Environmental Assessment Update (2022) of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023

Prepared by:

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Prepared for:

Multiklient Invest AS

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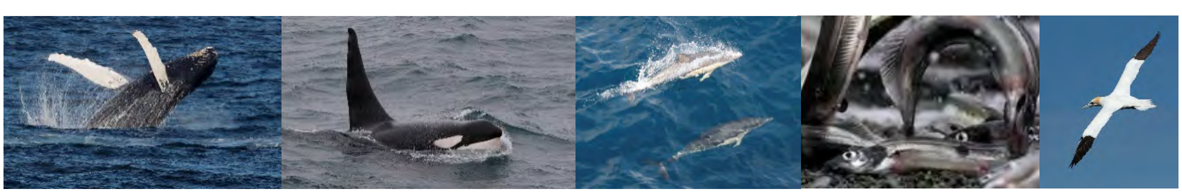

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Table of Contents

Page

List of Figures

List of Tables

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, 2020b, 2021a). In 2022, 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 2022. 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 2022. Previous EA Updates associated with this program were prepared in 2018, 2019, 2020, and 2021 (LGL 2018c, 2019, 2020b, 2021a).

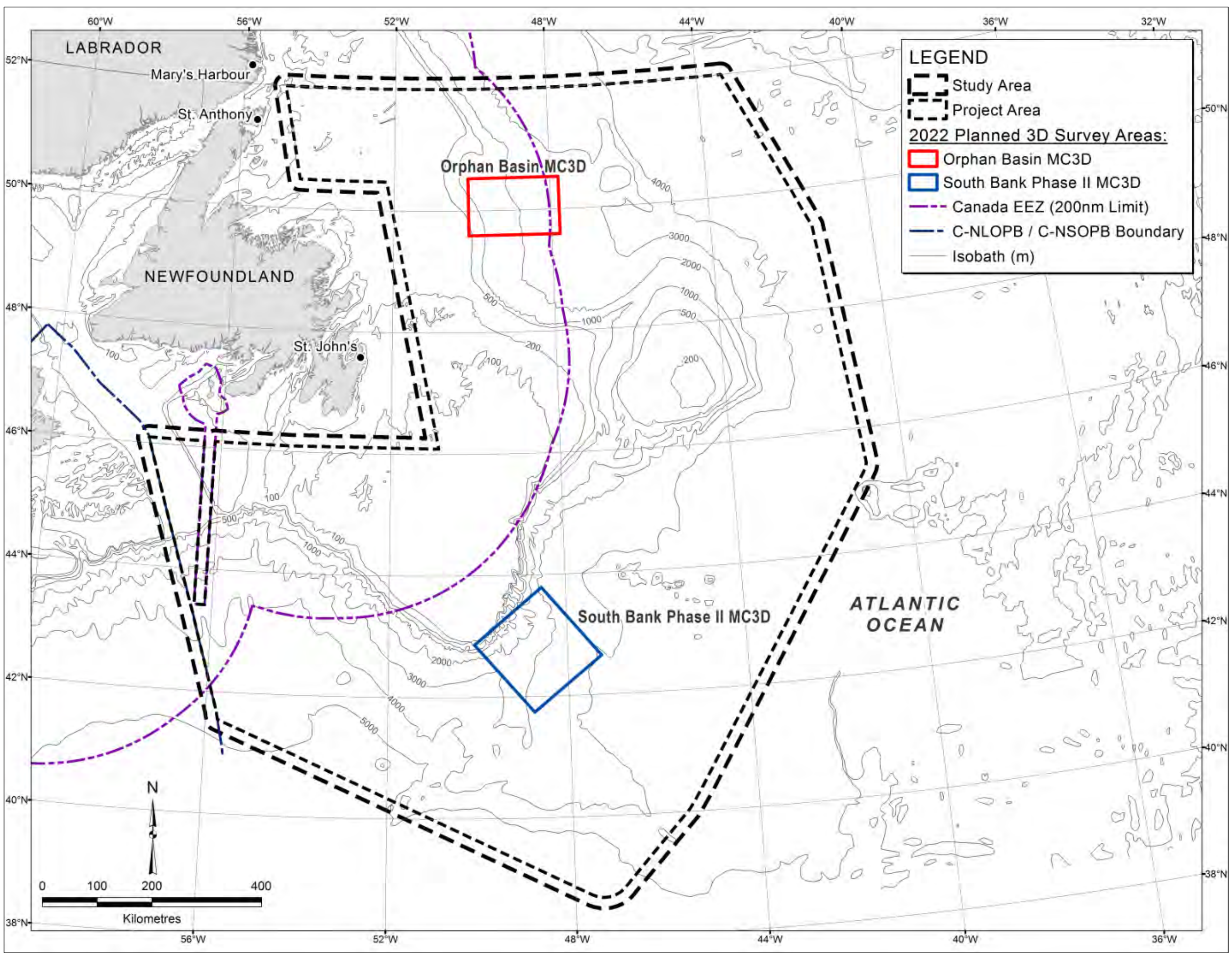


Figure 1.1. Locations of the Project Area, Study Area and 2022 Planned 3D Survey Areas for MKI's Newfoundland Offshore Seismic Program.

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.

Document Type	Temporal Scope	EA Document
Original EA	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]
EA Update	May 1 to November 30, 2018	Environmental Assessment Update (2018) of the Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023 (LGL 2018c)
EA Update	May 1 to November 30, 2019	Environmental Assessment Update (2019) of the Multiklient Invest Newfoundland Offshore Seismic Program, 2018−2023 (LGL 2019)
EA Update	May 1 to November 30, 2020	Environmental Assessment Update (2020) of the Multiklient Invest Newfoundland Offshore Seismic Program, 2018−2023 (LGL 2020b)
EA Update	May 1 to November 30, 2021	Environmental Assessment Update (2021) of the Multiklient Invest Newfoundland Offshore Seismic Program, 2018−2023 (LGL 2021a)
EA Amendment	May 1 to November 30, 2018–2023	Amendment to Environmental Assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023 (LGL 2020a)[b]
EA Amendment	May 1 to November 30, 2018–2023	Amendment to Environmental Assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023 (LGL 2021b)[c]

[a] On 15 May 2018, the C-NLOPB made a positive determination on this EA and EA Addendum.
[b] The C-NLOPB determined that this EA Amendment did not provide a satisfactory assessment.
[c] The EA Amendment was withdrawn.

The following sections provide information 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

The information in this section provides details of the Project specific to 2022.

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 2022, MKI is planning to conduct two simultaneous 3D surveys with the MV *Ramform Titan* and MV *Ramform Atlas*. All project description parameters described in the EA are applicable to MKI's 2022 activities. Specific details for 2022 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 2022

In 2022, MKI plans to conduct 3D seismic surveying in the Project Area. A maximum of two seismic survey vessels will be used in 2022. MKI is proposing to conduct approximately 10,000–15,400 km^2 of 3D seismic surveying in the Project Area in 2022 (see Figure 1.1).

In 2022, MKI will use the MV *Ramform Titan* and MV *Ramform Atlas* for the 3D seismic surveying. The *Ramform Titan* and *Ramform Atlas* 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 about 6.4 m. The vessels will travel at a speed of ~8.15–9 km/h (4.4–4.9 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 2022.

Figure 2.1. MV *Ramform Titan.*

Figure 2.2. MV *Ramform Atlas.*

2.4.1 Seismic Energy Source Parameters

For 3D seismic surveying MKI will use either a 4130 in^3 (dual source) or 3280 in^3 (triple source) 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 12.5 m, 18.75 m or 25 m.

2.4.2 Seismic Streamers

The *Titan* and *Atlas* will tow 16 streamers each 8.1 km in length. The streamers will be spaced 100 m (16 streamers) apart for a total maximum spread of 12.2 km^2.

2.4.3 Support Vessels

Two vessels may be used to support the 3D seismic surveys in 2022. The MV *Thor Magni* will be used as support vessel and the MV *Palaimon* will perform escort vessel duties. The operational objective is to have one of these escort 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 maximum number of MKI seismic vessels acquiring data within the Project Area as part of the Project at any given time would be two. However, at the time this EA Update was prepared, it is unlikely that a second seismic vessel will be utilized. The *Ramform Titan* will survey the South

Bank Phase II (~10,000 km^2) survey area and the *Ramform Atlas* may survey the Orphan Basin survey area (~5400 km^2). The *Ramform Titan* plans to mobilize and deploy its seismic gear from 15–28 May with demobilization planned for early to mid-September. If the Orphan Basin survey proceeds, the *Ramform Atlas* plans to mobilize and deploy its seismic gear from 15–22 June with demobilization planned for 27–30 August. Mobilization and demobilization dates may change.

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.

3.0 Physical Environment

A summary of the physical environment was provided in Section 3.0 of the EA (LGL 2018a). The sea-ice volume across the Newfoundland and Labrador Shelf was slightly below normal in 2020, continuing the trend of weak ice conditions in recent years; the last period with normal ice conditions was 2014–2016 (Cyr and Galbraith 2021). The number of icebergs that drifted south of 48°N onto the Northern Grand Bank was 169 and 1, for 2020 and 2021, respectively (International Ice Patrol 2022). These numbers are much lower relative to the 1515 iceberg count in 2019.

The annual sea-surface temperature and bottom temperature in Northwest Atlantic Fisheries Organization (NAFO) Divs. 3LNOPs were at normal levels in 2020 (Cyr and Galbraith 2021). The profile pattern was similar to that of 2019, with the bottom temperatures on the slopes of the Grand Banks in the normal range during spring, while bottom temperatures in NAFO Divs. 2HJ3KLNO were slightly above normal in fall, especially in 3K (Cyr et al. 2021; Cyr and Galbraith 2021).

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

The Atlantic Zone Monitoring Program (AZMP) findings in relation to oceanographic conditions in the Study Area have been updated to include findings from 2020 (DFO 2022a). Annual chlorophyll *a* inventories continued the previous year's trend and were above normal over much of the Newfoundland and Labrador Shelf. The spring phytoplankton bloom began later than normal in the Labrador Sea and near normal for the Newfoundland Shelf. The bloom's magnitude was generally higher than normal on the Newfoundland Shelf and included a record high in the Hibernia section; however, bloom duration was near normal throughout the Atlantic Zone. There was some variation relative to the recent shift in the zooplankton community reported in LGL (2021a); during 2020, the abundance of large, energy-rich *Calanus finmarchicus* increased while that of some small copepods decreased, and the overall abundance of copepods and non-copepods was elevated. Contrary to the previous year, the abundance of *Pseudocalanus* spp. was lower than normal throughout most of the Atlantic Zone, although a record high was recorded for the Bonavista section. The zooplankton biomass trend also inversed from the previous year; during 2020, it was normal to above normal for the Newfoundland and Labrador Shelves.

4.1.2 Benthic Invertebrates

Hierarchical Modelling of Species Communities indicated that benthic invertebrate communities in shallower portions (<500 m depth) of the Flemish Cap mainly include small- and medium-sized species with short lifespans, while larger species with longer lifespans and species that utilize broadcast spawning characterize deeper portions (500–1500 m) (Murillo et al. 2020). Sediment bioturbation plays a key role in nutrient exchange and biogeochemical cycles in marine ecosystems. Kernel density estimations suggested that the greatest biomass of bioturbating benthic invertebrates inhabiting the Flemish Cap occurs along its northern, northwestern, and northeastern slopes (Kenchington et al. 2020).

Remotely Operated Vehicle (ROV) surveys on the mounds of the Orphan Knoll indicated that they were mainly colonized by cold-water corals, predominantly including octocorals and some antipatharians, and sponges (Meredyk et al. 2020). Overall, the coral fauna on the Orphan Knoll is similar to species assemblages elsewhere offshore Newfoundland and Labrador, except for the presence of the gorgonian coral *Corallium niobe*, which was observed on the Southeast Orphan Knoll mounds, and the solitary scleractinian *Caryophyllia ambrosia*, which had not previously been recorded for the region (Meredyk et al. 2020).

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)

An updated stock assessment for snow crab in the Newfoundland and Labrador Region has not yet been released since 2021; therefore, there is no new stock information since the material presented in subsection 4.1.3.1 of LGL (2021a). The overall Total Allowable Catch (TAC) in the Newfoundland and Labrador Region increased by 32% from 2021, up to 50,470 t (DFO 2022b). This includes a 32% increase in NAFO Division (Div.) 3K (up to 9,840 t), 23% increase in 3LNO (30,940 t), and 54% increase in 3Ps (7,768 t), and an increase of 50 t for the Collaborative Post-Season Trap Survey (450 t) (DFO 2022b).

Northern Shrimp (Pandalus borealis)

An updated stock assessment for northern shrimp in the Newfoundland and Labrador Region has not been released since 2021; therefore, there is no new stock information since the material presented in subsection 4.1.3.1 of LGL (2021a). Fisheries management decisions have not yet been declared for the Newfoundland and Labrador Region for 2022; therefore, there is no new quota information since that which was provided in LGL (2021a).

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 (Arctic) Surf Clam (Mactromeris polynyma)

In 2022, the TAC for the Grand Bank remains the same as previous years, at 14,756 t (DFO 2022b). Otherwise, there have been no further relevant updates on Stimpson's surf clam since the information presented in subsection 4.1.3.1 of LGL (2021a).

Atlantic Halibut (Hippoglossus hippoglossus)

During 2021, 922 t of Atlantic halibut were landed in the Newfoundland and Labrador Region (DFO 2022c). Otherwise, there have been no further relevant updates on Atlantic halibut since the information presented in subsection 4.1.3.1 of LGL (2019).

Greenland Halibut (Reinhardtius hippoglossoides)

The TAC for Greenland halibut in NAFO Div. 3LMNO is 11,755 t for 2022, down from 12,225 t in 2021 (NAFO 2022).

Atlantic Cod (Gadus morhua)

An updated stock assessment for Atlantic cod in the Newfoundland and Labrador Region has not been released since 2021; therefore, there is no new stock information since the material presented in subsection 4.1.3.1 of LGL (2021a). The TAC for Atlantic cod in NAFO Div. 3M increased from 1,500 t in 2021 to 4,000 t in 2022 (NAFO 2022), and remains unchanged from 2021–2022 for Div. 3Ps, at 1,346 t (DFO 2022b).

American Plaice (Hippoglossoides platessoides)

The moratorium on American plaice is still in place for 2022 and the TAC is set at 0 t in Div. 3LMNO (NAFO 2022). Mean landings in NAFO Subarea 2 and Div. 3K were 31.9 t during 2010–2014 and 3.6 t during 2015–2019; reported bycatch discarded at sea averaged 6.8 t and 9.2 t during these periods, respectively (DFO 2021a). Bycatch primarily occurs during the Greenland halibut trawl fishery (DFO 2021a). Abundance and biomass declined drastically from the 1980s to 2000s, showed a minor increase in 2013, and has since declined again (DFO 2021a). Following a seven-year period of at or above average recruitment (2011–2018, except 2016), the recruitment index decreased to 74% of the long-term mean during 2019 (DFO 2021a). Spawning stock biomass significantly decreased during 1982–2005 and increased slightly thereafter, to 15% of the average from 1978–1982; no ageing data have been available since 2012 (DFO 2021a). Overall, the stock status is currently considered critical (DFO 2021a).

Yellowtail Flounder (Pleuronectes ferruginea)

The TAC for yellowtail flounder in NAFO Div. 3LNO increased from 17,000 t in 2021 to 20,000 t for 2022 (NAFO 2022). Otherwise, 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)

The TAC for white hake in NAFO Div. 3NO remained at 1,000 t during 2021 and 2022 (NAFO 2022). This is double the TAC (500 t) that was designated during 2018/2019 and 2020/2021, which were the first years that a TAC for white hake was implemented (LGL 2019).

Redfish (Sebastes sp.)

DFO has not yet released the 2022 TAC for redfish in Unit 2 (NAFO Div. 3PS, 4Va, a portion of 4W, and 3Pn + 4Pn); the 2022 TAC is 18,100 t for Div. 3LN, 10,933 t for 3M, and 20,000 t for 3O (NAFO 2022).

4.1.3.2 Other Fishes of Note

Capelin (Mallotus villosus)

The TAC for NAFO Div. 2J3KLPs capelin decreased by 25% between 2020 and 2021, down to 14,533 t (DFO 2022b). This was divided into 58 t for 2J, 5,108 t for 3K, 8,399 t for 3L, and 968 t for 3Ps (DFO 2022b). A moratorium remains in effect for Div. 3NO (NAFO 2022). Oceana Canada recently conducted research that suggests capelin is currently critically depleted and overfished and is calling upon DFO for a fishery closure until the stock improves (Jubinville et al. 2022).

Wolffishes (Anarhichas sp.)

There have been no further relevant updates on wolffishes since the information presented in subsection 4.1.3.2 of LGL (2020b).

Swordfish (Xiphias gladius)

There were no swordfish landings in Newfoundland during 2018, or 2019 (DFO 2021b); however, there was a single landing recorded in the 2020 DFO commercial landings database (see Table 4.1 below).

Anadromous Fishes

An updated stock assessment for Newfoundland and Labrador Atlantic salmon has not yet been released since 2020; therefore, there is no new stock information since the material presented in subsection 4.1.3.2 of LGL (2021a).

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 2019 and 2020 domestic commercial fisheries landings datasets. Results of analyses of the May–November 2019 and 2020 data did not indicate any major differences in distribution of harvest locations as compared to previous years (see Figures 4.5–4.8 of LGL [2015a,b]; Figure 4.1 of LGL [2016]; Figure 4.5 of LGL [2018a]; Figures 4.1–4.2 of LGL [2019]; and Figure 4.2 of LGL [2021a]. The distribution of May–November 2019 and 2020 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. Harvests mainly occurred between the 500 and 1000-m isobaths in the Orphan Basin MC3D survey area and the 100 and 1000-m isobaths in the South Bank Phase II MC3D survey area.

Catch weight and quartile counts by vessel length classes and species harvested in the Study Area are presented in Table 4.1, and in the Orphan Basin and South Bank survey areas in Table 4.2. Commercial harvests within the Study Area during May–November 2019 and 2020 were caught by fishers from Newfoundland and Labrador (74% and 78% during 2019 and 2020, respectively) and Nova Scotia (26% and 22% during 2019 and 2020, respectively). All commercial harvests within the Orphan Basin survey area were caught by fishers from Newfoundland and Labrador, whereas harvests within the South Bank survey area were acquired by Newfoundland and Labrador and Nova Scotian fishers.

During 2019 and 2020, snow crab and Atlantic halibut were the primary species harvested in the Study Area. Other notable species included redfish, northern shrimp, Greenland halibut, and Atlantic cod. Snow crab were harvested by vessels of length classes up to 124.9′ and Atlantic halibut by vessels up to 99.9′ and ≥125′.

During 2019 and 2020, Greenland halibut was the main species harvested in the Orphan Basin survey area. Other species harvested during May–November 2019 and 2020 include redfish, Atlantic halibut, snow crab, roughhead grenadier, and witch flounder. Greenland halibut were mostly harvested by vessels of the length class 45–64.9′, and to a lesser extent by vessels 35–44.9′, 65–99.9′ and ≥125′. Redfish were harvested by vessels between 35′ and 99.9′, Atlantic halibut were caught by vessels 45–64.9′ and ≥125′, snow crab by vessels ≤44.9′, roughhead grenadier by vessels 45–99.9′, and witch flounder by vessels ≥125′.

In the South Bank survey area, Atlantic halibut and Atlantic cod were the main species harvested during 2019 and 2020. Other species harvested during May–November 2019 and 2020 include cusk, white hake, Greenland halibut, roundnose and roughhead grenadiers, snow crab, cockle, Simpson's surf clam, and swordfish. Atlantic halibut and Atlantic cod were harvested by vessels 35–64.9′. Cusk, white hake, Greenland halibut, roundnose and roughhead grenadiers, and swordfish were harvested by vessels 45–64.9′, while snow crab were caught by vessels 100–124.9′ and cockle and Simpson's surf clam by vessels ≥125′.

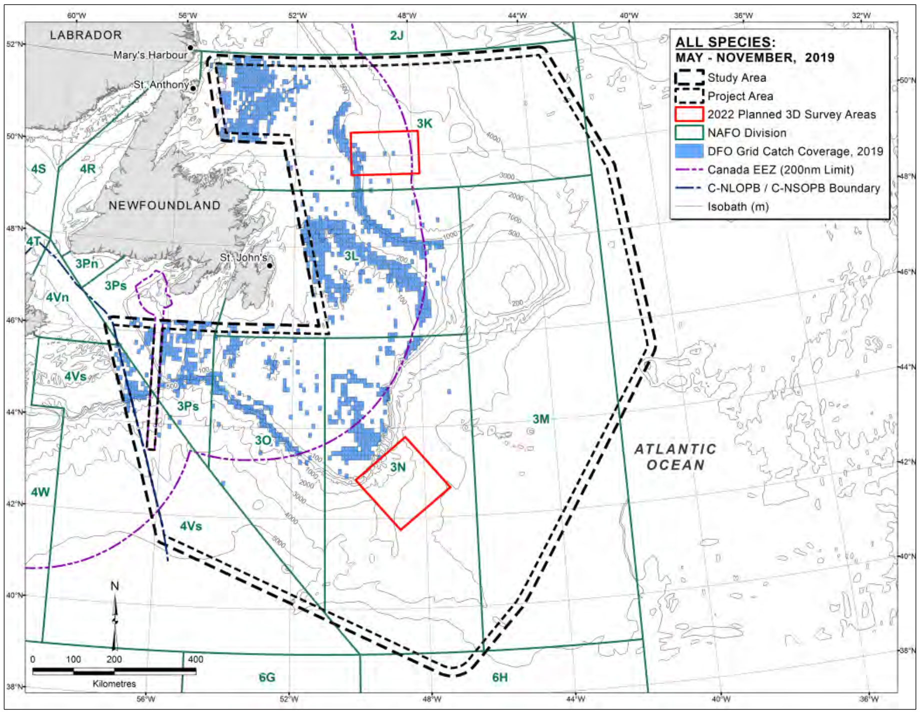


Figure 4.1. Distribution of commercial fishery harvest locations, all species, May–November 2019 (derived from DFO commercial landings database, 2019).

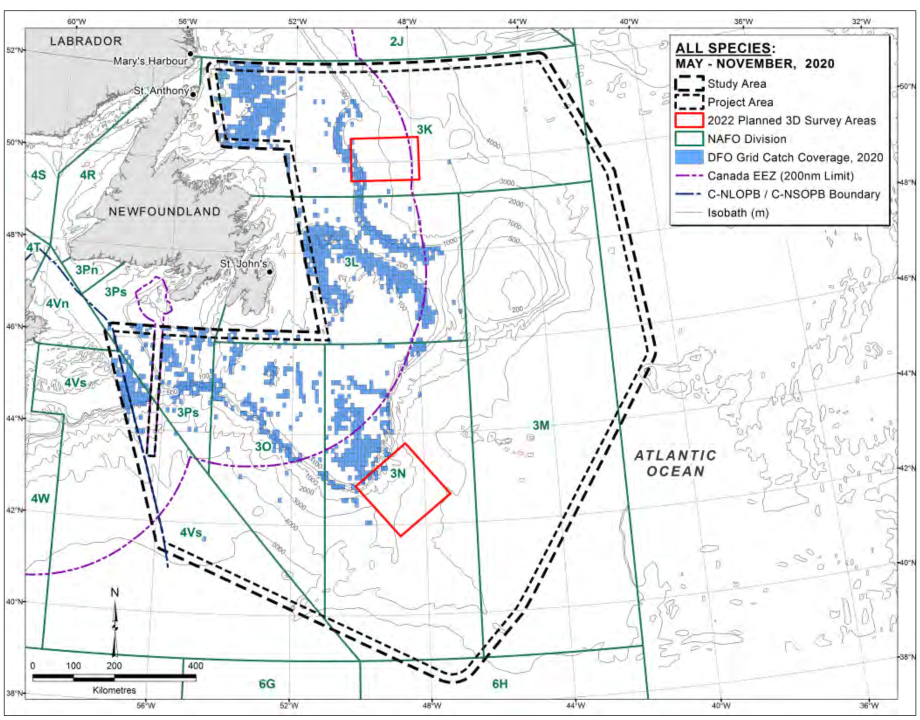


Figure 4.2. Distribution of commercial fishery harvest locations, all species, May–November 2020 (derived from DFO commercial landings database, 2020).

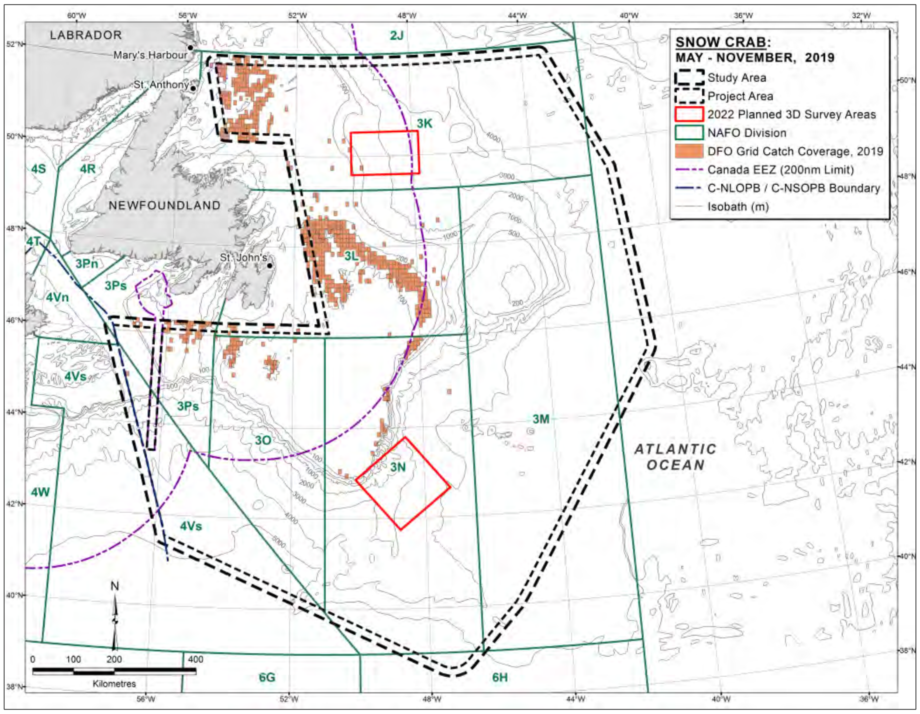


Figure 4.3. Distribution of commercial fishery harvest locations, snow crab, May–November 2019 (derived from DFO commercial landings database, 2019).

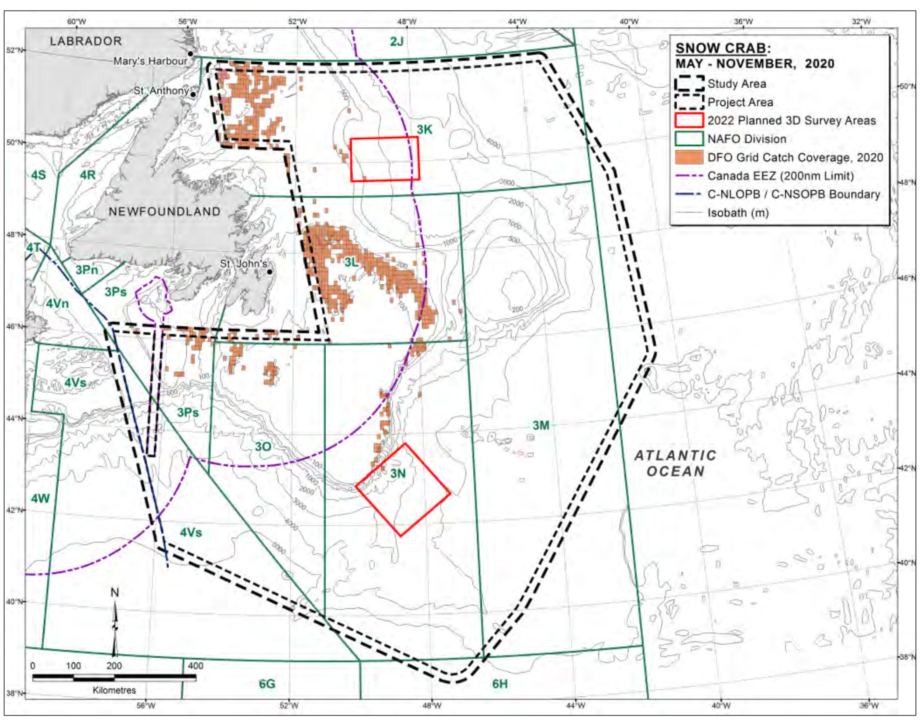


Figure 4.4. Distribution of commercial fishery harvest locations, snow crab, May–November 2020 (derived from DFO commercial landings database, 2020).

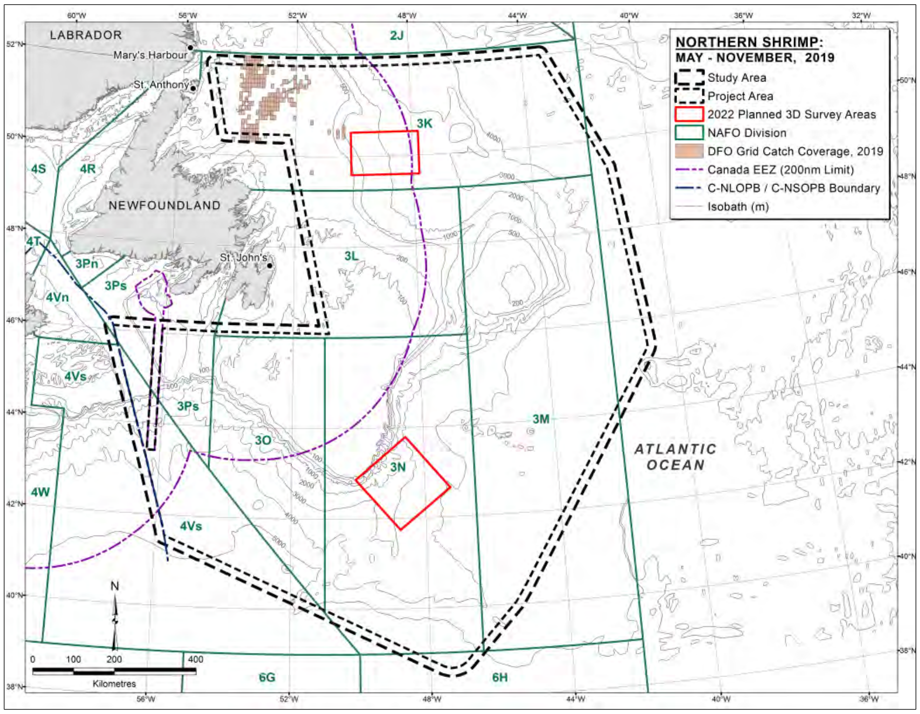


Figure 4.5. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2019 (derived from DFO commercial landings database, 2019).

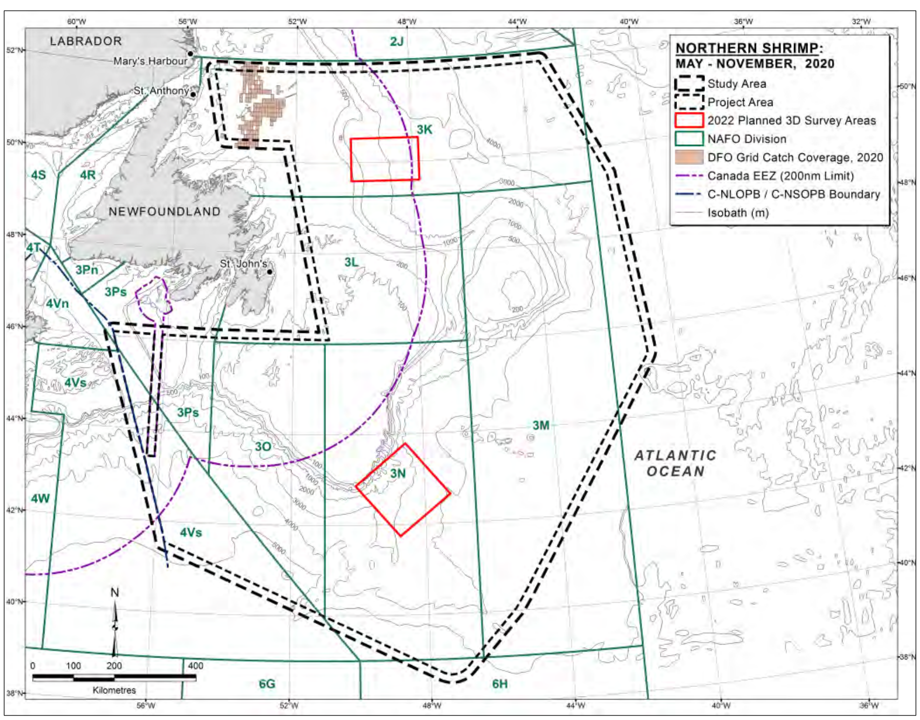


Figure 4.6. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2020 (derived from DFO commercial landings database, 2020).

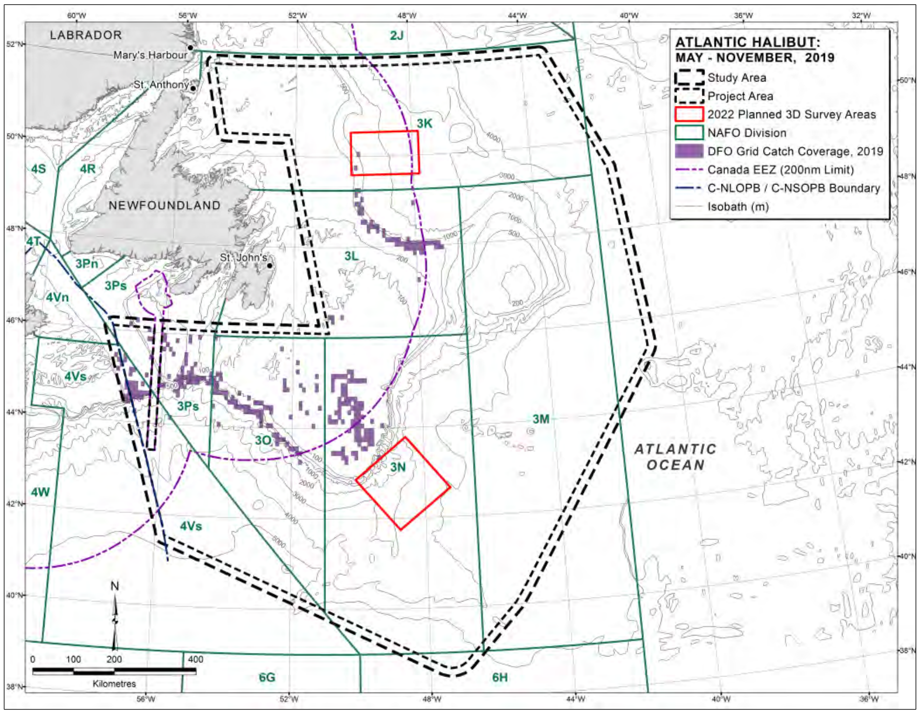


Figure 4.7. Distribution of commercial fishery harvest locations, Atlantic halibut, May–November 2019 (derived from DFO commercial landings database, 2019).

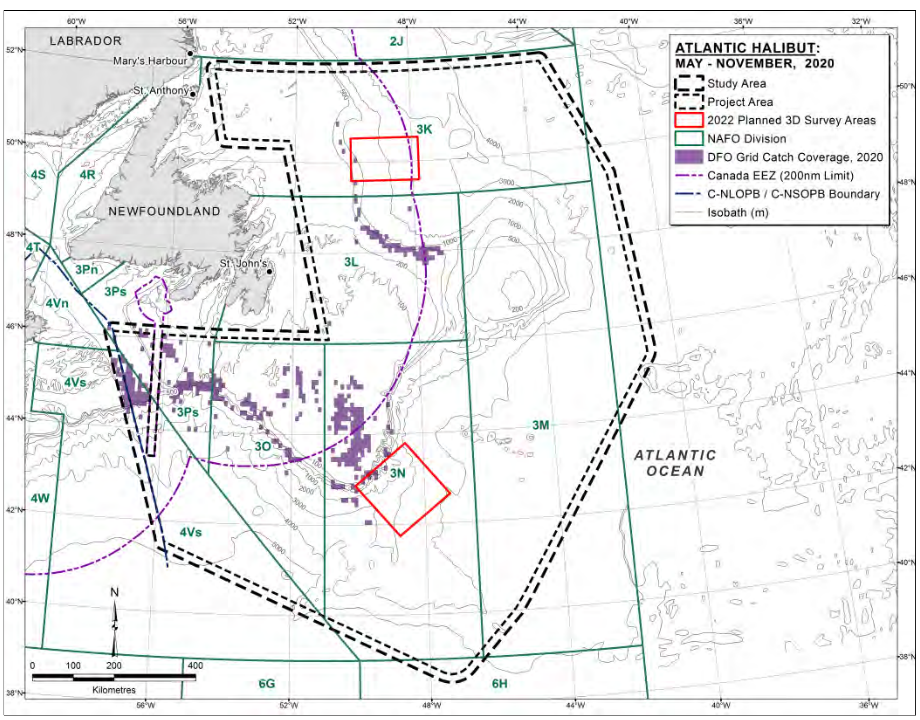


Figure 4.8. Distribution of commercial fishery harvest locations, Atlantic halibut, May–November 2020 (derived from DFO commercial landings database, 2020).

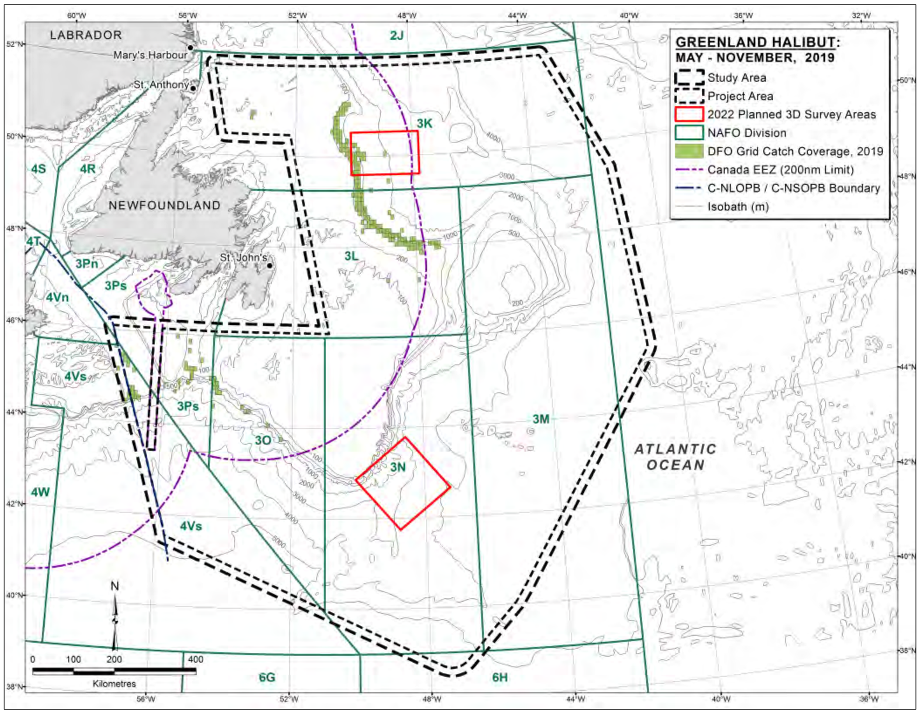


Figure 4.9. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2019 (derived from DFO commercial landings database, 2019).

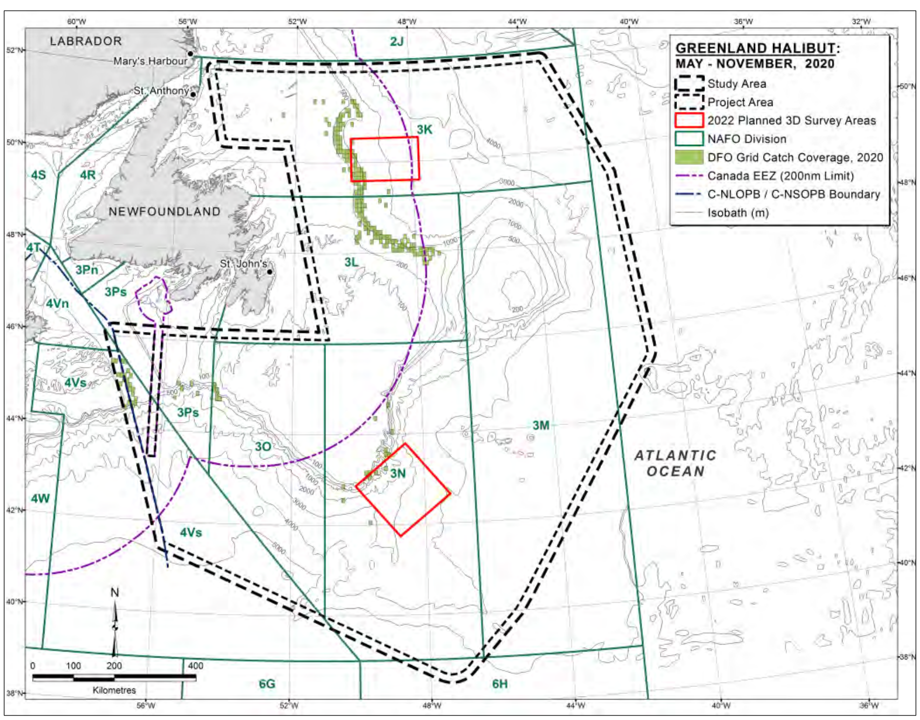


Figure 4.10. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2020 (derived from DFO commercial landings database, 2020).

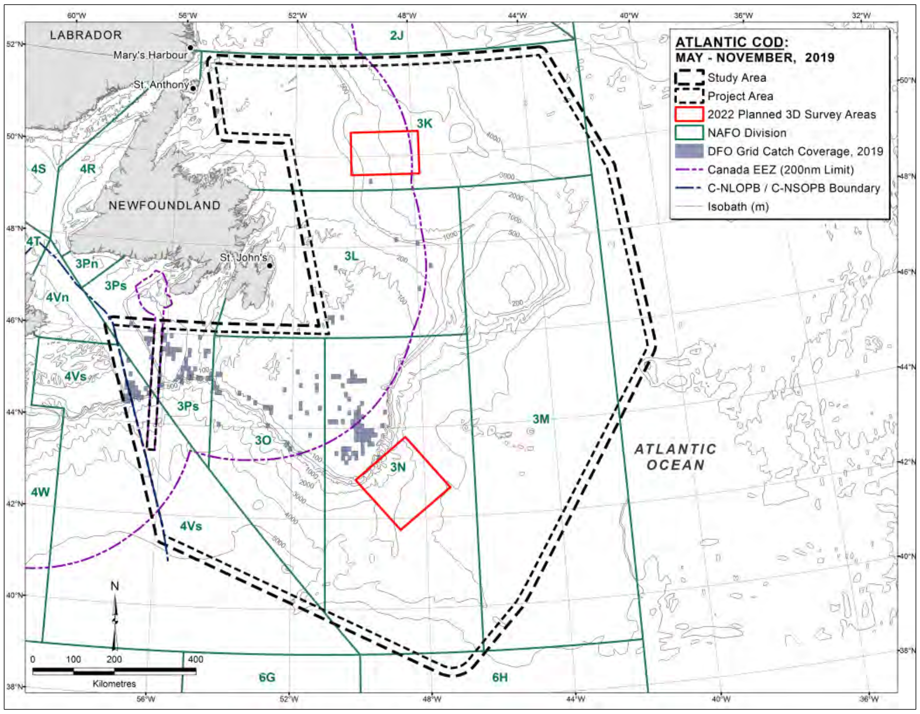


Figure 4.11. Distribution of commercial fishery harvest locations, Atlantic cod, May–November 2019 (derived from DFO commercial landings database, 2019).

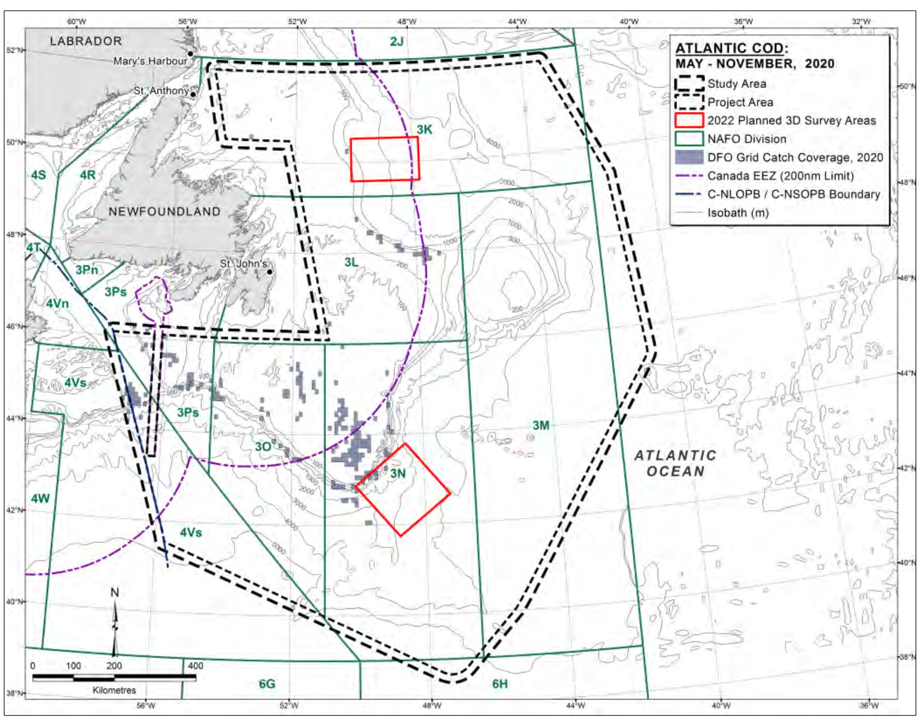


Figure 4.12. Distribution of commercial fishery harvest locations, Atlantic cod, May–November 2020 (derived from DFO commercial landings database, 2020).

Table 4.1. Commercial catch weights and values in the Study Area, May–November 2019 and 2020 (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, 2019/2020).

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’	
2019															
Snow Crab	234	423	532	126	129	280	496	410	50	335	791	139	0	0	1,315
Atlantic Halibut	104	223	197	155	241	243	163	32	1	101	251	77	0	249	679
Redfish	74	140	123	99	197	127	96	16	0	5	222	60	0	149	436
Northern Shrimp	125	114	109	86	155	113	100	66	0	7	333	54	0	40	434
Greenland Halibut	63	135	154	66	116	145	132	25	1	92	246	23	0	56	418
Atlantic Cod	63	94	87	113	111	118	108	20	2	64	142	47	0	102	357
White Hake	64	97	94	63	134	118	60	6	0	69	188	61	0	0	318
Yellowtail Flounder	13	63	76	64	56	88	53	19	0	1	0	0	0	215	216
American Plaice	10	53	78	71	48	87	58	19	0	10	20	0	0	182	212
Pollock	12	29	39	42	36	42	39	5	0	8	80	34	0	0	122
Monkfish	12	39	40	27	54	42	18	4	0	10	93	11	0	4	118
Cusk	12	31	40	32	29	46	38	2	0	46	38	31	0	0	115
Witch Flounder	7	19	25	37	23	26	23	16	0	0	11	4	0	73	88
Atlantic Haddock	10	22	22	17	26	28	17	0	0	15	36	16	0	4	71
Arctic Surf Clam	0	4	15	44	1	16	15	31	0	0	0	0	0	63	63
Swordfish	21	23	12	5	9	20	25	7	0	17	12	32	0	0	61
Cockle	0	3	15	42	0	15	14	31	0	0	0	0	0	60	60
Propeller Clam	0	2	15	38	0	14	12	29	0	0	0	0	0	55	55
Mako Shark	14	12	9	4	6	13	15	5	0	8	10	21	0	0	39
Whelk	9	13	10	3	12	16	7	0	0	25	10	0	0	0	35
Sea Cucumber	1	2	13	18	3	11	7	13	0	26	8	0	0	0	34
Silver Hake	22	8	2	2	22	9	3	0	0	0	8	0	0	26	34
Sea Scallop	3	8	4	13	11	3	7	7	0	0	4	4	12	8	28
Albacore Tuna	5	11	8	2	1	7	15	3	0	4	6	16	0	0	26
Skate	4	8	8	5	16	6	3	0	0	3	22	0	0	0	25
Bluefin Tuna	8	9	3	5	9	9	6	1	0	1	16	8	0	0	25
Bigeye Tuna	5	3	3	2	3	4	5	1	0	6	2	5	0	0	13
Roughhead Grenadier	0	3	4	3	2	2	4	2	0	1	9	0	0	0	10
Mahi Mahi (Dolphinfish)	1	4	3	1	1	0	6	2	0	3	3	3	0	0	9
Blue Shark	3	3	1	0	1	3	3	0	0	0	0	7	0	0	7
Ocean Quahaug	0	0	0	4	0	2	1	1	0	0	0	0	0	4	4
Capelin	0	1	0	1	1	1	0	0	2	0	0	0	0	0	2
Mackerel	1	0	1	0	1	1	0	0	0	2	0	0	0	0	2
Round-nose Grenadier	0	1	0	0	0	1	0	0	0	0	0	1	0	0	1
TOTAL	**900**	**1,600**	**1,742**	**1,190**	**1,454**	**1,656**	**1,549**	**773**	**56**	**859**	**2,561**	**654**	**12**	**1,290**	**5,432**
2020															
Snow Crab	209	487	694	225	131	354	627	503	50	370	1,027	152	16	0	1,615
Atlantic Halibut	171	263	206	131	224	323	184	40	0	123	221	129	0	298	771
Greenland Halibut	74	190	118	29	100	195	98	18	1	82	235	35	0	58	411
Redfish	57	127	108	60	116	128	90	18	0	1	134	98	0	119	352
Atlantic Cod	47	109	106	89	80	140	103	28	0	42	100	49	0	160	351
Northern Shrimp	86	100	85	43	116	110	57	31	0	0	235	53	0	26	314

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’	
Yellowtail Flounder	21	86	91	82	76	105	77	22	0	0	0	0	0	280	280
American Plaice	13	69	100	83	55	106	82	22	0	2	7	0	0	256	265
White Hake	31	87	62	39	62	88	59	10	0	41	114	64	0	0	219
Witch Flounder	1	22	35	48	11	34	46	15	0	0	27	0	0	79	106
Cusk	23	48	16	16	26	49	24	4	0	37	57	9	0	0	103
Monkfish	4	29	35	30	22	35	32	9	0	6	59	31	0	2	98
Pollock	2	29	30	22	15	31	33	4	0	9	45	29	0	0	83
Arctic Surf Clam	1	5	23	44	2	17	19	35	0	0	0	0	0	73	73
Cockle	0	5	18	38	1	14	13	33	0	0	0	0	0	61	61
Swordfish	20	17	19	1	33	19	5	0	0	21	1	35	0	0	57
Sea Cucumber	0	2	8	30	2	7	14	17	0	23	17	0	0	0	40
Propeller Clam	0	1	10	18	0	8	5	16	0	0	0	0	0	29	29
Atlantic Haddock	5	7	11	4	7	13	7	0	0	13	9	5	0	0	27
Bigeye Tuna	4	7	13	1	8	13	4	0	0	9	0	16	0	0	25
Albacore Tuna	10	5	7	0	13	8	1	0	0	4	0	18	0	0	22
Bluefin Tuna	14	1	5	1	14	3	4	0	0	14	0	7	0	0	21
Sea Scallop	0	4	1	13	0	4	1	13	0	0	3	0	10	5	18
Whelk	4	6	7	1	6	8	4	0	0	12	6	0	0	0	18
Roughhead Grenadier	2	11	3	0	3	10	3	0	0	0	7	9	0	0	16
Round-nose Grenadier	4	5	1	0	3	6	1	0	0	0	10	0	0	0	10
Mahi Mahi (Dolphinfish)	3	0	2	0	3	2	0	0	0	5	0	0	0	0	5
Silver Hake	0	0	0	3	0	0	2	1	0	0	3	0	0	0	3
White Marlin	2	1	0	0	3	0	0	0	0	1	0	2	0	0	3
Capelin	0	0	1	1	0	2	0	0	1	0	1	0	0	0	2
Skate	0	0	2	0	1	0	1	0	0	2	0	0	0	0	2
Atlantic Herring	0	0	0	1	0	1	0	0	0	0	1	0	0	0	1
TOTAL	**808**	**1,723**	**1,817**	**1,053**	**1,133**	**1,833**	**1,596**	**839**	**52**	**817**	**2,319**	**741**	**26**	**1,446**	**5,401**

Notes:

[a] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch weights in a given year, all species combined). 2019 quartile ranges: 1 = 0 – 1,938 kg; 2 = 1,939 – 8,218 kg; 3 = 8,219 – 33,113 kg; 4 = ≥33,114 kg. 2020 quartile ranges: 1 = 0 – 1,989 kg; 2 = 1,990 – 8,428 kg; 3 = 8,429 – 34,645 kg; 4 = ≥34,646 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). 2019 quartile ranges: 1 = $0 – $11,209; 2 = $11,210 – $46,951; 3 = $46,952 – $176,461; 4 = ≥$176,462. 2020 quartile ranges: 1 = $0 – $8,664; 2 = $8,665 – $38,347; 3 = $38,348 – $144,765; 4 = ≥$144,766.

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

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

Table 4.2. Commercial catch weights and values in the 2022 3D survey areas, May–November 2019 and 2020 (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, 2019/2020).

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’	
Orphan Basin															
2019															
Greenland Halibut	10	25	7	0	19	16	7	0	0	2	40	0	0	0	42
Redfish	6	8	1	0	8	6	1	0	0	2	13	0	0	0	15
Atlantic Halibut	0	2	0	0	1	1	0	0	0	0	2	0	0	0	2
Snow Crab	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1
Roughhead Grenadier	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1
TOTAL	**17**	**36**	**8**	**0**	**30**	**23**	**8**	**0**	**1**	**4**	**56**	**0**	**0**	**0**	**61**
2020															
Greenland Halibut	9	21	2	0	12	18	2	0	0	1	20	8	0	3	32
Roughhead Grenadier	0	6	1	0	1	5	1	0	0	0	0	7	0	0	7
Redfish	0	6	1	0	1	5	1	0	0	0	0	7	0	0	7
Witch	0	2	1	0	0	2	1	0	0	0	0	0	0	3	3
Snow Crab	2	0	0	0	0	2	0	0	0	2	0	0	0	0	2
Atlantic Halibut	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1
TOTAL	**11**	**36**	**5**	**0**	**14**	**33**	**5**	**0**	**0**	**3**	**20**	**22**	**0**	**7**	**52**
South Bank															
2019															
Atlantic Halibut	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1
Atlantic Cod	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1
TOTAL	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
2019															
Atlantic	0	7	2	0	0	7	2	0	0	0	9	0	0	0	9
Atlantic Cod	0	7	2	0	0	7	2	0	0	0	9	0	0	0	9
Cusk	0	4	2	0	0	4	2	0	0	0	6	0	0	0	6
White Hake	0	4	1	0	0	4	1	0	0	0	5	0	0	0	5
Greenland	0	3	1	0	0	3	1	0	0	0	4	0	0	0	4
Roundnose	0	3	0	0	0	3	0	0	0	0	3	0	0	0	3
Roughhead	0	1	1	0	0	1	1	0	0	0	2	0	0	0	2
Snow Crab	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1
Cockle	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1
Arctic Surf Clam	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1
Swordfish	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
TOTAL	**0**	**30**	**10**	**2**	**0**	**29**	**13**	**0**	**0**	**0**	**39**	**0**	**1**	**2**	**42**

Notes:

[a] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch weights in a given year, all species combined). 2019 quartile ranges: 1 = 0 – 1,938 kg; 2 = 1,939 – 8,218 kg; 3 = 8,219 – 33,113 kg; 4 = ≥33,114 kg. 2020 quartile ranges: 1 = 0 – 1,989 kg; 2 = 1,990 – 8,428 kg; 3 = 8,429 – 34,645 kg; 4 = ≥34,646 kg.

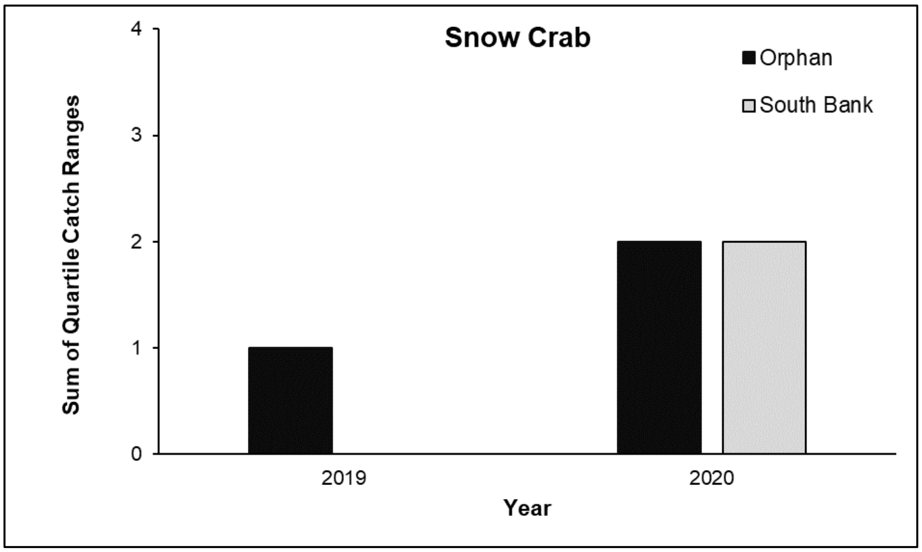
[b] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch value in a given year, all species combined). 2019 quartile ranges: 1 = $0 – $11,209; 2 = $11,210 – $46,951; 3 = $46,952 – $176,461; 4 = ≥$176,462. 2020 quartile ranges: 1 = $0 – $8,664; 2 = $8,665 – $38,347; 3 = $38,348 – $144,765; 4 = ≥$144,766.

[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.

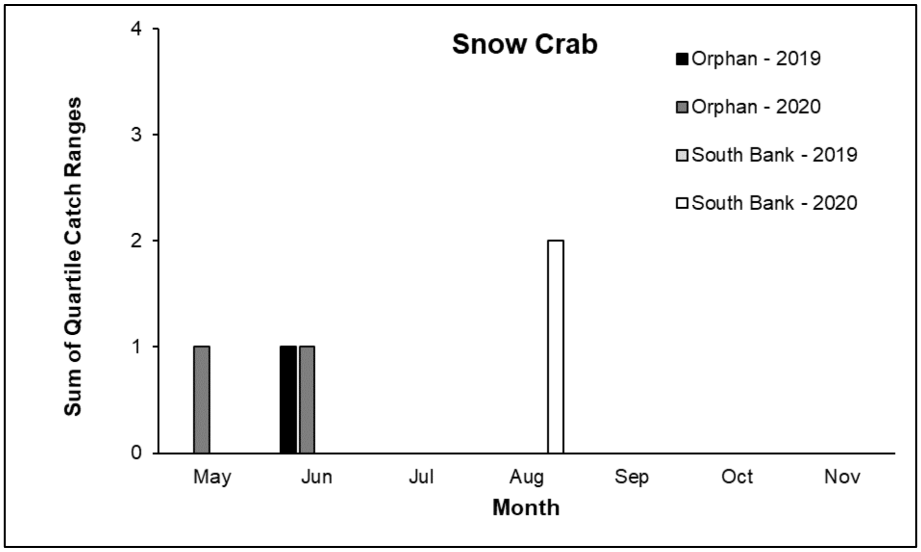
4.2.1.1 Snow Crab

During May–November 2019–2020, snow crab catches occurred in the Orphan Basin and South Bank survey areas, in water depths between 500 m and 1000 m (see Figures 4.3–4.4). During May–November, snow crab harvest within the Orphan Basin survey area slightly increased from 2019 to 2020, and only occurred during 2020 within the South Bank survey area (Figure 4.13). Snow crab catches occurred during May and June in the Orphan Basin survey area and during August in the South Bank survey area (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 2019–2020 for snow crab in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).



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).

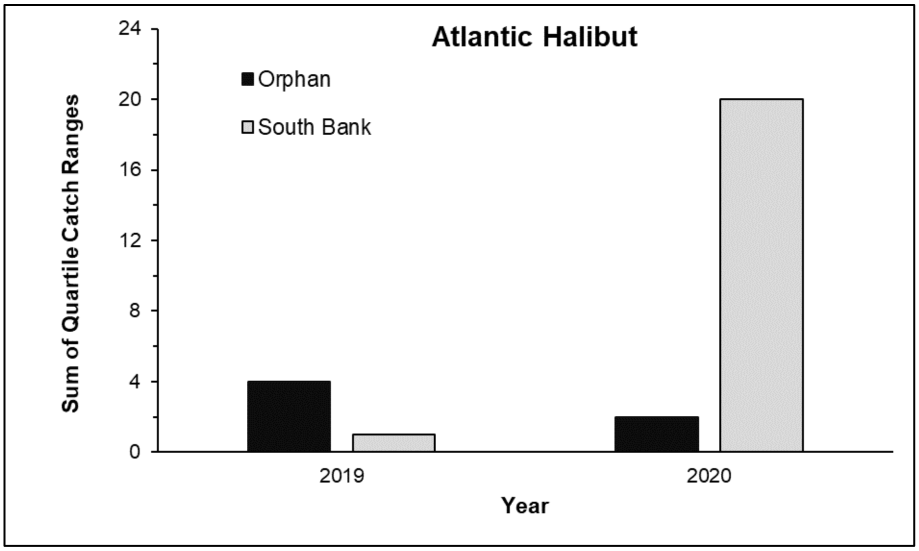
Figure 4.14. Total monthly catch weight quartile codes, May–November 2019–2020 for snow crab in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).

4.2.1.2 Northern Shrimp

During May–November 2019–2020, there were no harvest locations within the 3D survey areas (see Figures 4.5 and 4.6).

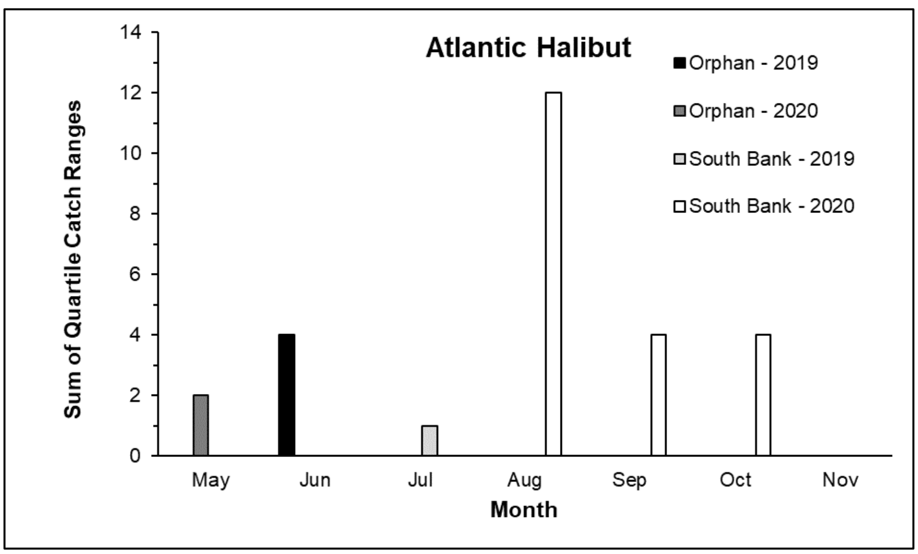
4.2.1.3 Atlantic Halibut

During May–November 2019 and 2020, harvest locations for Atlantic halibut occurred in the western portions of the Orphan Basin and South Bank survey areas, in water depths <1000 m (see Figures 4.7–4.8). Harvests within the Orphan Basin survey area decreased slightly between 2019 and 2020, but greatly increased in the South Bank survey area (Figure 4.15). Harvesting occurred during May and June in the Orphan Basin survey area and from July–October in the South Bank survey area, with peak catches in the South Bank survey area during August (Figure 4.16).



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

Figure 4.15. Total annual catch weight quartile codes, May–November 2019–2020 for Atlantic halibut in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).

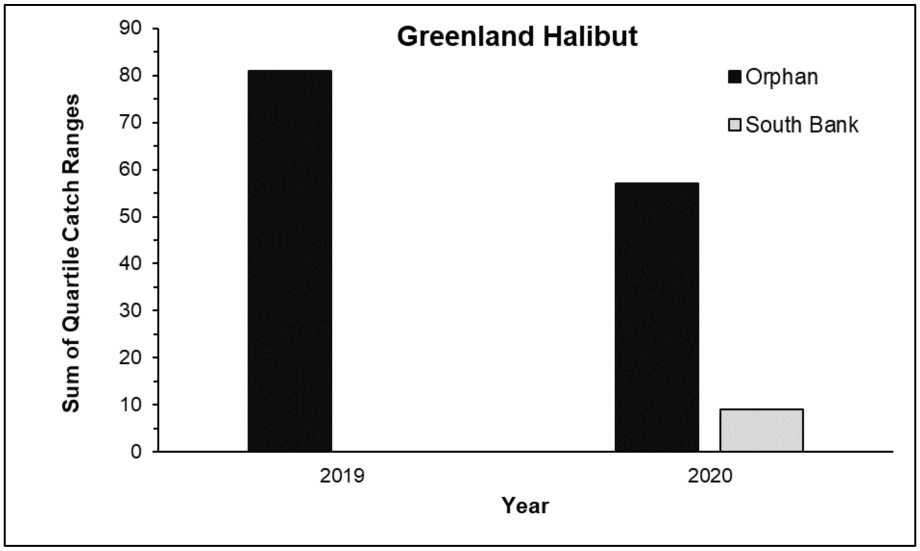


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.16. Total monthly catch weight quartile codes, May–November 2019–2020 for Atlantic halibut in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).

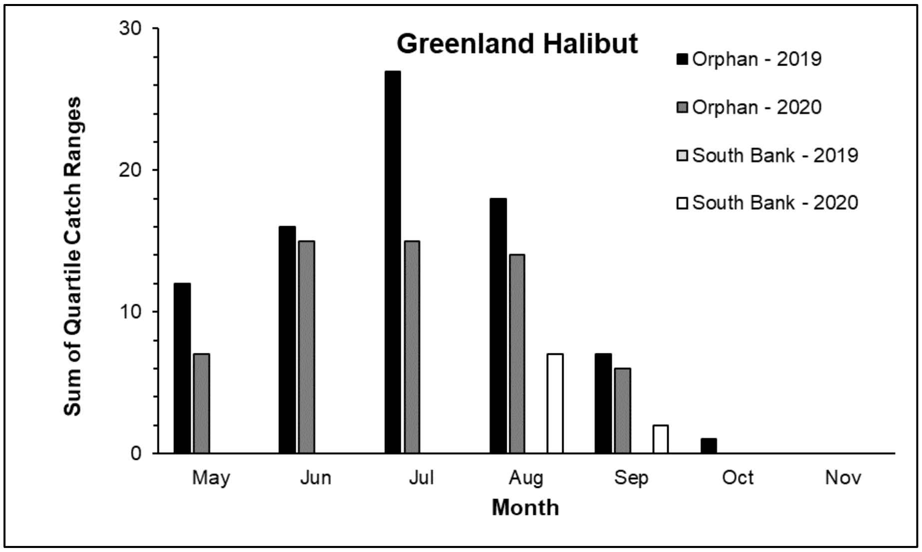
4.2.1.4 Greenland Halibut

During May–November 2019 and 2020, harvest locations for Greenland halibut only occurred in the western portions of the Orphan Basin and South Bank survey areas, mainly in water depths <1000 m (see Figures 4.9–4.10). Catches within the Orphan Basin survey area decreased from 2019 to 2020 and only occurred during 2020 in the South Bank survey area (Figure 4.17). Catches in the Orphan Basin survey area occurred during May–October, with peak catches during the summer; in the South Bank survey area, catches mainly occurred during August and to a lesser extent during September (Figure 4.18).



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

Figure 4.17. Total annual catch weight quartile codes, May–November 2019–2020 for Greenland halibut in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).

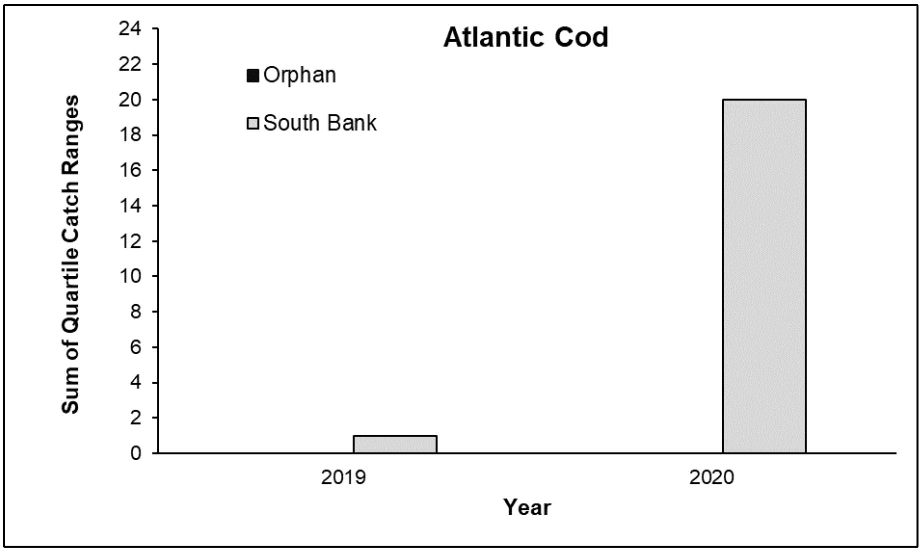


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.18. Total monthly catch weight quartile codes, May–November 2019–2020 for Greenland halibut in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).

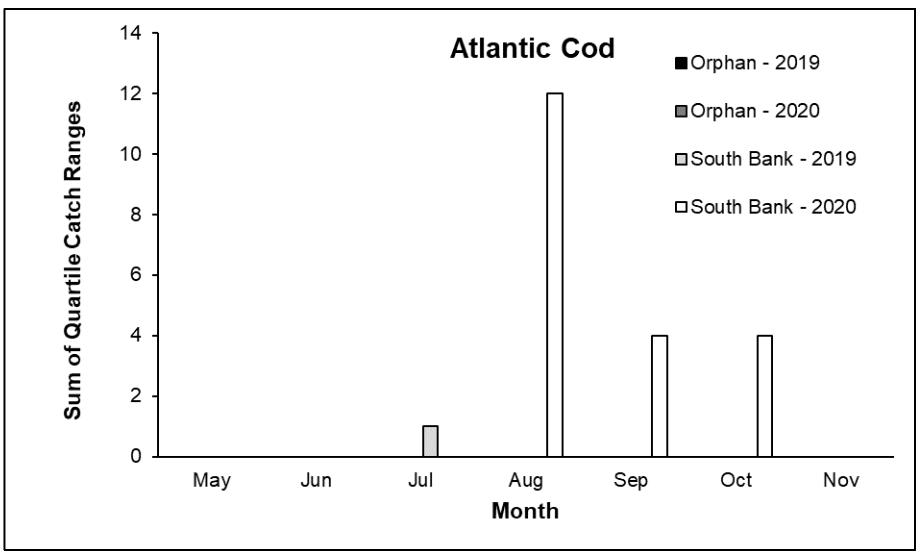
4.2.1.5 Atlantic Cod

During May–November 2019–2020, Atlantic cod were caught in water depths <1000 m in the South Bank survey area; there were no catches in the Orphan Basin survey area (see Figures 4.11–4.12). During May–November 2019–2020, Atlantic cod catches in the South Bank survey area greatly increased from 2019 to 2020 (Figure 4.19). Harvesting occurred during July–October, with peak catches during August (Figure 4.20).



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

Figure 4.19. Total annual catch weight quartile codes, May–November 2019–2020 for Atlantic cod in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).



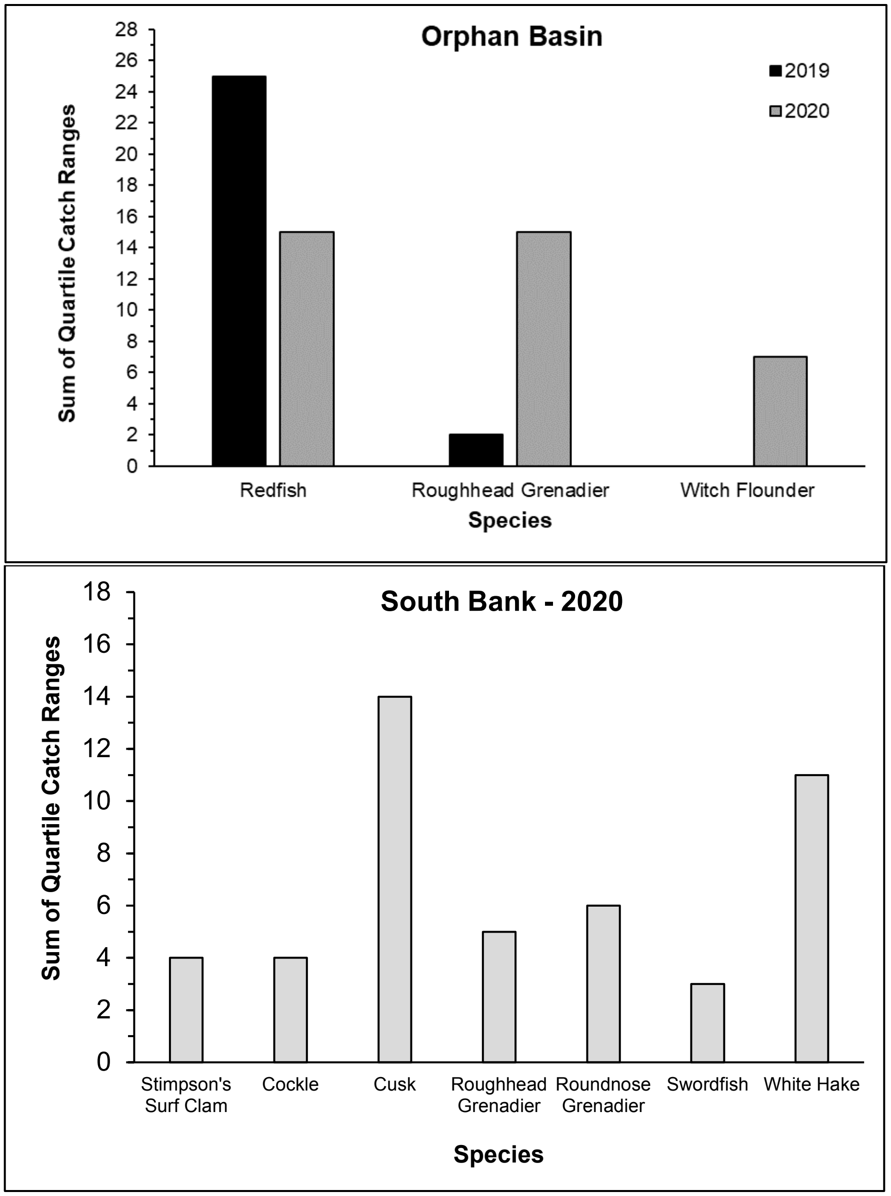
Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.20. Total monthly catch weight quartile codes, May–November 2019–2020 for Atlantic cod in the Orphan Basin and South Bank 3D survey areas (derived from DFO commercial landings database, 2019–2020).

4.2.1.6 Other Notable Commercial Species

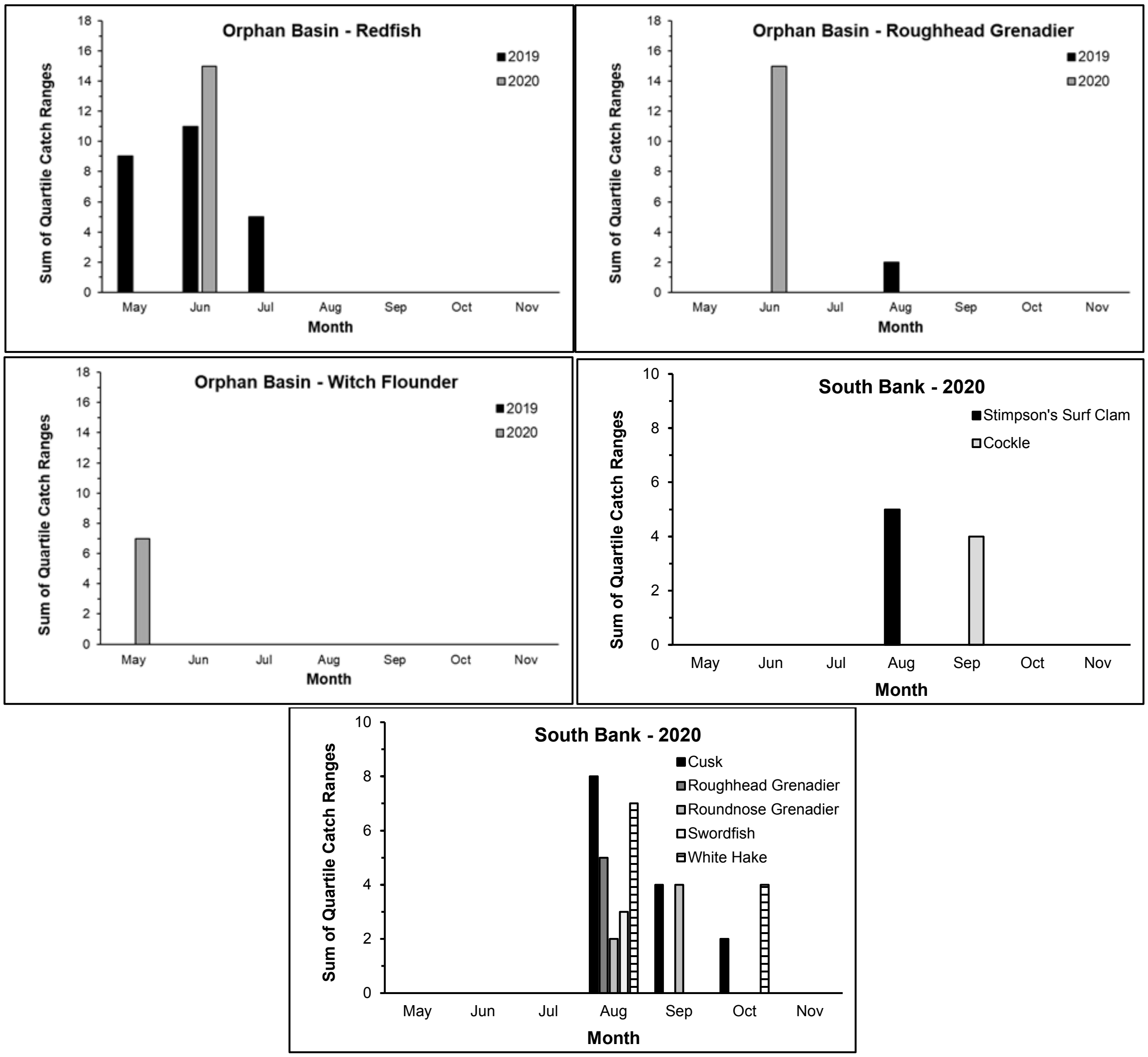
As noted in the EA (see Tables 4.3–4.8 *in* LGL 2018a) and 2019/2020/2021 EA Updates (see Table 4.1 and Section 4.2.1.6 *in* LGL 2019, 2020b, 2021a), redfish, yellowtail flounder, white hake, and American plaice are also important commercial species in the Study Area. Redfish, yellowtail flounder, and 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). Redfish were harvested within the Orphan Basin survey area, and white hake within the South Bank survey area (see Table 4.2 and Figure 4.21). Redfish harvests decreased in the Orphan Basin survey area between 2019 and 2020, while white hake was only harvested during 2020 in the South Bank survey area (Figure 4.21). Redfish were harvested during May–July and white hake during August and October (Figure 4.22). Yellowtail flounder and American plaice can occur within the western portion of the Study Area, within and/or near the western portions of the Orphan Basin and South Bank survey areas; however, there were no harvests of these species within the survey areas during 2019 or 2020 (see Table 4.2).

Harvests of roughhead grenadier during May–November increased between 2019 and 2020 in the Orphan Basin survey area (Figure 4.21); catches occurred during August 2019 and June 2020 (Figure 4.22). Witch flounder were only harvested during May 2020 in the Orphan Basin survey area (Figure 4.22). During 2020, Stimpson's surf clam were harvested during August and cockle during September in the South Bank survey area (Figure 4.22). Cusk, roughhead and roundnose grenadiers, swordfish, and white hake were harvested during August 2020 in the South Bank survey area; cusk was also caught during September and October, roundnose grenadier during September, and white hake during October (Figure 4.22).



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 4.21. Total annual catch weight quartile codes, May–November 2019–2020 for redfish, roughhead grenadier, and witch flounder in the Orphan Basin 3D survey area (top), and May−November 2020 for Stimpson's surf clam, cockle, cusk, roughhead grenadier, roundnose grenadier, swordfish, and white hake in the South Bank 3D survey area (bottom) (derived from DFO commercial landings database, 2019–2020).



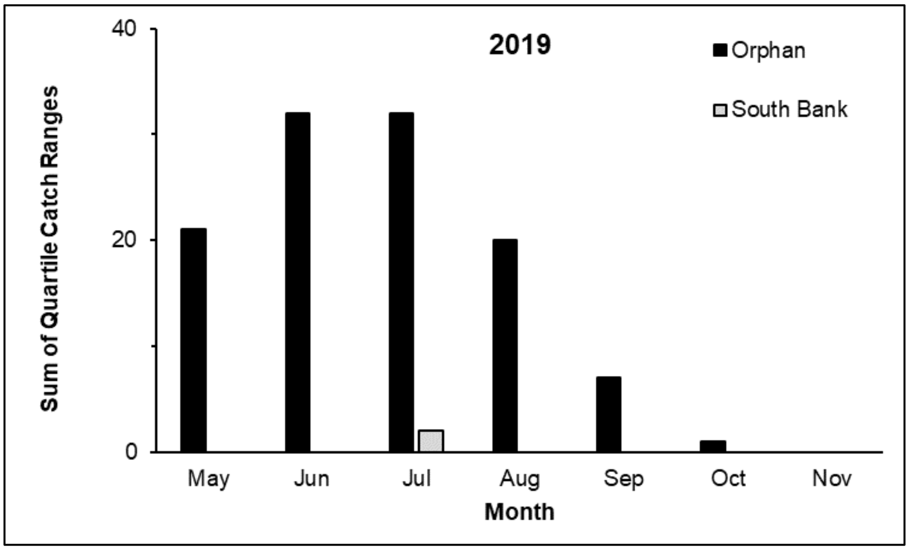
Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.22. Total monthly catch weight quartile codes, May–November 2019–2020 for redfish, roughhead grenadier, and witch flounder in the Orphan Basin 3D survey area, and May−November 2020 for Arctic surf clam, cockle, cusk, roughhead grenadier, roundnose grenadier, swordfish, and white hake in the South Bank survey area (derived from DFO commercial landings database, 2019–2020).

4.2.1.7 Timing and Gear Types

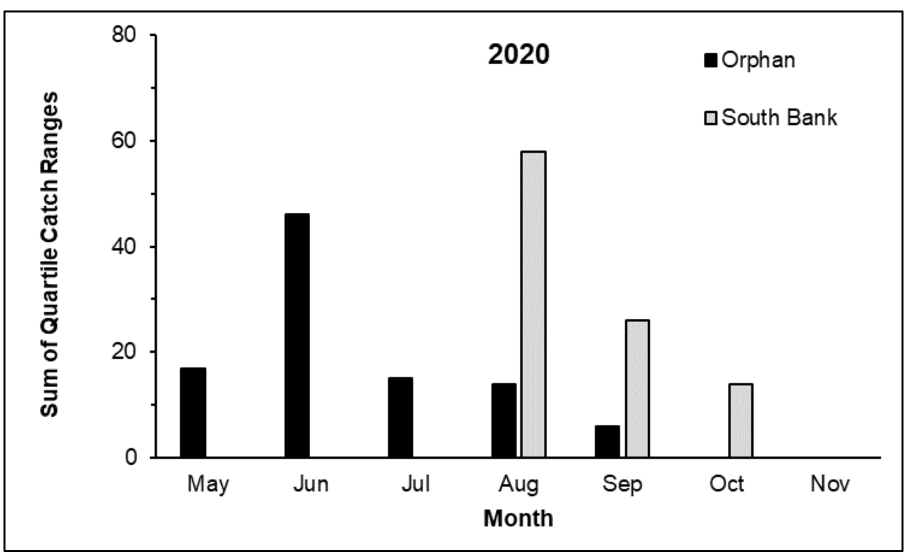
In 2019 and 2020, harvesting in the Orphan Basin 3D survey area primarily occurred throughout the May–August period (Figures 4.23–4.24 below). Harvesting in the South Bank survey area was restricted to July in 2019 and throughout August–October in 2020. Gear types used in the Study Area during 2019 and 2020 were typical of those used during previous years (see Table 4.10 *in* LGL 2018a; Table 4.7 *in* LGL 2019; Table 4.2 *in* LGL 2020b, LGL 2021a; and Tables 4.3–4.4 below).

The May–November 2019 and 2020 harvest locations for fixed and mobile gear are shown in Figures 4.25–4.28.



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 4.23. Total monthly catch weight quartile codes in the Orphan Basin and South Bank 3D survey areas, for all species combined during May–November 2019 (derived from DFO commercial landings database, 2019).



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 4.24. Total monthly catch weight quartile codes in the Orphan Basin and South Bank 3D survey areas, for all species combined during May–November 2020 (derived from DFO commercial landings database, 2020).

Table 4.3. Summary of gear type used and timing of the commercial fishery in the Study Area, May–November 2019–2020 (derived from DFO commercial landings database, 2019/2020).

Species	Harvest Month														Gear Type										
	2019							2020							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
Snow Crab	■	■	■	■				■	■	■	■				■										
Atlantic Halibut	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■						■
Greenland Halibut	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■						■
Redfish	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■						■
Northern Shrimp	■	■	■	■	■	■		■	■	■	■	■	■						■						
Atlantic Cod	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■						■
White Hake	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■						■
Yellowtail Flounder	■	■	■		■	■	■	■	■	■	■	■	■	■		■			■						
American Plaice	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■						
Cusk	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■						■
Monkfish	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■			■						
Pollock		■	■	■	■	■	■	■		■	■	■	■	■		■	■		■						■
Witch Flounder	■		■	■	■	■	■	■		■	■	■	■	■					■						
Arctic Surf Clam	■	■	■		■	■	■	■	■		■	■		■						■					
Cockle	■	■	■		■	■	■	■	■		■	■		■						■					
Swordfish				■	■	■	■				■	■	■								■		■		
Atlantic Haddock	■	■	■	■	■	■	■	■		■	■		■	■		■	■		■						■
Propeller Clam	■	■	■		■	■	■	■	■		■			■						■					
Sea Cucumber		■	■	■	■		■			■	■	■	■	■										■	
Whelk	■	■	■	■	■	■			■	■	■	■	■		■										
Albacore Tuna				■	■	■					■	■	■								■				
Bluefin Tuna				■	■	■			■		■	■	■	■							■	■	■		
Sea Scallop	■		■	■	■	■			■	■	■		■							■					
Mako Shark				■	■	■															■				
Bigeye Tuna				■	■	■					■	■	■								■				
Silver Hake														■			■		■						
Skate		■	■		■	■			■	■					■	■	■								
Roughhead Grenadier			■	■					■	■	■					■	■		■						
Mahi Mahi (Dolphinfish)				■	■						■	■									■				
Round-nose Grenadier							■				■	■					■								
Blue Shark				■																	■				
Capelin				■						■															■
Ocean Quahaug			■																	■					
White Marlin											■	■									■				
Mackerel		■			■											■									
Atlantic Herring												■													■

Table 4.4. Summary of gear type used and timing of the commercial fishery in the 3D survey areas, May–November 2019–2020 (derived from DFO commercial landings database, 2019/2020).

Species	Harvest Month														Gear Type										
	2019							2020							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
Orphan Basin																									
Greenland Halibut	■	■	■	■	■	■		■	■	■	■	■				■	■		■						
Redfish	■	■	■						■							■			■						
Roughhead Grenadier				■					■							■			■						
Atlantic Halibut		■						■											■						
Snow Crab		■						■	■						■										
Witch Flounder								■											■						
South Bank																									
Atlantic Halibut			■								■	■	■				■								

Species	Harvest Month														Gear Type										
	2019							2020							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
Atlantic Cod																									
Cusk																									
White Hake																									
Greenland Halibut																									
Rnd.-nose Grenadier																									
Swordfish																									
Snow Crab																									
Cockle																									
Stimpson's Surf Clam																									

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.

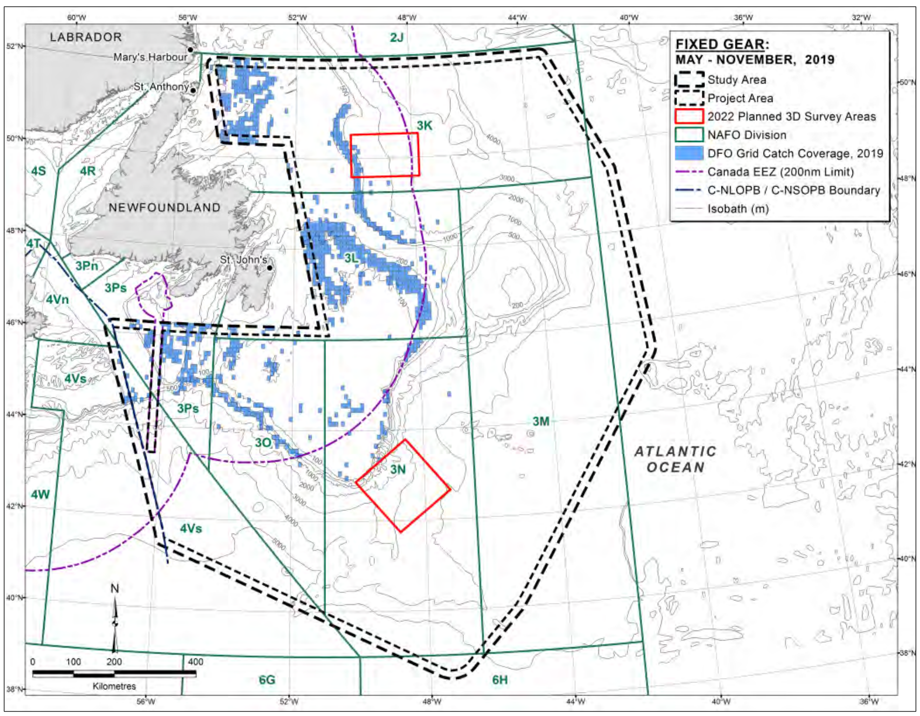


Figure 4.25. Harvest locations for fixed gear, all species, May–November 2019 (derived from DFO commercial landings database, 2019).

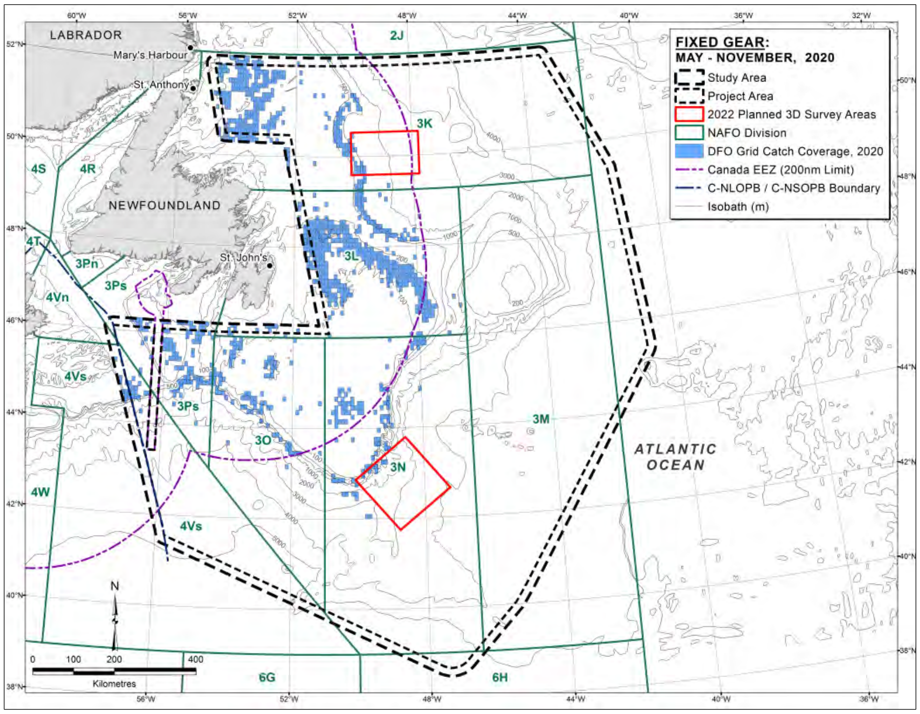


Figure 4.26. Harvest locations for fixed gear, all species, May–November 2020 (derived from DFO commercial landings database, 2020).

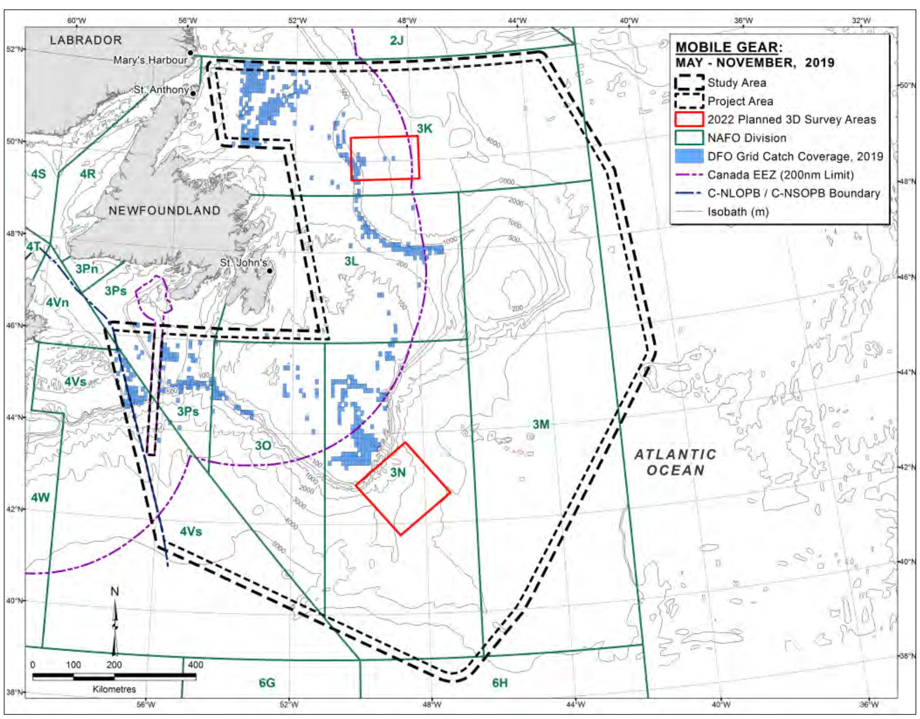


Figure 4.27. Harvest locations for mobile gear, all species, May–November 2019 (derived from DFO commercial landings database, 2019).

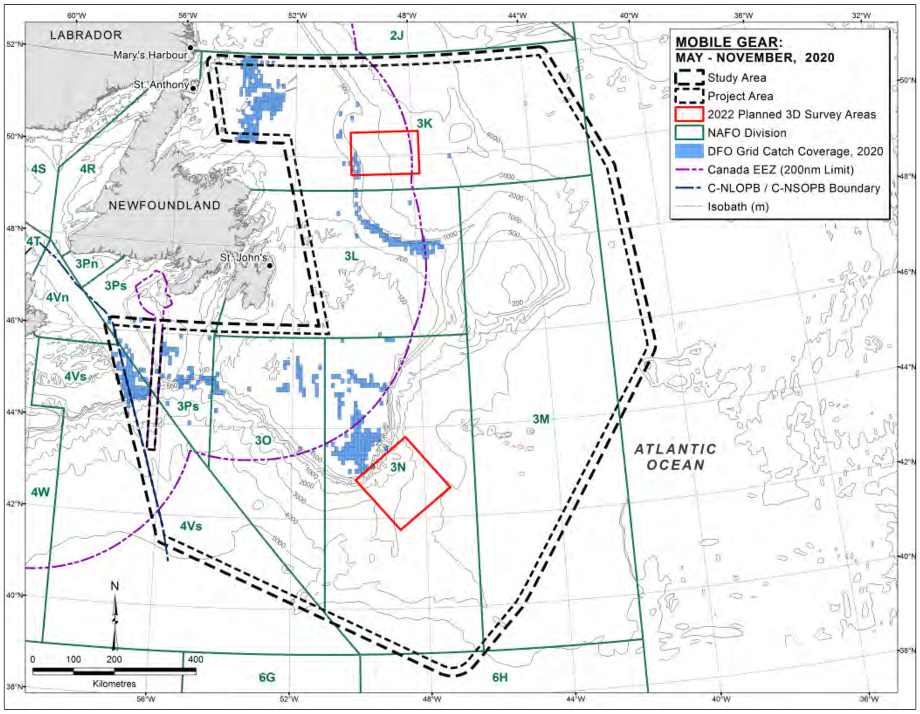


Figure 4.28. Harvest locations for mobile gear, all species, May–November 2020 (derived from DFO commercial landings database, 2020).

4.2.2 Indigenous Fisheries

The most recent (December 2021) Indigenous communal-commercial licences and allocations for NL-based groups and organizations providing commercial fisheries access within the Study Area for the 2021–2022 season are provided in Table 4.5. Indigenous commercial fisheries catches are included, but not differentiated, in the DFO commercial landings database, summarized above (see subsection 4.2.1) (G. Rowe, Resource Management and Indigenous Fisheries DFO, pers. comm., 20 April 2022). Updates from the 2020–2021 database (LGL 2021b) are shown in bold in Table 4.5.

Table 4.5. Indigenous communal-commercial licences and allocations for NL-based groups and organizations within the Study Area, 2021–2022. Bold font indicates updates from the 2020–2021 database.

Group/Organization	Licence	Quota Area (Fishing Area [FA]/NAFO Division [Div.])
Innu Nation	Capelin	FA 1-11
	Groundfish	Div. 0, 2GHJ, 3KL
	Groundfish (mobile)	Div. 2GHJ, 3KL
	Herring	FA 3-8
	Mackerel	FA 1-11
	Shrimp	FA 4
	Bluefin Tuna	Div. 3LNOP-P.H.
Innu Nation: Ueushuk Fisheries	Shrimp	FA **4-6**
	Cod	**Div. 2GHJ**
		Div. 3KLNO
		Div. 3Ps
		Div. 4VnVs**WX, 5YZ**
	Haddock	Div. 3LNOPs
		Div. 4TV**WX, 5YZ**
	Pollock	Div. 3Ps
	American Plaice	Div. 3LNO
	Witch Flounder	Div. **2J**, 3KL
	Greenland Halibut	Div. **0B, 2,** 3KLMNO
	Atlantic Halibut	Div. 3NOPs, 4**RST**V**WX, 5Zc**
	White Hake	Div. 3NOPs, **4TVWX, 5Zc**
	Skates	Div. 3LNOPs
NunatuKavut Community Council (NCC)	Seal	FA 4-33
	Shrimp	FA 5
NDC Fisheries (NCC, **Nunacor)**	Groundfish	Div. 2GHJ, 3KL, 4RS
	Shrimp	FA 5-6
	Scallop	FA 1-2
	Capelin	FA 2
	Herring	FA 1-**2**
	Snow Crab	FA 2
	Toad Crab	FA 2
	Whelk	FA 2J
	Seal	FA 4-33
NCC: IMAKPIK (50/50 partnership NCC/Labrador Fishermen's Union Shrimp Co. Ltd.)	**Shrimp**	**FA 5**
Nunatsiavut Government (NG)	Groundfish	Div. 2GHJ, 3KL, 3Pn, 3Ps
	Snow crab	FA 1-2, 2H (exploratory)

Group/Organization	Licence	Quota Area (Fishing Area [FA]/NAFO Division [Div.])
	Scallop	FA 1
	Arctic char	Cape Rouge to Cape Chidley, Labrador Coast
	Seal	FA 4-33
	Greenland Halibut	Div. 2, 3KLMNO, 0B
	Shrimp	**FA 4-5**
NG: Nunatsiavut Group of Companies (NGC)	**Shrimp**	**FA 5**
NG: Pikalujak Fisheries Ltd. (50/50 partnership NG/Ocean Prawns Canada Ltd.)	Shrimp	**FA (0, 4-6)**
Miawpukek First Nation (MFN)	Capelin	FA **1**-11
	Groundfish	Div. 2GHJ, 3KL, 3Pn, 3Ps
	Groundfish (mobile)	Div. 2GHJ, 3KL, 3Pn, 3Ps, 4R
	Herring	FA 11
	Mackerel	FA 1-11
	Sea Cucumber	Div. 3Ps
	Seal	FA 4-33
	Snow Crab	FA 10-11, Div. 3NO (offshore)
	Squid	FA 10
	Bluefin Tuna	Div. 3LNOP (Atlantic, Rotational)
	Swordfish	ICATT Area 3
	Scallop	FA 3, 4, 5, 6, 7, 8 and 9; portion of Area 10; portion of Area 11; that portion of NAFO Divisions 3LNO outside the 200-mile limit; additional permits for Inside North Bed & Inside Core Area (St. Pierre Bank)
	Sea urchin	FA 11
	Whelk	Div. 3Ps

Group/Organization	Licence	Quota Area (Fishing Area [FA]/NAFO Division [Div.])
Qalipu First Nation (QFN)	Capelin	**FA 3-4, 12-14**
	Capelin (mobile)	FA 1-14
	Groundfish	Div. 2GHJ, 3KLPn, 4RST
	Groundfish (mobile)	**Div. 2J, 3Pn, 4RST**
	Herring	FA **3-4**, 13-14
	Herring (mobile)	FA 3-8, **13-14**
	Lobster	FA 3, **4A**, **4B**, 13A, 13B
	Mackerel	FA 3-4, 12-14
	Mackerel (mobile)	FA 1-14
	Scallop	FA 3, 4, 5, 6, 7, 8, 9 and 13; portion of Area 10; that portion of NAFO Divisions 3LNO outside the 200nm limit
	Sea Urchins	**FA 12-14**
	Snow Crab	FA 3B, **3C**, 4, 12, 12C, 12E, 12F
	Squid	FA 3, 4, 13
	Whelk	FA 13-**14**, Div. 3K
Mi'kmaq Commercial Fisheries (QFN, Qalipu Development Corporation)	Groundfish	Div. 2GHJ, 3KL
	Herring	FA 3-8
	Mackerel	FA 4
	Mackerel (mobile)	FA 1-11
	Capelin	FA 1-11
	Squid	FA 4
	Lobster	FA 4B
	Shrimp	FA 6
	Snow Crab	FA 4
	Sea Cucumber	Div. 3LNO
Mi'kmaq Alsumk Mowimsikik Koqoey Association (MAMKA) (Aboriginal Aquatic Resource & Oceans Management [AAROM] Body – MFN and QFN)	Capelin	FA 10
	Groundfish	Div. 2GHJ, 3KL, 3Pn, 3Ps, 4RST
	Herring	FA 10, 13
	Snow Crab	FA 10-11, 12, 12C, 12F
	Lobster	FA 13A, 13B
	Whelk	Div. 3Ps
	Squid	**FA 13**

Source: G. Rowe, Resource Management and Indigenous Fisheries, DFO, pers. comm., 20 April 2022.

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, 2020b, 2021a). 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.

Management decisions for the 2022 NL recreational groundfish fishery have not yet been released (DFO 2022b). The 2021 NL recreational groundfish fishery was scheduled to be open for 39 days (i.e., during 3 July–3 October), which was essentially the same as the 2020 season (DFO 2021c). As in the 2020 season, there were still no requirement for fishing licenses or tags during 2021 (DFO 2021c).

Management measures for 2021–2022 allow the retention of a total of two salmon, with a maximum of one salmon on Class 2 rivers; no salmon may be retained from non-scheduled waters (DFO 2021c). The 2021–2022 Atlantic salmon seasons are open from June–September for all fishing zones and fall angling on the Gander, Exploits, and Humber rivers may occur during 8 September–7 October (DFO 2021c). The 2021–2022 NL recreational trout season will be open from February–April and May–September for Zone 1 and February–September for all other Zones, with various retention limits depending on species (DFO 2021d).

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 2022 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 2022; R.J. Keel, Manager of Aquaculture Licensing and Administration, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador, pers. comm., 19 April 2022).

4.2.5 Science Surveys

4.2.5.1 DFO Research Vessel (RV) Surveys

The most recent RV data available are from the 2020 dataset which were provided by DFO (A. Roberts, Data Archivist, DFO, pers. comm., 15 March and 1 April 2022). During May−November 2018–2020, RV survey catch locations occurred in the western portions of the Orphan Basin and South Bank survey areas (surveys only occurred within the Orphan Basin survey area during 2019) (Figures 4.29–4.31). Catch weights, numbers, and mean catch depths for species, and predominant species for all species caught at various mean depth ranges in the Orphan Basin and South Bank survey areas during May−November 2018–2020 are presented in Tables 4.6–4.8.

Deepwater redfish and witch flounder were predominant species in the Orphan Basin survey area, and deepwater redfish was the predominant species in the South Bank survey area during 2018–2020 (Table 4.6). Redfish were caught at mean depths of 571 m and 401 m in the Orphan Basin and South Bank survey areas, respectively; the mean catch depth for witch flounder was 507 m in the Orphan Basin (Table 4.7). Catches occurred between 500–699-m depth in the Orphan Basin survey area, and in depths from 100–699 m in the South Bank survey area (Table 4.8).

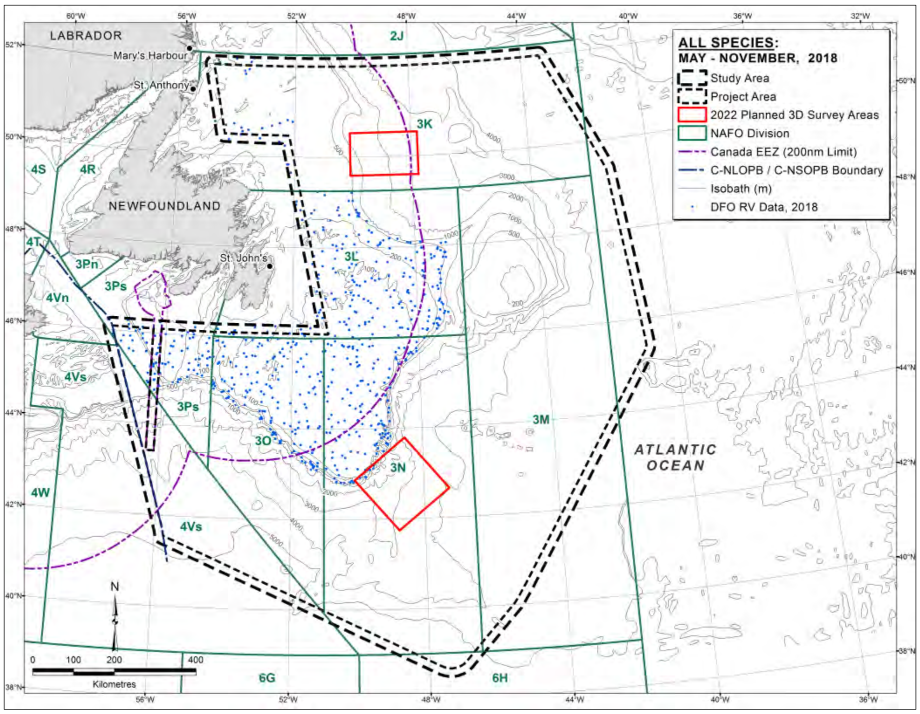


Figure 4.29. Distribution of DFO RV survey catch locations, all species, May–November 2018 (derived from DFO RV survey database, 2018).

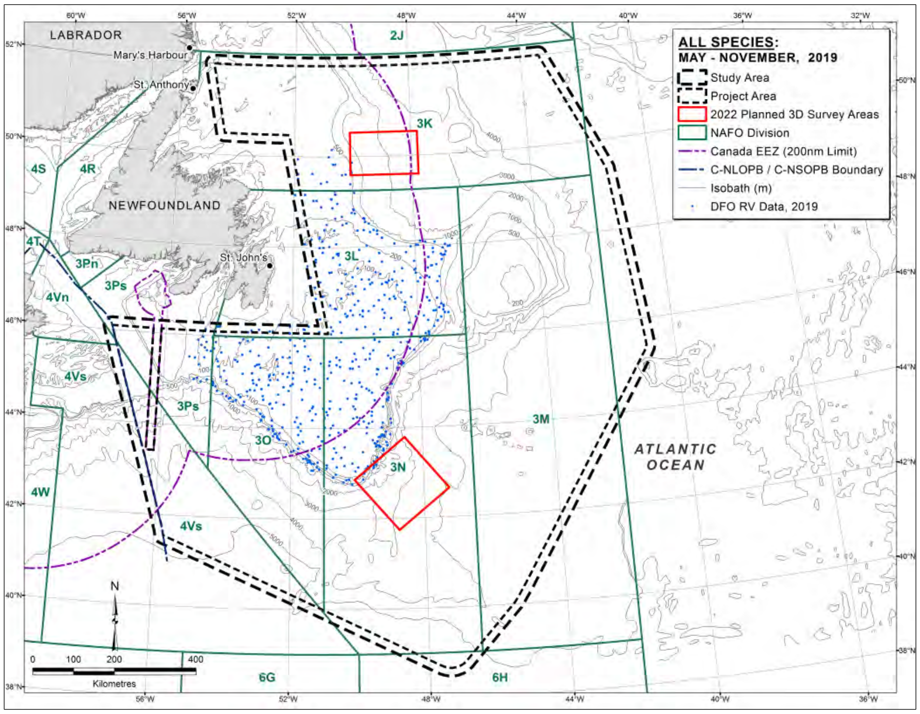


Figure 4.30. Distribution of DFO RV survey catch locations, all species, May–November 2019 (derived from DFO RV survey database, 2019).

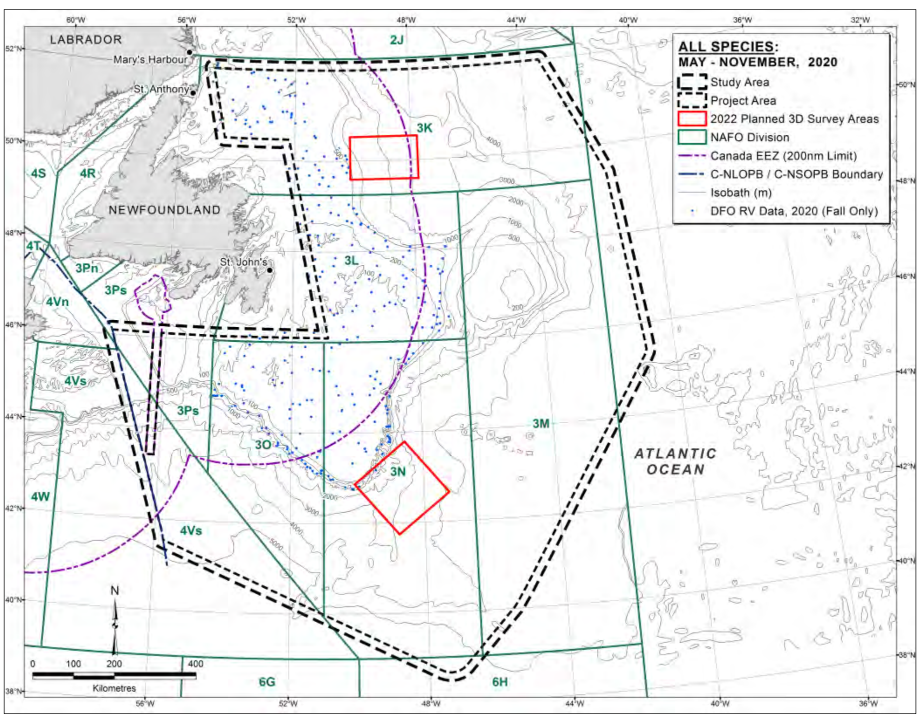


Figure 4.31. Distribution of DFO RV survey catch locations, all species, May–November 2020 (derived from DFO RV survey database, 2020).

Table 4.6. Catch weights and numbers of macroinvertebrates and fishes collected during DFO RV surveys in the Orphan Basin and South Bank 3D survey areas, May–November 2018–2020 (derived from DFO RV survey databases, 2018–2020).

Species	Catch Weight (mt)			Total Catch Weight (mt)	Catch Number			Total Catch Number
	2018	2019	2020		2018	2019	2020	
Orphan Basin								
Deepwater Redfish (*Sebases mentella*)	-	0.2	-	**0.2**	-	309	-	**309**
Witch Flounder (*Glyptocephalus cynoglossus*)	-	0.1	-	**0.1**	-	107	-	**107**
Roughhead Grenadier (*Macrourus berglax*)	-	<0.1	-	**<0.1**	-	91	-	**91**
Greenland Halibut (*Reinhardtius hippoglossoides*)	-	<0.1	-	**<0.1**	-	46	-	**46**
Jellyfish (Scyphozoa)	-	<0.1	-	**<0.1**	-	n/d	-	**n/d**
Northern Wolffish (*Anarhichas denticulatus*)	-	<0.1	-	**<0.1**	-	4	-	**4**
Atlantic Cod (*Gadus morhua*)	-	<0.1	-	**<0.1**	-	2	-	**2**
Sponge (Porifera)	-	<0.1	-	**<0.1**	-	n/d	-	**n/d**
Roundnose Grenadier (*Coryphaenoides rupestris*)	-	<0.1	-	**<0.1**	-	20	-	**20**
American Plaice (*Hippoglossoides platessoides*)	-	<0.1	-	**<0.1**	-	7	-	**7**
Pink Glass Shrimp (*Pasiphaea multidentata*)	-	<0.1	-	**<0.1**	-	238	-	**238**
Sea Anemone (Actinaria)	-	<0.1	-	**<0.1**	-	6	-	**6**
Thorny Skate (*Raja radiata*)	-	<0.1	-	**<0.1**	-	2	-	**2**
Shrimp (*Sergestes arcticus*)	-	<0.1	-	**<0.1**	-	n/d	-	**n/d**
Shrimp (*Acanthephyra pelagica*)	-	<0.1	-	**<0.1**	-	75	-	**75**
Whelk (*Buccinum sp.*)	-	<0.1	-	**<0.1**	-	20	-	**20**
Scarlet Shrimp (*Coryphaenoides rupestris*)	-	<0.1	-	**<0.1**	-	5	-	**5**
Total	**-**	**0.4**	**-**	**0.4**	**-**	**932**	**-**	**932**
South Bank								
Deepwater Redfish	9	11	1	**22**	47,405	66,839	6,745	**120,989**
Atlantic Cod	0.1	0.1	<0.1	**0.1**	52	97	10	**159**
Atlantic Halibut (*Hippoglossus hippoglossus*)	<0.1	0.1	<0.1	**0.1**	2	6	2	**10**
Thorny Skate	<0.1	0.1	<0.1	**0.1**	2	24	17	**43**
Black Dogfish (*Centroscyllium fabricii*)	<0.1	<0.1	<0.1	**0.1**	127	58	27	**212**

Species	Catch Weight (mt)			Total Catch Weight (mt)	Catch Number			Total Catch Number
	2018	2019	2020		2018	2019	2020	
Greenland Halibut	<0.1	0.1	<0.1	**0.1**	42	199	54	**295**
Golden Redfish (*Sebastes marinus*)	<0.1	<0.1	0	**0.1**	36	1	0	**37**
American Plaice	<0.1	<0.1	<0.1	**0.1**	15	123	34	**172**
Roughhead Grenadier	<0.1	<0.1	<0.1	**0.1**	33	59	18	**110**
Spinytail Skate	<0.1	<0.1	<0.1	**0.1**	3	1	1	**5**
Witch Flounder	<0.1	<0.1	<0.1	**0.1**	27	60	26	**113**
Jellyfish (Scyphozoa)	<0.1	<0.1	0	**0.05**	n/d	n/d	n/d	**n/d**
Sponge (Porifera)	<0.1	<0.1	<0.1	**0.04**	n/d	n/d	n/d	**n/d**
Northern Wolffish	0.1	<0.1	<0.1	**0.03**	10	8	2	**20**
Marlin Spike (*Nezumia bairdi*)	<0.1	<0.1	<0.1	**0.03**	99	104	266	**469**
Blue Hake (*Antimora rostrata*)	<0.1	<0.1	0	**0.02**	61	52	0	**113**
Atlantic Wolffish (*Anarhichas lupus*)	<0.1	<0.1	<0.1	**0.02**	13	16	15	**44**
Spotted Wolffish (*Anarhichas minor*)	<0.1	<0.1	<0.1	**0.0001**	2	1	2	**5**
Total	**10**	**12**	**1**	**23**	**47,929**	**67,648**	**7,219**	**122,796**

Note: n/d denotes data unavailable.

Table 4.7. Mean catch depths (m) of macroinvertebrates and fishes collected during DFO RV surveys in the Orphan Basin and South Bank 3D survey areas, May–November 2018–2020 (derived from DFO RV survey databases, 2018–2020).

Species	Spring Mean Catch Depth (m) [a]				Fall Mean Catch Depth (m) [b]			
	2018	2019	2020	Total	2018	2019	2020	Total
Orphan Basin								
Deepwater Redfish	-	-	-	**-**	-	571	-	**571**
Witch Flounder	-	-	-	**-**	-	507	-	**507**
Roughhead Grenadier	-	-	-	**-**	-	571	-	**571**
Greenland Halibut	-	-	-	**-**	-	571	-	**571**
Jellyfish	-	-	-	**-**	-	571	-	**571**
Northern Wolffish	-	-	-	**-**	-	571	-	**571**
Atlantic Cod	-	-	-	**-**	-	507	-	**507**
Sponge (Porifera)	-	-	-	**-**	-	571	-	**571**
Roundnose Grenadier	-	-	-	**-**	-	634	-	**634**
American Plaice	-	-	-	**-**	-	571	-	**571**
Pink Glass Shrimp (*P. multidentata*)	-	-	-	**-**	-	634	-	**634**
Sea Anemone (Actinaria)	-	-	-	**-**	-	571	-	**571**
Thorny Skate	-	-	-	**-**	-	507	-	**507**
Shrimp (*S. arcticus*)	-	-	-	**-**	-	507	-	**507**
Shrimp (*A. pelagica*)	-	-	-	**-**	-	634	-	**634**
Whelk (*Buccinum sp.*)	-	-	-	**-**	-	507	-	**507**
Scarlet Shrimp (*C. rupestris*)	-	-	-	**-**	-	507	-	**507**
Total	**-**	**-**	**-**	**-**	**-**	**563**	**-**	**563**
South Bank								
Deepwater Redfish	360	371	-	**366**	361	440	403	**401**
Atlantic Cod	292	265	-	**278**	216	253	208	**226**

Species	Spring Mean Catch Depth (m) [a]				Fall Mean Catch Depth (m) [b]			
	2018	2019	2020	Total	2018	2019	2020	Total
Atlantic Halibut	247	449	-	**348**	-	518	501	**510**
Thorny Skate	199	265	-	**232**	289	206	326	**274**
Black Dogfish	566	584	-	**575**	397	646	444	**496**
Greenland Halibut	360	449	-	**404**	361	487	403	**417**
Golden Redfish	294	-	-	**294**	-	300	-	**300**
American Plaice	199	216	-	**208**	253	206	208	**222**
Roughhead Grenadier	382	449	-	**415**	433	440	501	**458**
Spinytail Skate	474	-	-	**474**	577	206	558	**447**
Witch Flounder	566	371	-	**469**	361	487	403	**417**
Jellyfish (Scyphozoa)	414	-	-	**414**	361	628	-	**494**
Sponge (Porifera)	360	216	-	**288**	361	518	403	**427**
Northern Wolffish	566	-	-	**566**	433	518	501	**484**
Marlin Spike	360	449	-	**404**	-	-	501	**501**
Blue Hake	566	584	-	**575**	-	-	-	**-**
Atlantic Wolffish	247	265	-	**256**	289	300	208	**266**
Spotted Wolffish	294	-	-	**294**	289	300	208	**266**
Total	**363**	**375**	**-**	**369**	**361**	**442**	**405**	**403**

[a] Spring survey months: 2018 = June; 2019 = May; 2020 = DFO did not conduct RV surveys spring 2020.

[b] Fall survey months: 2018 = September; 2019 = October−November; 2020 = September.

Table 4.8. Total catch weights and predominant species caught at various mean catch depth ranges in the Orphan Basin and South Bank 3D survey areas during DFO RV surveys, May–November 2018–2020 (derived from DFO RV survey database, 2018–2020).

Mean Catch Depth Range (m)	Total Catch Weight (mt)			Predominant Species (% of Total Catch Weight)		
	2018	2019	2020	2018	2019	2020
Orphan Basin						
<100	-	-	-	-	-	-
100 – 199	-	-	-	-	-	-
200 – 299	-	-	-	-	-	-
300 – 399	-	-	-	-	-	-
400 – 499	-	-	-	-	-	-
500 – 599	-	0.3	-	-	Deepwater Redfish (47%) Witch Flounder (16%) Roughhead Grenadier (10%) Greenland Halibut (8%)	-
600 – 699	-	<0.1	-	-	Roundnose Grenadier (62%) Pink Glass Shrimp (*P. multidentata*; 30%) Shrimp (*A. pelagica*; 6%)	-
700 –799	-	-	-	-	-	-
800 –899	-	-	-	-	-	-
900 –999	-	-	-	-	-	-
≥1000	-	-	-	-	-	-
South Bank						
<100	-	-	-	-	-	-
100 – 199	<0.1	-	-	Short-finned Squid (I. illecebrosus; 55%) Atlantic Argentine (*Argentina silus*; 19%) Arctic Eelpout (*Lycodes reticulatus*; 16%)	-	-
200 – 299	0.2	0.2	<0.1	Golden Redfish (35%) Atlantic Cod (34%) Atlantic Halibut (18%)	Atlantic Cod (42%) Thorny Skate (31%) American Plaice (21%)	American Plaice (58%) Atlantic Cod (23%) Atlantic Wolffish (17%)

Mean Catch Depth Range (m)	Total Catch Weight (mt)			Predominant Species (% of Total Catch Weight)		
	2018	2019	2020	2018	2019	2020
				American Plaice (6%)	Atlantic Wolffish (3%)	
300 – 399	9	<0.1	<0.1	Deepwater Redfish (99%)	Golden Redfish (53%) Short-finned Squid (13%) Sand Dollar (*E. parma*; 12%) Whelk (*Buccinum sp.*; 11%)	Thorny Skate (99%)
400 – 499	0.1	11	1	Black Dogfish (*Centroscyllium fabricii*; 50%) Roughhead Grenadier (20%) Witch Flounder (11%) Northern Wolffish (10%)	Deepwater Redfish (98%)	Deepwater Redfish (96%)
500 – 599	<0.1	<0.1	<0.1	Spinytail Skate (75%) Blue Hake (16%)	Northern Wolffish (37%) Blue Hake (28%) Ctenophores (13%) Roughhead Grenadier (6%)	Atlantic Halibut (35%) Marlin Spike (28%) Northern Wolffish (15%) Spinytail Skate (15%)
600 – 699	-	<0.1	-	-	Black Dogfish (52%) Jellyfish (26%) Cusk (*Brosme brosme*; 11%)	-
700 –799	-	-	-	-	-	-
800 –899	-	-	-	-	-	-
900 –999	-	-	-	-	-	-
≥1000	-	-	-	-	-	-

The tentative schedule for the 2022 DFO multispecies RV surveys is presented in Table 4.9. Spring RV surveys within the Study Area began in early April and are set to continue into late-June. Fall RV surveys within the Study Area will begin late-September and end in mid-December. Three additional DFO RV surveys will occur during spring and late summer, including the NL Summer Atlantic Zone Monitoring Program and Capelin and Shellfish surveys.

Table 4.9. Tentative schedule of DFO RV surveys within the Study Area during 2022.

NAFO Division	Start Date	End Date	Vessel(s)
NL Spring/Fall RV Surveys			
3P	1 April	19 April	*Cabot*
3P	20 April	3 May	*Cabot*
3OP	4 May	17 May	*Cabot*
3LNO	18 May	31 May	*Cabot & Needler*
3LNO	1 June	14 June	*Cabot & Needler*
3LNO	15 June	28 June	*Cabot & Needler*
3LNO	20 September	4 October	*Cabot & Needler*
2HJ3K	4 October	18 October	*Cartier & Teleost*
3LNO	5 October	18 October	*Cabot & Needler*
3LNO	19 October	1 November	*Cabot & Needler*
2HJ3K	19 October	1 November	*Cartier & Teleost*
3LNO	2 November	15 November	*Cabot & Needler*
2HJ3K	2 November	15 November	*Cartier & Teleost*
3LNO	16 November	29 November	*Cabot & Needler*
2HJ3K	16 November	29 November	*Cartier & Teleost*
3LNO	30 November	16 December	*Cabot & Needler*
2HJ3K	30 November	16 December	*Cartier & Teleost*

NAFO Division	Start Date	End Date	Vessel(s)
Other DFO RV Surveys			
3KL	26 April	17 May	*Teleost* (Capelin Survey)
3L	3 July	28 July	*Teleost* (NL Summer AZMP)
3N	9 September	19 September	*Needler* (Shellfish Survey)

Source: L. Mello, Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO, pers. comm., 21 April 2022.
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 2022 TAC for this survey is 450t, a 50-t increase from 2020/2021 (DFO 2022b). There are no survey stations within the Orphan Basin or South Bank survey areas (Figure 4.32). As noted in LGL (2018a), survey stations are randomly sampled each year.

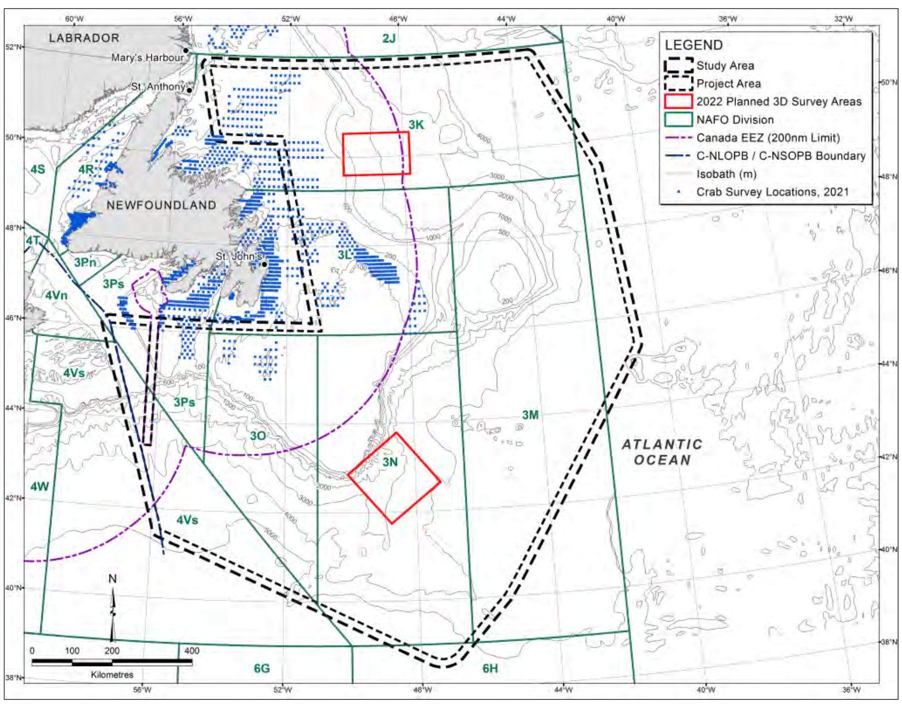


Figure 4.32. Locations of DFO-Industry collaborative 2021 post-season snow crab trap survey stations.

4.3 Marine-Associated Birds

New information on the temporal and spatial distribution for Leach's Storm-Petrel, Great Shearwater, Atlantic Puffin, Razorbill, Common Murre, Long-tailed Jaeger, and Red-necked Phalarope in the Study Area is summarized below. There are no updates to the breeding colony information presented in Table 4.8 of LGL (2020b).

Leach's Storm-Petrels nesting on Gull Island, Witless Bay feed largely in the deep water southeast of the Grand Banks (Collins et al. 2022). During five nesting seasons between 2016 and 2021, 127 nesting adults were outfitting with a GPS tracking device. Data was retrieved from 85 individuals and a total of 212 foraging trips were analysed. Leach's Storm-Petrels generally transit non-stop across the Grand Banks to reach their feeding destination in the deep waters beyond the Grand Banks. Myctophids, mesopelagic fish that migrate to the surface at night, dominate the diets of Leach's Storm-Petrels in the region, which is the reason foraging effort is concentrated over deep waters off the continental shelf edge. Leach's Storm-Petrels flew within the light catch-basin of an oil platform during 17.5% of trips; however, exposure to the catch-basin of an oil platform at night occurred in only 1.1% of trips. The areas used for transiting were consistent. Incubating and chick-rearing Leach's Storm-Petrels exhibited similar at-sea area uses, although incubating birds tended to forage farther off the continental shelf than chick-rearing birds. The duration of foraging trips ranged from 2.93 ± 1.33 days in 2018 to 3.76 ± 0.46 days in 2019 during incubation periods, and 2.84 ± 0.99 days in 2020 to 3.01 ± 0.88 days in 2021 during chick rearing.

Foraging movements of incubating Leach's Storm-Petrel from seven eastern Canadian breeding colonies were tracked using GPS sensors attached to the birds during the 2013 and 2014 breeding seasons (Hedd et al. 2018). Foraging trips lasted an average of 4.0 ± 1.4 days with targeted feeding areas in the deep water beyond the continental shelf edge on average 400–830 km from the colonies. There was minimal overlap of core feeding areas between colonies. Transits to feeding areas from colonies at Baccalieu Island, Gull Island, and Middle Lawn Islands crossed the Grand Banks throughout the Study Area.

A decline in the number of breeding Leach's Storm-Petrels at some of the largest colonies in the northeast Atlantic has been detected (Deakin et al. 2021). The breeding population of Leach's Storm-Petrels on Elliðaey, Iceland was estimated at 5,400 pairs in 2018, a decline of 40–49% since 1991. Deakin et al. (2021) detected declines on all four of the main St. Kilda Islands, Scotland, with reductions of 34–83% between the 2018/2019 surveys and 2000. Causes of population declines are unclear; however, Gulls, Great Skuas, and field mice known to prey on nesting Leach's Storm-Petrels were thought to have a minimal impact on the overall nesting populations at these nesting sites.

Grand Colombier Island in the Saint Pierre and Miquelon archipelago is the site of a seabird nesting colony containing approximately 9,540 pairs of Atlantic Puffins, 1,440 pairs of Razorbills, and 7,180 pairs of Common Murre (Delord et. 2020). GPS telemetry data from 15 individuals of alcids (five Razorbills, six Common Murres, and four Puffins) within the period 21 June to 2 July 2016 were analyzed to determine their distribution during the breeding period of 2016. Results revealed that the three species headed northward from their breeding colony, targeting coastal waters. These main foraging areas were within 55 km of the breeding colony, on the coastal shelf nearby the eastern coast of Miquelon Island, and on the east of Saint Pierre Island. There was limited overlap between the foraging zones of the three species and a gillnet fishery targeting Atlantic salmon. The accidental netting of alcids during the breeding season is considered a threat to the local breeding population of Common Murre, Razorbill, and Atlantic Puffin.

The Gulf of Maine, Scotian Shelf, and Grand Banks appear to be important 'wintering' areas for sub-adult Great Shearwaters during the boreal summer. From 2013–2018, 58 Great Shearwaters were outfitted with GPS platform terminal transmitters during their wintering season (June–November) in the southwest Gulf of Maine (Powers et al. 2020). About 55% stayed within the Gulf of Maine during the wintering season and the remainder moved eastward to the Scotian Shelf off Nova Scotia and the Grand Banks off Newfoundland. Analysis of fecal DNA from tagged birds and others captured with them indicated that Northern sand lance (*Ammodytes dubius)* was the primary prey while in the Gulf of Maine. Most birds (89%) were young (0–2 years), based on gonadal development, molt score, and/or bursa of Fabricius. Coupling demographic information from necropsies with spatial habits and movement timing of tagged birds suggests these regions serves as a winter "nursery" for Great Shearwaters.

Seyer et. al (2021) documented year-round movements of adult Long-tailed Jaegers nesting in the Canadian Arctic at Bylot Island and Igloolik Island, Nunavut. Over a six-year period, 43 tracks from geolocators deployed on nesting Long-tailed Jaegers were acquired. The jaegers departed the breeding site and traveled on average 32,375 km (round trip) before returning to breed, which is one of the longest documented migrations on Earth. The birds used a major stopover area east of the Grand Banks of Newfoundland in spring and fall, and wintered in high marine productivity areas of the South Atlantic. Routes of both spring and fall migrating Long-tailed Jaegers include the Grand Banks and waters of eastern Newfoundland and Labrador.

Red-necked Phalaropes nesting in the Western Palearctic have two greatly differing wintering areas and corresponding migration routes (van Bemmelen et al. 2019). Thirty-four Red-necked Phalaropes were outfitted with geolocators on their nesting areas. All eight from the northeastern North Atlantic breeding areas (Greenland, Iceland, and Scotland) wintered in the Pacific Ocean while the 26 from Fennoscandian-Russia wintered in the Arabian Sea. The northeastern North Atlantic breeding birds migrated off the east coast of North America and crossed over land at Central America to reach the Pacific Ocean, then to their wintering area in the northern Humboldt Current. The spring and fall migration routes of the birds from the northeastern North Atlantic breeding population include waters off southeastern Newfoundland and Labrador, especially the Grand Banks.

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).

In 2021 (late-May to early-September), marine mammal (and sea turtle) monitoring was conducted for the MKI seismic surveys located on the Orphan Basin (Cape Anguille MC3D survey area), Flemish Pass (Cambriol MC3D survey area), Sackville Spur (Lewis Hills survey area), and Jeanne d'Arc Basin (Phase II survey area) (Bishop and Lang 2021). Water depths across the survey areas ranged from ~55–3400 m. There were 535 visual sightings of marine mammals within the survey areas, totalling 3,041 individuals. Species included long-finned pilot whale; northern bottlenose whale; Atlantic white-sided, common, striped, and white-beaked dolphins; and humpback, fin, sei, blue, minke, sperm, and killer whales. Of these, the blue and northern bottlenose whales are considered species at risk. There were three sightings of the endangered blue whale in the Flemish Pass. All sightings of northern bottlenose whales occurred on the Orphan Basin during May, June, and July. In addition, 105 acoustic detections were made, including those identified to the species level as minke, fin and sperm whales; white-beaked and Atlantic white-sided dolphins; and long-finned pilot whale.

4.4.2 Updated Species Information

Since the preparation of the 2021 EA Update (LGL 2021a), relevant literature has become available for baleen whales, and specifically for blue, humpback, and sei whales, as well as for odontocetes, in particular northern bottlenose whales and killer whales, and for harp seals and leatherback sea turtles.

Delarue et al. (2022) reported baleen whale detections on acoustic recorders that were deployed off Nova Scotia and Newfoundland and Labrador from May 2015 to November 2017. Blue, fin, and humpback whales were detected year-round, with the Flemish Pass-Orphan Basin region appearing to be an important area for these species; however, these species were also detected on and along the edge of the Grand Banks. Blue whale detections were more frequently recorded along the slopes of the Grand Banks than on the shelf, with fewer detections in that region during late spring and early summer than during other times of the year. Fin whales were detected throughout the waters off Newfoundland, with frequent detections at Flemish Pass, in particular during winter and spring. Humpback whale detections were high on the southern Grand Banks, as well as in the Strait of Belle Isle, in particular during summer and fall. Sei, minke, and North Atlantic right whales were also detected during the study. Right whale detections were made off Nova Scotia, as well as to the east of the Laurentian Channel in November and in the Strait of Belle Isle during September. Sei whales were detected throughout the waters of Newfoundland

and Labrador. Minke whales were mainly detected off Nova Scotia, but were also recorded along the southern edge of the Grand Banks south of Newfoundland.

Oyarbide et al. (2021) reported on interactions with several odontocete species and a deep-water trawling vessel offshore Newfoundland. During 2007, interactions were reported for sperm whales, northern bottlenose whales, long-finned pilot whales, and short-beaked common dolphins. Interactions were noted along the eastern edge of the Grand Banks, as well as at the Flemish Cap.

4.4.2.1 Blue Whale

Jossey et al. (2021) used whole genome sequencing to elucidate the poorly understood population structure of North Atlantic blue whales. Despite the severe reduction in the population (due to whaling), North Atlantic blue whales have retained high genetic variability. The authors note that high genetic diversity within the species is promising for species recovery if low population numbers do not persist for an extended period of time. Knowledge of genetic diversity and structure is essential for developing conservation strategies for endangered species (Jossey et al. 2021).

4.4.2.2 Humpback Whale

Humpback whale vocalizations were detected on acoustic recorders deployed off eastern Canada from May 2015 to October 2017 (Kowarski et al. 2022). Detections were made throughout the fall and winter, including on the Grand Banks, as well as off Labrador and the Strait of Belle Isle. The first day of singing occurred as early as September in the Strait of Belle Isle, and regular signing was recorded starting in October off Labrador. First singing on the Grand Banks started in October, and regular singing was recorded in November. Photoperiod was negatively correlated to sightings.

4.4.2.3 Sei Whale

Sei whales were detected acoustically in the waters off Newfoundland and Labrador every month of the year during 2015–2017, but with few detections off Labrador during the winter (Macklin 2022). Peaks in vocalizations occurred during October, with a smaller peak during June. Differences in vocalizations between sei whales detected in Nova Scotia and Newfoundland suggest that two different populations may occur in Atlantic Canada.

4.4.2.4 Northern Bottlenose Whale

Stanistreet et al. (2021) noted that the population structure of northern bottlenose whales occurring off eastern Canada is not completely known. Important habitat for northern bottlenose whales may occur in slope areas extending from the Scotian Shelf to Newfoundland. Northern bottlenose whales have been seen along the Sackville Spur, near the Flemish Cap, in multiple years, but no photographic matches have been made between the Scotian Shelf population and northern bottlenose whales that occur in Newfoundland (Oyarbide et al. 2021; Stanistreet et al. 2021).

4.4.2.5 Killer Whale

Based on isotope analysis with tissues from stranded individuals, Matthews et al. (2021) reported that there is not a single killer whale population in the northwest Atlantic, but rather several ecotypes with dietary and morphological differences. They noted that killer whales occur off Newfoundland and Labrador throughout the year and reported several strandings for Newfoundland, with the most recent one occurring in 2002.

4.4.2.6 Harp Seal

The estimated population of Northwest Atlantic harp seals was 7.6 million in 2019, based on a population model that included pup production estimates up to 2017, annual estimates of age-specific reproductive rates, and removals and ice related mortality up to 2019 (DFO 2020c). The population appears to have been relatively stable since the mid-1990s but has been increasing in recent years, likely due to higher reproductive rates and lower removals. Inter-annual fluctuations in reproductive rates of harp seals have increased over the previous decade. This change can be explained by population size approaching carrying capacity and ice conditions and/or prey availability affecting reproductive rates. At current low levels of harvest, the Northwest Atlantic harp seal population is expected to continue to increase until the middle of the century (Hammill et al. 2021). Climate change is having an impact on ice-cover; the Gulf of St. Lawrence and the northeast Newfoundland area is expected to be ice-free by the end of the century. This will have a negative impact on harp seals unless new areas for pupping are found north of current whelping areas (Hammill et al. 2021).

4.4.2.7 Leatherback Turtle

DFO (2022d) assessed the potential recovery of the Northwest Atlantic leatherback turtle population. A recovery goal is to increase the number of leatherbacks in the broader Northwest Atlantic subpopulation by maintaining or increasing the numbers of adult and sub-adult leatherbacks using Atlantic Canada waters. DFO notes that progress towards this goal may be achieved by reducing human-induced interactions and mortalities in Atlantic Canada, supporting leatherbacks' persistent use of Canada waters as core foraging habitats, and continuing efforts to monitor leatherback spatial and temporal distributions. DFO has assessed and ranked the main threats to leatherbacks in the Northwest Atlantic (DFO 2020a). Bycatch in fishing gear ranked as the highest threat, followed by marine pollution (mainly plastics), legal and illegal harvesting, and coastal development. New information from citizen science reporting networks, at sea fishery observers, and *Species at Risk Act* (SARA) logbook programs suggest that leatherback turtles are vulnerable to entanglement in various types of fixed gear fisheries in Atlantic Canada (DFO 2019). Fixed fishing gear with vertical lines extending to the surface and horizontal lines at or near the surface pose the greatest risk to leatherback turtle entanglement. In addition, there is significant accidental bycatch of leatherback turtles on pelagic longlines, especially along the shelf edge on the Scotian Shelf. In general, interactions between the leatherback turtle and the fishery have been underestimated. DFO highlights that continued monitoring of leatherback turtle distribution and interactions with the fishery is needed (DFO 2019).

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 SARA and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) websites as of April 2022. Changes in species status since the preparation of the 2021 EA Update (LGL 2021a) are noted in bold font in Table 4.10.

Table 4.10. 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 Newfoundland and Labrador population	*Gadus morhua*				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	

Common Name	Scientific Name	*SARA* [a]			COSEWIC [a,b]		
		E	T	SC	E	T	SC
Atlantic Salmon South Newfoundland population	*Salmo salar*					X	
Quebec Eastern North Shore population							X
Quebec Western North Shore population							X
Anticosti Island population					X		
Inner St. Lawrence population							X
Gaspe-Southern Gulf of St. Lawrence population							X
Eastern Cape Breton population					X		
Nova Scotia Southern Upland population					X		
Outer Bay of Fundy population					X		
Basking Shark Atlantic population	*Cetorhinus maximus*						X
Shortfin Mako Shark Atlantic population	*Isurus oxyrinchus*				X		
Spiny Dogfish Atlantic population	*Squalus acanthias*						X
Thorny Skate	*Amblyraja radiata*						X
Marine-associated Birds							
Leach's Storm-Petrel Atlantic population	*Oceanodroma leucorhoa*					X	
Ivory Gull	*Pagophila eburnea*	S1			X		
Red Knot rufa spp. Patagonia wintering population	*Calidris canutus rufa*						X
Northeastern South America wintering population							X
Southeastern USA/Gulf of Mexico/Caribbean wintering population					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		

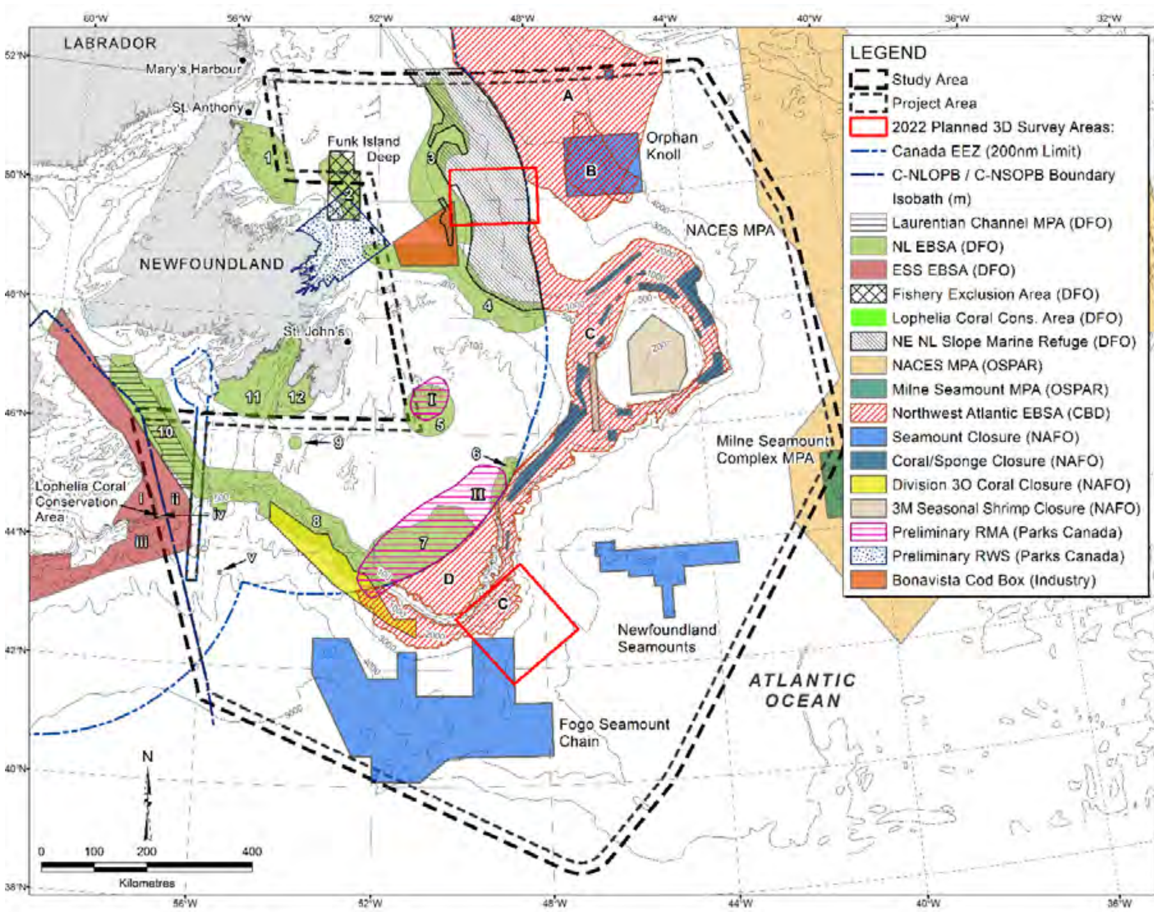
Note: E = Endangered; T = Threatened; SC = Special Concern; S = Schedule.

[a] SARA website (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html) accessed April 2022.

[b] COSWEIC website (http://cosewic.ca/index.php/en-ca/) accessed April 2022.

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* LGL (2018a) (see also Figure 4.40 *in* LGL 2018b), and Section 4.6 *in* LGL (2019, 2020b, 2021a). Based on a review of key biological components for sensitive areas that overlap or are adjacent to the 2022 planned 3D survey areas, 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 4.33–4.34 and listed in Table 4.11.



Source: DFO (2014); N. Wells, Biologist, Science Branch, DFO, pers. comm., 16 April 2021; CBD (2022); MCI (2022); NAFO (2022); OSPAR (2021); Protected Planet (2022).

Notes:

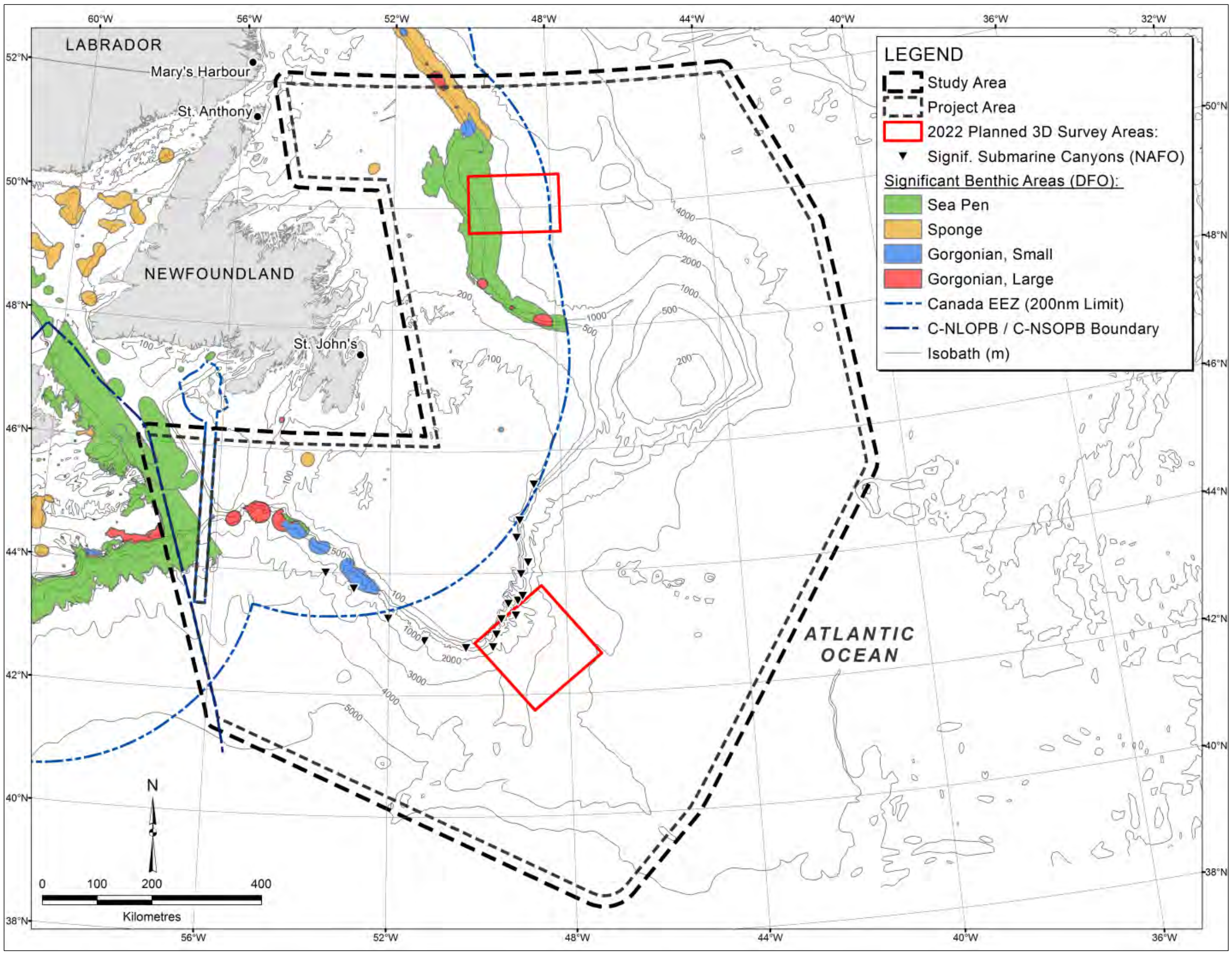
NL (Bioregion) EBSA: 1 = Grey Islands; 2= Notre Dame Channel; 3 = Orphan Spur; 4 = Northeast Slope; 5 = Virgin Rocks; 6 = Lilly Canyon-Carson Canyon; 7 = Southeast Shoal; 8 = Southwest Slope; 9 = Haddock Channel Sponges; 10 = Laurentian Channel; 11 = Placentia Bay;12 = St. Mary's Bay.

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 4.33. 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., 2 May 2022.

Figure 4.34. Sensitive areas that overlap or are adjacent to the Study Area (continued): Submarine canyons and Significant Benthic Areas (SBAs).

Table 4.11. 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, 2020, and 2021 EA Updates [LGL 2019; 2020b; 2021a]).

Governing Body	Area Type	Area Name
NAFO	Vulnerable Marine Ecosystem (VME)*	3O Coral Protection Zone
		Coral/Sponge Fishery Closure Area (14 total)*
		Seamount Closure Area Orphan Knoll Seamount Newfoundland Seamounts* Fogo Seamount Chain*
	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 (MPA)*	North Atlantic Current and Evlanov Sea (NACES) basin (overlaps and extends beyond the former Milne Seamount Complex)
DFO	MPA	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.

There were formerly 13 NAFO Coral/Sponge Closure VMEs; there are now 14 (NAFO 2022). Closure areas 7, 11, and the new 14 are now split into two areas with different boundaries based on regulatory end dates. Closure Areas 7a, 11a, 14a, and 14b are closed to bottom fishing until 31 December 2023, while Closure Areas 7 and 11 (there is no other area for 14) are closed to bottom fishing until 31 December 2026 (see Figure 5 in NAFO [2022]; the scale in Figure 4.33 is too broad to see the differences in boundary outlines between areas 7/7a and 11/11a).

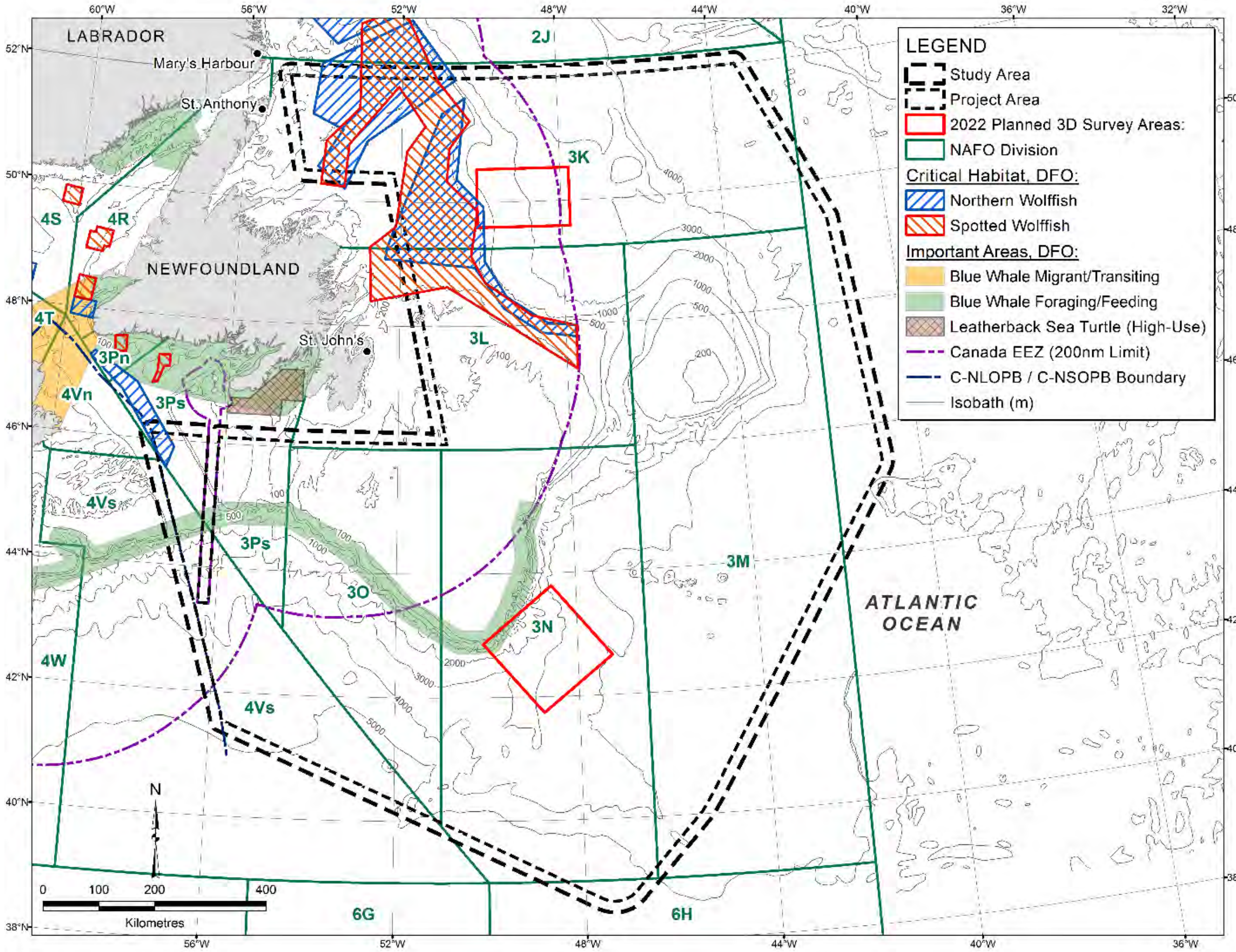
The boundaries and names of NAFO Seamount Closure Areas within the Study Area have changed since the 2021 Update (LGL 2021a; NAFO 2022). The former Newfoundland Seamount is now termed "Newfoundland Seamounts" (i.e., now plural) and the former separate Fogo Seamount Areas are now combined into a continuous area known as the "Fogo Seamount Chain". The revised Fogo Seamount Chain boundary overlaps the southwestern portion of the 2022 South Bank survey area. There is no change to the Orphan Knoll Seamount Closure Area and there are no changes to fisheries restrictions or management measures (NAFO 2022).

What was formerly the OSPAR Milne Seamount Complex has been significantly extended; a new MPA was designated in 2021 and is called the North Atlantic Current and Evlanov Sea (NACES) basin (OSPAR 2021). This new MPA encompasses a ~600,000-km^2 area designated to protect an important feeding and foraging area for seabirds, including species that breed on the coasts of the Northeast Atlantic and migrating/nesting birds from other global areas (OSPAR 2021). Workshops are currently underway to update conservation objectives and the adoption of an Amending Decision and Amending Recommendation is planned for June 2023 (OSPAR 2021).

4.6.1 Critical Habitat and Important Areas

The critical habitats for northern and spotted wolffishes were finalized in an updated Recovery Strategy (DFO 2020e *in* LGL 2020b) 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). Critical habitat for northern and spotted wolffishes overlaps the western boundary of the Orphan Basin 3D survey area; however, overlap is minimal at 487 km^2 and 2 km^2, respectively (Figure 4.35). Project activities within the Project Area are not anticipated to affect bottom temperature within or otherwise cause destruction to the critical habitats.

Important habitat information for leatherback sea turtles near the Study Area was presented in the 2021 EA Update (see Section 4.6.1 *in* LGL 2021a). The Placentia Bay high use feeding area for leatherback sea turtles is located north of the southwestern portion of the Study Area, far west of the 3D survey areas (Figure 4.35).



Source: DFO (2016, 2018, 2020d)

Figure 4.35. Finalized northern and spotted wolffish critical habitat, leatherback sea turtle feeding area, and important areas for blue whales.

DFO identified important foraging and transiting areas for the western Atlantic population of blue whale (DFO 2018 *in* LGL 2020b). 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, overlapping a small portion of the South Bank 3D survey area (see Figure 4.35). 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 (see Figure 4.35). No critical habitat has yet been identified for the western Atlantic population of blue whale (DFO 2018 *in* LGL 2020b).

5.0 Consultations

A newsletter describing the seismic activities proposed for 2022 was distributed on 30 March 2022 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.

In-person meetings were held with the FFAW (Mr. J. Joensen) and Ocean Choice (Mr. R. Ellis) on 22 and 23 March 2022, respectively at their offices. A presentation highlighting the planned 2022 seismic surveying activities was sent to One Ocean (Ms. M. Murphy) on 28 March 2022.

The following comments/concerns were discussed. FFAW and OCI did not raise any major concerns regarding the South Bank Phase II survey in SE Grand Banks. FFAW asked about looking into catch data from species other than Snow Crab and Turbot (i.e., Greenland halibut) for the South Bank Phase II survey (e.g., Scallops). MKI and FFAW agreed in the meeting that this additional catch data is more relevant for Southern Newfoundland as opposed to Southeast Newfoundland. OCI stated they will be mostly working along the 200 m contour line which is well away from the planned South Bank Phase II survey.

With regards to Orphan Basin 3D survey in the 3K fishing zone, MKI stated to FFAW that the production plan will be adjusted to account for the potential Turbot fishing in the area, as demonstrated in the previous years. OCI did not express any concerns with regards to the Orphan Basin 3D survey.

No major concerns or comments were expressed by One Ocean with regards to MKI's 2022 activities.

6.0 Environmental Assessment

This section presents a summary of mitigation measures that will be employed by MKI during its 2022 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 2022. 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 (29 April 2022)
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 permanent hearing damage/ disturbance to Species at Risk or other key habitats	• “Pre-watch” (30 minute) of 500 m safety zone using visual and PAM • Delay start-up if any marine mammals or sea turtles are detected within 500 m with visual and PAM • Ramp-up of airguns • Shutdown of airgun arrays for endangered or threatened marine mammals and sea turtles, as well as beaked whales, detected visually or acoustically within 500 m	• Confirmed • Confirmed • Confirmed • Confirmed • Confirmed

VEC, Potential Effects	Primary Mitigations	Status (29 April 2022)
	• 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
Marine-associated Bird VEC: Injury (mortality) to stranded seabirds	• Daily search of seismic and support vessels • Implementation of handling and release protocols • Switch off non-essential lighting, especially in lifeboat stations	• 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 most recent EA Update for the Project (LGL 2021a); these studies are summarized below.

Meekan et al. (2021) conducted a large-scale experiment that quantified the effects of exposure to commercial airgun arrays (two 2,600-in^3 arrays operated at 2,000 psi; source level of 247 dB re 1 μPa m peak-to-peak SPL) on an assemblage of tropical demersal fishes targeted by commercial fisheries on the Northwest Shelf of Western Australia. The authors demonstrated that there were no short-term (days) or long-term (months) effects of seismic sound exposure on the composition, abundance, size structure, behaviour, or movement of demersal fishes. The multiple lines of evidence indicate that seismic surveys have little effect on demersal fishes in the shelf waters off Western Australia (Meekan et al. 2021).

Day et al. (2021) examined the effects of airgun sound exposure on the early life-history stages of southern rock lobster (*Jasus edwardsii*). Puerulus (n=16) and juvenile (n=56) rock lobsters[1] were collected, exposed to the airgun pulses of a full-scale array (in water depths ranging from 51 m to 58 m) and then assessed for effects through the quantification of their dorsoventral righting reflex and their post-exposure development. Increased mortality in puerulus or juveniles was not observed after exposure to airgun sounds. The righting reflex was significantly impaired at

[1] From Day et al. (2021) "Following hatching, palinurid lobsters spend months to years as planktonic phyllosoma, undergoing a series of stages in offshore currents before metamorphosing into the postlarval puerulus stage (Booth and Phillips 1994; George 2005). The non-feeding puerulus is a transitional stage lasting several days, bridging larval and juvenile stages in which the lobster finds a suitable settlement site before metamorphosing into the benthic postpuerulus juvenile form, at which point it is essentially a small, fully developed lobster (Booth and Phillips 1994). These life stages tend to occur in low abundance over a spatially wide distribution (Jeffs and Holland 2000), making them difficult to study and potentially obscuring any impact."

distances at least 500 m from the seismic survey line when the airgun array was active. A range in the ability of puerulus and juvenile treatments to recover from impaired righting reflex was observed; juvenile lobsters exposed at 500 m from the source recovered from impairment after the first moult. Increased intermoult duration was observed in some juvenile lobsters (i.e., those closest to the airgun source), which suggested impacted development and potentially slowed growth, though the authors note that the "proximate cause was not identified" (Day et al. 2021).

Hawkins et al. (2020) reviewed available information and highlighted the data gaps which must be addressed before reasonable sound exposure criteria can be established for fishes. The authors highlight several key data gaps including the poor understanding of how various fishes detect and respond to sounds, which may enable an understanding of what sounds lead to adverse effects. They also noted that there is a poor understanding of the characteristics of the sounds that potentially affect fishes and how the sounds propagate.

de Jong et al. (2020) conducted a meta-analysis of studies conducted on fish response to noise to predict which types of noise may have the greatest impact on fish reproduction. Their findings suggested that irregular continuous sound (e.g., heavy ship traffic) may have the most pronounced effect on stress, masking, and hearing-loss in fishes, which consequently may lead to the most pronounced effect on fish reproduction.

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 2019/2020/2021 EA Updates (LGL 2018a, 2019, 2020b, 2021a); these studies are summarized below.

6.3.1 Vessel Lighting

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

Leach's Storm-Petrels comprised 93% of birds attracted to artificial light sources at night in a study of bird stranding reports from offshore and coastal industrial facilities in Atlantic Canada (Gjerdrum et al. 2021). Most (84%) of the strandings occurred during September and October, suggesting that most of the stranded storm-petrels were fledglings. The frequency of large stranding events (10 or more individuals on a single day) was significantly associated with moon phase. The moon was <20% illuminated for 46% of large stranding events and in nine out of ten of the largest stranding events.

Collins et al. (2022) tracked adult Leach's Storm-Petrels nesting at the colony on Gull Island, Newfoundland with GPS loggers to study their interactions with the oil production installations and drilling platforms in the existing oil oilfields in the Newfoundland offshore. Many of these birds' transit through the oilfields on their way to foraging areas off the continental shelf. The study found that the birds were no more likely to fly within a light catch basin of one of those platforms during the night than during the day, despite this species' documented attraction to artificial light at night. However, this is not unanticipated given that these birds are experienced adults and that most strandings occur when the naïve young fledge from their natal colonies.

Adult Manx Shearwaters engaged in nesting at a colony appeared to be repelled rather than attracted by artificial light (Syposz et al. 2021). Fewer shearwaters in flight were counted when a flashlight was illuminated at the colony, and fewer were counted in flight when using a bright light than a dim one. When short wavelengths of light (blue/green) were used, fewer birds were in flight than for long wavelengths (red). This is in contrast to land birds, which some studies suggest are disoriented by red light. Longer duration illuminations resulted in fewer birds in flight above the colony than shorter durations, except when a dim light was used. These results were found both at a site with no human access and a site with occasional human access. This avoidance of light at the colony by breeding shearwaters is consistent with the avoidance of the colonies on moonlit nights by adult breeders of several species of shearwaters and petrels, and is thought to be an adaptation to the risk of higher predation on adults on moonlit nights.

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.

Champoux et al. (2020) examined sublethal toxicity of the Deepwater Horizon blowout oil on Northern Gannets wintering in the Gulf of Mexico. Gannets were equipped with geolocators at the Bonaventure Island, Quebec nesting colony to determine their wintering locations. Upon returning to the colony, blood and feather samples were collected from the birds. Assays were conducted on the samples for parent and alkylated polycyclic aromatic hydrocarbons (PAHs); trace metals; stable isotopes of carbon, nitrogen, and hydrogen; and immune, thyroid, steroid, retinoid, and genetic endpoints. No differences were found in PAH and trace metal concentrations between gannets wintering in the Gulf of Mexico and those wintering elsewhere. However, gannets wintering in the Gulf of Mexico had higher feather corticosterone and plasma thyroid hormone levels. These elevated levels indicate increased energetic demands and/or exposure to environmental stressors, likely due to exposure to Deepwater Horizon oil and subsequent sublethal effects.

Weathered Mississippi Canyon 252 crude oil (the type of oil released during the Deepwater Horizon blowout) orally dosed to Zebra Finches (*Taenopygia gutta*) causes tissue-specific changes in the expression of mRNA, including decreased proinflammatory cytokine expression in the intestine and increased expression in liver and spleen, and a lower heterophil:lymphocyte ratio (Goodchild et al. 2020a). Dosed birds also showed reduced activity, a behaviour indicating illness. These effects suggest that oil spills may affect physiological and behavioural components important for disease defence in birds. These effects could, in turn, hinder recovery of bird populations impacted by oil spills. Weathered Mississippi Canyon 252 crude oil applied (1.0 or 2.5 µL) externally to the eggshells of Zebra Finches resulted in lower embryonic heart rate and metabolic rate on the 12th day of incubation (Goodchild et al. 2020b). Such effects could potentially lead to an increase in the time necessary to complete embryonic development and to impaired heart performance following hatching.

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, 2020, and 2021 Updates (LGL 2018a, 2019, 2020b, 2021a) are summarized below. Some information from studies cited in previous EA Updates is included for context.

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 2019; Erbe et al. 2019; Kyhn et al. 2019; Rako-Gospić and Picciulin 2019). Reactions to sound and auditory effects, if any, depend on sound levels and frequencies, exposure duration, occurrence of gaps within the exposure, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (e.g., Harding et al. 2019; Kastelein et al. 2019a,b,c, 2020a,b,c,d,e; Rako-Gospić and Picciulin 2019; Hückstädt et al. 2020; Hastie et al. 2021; Southall et al. 2021; Miller et al. 2022). Similarly, the frequency and duration of the masking sound, strength, temporal pattern, and location of the introduced sound play a role in the extent of any masking (Popov et al. 2020). Some cetaceans are known to increase the source levels of their calls, shift their peak frequencies, or otherwise modify their vocal behaviour in response to increased noise (recent publications include Thode et al. 2020 and Fernandez-Betelu et al. 2021).

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; Southall et al. 2021). There have been recent studies of arctic cetaceans, which further highlight the variability in marine mammal response to seismic sounds. Heide-Jørgensen et al. (2021) reported that narwhals exhibited avoidance reaction at distances >11 km from an active seismic vessel, as well as an increase in travel speed and changes in direction at distances up to 24 km from a seismic source. No long-term effects were reported. Tervo et al. (2021) reported that narwhal buzzing rates decreased in response to concurrent ship noise and airgun pulses (being 50% at 12 km from ship), that the whales discontinued to forage at 7–8 km from the vessel, and that exposure effects could still be detected >40 km from the vessel. Bowhead whales in the Beaufort Sea apparently decreased their calling rates in response to seismic operations, although movement out of the area could also have contributed to the lower call detection rate (Blackwell et al. 2013, 2015; Thode et al. 2020). Recent seismic monitoring programs offshore Newfoundland have reported sightings of long-finned pilot whale; northern bottlenose whale; Atlantic white-sided, common, Risso's, striped, and white-beaked dolphins; and humpback, fin, sei, blue, minke, sperm, and killer whales (Penney-Belbin 2020a,b; Bishop and Lang 2021).

Lucke et al. (2020) caution that some current thresholds may not be able to accurately predict hearing impairment and other injury to marine mammals due to noise. Recent publications on marine mammal hearing effects have raised some doubts as to whether Temporary Threshold Shift (TTS) should continue to be considered a non-injurious effect (Weilgart 2014; Tougaard et al. 2015, 2016; Houser 2021).

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 2022 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 2022. 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 2022 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, 2020, and 2021 EA Updates (LGL 2019, 2020b, 2021a) and in the 3D survey areas considered in this EA Update, including the most recent commercial fisheries data (from 2019–2020) available. In 2022, it is anticipated that the commercial harvest species and the timing and locations of commercial fisheries within the Study Area will be similar to previous recent years (see Section 5).

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 prior EA Updates (LGL 2019, 2020b, 2021a).

A Marine Traffic (2022) website was accessed and provided information on vessel density for 2020 and 2021 relative to the Project Area and 3D survey areas planned for 2022. 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 2020 and 2021, 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 2022). 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 >1000 vessels per year per 4.89-km^2

grid-cell. Figure outputs were centered on the Project and Study area boundaries; also shown are the planned 3D survey areas for 2022.

Within the Project Area, marine traffic density is generally concentrated in the southeast, 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 2020 (Figure 6.1) and 2021 (Figure 6.2). There were relatively few vessel transits recorded in the northern portion of the Project Area, including the Orphan Basin survey area. Vessel transits in the southeastern portion of the Project Area, including the South Bank survey area, are notably higher given its location relative to the great circle routes between major ports in Europe, Asia (via Suez Canal), and North America. Overall, shipping traffic data from 2020 and 2021 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.

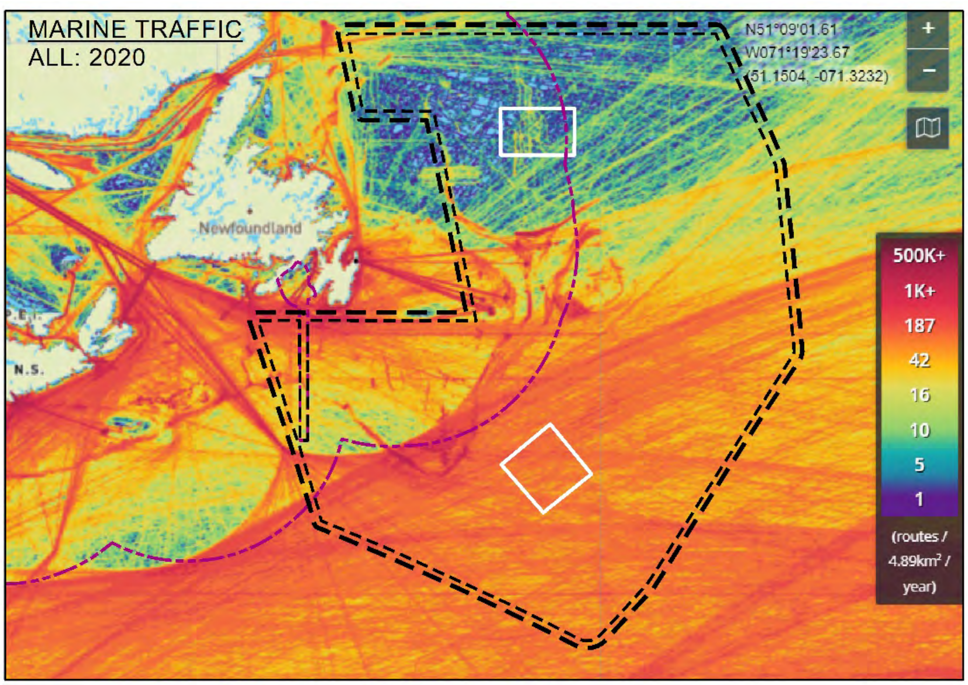


Figure 6.1. Marine shipping traffic density (routes per 4.89 km^2 grid cell) in 2020 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2022 3D Survey Areas.

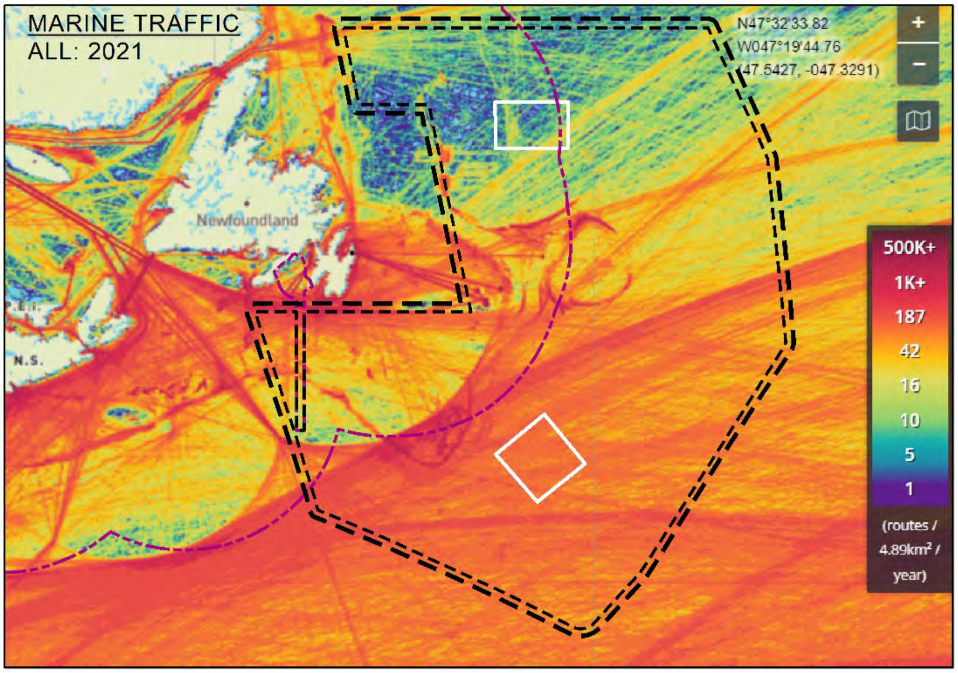


Figure 6.2. Marine shipping traffic density (routes per 4.89 km^2 grid cell) in 2021 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2022 3D Survey Areas.

6.5.1.3 Oil and Gas Activities

During 2022, MKI is planning to focus survey efforts in the South Bank survey area, with surveying occurring from late-May to early-September. It is possible that a second MKI seismic vessel may simultaneously conduct a seismic survey in the Orphan Basin survey area from mid-June to early-August (Figure 6.3). MKI will not survey in Labrador in 2022. If surveying occurs in the Orphan Basin survey area, concurrent surveying within the two survey areas would occur for approximately eight weeks with a closest point of approach (CPA) of about 645 km. Based on a review of the C-NLOPB website, there are currently no indications that other seismic surveys will occur in 2022. If other seismic surveys do occur offshore Newfoundland, 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, although the Terra Nova FPSO is currently offsite. The CPA between the production developments and the South Bank survey area and Orphan Basin survey area are 306 km and 311 km, respectively. 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. Equinor plans to drill two wells with the *West Hercules* drill rig in EL 1156 and ExxonMobil plans to drill a single well with the *Stena Forth* drillship in EL 1165A this summer. The CPA between the ELs where drilling is planned and the South Bank survey area and Orphan Basin survey area are 363 km and 184 km, respectively. MKI's survey areas are quite distant from production developments and exploratory drilling activities which may occur in the Project Area. As necessary, MKI commits to communicating closely with production and exploratory drilling operators to ensure appropriate spatial separation of activities.

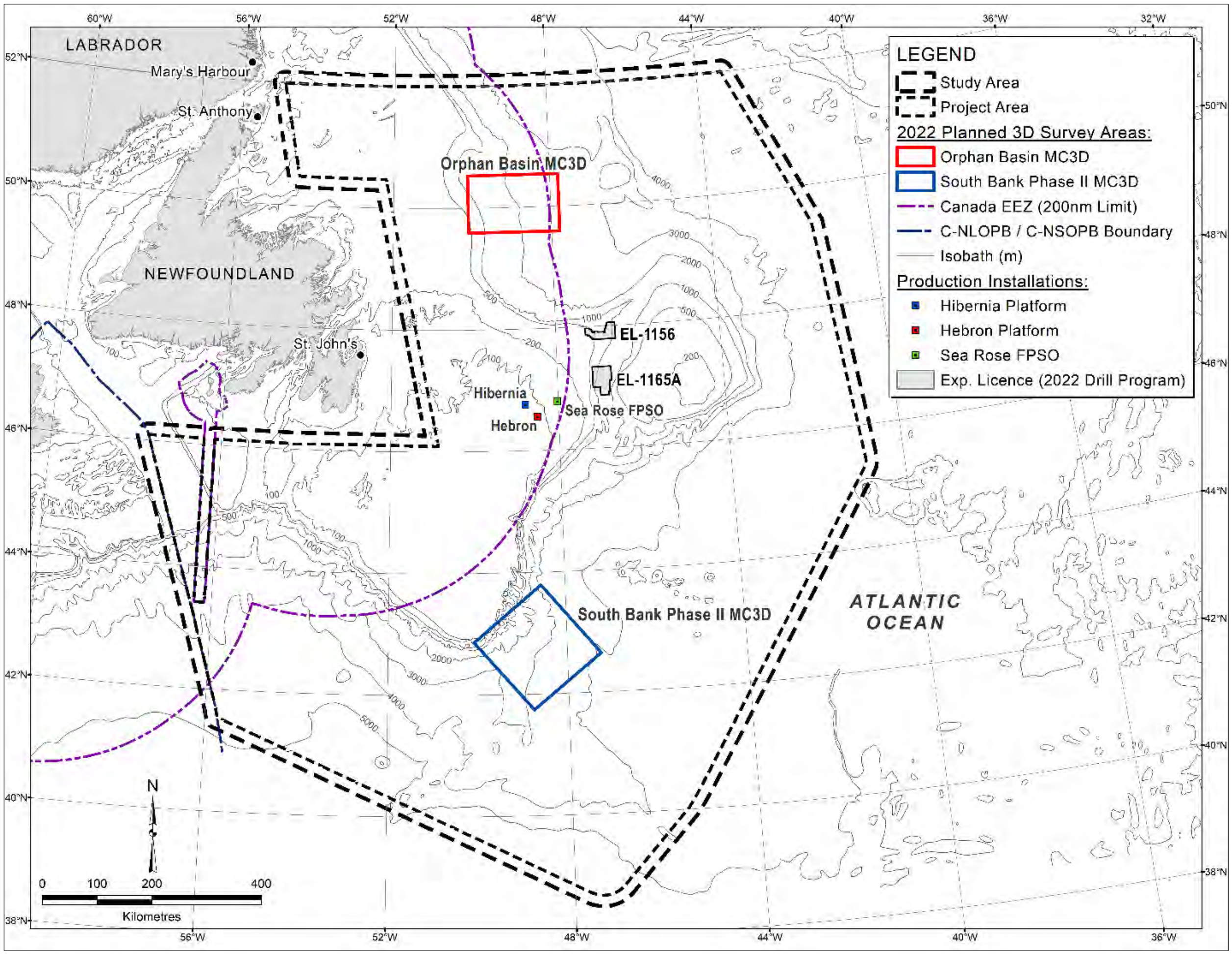


Figure 6.3. Locations of MKI's planned 3D seismic survey areas in 2022. Also shown are the production installations on the Grand Banks and Exploration Licenses where drilling is planned.

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 surveys 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. 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 seismic surveys, 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 2022 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). The 2022 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

Keel, R.J.	Manager of Aquaculture Licensing and Administration, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador. 19 April 2022.
Mello, L.	Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Fisheries and Oceans Canada. 21 and 22 April 2022.
Morrow, G.	Senior Contract Manager, PGS. June 2017.
Murillo-Perez, J.	Research Scientist, DFO, Bedford Institute of Oceanography. 2 May 2022.
Roberts, A.	Data Archivist, DFO. 1 March and 1 April 2022.
Rowe, G.	Resource Management and Indigenous Fisheries, DFO. 20 April 2022.
Wells, N.	Biologist, Science Branch, DFO. 16 April 2021.

Appendix A – MKI Newsletter Distributed to Consultees

Multiklient Invest AS

Seismic Programs Offshore Newfoundland 2022 Update

Potential Resumption of the Program in 2022

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 Titan and Ramform Atlas will be acquiring data between mid May and September 2022.

Figure 1: Seismic Vessels due to work in the province during 2022

Figure 2: MKI Planned 2022 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 seismic and 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.

How to Access Environmental Information about the Project

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

From the C-NLOPB homepage, click on the "*Environment*" link near the bottom of the page. Then click on the "Project-Based Environmental Assessments" 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
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	jaspell@townofbaybulls.com	Jennifer Aspell, Town Manager
Burin		
Town of Burin	lhartson@townofburin.com	Leo Hartson, Town Manager
Burin Harbour Authority	morrisfudge@yahoo.ca	Morris Fudge
College of the North Atlantic		
Wave Energy Research Centre	Gary.thompson@cna.nl.ca	Gary Thompson
Come by Chance		
Town of Come by Chance	townofcbc@eastlink.ca	Rex Benson, Boat Owner's Association
Conne River		
Miawpukek First Nation	rjeddore@mfngov.ca	Rene Jeddore, 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	townoffortune@eastlink.ca	Lacey Symes, Clerk
Fortune Harbour Authority	fortuneharbour@hotmail.com	Not available
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
Burin Peninsula Chamber of Commerce	burinpeninsulachamber@outlook.com	Not available
Marystown Shipyard and Offshore Facilities	butlerwa@hotmail.com	Wayne Butler, President

Organization or Group Name	Email Address	Contact Name
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		Tony Barry, Vice President
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	sydney.worthman@canada.ca Christie.spry@canada.ca	Sydney Worthman. EA Coordinator Christie Spry Senior 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	Not available
St. Johns Port Authority	info@sjpa.com	Not available
Newfoundland and Labrador Fisheries and Aquaculture	flrminister@gov.nl.ca	Hon. Gerry Byrne, Minister
City of St. Johns	soleary@stjohns.ca	Sheilagh O’Leary, 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
Conche Seafoods Inc.- Quinlin Brothers Subsidiary	dphilpott@quinsea.com	Derrick Philpott, Director
Deep Atlantic International Inc.	Martha@deepatlanticsea.com	Martha Mullowney, Director
GC Rieber Carino Ltd.	office@carino.ca	John Kearley, CEO
HSF Ocean Products Limited	todd@hsfgroup.ca	Todd Hickey, Director
Newfound Resources Limited	ottar@newfoundresources.com	Ottar Ingvason, Operations Coordinator
Notre Dame Seafoods Inc.	jeveleigh@notredameseafoods.com	Jason Eveleigh, President
San-Can Fisheries Limited	sgoff@san-can.com	Sandra Goff, Director

Organization or Group Name	Email Address	Contact Name
Ocean Choice International	rellis@oceanchoice.com	Rick Ellis, Director of Fleet Operations
Quinlan Brothers Ltd.	dearle@quinlanbros.ca	David Earle, Chief Financial Officer
Nature Newfoundland and Labrador	zedel@mun.ca	Len Zedel
St. Lawrence		
Town of St. Lawrence	townofstlawrence@nf.aibn.com	Not available
St. Mary's		
Town of St. Mary's	townofstmarys@nf.aibn.com	Not available
Deep Atlantic Sea Products (plant manager in St. Johns)	Martha@deepatlanticsea.com	Martha Mullowney, Plan Manager
Sunnyside		
Town of Sunnyside	townofsunnyside@eastlink.ca	Philip Smith, Town Manager
Trepassey		
Town of Trepassey	jill@townoftrepassey.com	Jill MacNeil, Clerk
Trepassey Management Corporation	chairperson@nf.aibn.com	Rita Pennell, Chairperson
Witless Bay		
Town of Witless Bay	townofwitlessbay@nl.rogers.com	Geraldine Caul, Clerk