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Environmental Assessment Update (2020) of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023

Prepared by:

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Prepared for:

Multiklient Invest AS

May 2020
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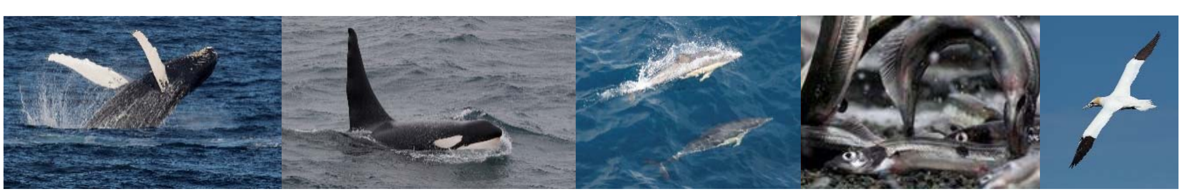

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1.0 Introduction

This document is an Update of the Environmental Assessment (EA) of the Multiklient Invest AS (MKI) Newfoundland Offshore Seismic Program, 2018–2023 (LGL 2018a), the associated Addendum (LGL 2018b), and EA Updates (LGL 2018c, 2019). In 2020, MKI is proposing to conduct 3D seismic surveying in the Newfoundland 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 2020. 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 2020. Previous EA Updates associated with this program were prepared in 2018 and 2019 (LGL 2018c, 2019).

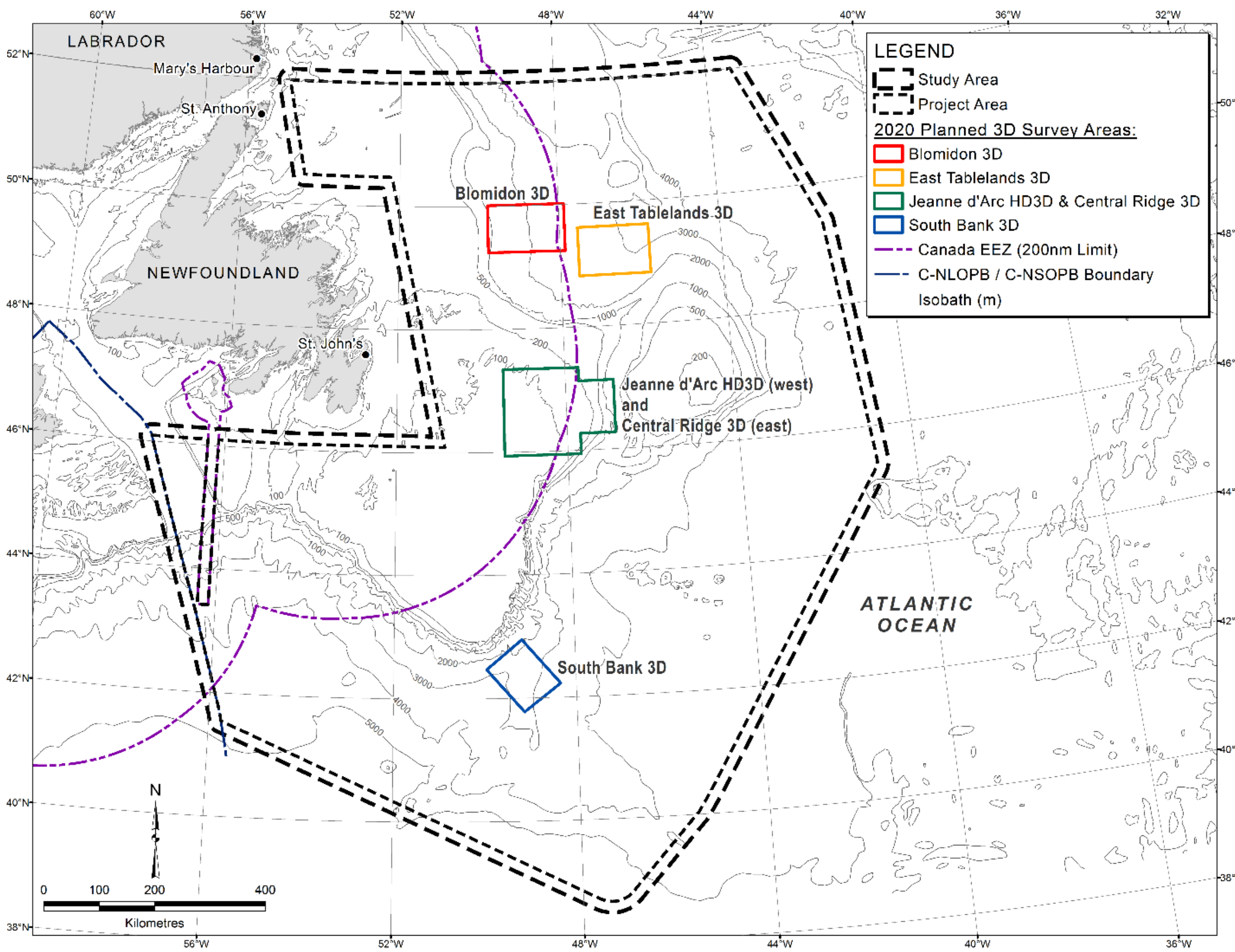


Figure 1.1. Locations of the Project Area, Study Area and 2020 Planned 3D Survey Areas for MKI's Newfoundland Offshore Seismic Program.

Table 1.1. Environmental Assessment documents for the MKI Newfoundland Offshore Seismic Program, 2018–2023. Screening determination reference number C-NLOPB File No. 45006-020-005.

Temporal Scope	EA Document
May 1 to November 30, 2018–2023	Environmental Assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023 and EA Addendum (LGL 2018a,b)[a]
May 1 to November 30, 2018	Environmental Assessment Update (2018) of the Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023 (LGL 2018c)
May 1 to November 30, 2019	Environmental Assessment Update (2019) of the Multiklient Invest Newfoundland Offshore Seismic Program, 2018−2023 (LGL 2019)
May 1 to November 30, 2018-2023	Amendment to Environmental Assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023 (LGL 2020)[b]

[a] On 15 May 2018, the C-NLOPB made a positive determination on this EA and EA Addendum.
[b] The EA Amendment is under review and a determination is pending.

In February 2020, MKI submitted an Amendment to the EA (LGL 2020) proposing to change the temporal/spatial avoidance mitigation measure for the collaborative Fisheries and Oceans Canada (DFO) and Fish, Food, and Allied Workers (FFAW)-Unifor post-season snow crab survey. MKI is proposing to remove the specific '7-day/30-km' temporal/spatial buffer from the mitigation protocol. The rationale for the change is that the buffer is considered operationally impractical based on MKI's recent experience in the Project Area. MKI instead commits to working cooperatively with FFAW-Unifor and DFO through communication channels to avoid snow crab survey stations prior to their sampling, to the best extent possible. The EA Amendment is under review and MKI commits to all mitigation measures presented in the original EA pending a determination by the C-NLOPB on the EA Amendment.

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 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 associated documents.

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 2020, MKI will conduct two simultaneous 3D surveys with the MV *Ramform Atlas* and MV *Ramform Titan*. All project description parameters described in the EA are applicable to MKI's 2020 activities. Specific details for 2020 are provided in Section 2.4.

2.2 Spatial Scope

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

2.3 Temporal Scope

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

2.4 Seismic Survey Activities Planned for 2020

In 2020, MKI plans to conduct 3D seismic surveying in the Project Area. A maximum of two seismic survey vessels will be used in 2020. MKI is proposing to conduct approximately 8100−10,700 km^2 of 3D seismic surveying in the Project Area in 2020 (see Figure 1.1).

In 2020, MKI will use the MV *Ramform Atlas* and MV *Ramform Titan* for the 3D seismic surveying. The *Ramform Atlas* and *Ramform Titan* are sister ships, both built in 2013 and flagged in the Bahamas (Figures 2.1 and 2.2). Both the *Atlas* and *Titan* are 104.2 m long, with a beam of 70 m and a draft of 6.4 m. The vessels will travel at a speed of ~9 km/h (4.9 knots) while conducting the 3D seismic surveying.

All other project details presented in Section 2.0 of the EA remain applicable to MKI's seismic survey activities in 2020.

Figure 2.1. MV *Ramform Atlas.*

Figure 2.2. MV *Ramform Titan.*

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 18.75 m or 25 m.

2.4.2 Seismic Streamers

The *Atlas* and *Titan* will tow 14 or 16 streamers each 9.0 or 8.1 km in length, respectively. The streamers will be spaced 75 m (14 streamers) or 100 m (16 streamers) apart for a total maximum spread of ~8.8 and 12.2 km^2, respectively.

2.4.3 Support Vessels

Four vessels may be used to support the 3D seismic surveys in 2020. The MV *Thor Magni* and/or MV *Thor Freyja* will be used as support vessels. The MV *Norcon Oceanus* and MV *Norcon Triton* will perform escort vessel duties. The operational objective is to have one of these vessels available with each seismic vessel and the support vessel(s) will be used to fill in for escort duties as required.

2.4.4 Survey Locations and Timing

The planned timing of MKI's 3D 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 June–July. The *Ramform*

Atlas will survey the Blomidon 3D (~4000 km²) survey area and the *Ramform Titan* will survey the South Bank 3D (~2500 km²) and Jeanne d'Arc HD3D (~600 km²) survey areas.

Although not presently scheduled for 2020, it is possible that MKI may also survey portions of the Central Ridge 3D (~1000 km²) and East Tablelands 3D (~2600 km²) survey areas. At any given time in 2020, there would be a maximum of two MKI seismic vessels surveying concurrently in the Project Area.

Table 2.1. Planned timing of MKI's 2020 seismic survey activities in the Project Area.

	May (week)		June (week)				July (week)				Aug (week)			
3D Survey Area	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Blomiden 3D	■	■	■	■	■	■	■	■						
South Bank 3D						■	■	■	■	■	■			
Jeanne d'Arc HD3D												■	■	■

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 2018a,) and its Addendum (LGL 2018b). Further details are provided in Table 6.1. Any change to the temporal/spatial avoidance mitigation measure for the collaborative DFO/FFAW-Unifor post-season snow crab survey as proposed in the recent EA Amendment will depend on the outcome of the Amendment review process.

3.0 Physical Environment

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

4.0 Biological Environment and Fisheries

4.1 Fish and Fish Habitat

New information is included for key points regarding plankton, oceanic conditions, benthic invertebrates, and fish species within the Study Area. The new information presented here does not change the effects predictions made in the EA (LGL 2018a).

4.1.1 Plankton

There have been no further relevant updates on plankton since the information presented in subsection 4.1.1 of LGL (2019).

4.1.2 Benthic Invertebrates

Gullage et al. (2017) used DFO Research Vessel (RV) data to predict suitable coral habitat in Newfoundland waters where Species Distribution Models (SDMs) were generated using a maximum entropy (Maxent) approach. SDMs for large and small gorgonians, solitary cup corals, sea pens, and soft corals were the focus of the study. Within the Study Area, the predicted areas of highest habitat suitability for large and small gorgonians and soft corals were on the eastern side of the Orphan Basin, Flemish Pass, Flemish Cap, and south of the Grand Banks. For sea pens, the greatest probability of suitable habitat occurred in the Flemish Pass, on the slopes of the Flemish Cap, and along the Tail of the Grand Banks. Predictive modelling could not be conducted for stony corals (cup corals) or black corals due to data limitations (Gullage et al. 2017).

Deep-sea sponges on the Flemish Cap are vulnerable marine ecosystems that are impacted by bottom trawling. It was estimated that sponge removal by bottom fishing efforts during 2010−2012 was between 661 t and 4815 t using grid-cell statistical and modelling approaches, respectively (Pham et al. 2019). Sponges play important functions in the ecosystem and sponge grounds around the Flemish Cap have been estimated to filter 56,143 ± 15,047 (standard deviation) million liters of seawater per day. Sponge removal by trawling efforts around the Flemish Cap in NAFO Division (Div.) 3M resulted in a decrease in sponge biomass of 2580 t and an estimated decrease in filtering activity by 627±168 million liters per day. Sponge removal by human activities may also increase sediment disposition in the area (Pham et al. 2019).

4.1.3 Fish

As 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 in the EA is on key commercially- and ecologically important fishes.

4.1.3.1 Principal Macro-invertebrates and Fishes Commercially Harvested

Macroinvertebrates

Snow Crab (Chionoecetes opilio)

Snow crab landings in NAFO Div. 3K were low during 2016−2018 (6000 t in 2018); however, catch-per-unit-effort (CPUE) increased in 2018 from a low in 2017. The exploitable biomass has remained low for the past five years (DFO 2019a). Offshore Div. 3LNO landings declined by 43% from 2016 to 2018 due to Total Allowable Catch (TAC) reductions. The exploitable biomass showed a modest increase in 2018 but remain at a near time-series low. Landings in Div. 3Ps increased from decadal lows to 1900 t in 2018, which exceeded the TAC limit of 1792 t. The Div. 3Ps exploitable biomass was at a time-series low in 2016 but showed improvement in 2018 (DFO 2019a).

Northern Shrimp (Pandalus borealis)

Bottom trawl surveys conducted on the Flemish Cap indicated an estimated total biomass of 9273 t of northern shrimp and a total female biomass of 8486 t during 2019, an increase from 2018 (Casas 2019). The 2019 fishery season for northern shrimp remained closed in SFA 7 (DFO 2019b).

Cockles (Cardiidae)

There have been no further relevant updates on cockles since the information presented in subsections 4.2.2.1 and 4.3.3.2 of LGL (2015a) and 4.2.2.1 of LGL (2018a).

Stimpson's Surf Clam (Spisula polynyma)

In 2018, landings from logbook records on the Grand Bank were 14,100 t against a TAC of 14,756 t (DFO 2019c). In 2020, the TAC remains at 14,756 t (DFO 2020a).

Atlantic Halibut (Hippoglossus hippoglossus)

There have been no further relevant updates on Atlantic halibut since the information presented in subsection 4.1.3.1 of LGL (2019).

Atlantic Cod (Gadus morhua)

During 2019, the spawning stock biomass for Atlantic cod in NAFO Div. 2J3KL remained in the critical zone at 48% of the limit reference point, which equated to 398,000 t (DFO 2019d). The 2019 stewardship fishery management approach included measures to ensure catches did not exceed 12,350 t, a 30% increase relative to 2018 (DFO 2019e). In NAFO Div. 3Ps, the spawning stock biomass was estimated to be 16 kt as of 1 January 2020. The TAC is set at 5980 t for 2019/2020. Provisional data indicated that landings during the 2019/2020 management year were 2370 t as of 20 October 2019 (DFO 2020b).

American Plaice (Hippoglossoides platessoides)

Despite the appearance of relatively strong year classes in 2008 and 2013, the American plaice stock has shown little or no growth in NAFO Div. 3Ps since 2008, and few fish greater than 30 cm have been found. DFO has determined that there is a high probability that stock growth of American plaice will not occur if this species is harvested (DFO 2020c).

Yellowtail Flounder (Pleuronectes ferruginea)

There have been no further relevant updates on yellowtail flounder since the information presented in subsection 4.1.3.1 of LGL (2019).

White Hake (Urophycis tenuis)

There have been no further relevant updates on white hake since the information presented in subsection 4.1.3.1 of LGL (2019).

Redfish (Sebastes sp.)

There have been no further relevant updates on redfish since the information presented in subsection 4.1.3.1 of LGL (2019).

4.1.3.2 Other Fishes of Note

Capelin (Mallotus villosus)

In NAFO Div. 2J3KL, the entire TAC of 19,823 t was landed in 2018 (DFO 2019f). In 2019, the TAC for 2J3KL was set at 22,796 t, which was divided into 90 t for Div. 2J, 8013 t for Div. 3K, 13,174 t for Div. 3L, and 1519 t in Div. 3Ps (DFO 2020d).

Wolffishes (Anarhichas sp.)

A Recovery Strategy for the northern (*A. denticulatus*) and spotted (*A. minor*) wolffishes and a Management Plan for Atlantic wolfish (*A. lupus*) were finalized during 2020 (DFO 2020e). An Action Plan was also finalized for northern and spotted wolffishes (DFO 2020f). There were no changes between the final and proposed critical habitats as described in subsection 4.1.3.1 of LGL (2019).

Swordfish (Xiphias gladius)

There have been no further relevant updates on swordfish since the information presented in subsection 4.1.3.1 of LGL (2019).

Anadromous Fishes

There have been no further relevant updates on Atlantic salmon (*Salmo salar*) since the information presented in subsection 4.1.3.1 of LGL (2019).

4.2 Fisheries

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

4.2.1 Commercial Fisheries

The most recent available commercial fisheries data are from the 2017 dataset [1], which were presented in the 2019 EA Update (see Section 4.2.1 *in* LGL 2019). The 2017 commercial fisheries data for the Study and Project areas are not repeated here. The recent commercial fisheries within the planned 3D survey areas for 2020 are summarized below.

The distribution of May–November 2016 and 2017 harvest locations for all species and principal commercial species (i.e., snow crab, northern shrimp, Atlantic halibut, Greenland halibut, and Atlantic cod) harvested in the planned 3D survey areas (and Study Area) are shown in Figures 4.1–4.12. There were no commercial fisheries harvest locations within the East Tablelands or South Bank 3D survey areas during May−November 2016 or 2017. Harvests mainly occurred between the 100 and 200-m isobaths in the Jeanne d'Arc and Central Ridge 3D survey area. There were few harvest locations in the Blomidon 3D survey area, in water depths <2000 m.

Catch weight and quartile counts by vessel length classes and species harvested in the Blomidon and Jeanne d'Arc/Central Ridge 3D survey areas are presented in Table 4.1. All commercial harvests within the 3D survey areas were caught by fishers from Newfoundland and Labrador.

During 2016 and 2017, Greenland halibut were harvested in the Blomidon 3D survey area; Atlantic cod was harvested there in 2017. Greenland halibut were mostly harvested by vessels of the length class 45−64.9', and to a lesser extent by vessels <35' and ≥125'. Atlantic cod were only harvested by vessels <35'.

Snow crab were the main species harvested during 2016 and the only species caught during 2017 in the Jeanne d'Arc and Central Ridge 3D survey area. Other species caught during 2016 included Stimpson's surf and propeller (*Cyrtodaria siliqua*) clams and cockle. Snow crab were primarily caught by vessels 45−64.9' in length, followed by vessels 65-99.9'. Stimpson's surf clam, propeller clam, and cockle were only caught by vessels ≥125'.

[1] DFO is currently updating their digital infrastructure, which, in combination with the necessity for alternative work arrangements in response to the COVID-19 situation, has delayed their ability to release commercial fisheries data from the 2018 dataset and limited their capacity to respond to geo-spatial data requests (J. Hosein, Chief, Statistical Services, DFO, pers. comm., 16 March 2020).

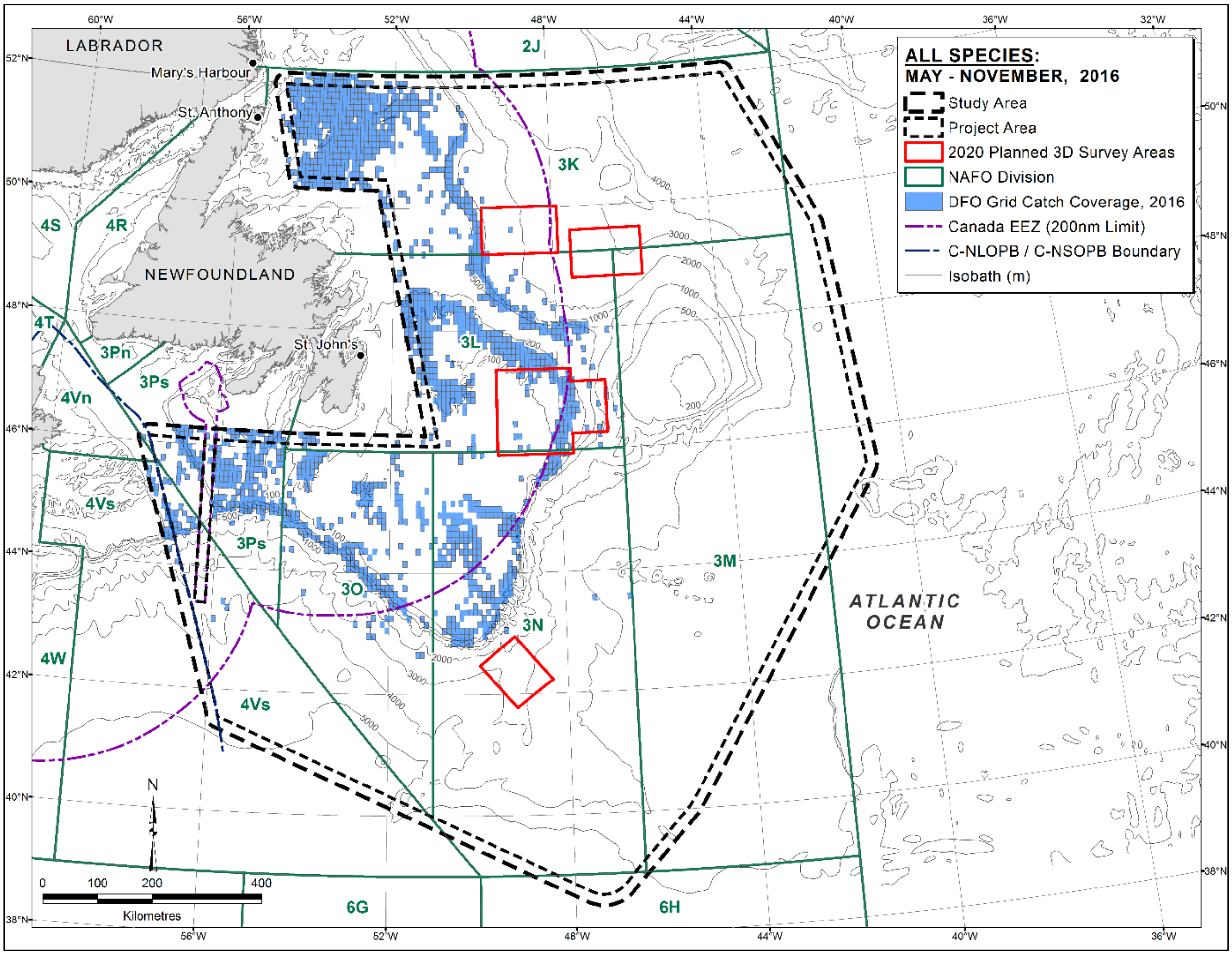


Figure 4.1. Distribution of commercial fishery harvest locations, all species, May–November 2016 (derived from DFO commercial landings database, 2016).

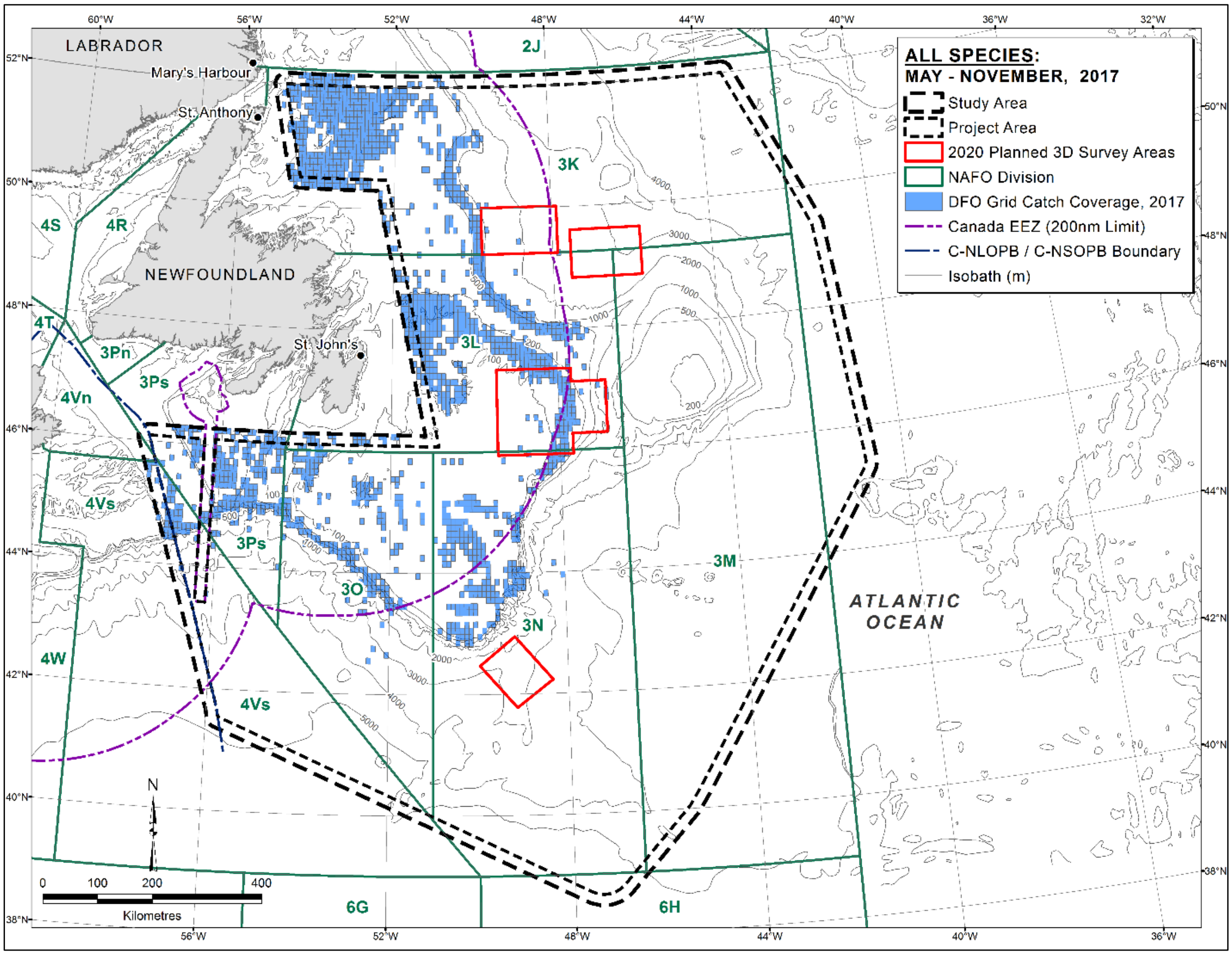


Figure 4.2. Distribution of commercial fishery harvest locations, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

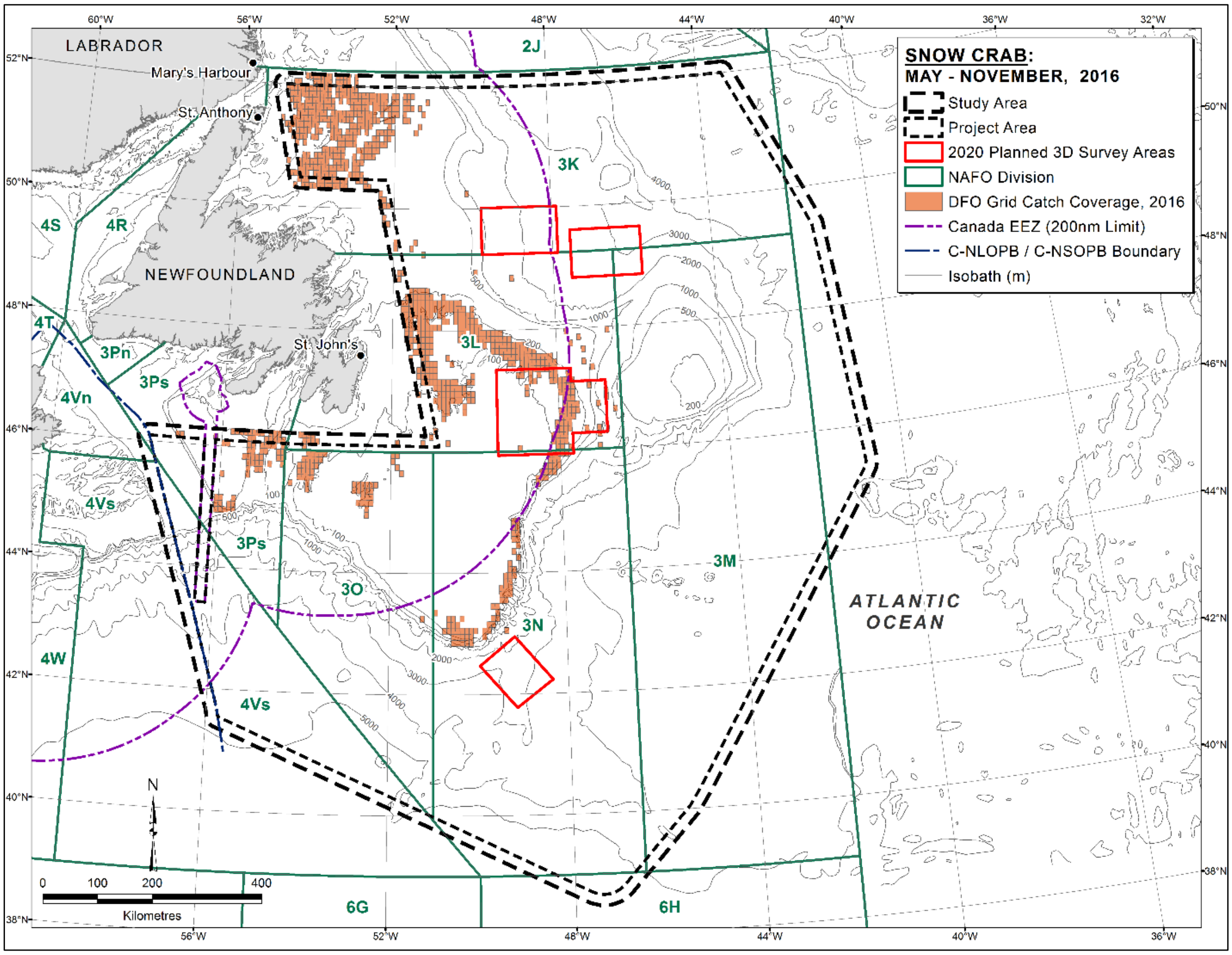


Figure 4.3. Distribution of commercial fishery harvest locations, snow crab, May–November 2016 (derived from DFO commercial landings database, 2016).

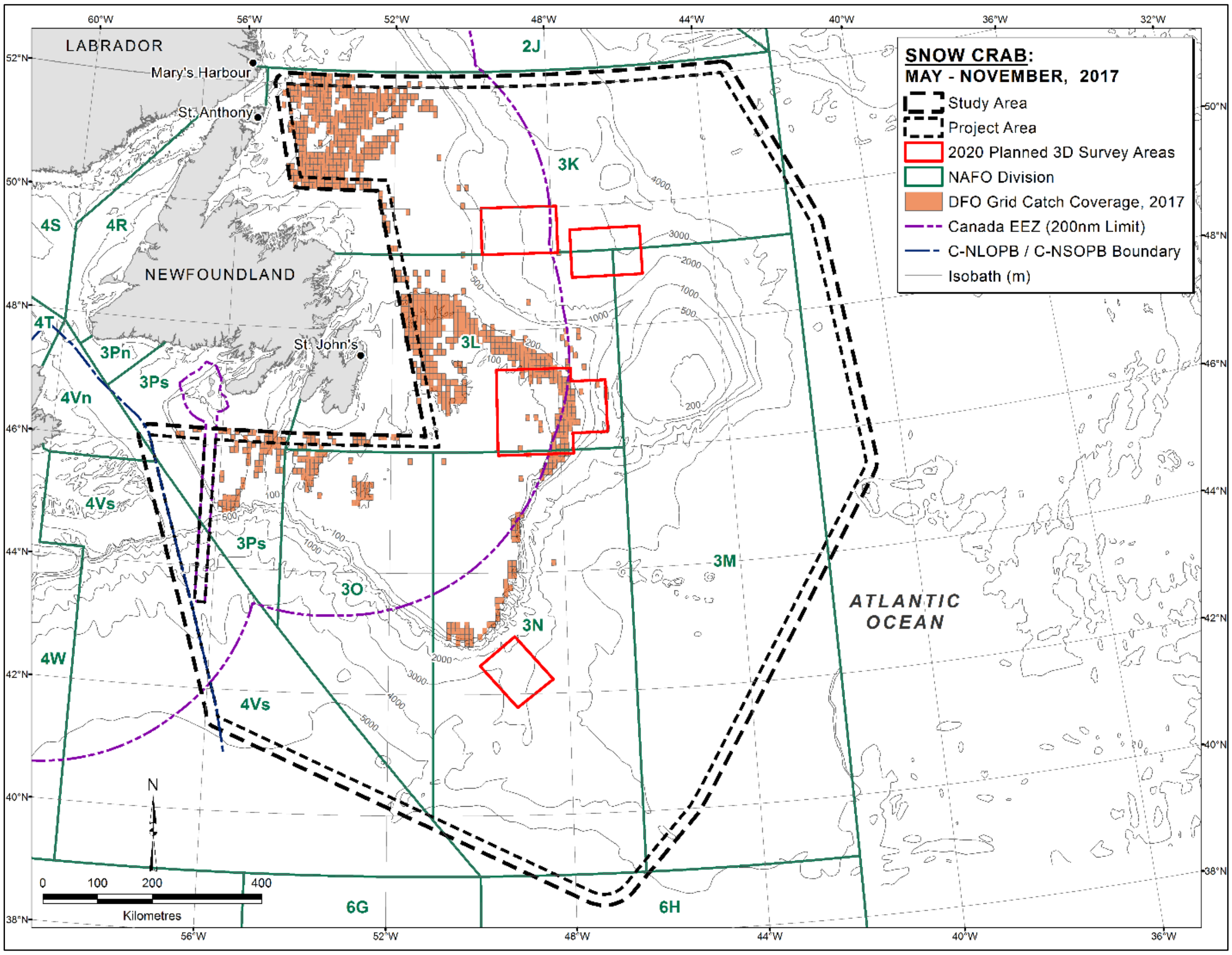


Figure 4.4. Distribution of commercial fishery harvest locations, snow crab, May–November 2017 (derived from DFO commercial landings database, 2017).

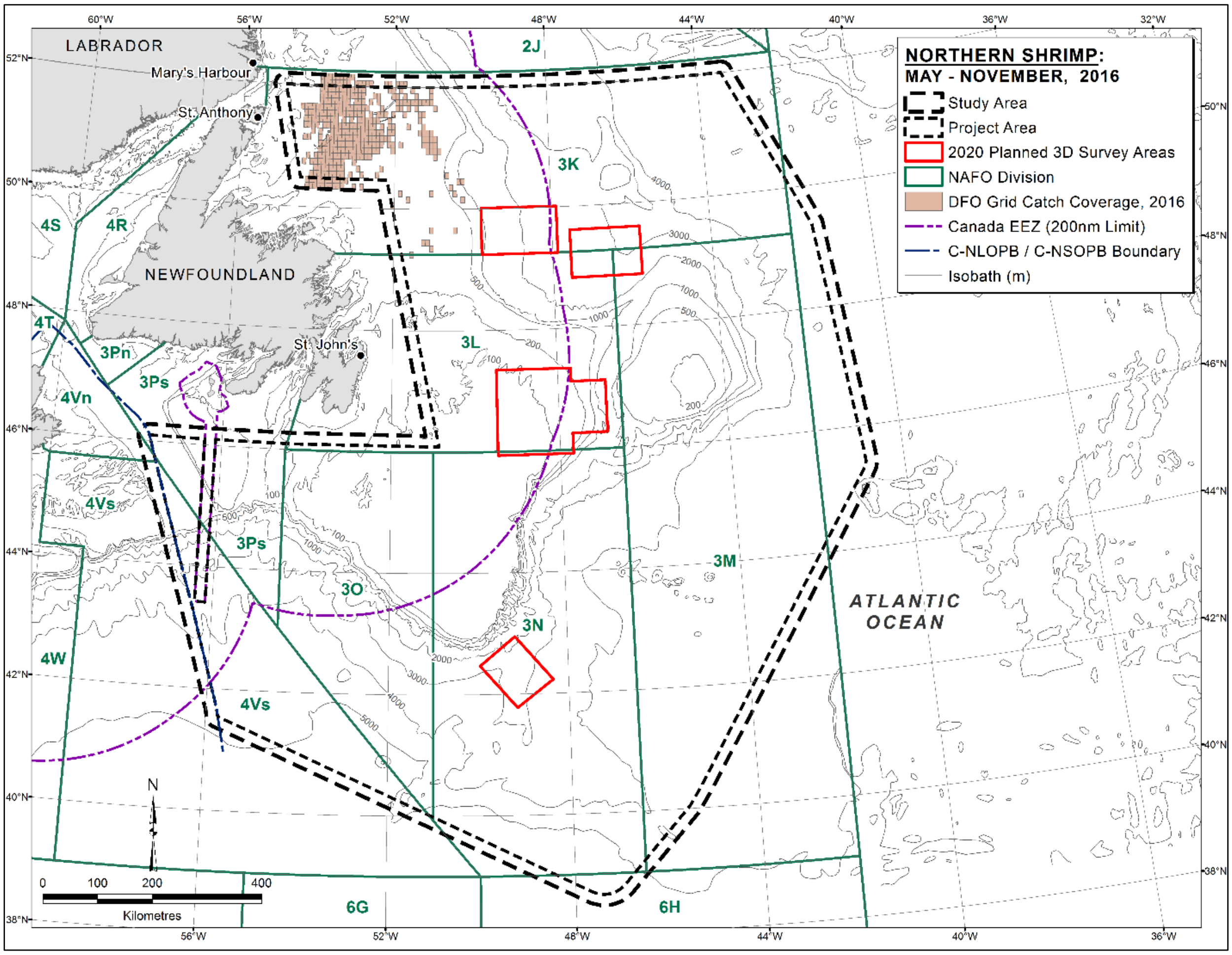


Figure 4.5. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2016 (derived from DFO commercial landings database, 2016).

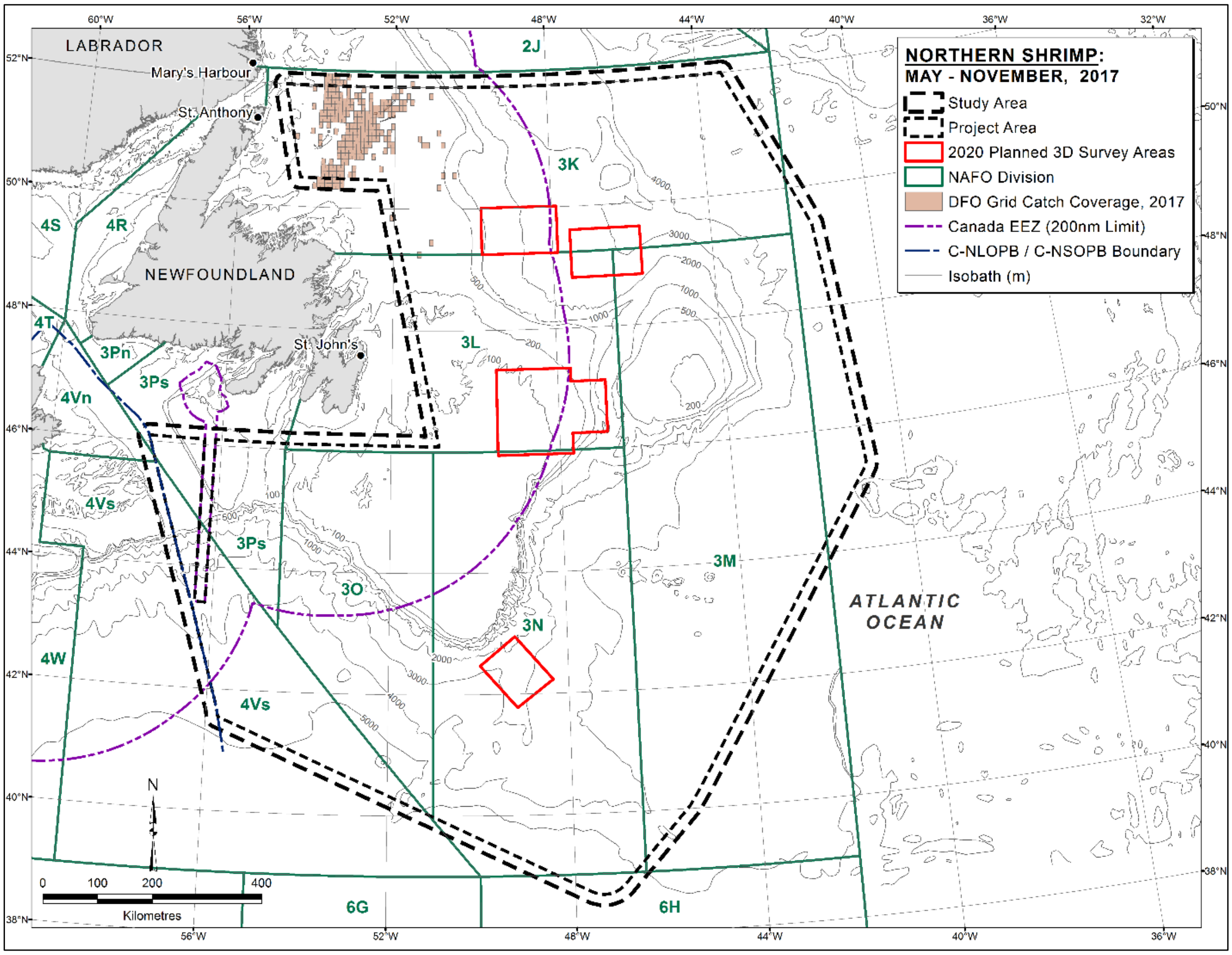


Figure 4.6. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2017 (derived from DFO commercial landings database, 2017).

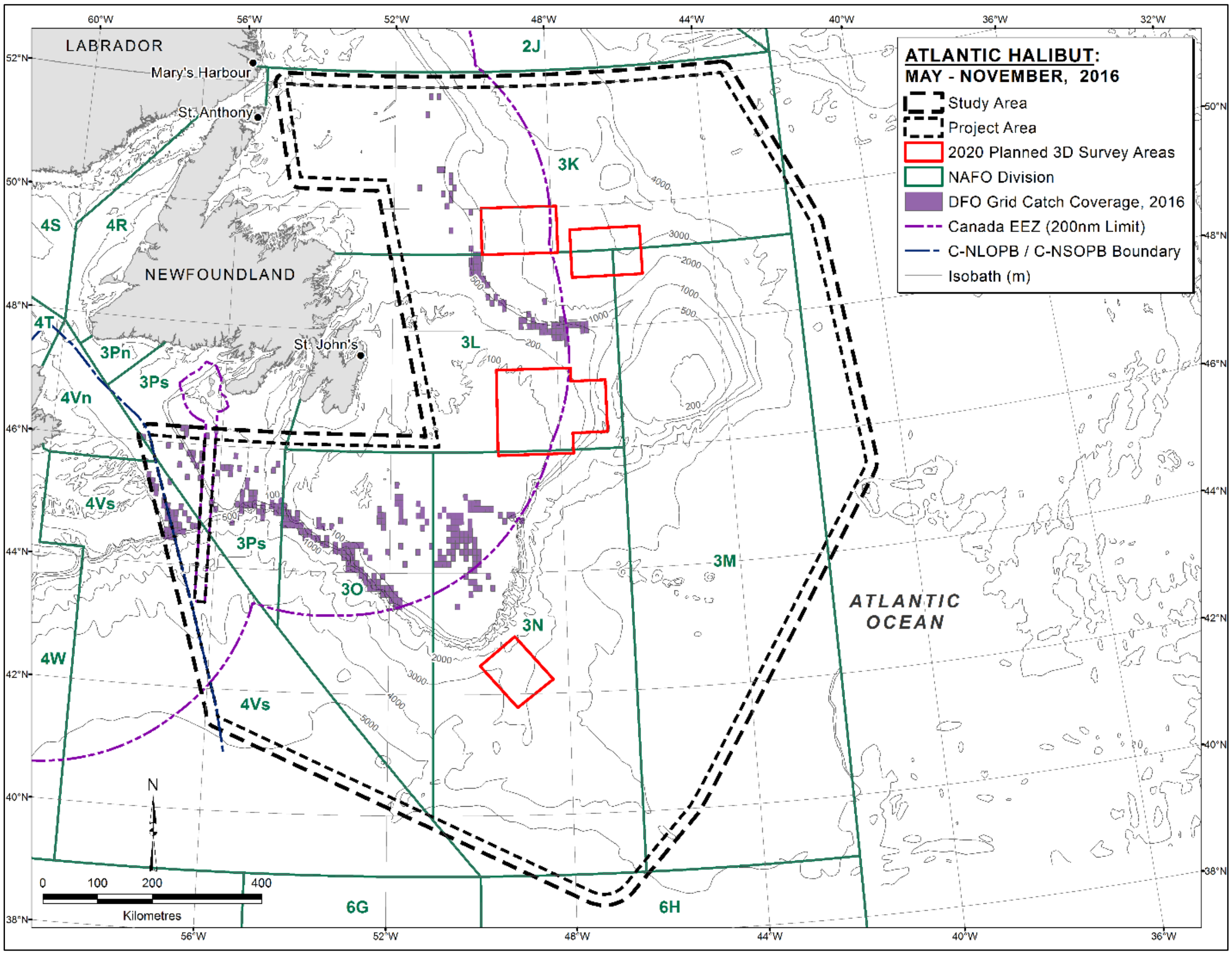


Figure 4.7. Distribution of commercial fishery harvest locations, Atlantic halibut, May–November 2016 (derived from DFO commercial landings database, 2016).

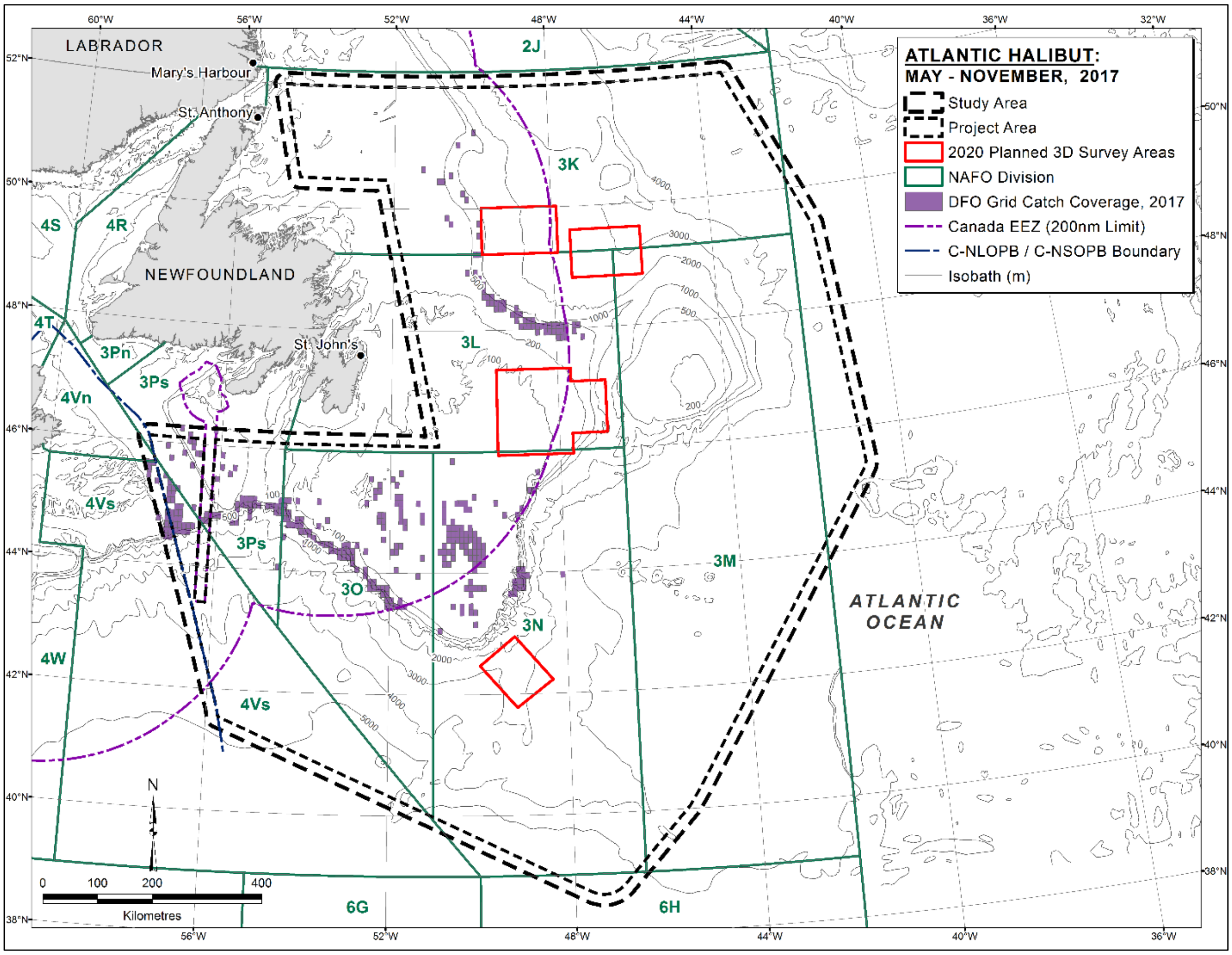


Figure 4.8. Distribution of commercial fishery harvest locations, Atlantic halibut, May–November 2017 (derived from DFO commercial landings database, 2017).

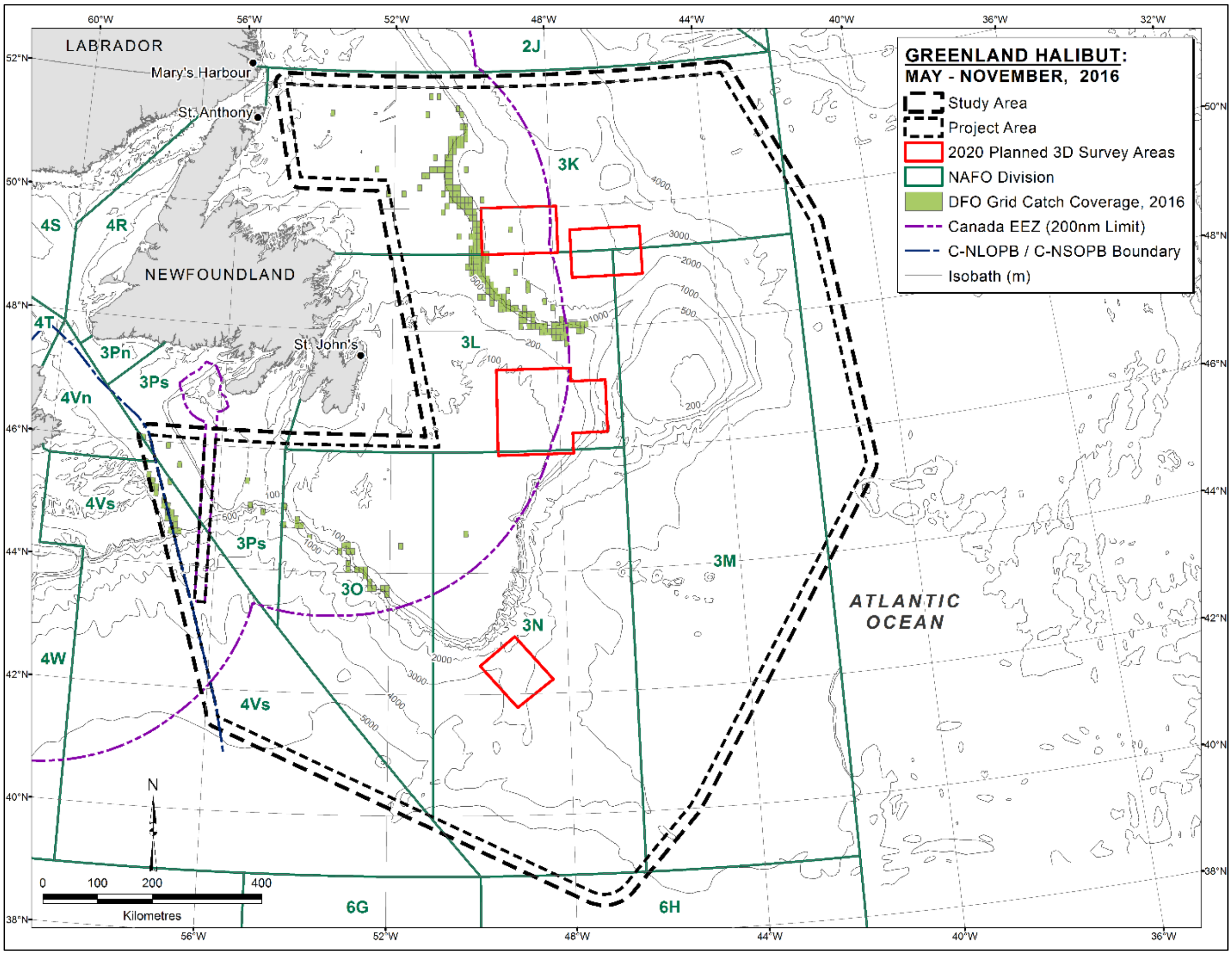


Figure 4.9. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2016 (derived from DFO commercial landings database, 2016).

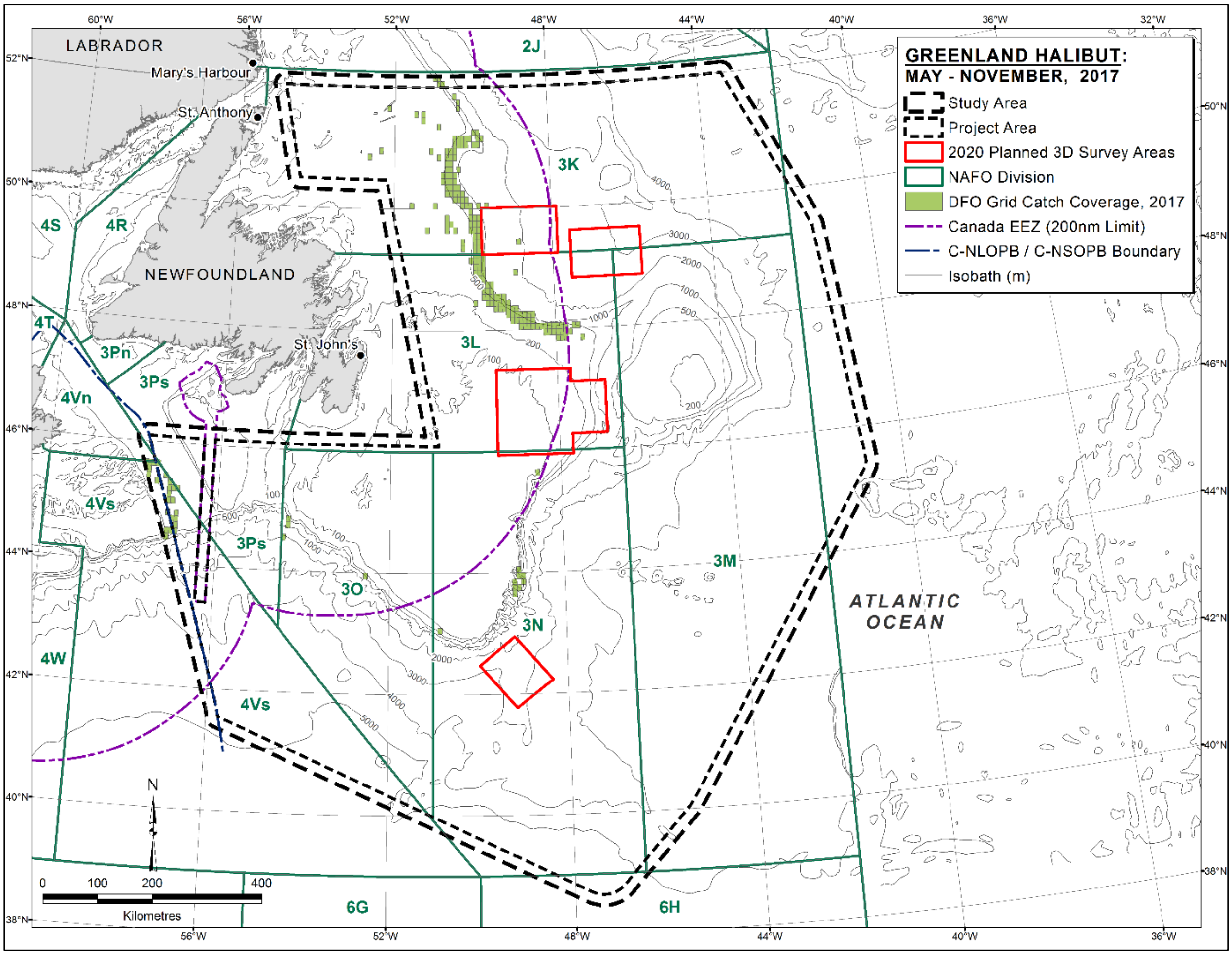


Figure 4.10. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2017 (derived from DFO commercial landings database, 2017).

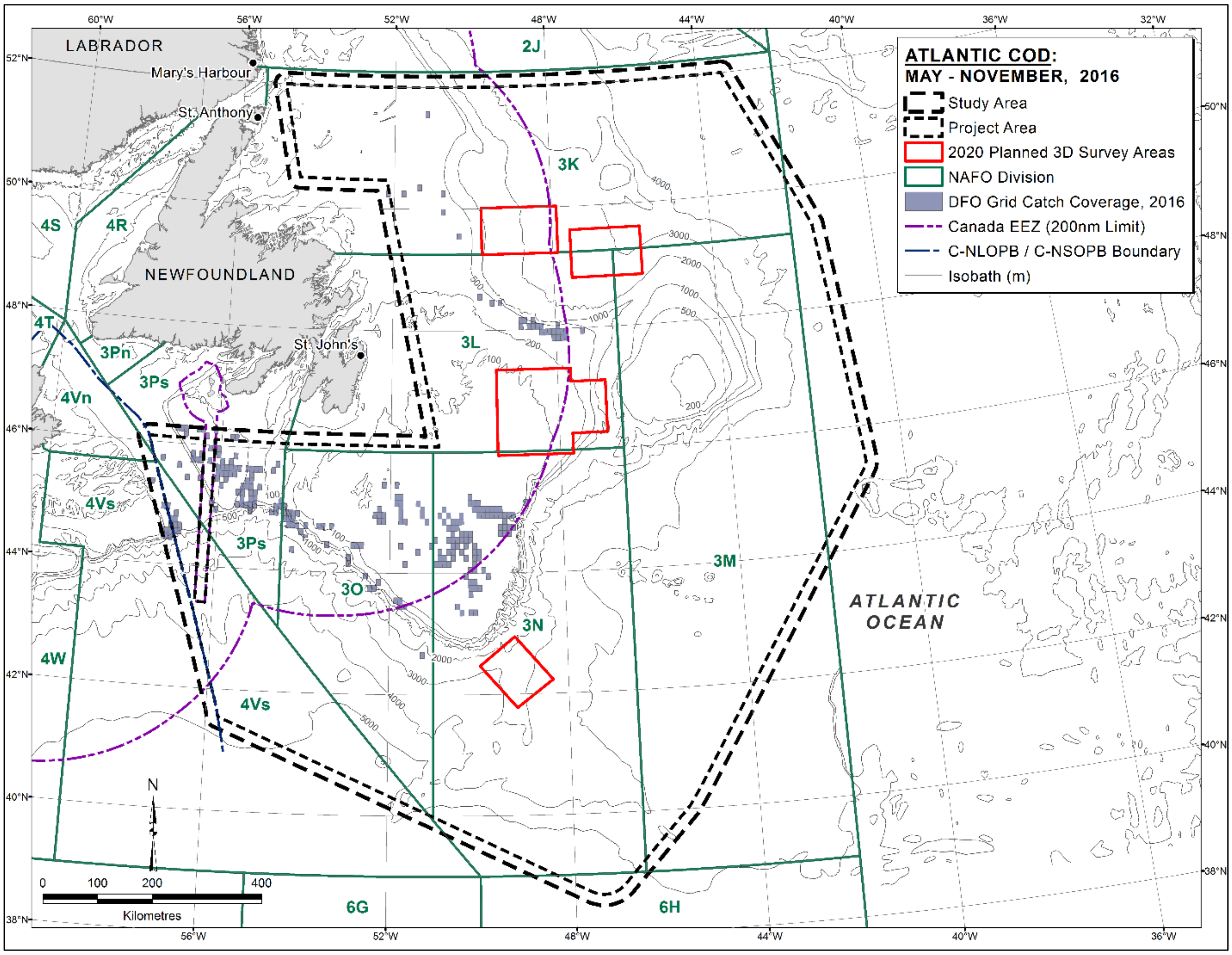


Figure 4.11. Distribution of commercial fishery harvest locations, Atlantic cod, May–November 2016 (derived from DFO commercial landings database, 2016).

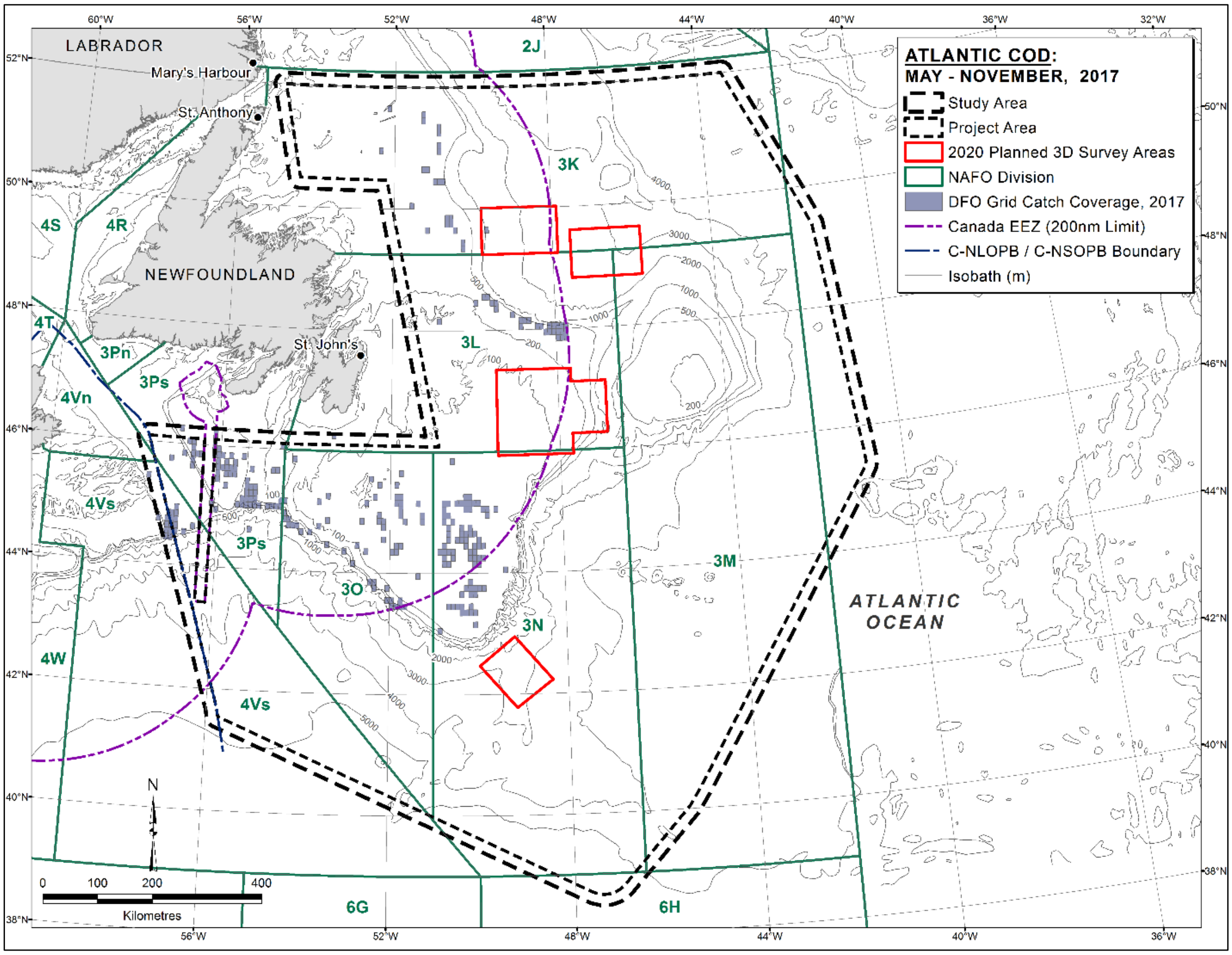


Figure 4.12. Distribution of commercial fishery harvest locations, Atlantic cod, May–November 2017 (derived from DFO commercial landings database, 2017).

Table 4.1. Commercial catch weights and values in the Blomidon and Jeanne d'Arc/Central Ridge 2020 3D survey areas, 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'	
Blomidon															
2016															
Greenland Halibut	2	2	0	0	2	2	0	0	0	1	2	0	0	1	**4**
Total	**2**	**2**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**1**	**4**
2017															
Greenland Halibut	0	2	0	0	0	2	0	0	0	0	2	0	0	0	**2**
Atlantic Cod	0	1	0	0	1	0	0	0	1	0	0	0	0	0	**1**
Total	**0**	**3**	**0**	**0**	**1**	**2**	**0**	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**3**
Jeanne d'Arc and Central Ridge															
2016															
Snow Crab	33	64	90	14	26	52	65	58	0	0	148	53	0	0	**201**
Stimpson's Surf Clam	1	2	1	1	1	2	1	1	0	0	0	0	0	5	**5**
Propeller Clam	0	2	1	1	0	2	1	1	0	0	0	0	0	4	**4**
Cockle	0	1	1	1	0	1	1	1	0	0	0	0	0	3	**3**
Total	**34**	**69**	**93**	**17**	**27**	**57**	**68**	**61**	**0**	**0**	**148**	**53**	**0**	**12**	**213**
2017															
Snow Crab	39	80	76	6	22	51	82	46	0	0	141	60	0	0	**201**
Total	**39**	**80**	**76**	**6**	**22**	**51**	**82**	**46**	**0**	**0**	**141**	**60**	**0**	**0**	**201**

[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 – 2136 kg; 2 = 2137 – 9436 kg; 3 = 9437 – 39,810 kg; 4 = ≥39,811 kg. 2017 quartile ranges: 1 = 0 – 1912 kg; 2 = 1913 – 8828 kg; 3 = 8829 – 35,206 kg; 4 = ≥35,207 kg.

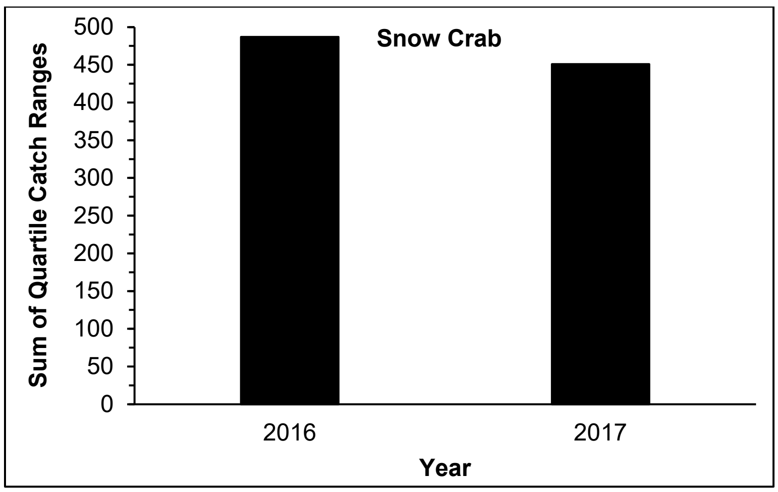
[b] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch value in a given year, all species combined). 2016 quartile ranges: 1 = $0 – $9,428; 2 = $9,429 – $41,474; 3 = $41,475 – $154,669; 4 = ≥$154,670. 2017 quartile ranges: 1 = $0 – $9,811; 2 = $9,812 – $43,514;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

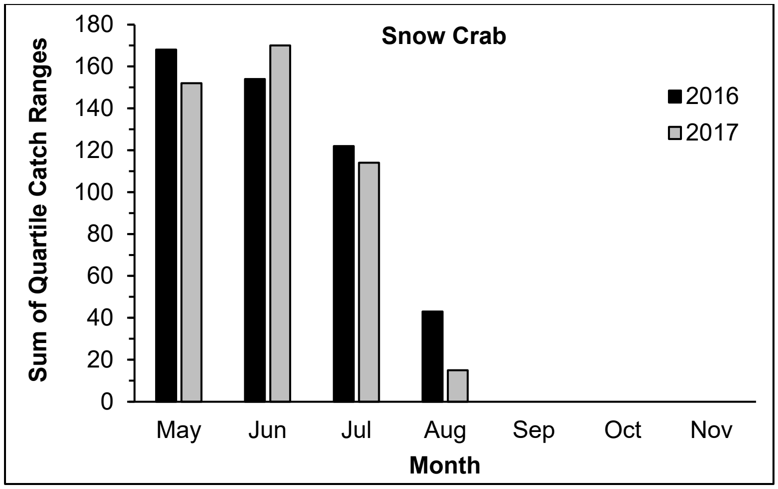
4.2.1.1 Snow Crab

During May−November 2016 and 2017, snow crab catches only occurred in the Jeanne d'Arc/Central Ridge 3D survey area, mainly in water depths between 100 m and 200 m (see Figures 4.3−4.4). The 2020 TAC values for snow crab have not yet been released by DFO for the Study Area (DFO 2020g). The 2019 TAC values were 5846 mt for Div. 3K (includes the Blomidon and a portion of the East Tablelands 3D survey areas) and 15,818 mt for Div. 3LNO (Jeanne d'Arc/Central Ridge, South Bank, and a portion of the East Tablelands 3D survey areas) (DFO 2020g). Snow crab harvest within the Jeanne d'Arc/Central Ridge 3D survey area during May−November slightly decreased from 2016 to 2017 (Figure 4.13), and most snow crab catches occurred during May–July in 2016 and 2017 (Figure 4.14).



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 2016–2017 for snow crab in the Jeanne d'Arc/Central Ridge 3D survey area (derived from DFO commercial landings database, 2016–2017).



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 2016−2017 for snow crab in the Jeanne d'Arc/Central Ridge 3D survey area (derived from DFO commercial landings database, 2016−2017).

4.2.1.2 Northern Shrimp

During May–November 2016 and 2017, there were no northern shrimp harvest locations within the 3D survey areas (see Figures 4.5−4.6). The shrimp fishery remains closed in Div. 3L (includes the Jeanne d'Arc/Central Ridge and a portion of the East Tablelands 3D survey areas) and Div. 3NO (South Bank 3D survey area) (NAFO 2020). Domestic TACs for Shrimp Fishing Areas (SFAs) 6 (Blomidon 3D survey area) and 7 (Jeanne d'Arc/Central Ridge 3D survey area), have not yet been released for 2020, but the 2019 TAC for SFA 6 was 8960 mt and the shrimp fishery remained closed in SFA 7 (DFO 2020g).

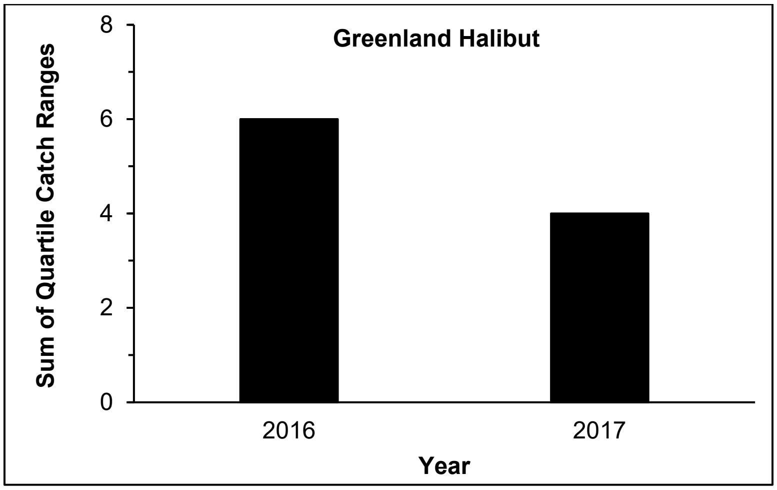
4.2.1.3 Atlantic Halibut

There were no harvest locations for Atlantic halibut within the 3D survey areas during May−November 2016 or 2017 (see Figures 4.7−4.8). No TACs have been posted on the DFO website for the Study Area since the 2014/2015 limit of 2738 mt in Div. 3NOPs4VWX+5 (includes the South Bank 2020 survey area) (DFO 2020g).

4.2.1.4 Greenland Halibut

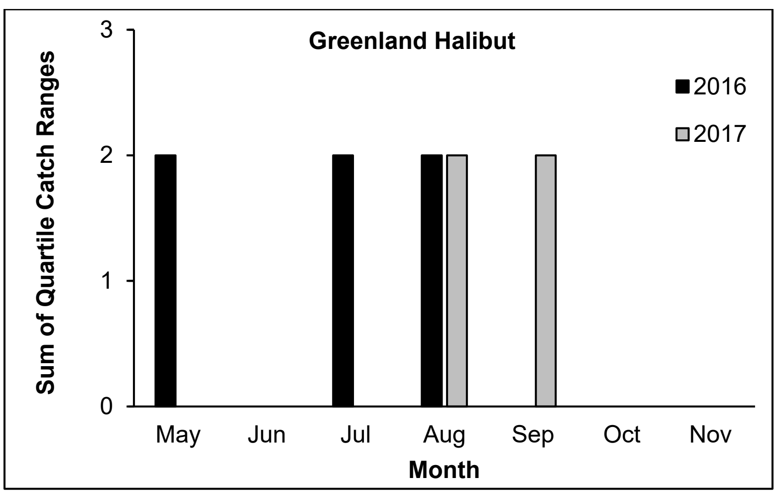
During May–November 2016 and 2017, harvest locations for Greenland halibut only occurred in the Blomidon 3D survey area, within the central and adjacent to the western portions of the survey area (see Figures 4.9−4.10). The TAC for Greenland halibut in Div. 3LMNO (includes the Jeanne d'Arc/Central Ridge, South Bank, and portions of the East Tablelands 3D survey areas) increased from 12,242 mt during 2019 to 12,542 mt in 2020 (NAFO 2020). Catches within the

Blomidon 3D survey area decreased from 2016 to 2017, and mainly occurred during the summer (Figures 4.15−4.16).



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 4.15. Total annual catch weight quartile codes, May–November 2016–2017 for Greenland halibut in the Blomidon 3D survey area (derived from DFO commercial landings database, 2016–2017).

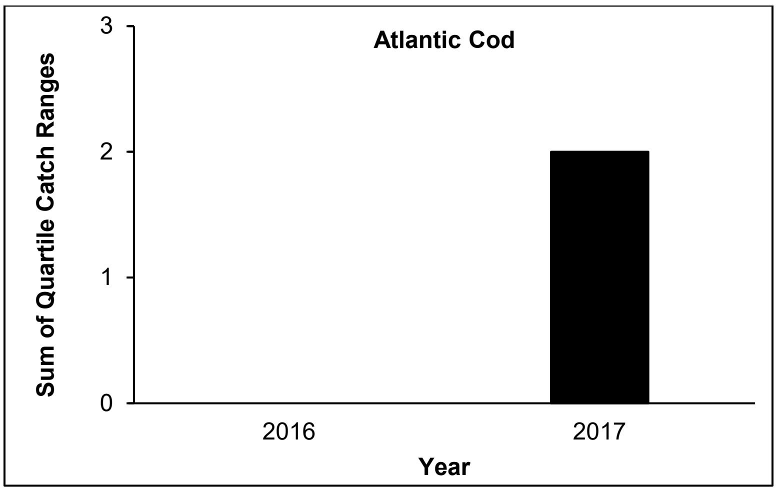


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.16. Total monthly catch weight quartile codes, May–November 2016−2017 for Greenland halibut in the Blomidon 3D survey area (derived from DFO commercial landings database, 2016−2017).

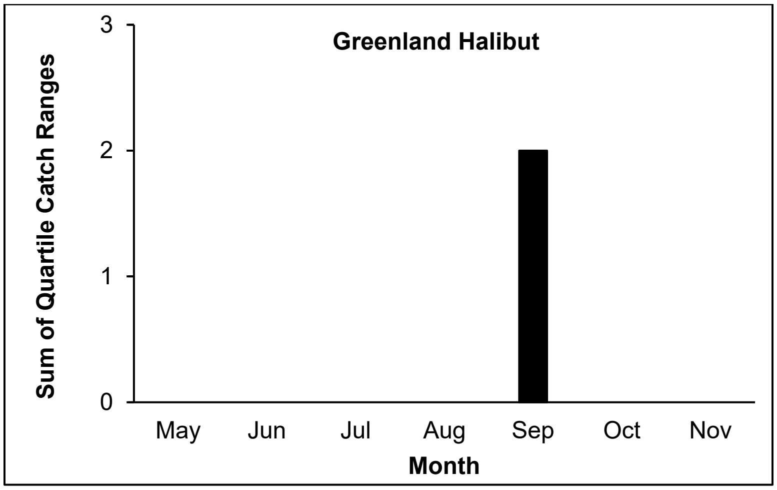
4.2.1.5 Atlantic Cod

During May−November 2016 and 2017, Atlantic cod were only caught in the Blomidon 3D survey area, near the 1000-m isobath in the western portion of the survey area (see Figures 4.11−4.12). The fishing ban for Atlantic cod has remained in place for Div. 3LNO (NAFO 2020). The 2020 TAC for Div. 3Ps has not yet been released, but it was set at 5980 mt for 2018 and 2019 (DFO 2020g). The TAC for Atlantic cod in Div. 3M decreased from 17,500 mt in 2019 to 8531 mt in 2020 (NAFO 2020). During May−November 2017, Atlantic cod were only harvested within the Blomidon 3D survey area during September (Figures 4.17−4.18).



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 2016–2017 for Atlantic cod in the Blomidon 3D survey area (derived from DFO commercial landings database, 2016–2017).



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 2017 for Atlantic cod in the Blomidon 3D survey area (derived from DFO commercial landings database, 2017).

4.2.1.6 Other Notable Commercial Species

As noted in the EA (see Tables 4.3–4.8 *in* LGL 2018a) and 2019 EA Update (see Table 4.1 and Section 4.2.1.6 *in* LGL 2019), redfish, yellowtail flounder, white hake and American plaice are also important commercial species in the Study Area. Redfish, yellowtail flounder, and American plaice are primarily harvested in areas where water depths are <500 m (see Figures 4.18, 4.20, and 4.22 *in* LGL 2018a) and white hake in water depths <1000 m (see Figure 3.33 *in* C-NLOPB 2010) (i.e., potentially within the western portion of the Study Area, including within and/or near the Jeanne d'Arc and Central Ridge 3D survey area). NAFO sets annual TAC limits for yellowtail flounder, while both DFO and NAFO manage the fisheries for redfish, white hake, and American plaice.

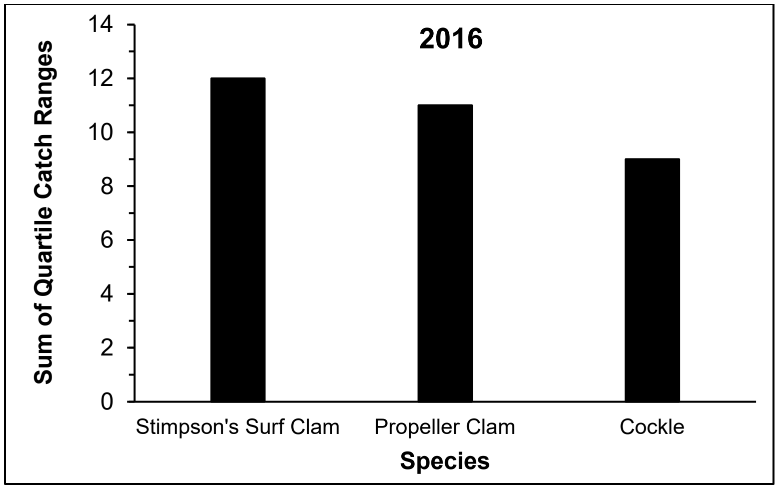
Redfish DFO Units 1 (Div. 4RST and 3PN+4Vn, during 1 January−31 May) and 2 (i.e., Div. 3Ps, 4Vs, a portion of 4W, and 3Pn+4Vn, during 1 June–31 December) occur far west of the 3D survey areas (DFO 2020g). The redfish TAC in Div. 3LN (includes the Jeanne d'Arc/Central Ridge, South Bank, and portions of the East Tablelands 3D survey areas) remained unchanged at 18,100 mt in 2019 and 2020 (NAFO 2020). The TAC decreased in Div. 3M (portion of the East Tablelands 3D survey area) from 10,500 to 3590 mt in 2019 and 2020, respectively (NAFO 2020). There have been no changes in TAC in Div. 3O (no 3D survey areas) or Sub-Area 2 and Div. 1F+3K (Blomidon and a portion of East Tablelands 3D survey areas) since the EA (LGL 2018a), with a limit of 20,000 mt in 3O and a fishing ban in place for Sub-Area 2/1F+3K (NAFO 2020). There were no redfish commercial harvest locations in the 3D survey areas during May−November 2016 and 2017.

The TAC for yellowtail flounder in Div. 3LNO (includes the Jeanne d'Arc/Central Ridge and portions of the East Tablelands 3D survey areas) has remained unchanged since the EA (LGL 2018a), set at 17,000 mt (NAFO 2020). There were no yellowtail flounder commercial harvest locations in the 3D survey areas during May−November 2016 and 2017.

A TAC was set by DFO for white hake in Div. 3Ps (far west of the 3D survey areas) for the first time during 2018, at 500 mt until at least 2020/2021 (DFO 2020g). The TAC in Div. 3NO (includes the South Bank 3D survey area) has remained at 1000 mt in recent years (NAFO 2020). There were no white hake commercial harvest locations in the 3D survey areas during May−November 2016 and 2017.

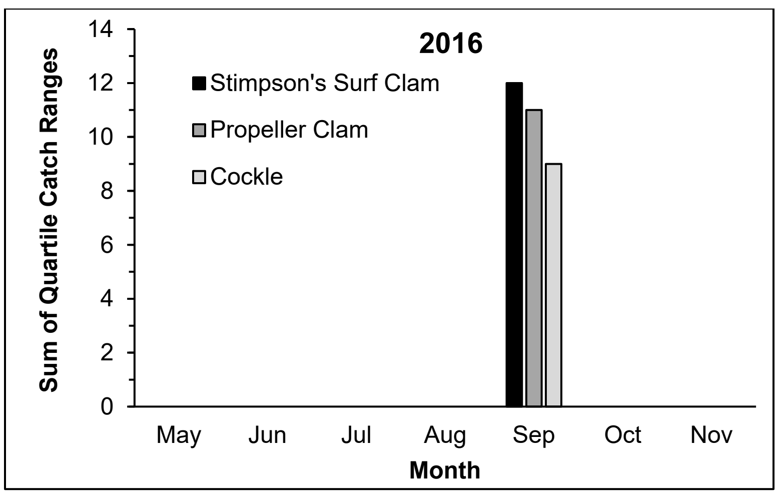
A fishing moratorium remains in effect for American plaice in Div. 3Ps (west of the 3D survey areas), 3LNO (Jeanne d'Arc/Central Ridge, South Bank, and a portion of the East Tablelands 3D survey areas), and 3M (portion of the East Tablelands 3D survey area) (DFO 2020g; NAFO 2020). There were no American plaice commercial harvest locations in the 3D survey areas during May−November 2016 and 2017.

During May−November 2016, there were 12 catch locations for Stimpson's surf clam, 11 locations for propeller clam, and 9 locations for cockle within the Jeanne d'Arc and Central Ridge 3D survey area, in water depths <500 m (Table 4.1; Figure 4.19). These species were not caught in any of the 3D survey areas during May−November 2017. There were relatively few catches of these species within the entire Study Area during 2016 and 2017, with ~50 and ~30 or fewer catch locations for each species during 2016 and 2017, respectively (see Table 4.1 *in* LGL 2019). All catches of these species occurred during September 2016 (Figure 4.20). Stimpson's surf and propeller clams were described in Section 4.1.3.1 of the 2019 EA Update (LGL 2019). Cockles were described in Section 4.2.2.1 of the EA (LGL 2018a). No TAC values are set for these species within the Study Area by DFO or NAFO (DFO 2020g; NAFO 2020).



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 2016 for Stimpson's surf clam, propeller clam, and cockle in the Jeanne d'Arc/Central Ridge 3D survey area (derived from DFO commercial landings database, 2016).

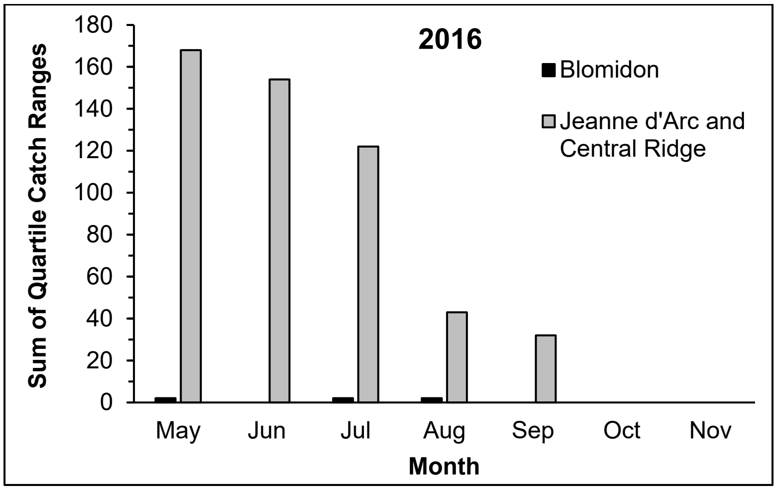


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.20. Total monthly catch weight quartile codes, May–November 2016 for Stimpson's surf clam, propeller clam, and cockle in the Jeanne d'Arc/Central Ridge 3D survey area (derived from DFO commercial landings database, 2016).

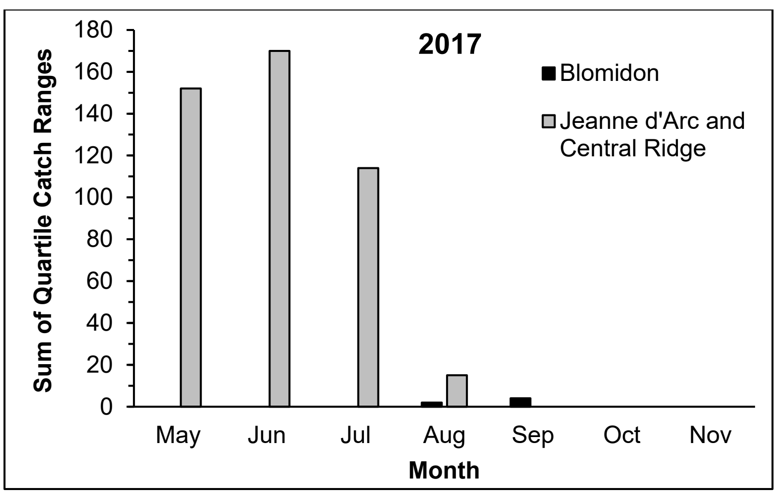
4.2.1.7 Timing and Gear Types

Most of the May–November 2016 and 2017 harvesting in the Blomidon and Jeanne d'Arc/Central Ridge 3D survey areas occurred during the May–July period (see 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 4.10 *in* LGL 2018a, Table 4.7 *in* LGL 2019, and Table 4.2 below). The May–November 2016 and 2017 harvest locations for fixed and mobile gear 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 Blomidon and Jeanne d'Arc/Central Ridge 3D survey areas, 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 Blomidon and Jeanne d'Arc/Central Ridge 3D survey areas, for all species combined during May–November 2017 (derived from DFO commercial landings database, 2017).

Table 4.2. Summary of gear type used and timing of the commercial fishery in the Blomidon and Jeanne d'Arc/Central Ridge 3D survey areas, 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	P	G	L	N	T	D	TL	R	H	C	S
Blomidon 3D Survey Area																									
Greenland Halibut	●	○	●	●	○	○	○	○	○	○	●	●	○	○	○	●	○	○	●	○	○	○	○	○	○
Atlantic Cod	○	○	○	○	○	○	○	○	○	○	○	●	○	○	○	●	○	○	○	○	○	○	○	○	○
Jeanne d'Arc and Central Ridge 3D Survey Area																									
Snow Crab	●	●	●	●	○	○	○	●	●	●	●	○	○	○	●	○	○	○	○	●	○	○	○	○	○
Stimpson's Surf Clam	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○
Propeller Clam	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○
Cockle	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○

Notes:
Fixed Gear Type: P = pot; G = gillnet; L = longline; N = trap net.
Mobile Gear Type: T = trawl ; D = dredge (boat); TL = troller lines; R = rod and reel (trolling); H = electric harpoon; C = sea cucumber drag; S = seine.

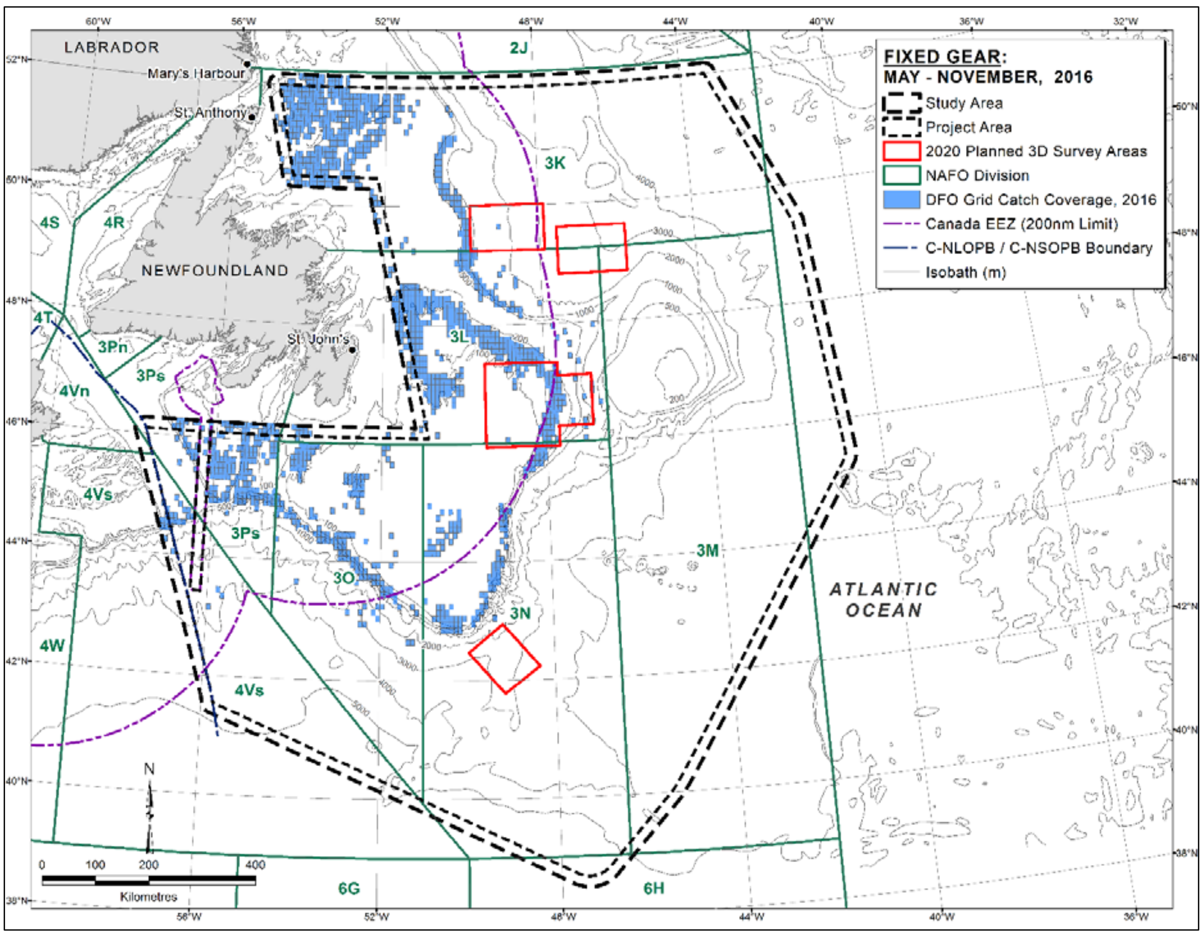


Figure 4.23. Harvest locations for fixed gear, all species, May–November 2016 (derived from DFO commercial landings database, 2016).

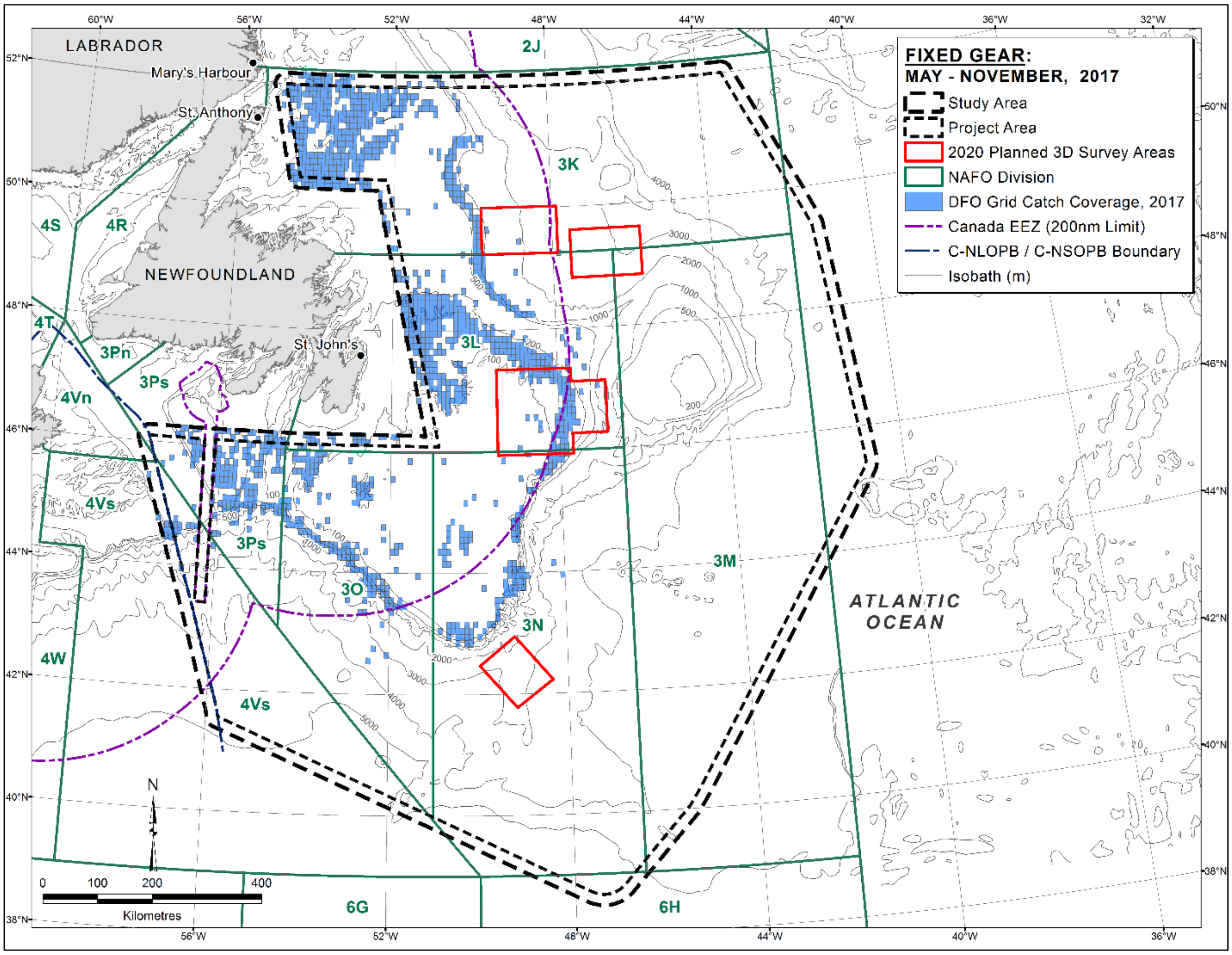


Figure 4.24. Harvest locations for fixed gear, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

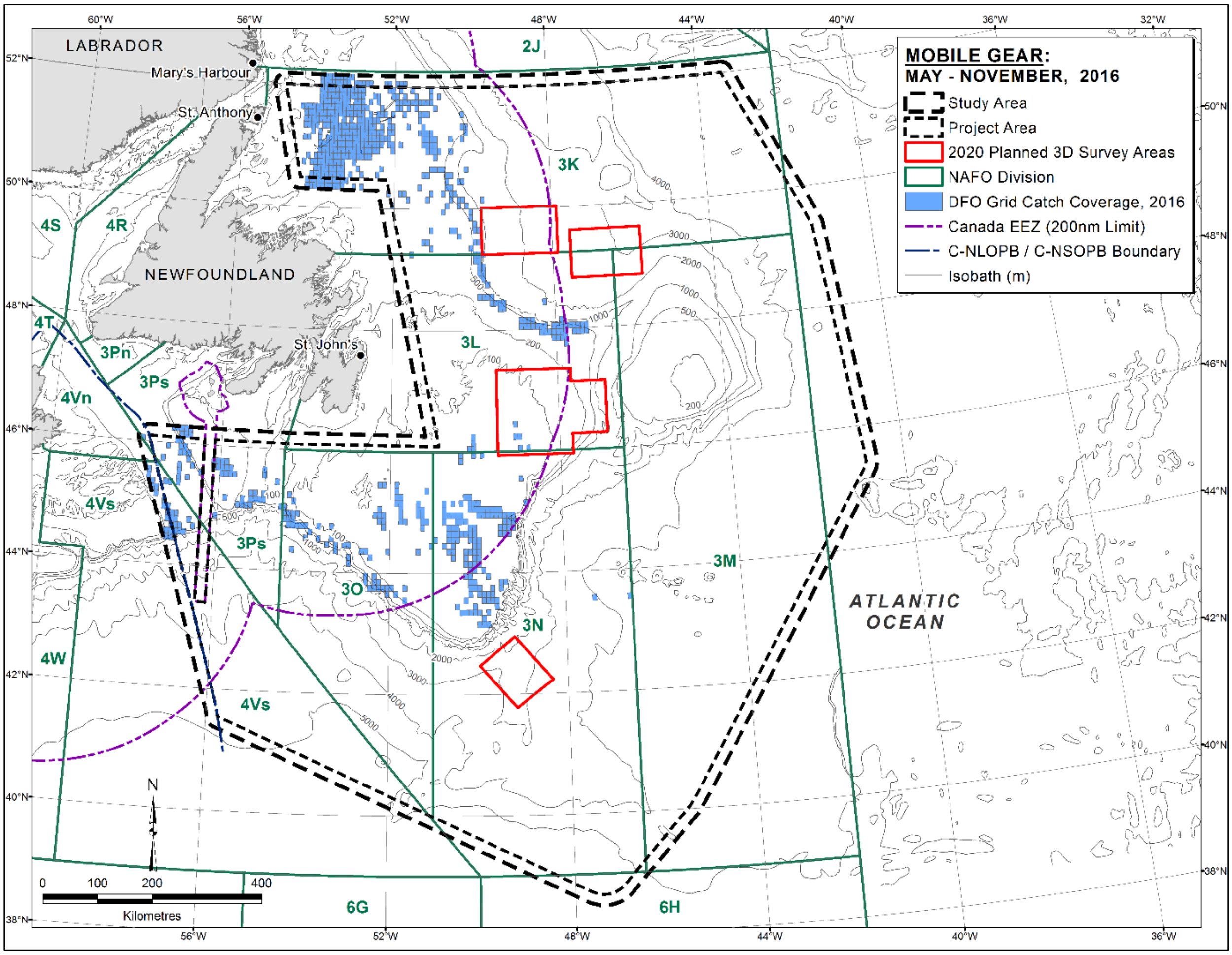


Figure 4.25. Harvest locations for mobile gear, all species, May–November 2016 (derived from DFO commercial landings database, 2016).

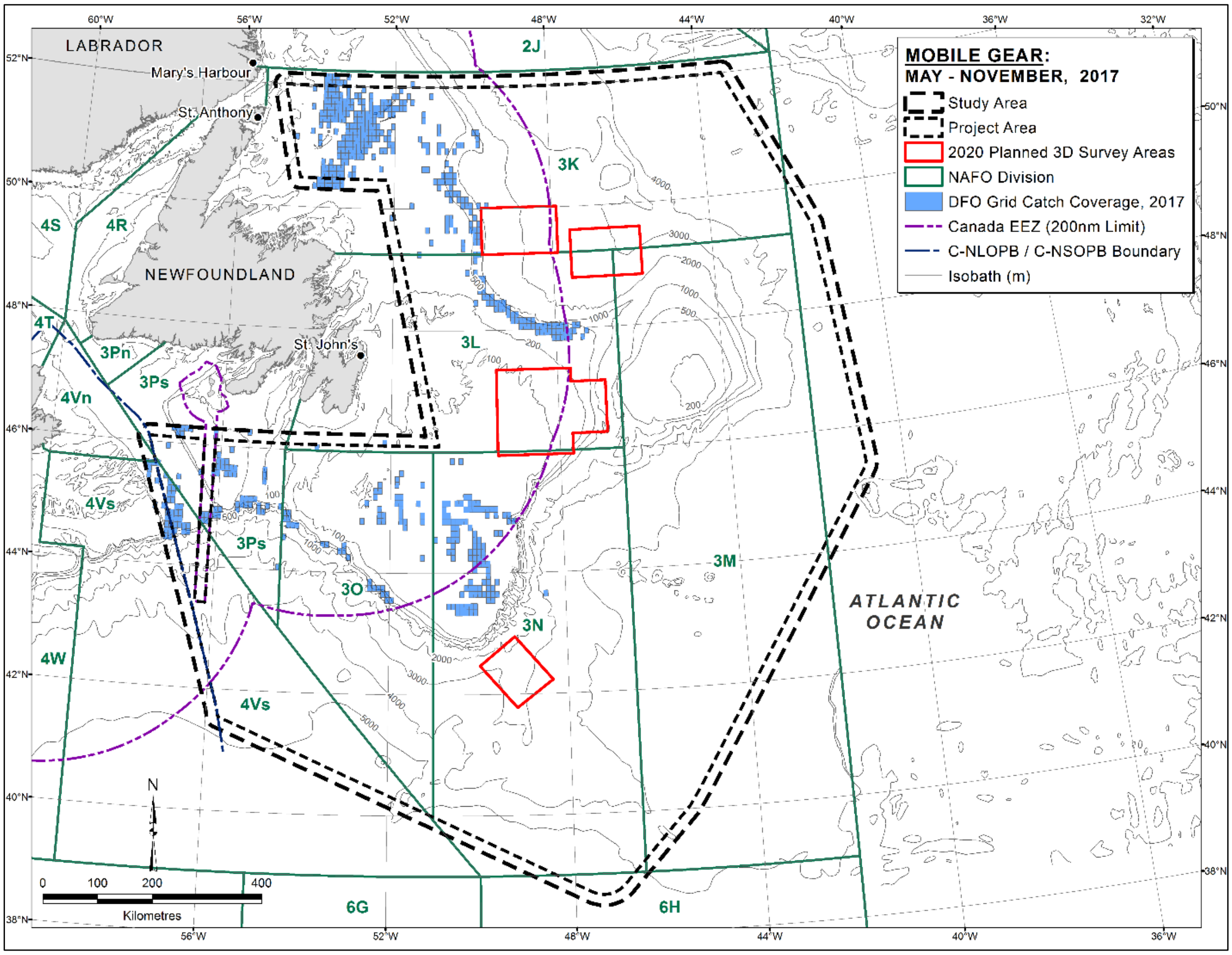


Figure 4.26. Harvest locations for mobile gear, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

4.2.2 Indigenous Fisheries

The most recent (2019) Indigenous communal-commercial licences and allocations for NL-based groups and organizations providing commercial fisheries access within the Study Area for the 2019-2020 season are provided in Table 4.3. Indigenous commercial fisheries catches are included, but not differentiated, in the DFO commercial landings database, summarized above (see subsection 4.2.1) (J. Hosein, Chief, Statistical Services, DFO, pers. comm., 15 April 2020). There are no food, social and ceremonial (FSC) fisheries within the Study Area (D. Ball, Resource Management, DFO, pers. comm., 17 March 2020).

Table 4.3. Indigenous communal-commercial licences and allocations for NL-based groups and organizations within the Study Area, 2019−2020.

Group/Organization	Licence	Quota Area (Fishing Area [FA]/NAFO Division [Div.])
Innu Nation	Capelin	FA 3-11
	Groundfish	Div. 3KL
	Groundfish (mobile)	Div. 3KL
	Herring (*Clupea harrengus*)	FA 3-8
	Mackerel (*Scomber scombrus*)	FA 3-11
	Bluefin Tuna (*Thunnus thynnus*)	Div. 3LNOP
Ueushuk Fisheries	Shrimp	FA 6-7
	Cod	Div. 3KLNO (M) Div. 3Ps (EA) Div. 4VnVs (B)
	Haddock (*Melanogrammus aeglefinus*	Div. 3LNOPs, 4V (M)
	Pollock (*Pollachius* sp.)	Div. 3Ps (M)
	American Plaice	Div. 3LNO (M)
	Witch Flounder (*Glyptocephalus cynoglossus*)	Div. 3KL (M)
	Greenland Halibut	Div. 3KLMNO (EA)
	Atlantic Halibut	Div. 3NOPs, 4V (EA, SQ, C)
	White Hake	Div. 3NOPs (C/B) Div. 4V (B)
	Skates	Div. 3LNOPs (C)
NunatuKavut Community Council (NCC)	Groundfish	Div. 3KL
	Seal	FA 5-8, 33
	Shrimp	FA 6
Nunatsiavut Government (NG)	Groundfish	Div. 3KLPs
	Seal	FA 5-8, 33
	Greenland Halibut	Div. 3KLMNO
Pikalujak Fisheries Ltd. (50/50 partnership NG/Ocean Prawns Canada Ltd.)	Shrimp	FA 6
Miawpukek First Nation (MFN)	Capelin	FA 3-11
	Groundfish	Div. 3KLPs
	Groundfish (mobile)	Div. 3KLPs
	Herring	FA 11
	Mackerel	FA 3-11
	Sea Cucumber	Div. 3Ps
	Seal	FA 5-8, 33
	Snow Crab	FA 10-11
	Squid	FA 10
	Bluefin Tuna	Div. 3LNOP (Atlantic, Rotational)
	Whelk (*Buccinum* sp.)	Div. 3Ps

Group/Organization	Licence	Quota Area (Fishing Area [FA]/NAFO Division [Div.])
Qualipu Mi'kmaq First Nation Band (QFNB)	Bait	Lobster FA 3, 4B
	Capelin	FA 3
	Capelin (mobile)	FA 3-11
	Groundfish	Div. 3KL
	Herring	FA 3
	Herring (mobile)	FA 3-8
	Lobster (*Homarus americanus*)	FA 3, 4B
	Mackerel	FA 3-4
	Mackerel (mobile)	FA 3-11
	Scallop	FA 3-9
	Sea Cucumber	Div. 3LNO
	Snow Crab	FA 3B, 4
	Squid	FA 4
	Whelk	Div. 3K
Mi'kmaq Alsumk Mowimsikik Koqoey Association (MAMKA) (Aboriginal Aquatic Resource & Oceans Management [AAROM] Body – MFN and QFNB)	Capelin	FA 10
	Groundfish	Div. 3KL
	Herring	FA 10
	Snow Crab	FA 10-11
	Whelk	Div. 3Ps

Source: D. Ball, Resource Management, DFO, pers. comm., 17 March 2020.
Notes:
Quota Area: M = moratorium; EA = enterprise allocation; SQ = science quota (use of fish); C = competitive/competitive reserve; B = bycatch.

4.2.3 Recreational Fisheries

Recreational fisheries in NL are described in Section 4.3.4.4 *in* C-NLOPB (2014), Section 3.3.3 *in* C-NLOPB (2010), Section 4.3.5 *in* LGL (2015b), Section 4.2.3 *in* LGL (2016), Section 4.3.5 *in* LGL (2018a), and Section 4.2.3 *in* LGL (2019). There have been no changes in the NAFO Div. in which the NL recreational groundfish and scallop fisheries occur, including 2GHJ, 3KLPsPn, and 4R but excluding the Eastport, Gilbert Bay, and Laurentian Channel Marine Protected Areas (MPAs), of which Div. 3KLPs overlap with the Study Area.

The 2019 NL recreational groundfish fishery was scheduled to be open for 39 days, the same as during 2018, from 29 June–29 September (DFO 2020g). As in the 2018 season, there was still no requirement for fishing licenses or tags during 2019 (DFO 2020g). The 2019 NL recreational scallop fishery was set to occur year-round and required the possession of a recreational scallop licence (DFO 2020g).

A full science stock assessment for Atlantic salmon in NL occurred in March 2019 (DFO 2020g). During 2018, an estimated 13,600 and 25,000 Atlantic salmon were retained and released, respectively (Whiffen 2019). Although there was some improvement in stocks during 2018, many rivers showed declines in salmon returns and/or abundance relative to recent years (Whiffen 2019). As a result, DFO released the *Implementation Plan 2019 to 2021* to restore and sustain wild

Atlantic salmon populations (DFO 2019g) and revised its management decision to allow the retention of one salmon on Class 2 rivers and two on Class 4/6 and unclassified rivers (DFO 2020g). The 2019 Atlantic salmon season was variably open from June–September or October, depending on the fishing zone (DFO 2020g). The 2019−2023 NL recreational trout season will be open from February or March to September, with various retention limits depending on species (DFO 2020g).

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 2020 3D survey areas.

4.2.4 Aquaculture

Aquaculture operations in NL are described in Section 4.3.4.3 *in* C-NLOPB (2014) and Section 3.3.2 *in* C-NLOPB (2010). All aquaculture sites within NL have remained coastally-based. There are no approved aquaculture sites within the Study Area (FLR 2020; R.J. Keel, Manager of Aquaculture Licensing and Administration, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador, pers. comm., 20 March 2020).

4.2.5 Science Surveys

4.2.5.1 DFO Research Vessel (RV) Surveys

The most recent RV data available are from the 2017 dataset [2], which was presented for the Study Area in the 2019 EA Update (see Section 4.2.5.1 *in* LGL 2019). The results of the analysis of DFO RV survey data within the Study Area will not be repeated here; instead, this section summarizes recent RV data within the 2020 3D survey areas.

During May−November 2015−2017, RV survey catch locations occurred throughout the Jeanne d'Arc and Central Ridge 3D survey area (Figures 4.27–4.29). There were no catch locations within the Blomidon, East Tablelands, or South Bank 3D survey areas. Catch weights, numbers, and 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 Jeanne d'Arc and Central Ridge 3D survey area during May−November 2015−2017 are presented in Tables 4.4–4.6. Similar to DFO RV surveys described in the EA (LGL 2018a) and 2019 EA Update (LGL 2019), deepwater redfish comprised the majority of total catch weight (30%), followed by sand lance (23%), American plaice (15%), yellowtail flounder (9%), thorny skate (6%), and Atlantic cod (3%). Total catch weight across all species caught in the Jeanne d'Arc and Central Ridge 3D survey area

[2] DFO is undergoing changes in their RV data request protocols and is currently not releasing multispecies spring and fall RV survey data (B. Pye, Environmental Sciences, Science Branch, DFO, pers. comm., 17 March 2020).

during DFO RV surveys during May−November 2015−2017 was 14 mt, with annual total catch weights ranging from 4−6 mt.

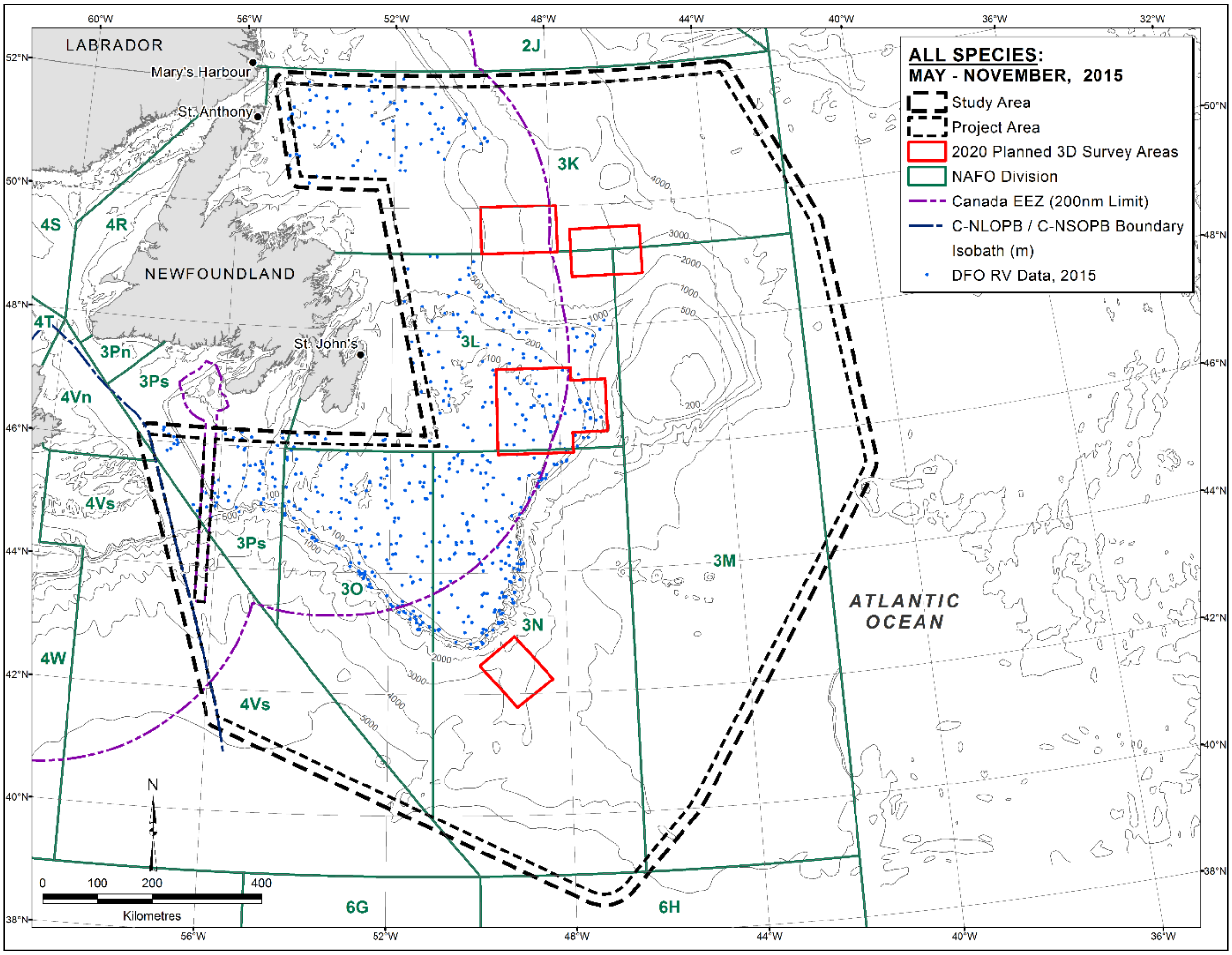


Figure 4.27. Distribution of DFO RV survey catch locations, all species, May–November 2015 (derived from DFO RV survey database, 2015).

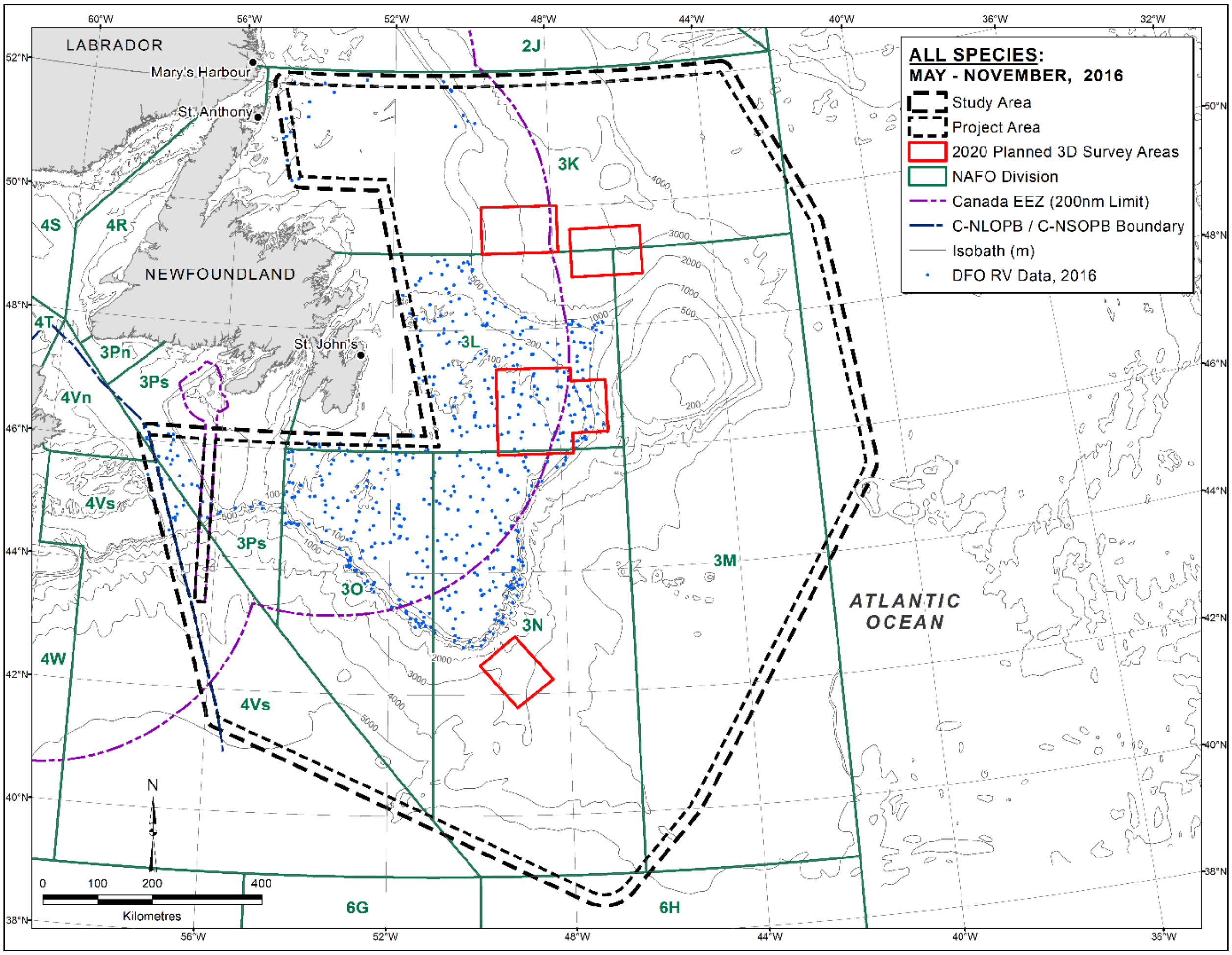


Figure 4.28. Distribution of DFO RV survey catch locations, all species, May–November 2016 (derived from DFO RV survey database, 2016).

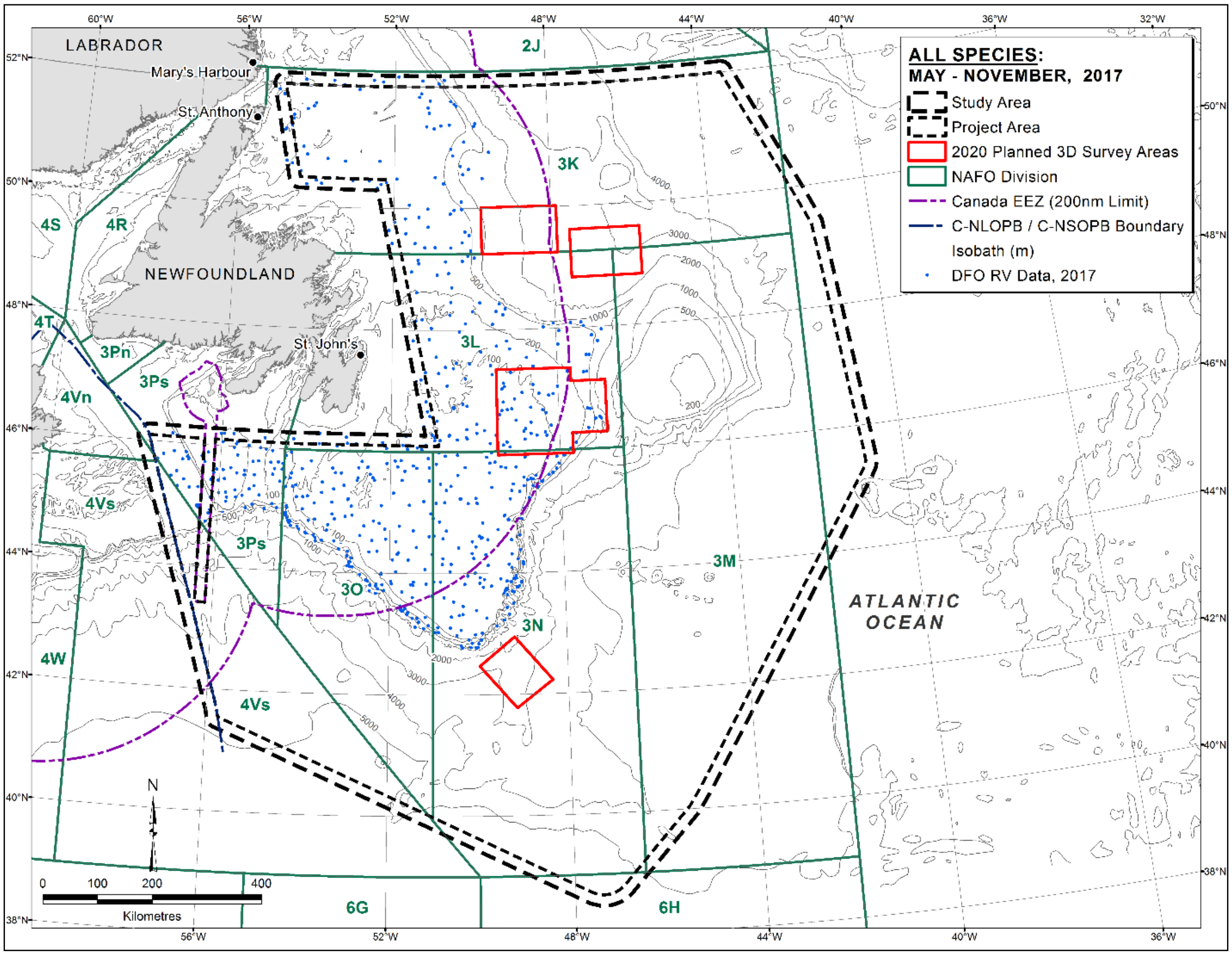


Figure 4.29. Distribution of DFO RV survey catch locations, all species, May–November 2017 (derived from DFO RV survey database, 2017).

Table 4.4. Catch weights and numbers of macroinvertebrates and fishes collected during DFO RV surveys in the Jeanne d'Arc and Central Ridge 3D survey area, May–November 2015–2017 (derived from DFO RV survey databases, 2015–2017).

Species	Catch Weight (mt)			Total Catch Weight (mt)	Catch Number			Total Catch Number
	2015	2016	2017		2015	2016	2017	
Deepwater Redfish (*Sebases mentella*)	2	2	0.4	**4**	9393	4833	1160	**15,386**
Sand Lance (*Ammodytes dubius*)	<0.1	2	1	**3**	6606	144,018	106,497	**257,121**
American plaice	1	1	1	**2**	10,756	10,233	8303	**29,292**
Yellowtail flounder	1	0.1	1	**1**	1621	404	2387	**4412**
Thorny Skate (*Raja radiata*)	0.4	0.2	0.2	**1**	285	311	219	**815**
Atlantic Cod	0.1	0.2	0.1	**0.4**	282	217	60	**559**
Roughhead Grenadier (*Macrourus berglax*)	0.1	0.1	0.1	**0.3**	335	308	245	**888**
Greenland Halibut	<0.01	0.1	<0.1	**0.1**	121	339	250	**710**
Sessile Tunicate (*Boltenia* sp.)	<0.1	0.1	<0.1	**0.1**	93	930	441	**1464**
Green Sea Urchin (*Strongylocentrotus droebachiensis*)	0.1	<0.1	<0.1	**0.1**	5149	3385	2407	**10,941**
Striped Shrimp (*Pandalus montagui*)	<0.1	<0.1	0.1	**0.1**	5029	8829	16,779	**30,637**
Sand Dollar (Clypeasteroida)	<0.1	<0.1	0.1	**0.1**	1025	1477	2398	**4900**
Jellyfish (Scyphozoa)	<0.1	<0.1	<0.1	**0.1**	n/d	n/d	n/d	**n/d**
Sponge (Porifera)	<0.1	<0.1	<0.1	**0.1**	n/d	n/d	n/d	**n/d**
Snow Crab	<0.1	<0.1	<0.1	**0.1**	287	406	165	**858**
Atlantic wolffish	0.1	<0.1	<0.1	**0.1**	58	34	12	**104**
Spinytail Skate (*Raja spinicauda*)	0	0.1	<0.1	**0.1**	0	6	3	**9**
Northern Shrimp	<0.1	<0.1	<0.1	**0.1**	6353	2477	6642	**15,472**
Spotted wolffish	<0.1	<0.1	<0.1	**0.1**	8	10	1	**19**
Witch Flounder	<0.1	<0.1	<0.1	**0.04**	45	37	14	**96**
Capelin	<0.1	<0.1	<0.1	**0.04**	433	1890	452	**2775**
Arctic Argid Shrimp (*Argis dentata*)	<0.1	<0.1	<0.1	**0.04**	3954	2776	1457	**8187**
Sea Anemone (Actinaria)	<0.1	<0.1	<0.1	**0.04**	511	535	264	**1310**
Sand Dollar (*Echinarachnius parma*)	<0.1	<0.1	<0.1	**0.04**	788	256	743	**1787**
Polar Sea Star (*Leptastarias polaris*)	<0.1	<0.1	<0.1	**0.03**	37	55	177	**269**
Moustache Sculpin (*Triglops murrayi*)	<0.1	<0.1	<0.1	**0.03**	715	1938	350	**3003**
Sessile Tunicate (Ascidiacea)	<0.1	<0.1	<0.1	**0.03**	64	48	585	**697**
Sculptured Shrimp (*Sclerocrangon boreas*)	<0.1	<0.1	<0.1	**0.02**	35	763	1213	**2011**

Species	Catch Weight (mt)			Total Catch Weight (mt)	Catch Number			Total Catch Number
	2015	2016	2017		2015	2016	2017	
Toad Crab (*Hyas araneus*)	0	<0.1	<0.1	**0.02**	0	80	1575	**1655**
Blue Hake (*Antimora rostrata*)	<0.1	<0.1	0	**0.02**	53	51	0	**104**
Sea Urchin (Echinoidea)	0	0	<0.1	**0.01**	0	0	991	**991**
Brittle Star (*Ophiura sarsi*)	<0.1	<0.1	<0.1	**0.01**	486	74	172	**732**
Spiny Lebbeid Shrimp (*Lebbeus groenlandicus*)	<0.1	<0.1	<0.1	**0.01**	936	791	1192	**2919**
Shrimp (*Acanthephyra pelagica*)	<0.1	<0.1	<0.1	**0.01**	760	110	900	**1770**
Corals	<0.1	<0.1	<0.1	**0.01**	2	140	29	**171**
Parrot Shrimp (*Spirontocaris spinus*)	<0.1	<0.1	<0.1	**0.01**	1489	1707	2186	**5382**
Northern Wolffish	<0.1	<0.1	<0.1	**0.01**	4	3	3	**10**
Toad Crab (*Hyas* sp.)	<0.1	<0.1	<0.1	**0.01**	402	389	6	**797**
Golden Redfish (*Sebastes marinus*)	<0.1	<0.1	0	**0.01**	1	2	0	**3**
Rigid Cushion Star (*Hippasteria phrygiana*)	<0.1	<0.1	0	**0.01**	44	55	0	**99**
Toad Crab (*Hyas coarctatus*)	0	<0.1	<0.1	**0.01**	0	186	121	**307**
Arctic Cod (*Boreogadus saida*)	<0.1	<0.1	<0.1	**0.01**	36	1025	10	**1071**
Total	**5**	**6**	**4**	**14**	**58,196**	**191,128**	**160,409**	**409,733**

Note: n/d denotes data unavailable.

Table 4.5. Mean catch depths of macroinvertebrates and fishes collected during DFO RV surveys in the Jeanne d'Arc and Central Ridge 3D survey 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
Deepwater Redfish	342	367	-	**355**	339	355	353	**347**
Sand Lance	99	106	69	**95**	-	-	-	**-**
American plaice	161	129	70	**122**	151	160	134	**146**
Yellowtail flounder	69	81	67	**74**	68	66	88	**77**
Thorny Skate	205	164	61	**149**	160	172	144	**156**
Atlantic Cod	185	153	67	**139**	156	97	127	**133**
Roughhead Grenadier	412	454	-	**433**	501	420	442	**466**
Greenland Halibut	327	403	-	**365**	342	230	202	**264**
Sessile Tunicate (*Boltenia* sp.)	-	147	66	**120**	88	84	79	**84**
Green Sea Urchin	125	106	62	**100**	133	111	113	**121**
Striped Shrimp	124	106	72	**102**	131	97	122	**121**
Sand Dollar (Clypeasteroida)	152	114	67	**112**	92	261	147	**162**
Jellyfish (Scyphozoa)	530	244	-	**340**	431	296	152	**292**
Sponge (Porifera)	451	342	86	**293**	469	368	279	**396**
Snow Crab	149	113	73	**112**	145	148	114	**133**
Atlantic wolffish	277	292	-	**285**	195	228	237	**218**
Spinytail Skate	-	364	-	**364**	-	546	485	**515**
Northern Shrimp	295	337	-	**316**	233	210	209	**215**
Spotted wolffish	170	410	-	**290**	238	186	296	**240**
Witch Flounder	327	374	-	**351**	322	546	369	**412**
Capelin	172	136	68	**128**	-	-	-	**-**
Arctic Argid Shrimp	113	107	73	**100**	143	146	124	**136**
Sea Anemone (Actinaria)	227	142	-	**170**	227	245	174	**205**
Sand Dollar	205	138	70	**137**	195	-	110	**138**
Polar Sea Star	78	136	71	**105**	107	112	75	**98**
Moustache Sculpin	113	106	71	**99**	-	-	-	**-**
Sessile Tunicate (Ascidiacea)	220	125	76	**137**	-	165	141	**153**
Sculptured Shrimp	-	74	67	**71**	75	69	84	**76**
Toad Crab	-	-	69	**69**	-	87	85	**86**
Blue Hake	668	694	-	**681**	-	-	-	**-**
Sea Urchin (Echinoidea)	-	-	74	**74**	-	-	-	**-**
Brittle Star	174	215	-	**194**	188	166	170	**173**
Spiny Lebbeid Shrimp	77	79	79	**79**	90	78	85	**84**
Shrimp (*Acanthephyra pelagica*)	668	-	-	**668**	673	628	674	**658**
Corals	238	157	70	**155**	445	223	139	**278**
Parrot Shrimp	163	100	72	**109**	135	94	98	**115**
Northern Wolffish	-	559	-	**559**	276	-	293	**287**
Toad Crab (*Hyas* sp.)	132	107	-	**115**	123	-	65	**104**
Golden Redfish	-	-	-	**-**	228	323	-	**276**
Rigid Cushion Star	452	364	-	**408**	513	356	-	**461**

Species	Spring Mean Catch Depth (m) [a]				Fall Mean Catch Depth (m) [b]			
	2015	2016	2017	Total	2015	2016	2017	Total
Toad Crab (*Hyas coarctatus*)	-	-	68	**68**	-	102	87	**94**
Arctic Cod	185	130	86	**133**	-	-	-	**-**
Total	**196**	**144**	**70**	**139**	**251**	**175**	**144**	**193**

[a] Spring survey months: 2015 = May; 2016 = May–June; 2017 = June.
[b] Fall survey months: 2015 = October−November; 2016 = November; 2017 = October−November.

Table 4.6. Total catch weights and predominant species caught at various mean catch depth ranges in the Jeanne d'Arc and Central Ridge 3D survey area 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	1	2	2	Yellowtail Flounder (89%) Sand Lance (8%)	Sand Lance (92%) Yellowtail Flounder (6%)	Sand Lance (55%) Yellowtail Flounder (32%) Sand Dollar (3%) Striped Shrimp (3%)
100 – 199	2	1	1	American Plaice (52%) Thorny Skate (29%) Atlantic Cod (8%)	American Plaice (53%) Thorny Skate (13%) Atlantic Cod (11%)	American Plaice (54%) Thorny Skate (21%) Atlantic Cod (6%)
200 – 299	0.2	0.2	0.1	Atlantic Wolffish (29%) Jellyfish (19%) Northern Shrimp (16%) Spotted Wolffish (11%)	Greenland Halibut (40%) Spotted Wolffish (28%) Atlantic Wolffish (17%)	Greenland Halibut (38%) Northern Shrimp (33%) Sponge (15%)
300 – 399	2	2	0.4	Deepwater Redfish (91%) Roughhead Grenadier (4%)	Deepwater Redfish (96%) Sponge (3%)	Deepwater Redfish (98%) Witch Flounder (1%) Northern Wolffish (1%)
400 – 499	<0.1	0.2	0.1	Rigid Cushion Star (79%) Scaled Lancetfish (*Notolepis rissoi kroyeri*; 10%)	Roughhead Grenadier (56%) Spinytail Skate (33%) Witch Flounder (10%)	Roughhead Grenadier (72%) Spinytail Skate (28%)
500 – 599	<0.1	<0.1	<0.1	Short Barracudina (*Paralepis brevis*; 51%) Marlin Spike (*Nezumia bairdi*; 49%)	Northern Wolffish (57%) Lanternfishes (16%) Marlin Spike (10%)	Octopus (*Bathypolypus arcticus*; 100%)
600 – 699	<0.1	<0.1	<0.1	Shrimp (*Acanthephyra pelagica*;31%) Blue Hake (30%) Black Dogfish (*Centroscyllium fabricii*; 29%)	Blue Hake (78%) Roundnose Grenadier (9%)	Shrimp (*A. pelagica*; 87%) Roundnose Grenadier (5%)
700 –799	-	-	-	-	-	-
800 –899	-	-	-	-	-	-
900 –999	-	-	-	-	-	-
≥1000	-	-	-	-	-	-

The tentative schedule for the 2020 DFO multispecies RV surveys is presented in Table 4.7. Spring RV surveys within the Study Area are set to begin late-March and continue into early-June. Fall RV surveys within the Study Area will begin early-September and end in late-December. Three additional DFO RV surveys will occur during spring and late summer, including the NL Spring Atlantic Zone Monitoring Program, Capelin, and Shellfish surveys. At the time of writing, the RV surveys are still on schedule but the occurrence of these surveys is subject to change in light of the COVID-19 situation (L. Mello, Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO, pers. comm., 17 March 2020).

Table 4.7. Tentative schedule of DFO RV surveys within the Study Area during 2020.

NAFO Division	Start Date	End Date	Vessel
NL Spring/Fall RV Surveys			
3P	28 Mar	9 Apr	*Needler*
3P	14 Apr	21 Apr	*Needler*
3OP	22 Apr	5 May	*Needler*
3NO	5 May	19 May	*Needler*
3LN	20 May	2 Jun	*Needler*
3O	9 Sep	22 Sep	*Needler*
3NO	23 Sep	6 Oct	*Needler*
3LN	7 Oct	20 Oct	*Needler*
3L	21 Oct	3 Nov	*Needler*
3KL	4 Nov	17 Nov	*Needler*
3K	18 Nov	1 Dec	*Teleost*
3K	2 Dec	18 Dec	*Teleost*
Other DFO RV Surveys			
3L	30 Mar	21 Apr	*Teleost* (NL Spring AZMP)
3KL	28 Apr	19 May	*Teleost* (Capelin Survey)
3N	26 Aug	7 Sep	*Needler* (Shellfish Survey)

Source: L. Mello, Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO, pers. comm., 17 March 2020.
Note:
AZMP = Atlantic Zone Monitoring Program

4.2.5.2 Industry and DFO Science Surveys

The DFO-Industry collaborative post-season snow crab trap survey is described in Section 4.3.8 *in* LGL (2018a). The 2020 snow crab TAC for this survey has not yet been released by DFO, but it remained at 400 mt during both 2018 and 2019 (DFO 2020g). A total of 432 survey stations occur within the Study Area, including 44 within the Jeanne d'Arc and Central Ridge 3D survey area (Figure 4.30). There are no survey stations within the Blomidon, East Tablelands, and South Bank 3D survey areas. As noted in LGL (2018a), survey stations are randomly sampled each year.

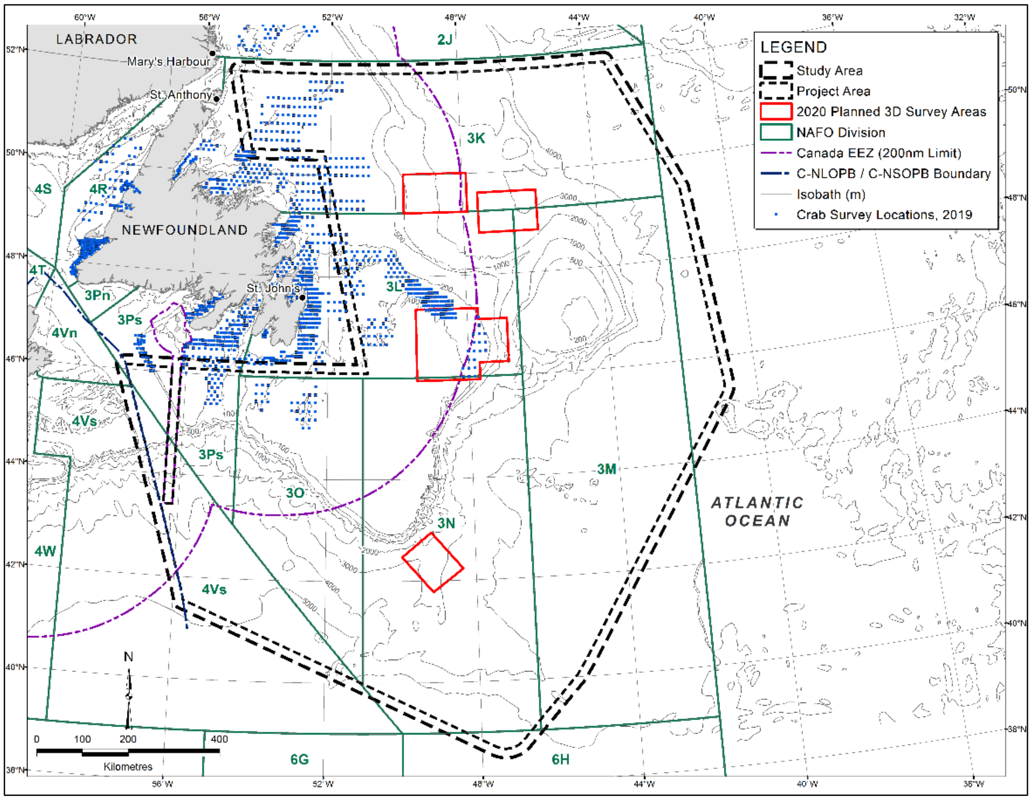


Figure 4.30. Locations of DFO-Industry collaborative post-season snow crab trap survey stations.

4.3 Marine-Associated Birds

The patterns of distribution and density in this updated summary largely confirm those presented in the summary of 2006–2009 ECSAS data (Fifield et al. 2009), those from seabird surveys conducted from geophysical exploration vessels by LGL (LGL 2018a), and those described in Section 4.3 of the 2019 EA Update (LGL 2019). As indicated in the 2019 EA Update (LGL 2019), recently collected data include previously unsampled areas of the southwestern Grand Banks and the Tail of the Bank. These data show a high density (20.0–96.5 birds/km^2) of combined murre species during the April–July period on the Tail of the Bank, which overlaps and/or is near the South Bank 3D survey area. These concentrations probably represent Thick-billed Murres (*Uria lomvia*) lingering into April and May before their departure to Arctic nesting and summering areas. The newly sampled areas around the Tail of the Bank also show high concentrations of Leach's Storm-Petrel (*Hydrobates leucorhous*; 11.8–29.7 birds/km^2) during August–November. This is consistent with the abandonment of storm-petrel nesting colonies during September and October, and this species' preference for foraging in the waters off the continental shelf (Hedd et al. 2018). Thirteen Leach's Storm-Petrels were tracked with geolocators during fall and winter from two breeding colonies in Bon Portage Island and Country Island, Nova Scotia. One bird wintered in waters off Newfoundland and the others overwintered in the North Atlantic Ocean, either in areas associated with the North Equatorial Current or in the South Atlantic Ocean, in areas associated with the Benguela Current off southwestern Africa. It was considered premature to estimate the proportions of birds from these colonies that wintered in each location due to the low sample size (Pollet et al. 2019). The updated data do not affect the conclusions of the original EA with its proposed mitigation measures of searching for, recovering, and releasing storm-petrels which may strand on Project vessels.

Since the EA and 2019 EA Update (LGL 2018a, 2019), Environment and Climate Change Canada-Canadian Wildlife Service (ECCC-CWS) has acquired updated nesting colony information for several species of seabirds (ECCC-CWS unpubl. data). These updated data are highlighted in red font in Table 4.8 and reflected in the text below on breeding colonies in Newfoundland. These updated data do not affect the conclusions in the original EA.

There are seabird breeding colonies of worldwide significance in eastern Newfoundland (Table 4.8). Over 4 million pairs of seabirds nest on the southeast coast of Newfoundland alone, including 2.8 million pairs of Leach's Storm-Petrels and ~756,000 pairs of Common Murres (*Uria aalge*) (Table 4.8). More than 3.4 million pairs of seabirds nest at Funk Island, Baccalieu Island, and Witless Bay Islands, which continue to host Atlantic Canada's largest seabird breeding colonies (Table 4.8). Also in the region are the largest Atlantic Canadian colonies of Leach's Storm-Petrel (1.97 million pairs on Baccalieu Island), Common Murre (~470,000 pairs on Funk Island), Black-legged Kittiwake (*Rissa tridactyla*; ~13,200 pairs on Witless Bay Islands), and Atlantic Puffin (*Fratercula arctica*; ~304,000 pairs on Witless Bay Islands). A decline in the number of Leach's Storm-Petrels nesting at Baccalieu Island that was described in the original EA based on unpublished ECCC-CWS data has since been published (Wilhelm et al. 2019). However no new information on the decline at that colony or at other colonies has come to light since the 2019 EA Update. There have been no updates to the temporal and spatial distribution of seabird species throughout the Study Area since the 2019 EA Update (see Section 4.3 *in* LGL 2019).

4.4 Marine Mammals and Sea Turtles

The new information presented in this section does not change the effects predictions for the Marine Mammal and Sea Turtle VEC made in the EA (LGL 2018a) or its Addendum (LGL 2018b).

4.4.1 General Cetacean and Sea Turtle Surveys

A large database of cetacean and sea turtle sightings in Newfoundland and Labrador 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 (LGL 2018a).

Table 4.8. Number of pairs (p) and individual (i) seabirds at nesting colonies in northern and eastern Newfoundland (46°N to 52°N).

Species	Northern Groais Island	Little Fogo Island Group	Wadham Islands	Funk Island	Cape Freels/ Cabot Island	Bonavista Peninsula	Baccalieu Island	Witless Bay Islands	Mistaken Point	Cape St. Mary's	Middle Lawn Island	Corbin Island	Green Island	Grand Colombier Island	Miquelon Cape	Total
Northern Fulmar (*Fulmarus glacialis*)	-		-	40p[l]	-	2p[a]	-	51p[a]	-	Present[a]	-	-	-			**93p**
Manx Shearwater (*Puffinus puffinus*)	-		-	-	-	-	-	-	-	-	7p[c]	-	-			**7p**
Leach's Storm-Petrel	-	7102p[a]	4504p[a]	-	10,115p[a,l]	1771p[a,l,m]	1,976,665p[b]	313,902p[a,j]	-	-	10,790p[a]	100,000p[b]	49,406p[a]	363,787p[e]		**2,838,042p**
Northern Gannet (*Morus bassanus*)	-		-	10,964p[a]	-	-	3488p[a]	-	-	14,598p[a]	-	-	-			**29,050p**
Herring Gull (*Larus argentatus*)	-		54i[a]	-	250p[a]	993i[a]	46p[a]	2266p[a]	-	39p[b]	20p[b]	50p[b]	Present[b]	60p[f]	265p[d]	**2996p 1,047i**
Great Black-backed Gull (*Larus marinus*)	-		2i[a]	75i[a]	14p[a]	1000i[a]	2p[a]	15p[a]	-	Present[b]	6p[b]	25p[b]	-	10p[f]		**72p 1,077i**
Black-legged Kittiwake	1050p[g]	350i[a]	-	95p[a]	43p[a]	2172p[a]	5096p[a]	13,211p[a]	4170p[f]	4391p[a]	-	50p[b]	-	196p[f]	2415p[d]	**32889p 350i**
Arctic and Common Terns (*Sterna paradisaea* and *S. hirundo*)	-		22p[g]	-	1420i[a]	17i[a]	-	-	-	-	-	-	Present[b]			**22p 1437i**
Common Murre	-		23p[a]	472,259p[g]	9897p[a]	-	1440p[a]	250,000p, 14,599i[a]	84p[b]	15,484p[a]	-	-	-	7176p[h]		**756,363p 14,599i**
Thick-billed Murre	-		-	250p[a]	-	-	73p[a]	240p[a]	-	1000p[f]	-	-	-			**1563p**
Razorbill (*Alca torda*)	25p[l]	1265p[a]	4103p[a]	200p[a]	54p[a]	142i[a]	456p[a]	201p, 639i[a]	22p[f]	100p[b]	-	-	-	1443p[h]		**7869p 781i**
Black Guillemot (*Cepphus grylle*)	-		25i[a]	1p[b]	7p, 182i[a]	25i[a]	113p[a]	1p, 13i[a]	Present[b]	Present[b]	-	-	-	95p[i]	Present[d]	**217p 245i**
Atlantic Puffin	1250p[a]	16,755 p[a,l]	29,508p[a]	2000p[a]	8900p[a]	16,668p[a]	75,000p[f]	304,042p[a,j]	79p[f]	-	-	-	-	9543p[i]		**463,745p**
TOTAL	**2325p**	**25,122p, 350i**	**38,160p, 81i**	**485,809p, 75i**	**29,280p, 1602i**	**20,613p, 2177i**	**2,062,379p**	**883,929p, 15,251i**	**4355p**	**35,612p**	**10,823p**	**100,125p**	**49,406p**	**382,310p**	**2680p**	**4,312,928p 19,536i**

Sources: [a] ECCC-CWS unpublished data, [b] Wilhelm et al. (2019); [c] Fraser et al. (2013); [d] Cairns et al. (1989); [e] Lormée et al. (2012); [f] Parks and Natural Areas Division, unpublished data; [g] Thomas et al. (2014); [h] Lormée et al. (2015); [i] Lormée (2008); [j] Wilhelm et al. (2015); [k] Robertson and Elliot 2002; [l] Montevecchi unpublished data; [m] Threfall unpublished data.

During a survey in offshore waters of Atlantic Canada to compare visual, acoustic, and infrared detections during summer 2017, numerous marine mammal detections were made using one or more of these methods (Smith et al. 2020). The survey departed from Halifax, Nova Scotia, on 30 July and returned there on 23 August, but also made port calls in Fortune and St. John's, Newfoundland; all survey effort occurred within Canada's Exclusive Economic Zone (EEZ). Thus, the survey overlapped the southwestern portion of the MKI Study Area. Detections included blue (*Balaenoptera musculus*), fin (*B. physalus*), minke (*B. acutorostrata acutorostrata*), humpback (*Megaptera novaeangliae*), sperm (*Physeter macrocephalus*), long-finned pilot (*Globicephala melas*), and possible killer whales (*Orcinus orca*), Atlantic white-sided (*Lagenorhynchus acutus*) and short-beaked common dolphins (*Delphinus delphis*), an unidentified seal, and acoustic detections of unidentified dolphins or beaked whales. Specific locations of detections were not provided by Smith et al. (2020).

During summer 2016, aerial surveys of the Atlantic Canadian shelf and shelf break habitats from northern Labrador to southern Nova Scotia were flown, known as the Northwest Atlantic International Sightings Survey (NAISS) (NAMMCO 2018). A total of 1073 sightings of 10,956 individuals were made in Newfoundland and Labrador waters, including fin, humpback, and minke whales. The most common cetacean was the white-beaked dolphin (*L. albirostris*). On the Scotian Shelf, 1182 sightings of 4819 individuals were made, including common dolphins. The data from this study are not yet published.

4.4.2 Updated Species Information

4.4.2.1 North Atlantic Right Whale

In addition to the single sighting of two right whales (*Eubalaena glacialis*) reported to have occurred in the Study Area in the EA (LGL 2018a), DFO (2019h) reported additional sightings in the Study Area, including one in the Flemish Pass during summer and several in the Laurentian Channel and south of the Grand Banks. DFO (2019h) noted that northeastern Newfoundland could benefit from increased survey effort for right whales. Passive acoustic monitoring for right whales occurred off Newfoundland and Nova Scotia from 2015 to 2017. No right whales were detected at a hydrophone on the southwestern edge of the Grand Banks. However, acoustic detections were made at a hydrophone in Placentia Bay during July 2017, in Cabot Strait/Laurentian Channel from spring through fall, and along the eastern Scotian Shelf throughout the year.

Thirty mortalities were reported for the North Atlantic right whale population over the last three years − 17 individuals in 2017, 3 individuals in 2018, and 10 mortalities in 2019; 9 of the mortalities in 2019 occurred in Canada (Pettis et al. 2019). Thirteen of the 30 mortalities involved anthropogenic factors, such as vessel strikes and entanglement in fishing gear. For all mortalities between 2003 and 2018 for which the cause of death was known, all mortalities were due to vessel collision or entanglement (Sharp et al. 2019). Over the last three years, 12 calves were born, including seven in 2019 and none in 2018 (Pettis et al. 2019). The best population estimate at the end of 2018 was 409 individuals (Pettis et al. 2019).

4.4.2.2 Sei Whale

COSEWIC released an assessment and status report on the sei whale (*B. borealis*) in 2019; the population size is thought to be a few hundred animals (COSEWIC 2019a). Acoustic detections were recorded throughout the Study Area, including at a site along the Scotian Shelf adjacent to the Laurentian Channel which was monitored by DFO. COSEWIC (2019a) also summarized visual sightings in the region, including records throughout the Study Area.

4.4.2.3 Fin Whale

COSEWIC released an assessment and status report on the fin whale in 2019; the population size in 2016 was estimated at 1664 based on NAISS (COSEWIC 2019b). Sightings during NAISS were made throughout the Study Area; COSEWIC (2019a) also summarized all other sightings in the region.

4.4.2.4 Humpback Whale

Acoustic detections of humpback whales were made on foraging grounds off northeast Newfoundland during summer 2015 and 2016, to characterize their call repertoire (Epp 2019). It was found that humpbacks occurring off Newfoundland have an extensive and possibly stable repertoire, and some calls were similar to those that occur in Hawaii.

4.4.2.5 Northern Bottlenose Whale

Northern bottlenose whales (*Hyperoodon ampullatus*) have been sighted and detected acoustically in the Sackville Spur/Flemish Pass area off Newfoundland during summer (Clarke et al. 2019; Feyrer et al. 2019). They have also been sighted and detected acoustically in their critical habitat (The Gully, Haldimand Canyon, Shortland Canyon) west of the Study Area, as well as off the northeastern edge of the Scotian Shelf within and near the Study Area (Clarke et al. 2019; DFO 2020h). Movement between critical habitat areas has been reported throughout the year, with the highest click detection rates reported outside of summer. The inter-canyon areas between the critical habitat are proposed as important habitat for northern bottlenose whales (DFO 2020h).

Overall, northern bottlenose whales show low genetic diversity (Feyrer et al. 2019). Based on genetic studies, the Scotian Shelf population is distinct from all others in the Atlantic (Feyrer et al. 2019). Although there is some genetic uncertainty, individuals that have been sampled off Newfoundland in the Flemish Cap/Pass region do not appear to be a distinct population or part of the Scotian Shelf population. Newfoundland waters may be an area of mixing, as some of these individuals appear to group genetically with those from Northern Labrador and one animal was grouped with the Scotian Shelf population. The Davis Strait-Baffin Bay-Labrador Sea population did not show genetic distinction from other populations in the North Atlantic.

4.4.2.6 Sowerby's Beaked Whale

COSEWIC released an assessment and status report on Sowerby's beaked whale (*Mesoplodon bidens*) in 2019 (COSEWIC 2019c). During NAISS in 2016, 12 Sowerby's beaked whales were seen off southern Newfoundland (Lawson and Gosselin 2018 *in* COSEWIC 2019c). COSEWIC (2019c) also summarized additional visual sightings in the region, including records along the shelf edge. Acoustic detections were recorded along the shelf edges of the Study Area, including at a site along the Scotian Shelf adjacent to the Laurentian Channel which was monitored by DFO.

4.4.2.7 Killer Whale

Jourdain et al. (2019) reviewed the current knowledge and threats for North Atlantic killer whales. They noted an urgent need for information on the abundance and population structure in eastern Canada. Based on North Atlantic Sighting Surveys in 2001, the abundance in the North Atlantic was estimated at 15,014 killer whales. The Northwest Atlantic/Eastern Arctic population is currently under consideration for addition to Schedule 1 of SARA.

4.4.2.8 Leatherback Turtle

An Action Plan was finalized for the Atlantic leatherback turtle (*Dermochelys coriacea*) in 2020 (DFO 2020i). The peak occurrence of leatherback turtles in Atlantic Canada appears to be July, with leatherback seasonality corresponding that of their jellyfish prey (Nordstrom et al. 2019). In Nova Scotian waters, turtle occurrence lagged two weeks behind jellyfish occurrence.

Mosnier et al. (2019) reported records for waters off Nova Scotia and Newfoundland (including within the Study Area) from June through November, with most records for August and September. Most sightings occurred on the shelf off southern and eastern Newfoundland, as well as on the Scotian Shelf. Mosnier et al. (2019) suggested that the Grand Banks also provide potentially important habitat for leatherbacks. A generalized additive model showed that their distribution in eastern Canadian waters was related to environmental characteristics, with turtle occurrence increasing when sea surface temperatures are >15°C, over flat bottoms, and in areas with low primary productivity; sea surface height was also correlated to turtle occurrence. As both ocean sunfish and leatherbacks feed on gelatinous prey such as jellyfish, the presence of sunfish was also a predictor of leatherback presence, but not densities.

4.5 Species at Risk

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

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 Committee on the Status of Endangered Wildlife in Canada (COSEWIC) websites as of March 2020. Changes in species status since the preparation of the 2019 EA Update (LGL 2019) are described below and noted in bold font in Table 4.9.

Table 4.9. SARA-listed and COSEWIC-assessed marine species that potentially occur in the Study Area.

Common Name	Scientific Name	*SARA* [a]			COSEWIC [a,b]		
		E	T	SC	E	T	SC
Marine Fish							
White Shark Atlantic population	*Carcharodon carcharias*	S1			X		
Northern Wolffish	*Anarhichas denticulatus*		S1			X	
Spotted Wolffish	*A. minor*		S1			X	
Atlantic Wolffish	*A. lupus*			S1			X
~~Atlantic Cod~~	*Gadus morhua*			**~~S3~~**			
Atlantic Cod Newfoundland and Labrador population					X		
Laurentian North population					X		
Cusk	*Brosme*				X		
Deepwater Redfish Gulf of St. Lawrence-Laurentian Channel population	*Sebastes mentella*				X		
Northern population						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		
Laurentian-Scotian population							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	
Maritime population						X	
Lumpfish	*Cyclopterus lumpus*					X	
White Hake Atlantic and Northern Gulf of St. Lawrence population	*Urophycis tenuis*					X	
Atlantic Sturgeon Maritimes 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		

Common Name	Scientific Name	*SARA* [a]			COSEWIC [a,b]		
		E	T	SC	E	T	SC
Basking Shark Atlantic population	*Cetorhinus maximus*						X
Shortfin Mako Shark **Atlantic population**	***Isurus oxyrinchus***				**X**		~~**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		
Harlequin Duck Eastern population	*Histrionicus*			S1			X
Barrow's Goldeneye Eastern population	*Bucephala islandica*			S1			X
Red-necked Phalarope	***Phalaropus lobatus***			**S1**			**X**
Marine Mammals							
Blue Whale Atlantic population	*Balaenoptera musculus*	S1			X		
North Atlantic Right Whale	*Eubalaena glacialis*	S1			X		
Sei Whale **Atlantic population**	***Balaenoptera borealis***				**X**		
Northern Bottlenose Whale Scotian Shelf population	*Hyperoodon ampullatus*	S1			X		
Davis Strait-Baffin Bay-Labrador Sea population							X
Harbour Porpoise Northwest Atlantic population	*Phocoena*		S2				X
Fin Whale Atlantic population	*Balaenoptera physalus*			S1			X
Humpback Whale Western North Atlantic population	*Megaptera novaeangliae*			S3			
Sowerby's Beaked Whale	*Mesoplodon bidens*			S1			X
Killer Whale Northwest Atlantic/ Eastern Arctic population	*Orcinus orca*						X
Sea Turtles							
Leatherback Sea Turtle Atlantic population	*Dermochelys coriacea*	S1			X		
Loggerhead Sea Turtle	*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 March 2020.
[b] COSWEIC website (http://cosewic.ca/index.php/en-ca/) accessed March 2020.

The Atlantic cod designated unit (DU) was removed (indicated by strikethrough text in Table 4.10). This DU was originally listed as *special concern* under Schedule 3 of SARA but has since been deactivated and instead split into four discrete populations. It had no designation under COSEWIC.

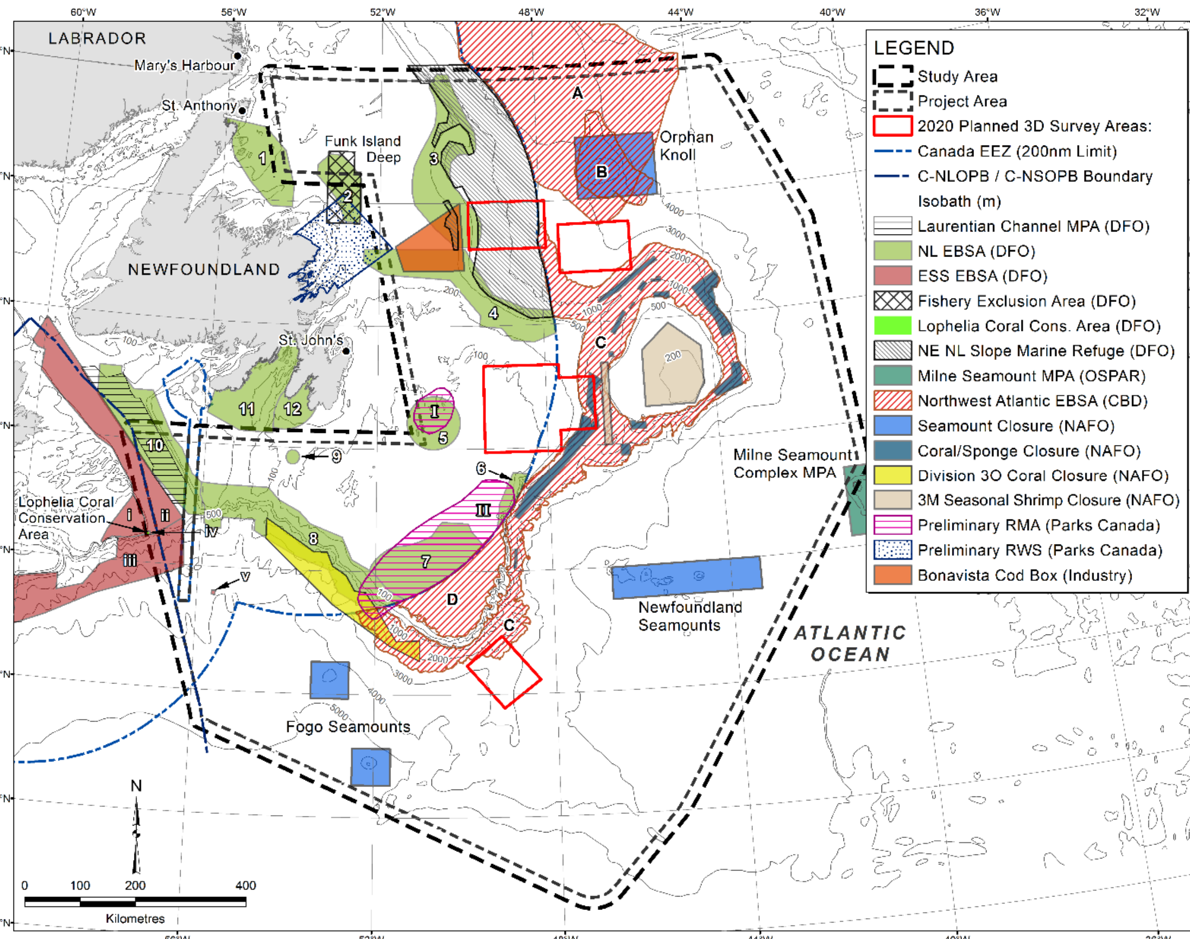
The Atlantic population of shortfin mako shark was reassessed from *special concern* to *endangered* by COSEWIC. It has no status under SARA.

Red-necked Phalarope was listed as *special concern* under SARA. Its designation as *special concern* under COSEWIC remains unchanged.

The Atlantic population of sei whale was added. It was assessed as *endangered* by COSEWIC but has no status under SARA.

4.6 Sensitive Areas

Sensitive Areas within the Study Area are described in Section 3.8 *in* C-NLOPB (2010), Section 4.2.4 *in* C-NLOPB (2014), Section 4.7 *in* LGL (2015a,b), Section 4.6 *in* LGL (2016), Section 4.7 *in* 2018a (see also Figure 4.40 *in* LGL 2018b), and Section 4.6 *in* LGL (2019). The new information presented in this section does not change the effects predictions made in the EA (LGL 2018a) and its associated Addendum (LGL 2018b). Sensitive areas that overlap or are adjacent to the Study Area are shown in Figures 4.31−4.32 and listed in Table 4.10.



Source: DFO (2014, 2020j,k); N. Wells, Biologist, Science Branch, DFO, pers. comm., 28 February 2019; CBD (2020); MCI (2020); NAFO (2020); OSPAR (2020); C. Pierce, Ecosystem Geomatics Technician, Protected Areas Establishment Branch, Parks Canada, pers. comm., 18 March 2020; Protected Planet (2020).

Notes:

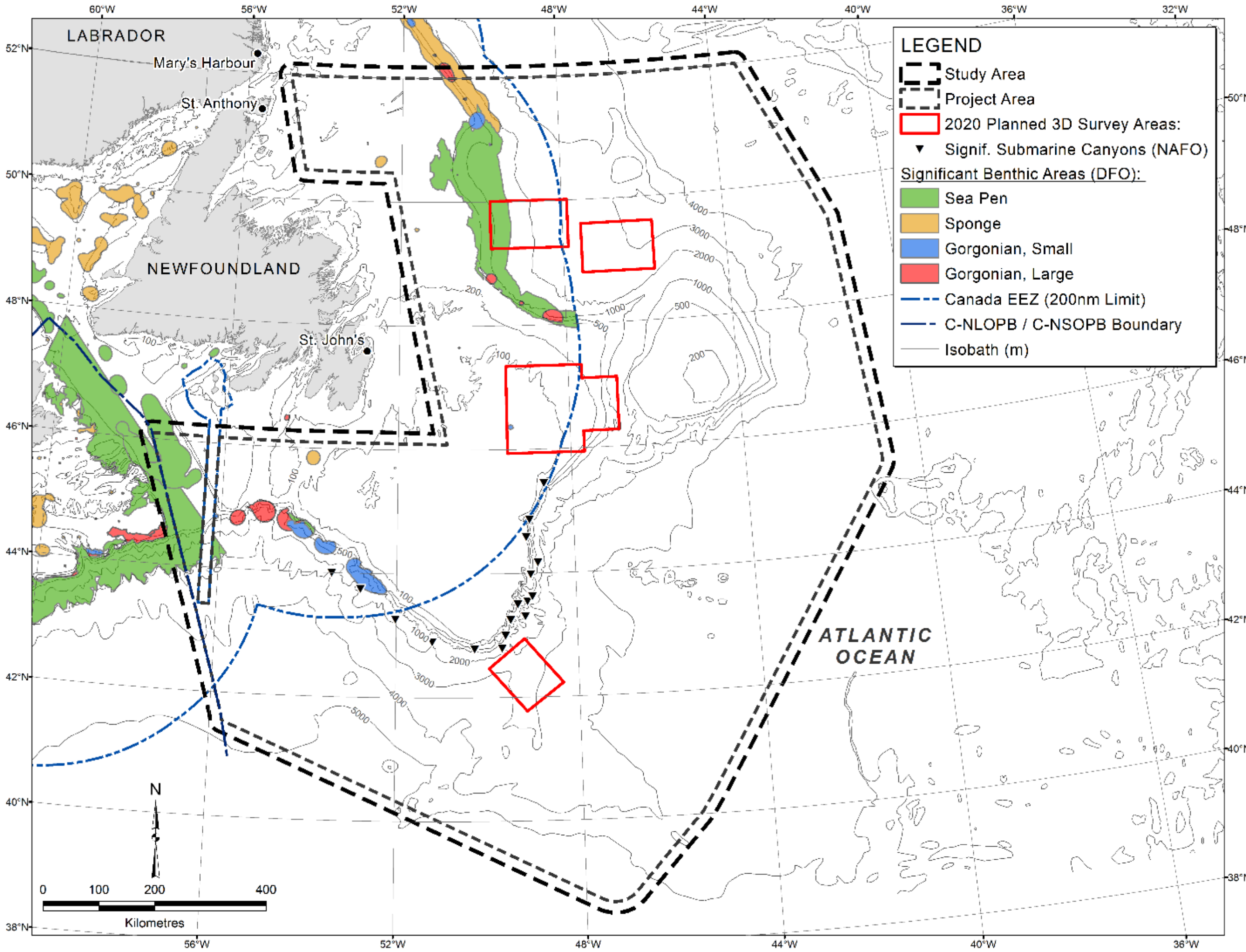
NL (Bioregion) EBSA: 1 = Grey Islands; 2= Notre Dame Channel; 3 = Orphan Spur; 4 = Northeast Slope; 5 = Virgin Rocks; 6 = Lilly Canyon-Carson Canyon; 7 = Southeast Shoal; 8 = Southwest Slope; 9 = Haddock Channel Sponges; 10 = Laurentian Channel; 11 = Placentia Bay; 12 = St. Mary's Bay.

ESS (Eastern Scotian Shelf) EBSA: I = Eastern Shoal; ii = Laurentian Channel Slope; iii = Scotian Slope; iv = Stone Fence and Laurentian Environs; v = Laurentian Channel Cold Seep Communities.

CBD EBSA: A = Southeast Shoal and Adjacent Areas on the Tail of the Grand Bank; B = Slopes of the Flemish Cap and Grand Bank; C = Orphan Knoll; D = Seabird Foraging Zone in the Southern Labrador Sea.

Parks Canada Preliminary RMA (Representative Marine Area): I = Virgin Rocks; II = South Grand Bank Area.

Figure 4.31. Sensitive areas that overlap or are adjacent to the Study Area.



Source: Kenchington et al. (2018a,b); J. Murillo-Perez, Research Scientist, Fisheries and Oceans Canada, Bedford Institute of Oceanography, pers. comm., 15 April 2020.

Figure 4.32. Sensitive areas that overlap or are adjacent to the Study Area (continued): Submarine canyons and Significant Benthic Areas (SBAs).

Table 4.10. Sensitive areas that overlap or are adjacent to the Study Area (items marked with an Asterix [*] are newly added or have been revised since the EA, its Addendum [LGL 2018a,b], or the 2019 EA Update [LGL 2019]).

Governing Body	Area Type	Area Name
NAFO	Vulnerable Marine Ecosystem (VME)	3O Coral Protection Zone Coral/Sponge Fishery Closure Area (13 total) Seamount Closure Area Orphan Knoll Seamount Newfoundland Seamount Fogo Seamount 1 Fogo Seamount 2
	Seasonal Fishery Closure	3M Seasonal 3M Shrimp Closure Area
	Submarine Canyons*	Shelf Indenting Canyons (Div. 3N) Canyons with head >400 m (Div. 3MN) Canyons with head >200 m (Div. 3O)
OSPAR	Marine Protected Area	Milne Seamount Complex
DFO	Marine Protected Area	Laurentian Channel Marine Protected Area
	Significant Benthic Area (SBA)*	Large Gorgonians Small Gorgonians Sea Pens Sponges
	Marine Refuge (Fishery Exclusion Area)	Funk Island Deep Closure Division 3O Coral Closure [a] Northeast Newfoundland Slope Closure *Lophelia* Coral Conservation Area
	NL Shelves Bioregion Ecologically and Biologically Significant Areas (EBSAs)	Grey Islands Notre Dame Channel Orphan Spur Northeast Slope* Virgin Rocks* Lilly Canyon-Carson Canyon* Southeast Shoal* Southwest Slope* Haddock Channel Sponges* Laurentian Channel* Placentia Bay* St. Mary's Bay*
	Eastern Scotian Shelf (ESS) EBSAs	Eastern Shoal Laurentian Channel Slope Scotian Slope Stone Fence and Laurentian Environs Laurentian Channel Cold Seep Communities
Convention on Biological Diversity (CBD)	EBSAs	Southeast Shoal and Adjacent Areas on the Tail of the Grand Bank Slopes of the Flemish Cap and Grand Bank Orphan Knoll Seabird Foraging Zone in the Southern Labrador Sea
Fishing Industry	Voluntary Fishery Closure Area	Bonavista Cod Box
Parks Canada	[Preliminary] Representative Marine Area (RMA)	Virgin Rocks South Grand Bank Area
	[Preliminary] Region Without Studies (RWS)	Unknown 17

[a] Same boundary as NAFO 3O Coral Protection Zone.

4.6.1 New or Revised Sensitive Areas

Submarine canyons are located along continental slopes and their steep-sided valleys support high biodiversity and/or vulnerable marine ecosystems (VMEs), such as cold-water corals and deep-sea fishes (NAFO 2008). NAFO identifies submarine canyons as one of several physical indicator elements for VMEs and categorizes those in the Study Area as shelf-indenting (located on the Tail of the Grand Bank, within Div. 3N), with head depth >400 m (South of the Flemish Cap and Tail of the Grand Bank, within Div. 3MN), and with head depth >200 m (Tail of the Grand Bank, within Div. 3O) (NAFO 2020). While little is known of the ecology of submarine canyons within the Study Area, those located on the upper continental shelf are recognized as ideal coral attachment habitat (NAFO 2008; Gullage et al. 2017). No known submarine canyons overlap the 3D survey areas (Figure 4.32; Marine Regions 2020; J. Murillo-Perez, Research Scientist, DFO, Bedford Institute of Oceanography, pers. comm., 15 April 2020).

DFO Significant Benthic Areas (SBAs) are "significant areas of cold-water corals and sponge dominated communities" (Kenchington et al. 2018a). DFO recently updated kernel density analyses and produced predictive coral and sponge hotspot distribution maps in eastern Canada to identify SBAs (Kenchington et al. 2018a,b). The resultant SBAs were developed for taxa considered by NAFO to be VME indicators, including large and small gorgonian corals (Alcyonacea), sea pens (Pennatulacea), and sponges (Porifera) (Kenchington et al. 2018a). SBAs do not receive legal protection but may serve as indicators for the designation of future special areas. SBAs for sea pens and large and small gorgonians are within the northwestern and southwestern portions of the Study Area, with a portion of one sea pen SBA overlapping the western portion of the Blomidon 3D survey area and one relatively small sea pen SBA within the southwestern boundary of the Jeanne d'Arc/Central Ridge 3D survey area (Figure 4.32). SBAs for sponges are mainly in the northwestern portion of the Study Area, with a relatively small sponge SBA also in the southwestern portion of the Study Area, south of Newfoundland's Avalon Peninsula. No sponge SBAs overlap the 3D survey areas for 2020 (Figure 4.32).

As noted in the 2019 EA Update (LGL 2019), EBSAs within the Placentia Bay-Grand Banks (PB-GB) portion of the NL Shelves Bioregion were recently modified, including the modification of some existing EBSA boundaries and the addition of new EBSAs. Descriptions for the revised EBSAs were not available at the time the 2019 EA Update was written. The DFO Science Advisory Documents describing the modified EBSAs were since approved and released (DFO 2019i; Wells et al. 2019), and summary descriptions are provided below. None of the new/revised PB-GB EBSAs overlap the 3D survey areas (Figure 4.31).

The Northeast Slope EBSA was revised and now extends from the Trinity Basin to the Sackville Spur. This EBSA features important areas for and/or high abundance of sponges, soft and black corals, sea pens, shrimp, Greenland halibut, witch flounder, American plaice, thorny and smooth skates, capelin, Atlantic cod, roughhead grenadier, all three wolffish species, non-breeding Common and Thick-billed Murre (during winter), and hooded seal (*Cystophora cristata*).

The Virgin Rocks EBSA boundaries were revised to encompass areas within a ~50-km radius from the center of the Virgin Rocks formation, a series of shallow shoals (≥3.6 m from the surface) with jagged ridges and rocks. This EBSA hosts high concentrations of sand lance, caplin, American plaice, Sooty Shearwater (*Ardenna grisea*), Thick-billed Murre, and killer whale. The Virgin Rocks EBSA features highly productive plankton and kelp bed communities, and is an important spawning habitat for Atlantic cod, American plaice, and yellowtail flounder.

The Lilly Canyon-Carson Canyon EBSA boundaries were expanded to include the shelf and slope areas surrounding Lilly and Carson canyons. This EBSA features an abundance of soft corals, sponges, snow crab, Iceland scallop (*Chlamys islandica*), Greenland halibut, American plaice, redfish, roughhead grenadier, thorny skate, Common Murre, Sooty Shearwater, blue whale, and harp seal (*Pagophilus groenlandicus*). A sponge SBA was identified in the northern portion of this EBSA, between 200−500 m in Carson Canyon.

The Southeast Shoal EBSA, previously the Southeast Shoal and Tail of the Banks EBSA, was revised to extend farther southwest and no longer includes areas beyond the Canadian EEZ. It encompasses a portion of the Southeast Shoal and Outer Shelf Zone of the Grand Bank. The revised EBSA is an important spawning and nursery area for American plaice, spawning area for capelin, and feeding, spawning, and nursery area for yellowtail flounder (the only EBSA to contain an important area for this species and the only known nursery area for the entire stock). It also includes important areas for Atlantic and northern wolffish, capelin, thorny skate, white hake, sand lance, and witch flounder. During the summer, humpback whales and other cetaceans converge to feed on the central portion of the Shoal. The southeastern portion of the Shoal has been known to feature the Grand Bank's highest benthic biomass.

The Southwest Slope EBSA, formerly the Southwest Shelf Edge and Slope EBSA, was revised to extend farther northwest (to the end of the Laurentian Channel) and southeast but no longer reaches beyond the Canadian EEZ. The Southwest Slope EBSA includes important areas for black, small/large gorgonian, and stony cup corals, sea pens, witch flounder, American plaice, Atlantic cod, northern wolffish, redfish, roundnose grenadier, smooth, thorny, and winter skate, white hake, blue whale, and surface shallow-diving seabirds. It also encompasses a haddock feeding and spawning area, and redfish spawning area.

The Haddock Channel Sponges EBSA is a new EBSA located in the southwestern portion of the Study Area, in the southern Avalon Channel and Haddock Channel. It includes the largest sponge SBA within the PG-GB area. Other key species for this EBSA include capelin and American plaice.

The boundaries of the Laurentian Channel EBSA, formerly the Laurentian Channel and Slope EBSA, shifted to the southeast and extended eastwards. This EBSA now overlaps portions of the Canadian and St. Pierre and Miquelon EEZs. The Laurentian Channel mainly features mud, clay, sand, and gravel and hosts high sea pen concentrations. Other abundant fauna include small gorgonian corals, Greenland halibut, witch flounder, black dogfish, and blue whale. This EBSA may be a pupping area for black dogfish, is a juvenile and nursery area for smooth skate, and includes important areas for thorny and winter skates, and white hake. Porbeagle shark are found in the EBSA during the spring before migrating southwards during the fall, and one of their known mating grounds partially occurs within the southern portion of the Laurentian Channel.

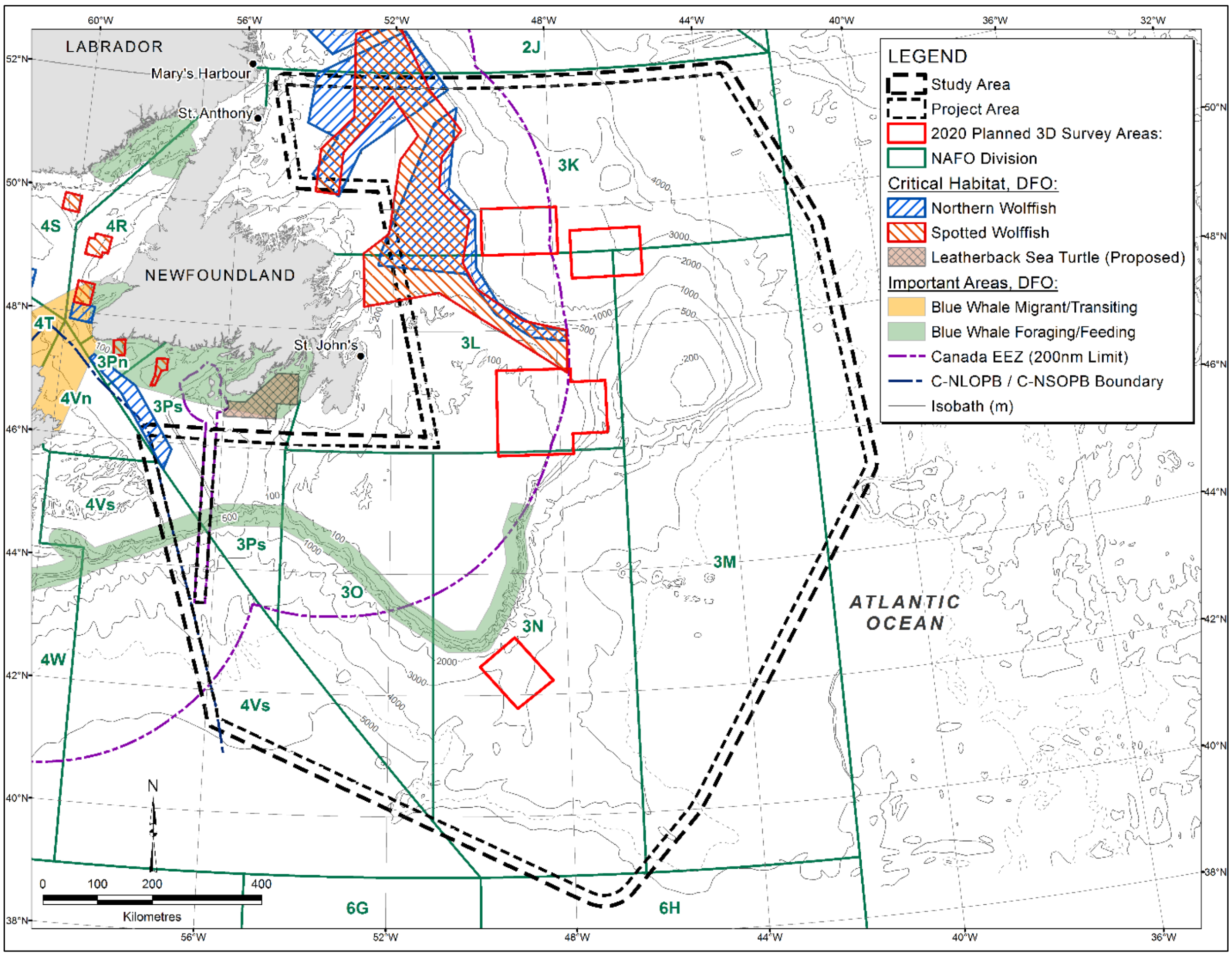
The Placentia Bay EBSA, formerly the Placentia Bay Extension EBSA, was revised to include the open waters south of Placentia Bay, near the southwestern boundary of the Study Area. It features important areas for large gorgonian and soft corals, sponges, blue whale, hooded seal, and various baleen whales, proposed critical habitat for leatherback sea turtle (see Figure 4.33 below), and the Placentia Bay IBA, which hosts a globally important Great (*P. gravis*) and Sooty Shearwater concentration, along with an abundance of terns, Common Murre, Black-legged Kittiwake, and overwintering Common Eider (*Somateria mollissima*). This EBSA also contains important Atlantic salmon rivers (including two that contain a genetically distinct salmon population that occurs on the Avalon and Burin peninsulas), capelin spawning beaches, spawning areas for Atlantic cod, eelgrass beds (*Zostera marina*), and two areas with high ichthyoplankton concentrations (western Placentia Bay and near Come by Chance at the head of the Bay).

The St. Mary's Bay EBSA was newly added and includes St. Mary's Bay, Cape St. Mary's, and the surrounding open water to the boundary of the southwestern portion of the Study Area. This EBSA is important for seabirds and waterfowl and features several capelin spawning beaches, eelgrass beds, and important Atlantic salmon rivers (including one river that hosts the genetically distinct salmon population noted for the Placentia Bay EBSA). The Cape St. Mary's portion of the EBSA contains the region's only important area for overwintering Harlequin Duck, an important Northern Gannet colony, and ≥25,000 breeding pairs of seabirds, especially Common Murre and Black-legged Kittiwake. The EBSA's boundaries include the foraging range of its seabirds, important areas for capelin, high concentrations of baleen whales, a late-spring migration corridor for hooded seal, and a portion of the proposed leatherback sea turtle critical habitat (see Figure 4.33 below).

4.6.2 Critical Habitat

The 2019 EA Update indicated that critical habitats were proposed for northern and spotted wolffishes (DFO 2018g *in* LGL 2019). The critical habitats were since finalized in an updated Recovery Strategy (DFO 2020e) and there were no changes in the final and proposed boundaries or habitat descriptions (see Section 4.6 and Figure 4.36 *in* LGL 2019). The critical habitat for northern and spotted wolffishes on the NL Shelves is vulnerable to activities that would alter the habitat's thermal properties or cause habitat destruction, particularly alterations to habitat depth (DFO 2020e). Critical habitat for spotted wolffish is adjacent to the northern boundary of the Jeanne d'Arc/Central Ridge 3D survey area, and for northern wolffish is west of the western boundary of the Blomidon 3D survey area (Figure 4.33). Project activities within the Project Area are not anticipated to affect bottom temperature within or otherwise cause destruction to the critical habitats.

Proposed critical habitat for leatherback sea turtles near the Study Area was also presented in the 2019 EA Update (DFO 2016; see also Figure 4.36 *in* LGL 2019). The critical habitat has not yet been finalized (DFO 2020i). The Placentia Bay proposed leatherback sea turtle critical habitat area is located north of the southwestern portion of the Study Area, far west of the 3D survey areas (Figure 4.33).



Source: DFO (2016, 2018, 2020e).

Figure 4.33. Finalized northern and spotted wolffish critical habitat, proposed leatherback sea turtle critical habitat, and important areas for blue whales.

DFO recently identified important foraging and transiting areas for the western Atlantic population of blue whale (DFO 2018). These areas were identified because they provide access to abundant, high quality prey items, migratory corridors, open spaces in which to freely maneuver, sufficiently high water quality that does not diminish habitat function, and an acoustic environment that neither interferes with communication/navigation nor otherwise prevents habitat use by blue whales or their prey (DFO 2018). Of the four foraging habitats and two transit corridors identified in the Newfoundland and Gulf of St. Lawrence regions, the continental shelf edge feeding area is within the southwestern portion of the Study Area, northwest of the South Bank 3D survey area (Figure 4.33). The south and southwestern Newfoundland feeding area and Cabot Strait transit corridor are otherwise nearest to the Study Area, north and northwest of the southwestern portion of the Study Area and far west of the 3D survey areas (Figure 4.33). No critical habitat has yet been identified for the western Atlantic population of blue whale (DFO 2018).

5.0 Consultations

A newsletter describing the seismic activities proposed for 2020 was distributed during April 2020 to the same stakeholders/groups consulted by MKI in previous years for seismic surveys offshore Newfoundland. The newsletter and details of those consulted by MKI are presented in Appendices A and B, respectively.

Telephone meetings were held with the key stakeholders following confirmation of the likely 2020 operational areas. Potential impacts of COVID-19 mitigation measures and the scenarios where this may impact the quota periods and post season crab survey were discussed at length. The situation is uncertain and will potentially impact the completion of the Jeanne d'Arc survey in August.

6.0 Environmental Assessment

This section presents a summary of mitigation measures that will be employed by MKI during its 2020 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 2018a,b) remain applicable to MKI's 3D seismic survey activities planned for 2020. 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 2019).

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 (20 April 2020)
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 • VMS data • Avoidance of actively fished areas • Start-up meetings on ships that discuss fishing activity and communication protocol with fishers	• Upfront planning with FFAW, OCI and One Ocean • Daily communications and weekly meetings when project commences • Contract in place • Contract in place • Planned upon commencement • 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 FFAW, OCI and One Ocean • Contracts being put 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	• Advisories and at-sea communications • FLOs (fishing vessels) • Use of escort vessel • SPOC (fishing vessels) • VMS data	• Planned upon commencement • Contract in place • Contracts being put in place • Contract in place • Planned upon commencement
Fisheries VEC: Interference with DFO/FFAW research program	• Communications and scheduling • MKI will work cooperatively with FFAW|Unifor and DFO in an effort to avoid survey stations prior to their sampling to the best extent possible. DFO does not indicate an official spatial and/or temporal buffer mitigation method for seismic operations in the vicinity of survey stations.	• Planned upon commencement • Meetings held with FFAW
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 MMSO(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, PGS, Senior Contract Manager, pers. comm., June 2017] and Greenland [LGL 2012]).	• Confirmed • Confirmed • Confirmed • Confirmed • Confirmed
Species at Risk and Sensitive Areas VEC: Temporary or	• "Pre-watch" (30 minute) of 500 m safety zone using visual and PAM	• Confirmed • Confirmed

VEC, Potential Effects	Primary Mitigations	Status (20 April 2020)
permanent hearing damage/ disturbance to Species at Risk or other key habitats	• 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 MMSO(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
Marine-associated Bird VEC: Injury (mortality) to stranded seabirds	• Daily search of seismic and support vessels • Implementation of handling and release protocols • Minimize lighting if safe	• Confirmed • 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

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 are summarized below.

Fields et al. (2019) conducted a study to test if exposure to pulses from airguns used in seismic surveys would affect mortality, predator escape response, or gene expression in the calanoid copepod species *Calanus finmarchicus*. The results from this study concluded that within 10 m of a seismic pulse, limited effects on copepod mortality or predator escape response were observed, and when exposed to pulses at a distance of over 10 m, there were no measurable impacts (Fields et al. 2019).

Elliot et al. (2019) suggested that despite current scientific knowledge of the effects of industrial seismic surveys on marine vertebrates, critical data gaps remain. Although literature has been published on the effects on individual organisms and species, little attention has been paid to population-level effects over large temporal and spatial scales. These studies are needed in order to assess the effects of seismic activities on marine megafauna, especially those highly vulnerable to noise (Elliot et al. 2019).

A recent publication by Day et al. (2019) describes a field-based study of the potential physical impacts of exposure to airgun sound on rock lobster. Following exposure to the equivalent of a full-scale commercial seismic survey passing within 100−500 m, lobsters exhibited impaired righting and damage to the sensory hairs of the statocyst which persisted up to 365 days after exposure.

Slabbekoorn et al. (2019) reviewed published literature on the behavioural and physical response of fish to airgun sound exposure. They found that behavioural and physiological stress effects are likely to be most relevant at the population level and should therefore be prioritized in research over effects on individuals. Additionally, they determined that there is a strong need for data on the natural patterns of particle motion and pressure variation in fish habitat, as these data are needed to establish statistically significant conclusions (Slabbekoorn et al. 2019). Further, it has been noted that it is difficult to reach clear conclusions on the extent to which anthropogenic sounds have on animal behaviour and physiology due to data gaps (Popper and Hawkins 2019).

In 2018, Popper and Hawkins published a study on the importance of particle motion to fishes and invertebrates, with the goal of ensuring that proper attention is given by scientists and regulators. They concluded that particle motion is substantially important to the lives of fishes and invertebrates in terms of sound and, to a certain degree, signals emanating from and within the substrate (Popper and Hawkins 2018).

Davidsen et al. (2019) conducted a controlled, short-term (three-day period) field experiment on Atlantic cod and saithe (*Pollachius virens*) to investigate the effects of sound exposure from an airgun on their behaviour and physiology. The heart rates and body temperatures of both species were recorded during experimental exposures (18−60 dB above ambient) in a sea cage (Davidsen et al. 2019). The results indicated that cod and saithe changed swimming behaviour more frequently in response to airgun exposure. The authors concluded that the effects observed during the experiment would likely be limited in duration and would not lead to permanent physiological or behavioural changes (Davidsen et al. 2019).

de Jong et al. (2020) conducted a meta-analysis to predict the effects of anthropogenic sound on fish reproduction by reviewing existing literature and using available data to categorize the effects of sound into three mechanistic classes: stress, masking, and hearing loss. They also tested which sound types, i.e., continuous vs. intermittent and regular vs. irregular, would likely produce the strongest effects. It was concluded that continuous sounds, such as heavy ship traffic, may have the highest effect on stress, sound masking, and hearing loss, which could negatively affect fish reproduction (de Jong et al. 2020). It was also predicted that stress induced by sound exposure would mainly affect fish species that are not able to relocate or delay spawning, such as species that have specific spawning grounds or periods. Most species, however, show high resiliency during the egg development and parental care stage even if they are unable to relocate. For species where sound is crucial for reproduction, i.e., those that use sound to locate spawning grounds and those that engage in acoustic communication during spawning (e.g., gobies, toadfishes, cichlids), masking and hearing-loss would have the greatest effect. The severity of the effects would depend on the flexibility of the fish species' signaling capabilities (de Jong et al. 2020).

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

6.3 Marine-Associated Birds

Recent publications relevant to the effects of vessel lighting and accidental release of hydrocarbons on marine-associated birds have become available since the original EA and 2019 EA Update (LGL 2018a, 2019); these studies are summarized below.

6.3.1 Vessel Lighting

Recently published studies on the effects of electrical lighting on marine-associated birds summarized below, including species protected by the *Migratory Birds Convention Act*, 1994, and on the risk to species in the Northwest Atlantic, largely reaffirm previous findings.

Syposz et al. (2018) found that Manx Shearwater strandings peak when moonlight levels are lowest (i.e., around the time of the new moon), as has been found in other species.

The various colours emitted by different kinds of electrical lighting have differing effects on nocturnally active birds. In studies of passerines (songbirds and suboscine birds; Passeriformes) nocturnally migrating, continuous green, blue, or white light attracted significantly higher numbers of birds than continuous red light, but only when the sky was overcast (Rebke et al. 2019). Experimentation with Short-tailed Shearwaters (*Ardenna tenuirostris*) showed that high pressure sodium lights (colour temperature 2000 K; i.e., warm) attract fewer Short-tailed Shearwaters than metal halide (4500 K; cool) or light emitting diode lights (4536 K; cool) (Rodríguez et al. 2017). High pressure sodium lights emit much less energy below 575 nm than the other two types.

The distance from which seabirds are attracted by artificial lighting is not well studied. However, large numbers of young Short-tailed Shearwaters that fledged from a nesting colony on a headland stranded at intense artificial lighting on the coast 15 km from the colony rather than at dimmer lighting on the coast only 2.5 km from the colony (Rodríguez et al. 2014).

Experts on North Atlantic seabirds rank light pollution as the human activity with the third highest risk of negative impacts on seabirds in Atlantic Canada waters, following fisheries by-catch and oiling (Lieske et al. 2019). Leach’s Storm-Petrel is considered the western North Atlantic seabird species at greatest risk of the negative effects of artificial lighting (Lieske et al. 2019). A tracking study shows that after fledglings and adults abandon the colonies many begin their southward migration, which takes them across the Study Area and that this species is occasionally present in the Study Area during winter (Pollet et al. 2019).

Diving Thick-billed Murres are attracted to underwater lights during the Arctic polar night, but dovekies are not, suggesting that some diving marine bird species could potentially be attracted to Mobile Offshore Drilling Units (MODUs) at night for foraging opportunities (Ostaszewska et al. 2017).

These new studies do not present findings that would change the conclusions of the effects assessment in the original EA (LGL 2018a).

6.3.2 Accidental Releases

There have been new publications on the effects of oiling from accidental hydrocarbon releases on marine birds since the original EA (LGL 2018a); the findings of these new studies confirm those from previous studies.

Matcott et al. (2019) found corroborating evidence that small amounts of oil from sheens affect the structure and function of seabird feathers, which has the potential to result in water penetrating plumage and displacing the layer of insulating air, resulting in loss of buoyancy and subsequent potential for hypothermia. The threshold sheen thickness above which oil significantly affects feathers is between 0.1 and 3 μm, depending on sheen exposure, environmental conditions and species (Matcott et al. 2019). The feathers of deep-diving seabird species such as alcids are more resistant to the effects of oil than those of shallow-diving species such as fulmars and shearwaters, which are in turn more resistant than those of surface-feeding species such as gulls (Matcott et al. 2019).

These newly published studies do not change the conclusions of the effects assessment of the original EA (LGL 2018a). 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.

6.3.3 Effects Assessment of other Routine Project Activities

6.3.3.1 Vessel/Equipment Presence

Vessels transiting between St. John's and the survey areas will use existing shipping lanes to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and to comply with provincial *Seabird Ecological Reserve Regulations, 2015* and federal guidelines in order to minimize disturbance to colonies (Government of Canada 2018).

6.4 Marine Mammals and Sea Turtles

Recent publications relevant to the effects of airgun sounds on marine mammals that have become available since the original EA and 2019 Update (LGL 2018a, 2019) are summarized below.

The potential effects of sounds from airguns on marine mammals could include masking, disturbance, hearing impairment, and non-auditory physical or physiological effects (e.g., Bröker et al. 2019; Kyhn et al. 2019; Rako-Gospić and Picciulin 2019). Reactions to sound, if any, depend on sound levels and frequencies, exposure duration, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (e.g., Rako-Gospić and Picciulin 2019). Behavioural reactions of marine mammals to sound are difficult to predict in the absence of site- and context-specific data (Ellison et al. 2018), and numerous data gaps remain regarding the consequences of those responses (Elliott et al. 2019). As behavioural responses are not consistently associated with received levels, Tyack and Thomas (2019) along with other authors have made recommendations on different approaches to assess behavioural reactions.

Kavanagh et al. (2019) analyzed more than 8000 hr of cetacean survey data in the northeastern Atlantic Ocean to determine the effects of the seismic surveys on cetaceans. They found that sighting rates of cetaceans were significantly lower during seismic surveys compared with control surveys. Similarly, sightings of toothed whales were lower during active airgun surveys compared with inactive periods during seismic surveys. Kastelein et al. (2019) reported that if disturbance by noise would displace harbour porpoises from a feeding area or otherwise impair foraging ability for a short period of time (e.g., 1 day), they would be able to compensate by increasing their food consumption following the disturbance.

Hastie et al. (2019) noted that the impulsive nature of sound is range-dependent, becoming less harmful (and non-impulsive) for marine mammals with distance from the source. Additionally, as sound pressure levels (SPLs) for impulsive sounds are generally lower just below the water surface, animals (e.g., seals) swimming near the surface are likely to be exposed to lower sound levels than when swimming at depth (Kastelein et al. 2018). However, the underwater sound hearing sensitivity for seals is the same near the surface and at depth (Kastelein et al. 2018).

Recent assessments and status reports for sei, fin, and Sowerby's beaked whales reported the threat from noise from seismic exploration as medium-low (COSEWIC 2019a,b,c). In the Action Plan for Atlantic leatherback turtles, one of the measures listed therein was to "Reduce leatherback sea turtle exposure to potentially harmful levels of underwater noise…..and evaluate the use of the '*Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment*' with respect to leatherback sea turtles" (DFO 2020i).

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 2018a).

6.5 Validity of Significance Determinations

Based on MKI's planned survey activities in 2020 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 2018a) and its Addendum (LGL 2018b) remain valid for the seismic survey activities planned by MKI in 2020. This includes consideration of cumulative effects; see below.

6.5.1 Cumulative Effects

Section 5.8 of the original EA (LGL 2018a) 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 2020 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 Study Area was summarized in the 2019 EA Update (LGL 2019) and in the 3D survey areas considered in this EA Update, including the most recent commercial fisheries data (from 2017) available. In 2020, it is anticipated that the commercial harvest species, and the timing and locations of commercial fisheries within the Study Area will be like previous years. This has also been confirmed during consultations with the fishing industry.

6.5.1.2 Vessel Traffic

Marine transportation within the Study Area is discussed in the Eastern Newfoundland SEA (subsection 4.3.5.1 of C-NLOPB 2014) and the Southern Newfoundland SEA (Section 5.3 of C-NLOPB 2010). Vessel traffic relative to the MKI Project Area was also described in subsection 6.5.1.2 of the EA Update (LGL 2019).

A Marine Traffic (2020) website was accessed and provided information on vessel density for 2016 and 2017 relative to the Project Area and 3D survey areas planned for 2020. While it was possible to distinguish vessel track lines by vessel type (i.e., fishing vessel, tanker, cargo, container ships, passenger vessels), track lines were not readily available for individual months or a monthly/seasonal range. 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 (Marine Traffic 2020). Publicly available density maps are colour-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 vessel per year per 23 km² grid-cell. Figure outputs were centered on the Project and Study area boundaries; also shown are the planned 3D survey areas for 2020.

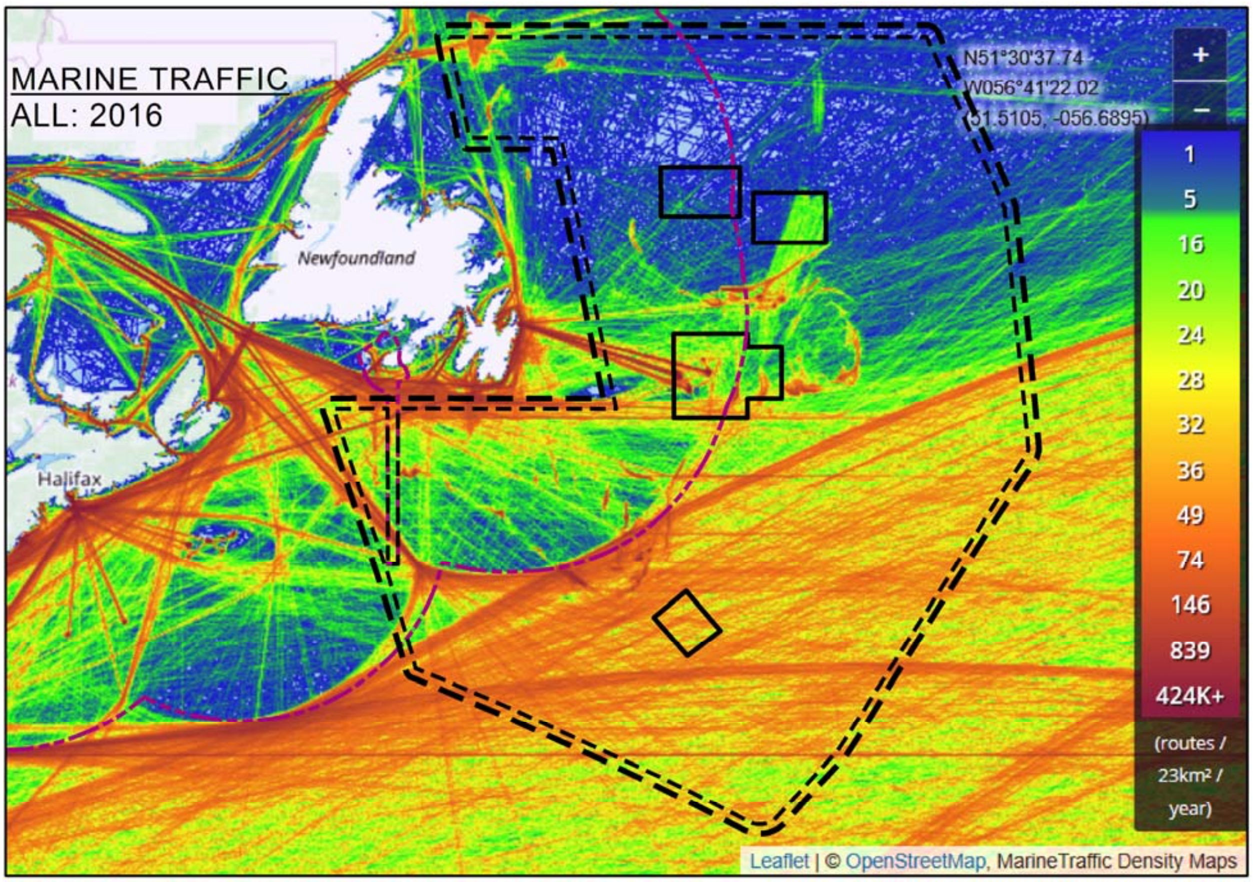


Figure 6.1. Marine shipping traffic density (routes per 23 km² grid cell) in 2016 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2020 3D Survey Areas.

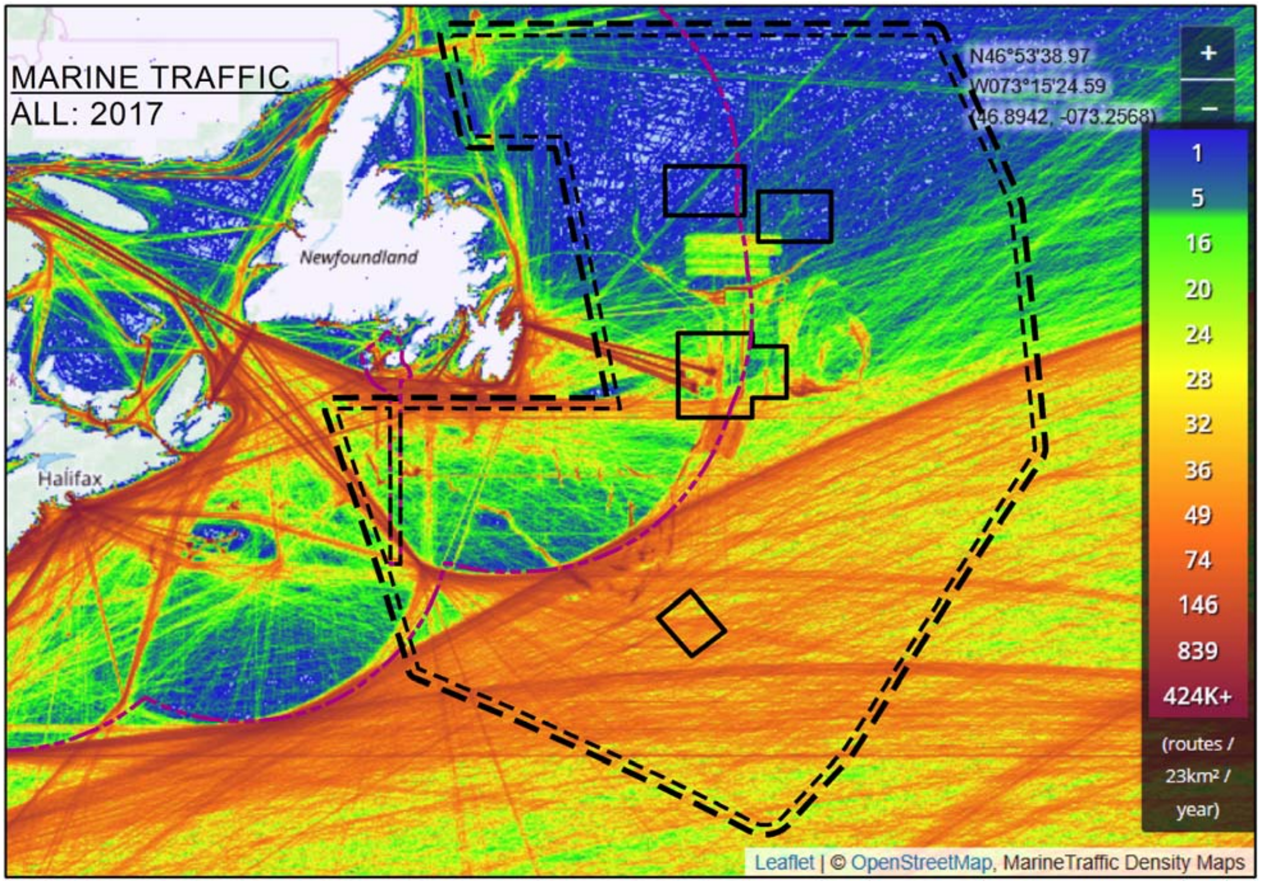


Figure 6.2. Marine shipping traffic density (routes per 23 km^2 grid cell) in 2017 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2020 3D Survey Areas.

Within the Project Area, marine traffic density is generally concentrated in the southeast (including the South Bank 3D survey area), coastal areas of Newfoundland, and shipping routes to oil production facilities in the Jeanne d'Arc Basin (Figures 6.1 and 6.2). Also evident are seismic survey areas off eastern Newfoundland in 2016 (Figure 6.1) and 2017 (Figure 6.2). There were relatively few vessel transits recorded in the northern portion of the Project Area, including the Blomiden 3D survey area and the East Tablelands 3D survey area (with the exception of seismic survey activity in 2016). Overall, shipping traffic data from 2016 and 2017 confirm the conclusions made in the relevant SEAs (C-NLOPB 2010, 2014) and the original EA for this Project (LGL 2018a).

To mitigate potential interactions between commercial shipping and the Project, MKI's seismic and escort vessels constantly monitor shipping activity and communicate with other vessels when appropriate to ensure that appropriate separation distances are maintained for safe operations.

6.5.1.3 Oil and Gas Activities

In 2020, MKI is planning to simultaneously conduct two 3D seismic surveys offshore Newfoundland and Labrador during the mid-May to August period (Figure 6.3). The timing of the planned MKI surveys is shown in Table 6.2, including those planned for Labrador (Torngat 3D Extension survey area). Note that it is uncertain at this stage if the East Tableland 3D survey area and Central Ridge 3D survey area will be surveyed in 2020. If surveying does occur there, it will be conducted with either the *Ramform Atlas* or *Ramform Titan*. In 2020, concurrent seismic surveys will be separated by at least 700 km (i.e., the minimum separation distance between Blomiden 3D and South Bank 3D survey area). When the South Bank 3D survey area is being surveyed by the *Ramform Titan*, the *Ramform Atlas* will be surveying offshore Labrador in the Torngat 3D Extension, which is almost 1400 km away (Figure 6.3). Based on a review of the C-NLOPB website, there are currently no indications that other seismic surveys will occur in 2020. If other seismic surveys do occur offshore Newfoundland (or offshore Labrador) MKI commits to communicating closely with these seismic operator(s) 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 and Central Ridge 3D 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 SIMOPS plans are in place. MKI commits to communicating closely with production and exploratory drilling operators to ensure appropriate spatial separation of activities.

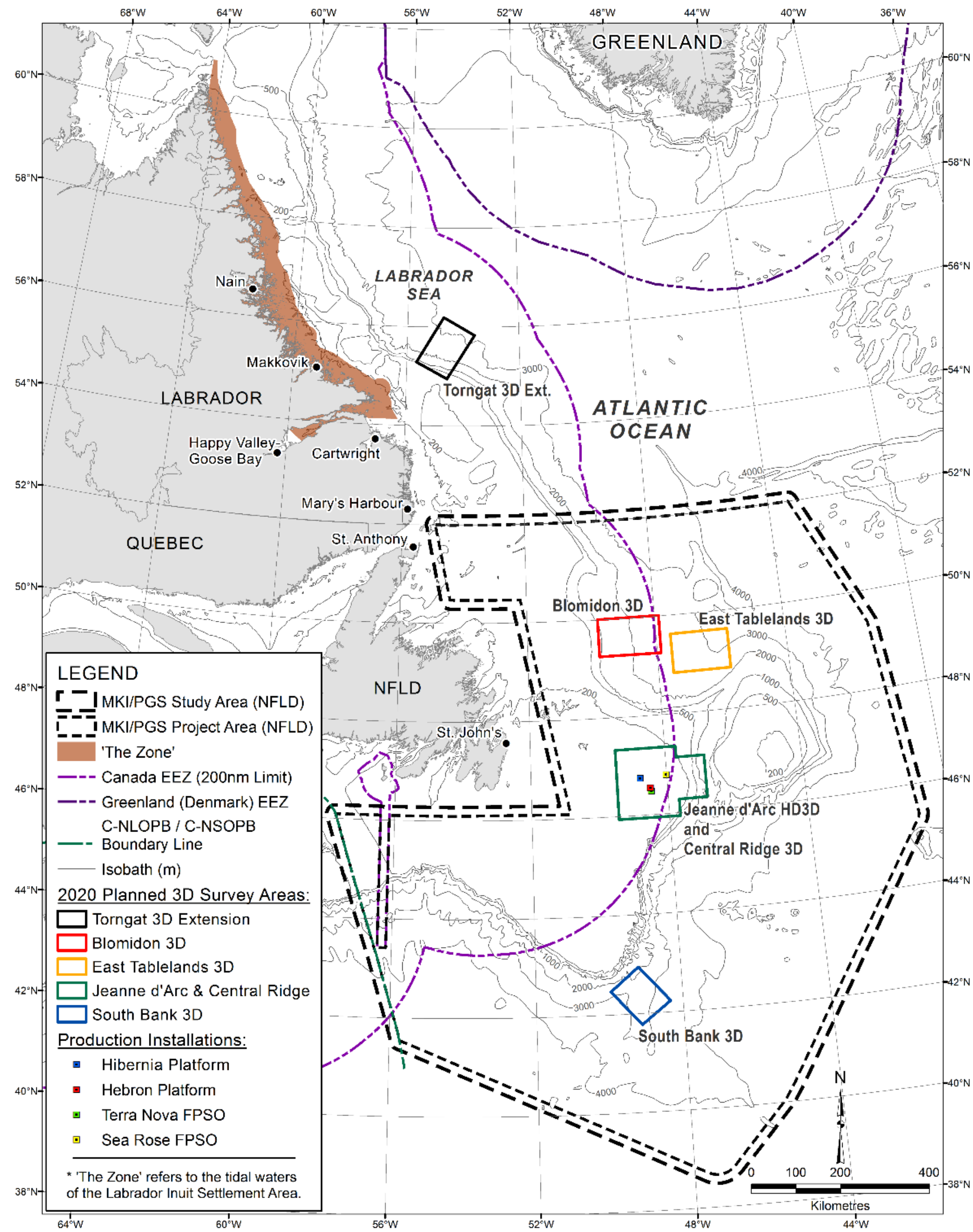


Figure 6.3. Locations of MKI's planned 3D seismic survey areas in 2020. Also shown are the production installations on the Grand Banks.

Table 6.2. Timing of MKI's planned seismic surveys in 2020.

3D Survey Area	May (week)		June (week)				July (week)				Aug (week)			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Blomiden 3D	■	■	■	■	■	■	■	■						
Jeanne d'Arc HD3D/Central Ridge 3D												■	■	■
South Bank 3D						■	■	■	■	■	■			
Torngat 3D									■	■	■	■	■	■

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 Sections 5.7 and 5.8 of LGL (2018a), 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 Section 5.7 of the EA; LGL 2018a).

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 2020, a minimum separation distance of 700 km between MKI planned 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 concurrent 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 3D seismic survey activities proposed by MKI for 2020 have been reviewed and determined to be within the scope of the EA (LGL 2018a) and its Addendum (LGL 2018b). 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 2020 seismic program includes two 3D surveys.

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.

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Personal Communications

Ball, D.	Resource Management, DFO. 17 March 2020.
Hosein, J.	Chief, Statistical Services, DFO. 16 March 2020 and 15 April 2020.
Keel, R.J.	Manager of Aquaculture Licensing and Administration, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador. 20 March 2020.
Mello, L.	Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO. 17 March 2020.
Morrow, G.	PGS, Senior Contract Manager. June 2017.

Murillo-Perez, J.	Research Scientist, Fisheries and Oceans Canada, Bedford Institute of Oceanography. 15 April 2020.
Pierce, C.	Ecosystem Geomatics Technician, Protected Areas Establishment Branch, Parks Canada. 18 March 2020.
Pye, B.	Environmental Sciences, Science Branch, DFO. 17 March 2020.
Wells, N.	Biologist, Science Branch, DFO. 28 February 2019.

Appendix A – MKI Newsletter Distributed to Consultees

Multiklient Invest AS Seismic Programs Offshore Newfoundland 2020 **Update**

Resumption of the Program in 2020

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 and, Ramform Titan will be acquiring data between late May and September 2020

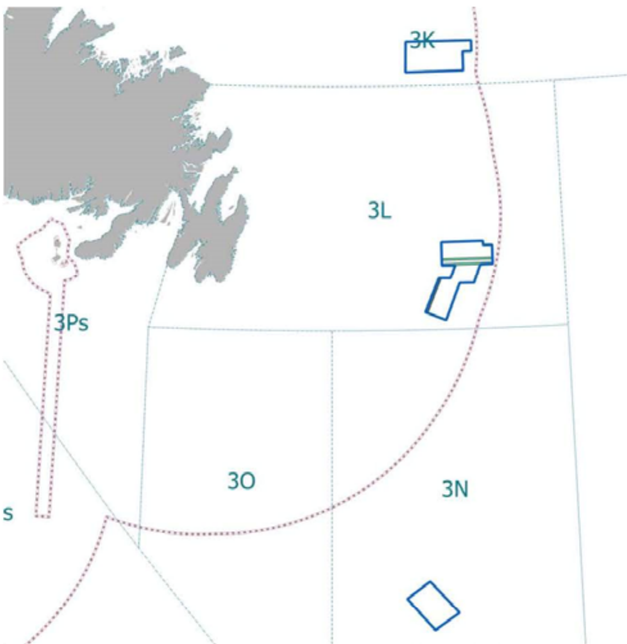

Figure 2: MKI Planned 2020 Seismic Activity Offshore Newfoundland

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

Figure 1: Seismic Vessels due to work in the province during 2020

How to Access Environmental Information about the Project

The Environmental Assessment (EA) for the Multiklient Invest AS Newfoundland 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 Newfoundland 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

Contact Information

If you have any inquiries regarding the Newfoundland 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
Aquaforte		
Aquaforte Town Council	rhondaokeefe@aim.com	Rhonda O’Keefe
Argentia		
Argentia Management Authority Inc.	w.brenton@argentia.ca	Harvey Brenton
Arnold’s Cove		
Town of Arnold's Cove	acadmin@bellaliant.com	Angie Gale
Avalon Ocean Products Inc.	Avalon.ocean@nf.aibn.com	Aloysius Wadman
Icewater Seafoods Inc.	awareham@icewaterseafoods.com	Alberto Wareham
Bay Bulls		
Town of Bay Bulls	townofbaybulls@nf.aibn.com	Not available
Burin		
Town of Burin	lhartson@townofburin.com	Leo Hartson, Town Manager
Burin Harbour Authority	morrisfudge@yahoo.ca	Morris Fudge
Burin Peninsula Environmental Reform Committee	info@greenburin.ca	Not available
College of the North Atlantic		
Wave Energy Research Centre	mike.graham@cna.nl.ca	Michael Graham, Administrator
Come by Chance		
Town of Come by Chance	townofcbc@eastlink.ca	Stephanie Eddy, Clerk
Conne River		
Miaqpukek First Nation	thowse@mfngov.ca	Tracey Howse, Director, Training and Economic Development
Corner Brook		
Qalipu Mi’kmaq First Nation Band	reldridge@qalipu.ca	Ralph Eldridge, Manager of Community Economic Development
Ferryland		
Town of Ferryland	Town.ferryland@nf.aibn.com	Not available
M. & A. Fisheries Limited	Ma.fisheries@nf.aibn.com	Angus O’Connell
Fortune		
Town of Fortune	norma@townoffortune.ca	Norma Stacey, Clerk
Fortune Harbour Authority	fortuneharbour@hotmail.com	
Atlantic Ocean Farms Limited	walsheslogybay@nl.rogers.com	David Walsh, President
Grand Bank		
Town of Grand Bank	Sdurnford@townofgrandbank.net	Sheila Durnford Office Administrator
Grand Bank Harbour Authority	hagb@bellaliant.com	Arch Evans
Marystown		
Town of Marystown	info@townofmarystown.ca	Dennis Kelly, Clerk
Burin Peninsula Community Business Development Corporation	Audrey.hennebury@cbdc.ca	Audrey Hennebury, Admin Assistant

Organization or Group Name	Email Address	Contact Name
Burin Peninsula Chamber of Commerce	administration@bpchamber.ca	Not available
Marystown Shipyard and Offshore Facilities	butlerwa@hotmail.com	Wayne Butler, President
Placentia		
Town of Placentia	dgear@placentia.ca	Debbie Gear, Executive Assistant
Placentia Area Chamber of Commerce	Eugene.collins@placentiachamber.ca	Eugene Collins, Executive Director
Harbour Authority of Placentia Area	cnrpomeroy@bellaliant.com	Carter Pomeroy
Avalon Gateway Regional Economic Development Inc.	contact@avalongateway.ca	Michael Mooney, Executive Director
Avalon West Community Business Development Corporation	Tanya.white@cbdc.ca	Tanya White, Administrative Assistant
Placentia Area Development Association	Pada44@hotmail.com	Tiffany Seay-Hepditch, Executive Director
Southern Harbour		
Town of Southern Harbour	twnsouthernhr@nf.aibn.com	Renee Hickey
St. Brides		
Town of St. Brides	Joanmorrissey01@yahoo.ca	Joan Morrissey, Clerk
St. Bride's Harbour Authority	Lorettaconway59@gmail.com	Loretta Conway
St. John's		
Fisheries and Oceans Canada-Coast Guard	Jason.kelly@dfo-mpo.gc.ca	Jason Kelly, Senior Fisheries Protection Biologist
Environment and Climate Change 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	Maureen Murphy, Director
Groundfish Enterprise Allocation Council	bchapman@sympatico.ca	Bruce Chapman, Executive Director
Association of Seafood Producers	dbutler@seafoodproducers.org	Derek Butler, Executive Director
Seafood Processors of Newfoundland and Labrador	gjoyce@nf.sympatico.ca	George Joyce, Executive Director
Beothic Fish Processors Ltd.	pgrant@beothic.com	Paul Grant, Executive Vice President
Breakwater Fisheries Limited	rrbarnes@nf.sympatico.ca	Randy Barnes
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Deep Atlantic International Inc.	Martha@deepatlanticsea.com	Martha Mullowney, Director

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San-Can Fisheries Limited	sgoff@san-can.com	Sandra Goff, Director
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Town of Trepassey	jill@townoftrepassey.com	Jill MacNeil, Clerk
Trepassey Management Corporation	chairperson@nf.aibn.com	Rita Pennell, Chairperson
Southern Avalon Development Association	southernavalondev@nf.aibn.com	Anita Molloy, VP and Board Member
Witless Bay		
Town of Witless Bay	townofwitlessbay@nl.rogers.com	Geraldine Caul, Clerk