

American Plaice

There has been a moratorium on American Plaice in NAFO Divs. 3LNOPs since 1995 (DFO 2019b). The last TAC of 8,400 t was set in 1994 (Wheeland et al. 2018). Bycatch of American plaice within 3LNO is mainly from the skate, redfish, Greenland halibut, and yellowtail flounder fisheries within the Canadian Exclusive Economic Zone (EEZ) (Wheeland et al. 2018).

Yellowtail Flounder

Fishing effort of yellowtail flounder in the NL region is focused in NAFO Divs. 3NLO, along the Grand Banks, and the Flemish Cap. While the TAC for yellowtail flounder within 3NLO has been set at 17,000 t since 2009 (Parsons et al. 2015), NL landings of yellowtail totaled 8,602 t in 2018 (DFO 2019b).

White Hake

In 2013, white hake populations in the Atlantic and northern Gulf of St. Lawrence (ANGSL) Designatable Unit (DU) were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and designated *threatened* (DFO 2016a). Biomass and abundance indices for hake in NAFO Divs. 3NOPs have been at stable yet low levels since 2003 (DFO 2016a). Within NAFO Divs. 3Ps, the TAC for white hake in 2018/19–2020/21 is 500 t, the first time a TAC for this species has been implemented (DFO 2019c). A total of 349 t was landed in 2018 (DFO 2019b).

Redfishes

The distributional area of the northern population of deepwater redfish *(Sebastes mentella)* includes the Grand Banks, the Labrador Shelf, Davis Strait, and Baffin Bay (NAFO Divs. 0+2+3KLNO) (DFO 2019d). The northern population was designated *threatened* by COSEWIC in 2010 (COSEWIC 2010). The commercial fishery for redfish takes place in Unit 1 (NAFO Divs. 4RST and 3Pn + 4Vn) from January 1st to May 31st, and in Unit 2 (NAFO Divs. 4Vs3Ps, a portion of 4W, and 3Pn + 4Vn) from June 1st to December 31st (DFO 2019a).

4.1.1.2 Other Fishes of Note

Capelin

In 2017, landings of capelin in NAFO Divs. 3KL and Sub-Area 2 totaled 19,917 t. This represents a decrease from 2016 and 2015, when landings were 27,708 t and 23,065 t respectively. It should be noted that there was no capelin fishery in Labrador in 2017 (DFO 2018b). In 2018, the TAC for 2J was set at 78 t and was fished by fixed gear (DFO 2019a).

Wolffishes

As of 2018, a Management Plan has been implemented for the Atlantic wolfish *(Anarhichas lupus)* and a final Recovery Strategy has been prepared for the northern *(Anarhichas denticulatus)* and spotted wolffishes *(Anarhichas minor)* (DFO 2018e). The proposed critical habitats for northern wolfish and spotted wolffish occur within NAFO Divs. 2HJ3KLPsPn4RS and 2J3KLPsPn4RS, respectively (DFO 2018e). See §4.6 for additional details.

4.2 Fisheries

The new information presented in this subsection does not change the effects predictions made in the EA (LGL 2018) or its associated addendum (LGL 2019).

4.2.1 Commercial Fisheries

Results of analyses of the May–November 2016 and 2017 domestic commercial fisheries landings data did not indicate any major differences in distribution of harvest locations as compared to May–November 2005–2010, 2014, and 2015 (see Figures 4.3–4.5 of LGL 2014, Figure 4.1 of LGL 2015, Figure 4.5 of LGL 2016, Figure 4.4 of LGL 2018, and Figure 4.1 below). The distribution of May–November 2016 and 2017 harvest locations for northern shrimp, snow crab, Greenland halibut, and striped (pink) shrimp is shown in Figures 4.2–4.10. Most of the harvesting in the Study Area was conducted in the western portion of the Study Area, in areas where water depths were <1,000 m, including the southern portion of the planned Torngat 3D 2019 survey area. There were no catches within the Orphan Basin 2D survey area during May–November 2016 or 2017.

Catch weight and value quartile counts by vessel length classes and species harvested in the Study Area and planned 2019 3D and 2D survey areas during May–November 2016 and 2017 are presented in Tables 4.1–4.2. Commercial harvests within the Study Area during May–November 2016 and 2017 were caught by fishers from NL (84%) and Nova Scotia (NS) (16%). During 2016, fishers from Quebec caught 0.1% of the total harvest. Harvests within the planned Torngat 3D 2019 survey area were only taken by fishers from NL.

As in recent years, northern shrimp (53% of total catch in the Study Area in terms of total catch weight quartile codes during May–November 2016 and 2017 combined), snow crab (28%), Greenland halibut (10%), and striped shrimp (7%) dominated the commercial catches in the Study Area. Other notable species caught commercially in 2016/2017 included Atlantic halibut (0.5%), redfish (0.5%), and witch flounder (0.3%). Northern shrimp harvest decreased within the Study Area during May–November 2017 relative to recent years, with approximately one third of the annual total quartile code counts reported in 2017 relative to 2011 (see Tables 4.4–4.8 *in* LGL 2018 and Table 4.1 below). Snow crab catches increased within the Study Area during 2016 and 2017 from 2014 and 2015, although they remained below 2011 and 2012 levels. Unlike previous recent years, pink glass shrimp (*Pasiphaea multidentata*) and capelin were harvested domestically within the Study Area during May–November 2017. Only Greenland halibut was harvested within the Torngat 3D survey area during May–November 2016 and 2017 (Table 4.2).

In the Study Area during May–November 2016 and 2017, northern shrimp, striped shrimp, Atlantic halibut, redfish, witch flounder, Atlantic cod, American plaice, and pink glass shrimp were mainly harvested by vessels of the length class ≥125’. Snow crab and Greenland halibut were mainly caught by 45–64.9’ vessels (Table 4.1). Commercial harvests within the Torngat 3D survey area were mainly conducted by vessels 45–64.9’, followed by vessels 35–44.9’ (Table 4.2).

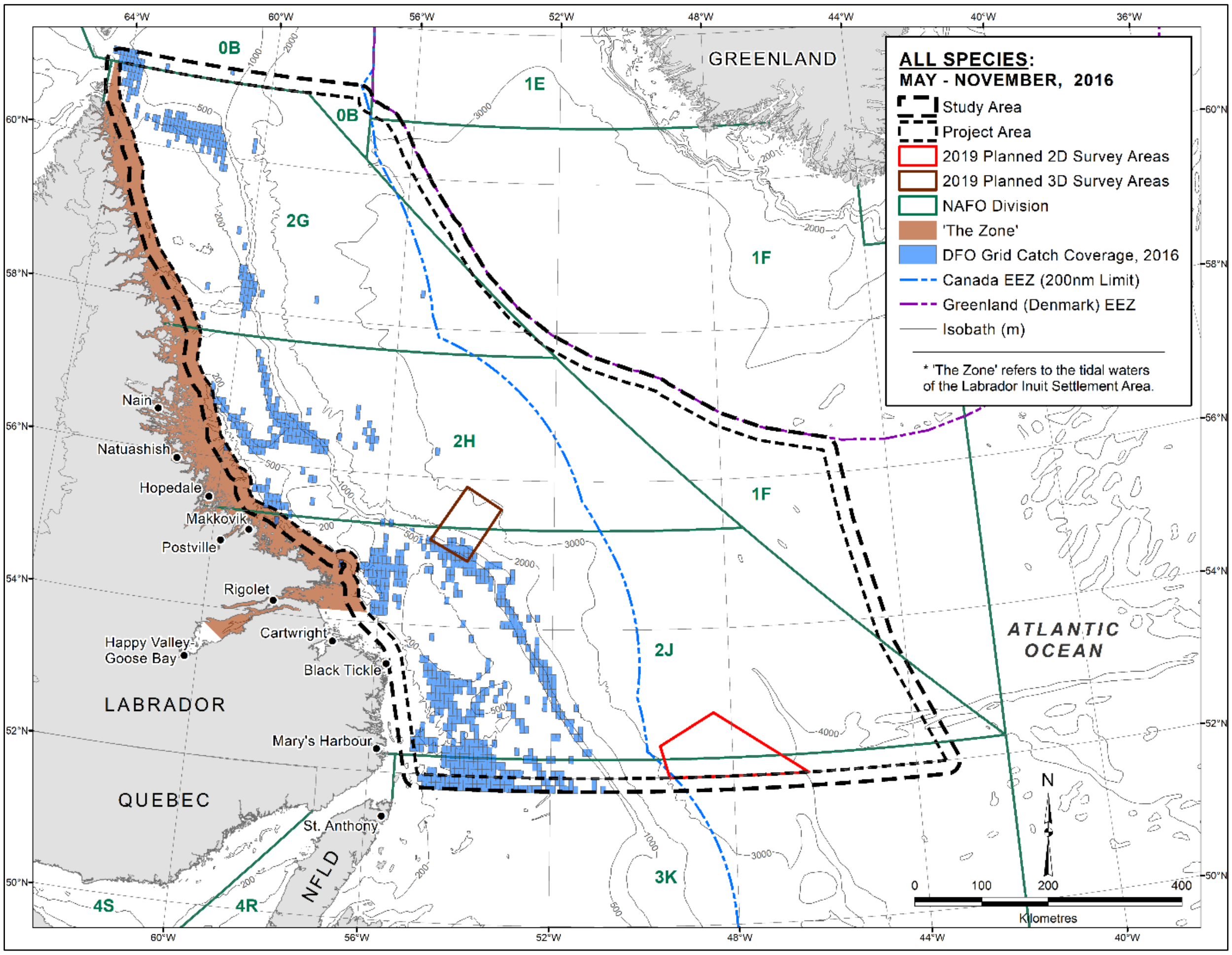


FIGURE 4.1. Distribution of commercial fishery harvest locations, all species, May–November 2016 (derived from DFO commercial landings database, 2016).

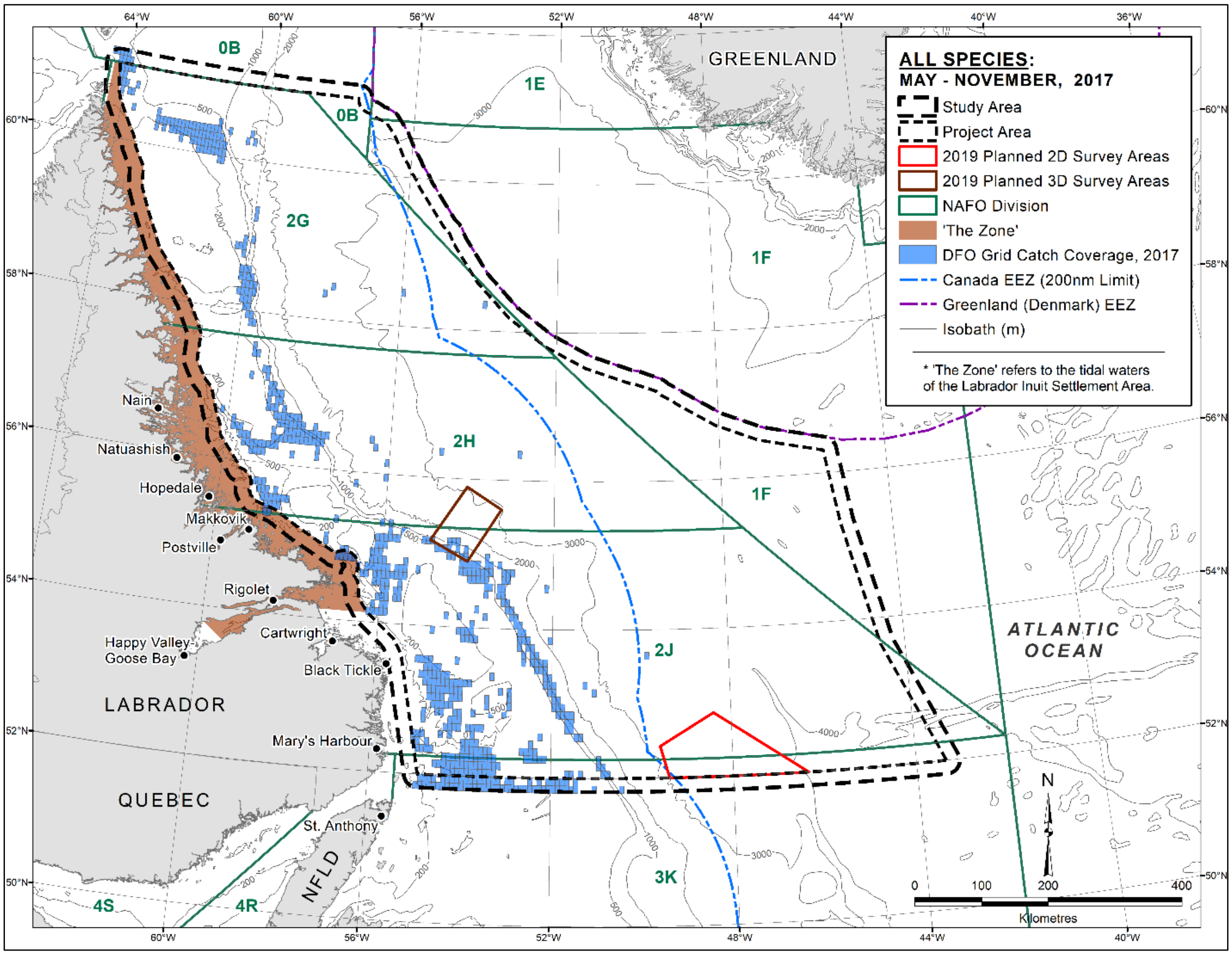


FIGURE 4.2. Distribution of commercial fishery harvest locations, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

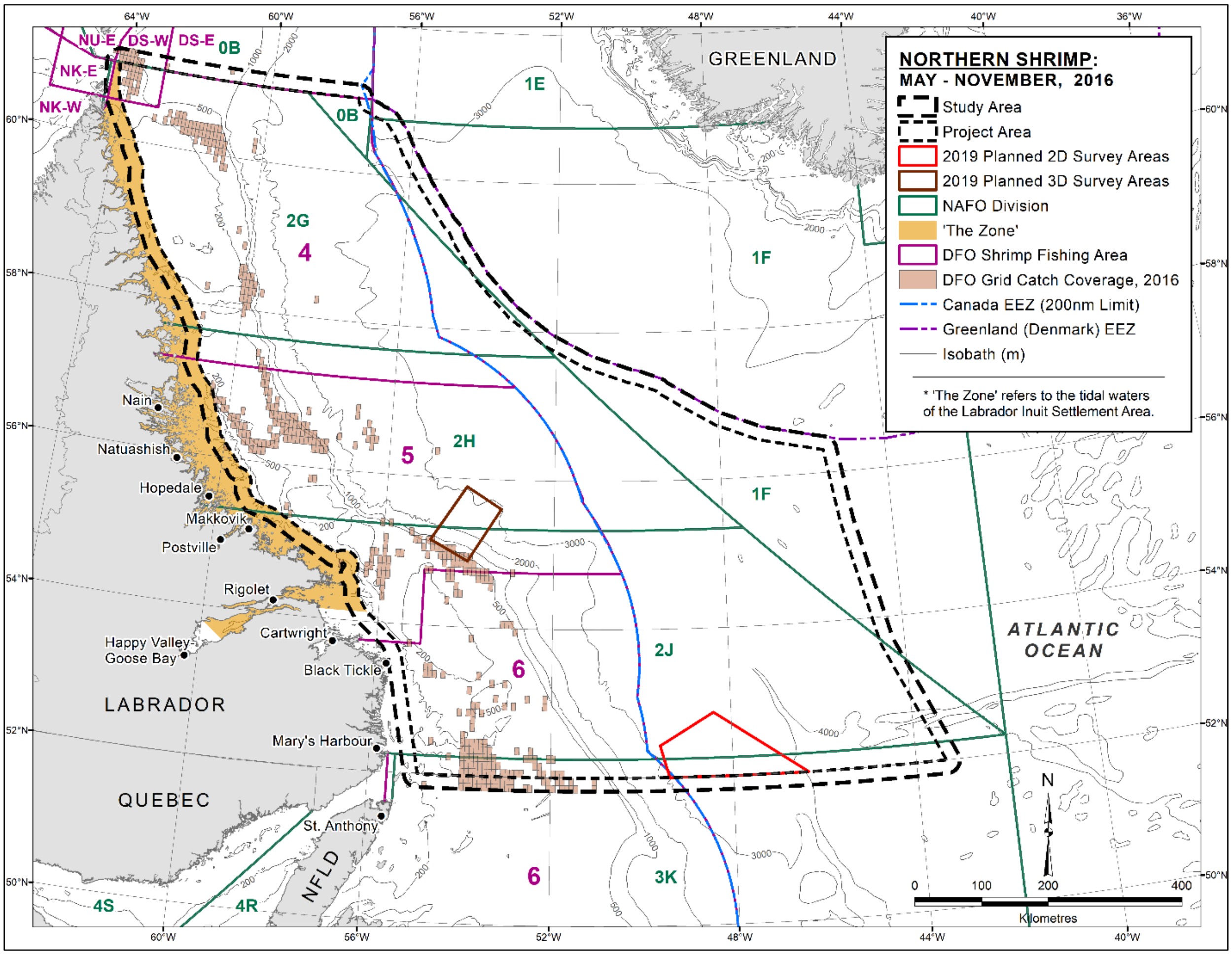


FIGURE 4.3. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2016 (derived from DFO commercial landings database, 2016).

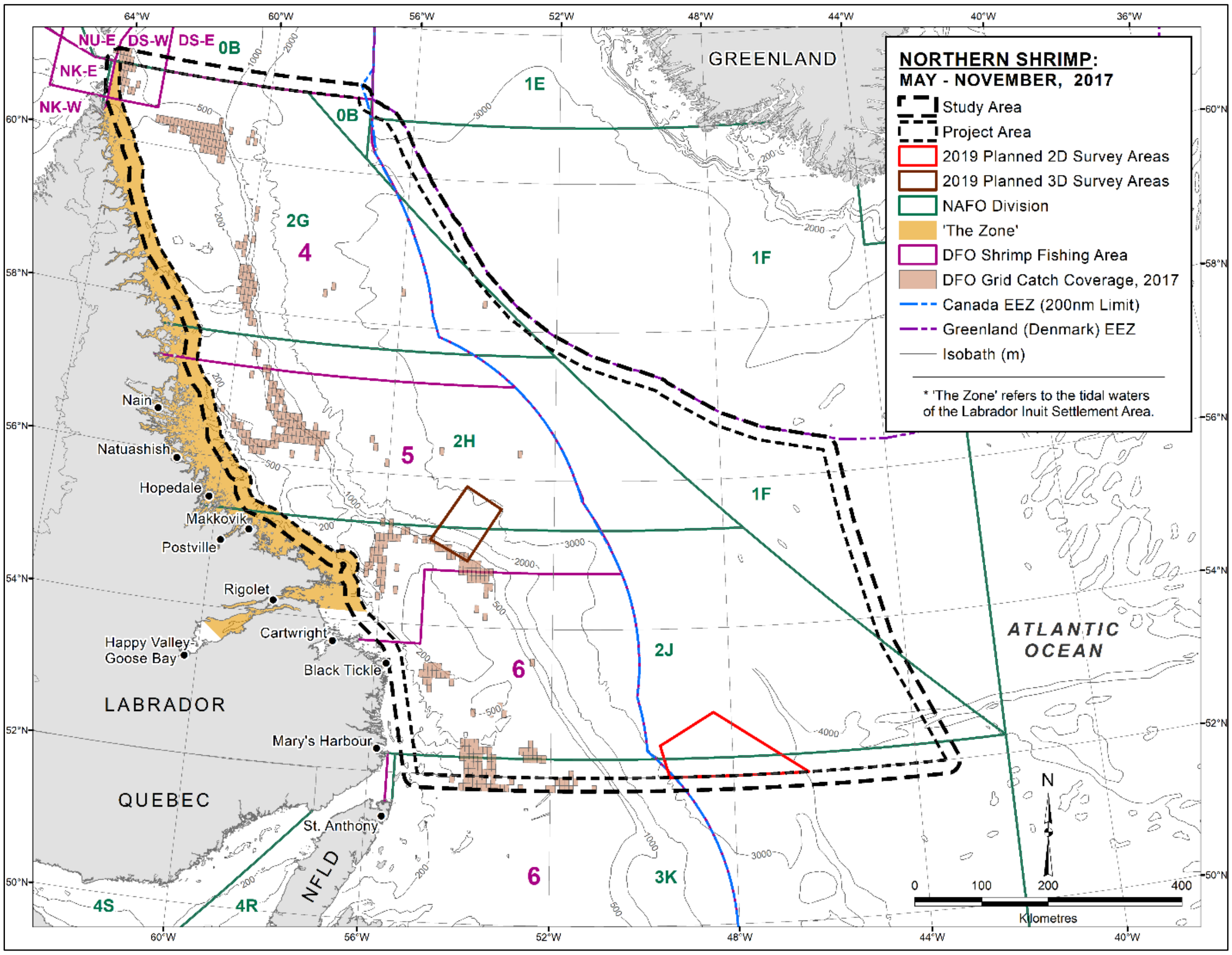


FIGURE 4.4. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2017 (derived from DFO commercial landings database, 2017).

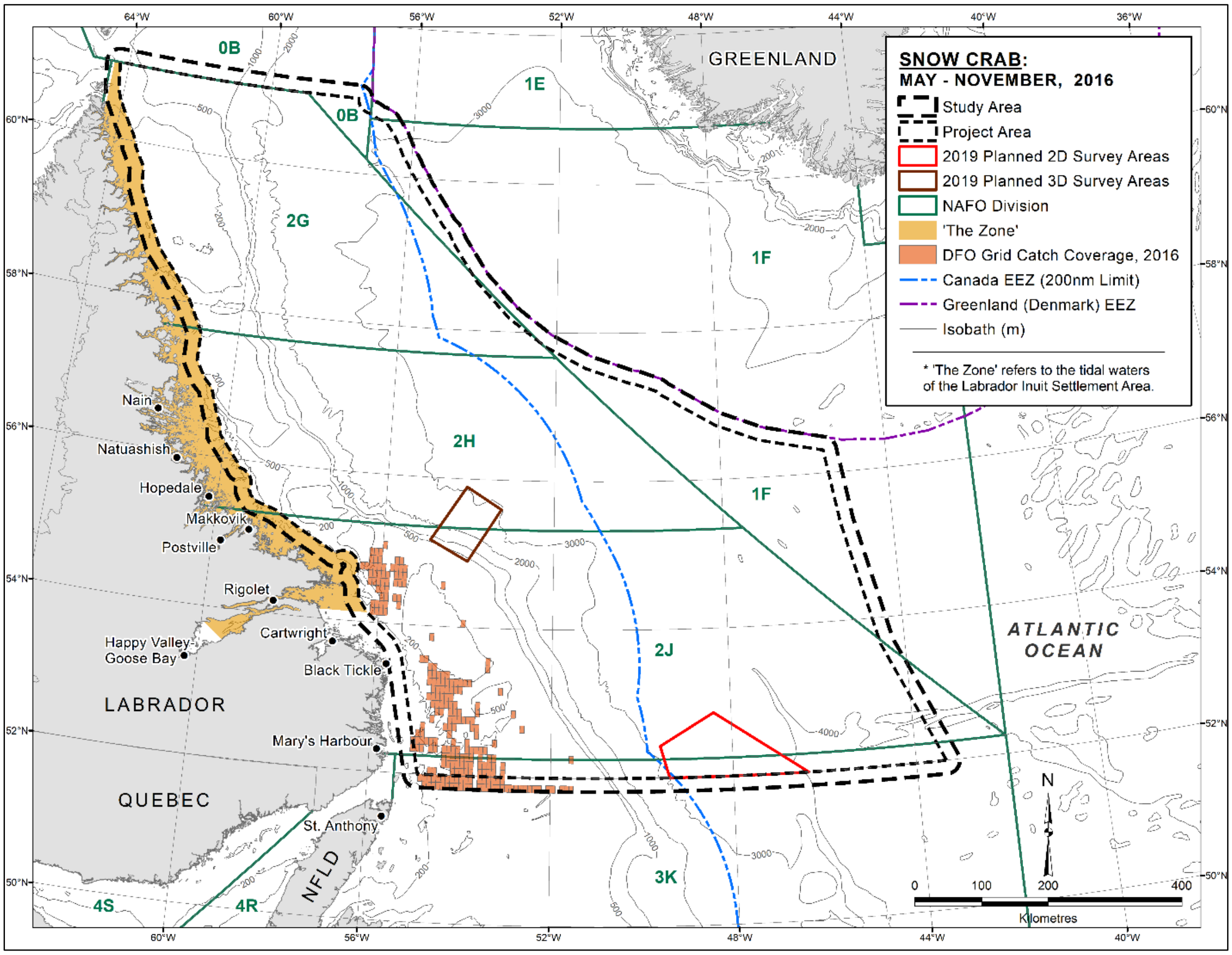


FIGURE 4.5. Distribution of commercial fishery harvest locations, snow crab, May–November 2016 (derived from DFO commercial landings database, 2016).

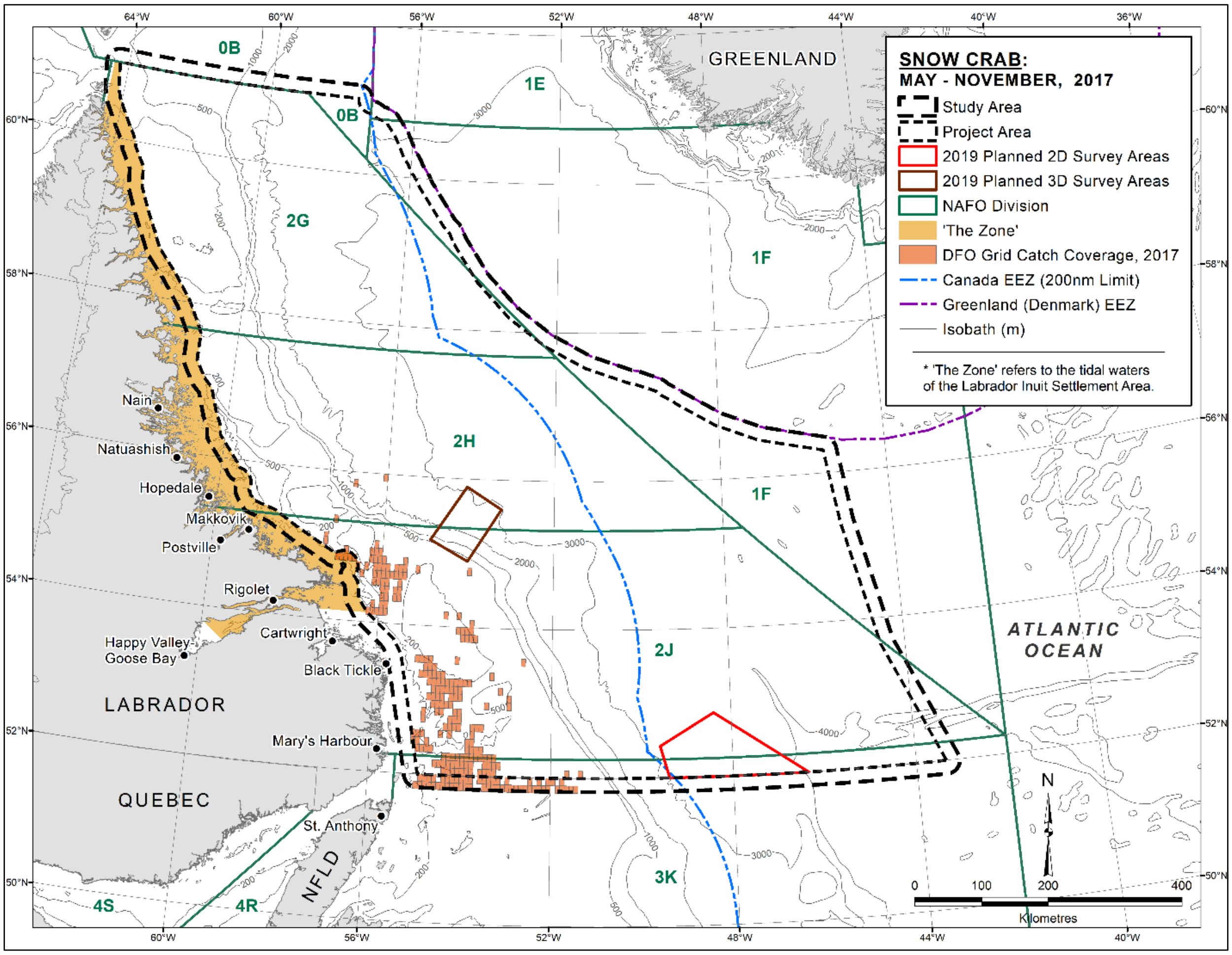


FIGURE 4.6. Distribution of commercial fishery harvest locations, snow crab, May–November 2017 (derived from DFO commercial landings database, 2017).

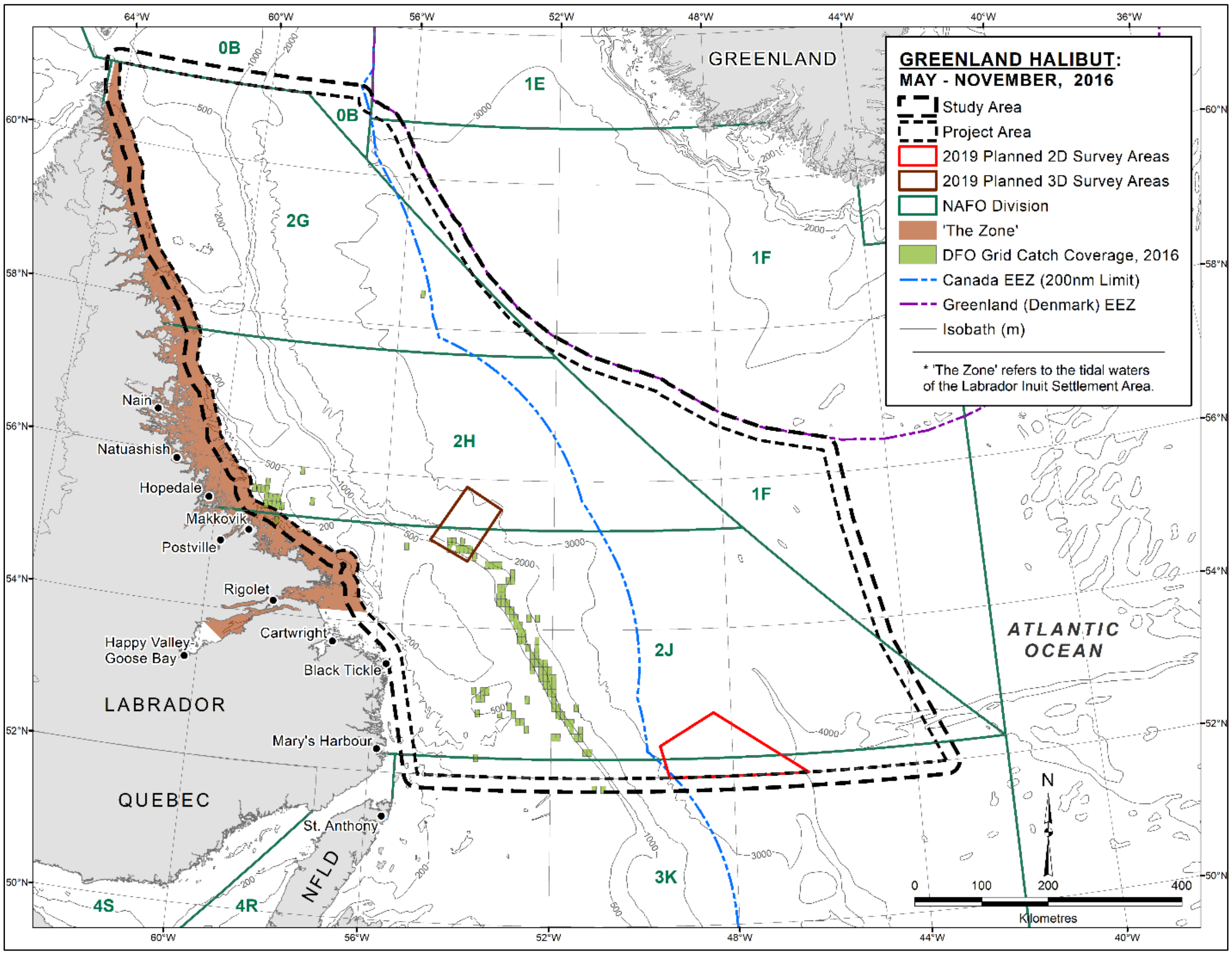


FIGURE 4.7. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2016 (derived from DFO commercial landings database, 2016).

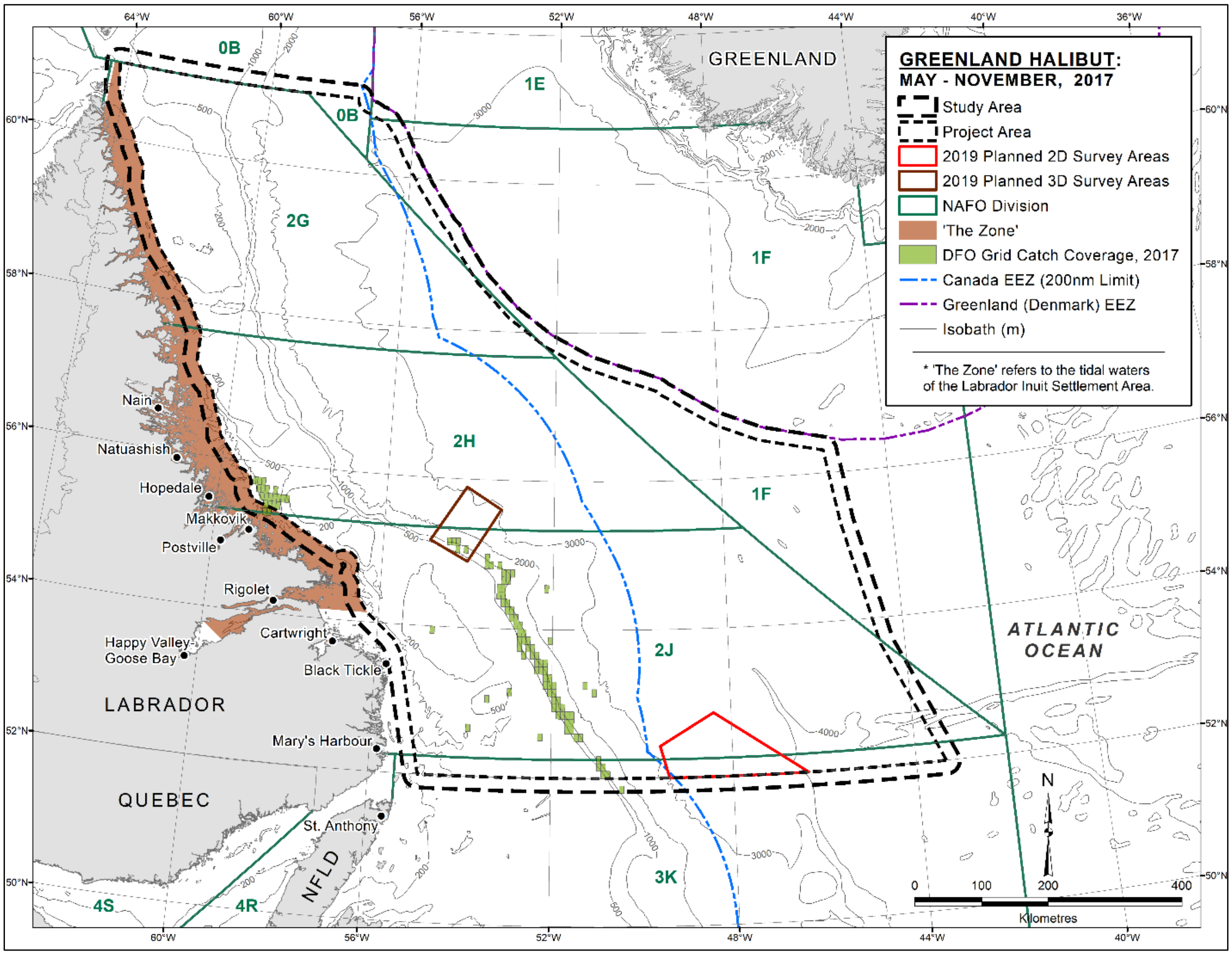


FIGURE 4.8. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2017 (derived from DFO commercial landings database, 2017).

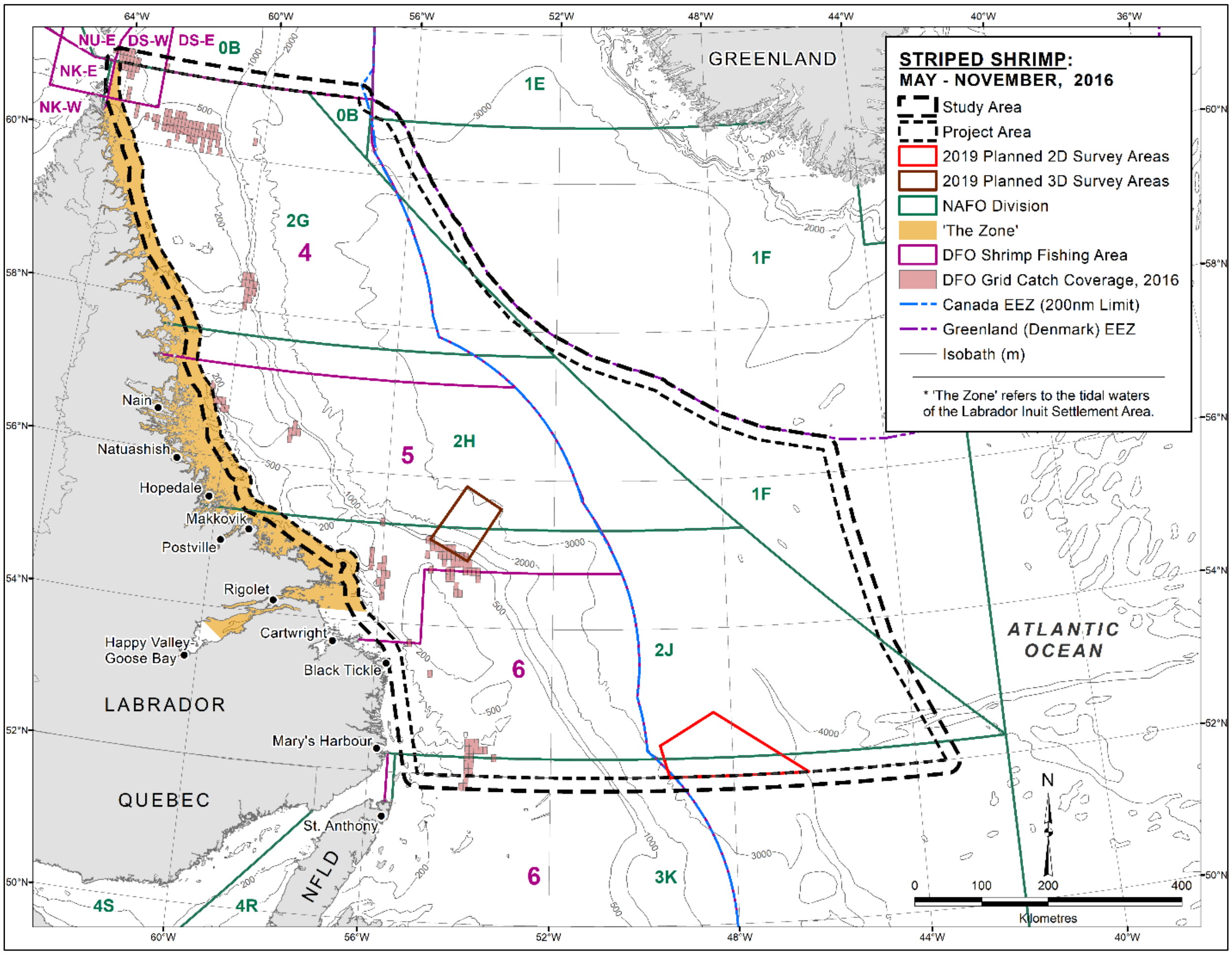


FIGURE 4.9. Distribution of commercial fishery harvest locations, striped (pink) shrimp, May–November 2016 (derived from DFO commercial landings database, 2016).

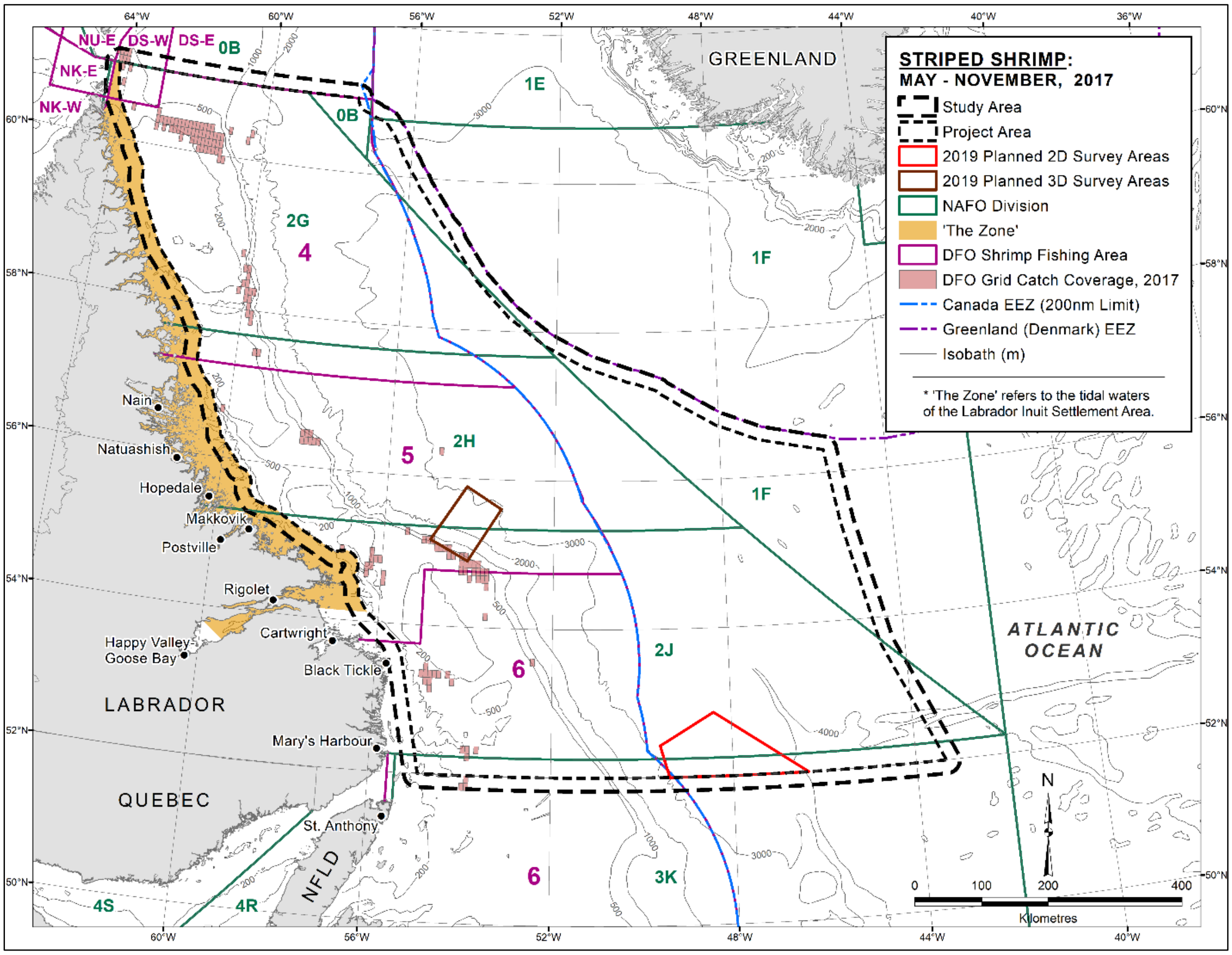


FIGURE 4.10. Distribution of commercial fishery harvest locations, striped (pink) shrimp, May–November 2017 (derived from DFO commercial landings database, 2017).

TABLE 4.1. Commercial catch weights and values in the Study Area, May–November 2016 and 2017 (values indicate the frequency of catch weight quartile codes [i.e., 1–4] or vessel length classes attributed to each species; derived from DFO commercial landings database, 2016/2017).

Species	Catch Weight Quartile Code Counts [a]				Catch Value Quartile Code Counts [b]				Vessel Length Class Total Quartile Code Counts [c]						Total Counts [d]
	1	2	3	4	1	2	3	4	1–34.9'	35–44.9'	45–64.9'	65–99.9'	100–124.9'	≥125'	
2016															
Northern Shrimp	117	187	279	426	137	160	252	460	0	0	281	136	–	592	1,009
Snow Crab	121	193	118	20	95	166	147	44	43	82	309	18	–	0	452
Greenland Halibut	16	85	44	7	16	91	33	12	3	51	83	0	–	15	152
Striped (Pink) Shrimp	12	23	35	36	12	22	31	41	0	0	0	0	–	106	106
Atlantic Halibut	4	6	0	0	4	6	0	0	0	6	0	0	–	4	10
Redfish	6	1	0	0	6	1	0	0	0	0	1	0	–	6	7
Atlantic Cod	2	0	1	0	2	0	0	1	0	0	1	0	–	2	3
Witch Flounder	2	0	0	0	2	0	0	0	0	0	0	0	–	2	2
Roughhead Grenadier	1	0	0	0	1	0	0	0	0	0	1	0	–	0	1
Total	**281**	**495**	**477**	**489**	**275**	**446**	**463**	**558**	**46**	**139**	**676**	**154**	**–**	**727**	**1,742**
2017															
Northern Shrimp	64	147	186	334	88	149	183	311	0	0	155	119	–	457	731
Snow Crab	148	183	130	6	105	142	174	46	51	92	285	39	–	0	467
Greenland Halibut	14	63	72	14	19	73	60	11	2	44	95	3	–	19	163
Striped (Pink) Shrimp	3	25	49	61	6	28	40	64	0	0	0	0	–	138	138
Witch Flounder	0	1	4	4	0	1	3	5	0	0	0	0	–	9	9
Redfish	0	1	5	2	0	1	4	3	0	2	1	0	–	5	8
Atlantic Halibut	1	0	2	3	1	0	1	4	0	1	0	0	–	5	6
American Plaice	0	0	1	0	0	0	0	1	0	0	0	0	–	1	1
Pink Glass Shrimp	0	0	1	0	0	0	1	0	0	0	0	0	–	1	1
Capelin	0	1	0	0	1	0	0	0	0	1	0	0	–	0	1
Total	**230**	**421**	**450**	**424**	**220**	**394**	**466**	**445**	**53**	**140**	**536**	**161**	**–**	**635**	**1,525**

Note:

[a] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch weights in a given year, all species combined). 2016 quartile ranges: 1 = 0 – 2,136 kg; 2 = 2,137 – 9,436 kg; 3 = 9,437 – 39,810 kg; 4 = ≥39,811 kg. 2017 quartile ranges: 1 = 0 – 1,912 kg; 2 = 1,913 – 8,828 kg; 3 = 8,829 – 35,206 kg; 4 = ≥35,207 kg.

[b] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch value in a given year, all species combined). 2016 quartile ranges: 1 = $0 – $9,428; 2 = $9,429 – $41,474; 3 = $41,475 – $154,669; 4 = ≥$154,670. 2017 quartile ranges: 1 = $0 – $9,811; 2 = $9,812 – $43,514; 3 = $43,515 – $166,502; 4 = ≥$166,503.

[c] Includes the total quartile code count for ranges 1–4, combined; total counts for catch weight and catch value are equal.

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

TABLE 4.2. Commercial catch weights and values in the Torngat 3D survey area, May–November 2016 and 2017 (values indicate the frequency of catch weight quartile codes [i.e., 1–4] or vessel length classes attributed to each species; derived from DFO commercial landings database, 2016/2017).

Species	Catch Weight Quartile Code Counts [a]				Catch Value Quartile Code Counts [b]				Vessel Length Class Total Quartile Code Counts [c]						Total Counts [d]
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1-34.9’**	**35–44.9’**	**45–64.9’**	**65–99.9’**	**100–124.9’**	**≥125’**	
2016															
Greenland Halibut	1	10	1	0	1	10	1	0	–	3	9	–	–	–	12
Total	**1**	**10**	**1**	**0**	**1**	**10**	**1**	**0**	**–**	**3**	**9**	**–**	**–**	**–**	**12**
2017															
Greenland Halibut	0	3	2	0	0	4	1	0	–	–	5	–	–	–	5
Total	**0**	**3**	**2**	**0**	**0**	**4**	**1**	**0**	**–**	**–**	**5**	**–**	**–**	**–**	**5**

Note:

[a] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch weights in a given year, all species combined). 2016 quartile ranges: 1 = 0 – 2,136 kg; 2 = 2,137 – 9,436 kg; 3 = 9,437 – 39,810 kg; 4 = ≥39,811 kg. 2017 quartile ranges: 1 = 0 – 1,912 kg; 2 = 1,913 – 8,828 kg; 3 = 8,829 – 35,206 kg; 4 = ≥35,207 kg.

[b] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch value in a given year, all species combined). 2016 quartile ranges: 1 = $0 – $9,428; 2 = $9,429 – $41,474; 3 = $41,475 – $154,669; 4 = ≥$154,670. 2017 quartile ranges: 1 = $0 – $9,811; 2 = $9,812 – $43,514; 3 = $43,515 – $166,502; 4 = ≥$166,503.

[c] Includes the total quartile code count for ranges 1–4, combined; total counts for catch weight and catch value are equal.

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

4.2.1.1 Northern Shrimp

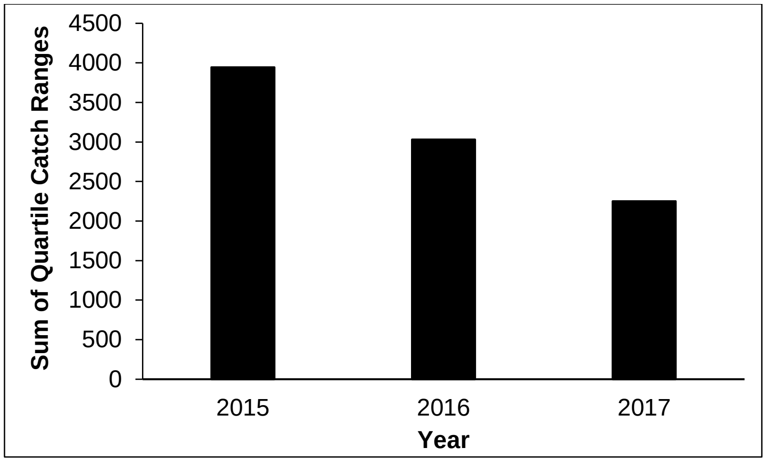
During May–November 2016 and 2017, the distribution of harvest locations for northern shrimp in the Study Area was consistent with that observed during May–November 2005–2015 (see Figures 4.11–4.13 *in* LGL 2014, Figure 4.2 *in* LGL 2015, Figure 4.10 *in* LGL 2016, Figure 4.8 *in* LGL 2018, and Figures 4.3–4.4 above). Catches primarily occurred in the western portion of the of the Study Area, including near the southern portion of the Torngat 3D 2019 survey area, principally in water depths between 200 m and 500 m. The TAC values for northern shrimp in SFA 4 (includes NAFO Div. 2G and portions of Div. 0B and 1F; northern portion of Study Area) increased from 14,971 mt in 2016 to 15,725 mt during 2017–2019 (DFO 2019a). The TAC in SFA 5 (includes Div. 2H and a portion of 2J; central portion of Study Area, including Torngat 3D 2019 survey area) increased from 22,000 mt in 2017 to 25,630 mt in 2018 and 2019 (DFO 2019a). The TAC in SFA 6 (includes Div. 2J and the northernmost portion of 3K; southern portion of Study Area, including Orphan Basin 2D 2019 survey area) decreased from 10,400 mt in 2016 to 8,730 mt in 2018 and 2019 (DFO 2019a). Overall, northern shrimp harvest within the Study Area during May–November decreased from 2015–2017 (Figure 4.11), and most northern shrimp catches occurred during the summer (Figure 4.12).

4.2.1.2 Snow Crab

Snow crab harvest locations during May–November 2016 and 2017 were similar to those reported during May–November 2005–2015 (see Figures 4.14–4.18 *in* LGL 2014, Figure 4.3 *in* LGL 2015, Figure 4.13 *in* LGL 2016, Figure 4.11 *in* LGL 2018, and Figures 4.5–4.6 above). Harvest locations were exclusively in the southwest portion of the Study Area. There were no snow crab catch locations within the planned 2019 3D and 2D survey areas during May–November 2016 or 2017. The snow crab fishery TAC in NAFO Div. 2GHJ has remained at 1,865 mt since 2016, while the TAC in Div. 3K decreased from 7,294 mt in 2015 to 5,856 mt in 2019 (DFO 2019a). Snow crab harvest within the Study Area increased from 2015–2016, then decreased somewhat by 2017 (Figure 4.13). Snow crab harvest nearly exclusively occurred during May–August in 2015–2017, with most catches during June and July (Figure 4.14).

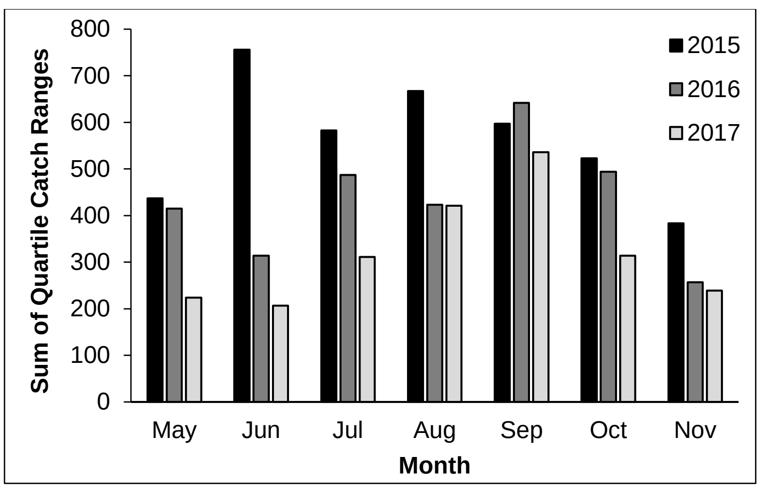
4.2.1.3 Greenland Halibut

Harvest locations for Greenland halibut in the Study Area were consistent during May–November 2016 and 2017 and May–November 2005–2015 (see Figures 4.48–4.51 *in* LGL 2015b, Figure 4.21 *in* LGL 2018, and Figure 4.7–4.8 above). Greenland halibut were primarily caught along the shelf and slope edges in the southwestern portion of the Study Area, including the southern portion of the Torngat 3D 2019 survey area. The TAC for Greenland halibut in NAFO Div. 0B is 8,592 mt for 2019 (DFO 2019a). Commercial harvests within the Study Area during May–November 2015–2017 were variable, and ultimately increased from 2015–2017 (Figure 4.15). Catches mainly occurred during July and August (Figure 4.16).



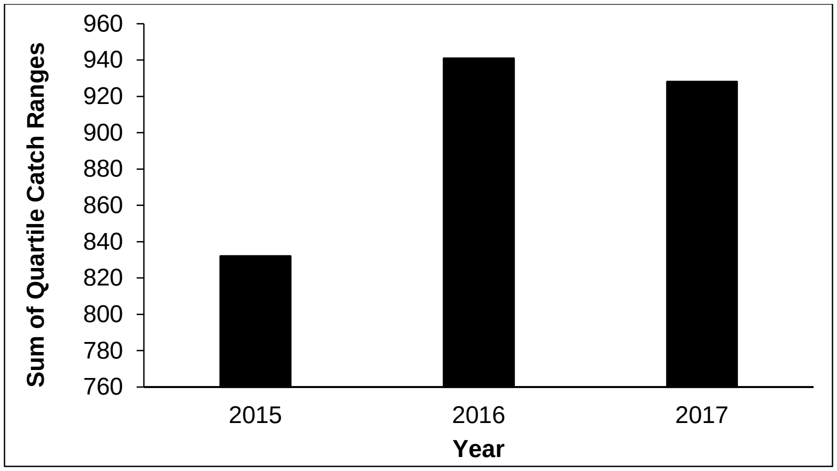
Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all catch records for all species; the greater the sum of quartile range counts, the greater the catch for a given year).

FIGURE 4.11. Total annual catch weight quartile codes, May–November 2015–2017 for northern shrimp in the Study Area (derived from DFO commercial landings database, 2015–2017).



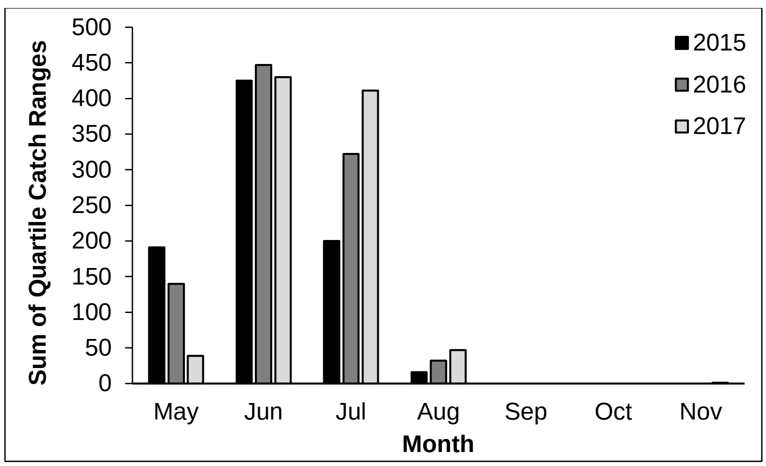
Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

FIGURE 4.12. Total monthly catch weight quartile codes, May–November 2015–2017 for northern shrimp in the Study Area (derived from DFO commercial landings database, 2015–2017).



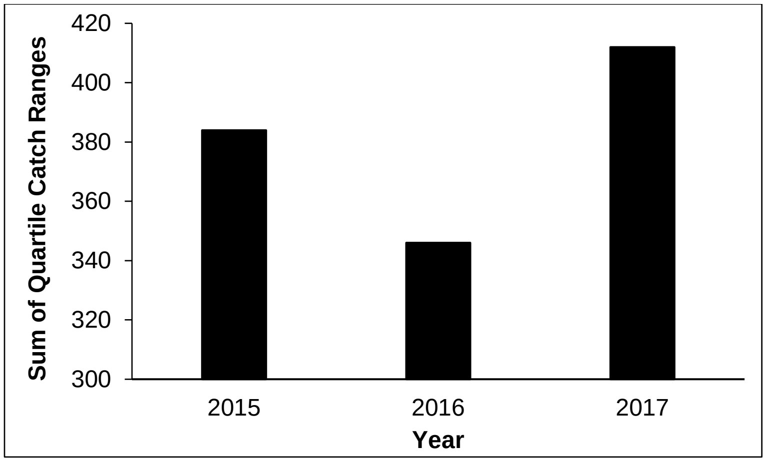
Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all catch records for all species; the greater the sum of quartile range counts, the greater the catch for a given year).

FIGURE 4.13. Total annual catch weight quartile codes, May–November 2015–2017 for snow crab in the Study Area (derived from DFO commercial landings database, 2015–2017).



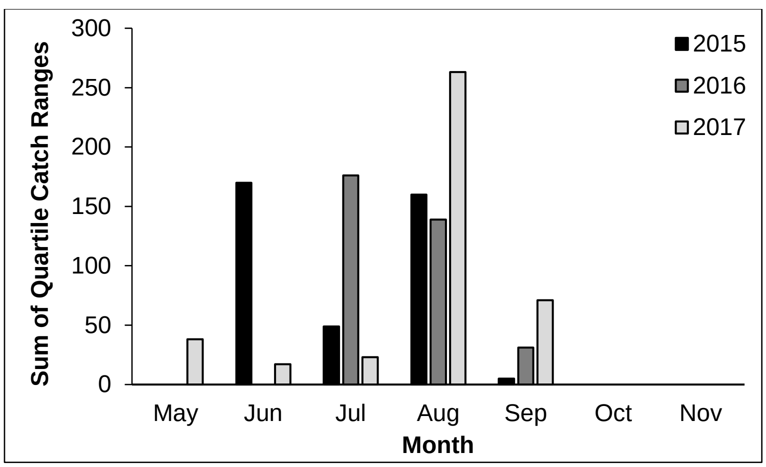
Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

FIGURE 4.14. Total monthly catch weight quartile codes, May–November 2015–2017 for snow crab in the Study Area (derived from DFO commercial landings database, 2015–2017).



Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all catch records for all species; the greater the sum of quartile range counts, the greater the catch for a given year).

FIGURE 4.15. Total annual catch weight quartile codes, May–November 2015–2017 for Greenland halibut in the Study Area (derived from DFO commercial landings database, 2015–2017).

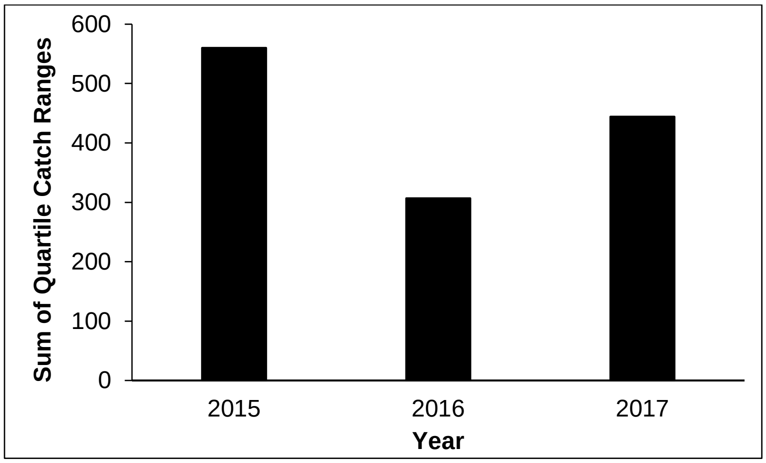


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

FIGURE 4.16. Total monthly catch weight quartile codes, May–November 2015–2017 for Greenland halibut in the Study Area (derived from DFO commercial landings database, 2015–2017).

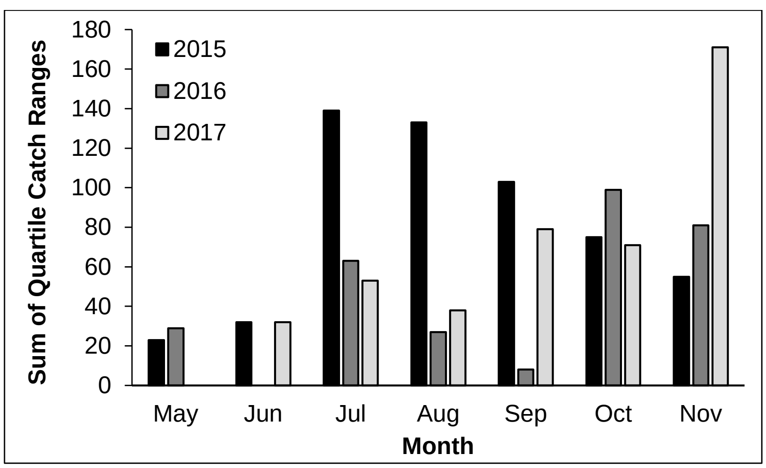
4.2.1.4 Striped (Pink) Shrimp

During May–November 2016 and 2017, the distribution of harvest locations for striped shrimp in the Study Area was consistent with locations observed during May–November 2010–2015 (see Figures 4.26–4.28 *in* LGL 2014, Figure 4.17 *in* LGL 2018, and Figures 4.9–4.10 above). Striped shrimp were mainly caught in the western portion of the Study Area, including near the southern portion of the Torngat 3D 2019 survey area, during May–November 2016 and 2017. There were more catch locations within the central-western and southwestern portions of the Study Area during 2016 and 2017 relative to recent years. The bycatch limit for striped shrimp in SFA 4 (northern portion of Study Area) has been set at 4,033 mt since 2017 (DFO 2019a). Overall, catches during May–November decreased from 2015–2017 in the Study Area (Figure 4.17). Most striped shrimp are harvested during the summer and fall (Figure 4.18).



Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all catch records for all species; the greater the sum of quartile range counts, the greater the catch for a given year).

FIGURE 4.17. Total annual catch weight quartile codes, May–November 2015–2017 for striped (pink) shrimp in the Study Area (derived from DFO commercial landings database, 2015–2017).



Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

FIGURE 4.18. Total monthly catch weight quartile codes, May–November 2015–2017 for striped (pink) shrimp in the Study Area (derived from DFO commercial landings database, 2015–2017).

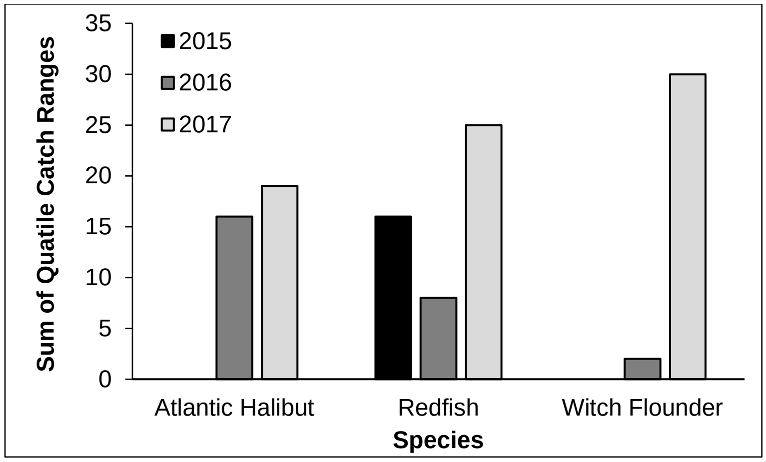
4.2.1.5 Other Notable Commercial Species

As noted in the EA (see Tables 4.3–4.8 *in* LGL 2018), Atlantic halibut, redfish, and witch flounder are also important commercial species in the Study Area (see also Table 4.1 above). These species are primarily harvested in areas where water depths are <1,000 m (see Figure 4.32 *in* LGL 2014, Figures 4.20–4.21 *in* LGL 2016, Figures 4.19–4.20 *in* LGL 2018) (i.e., on the shelf slope along the western portion of the Study Area, including within and/or near the southern portion of the Torngat 3D survey area). DFO sets annual TAC limits for Atlantic halibut, while both DFO and NAFO manage the fisheries for redfish and witch flounder.

No TAC has been set for Atlantic halibut within the Study Area in recent years (DFO 2019a). The TAC for Atlantic halibut in Div. 4RST (southwest of the Study Area) was 1,297 mt for 2017/2018 (DFO 2019a). Commercial harvests for Atlantic halibut in the Study Area during May–November increased from 2016–2017 (Figure 4.19). There were no commercial harvests for Atlantic halibut in the Study Area during May–November 2015. Atlantic halibut was only harvested during May–August, with most catches during July–August in 2016 and May–June in 2017 (Figure 4.20).

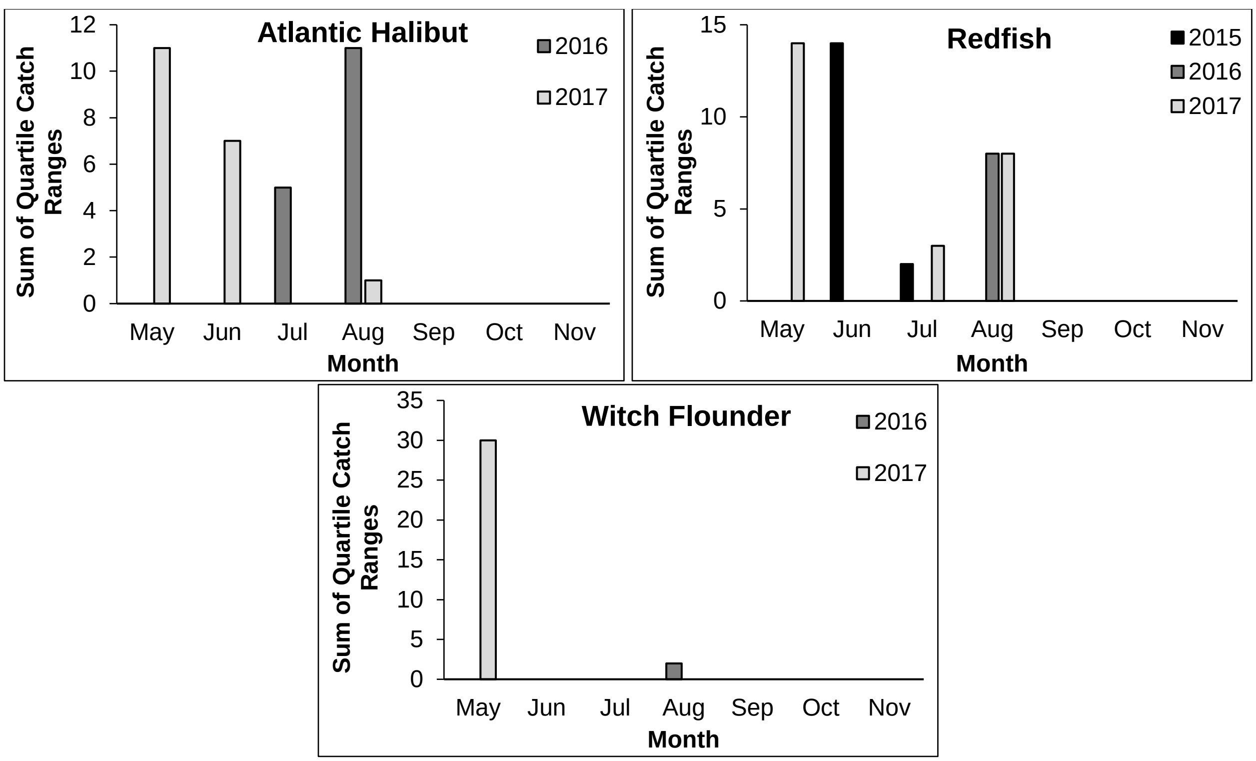
A fishing ban has remained in place for redfish in NAFO Subarea 2 and Div. 1F+3K (NAFO 2019). The TAC limits for redfish southwest of the Study Area in DFO Units 1 (i.e., Div. 4RST and 3PN + 4Vn, during 1 January to 31 May) and 2 (i.e., Div. 3Ps, 4Vs, a portion of 4W, and 3Pn+4Vn, during 1 June to 31 December) were set at 4,500 mt and 8,500 mt, respectively, for 2018 and 2019 (DFO 2019a). South of the Study Area, the 2019 redfish TAC limits in Div. 3LN, 3M, and 3O are 18,100 mt, 10,500 mt, and 20,000 mt, respectively (NAFO 2019). Overall, redfish commercial harvests in the Study Area during May–November increased from 2015–2017 (Figure 4.19), with the highest catches generally occurring during May–June and August (Figure 4.20).

No TAC has been designated for witch flounder in the Study Area in recent years (DFO 2019; NAFO 2019). The 2019–2020 TAC limits for witch flounder are 1,175 mt in Div. 3NO (well south of the Study Area; NAFO 2019), and 650 mt in Div. 3Ps (south of Newfoundland; DFO 2019a). A fishing moratorium remains in place for witch flounder in Div. 3L (south of the Study Area; NAFO 2019). Commercial witch flounder harvests during May–November in the Study Area increased from 2016–2017 (Figure 4.19). There were no witch flounder commercial harvests within the Study Area during May–November 2015. Witch flounder were caught during August in 2016 and May in 2017 (Figure 4.20).



Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all catch records for all species; the greater the sum of quartile range counts, the greater the catch for a given year).

FIGURE 4.19. Total annual catch weight quartile codes, May–November 2015–2017 for Atlantic halibut, redfish, and witch flounder (derived from DFO commercial landings database, 2015–2017).

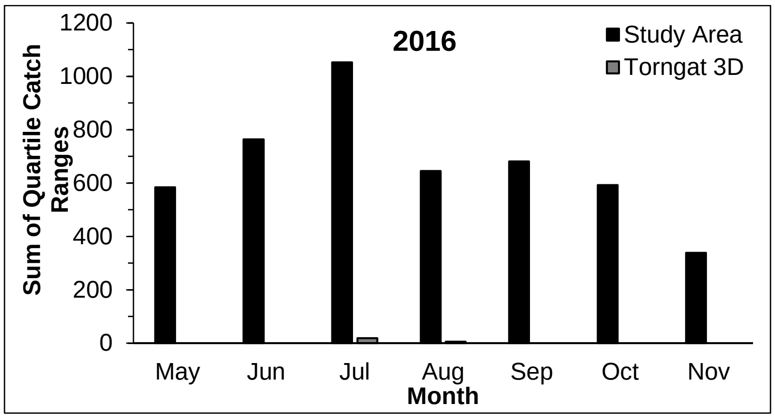


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

FIGURE 4.20. Total monthly catch weight quartile codes, May–November 2015–2017 for Atlantic halibut, redfish, and witch flounder (derived from DFO commercial landings database, 2015–2017).

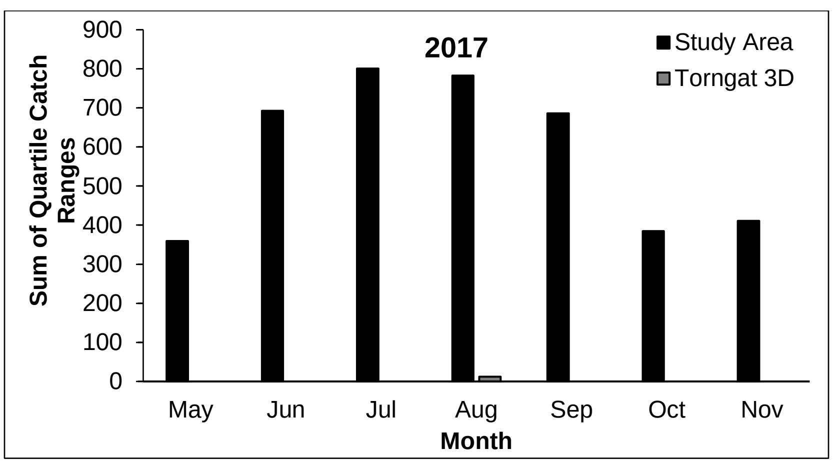
4.2.1.6 Timing and Gear Types

Consistent with previous years, most of the May–November 2016 and 2017 harvesting in the Study Area and planned 2019 3D survey area occurred during the summer (see Figure 4.8 *in* LGL 2014, Figure 4.5 *in* LGL 2015, Figure 4.6 *in* LGL 2018 and Figures 4.21–4.22 below). Gear types used in the Study Area during 2016 and 2017 were typical of those used during previous years (see Table 4.1 *in* LGL 2015, Table 4.10 *in* LGL 2018, and Table 4.3 below). The May–November 2016 and 2017 harvest locations for fixed and mobile gears are shown in Figures 4.23–4.26.



Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

FIGURE 4.21. Total monthly catch weight quartile codes in the Study Area and 2019 Torngat 3D survey area, for all species combined during May–November 2016 (derived from DFO commercial landings database, 2016).



Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

FIGURE 4.22. Total monthly catch weight quartile codes in the Study Area and planned 2019 Torngat 3D survey area, for all species combined during May–November 2017 (derived from DFO commercial landings database, 2017).

TABLE 4.3. Summary of gear type used and timing of the commercial fishery in the Study Area and Torngat 3D survey area, May–November 2016 and 2017 (derived from DFO commercial landings database, 2016/2017).

Species	Harvest Month														Gear Type	
	2016							2017							Fixed	Mobile
	M	J	J	A	S	O	N	M	J	J	A	S	O	N		
Study Area																
Northern Shrimp															–	Trawl
Snow Crab															Pot	–
Greenland Halibut															Gillnet; Longline	Trawl
Striped (Pink) Shrimp															–	Trawl
Atlantic Halibut															Longline	Trawl
Redfish															Gillnet	Trawl
Witch Flounder															–	Trawl
Atlantic Cod															Pot	Trawl
Pink Glass Shrimp															–	Trawl
American Plaice															–	Trawl
Capelin															–	Seine
Roughhead Grenadier															Gillnet	–
Torngat 3D Survey Area																
Greenland Halibut															Gillnet	–

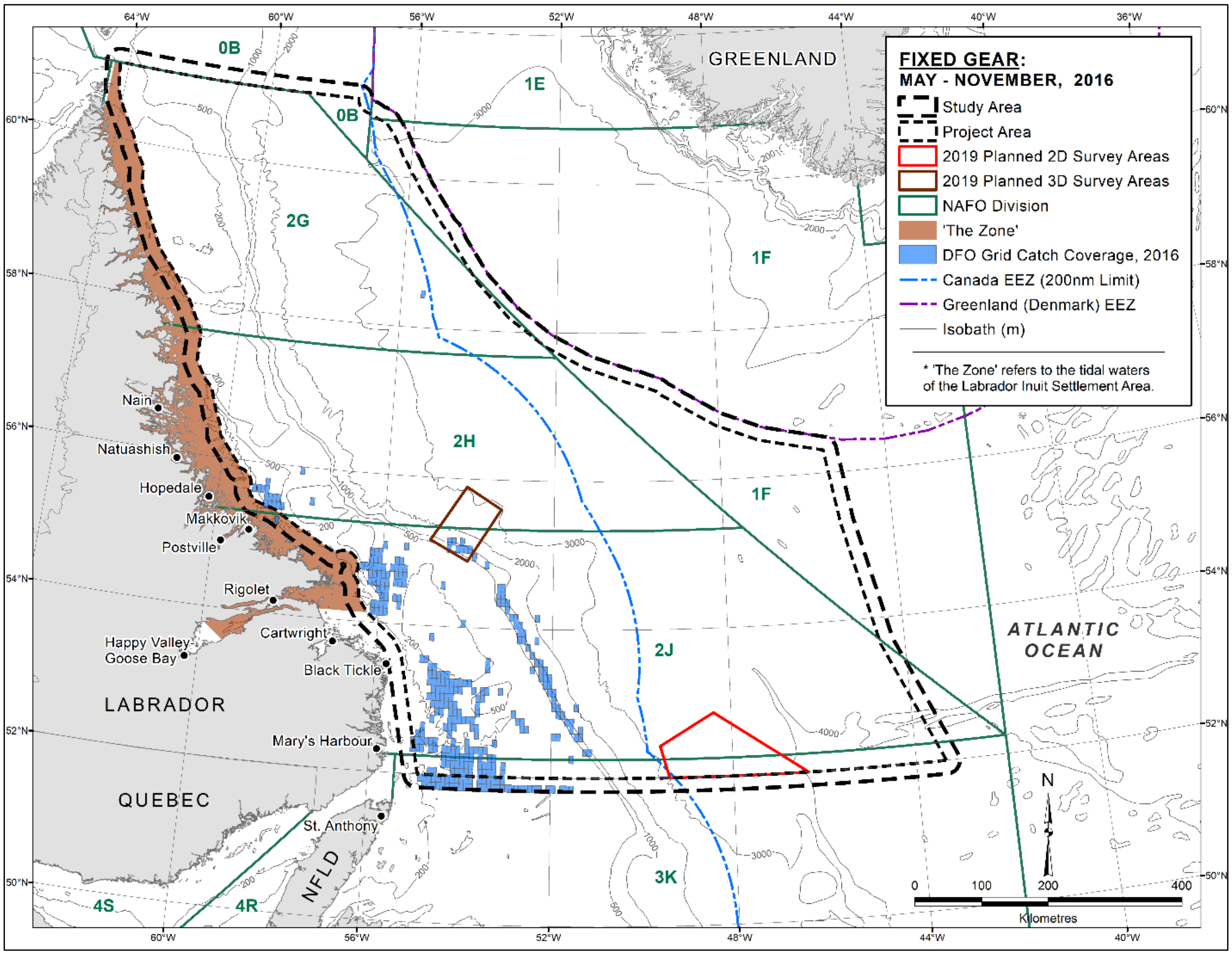


FIGURE 4.23. Harvest locations for fixed gear in the Study Area, all species, May–November 2016 (derived from DFO commercial landings database, 2016).

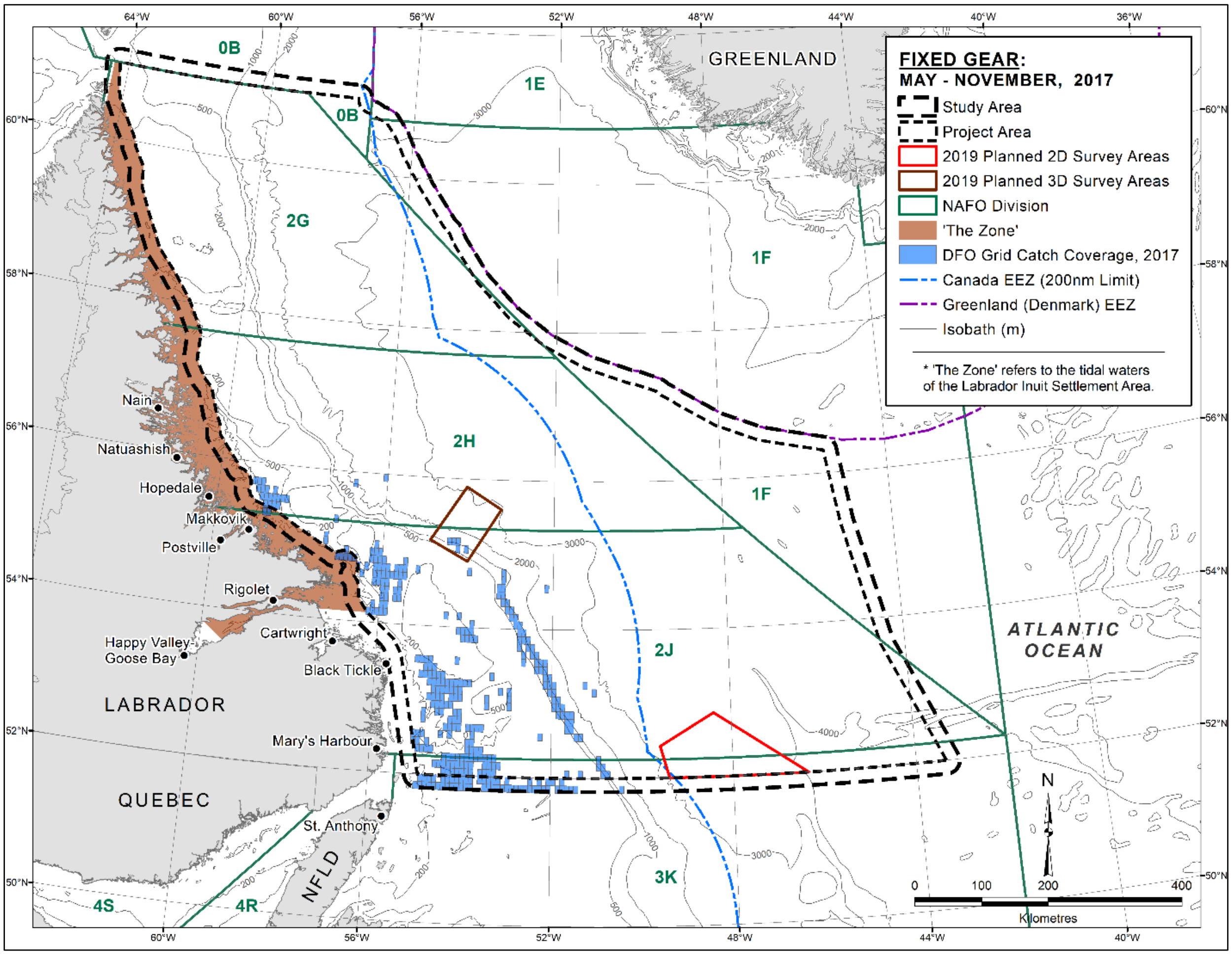


FIGURE 4.24. Harvest locations for fixed gear in the Study Area, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

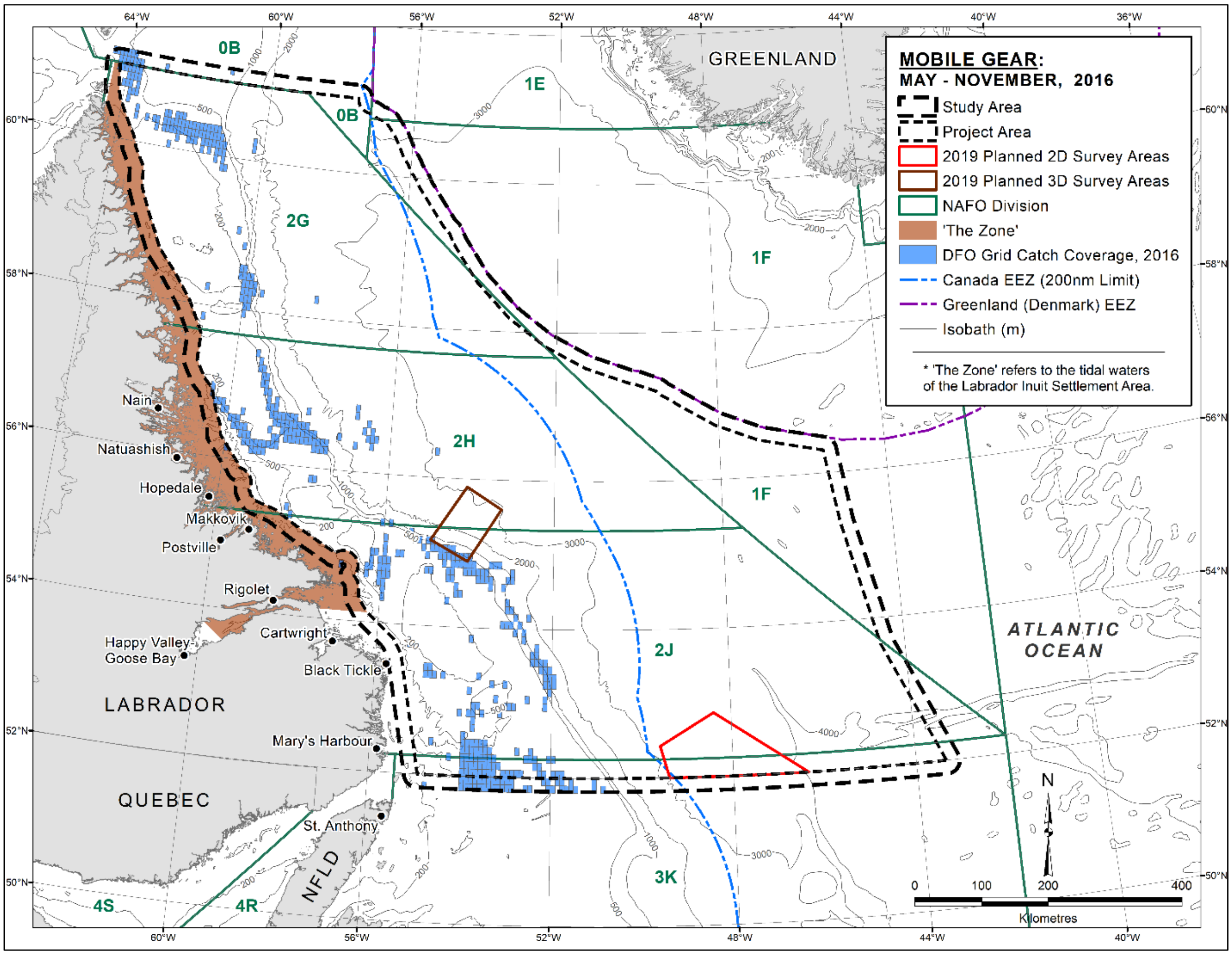


FIGURE 4.25. Harvest locations for mobile gear in the Study Area, all species, May–November 2016 (derived from DFO commercial landings database, 2016).

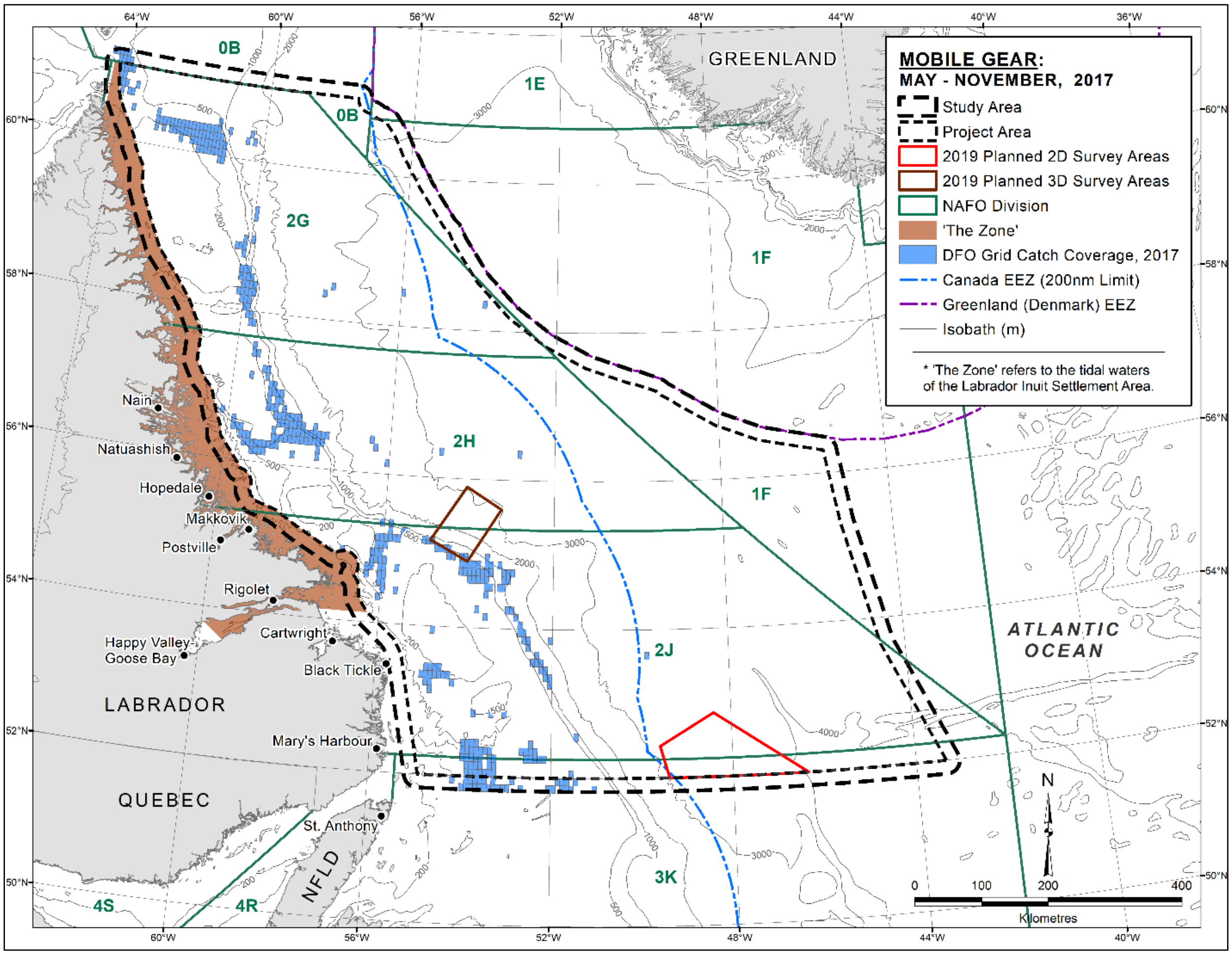


FIGURE 4.26. Harvest locations for mobile gear in the Study Area, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

4.2.2 Indigenous Fisheries

The most recent (December 2018) Indigenous communal-commercial licences and allocations for NL-based groups and organizations providing commercial fisheries access within the Study Area include the following (D. Ball, Resource Management, DFO, pers. comm., 19 April 2019):

- Innu Nation
  - Capelin – Capelin Fishing Areas 1–3
  - Groundfish – Div. 0, 2GHJ, 3K
  - Groundfish (Mobile) – Div. 2GHJ, 3K
  - Mid-shore Groundfish (Atlantic-wide) – Div. 0B, 2GHJ, 3K
  - Mackerel – Mackerel Fishing Areas 1–3
  - Shrimp – SFA 4, 5 & 6

- NunatuKavut Community Council (NCC)
    - Bait – Area of Home Port of Lobster Fishing Area 2
    - Capelin – Capelin Fishing Area 2
    - Groundfish – Div. 2GHJ, 3K
    - Herring – Herring Fishing Area 1
    - Scallop – Scallop Fishing Areas 1 & 2
    - Seal – Seal Fishing Areas 4 & 5
    - Shrimp – SFA 5 & 6
    - Snow Crab – Crab Fishing Area 2
    - Toad Crab – Crab Fishing Area 2
    - Whelk – Div. 2J
- Nunatsiavut Government (NG)
    - Arctic Char – Cape Rouge to Cape Chidley, NL
    - Greenland Halibut – Div. 0B, 2, 3K
    - Groundfish – Div. 2GHJ, 3K
    - Scallop – Scallop Fishing Area 1
    - Seal – Seal Fishing Areas 4 & 5
    - Shrimp – SFA 4 & 5
    - Snow Crab – Crab Fishing Areas 1 & 2, & Div. 2H (Exploratory)
- Miawpukek First Nation (MFN)
    - Capelin – Capelin Fishing Areas 1–3
    - Groundfish – Div. 2GHJ, 3K
    - Groundfish (Mobile) – Div. 2GHJ, 3K
    - Mackerel – Mackerel Fishing Areas 1–3
    - Seal – Seal Fishing Areas 4 & 5
- Qalipu Mi'kmaq First Nation Band (QFNB)
    - Capelin – Capelin Fishing Areas 1–3
    - Groundfish – Div. 2GHJ, 3K
    - Herring – Herring Fishing Area 3
    - Mackerel – Mackerel Fishing Areas 1–3
    - Shrimp – SFA 6
    - Snow Crab – Crab Fishing Area 4
- Mi'kmaq Alsumk Mowimsikik Koqoey Association (MAMKA) (Aboriginal Aquatic Resource & Oceans Management [AAROM] Body – MFN and QFNB)
    - Groundfish – Div. 2GHJ, 3K

There are several food, social and ceremonial (FSC) fisheries near the western boundary of the Study Area (D. Ball, Resource Management, DFO, pers. comm., 19 April 2019). The Innu Nation holds a FSC licence for salmon, trout and Arctic char for Sheshatshiu, from Fish Cove Point to Cape Harrison, including Lake Melville and the inland waters of Little Land and Grand Lake, and for Natuashish, including all tidal waters of Labrador extending north and east from Cape Harringan (55.86ºN, 60.35ºW) and south and east of Anaktalik Bay (56.34ºN, 61.69ºW). The NG holds a FSC licence for salmon, trout, and Arctic char for the Labrador Inuit Settlement

Area, including for the community fishing areas of Rigolet, Makkovik, Postville, Hopedale, and Nain. The NG also holds a FSC licence for salmon, trout, Arctic char, smelt, and seal for Upper Lake Melville, including the tidal waters outside the Labrador Inuit Settlement Area. The NCC holds a FSC for salmon, trout, Arctic char, Atlantic cod, rock cod, herring, scallop, whelk, smelt, and seal for the South Coast of Labrador, including coastal areas from Fish Cove Point to Cape Charles. The NCC also holds a FSC licence for salmon, trout, and Arctic char for portions of the tidal waters of Upper Lake Melville.

4.2.3 Recreational Fisheries

Recreational fisheries in NL are described in §5.8.4 *in* C-NLOPB (2008), §4.3.5 *in* LGL 2014, §4.2.3 *in* LGL (2015), and §4.3.5 *in* LGL (2018).

The 2018 NL recreational groundfish fishery was open for 39 days, a decrease of seven days from 2017, from 30 June to 30 September (DFO 2019a). As in the 2017 season, there was still no requirement for fishing licenses or tags during 2018 (DFO 2019a). There was no change in the NAFO Div. in which the recreational fishery occurred, including 2GHJ, 3KLPsPn, and 4R but excluding the Eastport and Gilbert Bay Marine Protected Areas (MPAs), of which 2GHJ and the northern portion of 3K overlap with the Study Area.

Pending the results of a full science stock assessment scheduled for March 2019, the 2019 recreational Atlantic salmon fishery interim management decision currently allows for the retention of at least one salmon on all rivers that permit retention, in light of the slight improvement observed in small salmon by the end of the 2018 angling season (DFO 2019a). The season will variably be open from June–September or October, depending on the fishing zone (DFO 2019a).

It is possible that recreational fisheries may occur within the shallower portions of the Study Area. Due to their depth and distance from shore, no recreational fisheries are anticipated within the planned 2019 3D and 2D survey areas.

4.2.4 Aquaculture

Aquaculture operations in NL are described in §4.10.4 *in* C-NLOPB (2008), §4.3.6 *in* LGL (2014), §4.2.3.1 *in* LGL (2015), and §4.3.6 *in* LGL (2018). All aquaculture sites within NL have remained coastally-based within the island portion of the province. There are no approved aquaculture sites within the Study Area (FLR 2018; C. Laing, Registrar of Aquaculture, Aquaculture Licencing Administrator, Department of Fisheries and Land Resources [DFLR], Government of Newfoundland and Labrador, Canada, pers. comm., 26 March 2019).

4.2.5 Science Surveys

4.2.5.1 DFO Research Vessel (RV) Surveys

Results of analysis of DFO RV survey data collected within the Study Area during annual spring and fall multi-species trawl surveys during May–November 2009–2014 are described in §4.3.7 of the EA (LGL 2018), and those for the May–November 2015, 2016 and 2017 datasets are summarized below for comparative purposes.

Similar to DFO RV surveys described in the EA (LGL 2018), the following species comprised the majority of the total catch weight during RV surveys between May and November 2015–2017: northern shrimp (21% of total catch weight), deepwater redfish (19%), and Greenland halibut (16%). Total catch weight across all species caught in the Study Area during DFO RV surveys during May–November 2015–2017 was 82 mt, with annual total catch weights (2015 = 31 mt; 2016 = 28 mt; 2017 = 24 mt) similar to those observed during recent years (LGL 2018). Catch weights and numbers for species/groups contributing ≥0.1% of the total catch weight in the Study Area during May–November 2015–2017 are presented in Table 4.4.

TABLE 4.4 Catch weights and numbers of macroinvertebrates and fishes collected during DFO RV surveys in the Study Area, May–November 2015–2017 (derived from DFO RV survey databases, 2015–2017).

Species	Catch Weight (mt)				Catch Number			
	2015	2016	2017	Total (mt)	2015	2016	2017	Total
Northern Shrimp (*Pandalus borealis*)	6	5	6	17	1,342,536	1,183,323	1,189,021	3,714,880
Deepwater Redfish (*Sebastes mentella*)	7	6	3	16	21,650	19,732	9,906	51,288
Greenland Halibut (*Reinhardtius hippoglossoides*)	4	5	3	13	12,755	20,247	17,084	50,086
Atlantic Cod (*Gadus morhua*)	5	3	3	12	6,309	5,702	4,411	16,422
Sponge (Porifera)	2	2	2	6	n/d	n/d	n/d	n/d
Northern Wolffish (*Anarhichas denticulatus*)	1	1	1	2	128	139	151	418
Striped (pink) Shrimp (*Pandalus montagui*)	1	1	1	2	152,461	175,441	161,810	489,712
American Plaice (*Hippoglossoides platessoides*)	1	1	1	2	4,431	3,255	2,727	10,413
Roughhead Grenadier (*Macrourus berglax*)	0.5	1	1	2	1,222	1,714	1,650	4,586
Jellyfish (Scyphozoa)	1	1	0.4	1	n/d	n/d	n/d	n/d
Basket Star (*Gorgonocephalus arcticus*)	0.3	0.4	0.5	1	7	43	10	60
Thorny Skate (*Raja radiata*)	0.4	0.3	0.3	1	1,000	2,406	1,735	5,141

Species	Catch Weight (mt)				Catch Number			
	2015	2016	2017	Total (mt)	2015	2016	2017	Total
Spotted Wolffish (*Anarhichas minor*)	0.2	0.4	0.2	1	105	133	81	319
Greenland Shark (*Somniosus microcephalus*)	0	0	1	1	0	0	1	1
Atlantic (striped) Wolffish (*Anarhichas lupus*)	0.2	0.1	0.2	1	990	421	480	1,891
Witch Flounder (*Glyptocephalus cynoglossus*)	0.2	0.1	0.1	0.4	284	264	227	775
Arctic Argid Shrimp (*Argis dentata*)	0.1	0.1	0.2	0.4	18,655	24,437	40,025	83,117
Roundnose Grenadier (*Coryphaenoides rupestris*)	0.1	0.2	0.2	0.4	374	1,266	1,582	3,222
Sea Anemone (Actinaria)	0.1	0.1	0.2	0.4	2,497	2,498	2,343	7,338
Green Sea Urchin (*Strongylocentrotus droebachiensis*)	0.2	0.1	0.1	0.3	16,271	6,557	8,422	31,250
Snow Crab (*Chionoecetes opilio*)	0.1	0.1	0.1	0.3	1,391	1,520	1,026	3,937
Greenland Shrimp (*Eualus macilentus*)	0.1	0.1	0.1	0.2	65,526	111,721	65,108	242,355
Common Lumpfish (*Cyclopterus lumpus*)	0.1	0.1	0.1	0.2	24	48	23	95
Atlantic Halibut (*Hippoglossus hippoglossus*)	0	0.1	0.1	0.2	0	2	2	4
Black Dogfish (*Centroscyllium fabricii*)	0.1	0.1	0.04	0.2	41	49	32	122
Sevenline Shrimp (*Sabinea septemcarinata*)	0.04	0.04	0.04	0.1	15,346	13,587	13,613	42,546
Spinytail Skate (*Raja spinicauda*)	0.1	0.02	0.03	0.1	4	3	5	12
Rigid Cushion Star (*Hippasteria phrygiana*)	0.02	0.04	0.04	0.1	81	163	190	434
Deepsea Cat Shark (*Apristurus profundorum*)	0.03	0.04	0.03	0.1	17	21	14	52
Golden Redfish (*Sebastes marinus*)	0.1	0.02	0.01	0.1	55	11	4	70
Mud Star (*Ctenodiscus crispatus*)	0.02	0.03	0.03	0.1	7,645	7,061	7,309	22,015
Jensen's Skate (*Raja jenseni*)	0.01	0.04	0.02	0.1	3	7	5	15
Sea Urchin (Echinoidea)	0.0001	0.002	0.1	0.1	0	100	7,152	7,252
Coral	0.03	0.02	0.02	0.1	51	222	219	492

Species	Catch Weight (mt)				Catch Number			
	2015	2016	2017	Total (mt)	2015	2016	2017	Total
Basket Star (Gorgonocephalidae)	0.002	0.06	0	0.1	n/d	n/d	n/d	n/d
Octopus (Octopoda)	0.01	0.03	0.02	0.1	83	71	132	286
Smooth Skate (*Raja senta*)	0.01	0.01	0.03	0.1	134	249	290	673
Sea Cucumber (*Psolus fabricii*)	0.02	0.01	0.02	0.05	673	297	678	1,648
Feather Star (Crinoidea)	0.03	0.003	0.01	0.04	890	175	140	1,205
Shrimp (*Acanthephyra pelagica*)	0.01	0.01	0.02	0.04	1,393	2,369	3,175	6,937
Shrimp (*Eualus gaimardii belcheri*)	0.01	0.01	0.02	0.04	4,175	5,521	8,246	17,942
Total	**30**	**28**	**24**	**82**	**1,679,207**	**1,590,825**	**1,549,039**	**4,819,071**

Note:
n/d denotes data unavailable.

As during May–November 2014, RV survey catch locations were in the central-western and southwestern portion of the Study Area in 2015–2017, mainly in water depths <1,000 m, including within the southern portion of the Torngat 3D 2019 survey area (see Figure 4.23 *in* LGL 2018, and Figures 4.27–4.29 below). There were no catch locations within the Orphan Basin 2D survey area. Mean catch depths for species/groups contributing ≥0.1% of the total catch weight and predominant species for all species caught at various mean depth ranges in the Study Area during May–November 2015–2017 are presented in Tables 4.5–4.7.

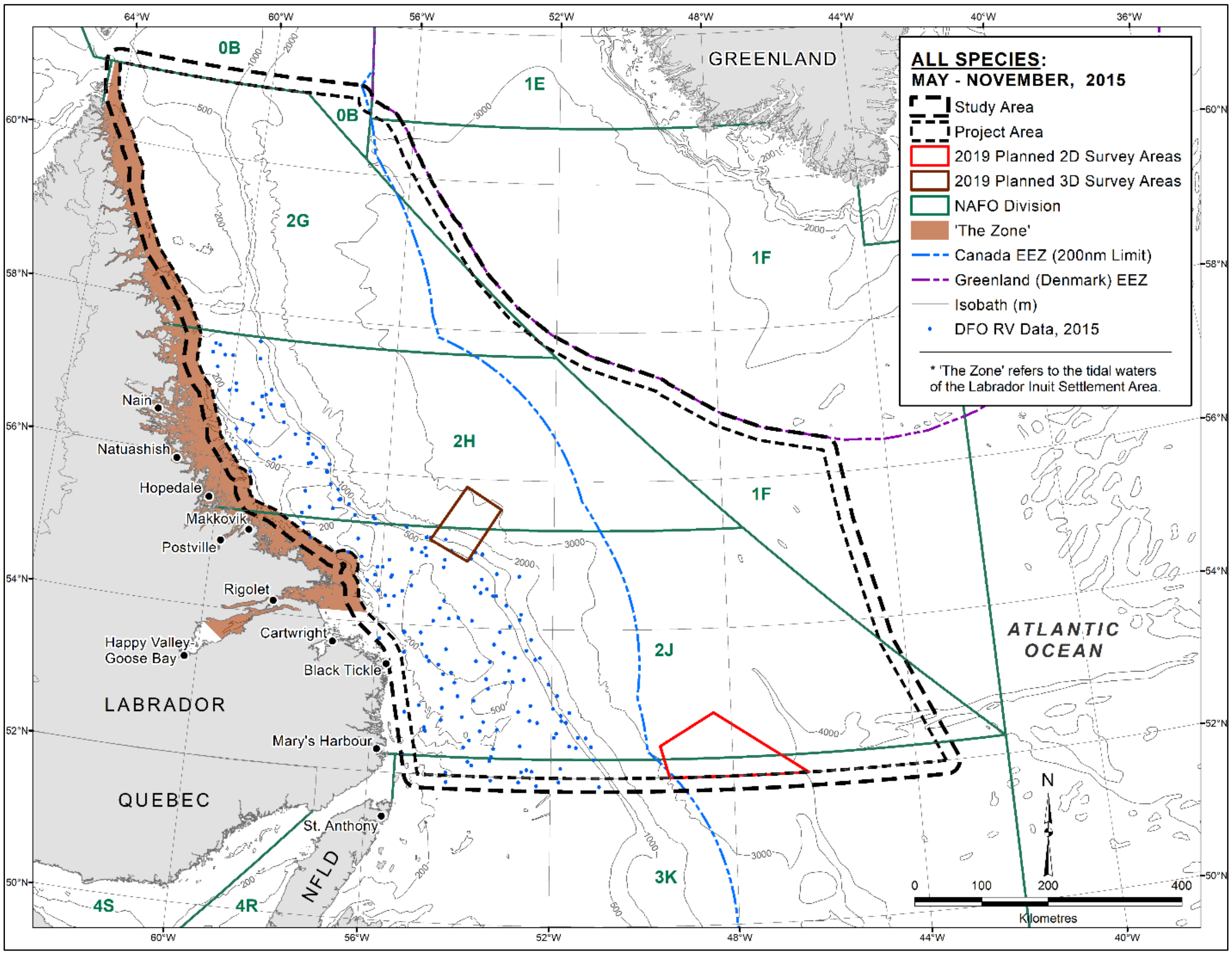


FIGURE 4.27. Distribution of DFO RV survey catch locations in the Study Area, all species, May–November 2015 (derived from DFO RV survey database, 2015).

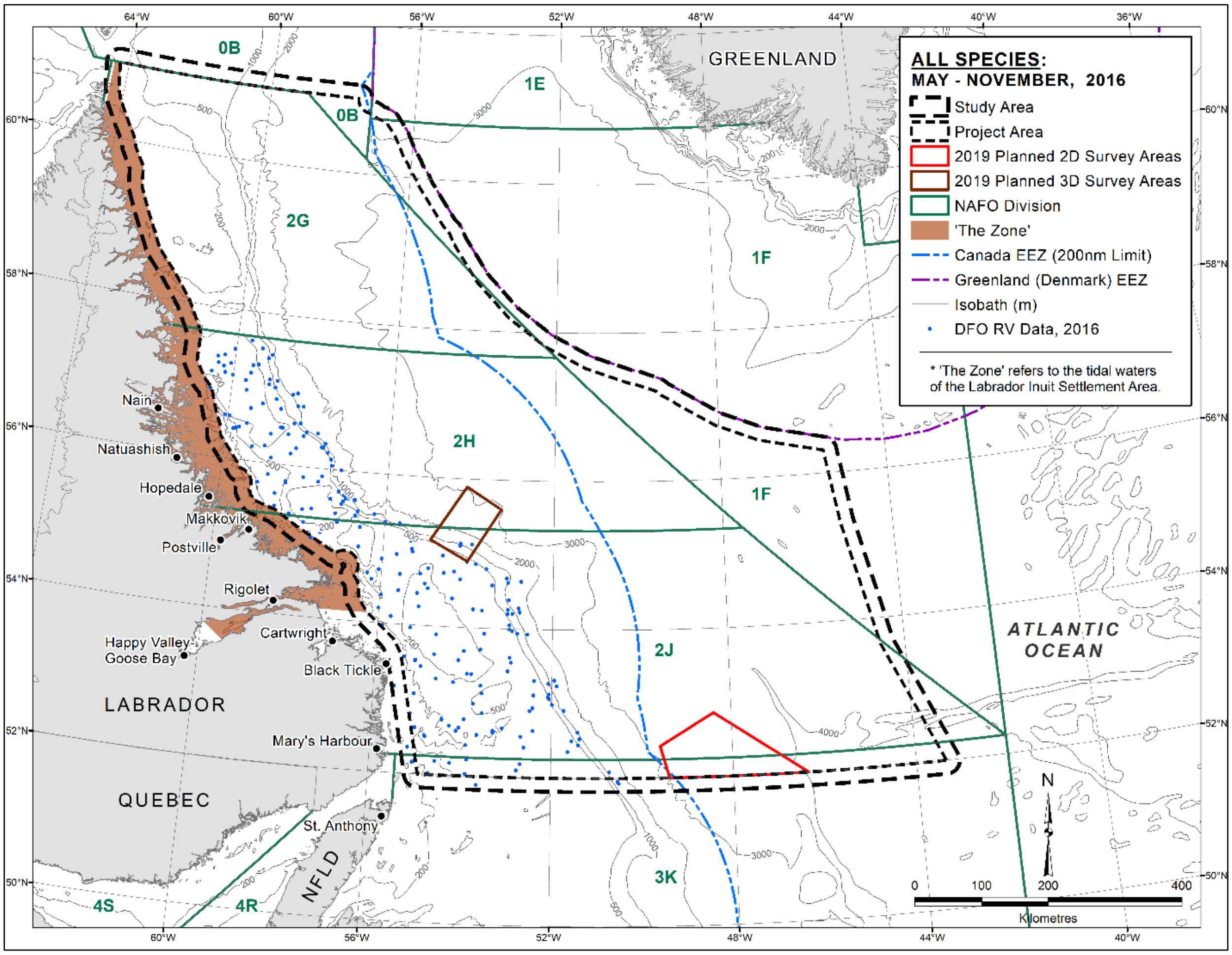


FIGURE 4.28. Distribution of DFO RV survey catch locations in the Study Area, all species, May–November 2016 (derived from DFO RV survey database, 2016).

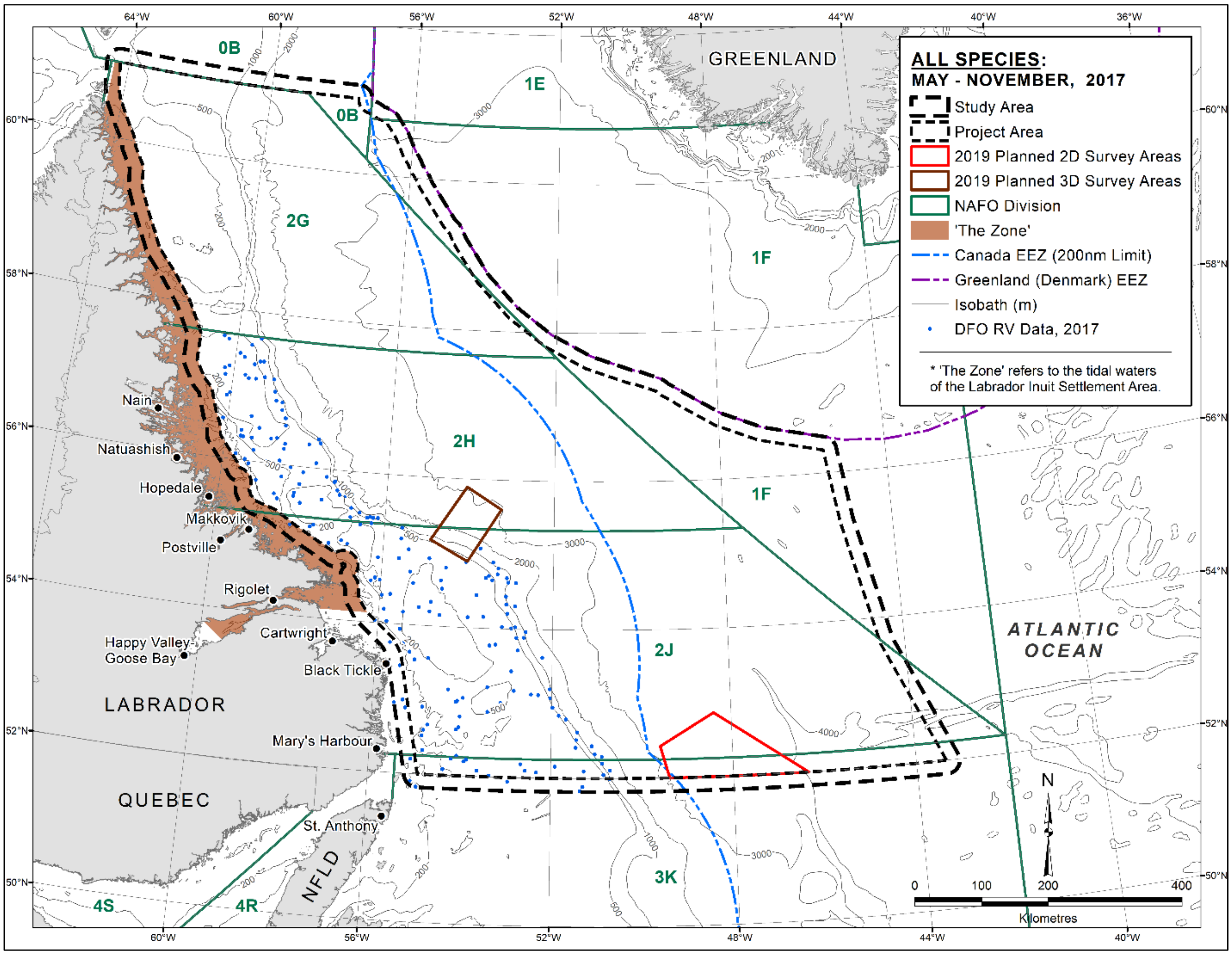


FIGURE 4.29. Distribution of DFO RV survey catch locations in the Study Area, all species, May–November 2017 (derived from DFO RV survey database, 2017).

TABLE 4.5. Mean catch depths of macroinvertebrates and fishes collected during DFO RV surveys in the Study Area, May–November 2015–2017 (derived from DFO RV survey databases, 2015–2017).

Species	Spring Mean Catch Depth (m) [a]				Fall Mean Catch Depth (m) [b]			
	2015	2016	2017	Total	2015	2016	2017	Total
Northern Shrimp (*Pandalus borealis*)	–	–	–	–	292	288	302	294
Deepwater Redfish (*Sebastes mentella*)	–	–	–	–	357	397	413	389
Greenland Halibut (*Reinhardtius hippoglossoides*)	–	–	–	–	407	441	381	410
Atlantic Cod (*Gadus morhua*)	–	–	–	–	280	279	268	276
Sponge (Porifera)	–	–	–	–	434	475	424	444
Northern Wolffish (*Anarhichas denticulatus*)	–	–	–	–	461	521	461	481
Striped (pink) Shrimp (*Pandalus montagui*)	–	–	–	–	193	197	203	198
American Plaice (*Hippoglossoides platessoides*)	–	–	–	–	290	298	301	296
Roughhead Grenadier (*Macrourus berglax*)	–	–	–	–	527	650	571	582
Jellyfish (Scyphozoa)	–	–	–	–	516	595	503	538

Species	Spring Mean Catch Depth (m) [a]				Fall Mean Catch Depth (m) [b]			
	2015	2016	2017	Total	2015	2016	2017	Total
Basket Star (*Gorgonocephalus arcticus*)	–	–	–	–	359	214	231	268
Thorny Skate (*Raja radiata*)	–	–	–	–	303	319	309	311
Spotted Wolffish (*Anarhichas minor*)	–	–	–	–	278	291	270	280
Greenland Shark (*Somniosus microcephalus*)	–	–	–	–	–	–	880	880
Atlantic (striped) Wolffish (*Anarhichas lupus*)	–	–	–	–	265	276	252	264
Witch Flounder (*Glyptocephalus cynoglossus*)	–	–	–	–	398	448	470	439
Arctic Argid Shrimp (*Argis dentata*)	–	–	–	–	176	179	181	179
Roundnose Grenadier (*Coryphaenoides rupestris*)	–	–	–	–	862	981	746	863
Sea Anemone (Actinaria)	–	–	–	–	423	450	394	422
Green Sea Urchin (*Strongylocentrotus droebachiensis*)	–	–	–	–	238	261	215	238
Snow Crab (*Chionoecetes opilio*)	–	–	–	–	264	335	258	286
Greenland Shrimp (*Eualus macilentus*)	–	–	–	–	190	226	169	195
Common Lumpfish (*Cyclopterus lumpus*)	–	–	–	–	255	328	218	267
Atlantic Halibut (*Hippoglossus hippoglossus*)	–	–	–	–	–	328	335	332
Black Dogfish (*Centroscyllium fabricii*)	–	–	–	–	708	863	689	753
Sevenline Shrimp (*Sabinea septemcarinata*)	–	–	–	–	258	234	204	232
Spinytail Skate (*Raja spinicauda*)	–	–	–	–	780	667	667	690
Rigid Cushion Star (*Hippasteria phrygiana*)	–	–	–	–	459	461	461	460
Deepsea Cat Shark (*Apristurus profundorum*)	–	–	–	–	1,216	1,235	1,223	1,225
Golden Redfish (*Sebastes marinus*)	–	–	–	–	381	478	440	444
Mud Star (*Ctenodiscus crispatus*)	–	–	–	–	333	382	408	374
Jensen's Skate (*Raja jenseni*)	–	–	–	–	1,218	1,330	1,108	1,246
Sea Urchin (Echinoidea)	–	–	–	–	369	141	263	259
Coral	–	–	–	–	523	563	443	510
Basket Star (Gorgonocephalidae)	–	–	–	–	220	189	–	199
Octopus (Octopoda)	–	–	–	–	657	679	621	652
Smooth Skate (*Raja senta*)	–	–	–	–	388	420	434	414
Sea Cucumber (*Psolus fabricii*)	–	–	–	–	205	186	210	200
Feather Star (Crinoidea)	–	–	–	–	389	777	436	534
Shrimp (*Acanthephyra pelagica*)	–	–	–	–	971	958	746	892
Shrimp (*Eualus gaimardii belcheri*)	–	–	–	–	754	257	187	400
Total	**–**	**–**	**–**	**–**	**382**	**392**	**353**	**376**

Note:

[a] No surveys occurred within the Study Area during spring 2015–2017.

[b] Fall survey months: 2015/2016/2017 = October–November.

TABLE 4.6. Total catch weights and predominant species caught at various mean catch depth ranges during DFO RV surveys, May–November 2015–2017 (derived from DFO RV survey database, 2015–2017).

Mean Catch Depth Range (m)	Total Catch Weight (mt)			Predominant Species (% of Total Catch Weight)		
	2015	2016	2017	2015	2016	2017
<100	0	0	0	–	–	–
100–199	1	1	0.3	Striped Shrimp (77%) Artic Argid Shrimp (11%)	Striped Shrimp (74%) Artic Argid Shrimp (13%)	Arctic Argid Shrimp (60%) Greenland Shrimp (23%)
200–299	14	11	5	Northern Shrimp (45%) Atlantic Cod (38%)	Northern Shrimp (51%) Atlantic Cod (31%)	Atlantic Cod (61%) Striped Shrimp (13%) Basket Star (*G. arcticus*; 10%)
300–399	11	6	10	Deepwater Redfish (59%) Greenland Halibut (38%)	Deepwater Redfish (92%) Thorny Skate (5%)	Northern Shrimp (55%) Greenland Halibut (33%)
400–499	3	7	6	Sponge (69%) Northern Wolffish (26%)	Greenland Halibut (68%) Sponge (27%)	Deepwater Redfish (55%) Sponge (27%) Northern Wolfish (13%)
500–599	1	1	1	Jellyfish (50%) Roughhead Grenadier (48%)	Northern Wolffish (90%) Golden Redfish (2%)	Roughhead Grenadier (57%) Jellyfish (41%)
600–699	0.01	1	0.03	Shrimp (*Pasiphaea* sp.; 83%) Cusk (*Brosme brosme*; 12%)	Roughhead Grenadier (49%) Jellyfish (46%)	Octopus (49%) Deepwater Skate (*Raja fyllae*; 30%) Shrimp (*Atlantopandalus propinqvus*; 15%)
700–799	0.1	0.003	0.04	Spinytail Skate (51%) Black Dogfish (43%)	*Munidopsis curvirostra* (49%) Deepwater Skate (44%)	Spinytail Skate (86%) Shrimp (*Pasiphaea* sp.; 13%)
800–899	0.001	0.1	1	Sea Star (*Asteroidea;* 78%) Sea Cucumber (*Holothurodea*; 11%)	Black Dogfish (90%) Shrimp (*Pasiphaea* sp.; 7%)	Greenland Shark (75%) Roundnose Grenadier (18%)
900–999	0.1	0.2	0.0004	Roundnose Grenadier (93%)	Roundnose Grenadier (91%)	Orange Brittle Star (*Stegophiura nodosa*; 100%)
≥1,000	0.1	0.1	0.1	Deepsea Cat Shark (41%) Skate (*Raja* sp.; 24%) Jensen's Skate (16%) Shrimp (*A. pelagica*; 11%)	Jensen's Skate (39%) Deepsea Cat Shark (38%)	Deepsea Cat Shark (44%) Jensen's Skate (32%) Octopus (*Cirroteuthis mulleri*; 10%)

The tentative schedule for the 2019 DFO multispecies RV surveys is presented in Table 4.7 (L. Mello, Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO, pers. comm., 27 March 2019). Spring RV surveys within the Study Area are currently set to begin late-April and continue into late-May. Fall RV surveys within the Study Area will begin early-October and end in late-December.

TABLE 4.7. Tentative schedule of DFO RV surveys within the Study Area during 2019.

NAFO Division	Start Date	End Date	Vessel
3KL	30 Apr	20 May	*Teleost*
2H	9 Oct	23 Oct	*Teleost*
2H + 2J	23 Oct	5 Nov	*Teleost*
3K + 3L	6 Nov	19 Nov	*Needler*
2J	6 Nov	19 Nov	*Teleost*
3K	19 Nov	3 Dec	*Teleost*
3K	4 Dec	20 Dec	*Teleost*

4.2.5.2 Industry and DFO Science Surveys

The DFO-Industry collaborative post-season snow crab trap survey is described in §4.3.9 *in* LGL (2018). The snow crab TAC for this survey increased from 350 mt during 2015 and 2016 to 470 mt in 2017, then decreased to 460 mt and 400 mt during 2018 and 2019, respectively (DFO 2019a). A total of 87 survey stations occur within the Study Area. No survey stations occur within the Torngat 3D or Orphan Basin 2D 2019 survey areas (Figure 4.30). As noted by Fish, Food and Allied Workers (FFAW) in LGL (2019), survey station locations have recently been modified to encompass a broader snow crab habitat range, and fixed stations will be sampled annually for five years while random stations will change each year. Regular communication with DFO will be required to determine whether stations within or near the planned 2019 3D or 2D survey areas will be sampled.

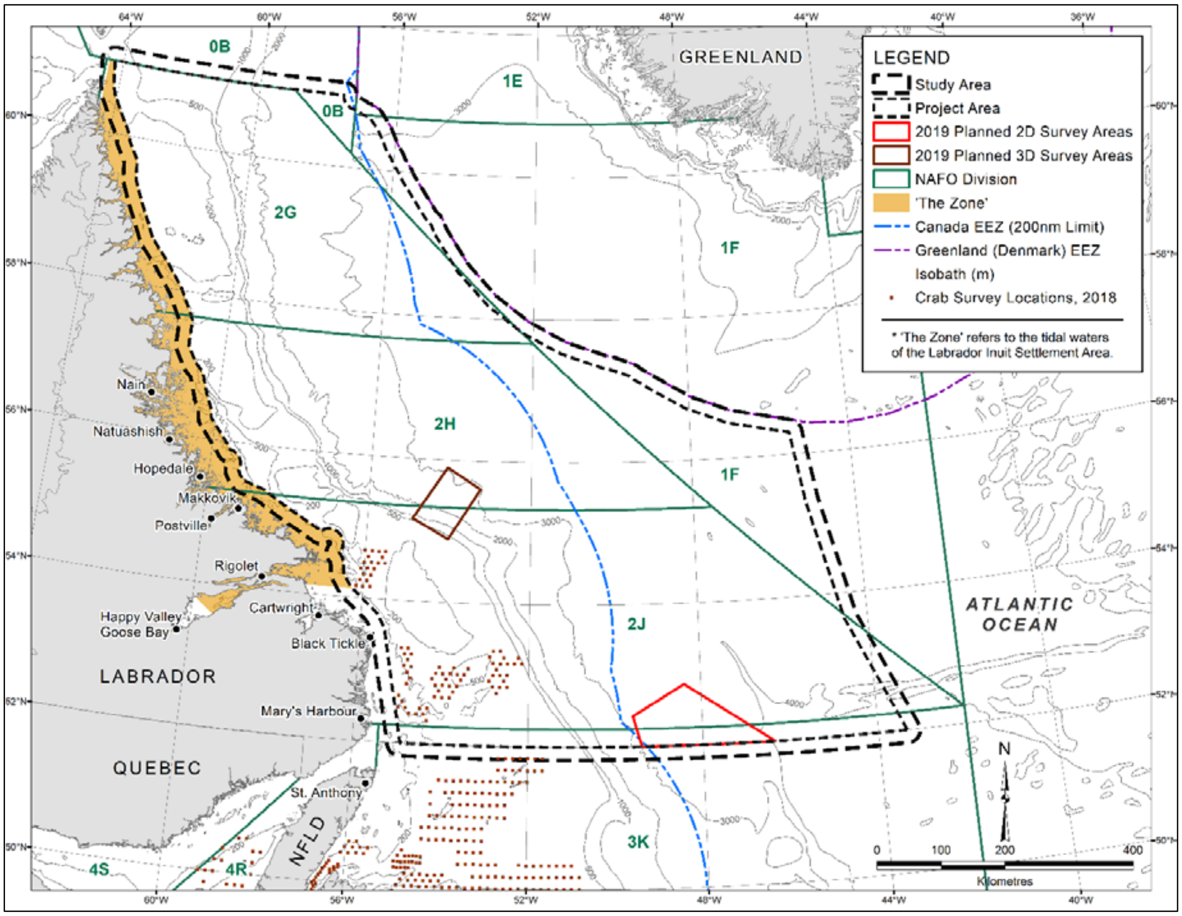


FIGURE 4.30. Locations of DFO-Industry collaborative post-season snow crab trap survey stations in relation to the Study Area and planned 2019 3D and 2D survey areas.

4.3 Marine-Associated Birds

Since the EA, there is no new nesting colony information or density estimates for seabirds in the Study Area (Environment and Climate Change Canada; ECCC-CWS unpubl. data).

4.4 Marine Mammals and Sea Turtles

4.4.1 General Cetacean and Sea Turtle Surveys

A large database of cetacean and sea turtle sightings in NL waters has been compiled from various sources by DFO in St. John's, and was made available during preparation of the EA for the purposes of describing species sightings within the Study Area. There have been no updates to that database since preparation of the original EA (J. Lawson, Research Scientist, DFO, pers. comm., 23 April 2019).

Delarue et al. (2018) deployed acoustic recorders at 20 sites off Canada's East Coast ranging from NS to Labrador from August 2015 to July 2017; four of those were located within the Study Area. Up to 23 marine mammal species were detected acoustically, some of which were only detected off NS (e.g., right whale) or off northern Labrador (e.g., walrus, bearded seal). Species diversity was higher at the deep-water stations than over the shelf or nearshore; species richness was reduced at the northerly stations during winter and spring, whereas it stayed consistent throughout the year at more southerly stations.

Blue whales were generally detected less frequently by acoustic recorders offshore Labrador than those located offshore NS and Newfoundland. Detections in Labrador typically occurred during September—January and occurred more often at the two recorders located on the southern Labrador shelf and slope waters (Delarue et al. 2018). Fin whales were detected on all four recorders offshore Labrador, typically from August through February, with most vocalizations recorded in southern Labrador. There were few humpback whale calls detected offshore Labrador relative to other baleen whale species and most detections occurred at the southern-most recorder during fall. However, Delarue et al. (2018) noted that bearded seal trills and airgun pulses limited the detection ability of the recorders. Minke whale vocalizations were not detected offshore Labrador. In the fall, sei whale calls were detected primarily at recording stations off Labrador and the eastern Grand Banks. Delarue et al. (2018) noted that the relative absence of sei whale signals at on-shelf stations suggests a preference of sei whales for deeper slope waters.

Sperm whale clicks were detected on all acoustic recorders offshore Labrador except the northern most recorder. There was a general seasonal decline in detection rates, except at sites in and adjacent to the Flemish Pass which had high rates year-round; this suggests that this area may be important to sperm whales (Delarue et al. 2018).

Killer whale vocalizations were mostly recorded during summer and fall, with detections in the northern portion of the Study Area (Delarue et al. 2018). Pilot whale acoustic occurrence varied seasonally at all 20 stations and was generally consistent from May to November. Vocalizations were typically absent in winter and spring at the Labrador recording stations. Vocalizations of dolphins were concentrated at the southern sites during winter and spring. High detection rates occurred near Flemish Pass, especially from July–November; the Grand Banks and Scotian Shelf also had high detection rates. Relatively few dolphin vocalizations were recorded offshore Labrador, and most were recorded at the southernmost Labrador station. Harbour porpoise clicks were detected primarily in the fall offshore Labrador with most detections made by recorders in the northern Labrador Sea. Northern bottlenose whales were detected throughout the year (almost every day) by the acoustic recorder located in slope waters offshore Labrador. There were no detections of Sowerby's beaked whales and Cuvier's beaked whales within the Study Area (Delarue et al. 2018).

Gomez et al. (2017) conducted species distribution models and showed that the most suitable habitats and therefore priority areas for monitoring of northern bottlenose whales on the edges of the eastern Scotian Shelf and Newfoundland and Labrador Shelves, canyons, and deep basins overlap with anthropogenic activities.

4.4.2 Updated Species Information

4.4.2.1 North Atlantic Right Whale

Twenty mortalities were reported for the North Atlantic right whale population over the last two years - 17 individuals in 2017 and 3 individuals in 2018 (Pettis et al. 2018). The best population estimate at the end of 2017 was 411 individuals; no calves were born in 2018 (Pettis et al. 2018). To date, in 2019, there have been four right whale deaths reported in the Gulf of St. Lawrence (https://www.cbc.ca/news/canada/new-brunswick/dead-north-atlantic-right-whales-gulf-1.5190096).

4.4.2.2 Blue Whale

In 2018, an action plan for blue whales was proposed (DFO 2018f). Lesage et al. (2018) reported that the continental shelf edge off NS, southern Newfoundland, and the Grand Banks is an important blue whale foraging area (also see DFO 2018g). Similarly, Moors-Murphy et al. (2019) reported that slope waters off the Scotian Shelf, Grand Banks, and deep water of the Laurentian Channel are potentially important habitat areas; the Labrador Shelf and Slope were not highlighted as important habitat for blue whales.

4.4.2.3 Sei Whale

Genetic studies have shown low divergence among North Atlantic sei whales suggesting a single rather than multiple stocks, including a Nova Scotian stock; however, the data showed high uncertainty (Huijser et al. 2018). COSEWIC recently changed the status of sei whales (Atlantic population) from *data deficient* to *endangered*.

4.5 Species at Risk

The new information presented in this section does not change the effects predictions made in the EA (LGL 2018).

Updated species at risk that could potentially occur in the Study Area are provided in this section, based on available information on the *Species at Risk Act* (SARA) and COSEWIC websites as of May 2019. Changes in species status since the preparation of the EA (LGL 2018) and its Addendum (LGL 2019) are described below and noted in bold font in Table 4.8.

TABLE 4.8. SARA-listed and COSEWIC-assessed marine species that potentially occur in the Study Area.

Common Name	Scientific Name	SARA [a]			COSEWIC [b]		
		E	T	SC	E	T	SC
MARINE FISH							
Northern Wolffish	*Anarhichas denticulatus*		S1			X	
Spotted Wolffish	*Anarhichas minor*		S1			X	
Atlantic Wolffish	*Anarhichas lupus*			S1			X
Atlantic Cod	*Gadus morhua*			S3			
Atlantic Cod Newfoundland and Labrador population					X		
Cusk	*Brosme brosme*				X		
Deepwater Redfish Northern population	*Sebastes mentella*					X	
Atlantic Bluefin Tuna	*Thunnus thynnus*				X		
Porbeagle Shark	*Lamna nasus*				X		
Roundnose Grenadier	*Coryphaenoides rupestris*				X		
Smooth Skate Funk Island Deep population	*Malacoraja senta*				X		
Winter Skate Eastern Scotian Shelf-Newfoundland population	*Leucoraja ocellata*				X		
Acadian Redfish Atlantic population	*Sebastes fasciatus*					X	
American Plaice Newfoundland and Labrador population	*Hippoglossoides platessoides*					X	
Lumpfish	*Cyclopterus lumpus*					X	
White Hake Atlantic and Northern Gulf of St. Lawrence population	*Urophycis tenuis*					X	
Atlantic Sturgeon St. Lawrence populations	***Acipenser oxyrinchus***					**X**	
American Eel	*Anguilla rostrata*					X	
Atlantic Salmon South Newfoundland population	*Salmo salar*					X	
Quebec Eastern North Shore population							X
Quebec Western North Shore population							X
Anticosti Island population					X		
Inner St. Lawrence population							X
Gaspe-Southern Gulf of St. Lawrence population							X
Eastern Cape Breton population					X		
Nova Scotia Southern Upland population					X		
Outer Bay of Fundy population					X		
Basking Shark Atlantic population	*Cetorhinus maximus*						X
Shortfin Mako Shark Atlantic population	*Isurus oxyrinchus*						X
~~**Roughhead Grenadier**~~	~~***Macrourus berglax***~~						~~**X**~~
Spiny Dogfish Atlantic population	*Squalus acanthias*						X
Thorny Skate	*Amblyraja radiata*						X
MARINE-ASSOCIATED BIRDS							
Ivory Gull	*Pagophila eburnea*	S1			X		
Red Knot *rufa* spp.	*Calidris canutus rufa*	S1			X		
Eskimo Curlew	***Numenius borealis***	**S1**			**X**		

Common Name	Scientific Name	SARA [a]			COSEWIC [b]		
		E	T	SC	E	T	SC
Ross's Gull	*Rhodostethia rosea*		S1			X	
Harlequin Duck Eastern population	*Histrionicus histrionicus*			S1			X
Barrow's Goldeneye Eastern population	*Bucephala islandica*			S1			X
Buff-breasted Sandpiper	*Tryngites subruficollis*			S1			X
Red-necked Phalarope	***Phalaropus lobatus***						**X**
MARINE MAMMALS							
Blue Whale Atlantic population	*Balaenoptera musculus*	S1			X		
Beluga Whale St. Lawrence Estuary population	*Delphinapterus leucas*	S1			X		
Cumberland Sound population			S1			X	
Eastern Hudson Bay population					X		
Ungava Bay population					X		
Eastern High Arctic-Baffin Bay population							X
Western Hudson Bay							X
Harbour Porpoise Northwest Atlantic population	*Phocoena phocoena*		S2				X
Fin Whale Atlantic population	*Balaenoptera physalus*			S1			X
Sei Whale **Atlantic population**	***Balaenoptera borealis***				**X**		
Humpback Whale Western North Atlantic population	*Megaptera novaeangliae*			S3			
Sowerby's Beaked Whale	*Mesoplodon bidens*			S1			X
Polar Bear	*Ursus maritimus*			S1			X
Northern Bottlenose Whale Davis Strait-Baffin Bay-Labrador Sea population	*Hyperoodon ampullatus*						X
Killer Whale Northwest Atlantic/ Eastern Arctic population	*Orcinus orca*						X
Bowhead Whale **Eastern Canada-West Greenland population**	***Balaena mysticetus***						**X**
Atlantic Walrus Central/Low Arctic population	*Odobenus rosmarus rosmarus*						X
SEA TURTLES							
Leatherback Sea Turtle Atlantic population	*Dermochelys coriacea*	S1			X		
Loggerhead Sea Turtle	*Caretta caretta*	S1			X		

Note:
E = Endangered; T = Threatened; SC = Special Concern; S = Schedule.
[a] SARA website (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html) accessed May 2019.
[b] COSWEIC website (https://www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife.html) accessed May 2019.

The St. Lawrence populations of Atlantic sturgeon were added. This species was assessed as *threatened* by COSEWIC and has no status under SARA. Additional information for this species is provided in §4.5.1 below.

Roughhead grenadier was removed (indicated by strikethrough text in Table 4.8), as it is no longer considered at risk. Roughhead grenadier was previously assessed as *special concern* under COSEWIC and had no status under SARA.

Eskimo Curlew was added as it may occur in the Study Area during its southward migration during the fall (COSEWIC 2009). Eskimo Curlew is listed as *endangered* under Schedule 1 of SARA was assessed as *endangered* by COSEWIC. Additional information for this species is provided in §4.2.10 of C-NLOPB (2008).

Red-necked Phalarope was added as it may occur in the Study Area during migration (COSEWIC 2014). This species was assessed as *special concern* by COSEWIC and has no status under SARA. Additional information on this species is provided in §4.4.2.5 *in* LGL (2014), and §4.4.2.6 *in* LGL (2016).

The Eastern Canada-West Greenland population of bowhead whale was added, as its southernmost distribution includes the northern portion of the Study Area (COSEWIC 2009 *in* LGL 2018). Sei whale (Atlantic population) was added because COSEWIC recently decided to change its status from *data deficient* to *endangered.* Additional information for both of these species is provided in §4.5.1.2 *in* LGL (2018).

The following recovery strategies, action plans and management plans have become available since the EA (LGL 2018):

- Recovery strategy (proposed) for northern and spotted wolffish (DFO 2018e).
- Recovery strategy (proposed) for leatherback sea turtle, Atlantic population (DFO 2016b).
- Management plan (proposed) for Atlantic wolffish (DFO 2018e).
- Action plan (proposed) for leatherback sea turtle, Atlantic population (DFO 2018h).
- Action plan (proposed) for blue whale, Northwest Atlantic population (DFO 2018i).
- Action plan (proposed) for northern and spotted wolffish (DFO 2018j).

4.5.1 Atlantic Sturgeon

The Atlantic sturgeon is a large, cartilaginous, slow-growing, late-maturing, anadromous finfish (COSEWIC 2011). This species spends most of its life in marine waters, returning to freshwater only to spawn when females mature at age 27–28 years and males at 16–24 years (COSEWIC 2011). Juveniles inhabit freshwater for several years before migrating seaward upon reaching a length of 80–120 cm (COSEWIC 2011). The St. Lawrence populations of Atlantic sturgeon spawn during June and July in the St. Lawrence River, with females spawning every 3–5 years and males once in five years (COSEWIC 2011). It may live for several decades and feeds on benthic invertebrates while in freshwater or brackish water, and small fish in marine waters (COSEWIC 2011). There are likely 500–1,000 adults in the St. Lawrence Designated

Unit (COSEWIC 2011). No Atlantic Sturgeon were caught during commercial harvests within the Study Area during May–November 2016 or 2017 (see Table 4.1). Atlantic sturgeon may occur within the westernmost portion of the Study Area (see Figure 3 *in* COSEWIC 2011).

4.6 Sensitive Areas

Sensitive areas within the Study Area are described in §4.11 *in* C-NLOPB (2008), §4.6 *in* LGL (2015), and §4.7 *in* LGL (2014, 2016, 2018). The information presented in this section does not change the effects predictions made in the EA (LGL 2018). Sensitive areas that overlap or are adjacent to the Study Area and planned 2019 2D and 3D survey areas are shown in Figure 4.31. No sensitive areas have been modified or newly designated in the Study Area since the EA (LGL 2018). Critical habitats were recently proposed for northern and spotted wolffish (see Figure 4.32 below).

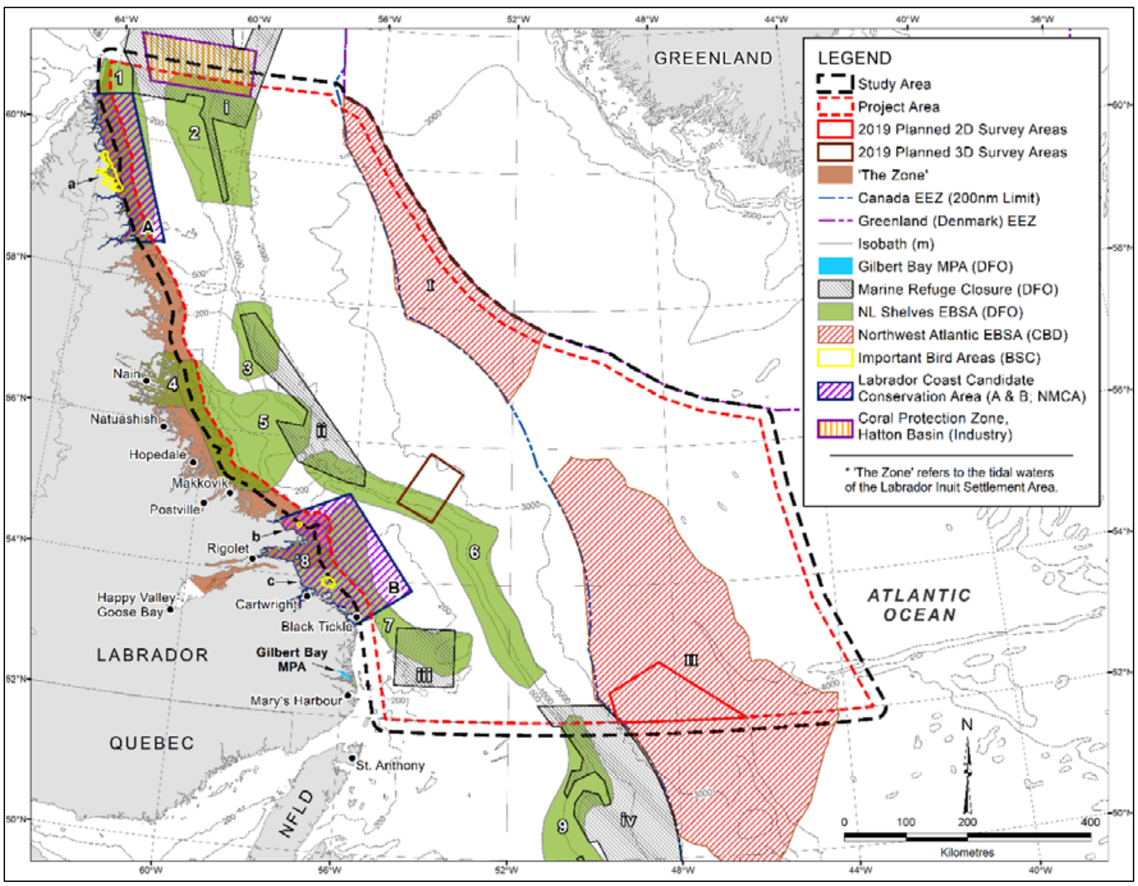


FIGURE 4.31. Sensitive areas that overlap or are adjacent to the Study Area (alpha/numeric identifiers provided in sensitive areas bulleted list below).

Sensitive areas which occur at least partially within or are immediately adjacent to the Study Area are as follows (where applicable, alpha/numeric identifiers for areas in Figure 4.31 are provided in italic font within parentheses):

- DFO NL Shelves Bioregion Ecologically and Biologically Significant Areas (EBSAs)
    - *(1)* Northern Labrador
    - *(2)* Outer Shelf Saglek Bank
    - *(3)* Outer Shelf Nain Bank
    - *(4)* Nain Area
    - *(5)* Hopedale Saddle
    - *(6)* Labrador Slope
    - *(7)* Labrador Marginal Trough
    - *(8)* Hamilton Inlet
    - *(9)* Orphan Spur
- Convention on Biological Diversity (CBD) EBSAs
    - *(I)* Labrador Sea Deep Convection Area
    - *(II)* Seabird Foraging Zone in the Southern Labrador Sea
- Parks Canada candidate National Marine Conservation Areas (NMCAs)
    - *(A)* Labrador Coast A
    - *(B)* Labrador Coast B
- DFO Marine Refuge (Fishery Exclusion Area)
    - *(i)* Hatton Basin Conservation Area
    - *(ii)* Hopedale Saddle Closure
    - *(iii)* Northeast Newfoundland Slope Closure
    - *(iv)* Hawke Channel Closure
- DFO Marine Protected Area (MPA)
    - Gilbert Bay
- Fishing Industry voluntary coral protection zone/fishery closure area
- 'The Zone'
- Important Bird Areas (IBAs)
    - *(a)* Seven Islands Bay
    - *(b)* Quaker Hat Island
    - *(c)* Gannet Islands
- Government of Newfoundland and Labrador Ecological Reserve
    - Gannet Islands (within Gannet Islands IBA)

Critical habitat was recently proposed for northern and spotted wolffishes within and/or near the Study Area (DFO 2018e; Figure 4.32). The proposed critical habitat for northern and spotted wolffishes include deep channels and edges of the Grand Banks and Labrador Shelf, and support all portions of wolffish life history (DFO 2018e). Northern and spotted wolffishes do not exhibit large-scale movements (DFO 2018e) and may be present within the proposed critical habitat year-round. A portion of proposed northern wolffish critical habitat overlaps the southernmost portion of the planned Torngat 3D 2019 survey area. A portion of proposed spotted wolffish critical habitat is adjacent to the Torngat 3D survey area. The nearest portions of proposed critical habitat for both species are located ~140 km west of the planned Orphan Basin 2D 2019 survey area.

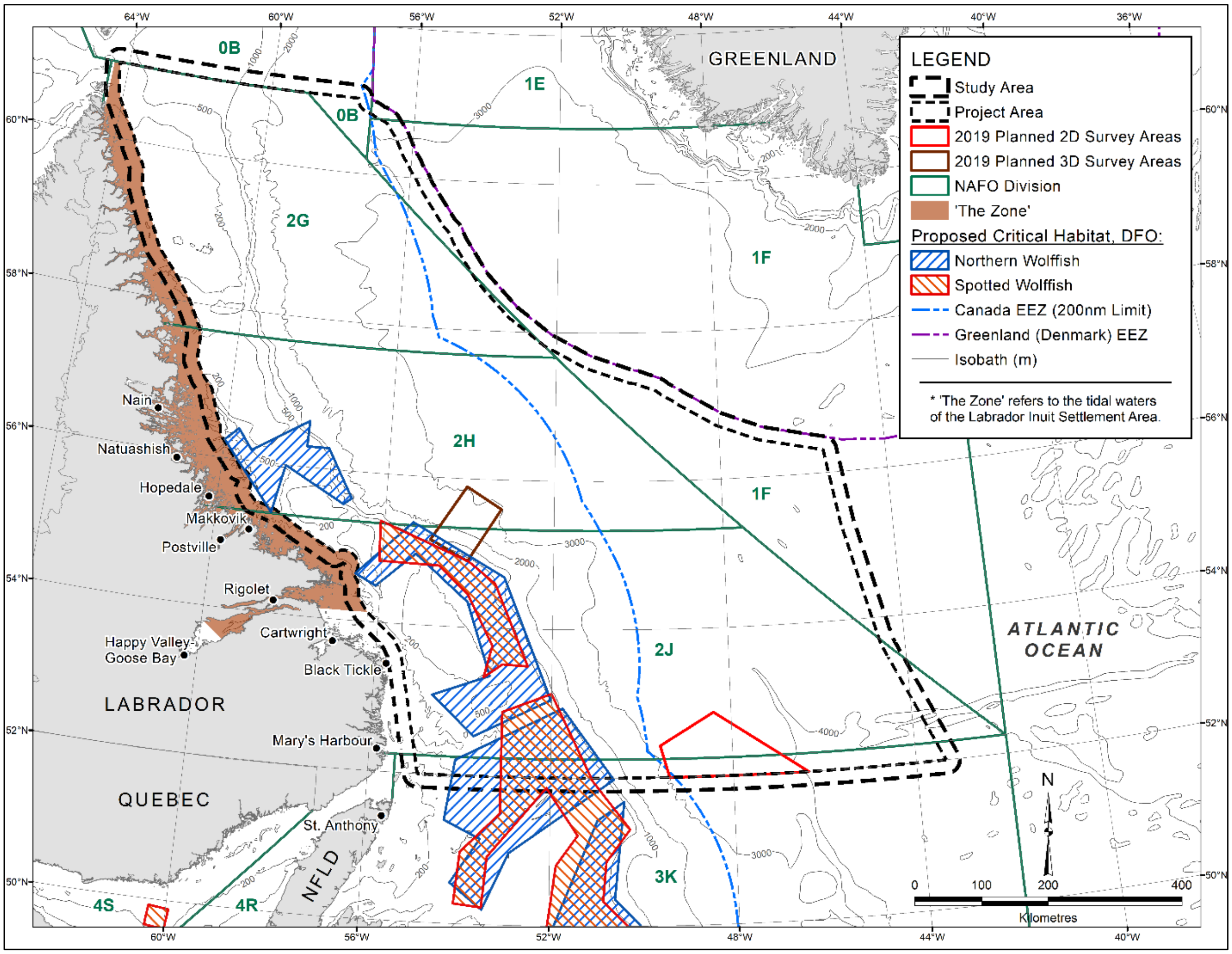


FIGURE 4.32. Proposed northern and spotted wolffish critical habitats (Source: DFO 2018e).

5.0 Consultations

A newsletter describing the seismic activities proposed for 2019 was distributed during April 2019 to the same stakeholders/groups consulted by MKI in previous years for seismic surveys offshore Labrador. The newsletter and details of those consulted by MKI are presented in Appendices A and B, respectively.

Face-to-face meetings were held with DFO, the Fish, Food and Allied Workers Union/Unifor (FFAW/Unifor), Ocean Choice International (OCI), Torngat Secretariat, and Torngat Fish

Producers Co-operative Society Ltd. in February and March 2019. During these meetings, no specific concerns were raised but the need for good routine communication and coordination between MKI and the fishing industry was noted. The Torngat Secretariat specifically noted that continued communication at the start of the season was needed in relation to the status of their snow crab survey. The Torngat Fish Producers Co-operative noted that MKI's survey areas did not impact their members as they are fish farther inshore. MKI will send weekly plans for the duration of the project to the Torngat Co-operative and other stakeholders.

Face-to-face meetings were offered to the Nunatsiavut Government (NG) representatives in Nain and subsequently a teleconference was proposed. Due to difficulties in coordinating availability, communication continued via email. There was an initial concern from NG that the Study Area was within the Land Claims Zone and MKI confirmed that the Project Area was outside the Zone and there will be no Project activities inside the Zone. It was also relayed to the NG that this approach is consistent with the previous MKI EA for Labrador. The NG also requested a map showing the seismic survey lines and associated survey timing. MKI provided an update on planned survey timing and a map showing the 3D seismic survey area.

6.0 Environmental Assessment

This section presents a summary of mitigation measures that will be employed by MKI during its 2019 seismic program. Additionally, it provides new and relevant literature for the effects assessment of Project activities on the following VECs: Fish and Fish Habitat, Marine-Associated Birds, and Marine Mammals and Sea Turtles.

6.1 Mitigation Measures

The mitigation measures described in the EA and EA Addendum (LGL 2018, 2019) remain applicable to MKI's 2D and 3D seismic survey activities planned for 2019. A summary of mitigation measures and commitments made in EA documents for the Project is provided below along with commentary on the status of implementing the mitigation measures and commitments (Table 6.1). This summary serves as a tracking table as per §5.1.4.1 of the C-NLOPB's *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2018).

TABLE 6.1. Summary of environmental commitments and mitigation measures and the current status of these commitments and measures.

VEC, Potential Effects	Primary Mitigations	Status (26 June 2019)
Fisheries VEC: Interference with fishing vessels/mobile and fixed gear fisheries	• Pre-survey communications, liaison and planning to avoid fishing activity • Continuing communications throughout the program • FLOs • SPOC • Advisories and communications	• Upfront planning with Torngat Fish Producers Co-operative, FFAW, OCI, GEAC, and CAPP complete • Daily communications and weekly meetings when project commences • Contract in place • Contract in place • Planned upon commencement

VEC, Potential Effects	Primary Mitigations	Status (26 June 2019)
	• VMS data • Avoidance of actively fished areas • Start-up meetings on ships that discuss fishing activity and communication protocol with fishers	• Planned upon commencement • Confirmed • To be addressed as part of survey start-up meeting
Fisheries VEC: Fishing gear damage	• Pre-survey communications, liaison and planning to avoid fishing gear • Use of escort vessel • SPOC • Advisories and communications • FLOs • Compensation program • Reporting and documentation • Start-up meetings on ships that discuss fishing activity, communication protocol with fishers, and protocol in the event of fishing gear damage	• Upfront planning with Torngat Fish Producers Co-operative, FFAW, OCI, GEAC, and CAPP complete • Contracts in place • Contract in place • Planned upon commencement • Contract in place • In place • Upon commencement of program • To be addressed as part of survey start-up meeting
Interference with shipping [a]	• Advisories and at-sea communications • FLOs (fishing vessels) • Use of escort vessel • SPOC (fishing vessels) • VMS data	• Planned upon commencement • Contract in place • Contracts in place • Contract in place • Planned upon commencement
Fisheries VEC: Interference with DFO/FFAW research program and Torngat Secretariat Snow Crab Survey	• Communications and scheduling • DFO does not indicate an official spatial and/or temporal buffer mitigation method for seismic operations in the vicinity of survey stations. MKI will work cooperatively with FFAW|Unifor, DFO, and Torngat Secretariat in an effort to avoid survey stations prior to their sampling to the best extent possible.	• Planned upon commencement • Meetings held with FFAW, DFO, and Torngat Secretariat
Fish and Fish Habitat, Marine Mammal and Sea Turtle, and Marine-associated Bird VECs: Temporary or permanent hearing damage/disturbance to marine animals (marine mammals, sea turtles, seabirds, fish, invertebrates)	• "Pre-watch" (30 minute) of 500 m safety zone using visual and PAM • Delay start-up if any marine mammals or sea turtles are detected within 500 m with visual and PAM • Ramp-up of airguns • Use of experienced, qualified MMO(s) to monitor for marine mammals and sea turtles during all daylight periods when airguns are in use • Minimum separation distance of 30 km for simultaneous seismic surveys in the Project Area based on separation distances required in other jurisdictions (i.e., Gulf of Mexico [G. Morrow, Senior Contract Manager, PGS, pers. comm., June 2017] and Greenland [LGL 2012]).	• Confirmed • Confirmed • Confirmed • Confirmed • Confirmed
Species at Risk and Sensitive Areas VEC: Temporary or permanent hearing damage/ disturbance to Species at Risk or other key habitats	• "Pre-watch" (30 minute) of 500 m safety zone using visual and PAM • Delay start-up if any marine mammals or sea turtles are detected within 500 m with visual and PAM • Ramp-up of airguns • Shutdown of airgun arrays for endangered or threatened marine mammals and sea turtles, as well as beaked whales, detected visually or acoustically within 500 m • Use of experienced, qualified MMO(s) to monitor for marine mammals and sea turtles during daylight seismic operations. • PAM will be used during pre-watch and during periods when visibility is <500 m in order to detect cetacean vocalizations • Minimum separation distance of 30 km for simultaneous seismic surveys in the Project Area based on separation distances required in other jurisdictions (see above).	• Confirmed • Confirmed • Confirmed • Confirmed • Confirmed • Confirmed • Confirmed
Marine-associated	• Daily search of seismic and support vessels	• Confirmed

VEC, Potential Effects	Primary Mitigations	Status (26 June 2019)
Bird VEC: Injury (mortality) to stranded seabirds	• Implementation of handling and release protocols • Minimize lighting if safe	• Confirmed • Confirmed
Marine-associated Bird VEC: Seabird oiling	• Adherence to MARPOL • Adherence to conditions of ECCC-CWS migratory bird permit • Spill contingency and response plans • Use of solid streamers	• Confirmed • Confirmed • Confirmed • Confirmed

Note:
[a] MKI has contacted Maritime Forces Atlantic (MARLANT) to obtain Director General Naval Strategic Readiness (DGNSR) details to ensure de-confliction with possible Allied submarine activities.

6.2 Fish and Fish Habitat

Recent publications relevant to the effects of airgun sound on the Fish and Fish Habitat VEC have become available since the original EA; these studies, all of which pertain to invertebrates, are summarized below.

In a recent study, McCauley et al. (2017) conducted an experiment whereby they exposed zooplankton off the coast (shallow water) of Tasmania to a 150 in^3 airgun source. Observations from the study indicate that seismic surveys may have a greater effect on zooplankton communities than previously understood. Treatment samples of zooplankton exposed to the airgun exhibited an increase of two to three-fold mortality versus the control group and impacts on zooplankton were observed as far as 1.2 km away from the airgun source. The sample size and number of replications was relatively small however since the study occurred over just two days, therefore additional sampling is required in order to determine the full extent of the impact that airgun sound has on zooplankton mortality.

A companion study completed by Richardson et al. (2017) attempted to model the impact of an airgun survey on zooplankton over a larger temporal and spatial scale than what was originally considered by McCauley et al. (2017). In total, the modeled survey area was 80 km × 36 km, with a water depth range of 300–800 m. Airgun impact was considered for a 35-day period. Modeling results indicate that significant impacts to zooplankton would most likely occur only at a local scale (i.e., within the 2.5 km linear survey area), with less of an impact on a larger spatial scale, contradictory to results obtained by McCauley et al. (2017). Richardson et al. (2017) attributes potential avoidance behaviour of the zooplankton as a possible reason why McCauley et al. (2017) observed such a marked decrease in zooplankton abundance during their study.

Of note, the U.S. Bureau of Ocean Energy Management (BOEM) are planning a follow-up study of the effects of seismic sound on zooplankton; the study is planned in deeper waters offshore the U.S. east coast or in the Gulf of Mexico (see https://www.boem.gov/FY-2019-2021-SDP/).

Other recent studies of invertebrates and seismic sound are summarized below.

Morris et al. (2018) conducted a two-year (2015–2016) Before-After-Control-Impact (BACI) study examining the effects of 2D seismic exploration on catch rates of snow crab (*Chionoecetes opilio*) along the eastern continental slope of the Grand Banks of Newfoundland. The airgun array used during both years of the study was operated from a commercial seismic exploration vessel. Overall, the findings of the study indicated that the sound from the commercial seismic survey did not significantly reduce snow crab catch rates in the short term (i.e., days) or longer term (i.e., weeks) in which the study took place. For this particular study, the experimenters attribute the natural temporal and spatial variations in the marine environment as a greater influence on observed differences of catch rates of snow crab between control and experimental sites.

Fitzgibbon et al. (2017) examined the impact of airgun sound exposure on spiny lobster through a companion study to studies by Day et al. (2016a,b, 2017). The same study site, experimental treatment methodologies, and airgun exposures were used for the lobsters in Fitzgibbon et al. (2017) as in Day et al. (2016a,b, 2017). The objectives of the study were to examine the haemolymph biochemistry and nutritional condition of groups of lobsters over a period of up to 365 days post airgun exposure. Overall, no mortalities were observed across both the experimental and control groups, however lobster total haemocyte count was determined to have decreased by 23% to 60% for all lobster groups up to 120 days post airgun exposure in the experimental group when compared to the control group. A lower haemocyte count increases the risk of disease through a lower immunological response. Also, the only other haemolyph parameter that was determined to have been significantly affected by airgun exposure was the Brix index of haemolymph at 120 and 365 days post exposure in just one of the experiments involving egg-laden females.

In summary, the new literature presented above does not change the effects assessment for the Fish and Fish Habitat VEC presented in the original EA (LGL 2018).

6.3 Marine-Associated Birds

Recent publications relevant to the effects of airgun sound and oiling on marine-associated birds have become available since the original EA; these studies are summarized below.

6.3.1 Sound

Hearing sensitivity has only recently been measured in seabirds. Crowell (2016) measured in-air auditory brainstem response in seabird species that included Long-tailed Duck, Lesser Scaup, Red-throated Loon, and Northern Gannet. This study found that hearing sensitivity of these species is greatest between 1,500 and 3,000 Hz. Underwater hearing thresholds in Great Cormorant are similar to seals and toothed whales in the 1–4 kHz frequency range (Anderson Hansen et al. 2016; Johansen et al. 2016). Great Cormorants also respond to underwater sounds and may have special adaptations for hearing underwater (Johansen et al. 2016; Anderson Hansen et al. 2017). A recent five-year study (2009–2013) using GPS tracking reported avoidance of a 2D seismic survey by African Penguins (*Spheniscus demersus*) when foraging close to their breeding colonies which were located less than 100 km from the seismic survey (Pichegru et al. 2017). The airgun array had a total volume of 4230 in^3 and nominally operated at 2000 psi during an approximate one-month period in 2013. The authors stated that it was unknown if the penguins (flightless birds which on average dive to depths of 30 m) were responding directly to airgun sound or to potential changes in the distribution of their prey. The birds reverted to normal behaviour when the seismic operation ceased. These new studies do not present findings that would change the conclusions of the original effects assessment.

6.3.2 Accidental Releases

There have been several new publications on the effects of oiling on marine birds since the original EA; the findings of these new studies confirm those from previous studies. Oiling of marine birds increases their thermoregulatory demands. Experimentally oiled Double-crested Cormorants (*Phalacrocorax auritus*) have significant decreases in surface body temperature and a predicted 13–18% increase in daily energetic demands that is consistent with an observed increase in food consumption (Mathewson et al. 2018). Oil ingested by marine birds through diet and through preening has been documented to cause oxidative injury to cytoplasmic hemoglobin (anemia) causing fatigue and reduction in energy available for metabolism in six species of marine birds, and results consistent with hemolytic anemia were found in a seventh species (Bursian et al. 2017a; Dean et al. 2017; Harr et al. 2017c; Horak et al. 2017; Maggini et al. 2017c; Pritsos et al. 2017; Fallon et al. 2018). These effects have the potential to reduce survival and fitness. Species-specific differences were found in this effect, potentially due to physiology, foraging strategies, habitat preferences, and behaviour (Fallon et al. 2018). This hemolytic anemia can have its greatest effects during migration, when metabolic oxygen requirements are very high (Bursian et al. 2017b). Increases in liver and kidney weights have been found in two species (Harr et al. 2017a; Horak et al. 2017). Lesions in kidney, liver, heart, and thyroid gland were found in one species (Harr et al. 2017a). Impaired heart function has also been noted in one species of marine bird (Harr et al. 2017b). In addition, experimentally applying a light oiling to the plumage of a marine bird reduces takeoff speed by 30% and increases flight energy cost by 20–45% (Maggini et al. 2017a,b).

These newly published studies do not change the conclusions of the effects assessment. The potential of accidental releases of hydrocarbons during the proposed seismic program is considered quite low and the evaporation/dispersion rate of any released hydrocarbons would be high.

6.4 Marine Mammals and Sea Turtles

Recent publications relevant to the effects of airgun sound on marine mammals have become available since the original EA including publications on masking, disturbance, hearing impairment, and noise exposure criteria. These studies are summarized below.

6.4.1 Masking

Sound, through masking, can reduce the effective communication distance of a marine mammal if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant fraction of time (e.g., Erbe et al. 2016; Jones et al. 2017). In addition to the frequency and duration of the masking sound, the strength, temporal pattern, and location of the introduced sound also play a role in the extent of the masking (e.g., Branstetter et al. 2016; Sills et al. 2017). Sills et al. (2017) reported that recorded airguns sounds at 1 km from the source may have masked the detection of low-frequency sounds by ringed and spotted seals completely at the onset of the airgun pulse when signal amplitude is variable (e.g., initial 200 ms).

In order to compensate for increased ambient sound, some cetaceans are known to increase the source levels of their calls in the presence of elevated noise levels from shipping, shift their peak frequencies, or otherwise change their vocal behaviour (e.g., Gridley et al. 2016; Tenessen and Parks 2016). Similarly, harbour seals increased the minimum frequency and amplitude of their calls in response to vessel sound (Matthews 2017). Several studies have shown that some marine mammals (e.g., bottlenose dolphins, false killer whales) can decrease their hearing sensitivity in order to mitigate the impacts of exposure to loud sounds (e.g., Nachtigall and Supin 2016; Nachtigall et al. 2018).

6.4.2 Disturbance

A ramp up was not superior to triggering humpbacks to move away from the vessel compared with a constant source at a higher level of 140 in^3, although an increase in distance from the airgun array was noted for both sources (Dunlop et al. 2016a). Avoidance was also shown when no airguns were operational, indicating that the presence of the vessel itself had an effect on the response (Dunlop et al. 2016a,b). Humpbacks were more likely to avoid active airgun arrays of 20 in^3 and 140 in^3 within 3 km and at received levels of at least 140 dB re 1 $\mu Pa^2 \cdot s$ (Dunlop et al. 2017a). Responses to ramp up and use of a 3130 in^3 array elicited greater behavioural changes in humpbacks when compared with small arrays (Dunlop et al. 2016c). Humpbacks reduced their southbound migration, or deviated from their path thereby avoiding the active array, when they were within 4 km of the active large airgun source, where received levels were >130 dB re 1 $\mu Pa^2 \cdot s$ (Dunlop et al. 2017b, 2018). However, some individuals did not show avoidance behaviours even at levels as high as 160–170 dB re 1 $\mu Pa^2 \cdot s$ (Dunlop et al. 2018).

Preliminary analysis of data collected on gray whales during a seismic program in 2015 showed some displacement of animals from the nearshore feeding area and responses to lower sound levels than expected (Gailey et al. 2017; Sychenko et al. 2017). Van Beest et al. (2018) exposed five harbour porpoise to a single 10 in^3 airgun for one minute at 2–3 s intervals at ranges of 420–690 m and levels of 135–147 dB $\mu Pa^2 \cdot s$. One porpoise moved away from the sound source but returned to natural movement patters within 8 h, and two porpoises had shorter and shallower dives but returned to natural behaviours within 24 h.

In 2017, MKI conducted a 2D seismic survey in southern Labrador and a marine mammal monitoring program was implemented for the duration of the survey which occurred from 12 July to 5 September. MMOs conducted ~747 h of visual watches: ~645 h when the airguns were active and ~102 hours when the airguns were inactive (EPI 2017). There were 74 marine mammal visual detections totaling 312 individuals. Visual detections of marine mammals included: long-finned pilot whales, sperm whales, sei whales, fin whales, northern bottlenose whales, humpback whales, minke whales, white-beaked dolphins, unidentified baleen whale, unidentified whale, and unidentified delphinids. The most commonly sighted species was long-finned pilot whales (20 sightings of 181 whales). Marine mammals were more frequently sighted when the airgun array was operated at full volume and were often observed within a kilometer of the active airgun array. One ramp up delay was implemented for a white-beaked dolphin that was detected 400 m from the array (EPI 2017).

McGeady et al. (2016) analyzed stranding data and found that the number of long-finned pilot whale stranding along Ireland's coast increased with seismic surveys operating offshore. Bottlenose dolphins exposed to multiple airgun pulses exhibited some anticipatory behaviour (Schlundt et al. 2016). Using a population consequences of disturbance (PCoD) framework, Farmer et al. (2018) suggested that changes in foraging behaviour associated with exposure to airgun sounds could have significant consequences on individual fitness. Pirotta et al. (2018) used a dynamic state model of behaviour and physiology to assess the consequences of disturbance (e.g., seismic surveys) on whales (in this case, blue whales). They found that the impact of localized, acute disturbance (e.g., seismic surveys) depended on the whale's behavioural response, with whales that remained in the affected area having a greater risk of reduced reproductive success than whales that avoided the disturbance. Chronic, but weaker disturbance (e.g., vessel traffic) appeared to have less effect on reproductive success. As behavioural responses are not consistently associated with received levels, some authors have made recommendations on different approaches to assess behavioural reactions (e.g., Gomez et al. 2016; Harris et al. 2017).

6.4.3 Hearing Impairment

Research has shown that sound exposure can cause cochlear neural degeneration, even when threshold shifts and hair cell damage are reversible (Liberman et al. 2016). These findings have raised some doubts as to whether temporary threshold shift (TTS) should continue to be considered a non-injurious effect (Tougaard et al. 2016). However, Morell et al. (2017)

examined the inner ears of long-finned pilot whales after a mass stranding in Scotland and reported damage to the cochlea compatible with over-exposure from underwater sound, but no specific sound-producing activity could be linked to the stranding.

Kastelein et al. (2017) reported that exposure to multiple pulses with most sound energy at low frequencies can lead to TTS at higher frequencies in some cetaceans, such as the harbour porpoise. When a porpoise was exposed to 10 and 20 consecutive shots (mean shot interval ~17 s) from two airguns with a SEL_{cum} of 188 and 191 $\mu Pa^2 \cdot s$, respectively, significant TTS occurred at a hearing frequency of 4 kHz and not at lower hearing frequencies that were tested, despite the fact that most of the airgun energy was <1 kHz; recovery occurred within 12 min post exposure (Kastelein et al. 2017).

Simulation modeling to assess the risk of sound exposure to marine mammals (gray seal and harbour porpoise) showed that sound exposure level (SEL) is most strongly influenced by weighting functions (Donovan et al. 2017). Houser et al. (2017), NMFS (2018), Tougaard and Beedholm (2019), and Southall et al. (2019) provide reviews of the development and application of auditory weighting functions, as well as recommendations for future work.

6.4.4 Noise-exposure Criteria

In 2016, NMFS released new guidance for assessing the effects of anthropogenic sound on marine mammals (NMFS 2016), taking some recommendations for science-based noise exposure criteria from Southall et al. (2007) into account. In 2018, NMFS released a revision to the technical guidance, which took into account comments from the public, regulators, and subject matter expects (NMFS 2018). NMFS did not make any changes to the dual criteria for impulsive sounds as set forth in the original Technical Guidance (which were included in the original MKI EA [LGL 2018]), but additional scientific studies were considered and revisions to improve the implementation of the Guidance were made. Since then, Southall et al. (2019) provided updated scientific recommendations regarding noise exposure criteria. These are similar to those presented by NMFS (2016, 2018), but include all marine mammals (including sirenians), a re-classification of hearing groups, and revised noise exposure criteria and auditory weighting functions. The previous high-frequency hearing group (e.g., porpoises, *Cephalorhynchus* spp., and *Kogia* spp.) is now considered to be very high-frequency cetaceans; mid-frequency cetaceans are now referred to as high-frequency cetaceans; the pinnipeds have been split into phocid carnivores (in water and in air), and other marine carnivores (in water and in air).

In summary, the new literature presented above does not change the effects assessment for the Marine Mammal and Sea Turtle VEC presented in the original EA (LGL 2018).

6.5 Validity of Significance Determinations

Based on MKI's planned survey activities in 2019 and the new information related to the biological environment and effects literature, the determinations of significance of the residual effects of seismic survey activities on VECs presented in the EA (LGL 2018) and its Addendum (LGL 2019) remain valid for the seismic survey activities planned by MKI in 2019. This includes consideration of cumulative effects; see below.

6.5.1 Cumulative Effects

Section 5.8 of the original EA (LGL 2018) provides an assessment of cumulative effects from other activities in the Regional Area including fisheries, vessel traffic, and other oil and gas exploration and development activities. Additional information and information specific to 2019 activities are summarized below followed by an assessment that considers the combined effects of offshore activities.

6.5.1.1 Fisheries

Fishing activity (commercial, traditional and Indigenous, and recreational) in the Project Area has been summarized in this EA Update and includes the most recent commercial fisheries data (from 2017) available. In 2019, it is anticipated that the commercial harvest species, and the timing and locations of commercial fisheries within the Study Area will be similar to previous years. This has also been confirmed during consultations with the fishing industry.

6.5.1.2 Vessel Traffic

Shipping activity in the Project Area occurs primarily during the ice-free months, typically June–November. Seasonal marine traffic consists of local transport and coastal ferries to/from Labrador ports, oil tanker and sea-lift cargo supply vessels servicing the eastern Canadian Arctic, bulk carrier transits to/from Voisey's Bay, fishing vessels, ecotourism cruise ships, and seismic vessels. Year-round marine traffic through the Labrador Sea is mainly comprised of offshore commercial factory-freezer trawlers and freighters transiting between Greenland and eastern North American ports, and shipping of concentrated ore from mining operations in Voisey's Bay (C-NLOPB 2008). Data obtained from Canadian Coast Guard, Marine Traffic and Communication Services, identified 624 and 608 vessel trips through the Labrador SEA area in 2006 and 2007, respectively. Information from the Coast Guard was provided with caveats however, in that it only recorded activities of vessels of 500 gross tonnage or greater, and of these, it could not provide a complete listing of vessels that travelled non-stop through the Labrador SEA area (C-NLOPB 2008).

More accurate assessments of regional marine traffic have been facilitated by the ubiquitous use of AIS transponders by vessels and technological advances in data storage, processing capabilities and online commercial service providers over the past decade. Figures 6.1 and 6.2 show cumulative marine traffic density that transited through the Project Area for calendar years 2016 and 2017, respectively. Source data to generate maritime routes for all vessel traffic was obtained from marine AIS tracking information archived and processed by marinetraffic.com. Publicly available density maps are color-coded to indicate concentrated maritime activity/traffic routes. Online visualizations are dynamic and based on unique vessel transits through a variable grid-cell size based on chosen zoom-level of a worldwide interactive map. Figures 6.1 and 6.2 are presented with similar scale for ease of comparison; vessel routes ranging from 1 to >800 per 23 km^2 grid-cell.

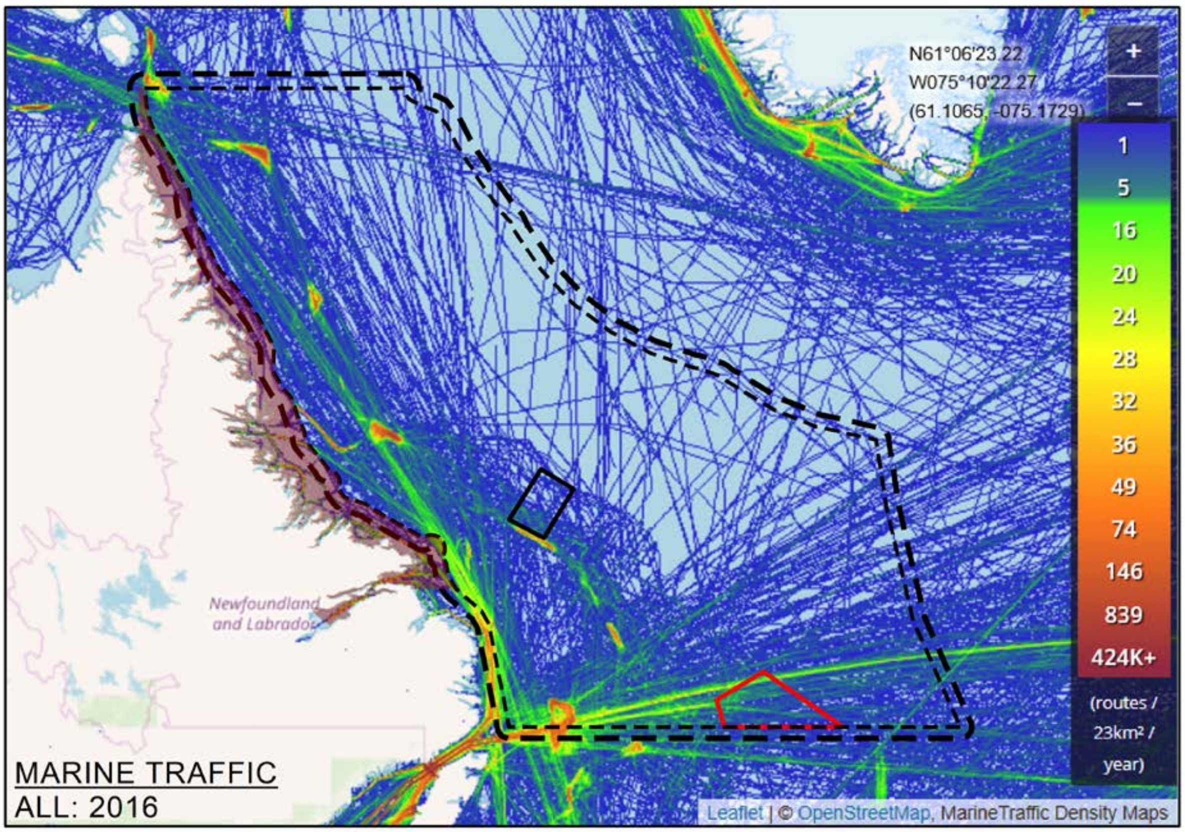


FIGURE 6.1. Marine shipping traffic density (routes per 23 km^2 grid cell) in 2016 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2019 2D and 3D Survey Areas.

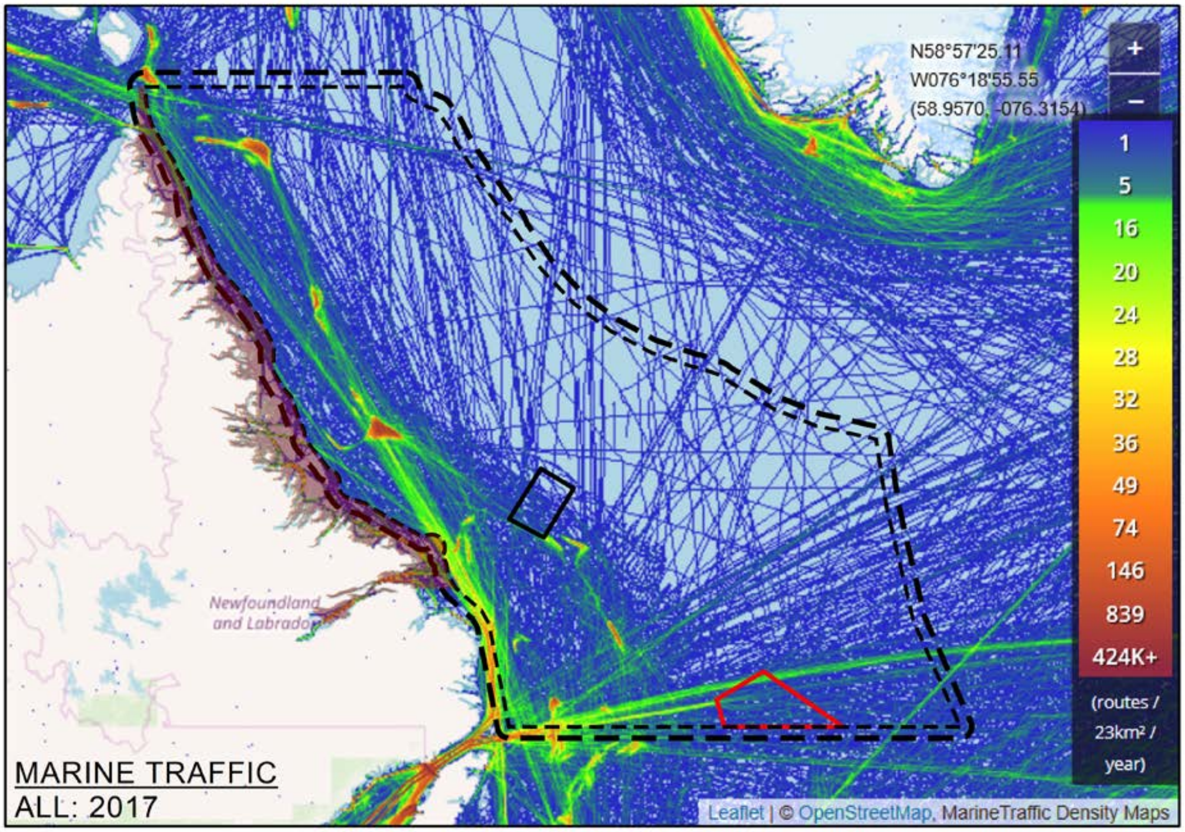


FIGURE 6.2. Marine shipping traffic density (routes per 23 km² grid cell) in 2017 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2019 2D and 3D Survey Areas.

Within the MKI Labrador offshore Project Area, marine traffic density is concentrated in the southwestern corner at the confluence of marine routes between the Strait of Belle Isle and the eastern coastline of the Great Northern Peninsula of Newfoundland. Localized concentrations (orange/red clusters; >40 vessel routes per 23 km^2 grid-cell) adhere strongly to commercial catch (0.1 x 0.1 decimal degree) grid data for both 2016 and 2017. Specifically, northern shrimp catch effort at depths between 200 and 500 m in the northern half (i.e., NAFO divisions 2H, 2G, 2G/0B) and southwest corner (2J) of the Project Area; Greenland halibut fishery along the Labrador Shelf (2J); and snow crab fishery locations at the southwestern extent of the Project Area (2J). Overall, shipping traffic levels through the Project Area are considered low, particularly in areas distant from coastal shipping routes. Shipping data from 2016 and 2017 confirm the conclusions made in the Labrador SEA (C-NLOPB 2008). Behavioural responses to periodic ship transits by marine mammals are expected to be short-term and localized. MKI (as well as other seismic operators) take steps to avoid close approach to other vessels. As such, while some animals may receive sound from a seismic program(s) and other vessels offshore Labrador, the current prediction is that no significant residual cumulative effects will result from exposure to underwater sound.

6.5.1.3 Oil and Gas Activities

In 2019, MKI is planning to simultaneously conduct two 3D seismic surveys and one 2D seismic survey offshore NL during the late-May–September period (Figure 6.3). Although there are three 2D survey areas, these surveys are being conducted by one vessel (i.e., M/V *Sanco Atlantic*). The timing of the planned MKI surveys is shown in Table 6.2 including those planned for Labrador (Torngat 3D survey area and northern portion of Orphan Basin 2D survey area). Note that it is uncertain at this stage if the Harbour Deep SE Ext. 3D survey area will be surveyed in 2019. If surveying does occur there, it will not occur at the same time as surveying in the Jeanne d'Arc HD3D survey area. Likewise, simultaneous seismic surveying will not occur in the Orphan Basin 2D survey area and the North Tablelands 3D survey area. In 2019, the minimum separation distance between MKI survey areas that will be surveyed concurrently is ~100 km (i.e., the minimum separation distance between Jeanne d'Arc HD3D and Grand Banks SE 2D survey area). However, in most situations, concurrent seismic surveying would be separated by ~260–400 km (Figure 6.3). Based on a review of the C-NLOPB website, it is understood that GX Technology Canada (GXT) is undertaking a 2D BasinSPAN™ survey in 2019. GXT started its seismic program in early-June and its survey lines (long, very widely spaced) are planned within the GrandSPAN Project Area, which is south of MKI's Labrador Project Area (see https://www.nlspan.com/). A total of approximately 11,500 km GXT survey lines were approved for 2019, with about 5,000 km of this outside Canada's 200-mile EEZ. There should be no overlap of MKI survey activities with GXT in the Labrador Project Area. Regardless, MKI commits to communicating closely with GXT to ensure appropriate spatial separation between surveys as required.

As discussed in the original EA, in addition to seismic survey activity, there are four existing offshore production developments (Hibernia, Terra Nova, White Rose, and Hebron) on the northeastern Grand Banks. The existing developments fall inside of the boundaries of MKI's Jeanne d'Arc HD3D survey area. Underwater sound generated from production installations and attending support vessels have lower source levels and are continuous in nature versus those produced during seismic surveys. MKI will avoid close approach to production developments and any exploratory drilling activities which may occur in its planned survey areas (and other areas of the Project Area) unless appropriate simultaneous operations (SIMOPS) plans are in place. MKI commits to communicating closely with production and exploratory drilling operators to ensure appropriate spatial separation of activities.

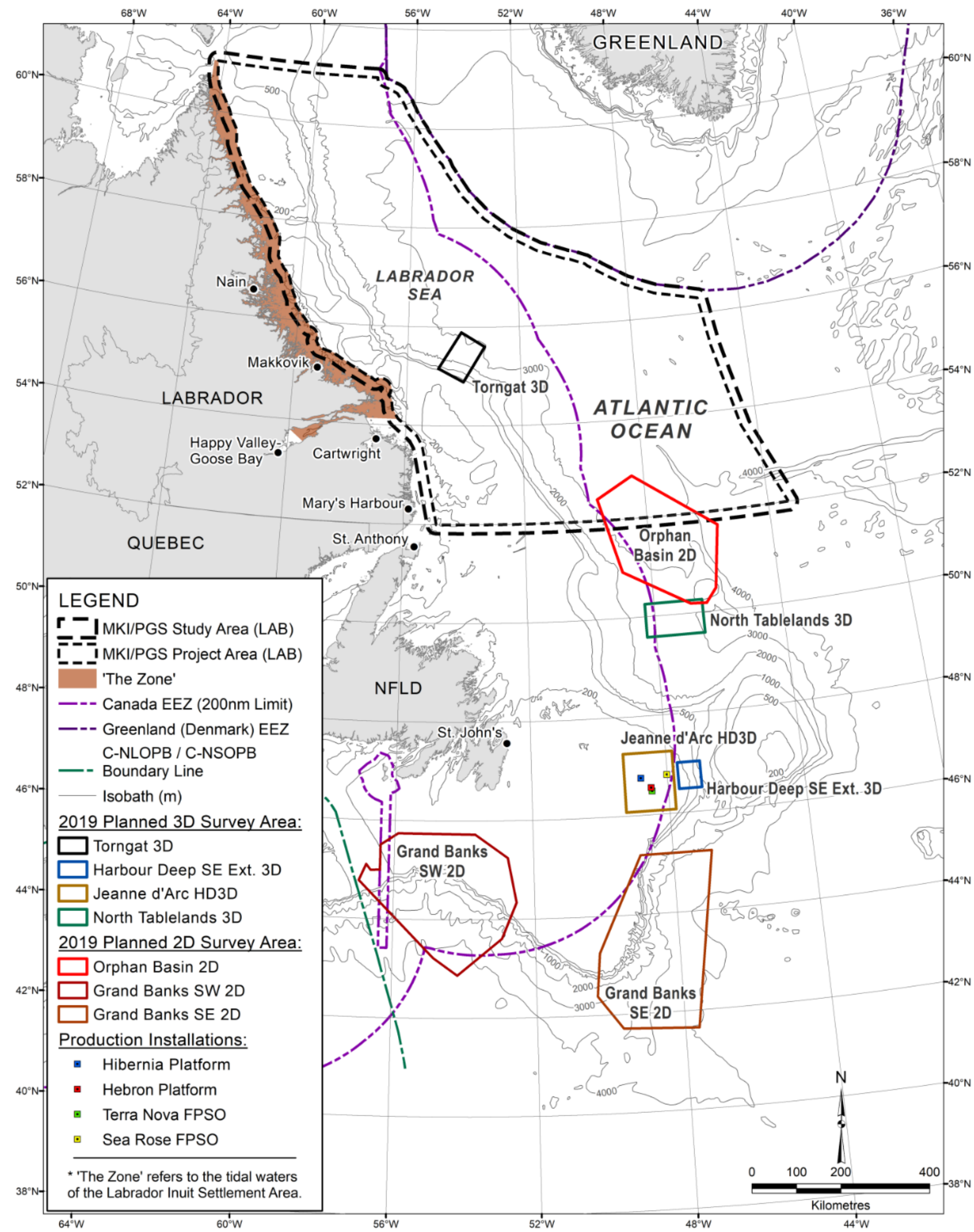


FIGURE 6.3. Locations of MKI's planned 3D and 2D seismic survey areas in 2019. Also shown are the production installations on the Grand Banks.

TABLE 6.2. Timing of MKI's planned 3D and 2D seismic surveys in 2019.

	May (week)		June (week)				July (week)				Aug (week)				Sep (week)			
3D Survey Area	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
North Tablelands																		
Torngat 3D																		
Jeanne d'Arc HD3D																		
Harbour Deep SE Ext.																?	?	?
	May (week)		June (week)				July (week)				Aug (week)				Sep (week)			
2D Survey Area	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2D Southwest																		
2D Southeast																		
2D Orphan Basin																		

6.5.1.4 Consideration of Combined Activities

The primary concern associated with seismic surveys in combination with other projects or activities in the Study Area is the effects of underwater sound on VECs. As discussed in §5.7 and §5.8 of LGL (2018), the cumulative effects of airgun sound from simultaneous seismic surveys on fish and fish habitat, fisheries, seabirds, marine mammals, sea turtles, species at risk and sensitive areas are predicted to be not significant. However, there are uncertainties regarding these predictions, particularly including the effects of masking and disturbance on marine mammals, and the effects of disturbance on marine invertebrates and fishes from sound produced during multiple seismic surveys. Note that possible disturbance effects on marine invertebrates and fishes might not only impact key life history components but also commercial fisheries and science surveys. However, disturbance effects on fisheries are more readily mitigated primarily through communication and temporal and spatial avoidance of seismic surveys from fishing activity. The uncertainties with the effects of underwater sound increase with the number of seismic surveys and additional sources of underwater sound in the area (e.g., commercial shipping, fishing vessels, oil developments, and exploratory drilling). Sound from vessels and sound associated with offshore production and drilling are generally continuous (vs. pulsed sound from airguns) and at much lower sound levels. There is little potential for hearing impairment or physical effects on VECs associated with underwater sound from vessels and offshore oil production. Any avoidance of vessels and offshore oil developments by VECs, including species at risk, is likely to be localized and temporary (e.g., see §5.7 of the EA; LGL 2018).

As discussed in the EA for this Project, negative effects (auditory, physical, and behavioural) on key sensitive VECs, such as marine mammals, appear unlikely beyond a localized area from the sound source. In addition, all seismic programs will use mitigation measures such as ramp-ups, delayed startups, and shut-downs of the airgun arrays as well as spatial separation between concurrent seismic surveys (in 2019, a minimum separation distance of 100 km between MKI survey areas). Seismic programs and other ocean users (commercial shipping, fishing, oil developments) will have to maintain an appropriate separation distance for safe operations. Marine mammal response (including species at risk) to commercial shipping noise is expected to be localized and temporary especially for vessels maintaining a constant course and speed, which is typical for transiting commercial vessels. Marine invertebrate and fish response to commercial shipping noise is also expected to be localized and temporary, especially given the much lower sound levels associated with commercial shipping. Thus, it seems likely that while some animals may receive sound from multiple seismic programs, other vessels, oil developments, and exploratory drilling in the Study Area, the current prediction is that no significant residual effects will result from exposure to underwater sound. The level of confidence associated with this prediction is rated as low to medium given the scientific data gaps.

7.0 Concluding Statement

The 2D and 3D seismic survey activities proposed by MKI for 2019 have been reviewed and determined to be within the scope of the EA (LGL 2018) and its Addendum (LGL 2019). The original EA assessed the potential effects of three 3D surveys and one 2D survey occurring simultaneously in a given year (i.e., during May–November 2018–2023). However, the 2019 seismic program includes one 3D survey and one 2D survey.

The environmental effects predicted in the EA and its associated Addendum remain valid. MKI reaffirms its commitment to implement the mitigation measures proposed in these assessment documents.

8.0 References

Anderson Hansen, K., O. N. Larsen, M. Wahlberg, and U. Siebert. 2016. Underwater hearing in the great cormorant (*Phalacrocorax carbo sinensis*): Methodological considerations. Proceedings of Meetings on Acoustics 27:010015.

Anderson Hansen, K., A. Maxwell, U. Siebert, O. N. Larsen, and M. Wahlberg. 2017. Great cormorants (*Phalacrocorax carbo*) can detect auditory cues while diving. The Science of Nature 104:45.

Branstetter, B.K., K.L. Bakhtiari, J.S. Trickey, and J.J. Finneran. 2016. Hearing mechanisms and noise metrics related to auditory masking in bottlenose dolphins (*Tursiops truncatus*). p. 109-116 *In:* A.N. Popper and A. Hawkins (eds.), The Effects of Noise on Aquatic Life II. Springer, New York, NY. 1292 p.

Bursian, S. J., K. M. Dean, K. E. Harr, L. Kennedy, J. E. Link, I. Maggini, C. Pritsos, K. L. Pritsos, R. E. Schmidt, and C. G. Guglielmo. 2017a. Effect of oral exposure to artificially weathered Deepwater Horizon crude oil on blood chemistries, hepatic antioxidant enzyme activities, organ weights and histopathology in western sandpipers (*Calidris mauri*). Ecotoxicology and Environmental Safety 146:91-97.

Bursian, S. J., C. R. Alexander, D. Cacela, F. L. Cunningham, K. M. Dean, B. S. Dorr, C. K. Ellis, C. A. Godard-Codding, C. G. Guglielmo, K. C. Hanson-Dorr, K. E. Harr, K. A. Healy, M. J. Hooper, K. E. Horak, J. P. Isanhart, L. V. Kennedy, J. E. Link, I. Maggini, J. K. Moye, C. R. Perez, C. A. Pritsos, S. A. Shriner, K. A. Trust, and P. L. Tuttle. 2017b. Reprint of: Overview of avian toxicity studies for the Deepwater Horizon Natural Resource Damage Assessment. Ecotoxicology and Environmental Safety 146:4-10.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2008. Labrador Shelf Offshore Area Strategic Environmental Assessment. Report by Sikumiut Environmental Management Ltd., St. John's, NL for the C-NLOPB, St. John's, NL. 519 p. + appendices.

C-NLOPB. 2018. Geophysical, Geological, Environmental and Geotechnical Program Guidelines, October 2018. 56 p + appendices.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2009. COSEWIC assessment and status report on the Eskimo Curlew *Numenius borealis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 32 p.

COSWEIC. 2010. COSEWIC assessment and status report on the Deepwater Redfish/ Acadian Redfish complex *Sebastes mentella* and *Sebastes fasciatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa x + 80 pp.

COSEWIC. 2011. COSEWIC assessment and status report on the Atlantic Sturgeon *Acipenser oxyrinchus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii + 49 p.

COSEWIC. 2014. COSEWIC assessment and status report on the Red-necked Phalarope *Phalaropus lobatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 52 p.

Crowell, S. C. 2016. Measuring in-air and underwater hearing in seabirds. Advances in Experimental Medicine and Biology 875:1155-1160.

Day, R.D., R.D. McCauley, Q.P. Fitzgibbon, and J.M. Semmens. 2016a. Seismic air gun exposure during early-stage embryonic development does not negatively affect spiny lobster *Jasus edwardsii* larvae (Decapoda: Palinuridae). Sci. Rep. 6, 22723.

Day, R.D., R.D. McCauley, Q.P. Fitzgibbon, K. Hartmann and J.M. Semmens. 2016b. Assessing the impact of marine seismic surveys on southeast Australian scallop and lobster fisheries. Fisheries Research & Development Corporation (FRDC). FRDC Project No 2012/008. 144 p.

Day, R.D., R.D. McCauley, Q.P. Fitzgibbon, K. Hartmann, and J.M. Semmens. 2017. Exposure to seismic air gun signals causes physiological harm and alters behavior in the scallop *Pecten fumatus*. P. NATL. ACAD. SCI. USA. 114(40) 8537-8546.

Dean, K. M., S. J. Bursian, D. Cacela, M. W. Carney, F. L. Cunningham, B. Dorr, K. C. Hanson-Dorr, K. A. Healy, K. E. Horak, J. E. Link, I. Lipton, A. K. McFadden, M. A. McKernan, and K. E. Harr. 2017. Changes in white cell estimates and plasma chemistry measurements following oral or external dosing of double-crested cormorants, *Phalacrocorax auritus*, with artificially weathered MC252 oil. Ecotoxicology and Environmental Safety 146:40-51.

Delarue, J., K.A. Kowarski, E.E. Maxner, J.T. MacDonnell, and S.B. Martin. 2018. Acoustic monitoring along Canada's East Coast: August 2015 to July 2017. Document Number 01279, Environmental Studies Research Funds Report Number 215, Version 1.0. Technical Report by JASCO Applied Sciences for Environmental Studies Research Fund, Dartmouth, NS, Canada. 120 p. + appendices.

DFO. 2016a. Recovery potential assessment for white hake (*Urophycis tenuis*) of the Atlantic and Northern Gulf of St. Lawrence. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/035.

DFO. 2016b. Recovery strategy for the leatherback sea turtle (*Dermochelys coriacea*) in Atlantic Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. vii + 43 p.

DFO. 2017. An assessment of northern shrimp (*Pandalus borealis*) in shrimp fishing areas 4-6 and of striped shrimp (*Pandalus montagui*) in shrimp fishing area 4 in 2016. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/012.

DFO. 2018a. Assessment of Newfoundland and Labrador (Divisions 2HJ3KLNOP4R) Snow Crab. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/024.

DFO. 2018b. Stock status update of Atlantic halibut (*Hippoglossus hippoglossus*) on the Scotian Shelf and Southern Grand Banks in NAFO Divisions 3NOPs4VWX5Zc. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/022.

DFO. 2018c. Assessment of capelin in SA2 and Devs. 3KL in 2017. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/030.

DFO. 2018d. Stock assessment of Northern cod (NAFO Divisions 2J3KL) in 2018. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/038.

DFO. 2018e. Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada [proposed]. Fisheries and Oceans Canada, Ottawa. vii + 82 p.

DFO. 2018f. Action plan for the blue whale (*Balaenoptera musculus*), Northwest Atlantic population, in Canada. Species at Risk Act Management Plan Series, DFO, Ottawa. iv + 21 p.

DFO. 2018g. Identification of habitats important to the blue whale in the western North Atlantic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/003.

DFO. 2018h. Action plan for the leatherback sea turtle (*Dermochelys coriacea*) in Atlantic Canada [Proposed]. Species at Risk Act Action Plan Series. Fisheries and Oceans Canada, Ottawa. v + 29 p.

DFO. 2018i. Action plan for the blue whale (*Balaenoptera musculus*), Northwest Atlantic population, in Canada [Proposed]. Species at Risk Act Action Plan Series. Fisheries and Oceans Canada, Ottawa. iv + 21 p.

DFO. 2018j. Action plan for the northern wolffish (*Anarhichas denticulatus*) and spotted wolffish (*Anarhichas minor*) in Canada [Proposed]. Species at Risk Act Action Plan Series. Fisheries and Oceans Canada, Ottawa. v + 23 p.

DFO. 2019a. Fisheries Management Decisions, Newfoundland and Labrador. Available at http://www.dfo-mpo.gc.ca/decisions/index-eng.htm. Accessed April 2019.

DFO. 2019b. Landings and Landed value by Species Newfoundland and Labrador Region – Preliminary Data. Available at: http://www.nfl.dfo-mpo.gc.ca/publications/reports_rapports/Land_All_Vessels_Debarquer_Tous_Les_Navires_2018_eng.htm. Accessed April 2019.

DFO. 2019c. 3Ps Groundfish Newfoundland and Labrador (2018-2019) (thorny skate and white hake). Available at http://www.dfo-mpo.gc.ca/decisions/fm-2018-gp/atl-14-eng.htm. Accessed April 2019.

DFO. 2019d. Aquatic Species at Risk – Deepwater Redfish (Northern Population). Available at http://www.dfo-mpo.gc.ca/species-especes/profiles-profils/deepwater-redfish-sebaste-northern-eng.html. Accessed April 2019.

Donovan, C.R., C.M. Harris, L. Milazzo, J. Harwood, L. Marshall, and R. Williams. 2017. A simulation approach to assessing environmental risk of sound exposure to marine mammals. Ecol. Evol.7:2101-2111.

Dunlop, R.A., M.J. Noad, R.D. McCauley, E. Kniest, R. Slade, D. Paton, and D.H. Cato. 2016a. Response of humpback whales (*Megaptera novaeangliae*) to ramp-up of a small experimental air gun array. Mar. Poll. Bull. 103:72-83.

Dunlop, R.A., M.J. Noad, and D.H. Douglas. 2016b. A spatially explicit model of the movement of humpback whales relative to a source. Proceedings of Meetings on Acoustics 4ENAL 27(1):010026. doi:10.1121/2.0000296.

Dunlop, R., M.J. Noad, R. McCauley, and D. Cato. 2016c. The behavioral response of humpback whales to seismic air gun noise. J. Acoust. Soc. Am. 140(4):3412.

Dunlop, R.A., M.J. Noad, R.D. McCauley, L. Scott-Hayward, E. Kniest, R. Slade, D. Paton, and D.H. Cato. 2017a. Determining the behavioural dose–response relationship of marine mammals to air gun noise and source proximity. J. Exp. Biol. 220:2878-2886.

Dunlop, R.A., M.J. Noad, R.D. McCauley, E. Kniest, R. Slade, D. Paton, and D.H. Cato. 2017b. The behavioural response of migrating humpback whales to a full seismic airgun array. Proc. R. Soc. B 284:20171901. http://dx.doi.org/10.1098/rspb.2017/1901.

Dunlop, R.A., M.J. Noad, R.D. McCauley, E. Kniest, R. Slade, D. Paton, and D.H. Cato. 2018. A behavioural dose-response model for migrating humpback whales and seismic air gun noise. Mar. Poll. Bull. 133:506-516.

EPI. 2017. South Labrador Sea 2D Marine Seismic Survey 2017. Marine Mammal & Seabird Observer Final Environmental Report. EPI Report No. 60003-MMO.

Erbe, C., C. Reichmuth, K. Cunningham, K. Lucke, and R. Dooling. 2016. Communication masking in marine mammals: a review and research strategy. Mar. Poll. Bull. 103(1-2):15-38.

Fallon, J. A., E. P. Smith, N. Schoch, J. D. Paruk, E. A. Adams, D. C. Evers, P. G. R. Jodice, C. Perkins, S. Schulte, and W. A. Hopkins. 2018. Hematological indices of injury to lightly oiled birds from the Deepwater Horizon oil spill. Environmental Toxicology and Chemistry 37:451-461.

Farmer, N.A., K. Baker, D.G. Zeddies, S.L. Denes, D.P. Noren, L.P. Garrison, A. Machernis. E.M. Fougères, and M. Zykov. 2018. Population consequences of disturbance by offshore oil and gas activity for endangered sperm whales (*Physeter macrocephalus*). Biol. Conserv. 227:189-204.

Fitzgibbon, Q.P., R.D. Day, R.D. McCauley, C.J. Simon, and J.M. Semmens. 2017. The impact of seismic air gun exposure on the haemolymph physiology and nutritional condition of spiny lobster, *Jasus edwardsii*. Mar. Poll. Bull. 125(1-2):146-156. doi: 10.1016/j.marpolbul.2017.08.004.

FLR (Fisheries and Land Resources). 2018. Aquaculture. Fisheries and Aquaculture, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador, Canada. Available at https://www.fishaq.gov.nl.ca/aquaculture/index.html.

Gailey, G., O. Sychenko, A. Rutenko, and R. Racca. 2017. Western gray whale behavioral response to extensive seismic surveys conducted near their feeding grounds. Abstract and presentation at the Society for Marine Mammalogy's 22nd Biennial Conference on the Biology of Marine Mammals, 22–27 October, Halifax, Nova Scotia, Canada.

Gomez, C., J.W. Lawson, A.J. Wright, A.D. Buren, D. Tollit, and V. Lesage. 2016. A systematic review on the behavioural responses of wild marine mammals to noise: the disparity between science and policy. Can. J. Zool. 94(12):801-819.

Gomez, C., J. Lawson, A.-L. Kouwenberg, H. Moors-Murphy, A. Buren, C. Fuentes-Yaco, E. Marotte, Y.F. Wiersma, and T. Wimmer. 2017. Predicted distribution of whales at risk: identifying priority areas to enhance cetacean monitoring in the Northwest Atlantic Ocean. Endang. Species Res. 32:437-458.

Gridley, T., S.H. Elwen, G. Rashley, A.B. Krakauer, and J. Heiler. 2016. Bottlenose dolphins change their whistling characteristics in relation to vessel presence, surface behavior and group composition. Proceedings of Meetings on Acoustics 4ENAL 27(1):010030. http://dx.doi.org/doi:10.1121/2.0000312.

Harr, K. E., D. R. Reavill, S. J. Bursian, D. Cacela, F. L. Cunningham, K. M. Dean, B. S. Dorr, K. C. Hanson-Dorr, K. Healy, K. Horak, J. E. Link, S. Shriner, and R. E. Schmidt. 2017a. Organ weights and histopathology of double-crested cormorants (*Phalacrocorax auritus*) dosed orally or dermally with artificially weathered Mississippi Canyon 252 crude oil. Ecotoxicology and Environmental Safety 146:52-61.

Harr, K. E., M. Rishniw, T. L. Rupp, D. Cacela, K. M. Dean, B. S. Dorr, K. C. Hanson-Dorr, K. Healy, K. Horak, J. E. Link, D. Reavill, S. J. Bursian, and F. L. Cunningham. 2017b. Dermal exposure to weathered MC252 crude oil results in echocardiographically identifiable systolic myocardial dysfunction in double-crested cormorants (*Phalacrocorax auritus*). Ecotoxicology and Environmental Safety 146:76-82.

Harr, K. E., F. L. Cunningham, C. A. Pritsos, K. L. Pritsos, T. Muthumalage, B. S. Dorr, K. E. Horak, K. C. Hanson-Dorr, K. M. Dean, D. Cacela, A. K. McFadden, J. E. Link, K. A. Healy, P. Tuttle, and S. J. Bursian. 2017c. Weathered MC252 crude oil-induced anemia and abnormal erythroid morphology in double-crested cormorants (*Phalacrocorax auritus*) with light microscopic and ultrastructural description of Heinz bodies. Ecotoxicology and Environmental Safety 146:29-39.

Harris, C.M., L. Thomas, E.A. Falcone, J. Hildebrand, D. Houser, P.H. Kvadsheim, F.-P.A. Lam, P.J.O. Miller, D.J. Moretti, A.J. Read, H. Slabbekoorn, B.L. Southall, P.L. Tyack, D. Wartzok, and V.M. Janik. 2017. Marine mammals and sonar: dose–response studies, the risk-disturbance hypothesis and the role of exposure context. J. Appl. Ecol. 55(1):396-404.

Horak, K. E., S. J. Bursian, C. K. Ellis, K. M. Dean, J. E. Link, K. C. Hanson-Dorr, F. L. Cunningham, K. E. Harr, C. A. Pritsos, K. L. Pritsos, K. A. Healy, D. Cacela, and S. A. Shriner. 2017. Toxic effects of orally ingested oil from the Deepwater Horizon spill on laughing gulls. Ecotoxicology and Environmental Safety 146:83-90.

Houser, D.S., W. Yost, R. Burkhard, J.J. Finneran, C. Reichmuth, and J. Mulsow. 2017. A review of the history, development and application of auditory weighting functions in humans and marine mammals. J. Acoust. Soc. Am. 141(1371). http://dx.doi.org/doi:10.1121/1.4976086.

Huijser, L.A.E., M. Berube, A.A. Cabrera, R. Prieto, M.A. Silva, J. Robbins, N. Kanda, L.A. Pastene, M. Goto, H. Yoshida, G.A. Vikingsson, and P.J. Palsboll. 2018. Population structure of North Atlantic and North Pacific sei whales (*Balaenoptera borealis*) inferred from mitochondrial control region DNA sequences and microsatellite genotypes. Conserv. Genetics 19:1007-1024.

Johansen, S., O. N. Larsen, J. Christensen-Dalsgaard, L. Seidelin, T. Huulvej, K. Jensen, S.-G. Lunneryd, M. Boström, and M. Wahlberg. 2016. In-air and underwater hearing in the great cormorant (*Phalacrocorax carbo sinensis*). Advances in Experimental Medicine and Biology 875:505-512.

Jones, E.L., G.D. Hastie, S. Smout, J. Onoufriou, N.D. Merchant, K.L. Brookes, and D. Thompson. 2017. Seals and shipping: quantifying population risk and individual exposure to vessel noise. J. Appl. Ecol. 54(6):1930-1940.

Kastelein, R.A., L. Helder-Hoek, S. Van de Voorde, A.M. von Benda-Beckmann, F.P.A. Lam, E. Jansen, C.A.F. de Jong, and M.A. Ainslie. 2017. Temporary hearing threshold shift in a harbor porpoise (*Phocoena phocoena*) after exposure to multiple airgun sounds. J. Acoust. Soc. Am. 142(4):2430-2442.

Lesage, V., J.-F. Gosselin, J.W. Lawson, I. McQuinn, H. Moors-Murphy, S. Plourde, R. Sears, and Y Simar. 2018. Habitats important to blue whales (*Baleanoptera musculus*) in the western North Atlantic. DFO Can. Sci. Advis. Res. Doc. 2016/080. iv + 50 p.

LGL (Limited). 2012. Environmental Impact Assessment of the Shell Kanumas A/S 2012 Anu-Napu 3D Seismic Survey in Baffin Bay Blocks 5 and 8. Report prepared by LGL Limited, Canada in association with Grontmij A/S, Denmark for Shell Kanumas A/S, Denmark.

LGL. 2014. Environmental assessment MKI Labrador Sea Seismic Program, 2014-2018. LGL Rep. SA1245. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway and TGS-NOPEC Geophysical Company ASA, Houston, TX. 241 p. + appendices.

LGL. 2015. Environmental assessment update of the MKI Labrador Sea Seismic Program, 2014-2018. LGL Rep. FA0039. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway and TGS-NOPEC Geophysical Company ASA, Houston, TX. 26 p. + appendices.

LGL. 2016. Environmental assessment of Seitel's East Coast Offshore Seismic Program, 2016-2025. LGL Rep. FA0071. Rep. by LGL Limited, St. John's, NL for Seitel Canada Ltd., Calgary, AB. 211 p. + appendix.

LGL. 2018. Environmental assessment of Multiklient Invest Labrador Offshore Seismic Program, 2018–2023. LGL Rep. FA0106B. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 221 p. + appendices.

LGL. 2019. Revised environmental assessment addendum of Multiklient Invest Labrador Offshore Seismic Program, 2018–2023. LGL Rep. FA0106B-02. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 31 p.

Liberman, M.C., M.J. Epstein, S.S. Cleveland, H. Wang, and S.F. Maison. 2016. Toward a differential diagnosis of hidden hearing loss in humans. PLoS ONE 11(9):e0162726. doi:10.1371/journal/pone.0162726.

Maggini, I., L. V. Kennedy, A. Macmillan, K. H. Elliott, K. Dean, and C. G. Guglielmo. 2017a. Light oiling of feathers increases flight energy expenditure in a migratory shorebird. The Journal of Experimental Biology 220:2372-2379.

Maggini, I., L. V. Kennedy, K. H. Elliott, K. M. Dean, R. MacCurdy, A. Macmillan, C. A. Pritsos, and C. G. Guglielmo. 2017b. Reprint of: Trouble on takeoff: Crude oil on feathers reduces escape performance of shorebirds. Ecotoxicology and Environmental Safety 146:111-117.

Maggini, I., L. V. Kennedy, S. J. Bursian, K. M. Dean, A. R. Gerson, K. E. Harr, J. E. Link, C. A. Pritsos, K. L. Pritsos, and C. G. Guglielmo. 2017c. Toxicological and thermoregulatory effects of feather contamination with artificially weathered MC 252 oil in western sandpipers (*Calidris mauri*). Ecotoxicology and Environmental Safety 146:118-128.

Mathewson, P. D., K. C. Hanson-Dorr, W. P. Porter, S. J. Bursian, K. M. Dean, K. Healy, K. Horak, J. E. Link, K. E. Harr, and B. S. Dorr. 2018. Experimental and modeled thermoregulatory costs of repeated sublethal oil exposure in the Double-crested Cormorant, *Phalacrocorax auritus*. Marine Pollution Bulletin 135:216-223.

Matthews, L. 2017. Harbor seal (*Phoca vitulina*) reproductive advertisement behavior and the effects of vessel noise. Ph.D. Thesis, Syracuse University. 139 p.

McCauley, R.D., R.D. Day, K.M. Swadling, Q.P. Fitzgibbon, R.A. Watson, and J.M. Semmens. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1, 0195.

McGeady, R., B.J. McMahon, and S. Berrow. 2016. The effects of surveying and environmental variables on deep diving odontocete stranding rates along Ireland's coast. Proceedings of Meetings on Acoustics 4ENAL 27(1):040006. http://dx.doi.org/doi:10.1121/2.0000281.

Moors-Murphy, H.B., J.W. Lawson, B. Rubin, E. Marotte, G. Renaud, and C. Fuentes-Yaco. 2019. Occurrence of blue whales (*Balaenoptera musculus*) off Nova Scotia, Newfoundland, and Labrador. DFO Can. Sci. Advis. Sec. Res. Doc. 2018/007. iv + 55 p.

Morell, M., A. Brownlow, B. McGovern, S.A. Raverty, R.E. Shadwick, and M. André. 2017. Implementation of a method to visualize noise-induced hearing loss in mass stranded cetaceans. Sci. Rep. 7:41848 doi:10.1038./srep41848.

Morris, C.J., D. Cote, B. Martin, and D. Kehler. 2018. Effects of 2D seismic on the snow crab fishery. Fish. Res. 197: 67-77.

Nachtigall, P.E. and A.Y. Supin. 2016. Hearing sensation changes when a warning predict a loud sound in the false killer whale (*Pseurorca crassidens*). p. 743-746 *In:* A.N. Popper and A. Hawkins (eds.), The Effects of Noise on Aquatic Life II. Springer, New York, NY. 1292 p.

Nachtigall, P.E., A.Y. Supin, A.F. Pacini, and R.A. Kastelein. 2018. Four odontocete species change hearing levels when warned of impending loud sound. Integrative Zool. 13:160-165.

NAFO (Northwest Atlantic Fisheries Organization). 2011. An Assessment of Greenland Halibut *(Reinhardtius hippoglossoides)* in NAFO Subarea 2 and Divisions 3KLMNO. Scientific Council Meeting. NAFO SCR Doc. 11/036.

NAFO. 2019. NAFO conservation and enforcement measures. Available at https://www.nafo.int/Fisheries/Conservation.

NMFS. 2016. Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing: underwater acoustic thresholds for onset of permanent and temporary threshold shifts. U.S. Dept. of Commer., NOAA. 178 p.

NMFS. 2018. 2018 revision to: technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (version 2.0). Underwater thresholds for onset of permanent and temporary threshold shifts. Office of Protected Resources Nat. Mar. Fish. Serv., Silver Spring, MD. 167 p.

Parsons, D.M., J. Morgan, D. Power and B. Healey. 2015. Assessment of NAFO Div. 3LNO Yellowtail Flounder. NAFO SCR Doc. 15/029.

Pettis, H.M., R.M. Pace III, and P.K. Hamilton. 2018. North Atlantic Right Whale Consortium 2018 annual report card. Report to the North Atlantic Right Whale Consortium. 17 p.

Pichegru, L., R. Nyengera, A. M. McInnes, and P. Pistorius. 2017. Avoidance of seismic survey activities by penguins. Scientific Reports (Nature Lond.) 7:16305.

Pirotta, E., M. Mangel, D.P. Costa, B. Mate, J.A. Goldbogen, D.M. Palacios, L.A. Hückstädt, E.A. McHuron, L. Schwartz, and L. New. 2018. A dynamic state model of migratory behavior and physiology to assess the consequence of environmental variation and anthropogenic disturbance on marine vertebrates. Am. Nat. 191(2):E000-E000. http://dx.doi.org/doi:10.5061/dryad.md416.

Pritsos, K. L., C. R. Perez, T. Muthumalage, K. M. Dean, D. Cacela, K. Hanson-Dorr, F. Cunningham, S. J. Bursian, J. E. Link, S. Shriner, K. Horak, and C. A. Pritsos. 2017. Dietary intake of Deepwater Horizon oil-injected live food fish by double-crested cormorants resulted in oxidative stress. Ecotoxicology and Environmental Safety 146:62-67.

Richardson, A.J., R.J. Matear, and A. Lenton. 2017. Potential impacts on zooplankton of seismic surveys. CSIRO, Australia. 34 p.

Schlundt, C.E., J.J. Finneran, D.A. Carder, and S.H. Ridgway. 2016. Auditory effects of multiple impulses from a seismic air gun on bottlenose dolphins (*Tursiops truncatus*). p. 987-991 *In:* A.N. Popper and A. Hawkins (eds.), The Effects of Noise on Aquatic Life II. Springer, New York, NY. 1292 p.

Sills, J.M., B.L. Southall, and C. Reichmuth. 2017. The influence of temporally varying noise from seismic air guns on the detection of underwater sounds by seals. J. Acoust. Soc. Am. 141(2):996-1008.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquat. Mamm. 33(4):411-522.

Southall, B.L., J.J. Finneran, C. Reichmuth, P.E. Nachtigall, D.R. Ketten, A.E. Bowles, W.T. Ellison, D.P. Nowacek, and P.L. Tyack. 2019. Marine mammal noise exposure criteria: updated scientific recommendations for residual hearing effects. Aquat. Mamm. 45(4):411-522.

Stanistreet, J.E., D.P. Nowacek, S. Baumann-Pickering, J.T. Bell, D.M. Cholewiak, J.A. Hildebrand, L.E. Hodge, H.B. Moors-Murphy, S.M. Van Parijs, and A.J. Read. 2017. Using passive acoustic monitoring to document the distribution of beaked whale species in the western North Atlantic Ocean. Can. J. Fish. Aquat. Sci. 74(12):2098-2109.

Sychenko, O., G. Gailey, R. Racca, A. Rutenko, L. Aerts, and R. Melton. 2017. Gray whale abundance and distribution relative to three seismic surveys near their feeding habitat in 2015. Abstract and presentation at the Society for Marine Mammalogy's 22nd Biennial Conference on the Biology of Marine Mammals, 22–27 October, Halifax, Nova Scotia, Canada.

Tenessen, J.B. and S.E. Parks. 2016. Acoustic propagation modeling indicates vocal compensation in noise improves communication range for North Atlantic right whales. Endang. Species Res. 30:225-237.

Tougaard, J. and K. Beedholm. 2019. Practical implementation of auditory time and frequency weighting in marine bioacoustics. Appl. Acoust. 145:137-153.

Tougaard, J., A.J. Wright, and P.T. Madsen. 2016. Noise exposure criteria for harbor porpoises. p. 1167-1173 *In:* A.N. Popper and A. Hawkins (eds.), The effects of noise on aquatic life II. Springer, New York, NY. 1292 p.

van Beest, F.M., J. Teilmann, L. Hermannsen, A. Galatius, L. Mikkelsen, S. Sveegaard, J.D. Balle, R. Dietz, J. Nabe-Nielsen. 2018. Fine-scale movement responses of free-ranging harbour porpoises to capture, tagging and short-term noise pulses from a single airgun. R. Soc. Open Sci. 5:170110. http://dx.doi.org/doi:10.1098/rsos.170110.

Wheeland, L., K. Dwyer, J. Morgan., R. Rideout, R. Rogers. 2018. Assessment of American Plaice in Div. 3LNO. NAFO SCR Doc. 18/039.

Personal Communications:

Ball, D.	Resource Management, DFO, 19 April 2019.
Laing, C.	Registrar of Aquaculture, Aquaculture Licensing Administrator, DFLR, Government of NL, Canada, 26 March 2019.
Lawson, J.	Research Scientist, DFO, 23 April 2019.
Mello, L.	Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO, 27 March 2019.
Morrow, G.	Senior Contract Manager, PGS, June 2017.

List of Appendices

Appendix A – MKI Newsletter Distributed to Consultees

Appendix B – List of Consultees Contacted by MKI

Appendix A

MKI Newsletter Distributed to Consultees

Multiklient Invest AS

Seismic Programs Offshore Labrador 2019 Update

Resumption of the Program in 2019

This news update is to inform stakeholders and other interested parties of the continuation of MKI's current seismic program, started in 2012, in waters offshore Newfoundland and Labrador. The Project Area is within the regulatory jurisdiction of the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and it is expected that the Ramform Atlas will be acquiring data between July and September 2019.

Figure 1: Ramform Atlas is seismic vessel due to work in Labrador during the 2019 season

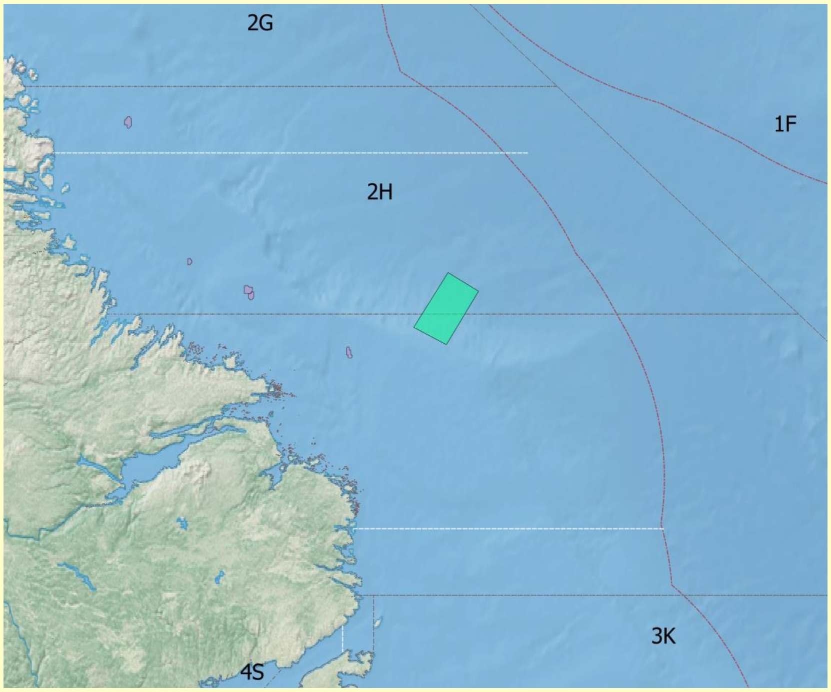


Figure 2: Labrador 2019 3D survey

How to Access Environmental Information about the Project

The Environmental Assessment (EA) for the Multiklient Invest AS Labrador Offshore Seismic Program 2018-2023 along with additional documentation including the Annual EA Update can be accessed on the C-NLOPB website (www.cnlopb.ca).

From the C-NLOPB homepage, click on the "*Environment*" link near the bottom of the page. Then click on the "Project-Based Environmental Assessment" link. Click on the "*Completed*" link. Once this page has opened, scroll down to the project titled *"Multiklient Invest AS Labrador Offshore Seismic Program 2018-2023"* and click on the link. Here you can find all environmental documents related to this project.

The EA provides a comprehensive and detailed overview of the project. The overview includes: information on the Physical and Biological Environment, including Fisheries, Fish and Fish Habitat, Marine Mammals and Species at Risk, and a Cumulative Effects Assessment.

Upon the completion of every acquisition season an Environmental Report is supplied to the C-NLOPB and other government agencies. This report summarizes the marine mammal observations, bird observations and interactions with fishing

Ongoing Communication

As a component of the ongoing communications between MKI and local fisheries organizations, MKI will be providing weekly briefing materials including information such as updated schedules, maps, and/or revised timelines.

Employment Opportunities

Employment opportunities associated with this year's operating season have been considered and it has been determined that there will be possible hiring opportunities as part of the maritime crew. The recruitment process through a local agency will commence in the coming weeks and interested parties should look out for notices posted in community employment offices and other advertisements

Contact Information

If you have any inquiries regarding the Labrador Offshore Seismic Program (2018-2023) please feel free to contact:

Petroleum Geo-Services
15375 Memorial Drive, Suite 100
Houston, Texas, 77079
(P) 1-281-509-8000
(F) 1-281-509-8500
canada@pgs.com

PGS

Appendix B

List of Consultees Contacted by MKI

Organization or Group Name	Email Address	Contact Name
Cartwright		
Municipality of Cartwright	twcouncil@bellaliant.com	Shirley Hopkins
Labrador Fishermen's Union Shrimp Company Limited	Generalmanager@lfuscl.com	Gilbert Linstead
Pratt Falls Salmon Lodge	Dwight@prattfallslodge.com	Dwight Lethbridge
Cloud 9 Salmon Lodge	Cloud9salmonlodge@hotmail.com	Norman Lethbridge
Southeastern Aurora Development Corporation	bgillis@nf.sympatico.ca	Blair Gillis
Charlottetown		
Town of Charlottetown	ctown@nf.aibn.com	Charmaine Powell
Labrador Choice Seafoods Ltd.	pwalsh@labchoice.net	Pius Walsh
Fishers' Committee	ddkippenhuck@nf.sympatico.ca	Don Kippenhuck
Forteau		
Forteau Community Council	forteautowncouncil@hotmail.com	Lauralee James
Happy Valley Goose Bay		
Town of Happy Valley-Goose Bay	development@happyvalley-goosebay.com	Karen Wheeler
Newfoundland and Labrador Department of Innovation, Business, and Rural Development	rkean@gov.nl.ca	Reg Kean
Newfoundland and Labrador Department of Labrador and Aboriginal Affairs	Michellewatkins@gov.nl.ca	Michelle Watkins
Nunatukavut Community Council Inc. (Labrador Metis Nation)	grussell@nunatukavut.ca	George Russell
Nunacor Development Corporation	andy@nunacor.com	Andy Turnbull
Torngat Fish Producers Co-operative Society Ltd.	gm@torngatfishcoop.com	Keith Watts
Torngat Secretariat	craig.taylor@torngatsecretariat.com	Craig Taylor
Labrador Friendship Centre	Jhefler-elson@lfchvgb.ca	Jennifer Hefler-Elson
Hopedale		
Hopedale Inuit Community Government	Wayne.piercy@nunatsiavut.com	Wayne Piercy
L'Anse au Clair		
L'Anse au Clair Community	townoflanseauclair@hotmail.com	
L'Anse au Loup		
Town of L'Anse au Loup	lanseauloup@nf.aibn.com	Janice Normore
Labrador Fishermen's Union Shrimp Company Limited	generalmanager@lfuscl.com	Gilbert Linstead
Mary's Harbour		
Town of Mary's Harbour	maryshbr@nf.aibn.com	Glenys Rumbolt
Labrador Fishermen's Union Shrimp Company Limited	Generalmanager@lfuscl.com	Gilbert Linstead
Makkovik		
Makkovik Inuit Community Government	Herbert.jacque@nunatsiavut.com	Herbert Jacque
Mud Lake		
Mud Lake Community	Dave.raeburn@xplornet.ca	Dave Rayburn
Nain		
Nunatsiavut Government, Dept. of Lands and Natural Resources	claude.sheppard@nunatisiavut.com	Claude Sheppard
Nunatsiavut Government, Director of Environment	rodd.laing@nunatsiavut.com	Rodd Laing
Nunatsiavut Government Department of Education and Economic Development	gary.mitchell@nunatsiavut.com	Gary Mitchell
Nain Inuit Community Government	tony.andersen@nunatsiavut.com	Tony Andersen
Fishers' Committee	jangnatok@hotmail.com	Joey Angnatok
Natuashish		
Mushuau Innu Band Council	Kanikue@gmail.com	Gregory Rich
Innu Nation	Ppoker@innu.ca	Prote Poker
North West River		
Town of North West River	manager@townofnwr.ca	Arthur Williams
Sivunivut Inuit Community Corporation Inc.	Ed.tuttauk@nunatsiavut.com	Ed Tuttauk
Innu Nation	Preid@innu.ca	Paula Reid
Pinsent's Arm		
Community of Pinsent's Arm	localservicepa@yahoo.ca	Mildred Clark (secretary)
Labrador Fishermen's Union Shrimp Company Limited	generalmanager@lfuscl.com	Gilbert Linstead
Port Hope Simpson		
Town of Port Hope Simpson	porthopesimpson@nf.aibn.com	Michelle Clark
Labrador Southeast Coastal Action Program	lscap@nf.aibn.com	Rex Turnbull

Organization or Group Name	Email Address	Contact Name
Postville		
Postville Inuit Community Government	Diane.gear@nunatsiavut.com	Diane Gear
Nunatsiavut Government Department of Lands and Natural Resources	Glen.sheppard@nunatsiavut.com	Glen Sheppard
Rigolet		
Rigolet Inuit Community Government	townmanager@rigolet.ca	Sherri Wolfrey
Fishers' Committee	richardrich749@gmail.com	Richard Rich
Sheshatshiu		
Sheshatshiu Innu First Nation Band Council	jandrew@innu.ca	Jeremy Andrew
Innu Development Ltd. Partnership	madams@innudev.com	Melissa Adams
St. Anthony		
Town of St. Anthony	stanthony@nf.aibn.com	Ernest Simms
Clearwater Fisheries Limited	lsmith@clearwater.ca	
St. Anthony Port Authority	Stanthonyportauthorityinc@bellaliant.com	Malcolm Campbell
St. Anthony Basin Resources Inc.	s.elliott@nf.aibn.com	Sam Elliott
St. Johns		
Fisheries and Oceans Canada- Coast Guard	Jason.kelly@dfo-mpo.gc.ca	Jason Kelly, Senior Fisheries Protection Biologist
Environment Canada	Glenn.troke@ec.gc.ca	Glenn Troke. EA Coordinator
Transport Canada	Clement.murphy@tc.gc.ca	Clement Murphy, Manager, Examinations, and Enforcement
Parks Canada	Randy.thompson@pc.gc.ca	Randy Thompson, Resource Management Officer
National Defence	information@forces.gc.ca	
St. Johns Port Authority	jmcgrath@sjpa.com	Jeff McGrath, Director of Marine Safety and Security
Newfoundland and Labrador Fisheries and Aquaculture	Davidlewis@gov.nl.ca	David Lewis, Deputy Minister
City of St. Johns	rellsworth@stjohns.ca	Ron Ellsworth, Deputy Mayor
Food, Fish, and Allied Workers	jjoensen@ffaw.net	Johan Joensen, Petroleum Industry Liaison
One Ocean	Maureen.murphy@mi.mun.ca	Director
Groundfish Enterprise Allocation Council	bchapman@sympatico.ca	Bruce Chapman, Executive Director
Association of Seafood Producers	dbutler@seafoodproducers.org	Derek Butler, Executive Director
Beothic Fish Processors Ltd.	pgrant@beothic.com	Paul Grant, Executive Vice President
Breakwater Fisheries Limited	rrbarnes@nf.sympatico.ca	Randy Barnes
Conche Seafoods Inc.	dphilpott@quinsea.com	Derrick Philpott, Director
Deep Atlantic International Inc.	Martha@deepatlanticsea.com	Martha Mullowney, Director
Dorset Fisheries Limited	dphilpott@quinsea.com	Derrick Philpott, Director
GC Rieber Carino Ltd.	John.c.kearley@carino.ca	John Kearley, CEO
Gulf Shrimp Limited	Dphilpott@quinsea.com	Derrick Philpott, Director
HSF Ocean Products Limited	todd@hsfgroup.ca	Todd Hickey, Director
Nataaqnaq Fisheries	keith@natfish.ca	Keith Coady, Fleet Manager
Newfound Resources Limited	jeff@nrl.nf.net	Jeff Simms, Operations Manager
Notre Dame Seafoods Inc.	jeveleigh@notredameseafoods.com	Jason Eveleigh, President
San-Can Fisheries Limited	sgoff@san-can.com	Sandra Goff, Director
Ocean Choice International	rellis@oceanchoice.com	Rick Ellis, Director of Fleet Operations
Quinlan Brothers Ltd.	dearle@quinlanbros.ca	David Earle, Chief Financial Officer
Nature Newfoundland and Labrador	zedel@mun.ca	Len Zedel