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Environmental Assessment Update (2021) of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023

Prepared by:

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CELEBRATING 50 YEARS

Prepared for:

Multiklient Invest AS

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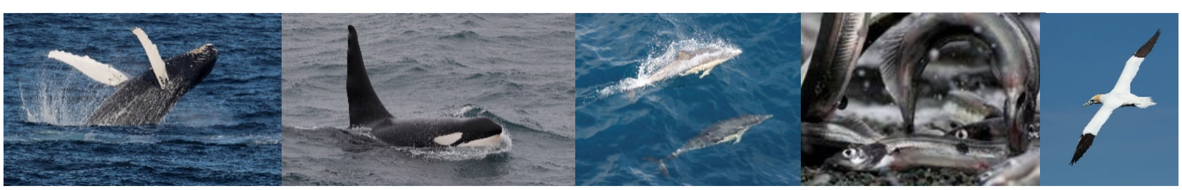

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1.0 Introduction

This document is an Update of the Environmental Assessment (EA) of the Multiklient Invest AS (MKI) Newfoundland Offshore Seismic Program, 2018–2023 (LGL 2018a), the associated Addendum (LGL 2018b), and EA Updates (LGL 2018c, 2019, 2020b). In 2021, 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 2021. 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 2021. Previous EA Updates associated with this program were prepared in 2018, 2019, and 2020 (LGL 2018c, 2019, 2020b).

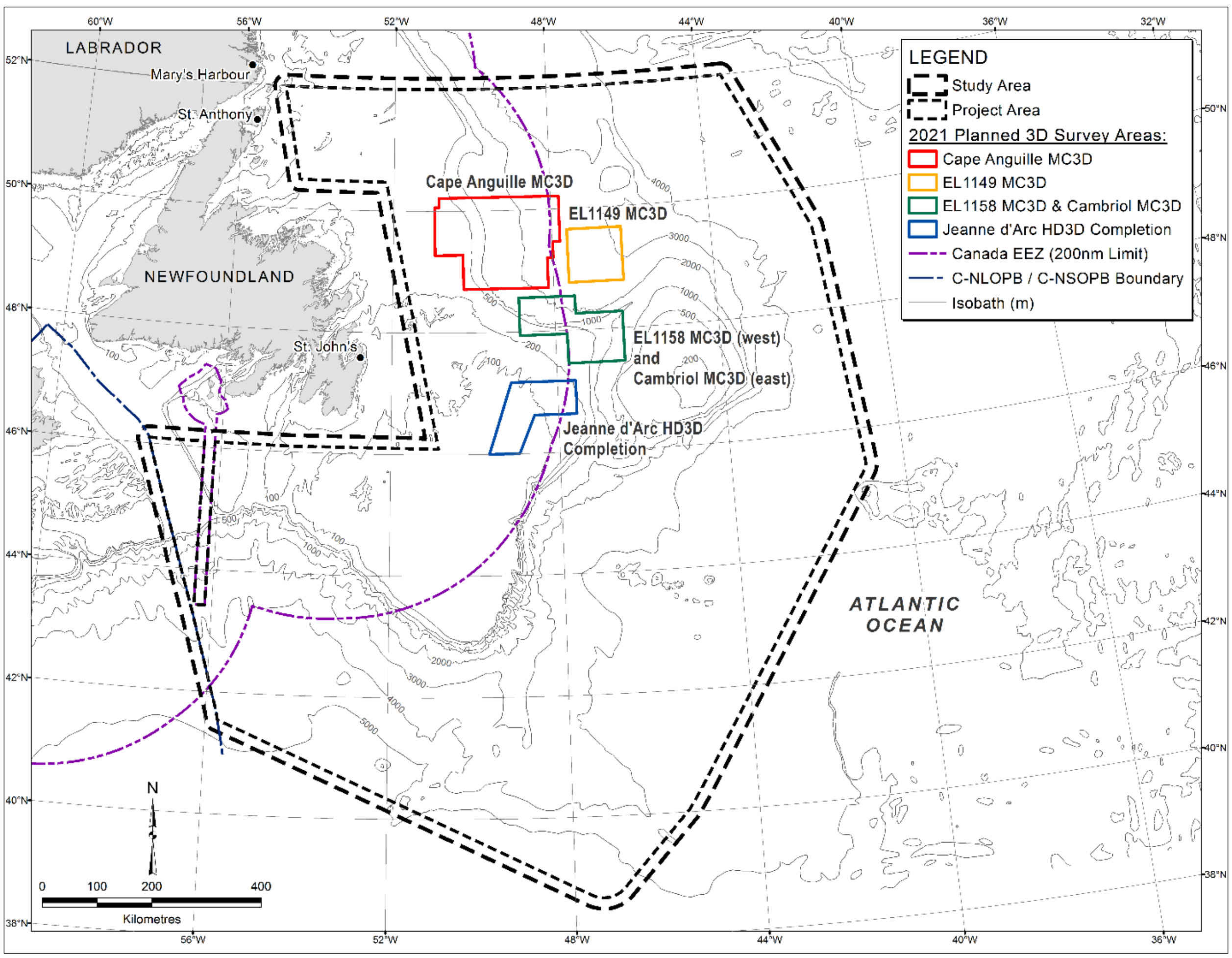


Figure 1.1. Locations of the Project Area, Study Area and 2021 Planned 3D Survey Areas for MKI's Newfoundland Offshore Seismic Program.

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 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 2021)[c]

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

In April 2021, MKI submitted an Amendment to the EA (LGL 2021) proposing to test its eSeismic technology. This technology involves the activation of individual airguns in a pseudo-random pattern every 200 ms. The sound pressure level (SPL) of the sound source is reduced due to smaller airgun volumes being activated at once but airguns are activated on a near continuous basis. The EA Amendment is under review and MKI commits to all mitigation measures presented in the original EA pending a determination by the C-NLOPB on the EA Amendment.

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

2.0 Project Description

The information in this section provides details of the Project specific to 2021.

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 2021, MKI will conduct two simultaneous 3D surveys with the MV *Ramform Atlas* and MV *Ramform Titan*. All project description parameters described in the EA are applicable to MKI's 2021 activities. Specific details for 2021 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 2021

In 2021, MKI plans to conduct 3D seismic surveying in the Project Area. A maximum of two seismic survey vessels will be used in 2021. MKI is proposing to conduct approximately 11,000–15,000 km^2 of 3D seismic surveying in the Project Area in 2021 (see Figure 1.1).

In 2021, MKI will use the MV *Ramform Atlas* and MV *Ramform Titan* for the 3D seismic surveying. The *Ramform Atlas* and *Ramform Titan* are sister ships, both built in 2013 and flagged in the Bahamas (Figures 2.1 and 2.2). Both the *Atlas* and *Titan* are 104.2 m long, with a beam of 70 m and a draft of 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 2021.

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. Any change relative to the testing of the eSeismic survey procedure as proposed in the recent EA Amendment will depend on the outcome of the Amendment review process.

Figure 2.1. MV *Ramform Atlas.*

Figure 2.2. MV *Ramform Titan.*

2.4.2 Seismic Streamers

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

2.4.3 Support Vessels

Four vessels may be used to support the 3D seismic surveys in 2021. The MV *Thor Magni* will be used as support vessel. The MV *Norcon Triton*, MV *Dantzig, and* 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 planned timing of MKI's 3D surveys in the Project Area is summarized in Table 2.1. The maximum number of MKI seismic vessels acquiring data within the Project Area as part of the Project at any given time would be two; this is planned to occur through most of June, July, August, and early September. The *Ramform Titan* will survey the Cape Anguille MC3D (~10,000 km^2) survey area (also referred to as the Orphan Basin MC3D survey area) and the *Ramform Atlas* will survey the Cambriol MC3D (~1180 km^2), EL1149 (2300 km^2), and Jeanne d'Arc HD3D Completion (~600 km^2) survey areas. It is possible that the *Ramform Atlas* may also survey some of EL1158 (1000 km^2). The *Ramform Titan* plans to mobilize and deploy its seismic gear from 21–28 May with demobilization planned for 6–10 September. The *Ramform Atlas* plans to mobilize and deploy its seismic gear from 7–14 June with demobilization planned for 9–12 September. Mobilization and demobilization dates may change.

Table 2.1. Planned timing of MKI's 2021 seismic survey activities (data acquisition) in the Project Area.

	May	June (week)				July (week)				Aug (week)				Sep (week)			
3D Survey Area	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Cape Anguille MC3D																	
Cambriol MC3D																	
EL1149 MC3D																	
Jeanne d'Arc HD3D Completion																	

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 2019 and was characterized by a large negative anomaly in March–April which led to an early ice-retreat on the Newfoundland Shelf (Cyr et al. 2021). The sea-ice cover first appeared at near-normal to later than normal times in 2019 and declined sharply on the Newfoundland Shelf in March. The highest number of icebergs (1515) that drifted south of 48°N onto the Northern

Grand Bank was recorded in 2019 which was the 7th highest record since 1900. Monthly iceberg recordings in 2019 showed that 792 icebergs were documented in May alone, which was nearly four times more than the total in 2018 (Cyr et al. 2021).

The annual sea-surface temperature and bottom temperature in Northwest Atlantic Fisheries Organization (NAFO) Divs. 3LNOPs were at normal levels in 2019; however, the bottom temperatures on the slopes of the Grand Banks were above normal. During fall 2019, the bottom temperatures in NAFO Divs. 2HJ3KLNO were also above normal, especially in 3K (Cyr et al. 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 2019 (DFO 2020a). Overall, the annual chlorophyll-*a* inventories were above normal over most of the Newfoundland and Labrador Shelf. The onset of the spring phytoplankton bloom was highly variable across the Atlantic Zone, and a delayed onset occurred on the Northeast Newfoundland Shelf. The magnitude of the bloom was near or below normal throughout the Atlantic Zone. Bloom duration was generally near or above normal on the Newfoundland and Labrador Shelf, reaching record high durations in the St. Anthony Basin and over the Southeast Shoal. The zooplankton community shift observed in recent years (2014–2018), characterized by lower abundance of large energy-rich copepod *Calanus finmarchicus*, higher abundance of small copepods and non-copepods, persisted in 2019 despite the apparent shift toward normal conditions in 2018. *C. finmarchicus* abundance levels remained near or slightly below normal across most of the Atlantic Zone. The abundance of *Pseudocalanus* spp. was above or near normal throughout the Atlantic Zone. The abundance of non-copepod species such as dinoflagellates, cnidarians, ctenophores, and tunicates were near or above normal throughout the Atlantic Zone. Zooplankton biomass was generally below normal across most of the Atlantic Zone with exceptions observed in the Bonavista section.

4.1.2 Benthic Invertebrates

There have been no further relevant updates on benthic invertebrates since the information presented in subsection 4.1.2 of LGL (2020b).

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)

In 2019, the exploitable biomass of snow crab in the NAFO Assessment Divisions (AD) 3K and 3LNO Offshore increased from previous years; however, there was reduced coverage in the fall multispecies survey in 3K in 2019. In 3LNO, the trap-derived exploitable biomass index showed a more modest increase and still remains near the time-series low (DFO 2021a). In AD 3K, landings have remained consistently low over the past four years (6,000 t in 2019), while the fishing effort decreased to the lowest level in 20 years in 2019. In AD 3LNO Offshore, snow crab landings were at the lowest levels in two decades due to a 48% decline from 2016 to less than 13,000 t in 2019, in part due to reductions in the Total Allowable Catch (TAC). The TAC in NAFO Div. 3K in 2021 had a 16% increase to 7,454 t from 6,412 t in 2020 and Div. 3LNO had an increase of 34% to 23,648 t from 17, 587 t in 2020 (DFO 2021b).

Northern Shrimp (Pandalus borealis)

The 2020/21 fisheries management decision for Shrimp Fishing Area (SFA) 6, which occurs in the northern portion of the Study Area, was reduced from 2017/18 to 2018/19 by 16% to 8,290 t (to maintain a 10% exploitation rate) and was increased by 3% to 8,961 t in 2019/2020 (DFO 2021b,c). Northern shrimp biomass in SFA 6 is currently similar to the 1980–90 period, which was at a substantially low level compared to the peak level in the mid-2000s. Between 1996–2019 the fishable biomass index of northern shrimp in SFA 6 averaged 380,000 t and in 2019 the fishable biomass index decreased by 8% from 2018 to 82,900 t (DFO 2021c).

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).

Arctic Surfclam (Mactromeris polynyma)

In 2019, landings of Arctic surfclam (previously Stimpson's Surf Clam) in the Maritime Fishery Information System 1.0 and 2.0 (MARFIS) and the Newfoundland and Labrador region's Catch and Effort Database were 14,925 t against a TAC of 14,756 t (DFO 2020a). In 2021, the TAC for the Grand Banks remains at 14,756 t (DFO 2021b).

Atlantic Halibut (Hippoglossus hippoglossus)

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

Greenland Halibut (Reinhardtius hippoglossoides)

The TAC for Greenland halibut in NAFO Div. 3LMNO is 12,225 t in 2021, down from 12,542 t in 2020 (NAFO 2021).

Atlantic Cod (Gadus morhua)

The one-year management plan for 2020 followed the 2019 steward fishery management approach, which included efforts to ensure that catches for the northern cod fishery in NAFO Div. 2J3KL did not exceed 12,350 t (DFO 2021a). Since 2016, commercial fishery removals have been regulated by weekly limits (lbs/week) by NAFO Division and time of year. Reported landings in 2019 were 10,559 t, including 10,410 t in the stewardship fishery, 123 t in the sentinel surveys, and 2 t taken as by-catch. In 2019, most of the abundance (60%) and biomass (52%) indices were located in the northern portion of the stock area (Divs. 2J). The productivity of 2J3KL cod is associated with capelin availability, which was forecasted to decline in 2020 and will also likely negatively impact cod (DFO 2021d). The TAC for Atlantic cod in Div. 3M decreased from 8,531 t in 2020 to 1,500 t in 2021 (NAFO 2021).

American Plaice (Hippoglossoides platessoides)

The moratorium on American plaice is still in place for 2021 and the TAC is set at 0 t in Divs. 3LMNO (NAFO 2021). Perreault et al. (2020) developed a state-stock assessment model that accounts for uncertainties in the landings data and improves the current stock assessment model that is used to inform management of the American plaice on the Grand Banks. The new model has the potential to increase the confidence in the assessment output that is provided to fisheries managers (Perreault et al. 2020). As noted in LGL (2020b), DFO has determined that there is a high probability that stock growth of American plaice will not occur if this species is harvested (DFO 2020c).

Yellowtail Flounder (Pleuronectes ferruginea)

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

White Hake (Urophycis tenuis)

The TAC for Yellowtail flounder in NAFO Div. 3LNO remains at 17,500 t in 2021 (NAFO 2021).

Redfish (Sebastes sp.)

The TAC for redfish in Unit 2 (NAFO Div. 3Ps, 4Va, a portion of 4W, and 3Pn + 4Pn) continues to be set at 8,500 t for 2020/21 (DFO 2021b).

4.1.3.2 Other Fishes of Note

Capelin (Mallotus villosus)

In 2020, the TAC for capelin in NAFO Divs. 2J3KLPs was set at 19,377 t, which was divided into 77 t for Div. 2J, 6,811 t for Div. 3K, 11, 198 t for Div. 3L, and 1,291 t for Div. 3Ps (DFO 2021b).

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

Anadromous Fishes

The estimated number of Atlantic salmon retained by the recreational fishery throughout Newfoundland and Labrador has been highly variable since 2005 as total catch has ranged from 38,900 to 76,100 individuals. Preliminary estimates of retained and released salmon in 2018 were 13,626 and 25,055 individuals, respectively, totaling 38,681 salmon (DFO 2020c).

4.2 Fisheries

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

4.2.1 Commercial Fisheries

The most recent available commercial fisheries data are from the 2017 and 2018 datasets. The 2017 commercial fisheries data, which were presented in the 2020 EA Update (LGL 2020b), are re-analyzed here relative to the 2021 planned 3D survey areas. Note that the Cape Anguille MC3D survey area is referred to as the Orphan Basin MC3D or Orphan Basin 3D survey area.

The distribution of May–November 2017 and 2018 harvest locations for all species and principal commercial species (i.e., snow crab, northern shrimp, Atlantic halibut, Greenland halibut, and Atlantic cod) harvested in the planned 3D survey areas (and Study Area) are shown in Figures 4.1–4.12. There were no commercial fisheries harvest locations within the EL1149 MC3D survey area during May−November 2017; however, there were for 2018. Harvests mainly occurred between the 100 and 200-m isobaths in the Jeanne d'Arc HD3D Completion survey area and the 500 and 1000-m isobaths in the Orphan Basin and EL1158 and Cambriol MC3D survey areas. Harvests in the EL1149 MC3D survey area in 2018 occurred between the 2000 and 3000-m isobaths.

Catch weight and quartile counts by vessel length classes and species harvested in the Orphan Basin, EL1149, EL1158 and Cambriol, and Jeanne d'Arc HD3D Completion survey areas are presented in Table 4.1. All commercial harvests within the 3D survey areas were caught by fishers from Newfoundland and Labrador.

During 2017 and 2018, Greenland halibut were the main species harvested in the Orphan Basin MC3D survey area. Other species harvested during May−November 2017 and 2018 include snow crab, Atlantic halibut, Atlantic cod, redfish, witch flounder, and roughhead grenadier. Greenland halibut were mostly harvested by vessels of the length class 34–44.9′ and vessels 45−64.9′. Snow crab were mainly caught by vessels <35′. Atlantic cod were harvested by vessels <35′ and 45−64.9′ during 2017 and by 35–44.9′ during 2018. During 2017 and 2018, Atlantic halibut were mainly caught by vessels ≥125′.

In the EL1158 and Cambriol 3D survey areas, redfish were the main species harvested during 2017 and 2018. Other species harvested during May−November 2017 and 2018 include Greenland halibut, snow crab, Atlantic halibut, witch flounder, Atlantic cod, and American plaice. Redfish were harvested by vessels ≥125′in 2017 and 2018. Greenland halibut were mostly harvested by vessels of the length class 45−64.9′ and ≥125′ and snow crab were harvested by vessels of the length class 45−64.9′ and 65–99.9′. Atlantic halibut, witch flounder, Atlantic cod, and American plaice were all mainly caught by vessels ≥125′.

In the Jeanne d'Arc HD3D Completion survey area, snow crab were the only species caught during 2017, and were the main species harvested in 2018. Other species caught during 2018 included Arctic surfclam, propeller clam (*Cyrtodaria siliqua*), and cockle. Snow crab were primarily caught by vessels 45−64.9′ in length, followed by vessels 65–99.9′. Arctic surfclam, propeller clam, and cockle were only caught by vessels ≥125′.

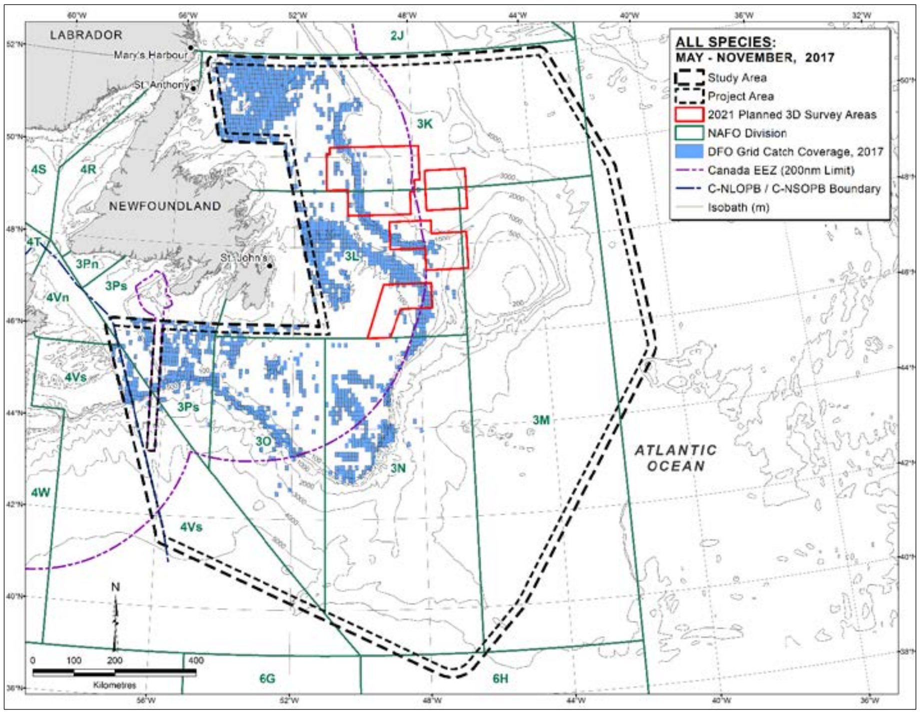


Figure 4.1. Distribution of commercial fishery harvest locations, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

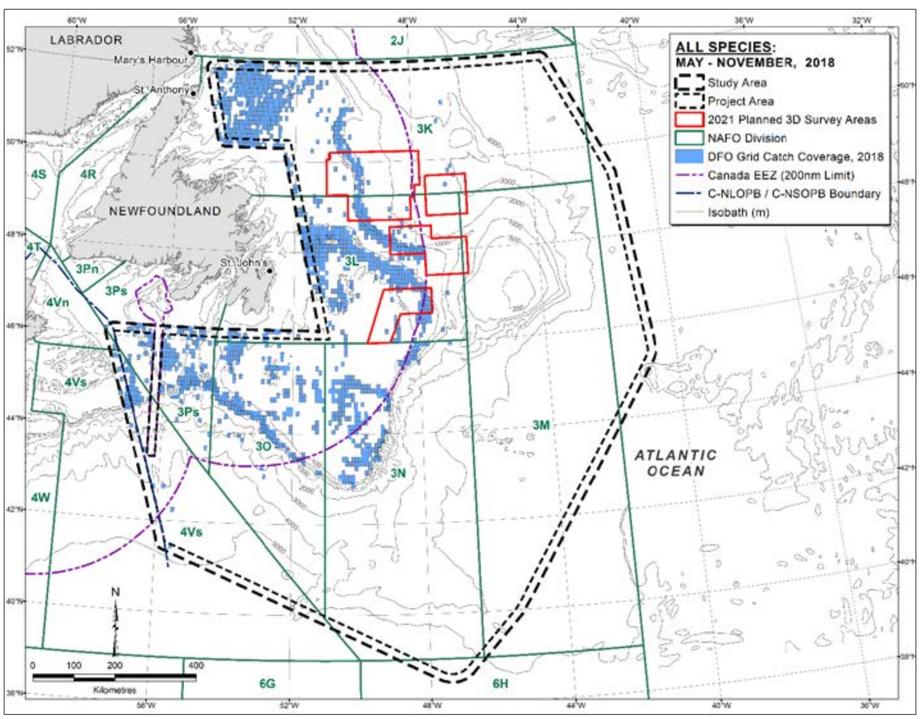


Figure 4.2. Distribution of commercial fishery harvest locations, all species, May–November 2018 (derived from DFO commercial landings database, 2018).

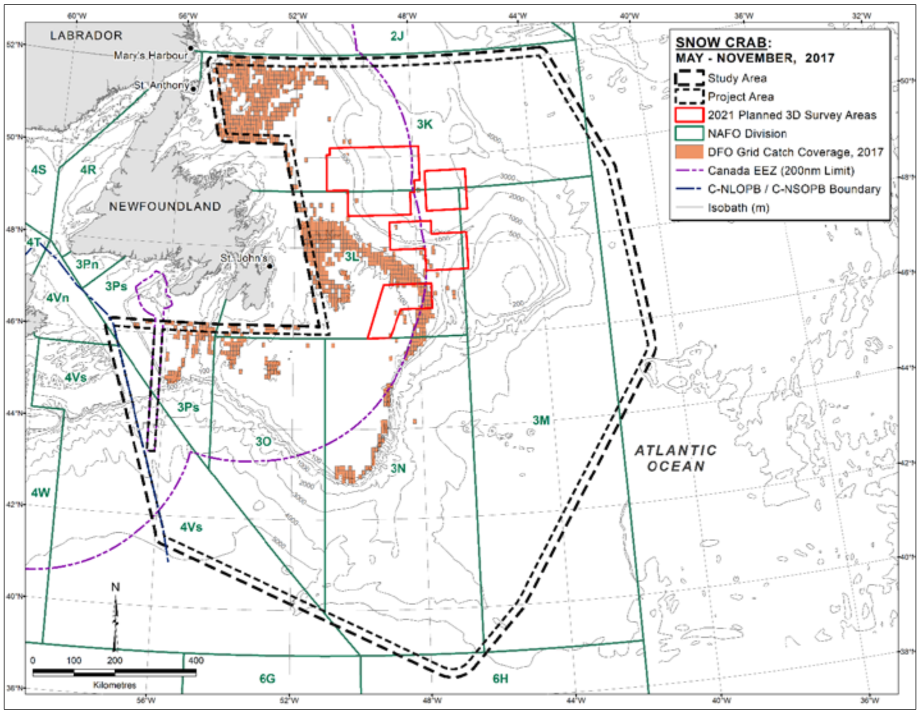


Figure 4.3. Distribution of commercial fishery harvest locations, snow crab, May–November 2017 (derived from DFO commercial landings database, 2017).

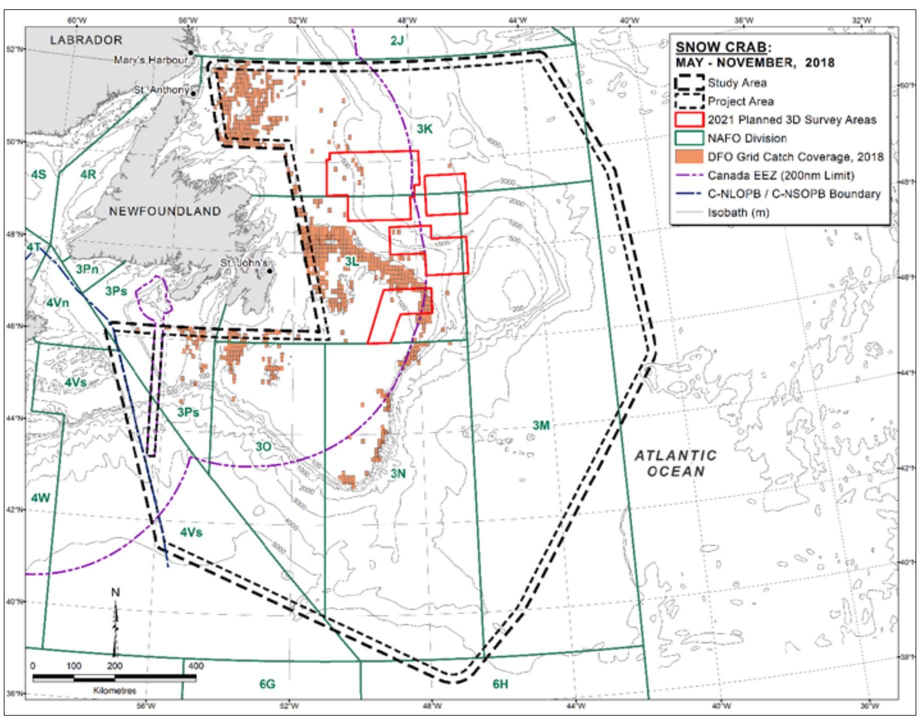


Figure 4.4. Distribution of commercial fishery harvest locations, snow crab, May–November 2018 (derived from DFO commercial landings database, 2018).

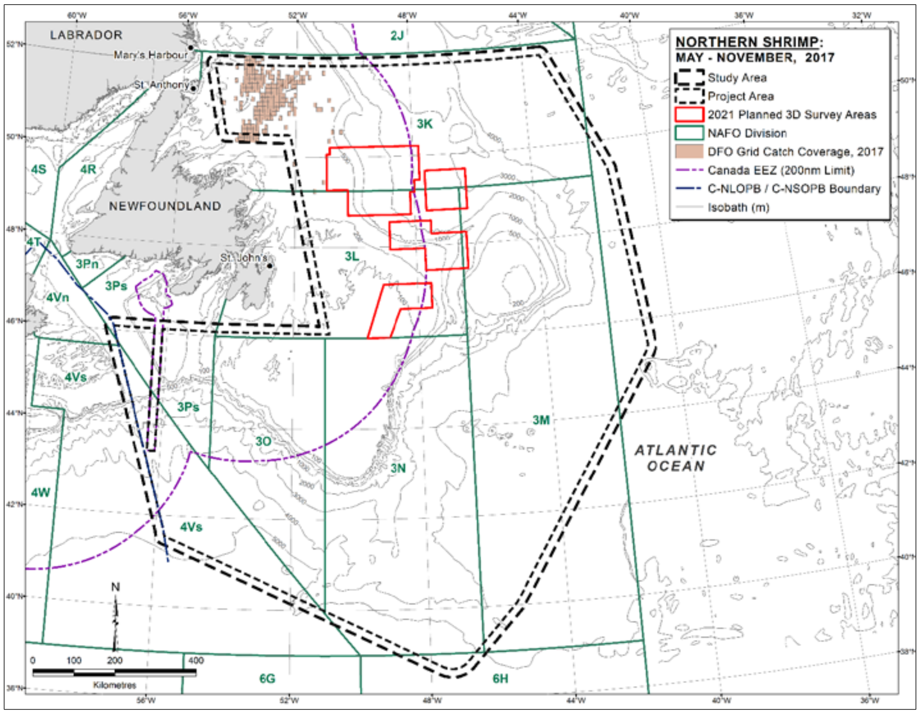


Figure 4.5. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2017 (derived from DFO commercial landings database, 2017).

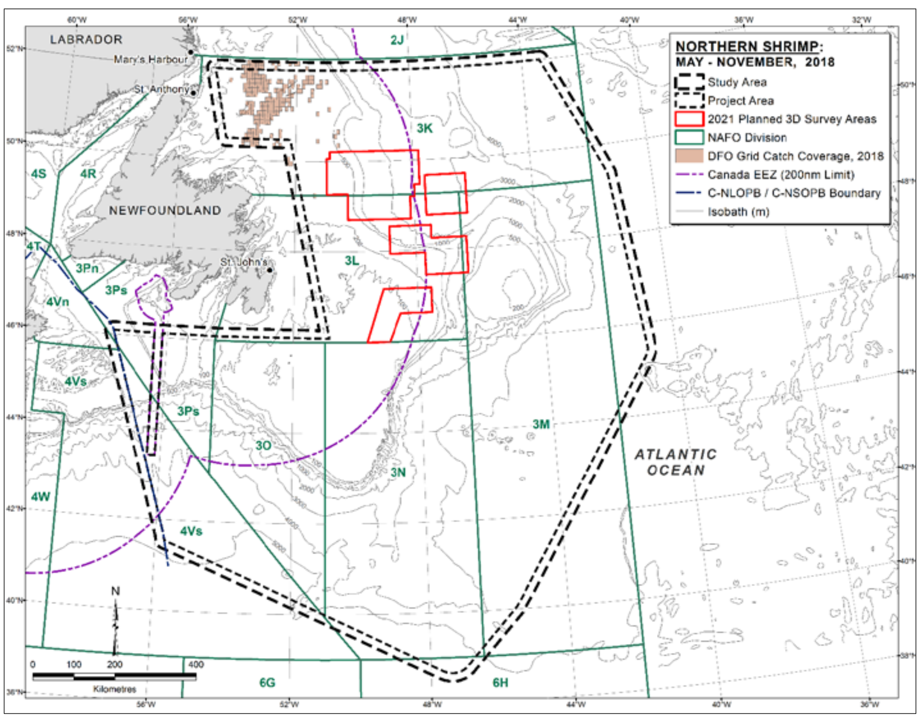


Figure 4.6. Distribution of commercial fishery harvest locations, northern shrimp, May–November 2018 (derived from DFO commercial landings database, 2018).

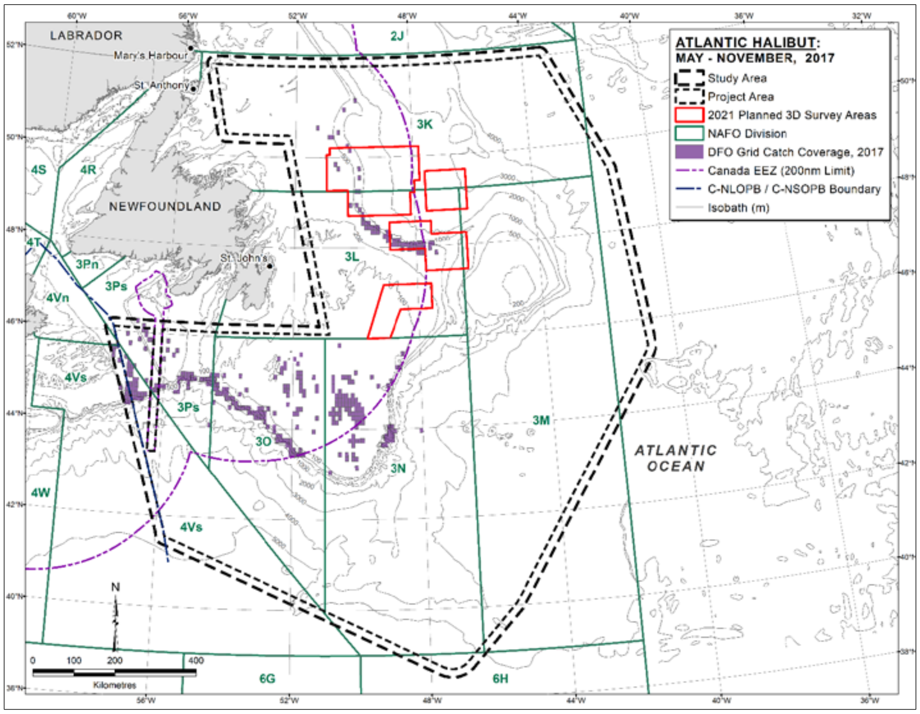


Figure 4.7. Distribution of commercial fishery harvest locations, Atlantic halibut, May–November 2017 (derived from DFO commercial landings database, 2017).

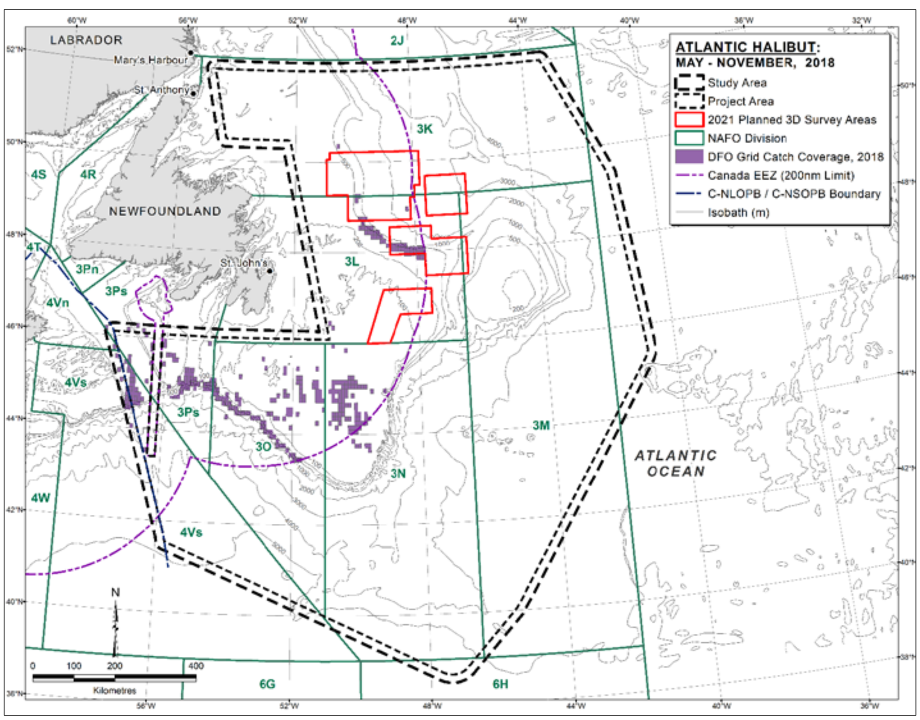


Figure 4.8. Distribution of commercial fishery harvest locations, Atlantic halibut, May–November 2018 (derived from DFO commercial landings database, 2018).

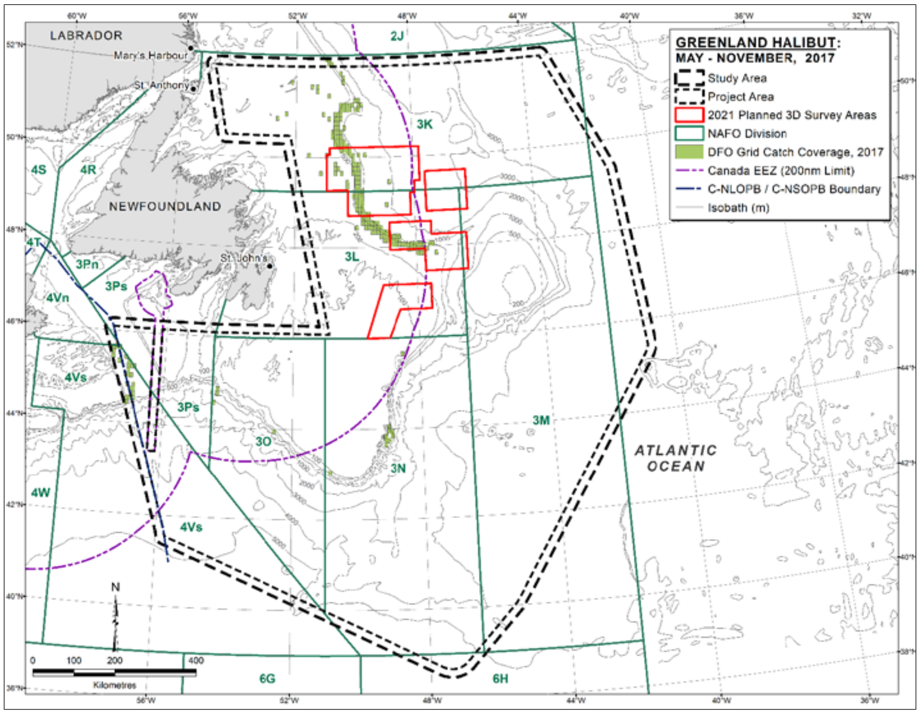


Figure 4.9. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2017 (derived from DFO commercial landings database, 2017).

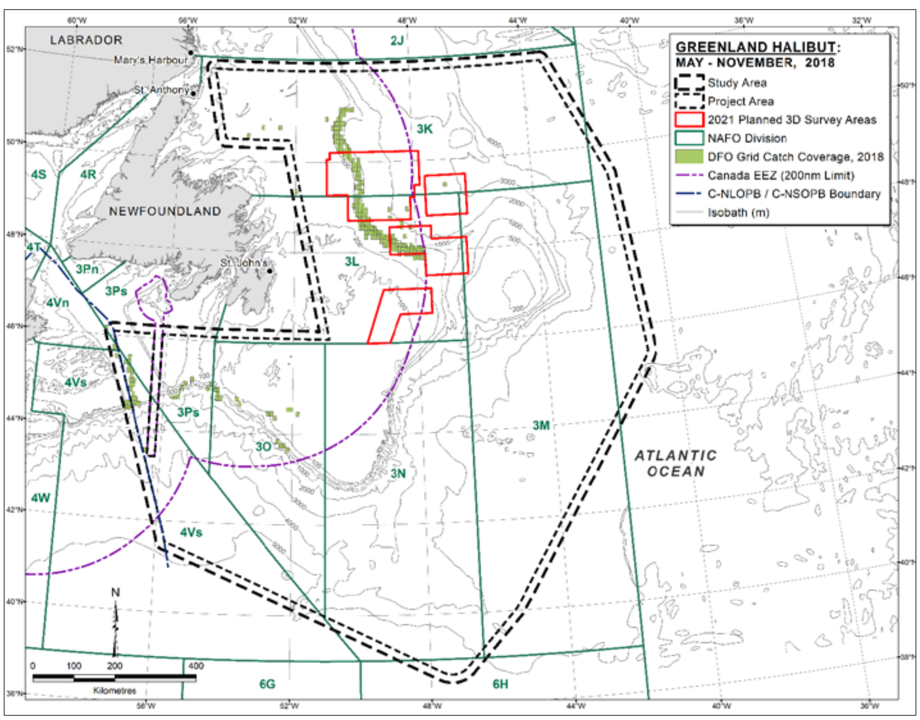


Figure 4.10. Distribution of commercial fishery harvest locations, Greenland halibut, May–November 2018 (derived from DFO commercial landings database, 2018).

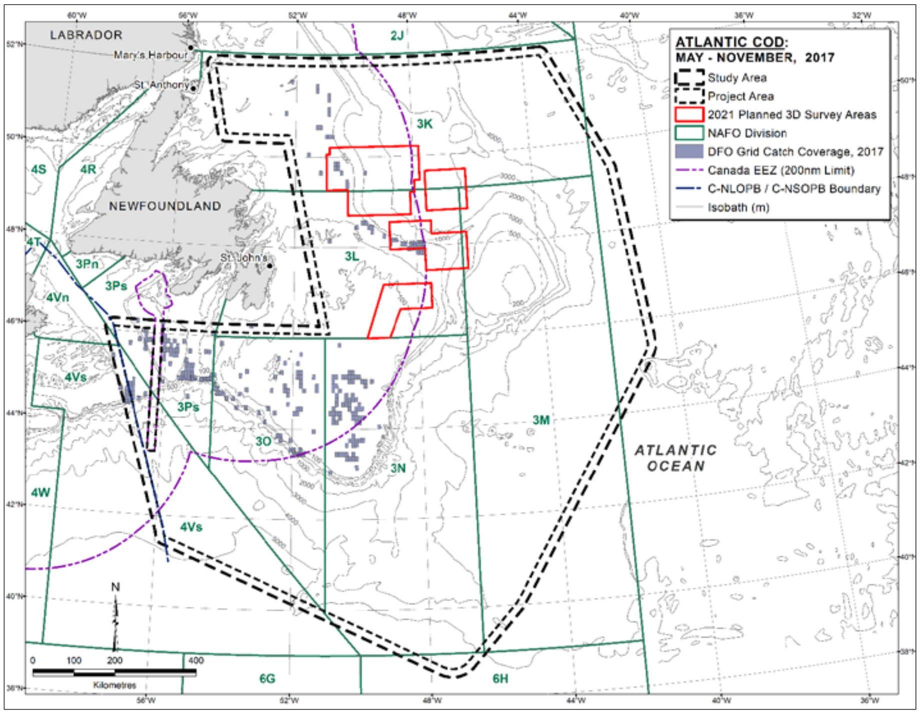


Figure 4.11. Distribution of commercial fishery harvest locations, Atlantic cod, May–November 2017 (derived from DFO commercial landings database, 2017).

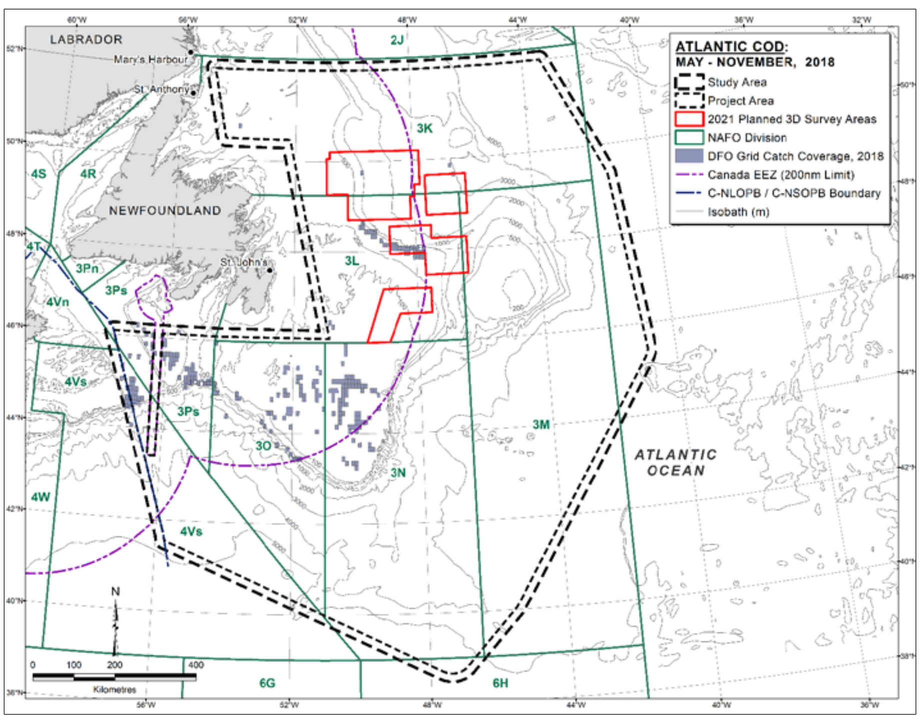


Figure 4.12. Distribution of commercial fishery harvest locations, Atlantic cod, May–November 2018 (derived from DFO commercial landings database, 2018).

Table 4.1. Commercial catch weights and values in the 2021 3D survey areas, May–November 2017 and 2018 (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, 2017/2018).

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															
2017															
Greenland Halibut	15	56	56	10	21	51	55	10	1	27	86	9	0	14	137
Redfish	8	16	10	1	13	13	7	2	0	1	22	6	0	6	35
Witch Flounder	6	12	5	0	10	5	7	1	0	0	14	0	0	9	23
Atlantic Halibut	1	3	7	0	2	1	6	2	0	0	2	0	0	9	11
Atlantic Cod	3	3	2	0	6	2	0	0	1	0	7	0	0	0	8
Roughhead Grenadier	1	3	1	2	1	3	1	2	0	2	1	4	0	0	7
Snow Crab	0	2	0	0	0	1	1	0	1	0	1	0	0	0	2
Total	34	95	81	13	53	76	77	17	3	30	133	19	0	38	223
2018															
Greenland Halibut	14	42	61	5	19	55	43	5	0	34	82	0	0	6	122
Redfish	1	3	6	2	1	4	5	2	0	2	6	0	0	4	12
Snow Crab	11	0	0	0	9	2	0	0	8	2	1	0	0	0	11
Atlantic Halibut	1	1	3	2	1	0	4	2	0	0	1	0	0	6	7
Witch Flounder	0	0	1	2	0	0	1	2	0	0	0	0	0	3	3
Atlantic Cod	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1
Capelin	0	0	1	0	1	0	0	0	0	0	1	0	0	0	1
Roughhead Grenadier	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1
Total	27	48	72	11	31	63	53	11	8	39	92	0	0	19	158
EL1158 & Cambriol															
2017															
Redfish	10	35	28	33	23	41	29	13	0	0	0	0	0	106	106
Atlantic Halibut	4	27	26	29	14	34	26	12	0	0	1	0	0	85	86

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'	
Greenland Halibut	3	24	20	26	11	27	25	10	0	0	7	0	0	66	73
Witch Flounder	0	10	8	13	3	12	10	6	0	0	0	0	0	31	31
American Plaice	4	6	7	9	6	7	9	4	0	0	0	0	0	26	26
Atlantic Cod	3	4	6	10	4	8	9	2	0	0	0	0	0	23	23
Snow Crab	3	3	0	1	1	3	3	0	0	0	5	2	0	0	7
Total	27	109	95	121	62	132	111	47	0	0	13	2	0	337	352
2018															
Greenland Halibut	14	23	38	31	23	29	46	8	0	6	20	2	0	78	106
Redfish	7	13	33	31	11	25	40	8	0	0	0	0	0	84	84
Atlantic Halibut	4	12	33	31	8	24	40	8	0	0	0	0	0	80	80
Witch Flounder	4	7	15	20	6	11	24	5	0	0	0	0	0	46	46
Atlantic Cod	1	7	12	15	4	11	18	2	0	0	0	0	0	35	35
American Plaice	2	3	1	4	4	2	4	0	0	0	0	0	0	10	10
Snow Crab	2	2	1	0	1	2	2	0	0	0	4	1	0	0	5
Total	34	67	133	132	57	104	174	31	0	6	24	3	0	333	366
Jeanne d'Arc															
2017															
Snow Crab	12	33	37	2	5	19	34	26	0	0	62	22	0	0	84
Total	12	33	37	2	5	19	34	26	0	0	62	22	0	0	84
2018															
Snow Crab	12	27	35	1	7	16	34	18	0	0	56	19	0	0	75
Arctic Surfclam	0	1	2	2	1	2	0	2	0	0	0	0	0	5	5
Propeller Clam	0	1	2	2	1	2	0	2	0	0	0	0	0	5	5
Cockle	0	0	2	2	0	2	0	2	0	0	0	0	0	4	4
Total	12	29	41	7	9	22	34	24	0	0	56	19	0	14	89
EL1149															

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’	
2018															
Greenland Halibut	0	-	-	-	1	-	-	-	0	0	1	0	0	0	1
Atlantic Cod	1	-	-	-	1	-	-	-	0	1	0	0	0	0	1
Total	1	-	-	-	2	-	-	-	0	1	1	0	0	0	2

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). 2017 quartile ranges: 1 = 0 – 1,912 kg; 2 = 1,913 – 8,828 kg; 3 = 8,829 – 35,206 kg; 4 = ≥35,207 kg. 2018 quartile ranges: 1 = 0 – 2,045 kg; 2 = 2,046 – 8,549 kg; 3 = 8,550 – 33,818 kg; 4 = ≥33,818 kg.

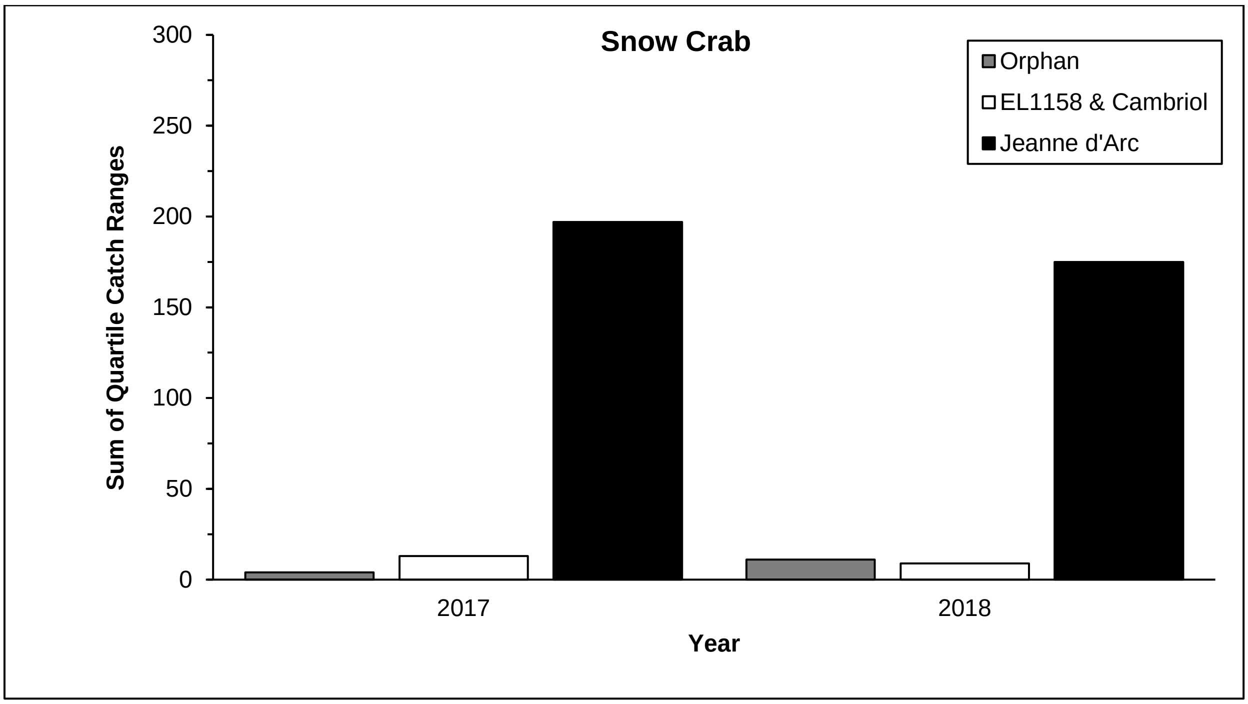
[b] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch value in a given year, all species combined). 2017 quartile ranges: 1 = $0 – $9,811; 2 = $9,812 – $43,514; 3 = $43,515 – $166,502; 4 = ≥$166,503. 2018 quartile ranges: 1 = $0 – $10,353; 2 = $10,354 – $45,610; 3 = $45,611 – $166,300; 4 = ≥$166,301.

[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.

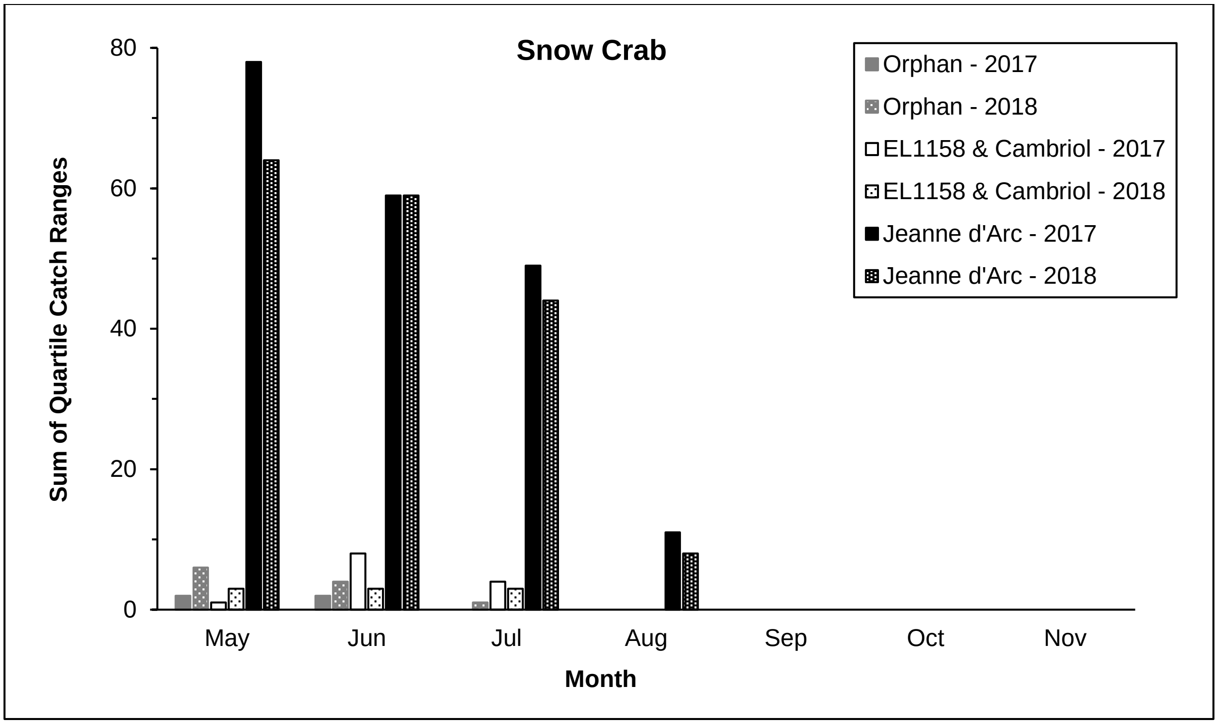
4.2.1.1 Snow Crab

During May−November 2017–2018, snow crab catches occurred in the Orphan Basin, EL1158 and Cambriol, and Jeanne d'Arc 3D survey areas, mainly in water depths between 100 m and 200 m (see Figures 4.3−4.4). The 2021 snow crab TAC in NAFO Div. 3K increased by 16% to 7,454 t from 6,412 t in 2020 and increased in Div. 3LNO by 34% to 23,648 t from 17, 587 t in 2020 (DFO 2021b). During May−November, snow crab harvest within the EL1158 and Cambriol and Jeanne d'Arc 3D survey areas slightly decreased from 2017 to 2018 and increased in the Orphan Basin 3D survey area (Figure 4.13). Most snow crab catches occurred during May–July in 2017 and 2018 (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 2017–2018 for snow crab in the Orphan Basin, EL1158 & Cambriol, and Jeanne d'Arc 3D survey areas (derived from DFO commercial landings database, 2017–2018).



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).

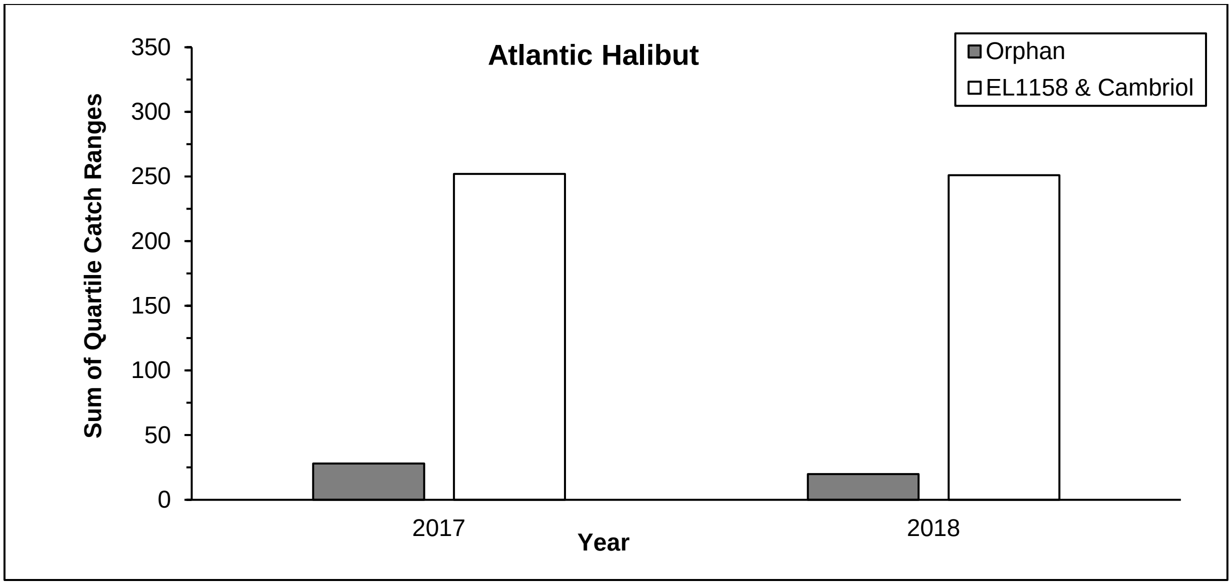
Figure 4.14. Total monthly catch weight quartile codes, May–November 2017–2018 for snow crab in the Orphan Basin, EL1158 & Cambriol, and Jeanne d'Arc 3D survey areas (derived from DFO commercial landings database, 2017–2018).

4.2.1.2 Northern Shrimp

During May–November 2017–2018, there were no harvest locations within the 3D survey areas (see Figures 4.5 and 4.6).

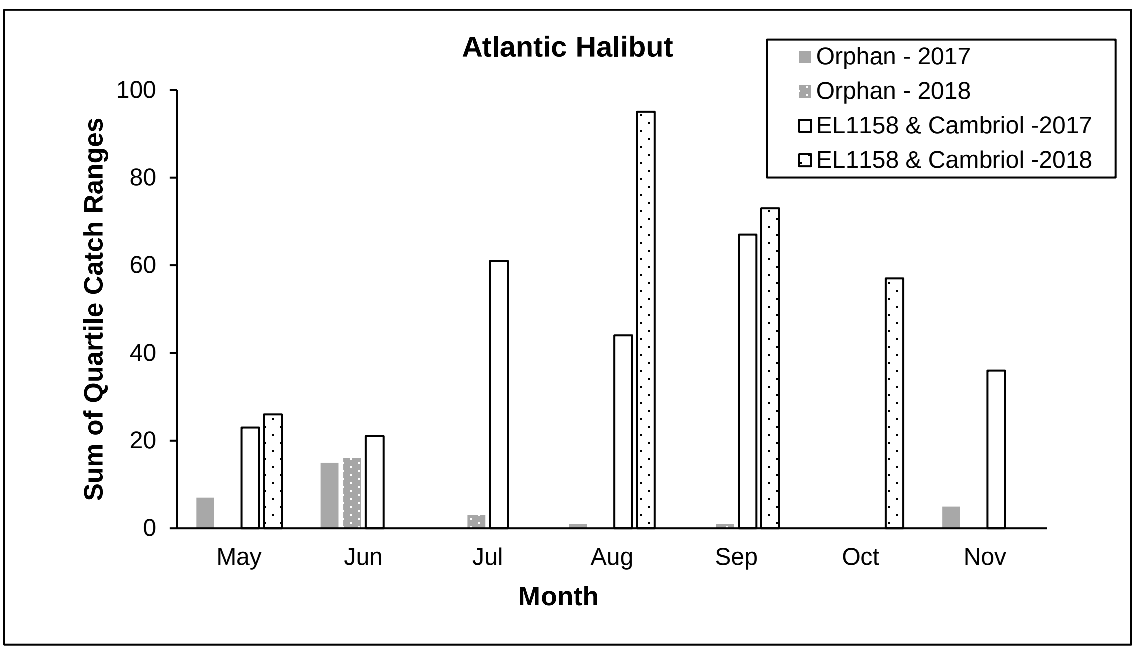
4.2.1.3 Atlantic Halibut

During May–November 2017 and 2018, harvest locations for Atlantic halibut occurred in the central portions of the Orphan Basin and EL1158 and Cambriol 3D survey areas, between the 500 and 1000-m isobaths (see Figures 4.7−4.8). No TACs have been posted on the DFO website for the Study Area since the 2014/2015 limit of 2,738 t in Div. 3NOPs4VWX+5 (includes the South Bank 2020 survey area) (DFO 2021b). Harvests within the Orphan Basin and EL1158 and Cambriol 3D survey areas were similar during 2017 and 2018 (Figure 4.15). Harvesting occurred throughout May−August with peak catches in the EL1158 and Cambriol 3D survey areas in August and September (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 2017–2018 for Atlantic halibut in the Orphan Basin and EL1158 & Cambriol 3D survey areas (derived from DFO commercial landings database, 2017–2018).

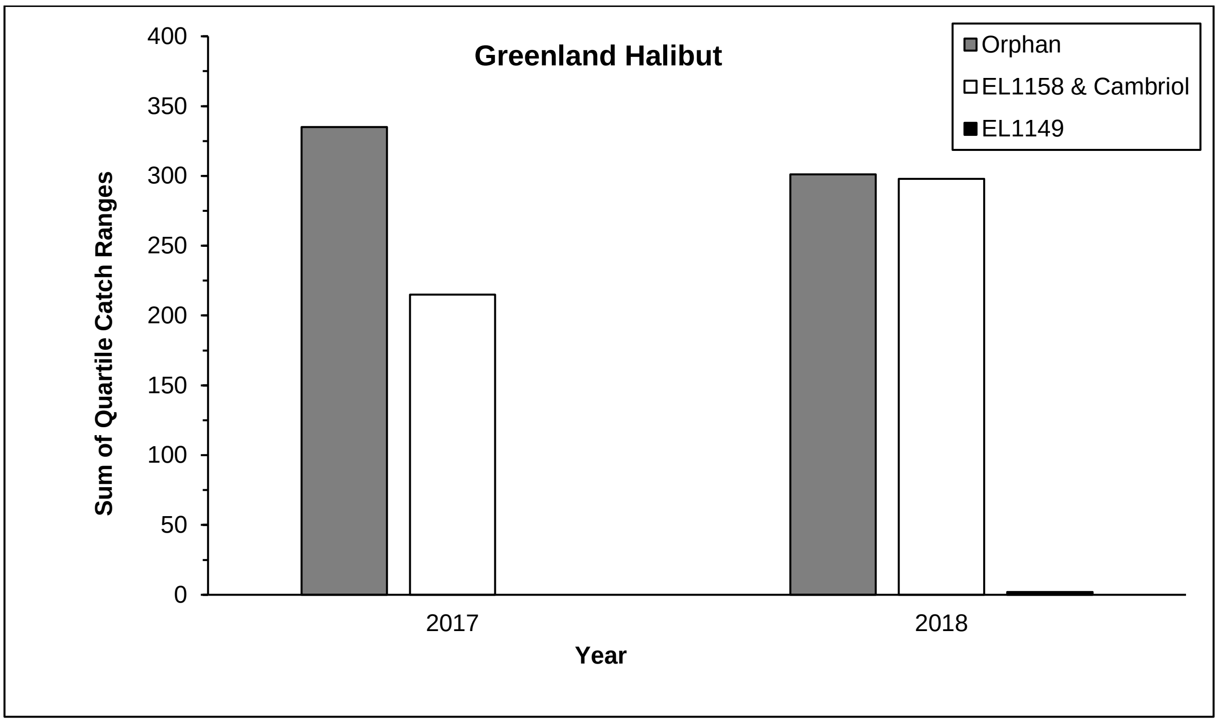


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.16. Total monthly catch weight quartile codes, May–November 2017–2018 for Atlantic halibut in the Orphan Basin and EL1158 & Cambriol 3D survey areas (derived from DFO commercial landings database, 2017–2018).

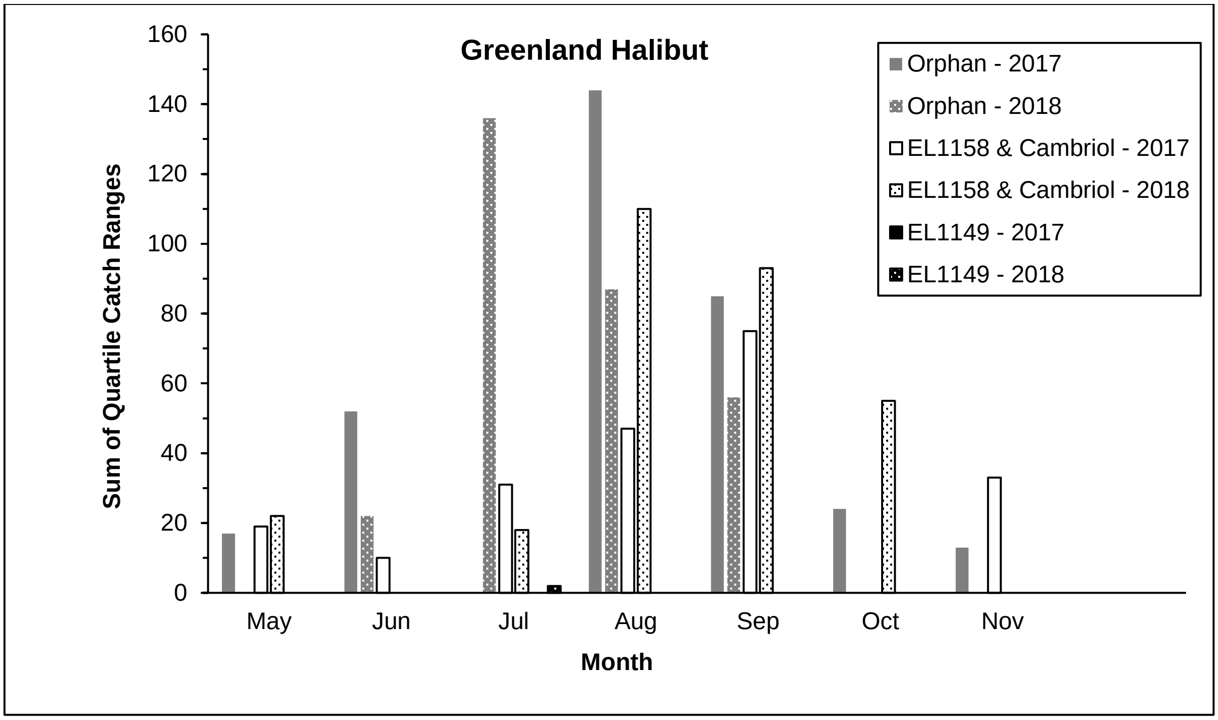
4.2.1.4 Greenland Halibut

During May–November 2017 and 2018, harvest locations for Greenland halibut only occurred in the Orphan Basin and EL1158 and Cambriol 3D survey areas, mainly between the 500 and 1000-m isobaths within the central portion of the survey area (see Figures 4.9−4.10). The TAC for Greenland halibut in NAFO Div. 3LMNO (which includes all survey areas) was set at 12,225 t for 2021, down slightly from 12,542 t in 2020 (NAFO 2021). Catches within the Orphan Basin 3D survey area decreased from 2017 to 2018 and increased in the EL1158 and Cambriol 3D survey area. Catches mainly occurred during the summer (Figures 4.17−4.18).



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

Figure 4.17. Total annual catch weight quartile codes, May–November 2017–2018 for Greenland halibut in the Orphan Basin, EL1158 & Cambriol, and EL1149 3D survey areas (derived from DFO commercial landings database, 2017–2018).

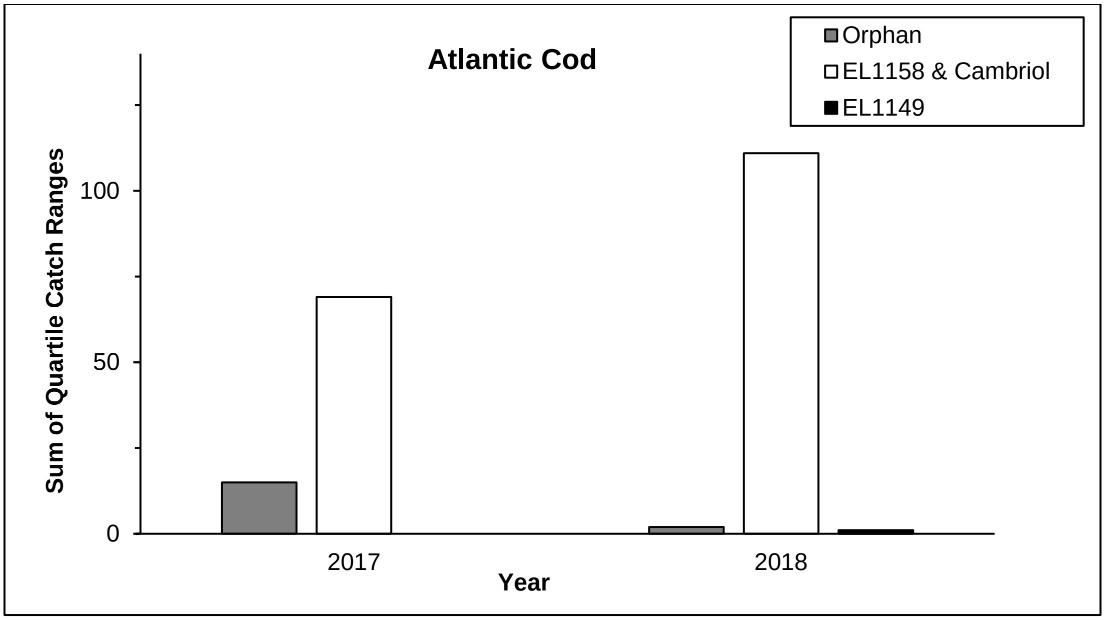


Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.18. Total monthly catch weight quartile codes, May–November 2017–2018 for Greenland halibut in the Orphan Basin, EL1158 & Cambriol, and EL1149 3D survey areas (derived from DFO commercial landings database, 2017–2018).

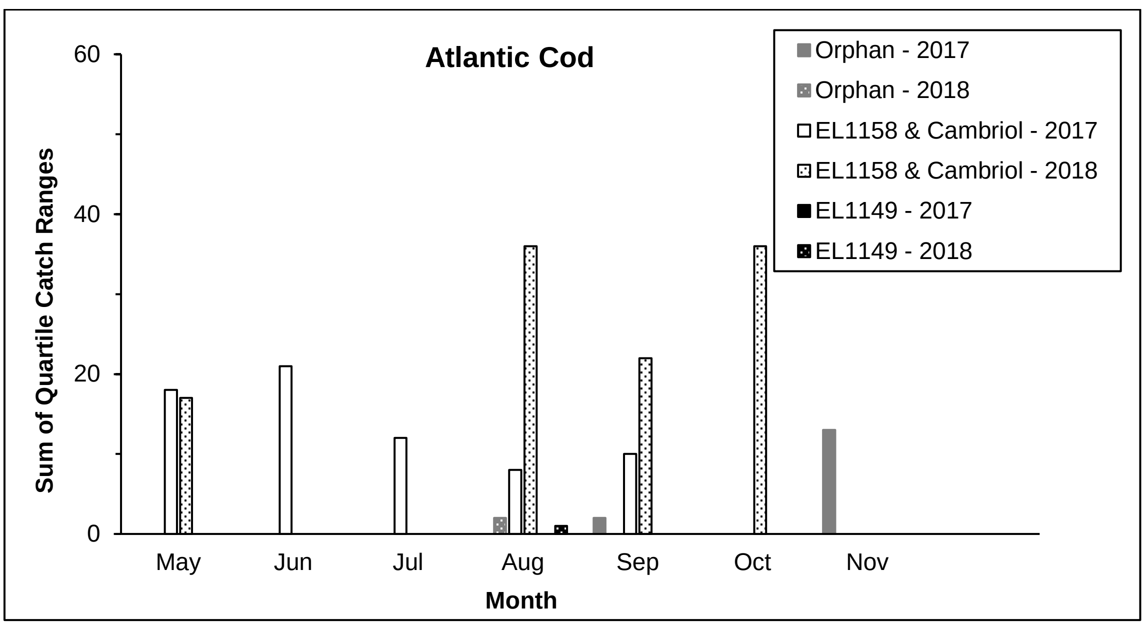
4.2.1.5 Atlantic Cod

During May−November 2017–2018, Atlantic cod were mainly caught in water depths between the 200–500 m and 500–1,000 m isobaths within the Orphan Basin, EL1158 and Cambriol, and EL1149 3D survey areas (see Figures 4.11−4.12). The fishing ban for Atlantic cod has remained in place for Div. 3LNO (NAFO 2021). The 2021 TAC for Div. 3Ps has not yet been released, but it was set at 2,691 t for 2020 (DFO 2021b). The TAC for Atlantic cod in Div. 3M decreased from 8,531 t in 2020 to 1,500 t in 2021 (NAFO 2021). During May−November 2017–2018, Atlantic cod catches in the Orphan Basin 3D survey area decreased from 2017 to 2018 and increased in the EL1158 and Cambriol 3D survey area (Figures 4.19−4.20).



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 2017–2018 for Atlantic cod in the Orphan Basin, EL1158 & Cambriol, and EL1149 3D survey areas (derived from DFO commercial landings database, 2017–2018).



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 2017–2018 for Atlantic cod in the Orphan Basin, EL1158 & Cambriol, and EL1149 3D survey areas (derived from DFO commercial landings database, 2017–2018).

4.2.1.6 Other Notable Commercial Species

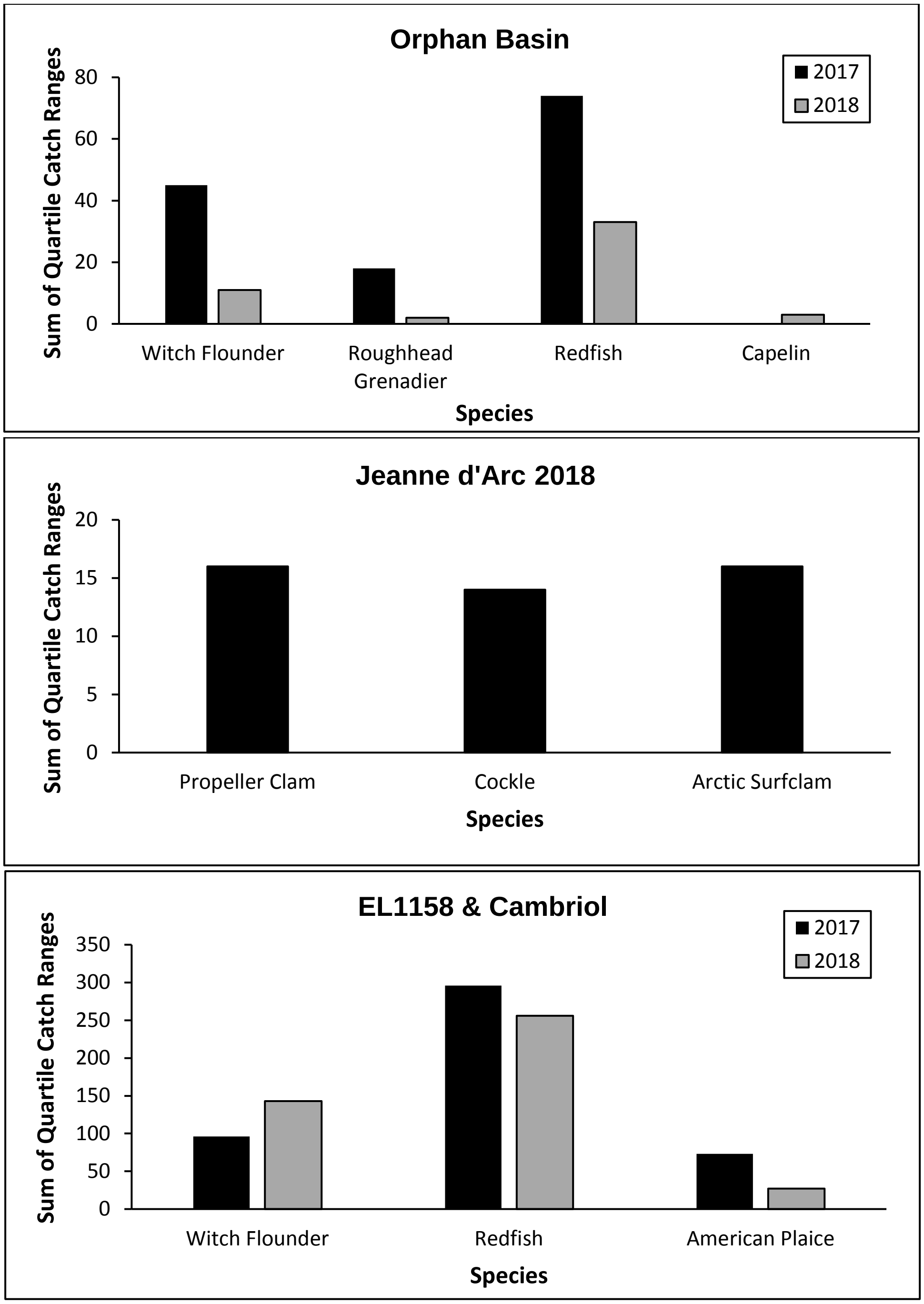
As noted in the EA (see Tables 4.3–4.8 *in* LGL 2018a) and 2019/2020 EA Updates (see Table 4.1 and Section 4.2.1.6 *in* LGL 2019; 2020b), redfish, yellowtail flounder, white hake, and American plaice are also important commercial species in the Study Area. Redfish, yellowtail flounder, and American plaice 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 and American plaice can occur within the western portion of the Study Area, within and/or near the Orphan Basin and EL1158 and Cambriol 3D survey areas. NAFO sets annual TAC limits for yellowtail flounder, while both DFO and NAFO manage the fisheries for redfish, white hake, and American plaice.

Redfish DFO Units 1 (Div. 4RST and 3PN+4Vn, during 1 January−31 May) and 2 (i.e., Div. 3Ps, 4Vs, a portion of 4W, and 3Pn+4Vn, during 1 June–31 December) occur far west of the 3D survey areas (DFO 2021b). The redfish TAC in Div. 3LN (includes the Jeanne d'Arc, EL1158 and Cambriol, and portions of the Orphan Basin and EL1149 3D survey areas) remained unchanged at 18,100 t in 2021 (NAFO 2021). The TAC increased in Div. 3M (portions of the EL1149 and EL1158 and Cambriol 3D survey areas) from 3,590 t to 8,448 t in 2020 and 2021, respectively (NAFO 2021). There have been no changes in TAC in Div. 3O (no 3D survey areas) or Sub-Area 2 and Div. 1F+3K (portions of the Orphan Basin and EL1149 3D survey areas) since the EA (LGL 2018a), with a limit of 20,000 t in 3O and a fishing ban in place for Sub-Area 2/1F+3K (NAFO 2021). During May−November 2016 and 2017, redfish harvest locations occurred in the Orphan Basin and EL1158 and Cambriol 3D survey areas where they decreased from 2017 to 2018 (Figures 4.21 and 4.22).

The TAC for yellowtail flounder in Div. 3LNO (includes the Jeanne d'Arc, EL1158 and Cambriol, and portions of the Orphan Basin and EL1149 3D survey areas) has remained unchanged since the EA (LGL 2018a), set at 17,000 t (NAFO 2021). There were no yellowtail flounder commercial harvest locations in the 3D survey areas during May−November 2017 and 2018.

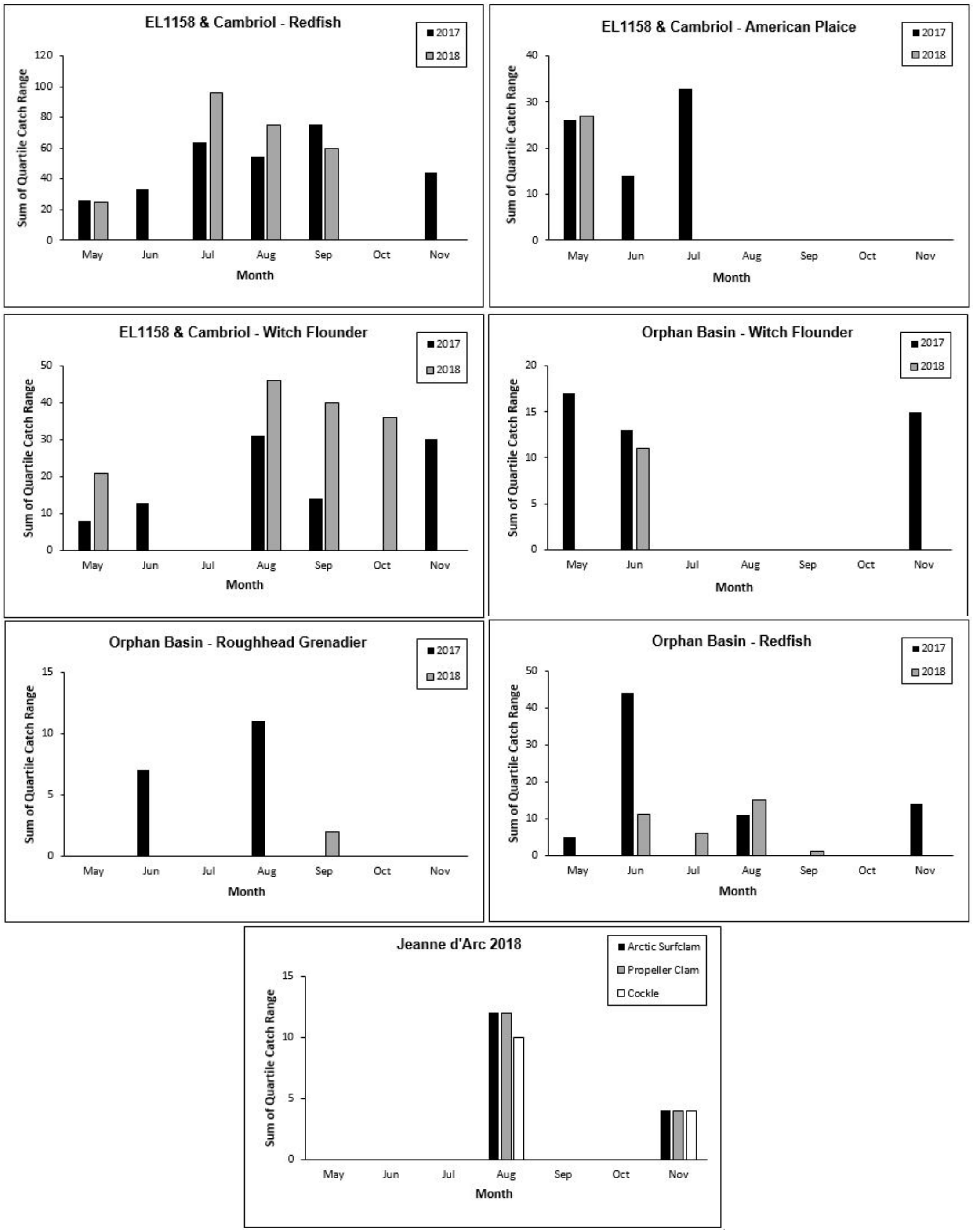
There have been no updates to the white hake TAC in Div. 3Ps and it remains at 500 t for the 2020/2021 season (DFO 2021b). There were no white hake commercial harvest locations in the 3D survey areas during May−November 2017 and 2018.

A fishing moratorium remains in effect for American plaice in Div. 3Ps (west of the 3D survey areas), 3LNO (includes the Jeanne d'Arc, EL1158 and Cambriol, and portions of the Orphan Basin and EL1149 3D survey areas), and 3M (portions of the EL1149 and EL1158 and Cambriol 3D survey areas) (DFO 2021b; NAFO 2021). During May−November 2017 to 2018, American plaice commercial harvest locations occurred in the EL1158 and Cambriol survey area and decreased from 2017 to 2018 (Figures 4.21 and 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 2017–2018 for American plaice, redfish, roughhead grenadier, and witch flounder in the Orphan Basin 3D survey area (top), May−November 2018 for cockle, propeller clam, and Arctic surfclam in the Jeanne d'Arc 3D survey area (middle), and May–November 2017–2018 for American plaice, redfish, and witch flounder in the EL1158 & Cambriol 3D survey area (bottom) (derived from DFO commercial landings database, 2017–2018).



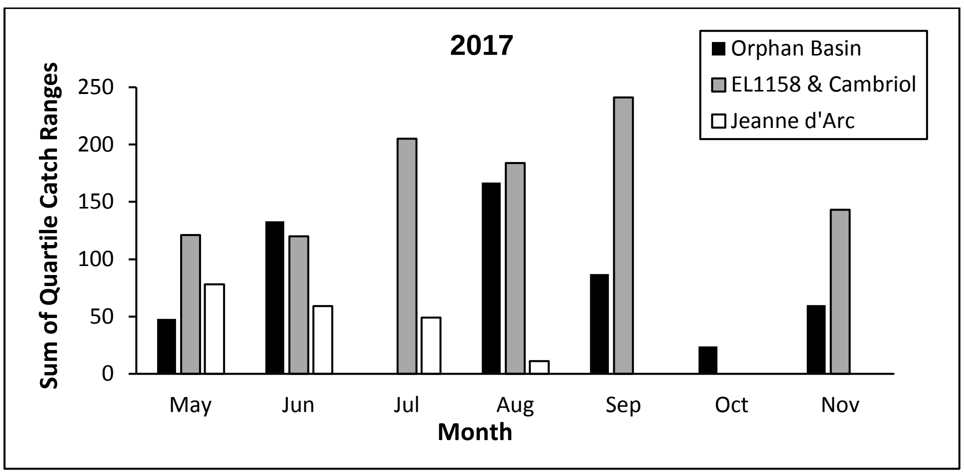
Note: Sum of quartile catch ranges is the summation of catch weight quartile ranges (i.e., 1–4) for all species; the greater the sum of quartile range counts, the greater the catch weight for a given month).

Figure 4.22. Total monthly catch weight quartile codes, May–November 2017–2018 for redfish, American plaice, and witch flounder in the EL1158 and Cambriol 3D survey area, witch flounder, roughhead grenadier, and redfish in the orphan Basin 3D survey area, and May−November 2018 for cockle, propeller clam, and Arctic surfclam in the Jeanne d'Arc 3D survey area (derived from DFO commercial landings database, 2017–2018).

During May−November 2018, there were 16 catch locations for Arctic surfclam, 16 locations for propeller clam, and 14 locations for cockle within the Jeanne d'Arc 3D survey area, in water depths <500 m (see Table 4.1; Figure 4.21). These species were not caught in any of the 3D survey areas during May−November 2017. All catches of these species occurred during August and November of 2018 (see Figure 4.22). Arctic surfclam and propeller clams were described in Section 4.1.3.1 of the 2019 EA Update (LGL 2019). Cockles were described in Section 4.2.2.1 of the EA (LGL 2018a). The TAC on the Grand Banks for Arctic surfclams has been set at 14,756 t in 2021. No TAC values are set for propeller clams or cockles within the Study Area by DFO or NAFO (DFO 2021b; NAFO 2021).

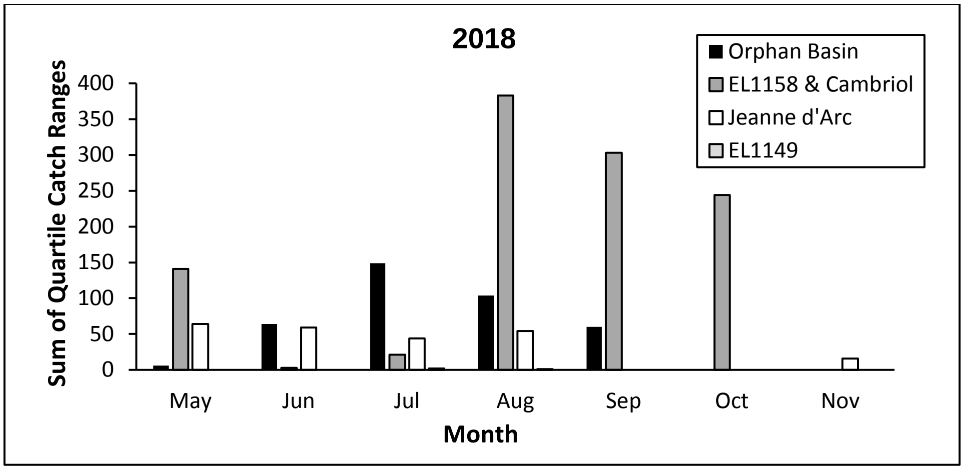
4.2.1.7 Timing and Gear Types

In 2017 and 2018 harvesting in the EL1158 and Cambriol and Orphan Basin 3D survey areas occurred throughout the May–September period (Figures 4.23–4.24 below). Gear types used in the Study Area during 2017 and 2018 were typical of those used during previous years (see Table 4.10 *in* LGL 2018a, Table 4.7 *in* LGL 2019, Tables 4.2 *in* LGL 2020b, and Table 4.2 below). The May–November 2017 and 2018 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, EL1158 and Cambriol, and the Jeanne d'Arc 3D survey areas, for all species combined during May–November 2017 (derived from DFO commercial landings database, 2017).



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

Figure 4.24. Total monthly catch weight quartile codes in the Orphan Basin, EL1158 and Cambriol, Jeanne d'Arc, and EL1149 3D survey areas, for all species combined during May–November 2018 (derived from DFO commercial landings database, 2018).

Table 4.2. Summary of gear type used and timing of the commercial fishery in the 3D survey areas, May–November 2017–2018 (derived from DFO commercial landings database, 2017/2018).

Species	Harvest Month														Gear Type										
	2017							2018							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	■	■		■			■		■	■	■	■				■			■						
Witch Flounder	■	■					■		■										■						
Atlantic Halibut	■	■		■			■		■	■		■							■						
Snow Crab	■	■						■	■	■					■										
Atlantic Cod					■		■				■					■			■						
Roughhead Grenadier		■		■								■				■			■						
Capelin										■															■
EL1158 & Cambriol																									
Redfish	■	■	■	■	■		■	■			■	■	■						■						
Greenland Halibut	■	■	■	■	■		■	■	■	■	■	■	■			■			■						
Atlantic Halibut	■	■	■	■	■		■	■			■	■	■			■			■						
Witch Flounder	■	■		■	■		■	■			■	■	■						■						
Atlantic Cod	■	■	■	■	■			■			■	■	■						■						
American Plaice	■	■	■					■											■						
Snow Crab	■	■	■					■	■	■					■										
Jeanne d'Arc																									
Snow Crab	■	■	■	■				■	■	■	■				■										
Arctic Surfclam											■			■						■					
Propeller Clam											■			■						■					
Cockle											■			■						■					
EL1149																									
Greenland Halibut			■													■									
Atlantic Cod											■					■									

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.

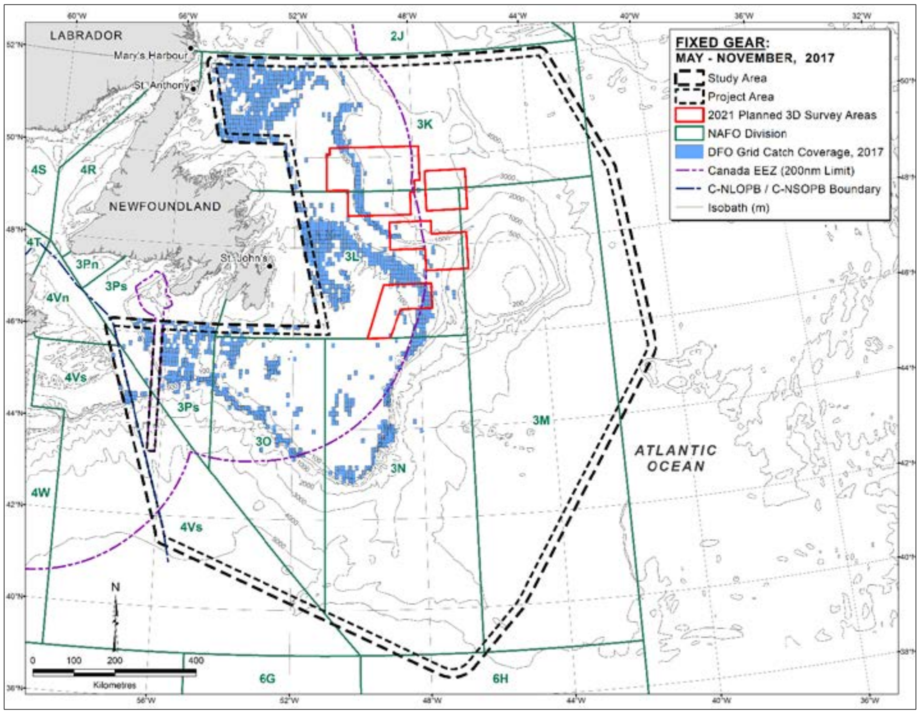


Figure 4.25. Harvest locations for fixed gear, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

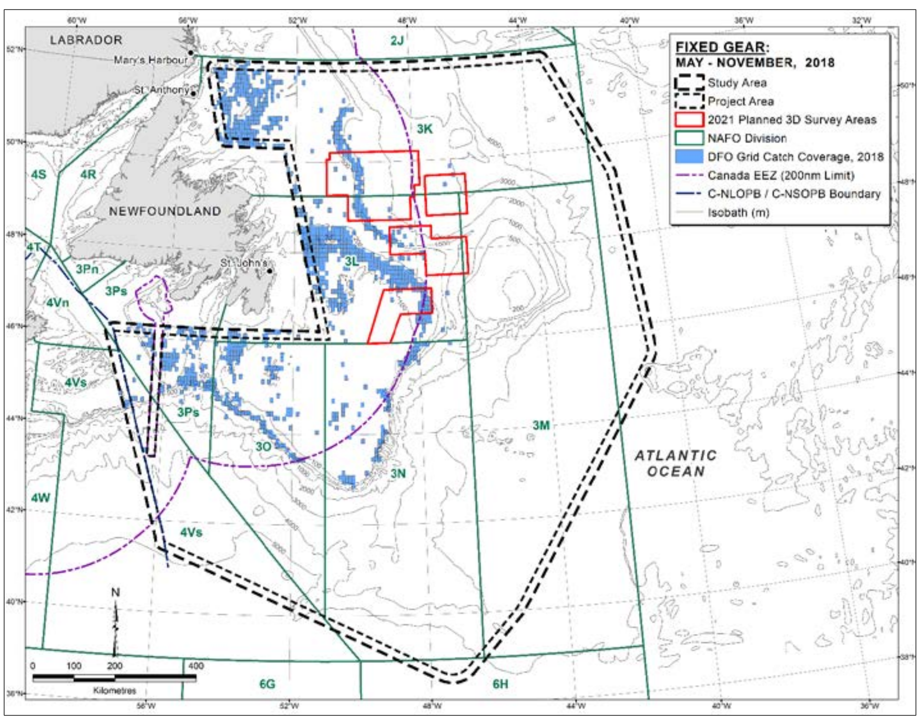


Figure 4.26. Harvest locations for fixed gear, all species, May–November 2018 (derived from DFO commercial landings database, 2018).

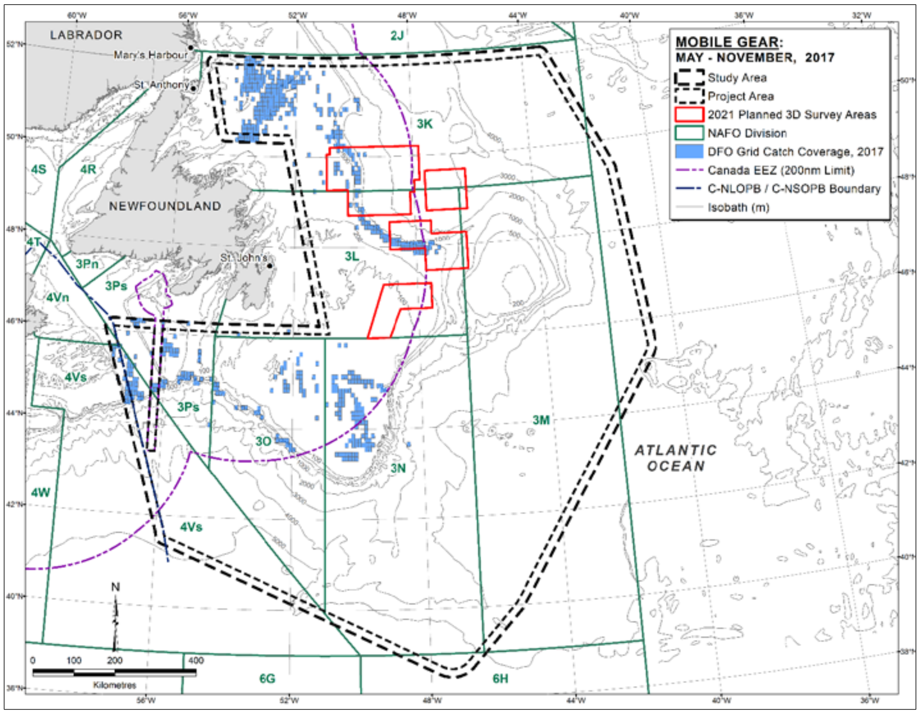


Figure 4.27. Harvest locations for mobile gear, all species, May–November 2017 (derived from DFO commercial landings database, 2017).

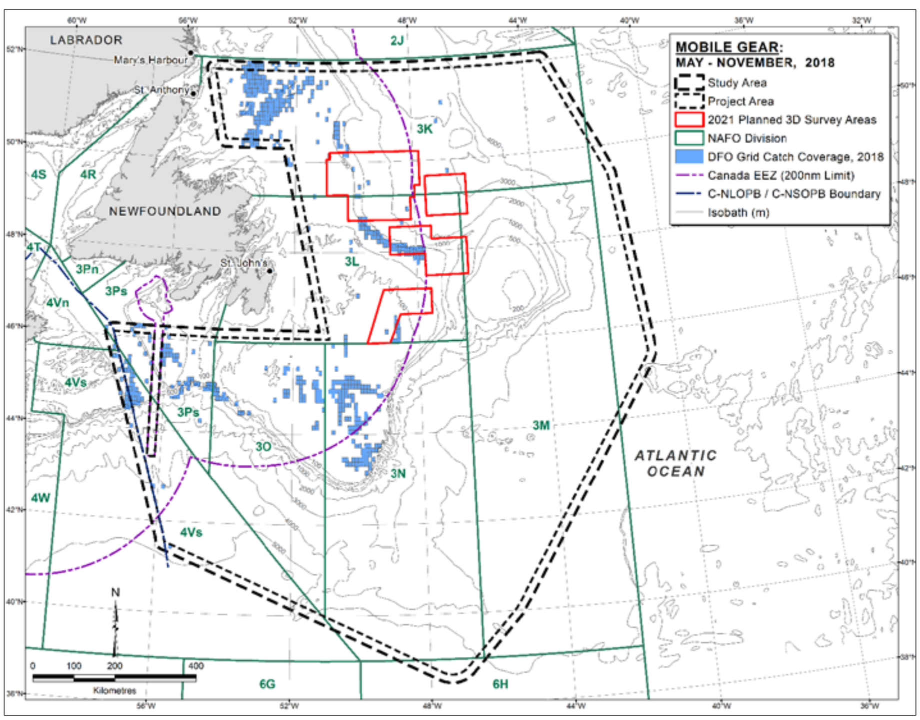


Figure 4.28. Harvest locations for mobile gear, all species, May–November 2018 (derived from DFO commercial landings database, 2018).

4.2.2 Indigenous Fisheries

The most recent (2021) Indigenous communal-commercial licences and allocations for NL-based groups and organizations providing commercial fisheries access within the Study Area for the 2020–2021 season are provided in Table 4.3. Indigenous commercial fisheries catches are included, but not differentiated, in the DFO commercial landings database, summarized above (see subsection 4.2.1) (G. Rowe, Resource Management and Indigenous Fisheries DFO, pers. comm., 26 April 2021). Updates from the 2019–2020 database (LGL 2020b) are shown in bold in Table 4.3.

Table 4.3. Indigenous communal-commercial licences and allocations for NL-based groups and organizations within the Study Area, 2020–2021. Bold font indicates updates from the 2019–2020 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 (*Clupea harrengus*)	FA 3-8
	Mackerel (*Scomber scombrus*)	FA **1**-11
	Shrimp	**FA 4**
	Bluefin Tuna (*Thunnus thynnus*)	Div. 3LNOP-**P.H.**
Innu Nation: Ueushuk Fisheries	Shrimp	FA 6-7
	Cod	Div. 3KLNO (M)
		Div. 3Ps (EA)
		Div. 4VnVs (B)
	Haddock (*Melanogrammus aeglefinus*	Div. 3LNOPs, 4V (M)
	Pollock (*Pollachius* sp.)	Div. 3Ps (M)
	American Plaice	Div. 3LNO (M)
	Witch Flounder (*Glyptocephalus cynoglossus*)	Div. 3KL (M)
	Greenland Halibut	Div. 3KLMNO (EA)
	Atlantic Halibut	Div. 3NOPs, 4V (EA, SQ, C)
	White Hake	Div. 3NOPs (C/B)
		Div. 4V (B)
	Skates	Div. 3LNOPs (C)

Group/Organization	Licence	Quota Area (Fishing Area [FA]/NAFO Division [Div.])
NunatuKavut Community Council (NCC)	Groundfish	Div. **2GHJ,** 3KL, **4RS**
	Seal	FA 5-8, 33
	Shrimp	FA **5-**6
	Scallop	**FA 1-2**
	Capelin	**FA 2**
	Herring	**FA 1**
	Snow Crab	**FA 2**
	Toad Crab	**FA 2**
	Whelk	**FA 2J**
	Seal	**FA 4-33**
Nunatsiavut Government (NG)	Groundfish	Div. **2GHJ, 3KL, 3Pn, 3Ps**
	Snow crab	**FA 1-2, 2H (exploratory)**
	Scallop	**FA 1**
	Capelin	**FA 2**
	Arctic char	**Cape Rouge to Cape Chidley, Labrador Coast**
	Seal	FA **4-**33
	Greenland Halibut	Div. **2**, 3KLMNO, **0B**
NG: Pikalujak Fisheries Ltd. (50/50 partnership NG/Ocean Prawns Canada Ltd.)	Shrimp	FA **0-**6
Miawpukek First Nation (MFN)	Capelin	FA 3-11
	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 (*Buccinum* sp.)	Div. 3Ps

Group/Organization	Licence	Quota Area (Fishing Area [FA]/NAFO Division [Div.])
Qalipu First Nation (QFN)	Bait	Lobster FA 3, 4B
	Capelin	FA **1-14**
	Capelin (mobile)	FA **1-14**
	Groundfish	Div. **3KL, 2J, 3Pn, 4RST, 2GHJ**
	Herring	FA **13-14**
	Herring (mobile)	FA 3-8
	Lobster (*Homarus americanus*)	FA 3, **13A, 13B**
	Mackerel	FA 3-4, **12-14**
	Mackerel (mobile)	FA **1-**11, **12-14**
	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 Cucumber	Div. 3LNO
	Snow Crab	FA 3B, 4, **12, 12C, 12E and 12F**
	Squid	FA **3,** 4, **13**
	Whelk	**FA 13,** Div. 3K
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

Source: G. Rowe, Resource Management and Indigenous Fisheries, DFO, pers. comm., 26 April 2021.
Notes: Quota Area: M = moratorium; EA = enterprise allocation; SQ = science quota (use of fish); C = competitive/competitive reserve; B = bycatch.

4.2.3 Recreational Fisheries

Recreational fisheries in NL are described in Section 4.3.4.4 *in* C-NLOPB (2014), Section 3.3.3 *in* C-NLOPB (2010), Section 4.3.5 *in* LGL (2015b), Section 4.2.3 *in* LGL (2016), Section 4.3.5 *in* LGL (2018a), and Section 4.2.3 *in* LGL (2019; 2020b). There have been no changes in the NAFO Div. in which the NL recreational groundfish and scallop fisheries occur, including 2GHJ, 3KLPsPn, and 4R but excluding the Eastport, Gilbert Bay, and Laurentian Channel Marine Protected Areas (MPAs), of which Div. 3KLPs overlap with the Study Area.

The 2020 NL recreational groundfish fishery was scheduled to be open for 39 days (i.e., during 4 July–4 October), which differed slightly from the 2019 season (i.e., 29 June–29 September) (DFO 2021b). As in the 2019 season, there were still no requirement for fishing licenses or tags during 2020 (DFO 2021b).

The DFO Atlantic salmon *Implementation Plan 2019 to 2021* is still in place which allows the retention of one salmon on Class 2 rivers and two on Class 4/6 and unclassified rivers (DFO 2021e). The 2020 Atlantic salmon season was variably open from June–September or October, depending on the fishing zone (DFO 2021e). The 2019−2023 NL recreational trout season will be open from February or March–September, with various retention limits depending on species (DFO 2021e).

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 2021 3D survey areas.

4.2.4 Aquaculture

Aquaculture operations in NL are described in Section 4.3.4.3 *in* C-NLOPB (2014) and Section 3.3.2 *in* C-NLOPB (2010). All aquaculture sites within NL have remained coastally-based. There are no approved aquaculture sites within the Study Area (FLR 2021; R.J. Keel, Manager of Aquaculture Licensing and Administration, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador, pers. comm., 19 April 2021).

4.2.5 Science Surveys

4.2.5.1 DFO Research Vessel (RV) Surveys

The most recent RV data available are from the 2019 dataset which were provided by DFO (A. Roberts, Data Archivist, DFO, pers. comm., 23 April 2021). During May−November 2017–2019, RV survey catch locations occurred throughout the Orphan Basin, EL1158 and Cambriol, and Jeanne d'Arc 3D survey areas (Figures 4.29–4.31). There were no catch locations within the EL1149 3D survey area. 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, EL1158 and Cambriol, and Jeanne d'Arc 3D survey areas during May−November 2019–2021 are presented in Tables 4.4–4.6.

Atlantic cod, deepwater redfish, and blue hake were predominant species in the Orphan Basin 3D survey area between 2017–2019, whereas in the EL1158 and Cambriol 3D survey area, thorny skates, deepwater redfish, black dogfish, roundnose grenadiers, and blue hake were among the predominant species between 2017–2019. In the Jeanne d'Arc 3D survey area, sand lance, American plaice, and yellowtail flounder were predominant species during the RV surveys between 2017–2019 within the Project Area (Table 4.6).

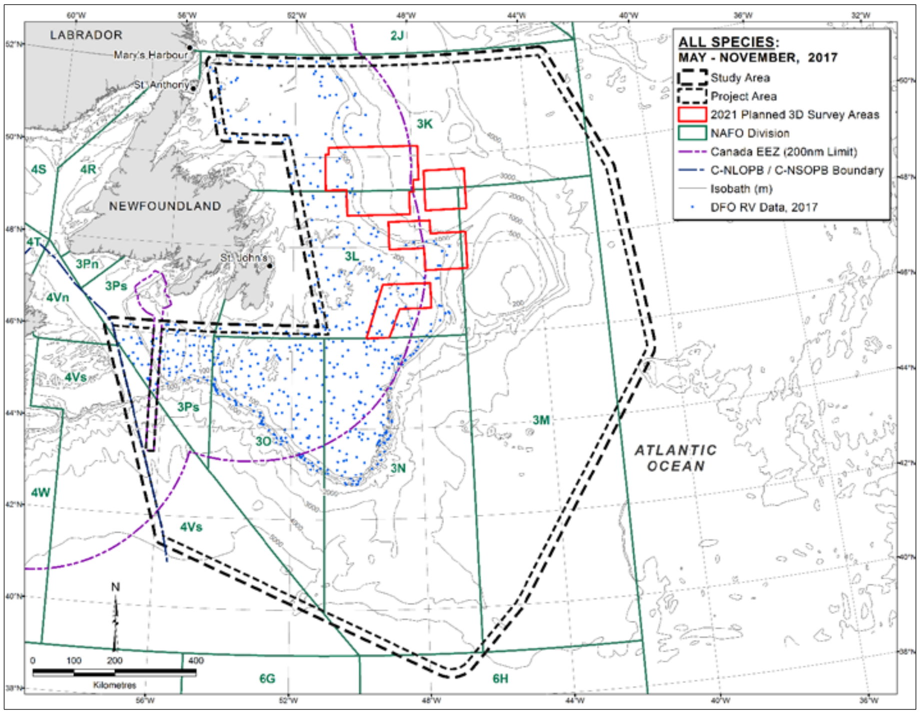


Figure 4.29. Distribution of DFO RV survey catch locations, all species, May–November 2017 (derived from DFO RV survey database, 2017).

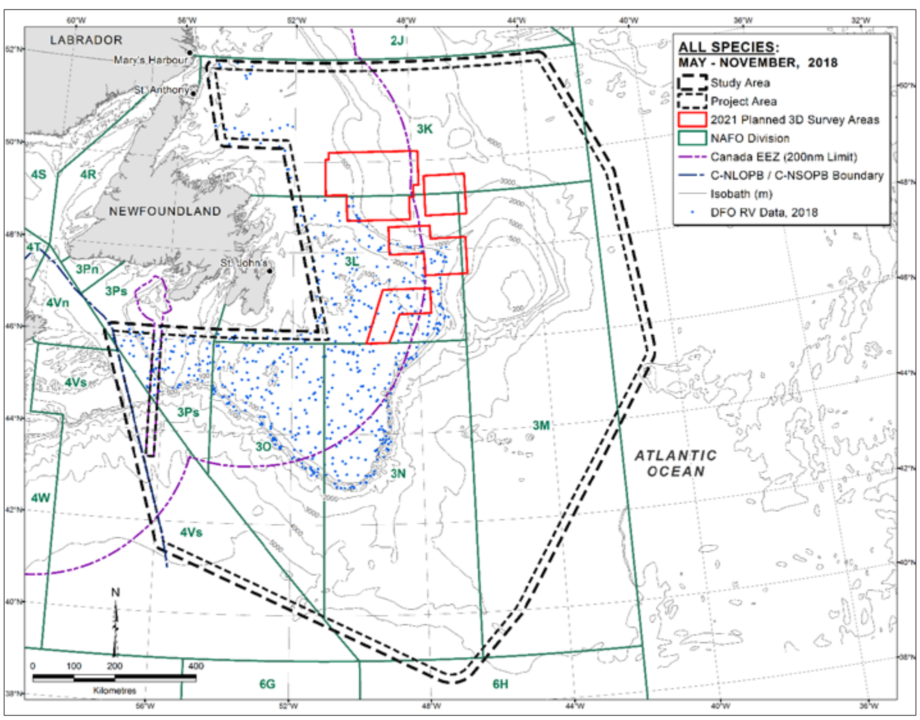


Figure 4.30. Distribution of DFO RV survey catch locations, all species, May–November 2018 (derived from DFO RV survey database, 2018).

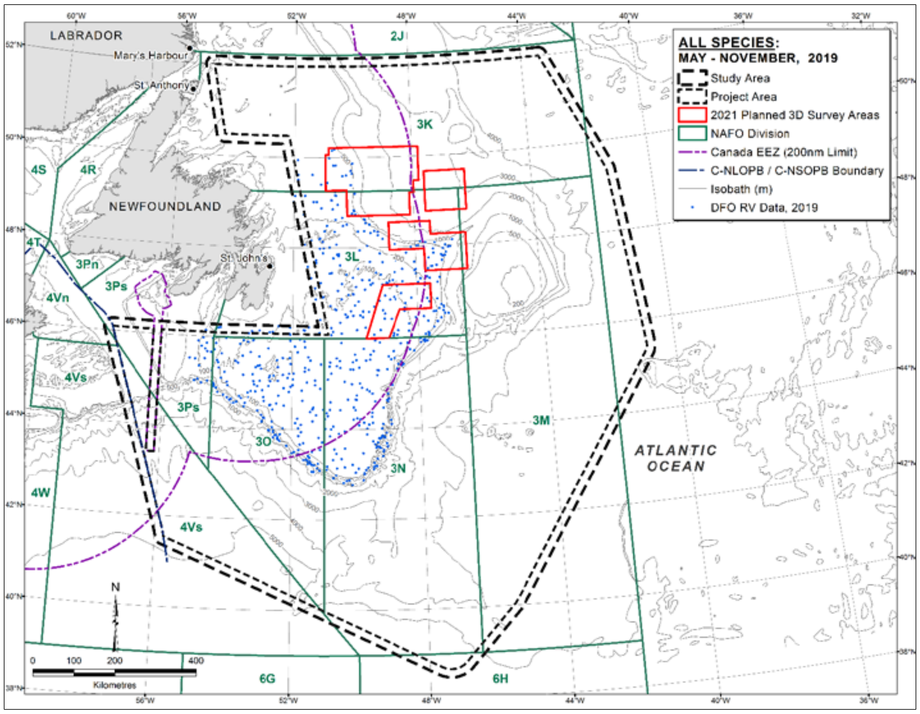


Figure 4.31. Distribution of DFO RV survey catch locations, all species, May–November 2019 (derived from DFO RV survey database, 2019).

Table 4.4. Catch weights and numbers of macroinvertebrates and fishes collected during DFO RV surveys in the Orphan Basin, EL1158 and Cambriol, and the Jeanne d'Arc 3D survey areas, May–November 2017–2019 (derived from DFO RV survey databases, 2017–2019).

Species	Catch Weight (t)			Total Catch Weight (t)	Catch Number			Total Catch Number
	2017	2018	2019		2017	2018	2019	
Orphan Basin								
	1.2	0.1	2.9	4.1	5647	670	8162	14479
Atlantic Cod	0.1	0.1	1.3	1.5	108	86	1424	1618
Greenland Shark	0.8	0.0	0.0	0.8	1	0	0	1
Witch Flounder	0.1	0.1	0.2	0.4	329	183	376	888
Roughhead Grenadier	0.1	0.0	0.1	0.3	328	102	328	758
Greenland Halibut	0.1	0.1	0.1	0.3	139	194	260	593
Jellyfish	0.1	0.0	0.1	0.2	0	0	0	0
American Plaice	0.0	0.0	0.1	0.2	75	14	472	561
Thorny Skate	0.1	0.0	0.0	0.1	42	28	44	114
Northern Wolffish	0.0	0.0	0.1	0.1	13	7	19	39
Sea Anemone (Actinaria)	0.0	0.0	0.1	0.1	167	80	363	610
Atlantic Halibut	0.0	0.0	0.1	0.1	0	0	4	4
Total	2.6	0.5	5.2	8.2	6849	1364	11452	19665
EL1158 & Cambriol								
Deepwater Redfish	2.4	0.8	1.0	4.2	5734	2749	3768	12251
Roughhead Grenadier	0.3	0.2	0.4	0.8	491	433	843	1767
Greenland Halibut	0.0	0.4	0.2	0.6	75	1143	659	1877
Sea Anemone (Actinaria)	0.2	0.2	0.2	0.5	1905	816	2848	5569
Thorny Skate	0.1	0.1	0.2	0.5	55	80	156	291
Jellyfish	0.1	0.1	0.2	0.3	0	0	0	0

Species	Catch Weight (t)			Total Catch Weight (t)	Catch Number			Total Catch Number
	2017	2018	2019		2017	2018	2019	
Atlantic Cod	0.0	0.1	0.2	0.3	38	213	617	868
Northern Shrimp	0.0	0.1	0.2	0.3	239	12096	20530	32865
	0.0	0.1	0.1	0.2	9	20	24	53
American Plaice	0.0	0.1	0.1	0.2	52	429	284	765
Witch Flounder	0.0	0.0	0.1	0.2	86	93	127	306
Total	3.2	2.2	2.7	8.1	8684	18072	29856	56612
Jeanne d'Arc								
Sand Lance	0.5	0.6	0.0	1.1	41624	38113	1549	81286
Yellowtail Flounder	0.5	0.1	0.2	0.8	1968	240	934	3142
American Plaice	0.3	0.3	0.1	0.7	4943	2970	1245	9158
Thorny Skate	0.0	0.0	0.1	0.1	27	20	54	101
Total	1.3	1.0	0.4	2.7	48562	41343	3782	93687

Table 4.5. Mean catch depths (m) of macroinvertebrates and fishes collected during DFO RV surveys in the Orphan Basin, EL1158 and Cambriol, and the Jeanne d'Arc 3D survey areas, May–November 2017–2019 (derived from DFO RV survey databases, 2017–2019).

Species	Mean Catch Depths (m)							
	Spring[a]				Fall[b]			
	2017	2018	2019	Total	2017	2018	2019	Total
Orphan Basin								
Greenland Shark	-	0	0	0	552	0	0	184
Thorny Skate	-	616	413	515	424	345	353	374
Jensen's Skate	-	0	0	0	0	604	0	201
Spinytail Skate	-	616	694	655	420	0	322	247
Atlantic Herring	-	0	289	144	0	0	0	0
Longnose Eel	-	571	538	554	0	0	0	0
Blue Hake	-	571	694	632	0	0	0	0
Atlantic Cod	-	0	320	160	344	262	363	323
Roughhead Grenadier	-	571	470	520	443	501	384	442
Marlin Spike Grenadier	-	571	514	542	0	0	0	0
Roundnose Grenadier	-	0	694	347	692	604	634	643
Northern Wolffish	-	525	424	474	436	411	419	422
Striped Wolffish	-	0	289	144	328	262	332	307
Spotted Wolffish	-	0	289	144	388	262	329	326
Eelpout (Lycodes sp.)	-	571	320	445	0	0	0	0
Golden Redfish	-	0	0	0	384	0	355	246
Deepwater Redfish	-	571	413	492	422	443	384	416
Moustache Sculpin	-	0	313	157	0	0	0	0
American Plaice	-	525	320	422	409	403	384	399
Witch Flounder	-	571	413	492	443	443	363	416
Greenland Halibut	-	571	413	492	467	443	388	433
Atlantic Halibut	-	0	0	0	0	0	340	113
Sponge	-	525	320	422	422	410	387	407
Jellyfish	-	571	514	542	443	565	384	464
Sea Anemone (Actinaria)	-	0	469	235	436	345	384	388
Average	-	255	356	306	207	175	181	188
EL1158 & Cambriol								
Black Dogfish	-	0	0	0	525	493	613	544
Thorny Skate	-	450	404	427	416	367	328	370
Round Skate	-	0	0	0	0	491	0	164
Spinytail Skate	-	509	581	545	342	457	590	463
Atlantic Herring	-	0	269	135	0	0	0	0
Longnose Eel	-	561	544	553	0	0	0	0
Blue Hake	-	628	637	633	0	0	0	0
Atlantic Cod	-	348	323	336	334	292	304	310
Haddock	-	0	0	0	0	318	0	106
White Hake	-	0	346	173	0	0	0	0
Roughhead Grenadier	-	482	483	482	475	447	456	459
Marlin Spike Grenadier	-	533	503	518	0	0	0	0
Roundnose Grenadier	-	659	561	610	0	0	0	0

Species	Mean Catch Depths (m)							
	Spring[a]				Fall[b]			
	2017	2018	2019	Total	2017	2018	2019	Total
Sand Lance	-	0	477	239	0	0	0	0
Northern Wolffish	-	525	471	498	506	467	443	472
Striped Wolffish	-	354	319	336	338	304	328	323
Spotted Wolffish	-	354	0	177	334	418	321	357
Eelpout (Lycodes sp.)	-	665	372	519	0	0	0	0
Golden Redfish	-	610	341	475	0	491	525	339
Deepwater Redfish	-	482	447	465	475	447	456	459
Moustache Sculpin	-	324	0	162	0	0	0	0
American Plaice	-	348	362	355	338	347	349	345
Witch Flounder	-	505	461	483	411	423	439	424
Greenland Halibut	-	482	447	465	471	456	441	456
Atlantic Halibut	-	338	430	384	418	371	303	364
Sponge	-	456	446	451	471	468	456	465
Jellyfish	-	505	464	484	475	468	456	466
Sea Anemone (Actinaria)	-	423	429	426	475	447	439	454
Average	-	312	368	340	166	194	177	179
Jeanne d'Arc								
Thorny Skate	61	140	0	67	130	92	88	104
Atlantic Herring	0	70	85	52	0	0	0	0
Atlantic Cod	62	68	73	68	123	81	98	100
Haddock	0	0	62	21	0	0	0	0
Sand Lance	65	102	78	82	0	0	0	0
Striped Wolffish	0	70	63	44	0	114	168	94
Eelpout (Lycodes sp.)	0	75	95	57	0	0	0	0
Deepwater Redfish	65	0	0	22	0	0	0	0
Moustache Sculpin	66	98	87	84	0	0	0	0
Common Lumpfish	0	0	0	0	0	114	0	38
American Plaice	64	100	87	84	119	92	88	100
Yellowtail Flounder	65	65	63	64	104	72	67	81
Greenland Halibut	0	162	112	91	119	97	92	103
Sponge	0	0	0	0	0	0	100	33
Jellyfish	0	0	0	0	110	95	67	91
Sea Anemone (Actinaria)	0	97	88	62	118	80	0	66
Average	29	58	46	44	28	29	27	28

[a] Spring survey months: 2017 = June; 2018 = May–June; 2019 = May–June.

[b] Fall survey months: 2017 = October−November; 2018 = October; 2019 = October−November.

Table 4.6. Predominant species caught at various mean catch depth ranges in the Orphan Basin, EL1158 and Cambriol, and Jeanne d'Arc 3D survey areas during DFO RV surveys, May–November 2017–2019 (derived from DFO RV survey database, 2017–2019).

Mean Catch Depth Range (m)	Predominant Species (% of Total Catch Weight)		
	2017	2018	2019
Orphan Basin			
200–299	-	Atlantic Cod (87%), Striped Wolffish (8%), Barnacle (Cirripedia [4%])	Atlantic Herring (32%), Northern Alligatorfish (31%), Common Alligatorfish (31%)
300–399	Atlantic Cod (39%), Northern Shrimp (19%), Golden Redfish (17%)	Striped Shrimp (52%), Sea Anemone (Actinaria [27%]), Rigid Cushion Star (18%)	Deepwater Redfish (57%), Atlantic Cod (26%), Witch Flounder (4%)
400–499	Deepwater Redfish (65%), Witch Flounder (8%), Roughhead Grenadier (6%)	Deepwater Redfish (39%), Greenland Halibut (21%), Witch Flounder (20%)	Jellyfish (43%), Northern Wolffish (37%), Spinytail Skate (18%)
500–599	Greenland Shark (100%)	Roughhead Grenadier (44%), Jellyfish (38%), Shrimp (Sergestes arcticus [3%])	Longnose Eel (44%), Pink Glass Shrimp (Pasiphaea multidentata [21%]), Marlin Spike Grenadier (15%)
600–699	Shrimp (Acanthephyra pelagica [43%]), Roundnose Grenadier (39%), Pink Glass	Jensen's Skate (64%), Spinytail Skate (21%), Barracudina (Paralepis brevis [2%])	Blue Hake (56%), Roundnose Grenadier (23%), Shrimp (A. pelagica [3%])

Mean Catch Depth Range (m)	Predominant Species (% of Total Catch Weight)		
	2017	2018	2019
	Shrimp (P. multidentata [15%])		
700–799	Squid (Gonatus sp. [84%]), Bivalve (Astartidae [8%]), Basket Star (Gorgonocephalus arcticus [4%])	-	-
EL1158 & Cambriol			
200–299	Gastropod (Tachrhynchus erosa [100%])	Striped Shrimp (59%), Barnacle (Cirripedia [38%]), Basket Star (G. arcticus [2%])	Capelin (62%), Sand Dollar (Echinarachnius parma [24%]), Atlantic Herring (6%)
300–399	Thorny Skate (63%), Striped Wolffish (12%), American Plaice (11%)	Northern Shrimp (26%), Atlantic Cod (24%), American Plaice (23%)	Thorny Skate (30%), Atlantic Cod (24%), Northern Shrimp (20%)
400–499	Deepwater Redfish (76%), Roughhead Grenadier (9%), Sean Anemone (Actinaria [6%])	Deepwater Redfish (41%), Greenland Halibut (19%), Roughhead Grenadier (9%)	Deepwater Redfish (46%), Roughhead Grenadier (17%), Greenland Halibut (10%)
500–599	Black Dogfish (60%), Spinytail Skate (33%), Bubblegum Coral (6%)	Northern Wolffish (48%), Golden Redfish (26%), Longnose Eel (6%)	Lamp Shell (Brachiopoda [38%]), Marlin Spike Grenadier (195), Spinytail Skate (15%)
600–699	Roundnose Grenadier (79%), Golden Redfish (7%), Squid (Gonatus steenstrupi [3%])	Blue Hake (70%), Roundnose Grenadier (11%), Shrimp (Pasiphaea sp. [5%])	Black Dogfish (63%), Blue Hake (20%), Porcupine Crab (8%)
Jeanne d'Arc			
<100	Yellowtail Flounder (35%), Sand Lance (32%), American Plaice (17%)	American Plaice (55%), Yellowtail Flounder (17%), Capelin (4%)	Yellowtail Flounder (37%), American Plaice (30%), Thorny Skate (10%)
100–199	Greenland Halibut (33%), Arctic Argid (31%), Brittle Star (O. sarsi [27%])	Sand Lance (87%), Snow Crab (5%), Thorny Skate (5%)	Brittle Star (Ophiura sarsi [25%]), Snow Crab (24%), Capelin (20%)

The tentative schedule for the 2021–2022 DFO multispecies RV surveys is presented in Table 4.7. Spring RV surveys within the Study Area began early April and are set to continue into early-June. Fall RV surveys within the Study Area will begin early-September and end in late-December. Three additional DFO RV surveys will occur during spring and late summer, including the NL Spring Atlantic Zone Monitoring Program, Capelin, and Shellfish surveys. At the time of writing, the RV surveys set to occur between early October- late November involving the RV *Teleost, Needler,* and the new RV *John Cabot* will be carrying out comparative fishing surveys of which the locations are yet to be determined (L. Mello, Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO, pers. comm., 16 April 2021).

Table 4.7. Tentative schedule of DFO RV surveys within the Study Area during 2021–2022.

NAFO Division	Start Date	End Date	Vessel
NL Spring/Fall RV Surveys			
3Ps	7 April	20 April	*Teleost*
TBD	21 April	4 May	*Teleost*
TBD	5 May	18 May	*Teleost*
TBD	19 May	1 June	*Needler*
TBD	2 June	15 June	*Needler*
TBD	22 September	5 October	*Needler*
TBD	6 October	19 October	*Teleost & Needler*
TBD	20 October	2 November	*Teleost & Needler*
TBD	3 November	16 November	*Teleost & Needler*
TBD	17 November	30 November	*Teleost & Needler*
TBD	1 December	14 December	*Needler*
TBD	1 December	17 December	*Teleost*
Other DFO RV Surveys			
3L	29 June	19 July	*Teleost* (NL Summer AZMP)
3N	26 August	5 September	*Needler* (Shellfish Survey)
3KL	10 January	24 January	*Teleost* (Capelin Survey)

Source: L. Mello, Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Northwest Atlantic Fisheries Centre, DFO, pers. comm., 16 April 2021.
Note: AZMP = Atlantic Zone Monitoring Program.

4.2.5.2 Industry and DFO Science Surveys

The DFO-Industry collaborative post-season snow crab trap survey is described in Section 4.3.8 *in* LGL (2018a). The 2020 TAC for this survey was 400 t and remains the same for the 2021 survey (DFO 2021b). A total of 432 survey stations occur within the Study Area, including two within the Orphan Basin and 12 within the Jeanne d'Arc 3D survey areas (Figure 4.32). There are no survey stations within the EL1149 and EL1158 and Cambriol 3D survey areas. As noted in LGL (2018a), survey stations are randomly sampled each year.

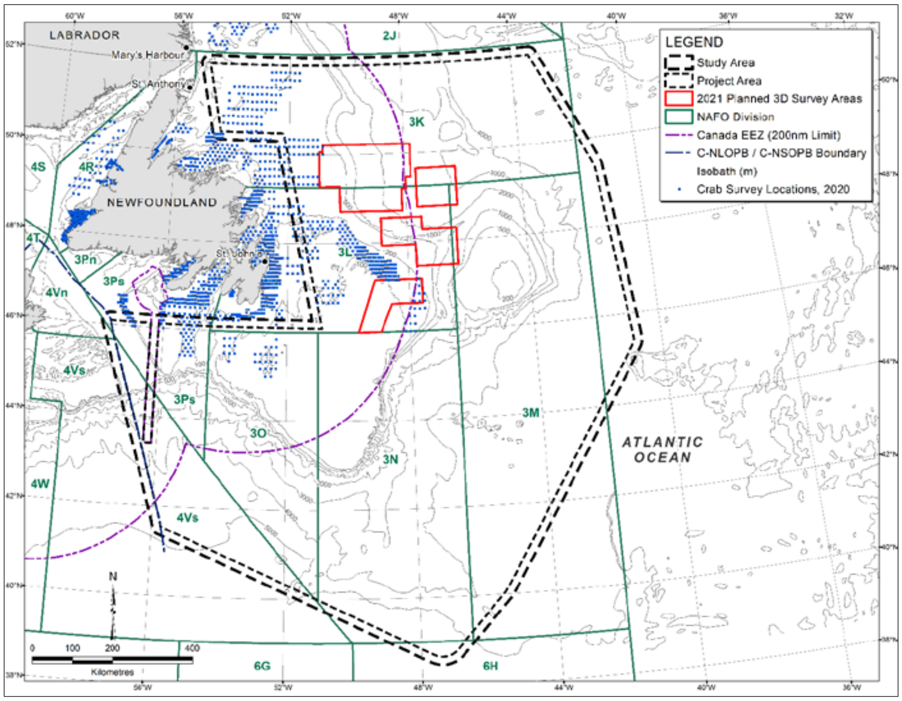


Figure 4.32. Locations of DFO-Industry collaborative 2020 post-season snow crab trap survey stations.

4.3 Marine-Associated Birds

There have been no updates to the temporal and spatial distribution of seabird species throughout the Study Area since the 2019 EA Update (see Section 4.3 *in* LGL 2019). Likewise, there are no updates to the breeding colony information presented in Table 4.8 of LGL (2020b).

A decline in the number of Leach's Storm-Petrels nesting at Baccalieu Island that was described in the EA based on unpublished ECCC-CWS data has since been published (Wilhelm et al. 2021). However, no new information on the decline at that colony or at other colonies has come to light since the 2019 EA Update. Marine pollution may be partly responsible for the population decline of Leach's Storm-Petrels in the North Atlantic as evidenced by recently examined birds (Krug et al. 2021). On 11 and 12 October 2018, 100 Leach's Storm-Petrels were accidentally killed at two industrial sites on the Avalon Peninsula, Newfoundland during a storm and these birds were examined for plastics and hepatic total mercury (THg). The results showed that 87.5% of the birds contained plastic and many birds already had elevated levels of THg even though they were recently fledged. The concentrations were below those known to lead to acute toxicity. However, this form of marine pollution places stress on Leach's Storm-Petrels (Krug et al. 2021). The updated information presented here does not affect the conclusions of the original EA with its proposed mitigation measures of searching for, recovering, and releasing storm-petrels which may strand on Project vessels.

Environmental change in the ocean is having an impact on some nesting seabirds. Partial and temporary abandonment of adult Northern Gannets from the Cape St. Mary's colony in August 2012, 2014, 2015 and 2018 was thought to be caused by above average sea surface temperatures. Cold water prey items, importantly mackerel, were thought to go deeper into the water column beyond the 20 m diving depth of gannets or moved elsewhere beyond their average ~100 km foraging range from the nesting colony. During 2012, gannets colonies suffered from record poor breeding success at three of eastern North American gannet colonies including Cape St. Mary's. The breeding success rate of 41% in 2012 was well below the 53.9% average during 2009–2020. The relationship between Northern Gannet breeding success and warming sea surface temperatures is an ongoing study (Montevecchi et al. 2021).

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).

During summer 2016, aerial surveys of the Atlantic Canadian shelf and shelf break habitats from northern Labrador to southern Nova Scotia were flown, known as the Northwest Atlantic International Sightings Survey (NAISS) (NAMMCO 2018). A total of 841 sightings of 8,660 marine mammals were made in Newfoundland and Labrador waters, including fin, humpback, and minke whales; the most common cetacean was the white-beaked dolphin. For the Scotian Shelf, Gulf of St. Lawrence, and Bay of Fundy, a total of 1,035 sightings of 4,449 marine mammals were made. The 2016 surveys showed higher abundances of white-beaked dolphins (536,016 individuals), harbour porpoise (256,355), minke whales (19,166), fin whales, (4,412), and humpback whales (10,293) than the 2007 surveys. The data from this study have not yet been published.

During marine mammal monitoring in MKI's Blomidon 3D Survey Area in the Orphan Basin region from 25 May–23 July 2020, 35 sightings totaling 184 marine mammals were made, including six sightings of 10 fin whales, four sightings of six humpbacks, one group of three killer whales, 12 sightings of 119 long-finned pilot whales, one pod of six short-beaked common dolphins, four sightings of unidentified baleen whales, three groups of unidentified dolphins, and two harp seals; two acoustic detections of toothed whales were also made (Penney-Belbin 2020a). During marine mammal monitoring in MKI's South Bank 3D Survey Area, south of the Grand Banks, from 29 June–11 August 2020, 80 sightings totaling 1,128 marine mammals were made, including one blue whale, 16 sightings of 23 sperm whales, three groups of 53 long-finned pilot whales, two sightings of 13 Atlantic white-sided dolphin, 23 pods of short-beaked common dolphin totaling 566 individuals, one group of eight Risso's dolphins, three groups of 86 striped dolphins, one group of three unidentified beaked whales, four sightings of unidentified baleen whales, one group of three unidentified whales, and 25 groups of 368 unidentified dolphins (Penney-Belbin 2020b). In addition, 14 acoustic detections were made including long-finned pilot whale and short-beaked common dolphin.

DFO scientists have developed species distribution models (SDM) that predict suitable habitat that in turn indicate the potential distribution of some key marine mammal species in Newfoundland and the Scotian Shelf, based on various factors such as the known habitat requirements and preferences of these species (Gomez et al. 2017, 2020). The models include areas that overlap with the Study Area, such as the Grand Banks, northeastern Scotian Shelf, and Laurentian Channel. While the results of the SDM do not delineate identified key areas or represent the current distribution of cetaceans in the region, the information can be used to help identify priority areas in which to target and enhance monitoring efforts for key species in the Study Area, enabling a more standardized approach to identifying marine mammal presence and distribution on a regional scale. The SDM found that the Scotian Shelf was a priority area for monitoring of sei, humpback, and long-finned pilot whales; Atlantic white-sided dolphins, short-beaked common dolphins; and harbour porpoise. The Newfoundland Shelf was deemed to be a priority area for monitoring of humpback, Atlantic white-sided dolphin, white-beaked dolphin, and harbour porpoise. Priority areas for fin and minke whales were predicted throughout the region, with lower predictions in deep water around the Flemish Cap. For short-beaked common dolphins, priority areas also included deep water off the Scotian Shelf and the area south of the Newfoundland Shelf; for Atlantic white-sided dolphin, the Laurentian Channel was also deemed a priority area. The deep waters of the Scotian, Newfoundland, and Labrador Shelf edges were predicted as priority areas for sperm whales and long-finned pilot whales. Further work is currently underway by DFO to develop these models for additional cetacean species as well as various functional groups.

4.4.2 Updated Species Information

4.4.2.1 North Atlantic Right Whale

During acoustic monitoring off southern Newfoundland in 2017–2019, acoustic detections of North Atlantic right whales were made off southeastern Newfoundland, particularly in Placentia Bay, during the summer/early fall each year of monitoring (DFO 2020a). An unconfirmed right whale detection was made during October 2018 in Flemish Pass, one unconfirmed vocalization was recorded at St. Pierre Bank on July 2018, and several unconfirmed vocalizations were reported for southwestern Newfoundland during the winter.

Thirty-two mortalities were reported for the North Atlantic right whale population over the last four years − 17 individuals in 2017, 3 individuals in 2018, 10 mortalities in 2019, and 2 mortalities in 2020 (Pettis et al. 2021). Nine of the mortalities in 2019 occurred in Canada, but no mortalities were reported for Canada in 2020 (Pettis et al. 2021). Eighteen of the 32 mortalities involved anthropogenic factors, such as vessel strikes and entanglement in fishing gear (Pettis et al. 2021). For all mortalities between 2003 and 2018 for which the cause of death was known, all mortalities were due to vessel collision or entanglement (Sharp et al. 2019). However, Pace et al. (2021) caution that many deaths could go unseen; for example, observed carcasses only accounted for 36% of all estimated deaths during 1990–2017. Although seven calves were born in 2019 and 10 calves were born in 2020, detected mortalities during 2017–2020 outnumbered births by 3:2 (Pettis et al. 2021). In addition, poor body condition is thought to play a factor in the population decline (Christiansen et al. 2020). The best population estimate at the end of 2019 was 356 individuals (Pettis et al. 2021). An Action Plan specifically addressing the threat of fisheries interactions as well as other threats on right whales was released in 2020 (DFO 2020b).

4.4.2.2 Sei Whale

Sei whale calls were detected on the Scotian Shelf, adjacent to the Study Area, in all seasons during acoustic monitoring in 2004–2014; however, there were fewer detections after 2010 (Davis et al. 2020). The Flemish Cap, Scotian Shelf, Bay of Fundy, and northern Labrador Shelf have been identified by SDM as priority areas to target and enhance monitoring efforts for sei whales (Gomez et al. 2020).

4.4.2.3 Fin Whale

Fin whale calls were detected on the Scotian Shelf, adjacent to the Study Area, in all seasons during acoustic monitoring during 2004–2014; however, there were fewer fin whale detections after 2010 (Davis et al. 2020). Based on SDM, Gomez et al. (2020) reported that the entire Study Area is predicted to be a priority area to target and enhance monitoring efforts for fin whales; however, deep waters of the Flemish Cap had lower predictions.

4.4.2.4 Blue Whale

An Action Plan for the Northwest Atlantic population of blue whale was released in 2020 (DFO 2020c). Blue whale calls were detected on the Scotian Shelf, adjacent to the Study Area, in all seasons during acoustic monitoring during 2004–2014; however, there were fewer blue whale detections after 2010 (Davis et al. 2020).

4.4.2.5 Humpback Whale

Humpback whale distribution along the east coast of Newfoundland is influenced by the timing of capelin spawning, with humpbacks tending to occur slightly later than capelin (Johnson and Davoren 2021). Humpback whale calls were detected on the Scotian Shelf, adjacent to the Study

Area, in all seasons during acoustic monitoring in 2004–2014; however, there were fewer humpback detections after 2010 (Davis et al. 2020). The Scotian, Newfoundland, and part of the Labrador shelves have been identified by SDM as priority areas to target and enhance monitoring efforts for humpbacks (Gomez et al. 2020).

4.4.2.6 Killer Whale

Killer whales that were outfitted with satellite tracking devices off northern Baffin Island during summer 2009 travelled southward and arrived in Newfoundland waters in the fall (Lefort et al. 2020), passing through the eastern portion of the Study Area. Based on an analysis of oxygen isotopes from stranded individuals, Matthews et al. (2021) suggested that there is likely more than one killer whale population inhabiting the Northwest Atlantic. The Northwest Atlantic/Eastern Arctic population is currently under consideration for addition to Schedule 1 of SARA.

4.4.2.7 Harp Seal

Harp seals pup in the Gulf of St. Lawrence and the Front off Newfoundland, west of the northern Study Area, during February and March (Stenson et al. 2020). In 2017, 96% of harp seals pups (714,600) were born off the northeastern coast of Newfoundland (Front), an additional 18,300 pups were born in the southern Gulf of St. Lawrence, and another 13,600 pups were born in the northern Gulf of St. Lawrence, totaling 746,500 pups (DFO 2020d). The modeled pup production estimate for 2019 was 1.4 million, with a total population size of 7.6 million (DFO 2020d). During April and/or May, older harp seals form large moulting concentrations off southern Labrador/northeastern Newfoundland at the southern edge of the seasonal pack ice and in the northern Gulf of St. Lawrence, then eventually migrate northward to summer feeding grounds in the Arctic (DFO 2020e; Stenson et. al 2020).

4.4.2.8 Grey Seal

Tagged grey seals were found to occur adjacent to the Study Area along the Laurentian Channel and the Scotian Shelf from June–October (Nowak et al. 2020). At least one male was documented to have traveled through the southern Survey Area along the edge of the Grand Banks during fall. Their foraging behaviour appears to be associated with chlorophyll-a concentrations.

4.4.2.9 Leatherback Turtle

The peak occurrence of leatherback turtles in Atlantic Canada takes place during the summer, with leatherback seasonality corresponding to that of their jellyfish prey (Nordstrom et al. 2020). Nordstrom et al. (2020) found significant overlap in the distribution of sea turtles and jellyfish on the Scotian Shelf. Two primary high-use feeding areas in Canadian waters have been identified by DFO (2020f), including: 1) waters south and east of the Burin Peninsula, Newfoundland, including parts of Placentia Bay; and 2) the southeastern Gulf of St. Lawrence and waters of eastern Cape Breton Island; neither of these areas occur within the Study Area. A third high-use feeding area was initially identified east and southeast of Georges Bank; this area is likely less important than the two aforementioned areas, but could be of relevance very early or late in the feeding season (DFO 2020f). The information regarding high-use feeding areas is being used to inform the identification of critical habitat in a forthcoming amended Recovery Strategy (DFO 2020g). An Action Plan for the leatherback turtle was finalized in 2020 (DFO 2020g). A Threat Assessment was published in 2020 (DFO 2020h), identifying the greatest threats to leatherbacks as bycatch in fisheries, followed by plastic marine pollution, and harvesting and coastal development at nesting beaches.

4.5 Species at Risk

The new information presented in this section does not change the effects predictions made in the EA (LGL 2018a) or its Addendum (LGL 2018b). Updated species at risk that could potentially occur in the Study Area are provided in this section, based on available information on the *Species at Risk Act* (SARA) and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) websites as of April 2021. Changes in species status since the preparation of the 2020 EA Update (LGL 2020b) are noted in bold font in Table 4.8. In November 2020, COSEWIC assessed the Leach's Storm-Petrel (Atlantic population) as Threatened given the substantial and continuing decline in colony numbers (see Section 4.3 in this document and LGL 2019, 2020b).

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

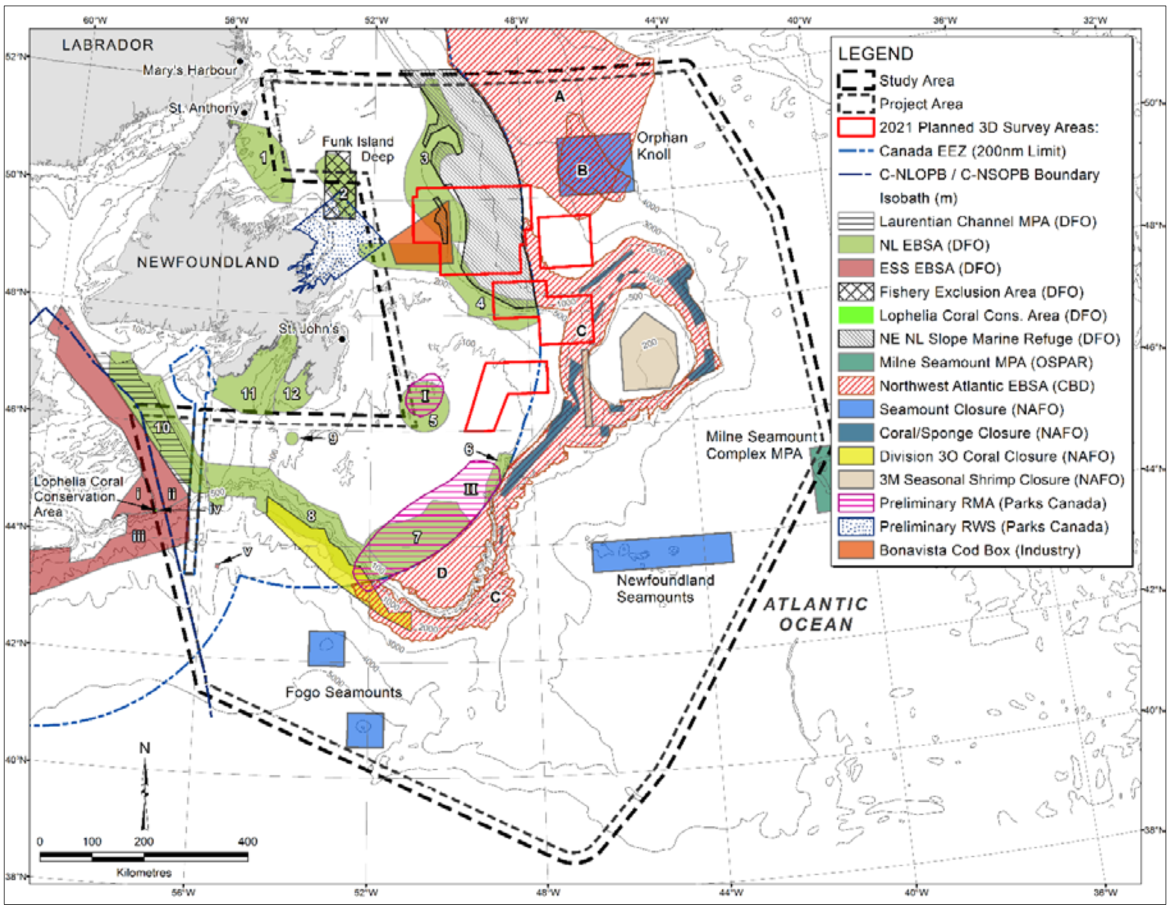
Common Name	Scientific Name	*SARA* [a]			COSEWIC [a,b]		
		E	T	SC	E	T	SC
Marine Fish							
White Shark Atlantic population	*Carcharodon carcharias*	S1			X		
Northern Wolffish	*Anarhichas denticulatus*		S1			X	
Spotted Wolffish	*A. minor*		S1			X	
Atlantic Wolffish	*A. lupus*			S1			X
Atlantic Cod Newfoundland 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	

Common Name	Scientific Name	SARA [a]			COSEWIC [a,b]		
		E	T	SC	E	T	SC
Maritime population						X	
Lumpfish	*Cyclopterus lumpus*					X	
White Hake Atlantic and Northern Gulf of St. Lawrence population	*Urophycis tenuis*					X	
Atlantic Sturgeon Maritimes populations	*Acipenser oxyrinchus*					X	
American Eel	*Anguilla rostrata*					X	
Atlantic Salmon South Newfoundland population	*Salmo salar*					X	
Quebec Eastern North Shore population							X
Quebec Western North Shore population							X
Anticosti Island population					X		
Inner St. Lawrence population							X
Gaspe-Southern Gulf of St. Lawrence population							X
Eastern Cape Breton population					X		
Nova Scotia Southern Upland population					X		
Outer Bay of Fundy population					X		
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-Petrels **Atlantic population**	***Oceanodroma leucorhoa***					**X**	
Ivory Gull	*Pagophila eburnea*	S1			X		
Red Knot *rufa* spp. **Patagonia wintering population**	*Calidris canutus rufa*	S1			X		
Harlequin Duck Eastern population	*Histrionicus*			S1			X
Barrow's Goldeneye Eastern population	*Bucephala islandica*			S1			X
Red-necked Phalarope	*Phalaropus lobatus*			S1			X
Marine Mammals							
Blue Whale Atlantic population	*Balaenoptera musculus*	S1			X		
North Atlantic Right Whale	*Eubalaena glacialis*	S1			X		
Sei Whale Atlantic population	*Balaenoptera borealis*				X		
Northern Bottlenose Whale Scotian Shelf population	*Hyperoodon ampullatus*	S1			X		
Davis Strait-Baffin Bay-Labrador Sea population							X
Harbour Porpoise Northwest Atlantic population	*Phocoena*		S2				X
Fin Whale Atlantic population	*Balaenoptera physalus*			S1			X
Humpback Whale Western North Atlantic population	*Megaptera novaeangliae*			S3			
Sowerby's Beaked Whale	*Mesoplodon bidens*			S1			X
Killer Whale Northwest Atlantic/ Eastern Arctic population	*Orcinus orca*						X
Sea Turtles							
Leatherback Sea Turtle Atlantic population	*Dermochelys coriacea*	S1			X		
Loggerhead Sea Turtle	*Caretta*	S1			X		

Note: E = Endangered; T = Threatened; SC = Special Concern; S = Schedule.
[a] SARA website (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html) accessed April 2021.
[b] COSWEIC website (http://cosewic.ca/index.php/en-ca/) accessed April 2021.

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). Based on a review of key biological components for sensitive areas that overlap or are adjacent to the 2021 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 4.9.



Source: DFO (2014, 2020e); N. Wells, Biologist, Science Branch, DFO, pers. comm., 16 April 2021; CBD (2021); MCI (2021); NAFO (2021); OSPAR (2021); Protected Planet (2021).

Notes:

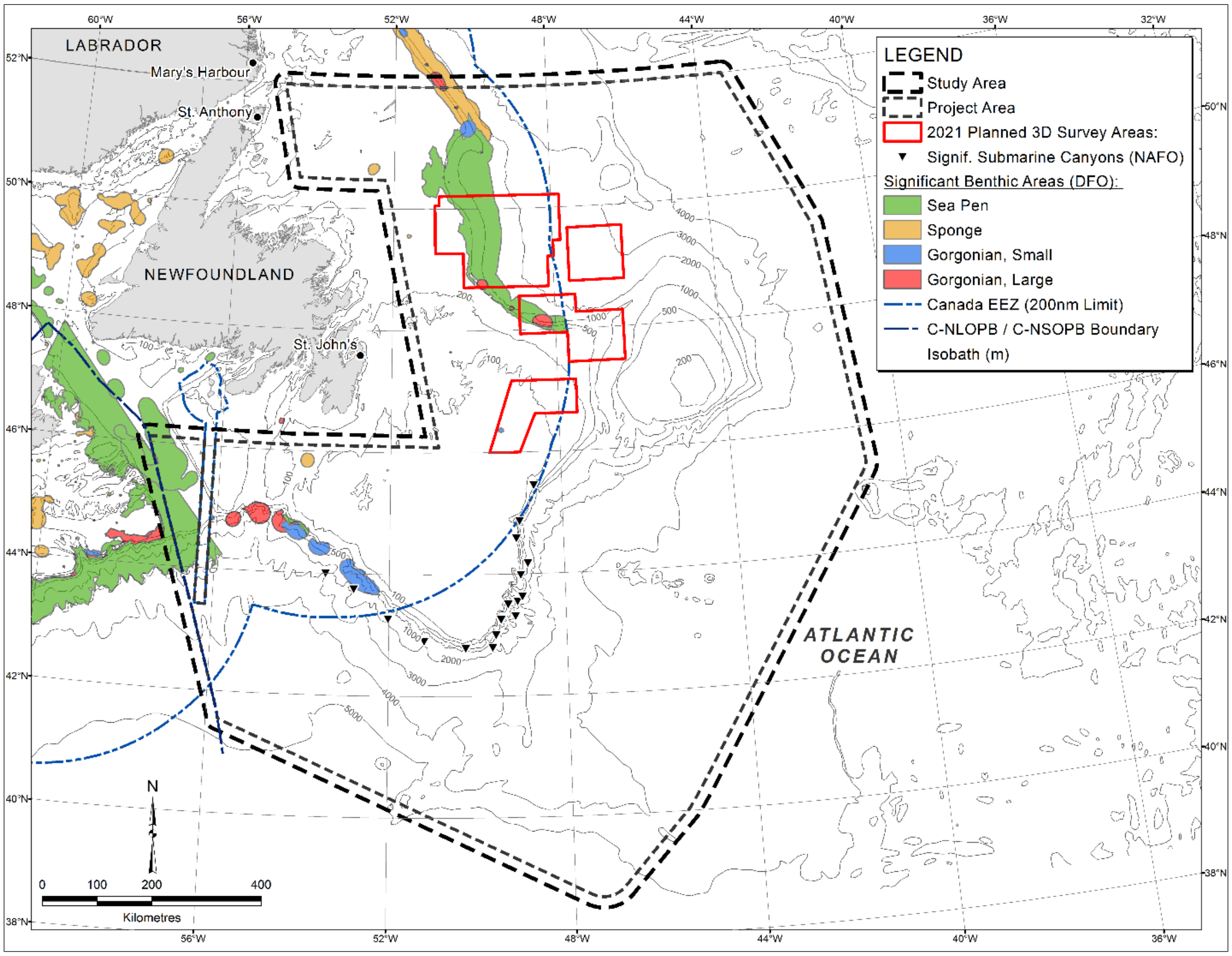
NL (Bioregion) EBSA: 1 = Grey Islands; 2= Notre Dame Channel; 3 = Orphan Spur; 4 = Northeast Slope; 5 = Virgin Rocks; 6 = Lilly Canyon-Carson Canyon; 7 = Southeast Shoal; 8 = Southwest Slope; 9 = Haddock Channel Sponges; 10 = Laurentian Channel; 11 = Placentia Bay;12 = St. Mary's Bay.

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., 16 April 2021.

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

Table 4.9. 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 and 2020 EA Updates [LGL 2019; 2020b]).

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

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

NAFO identifies submarine canyons as one of several physical indicator elements for VMEs and categorizes those in the Study Area as shelf-indenting (located on the Tail of the Grand Bank, within Div. 3N), with head depth >400 m (South of the Flemish Cap and Tail of the Grand Bank, within Div. 3MN), and with head depth >200 m (Tail of the Grand Bank, within Div. 3O) (NAFO 2021). While little is known of the ecology of submarine canyons within the Study Area, those located on the upper continental shelf are recognized as ideal coral attachment habitat (Gullage et al. 2017). No known submarine canyons overlap the 3D survey areas (see Figure 4.34; J. Murillo-Perez, Research Scientist, DFO, Bedford Institute of Oceanography, pers. comm., 16 April 2021). There were also no changes to the 3M Seasonal Shrimp Closure Area (see Table 4.9) in 2021 (NAFO 2021).

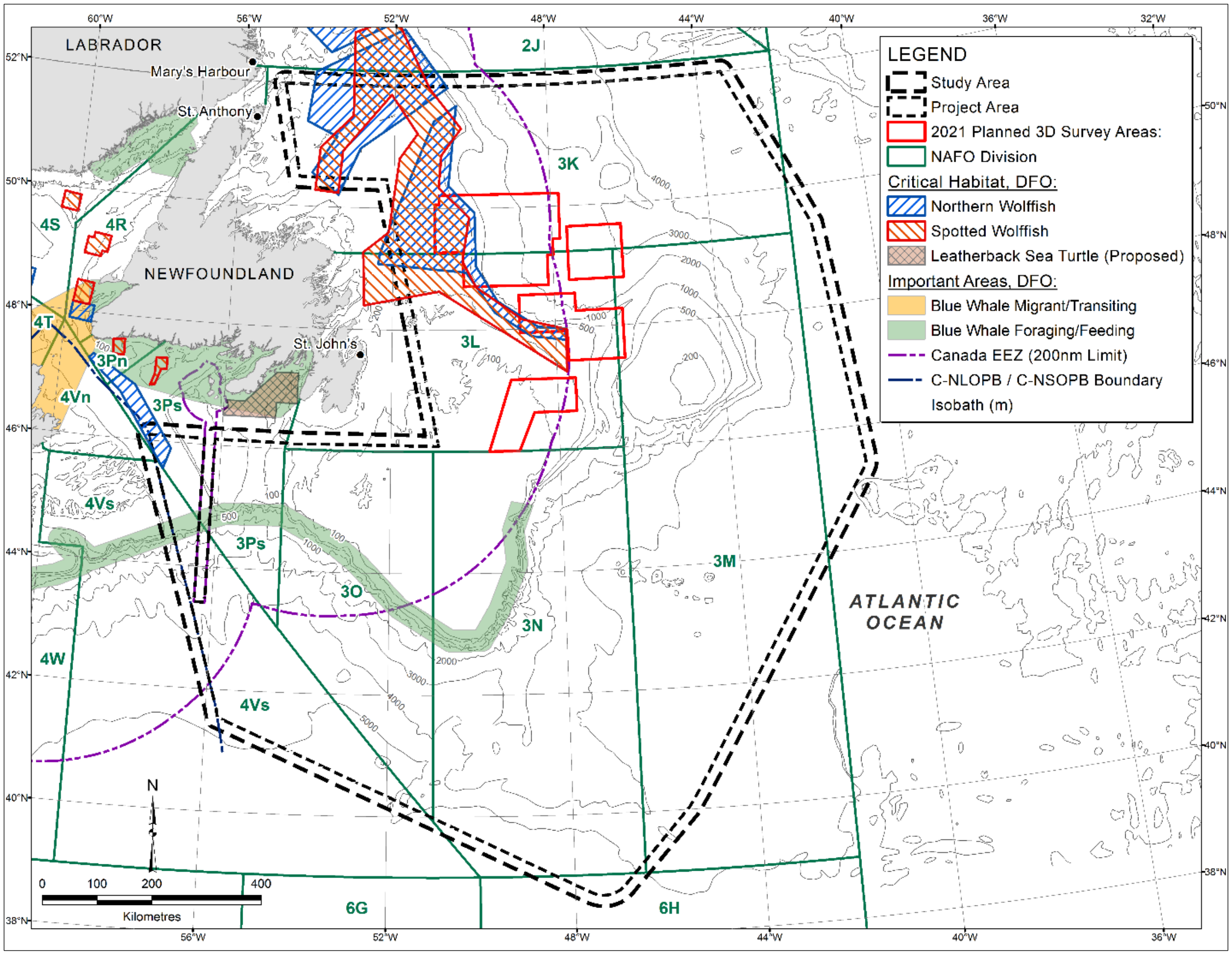
Significant Benthic Areas (SBAs) are "significant areas of cold-water corals and sponge dominated communities" (Kenchington et al. 2018a,b) and do not receive legal protection but may serve as indicators for the designation of future special areas. SBAs for sea pens and large and small gorgonians are within the northwestern and southwestern portions of the Study Area, with sea pen and large gorgonian SBAs overlapping the central portion of the Orphan Basin 3D survey area and the western boundary of the EL1158 and Cambriol 3D survey area, and a small gorgonian SBA within the southwestern portion of the Jeanne d'Arc 3D survey area (see Figure 4.34). SBAs for sponges are mainly in the northwestern portion of the Study Area, with a relatively small sponge SBA also in the southwestern portion of the Study Area, south of Newfoundland's Avalon Peninsula. No sponge SBAs overlap the 3D survey areas for 2021 (see Figure 4.34).

There have been no modifications to the EBSAs within the Placentia Bay-Grand Banks (PB−GB) portion of the NL Shelves Bioregion since the 2020 EA Update (LGL 2020b) (N. Wells, Biologist, Science Branch, DFO, pers. comm., 16 April 2021). None of the PB-GB EBSAs overlap the 3D survey areas (see Figure 4.33). There have been no modifications to the EBSAs within the Eastern Scotian Shelf, nor do they overlap with the 3D survey areas. There have also been no changes to the sensitive areas managed by Parks Canada since the 2020 EA Update (LGL 2020b).

4.6.1 Critical Habitat

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 and the western portion of the EL1158 and Cambriol 3D survey area (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.

Proposed critical habitat for leatherback sea turtles near the Study Area was also presented in the 2019 EA Update (DFO 2016; see also Figure 4.36 *in* LGL 2019). Since that time, DFO (2020f) references these areas as high-use feeding areas and the information regarding these high-use feeding areas will be used in the identification of critical habitat in a forthcoming amended Recovery Strategy (DFO 2020g). The Placentia Bay high-use feeding area for leatherback sea turtles, which will be used to define critical habitat 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, proposed leatherback sea turtle critical habitat, 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, northwest 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 2021 was distributed on 26 March 2021 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.

A first round of meetings (via MS Teams) were held with the FFAW (Ms. R. Lee) and Ocean Choice (Mr. R. Ellis) on 11 and 15 March 2021, respectively. A presentation highlighting the planned 2021 seismic surveying activities was sent to One Ocean (Ms. M. Murphy) at her request (on 22 March 2021). A second round of consultations were held with the FFAW (Ms. R. Lee) and Ocean Choice (Mr. R. Ellis) on 27 and 29 April 2021, respectively. A presentation showing the updated 2021 seismic surveying activities was sent to One Ocean (Ms. M. Murphy) on 29 April 2021.

The following comments/concerns were discussed. FFAW stated that turbot fishing activity is expected in the Cape Anguille 3D survey area from June through October 2021. MKI presented an acquisition plan to FFAW starting from the southern end of the survey moving northwards that would reduce the interference with turbot fishing activity. With regards to the Jeanne d'Arc survey area, FFAW advised MKI to start the survey at the end of July/early August 2021 to reduce overlap with the post-season survey. MKI will endeavor to honour this timeline for the Jeanne d'Arc survey.

Ocean Choice stated that there is planned fishing activity from mid-June through late-July in the Cambriol 3D survey area. Ocean Choice advised MKI to start surveying in the northern section of the survey area and work towards the south. MKI will endeavor to start surveying the northern section of the Cambriol 3D area first.

No major concerns or comments were expressed by One Ocean with regards to MKI's 2021 activities.

6.0 Environmental Assessment

This section presents a summary of mitigation measures that will be employed by MKI during its 2021 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 2021. 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 (30 April 2021)
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,	• "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	• Confirmed • Confirmed • Confirmed • Confirmed

VEC, Potential Effects	Primary Mitigations	Status (30 April 2021)
seabirds, fish, invertebrates)	• 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
Species at Risk and Sensitive Areas VEC: Temporary or permanent hearing damage/ disturbance to Species at Risk or other key habitats	• "Pre-watch" (30 minute) of 500 m safety zone using visual and PAM • Delay start-up if any marine mammals or sea turtles are detected within 500 m with visual and PAM • Ramp-up of airguns • Shutdown of airgun arrays for endangered or threatened marine mammals and sea turtles, as well as beaked whales, detected visually or acoustically within 500 m • Use of experienced, qualified MMSO(s) to monitor for marine mammals and sea turtles during daylight seismic operations. • PAM will be used during pre-watch and during periods when visibility is <500 m in order to detect cetacean vocalizations • Minimum separation distance of 30 km for simultaneous seismic surveys in the Project Area based on separation distances required in other jurisdictions (see above).	• Confirmed • Confirmed • Confirmed • Confirmed • Confirmed • Confirmed • Confirmed
Marine-associated Bird VEC: Injury (mortality) to stranded seabirds	• Daily search of seismic and support vessels • Implementation of handling and release protocols • Minimize lighting if safe	• Confirmed • Confirmed • Confirmed
Marine-associated Bird VEC: Seabird oiling	• Adherence to MARPOL • Adherence to conditions of ECCC-CWS migratory bird permit • Spill contingency and response plans • Use of solid streamers	• Confirmed • Confirmed • Confirmed • Confirmed

6.2 Fish and Fish Habitat

Recent publications relevant to the effects of airgun sound on the Fish and Fish Habitat VEC have become available since the most recent EA Update for the Project (LGL 2020b); these studies are summarized below.

Perhaps the most notable and relevant publications to this EA Update are those studies of the effects of seismic survey sound on snow crab in slope waters offshore Newfoundland. This four-year field program (2015–2018) was led by DFO and funded through the Environmental Studies Research Fund (ESRF; Morris et al. 2021). In 2017 and 2018, a Before-After-Control Impact (BACI) study was conducted to investigate the effect of industrial 3D seismic exposure on the catch rate of snow crab on the slope of the Grand Banks, at Carson Canyon with a control site at Lilly Canyon (Morris et al. 2020; 2021). The duration of potential seismic exposure was nine and five weeks in 2017 and 2018, respectively. The airgun array (4130 in^3) used was from a commercial seismic vessel operated by PGS and was in operation for 8–10 days. Snow crab catch rates were inconsistent during 3D surveying, with reduced catches in 2017 and higher catch rates in 2018 in response to long-duration exposure (Morris et al. 2020; 2021). The study concluded the observed effects of seismic surveying on snow crab catch rates were driven by spatiotemporal variation external to exposure to the airgun source. The authors acknowledged that there is a possibility that seismic surveying may affect catch rates but that any effects remain unpredictable in magnitude and direction, and that effects occur at short temporal and localized spatial scales.

Another component of the multi-year ESRF program, was a BACI study of the effects of 2D seismic surveying on the movement behaviour of snow crabs (Cote et al. 2020; Morris et al. 2021). In total, 201 and 115 snow crab were tagged in Carson and Lilly canyons, respectively. Before, During, and After exposure periods to a single 2D seismic surveying line (5–8 hours duration) were matched in time across control and test sites—each site monitored an area 4 km^2. There were no obvious effects of seismic exposure on the movement ecology of adult male snow crab; variation in snow crab movement was primarily attributable to individual variation and factors like handling, water temperature and time of day. The authors concluded that the effects of seismic exposure on the behaviour of adult male snow crab are at most subtle and are "not likely to be a prominent threat to the fishery." There was also no evidence of physical damage to internal organs based on histological examinations (Morris et al. 2021).

As part of the same multi-year ESRF program, Hall et al. (2021) collected tissue samples to investigate the potential impact of seismic surveying on the transcriptome responses of snow crab hepatopancreas. The hepatopancreas is an organ that aids in the absorption and storage of nutrients and produces important digestive enzymes and was assumed to be a suitable indicator for examining sound exposure effects on crab physiology and health. Snow crabs were subjected to 2D seismic sound in 2016 for 2 h and sampled before, 18 h after, and three weeks after exposure in Carson Canyon. In 2017, 2D seismic exposure was repeated, and samples were collected prior to seismic testing, and 1 day, 2 days, and 6 weeks after exposure (Morris et al. 2020). Additionally, in 2017 snow crabs were subjected to 3D seismic sound for 2 months and were sampled 6 weeks after exposure (Morris et al. 2020; 2021). Transcriptomic (RNA-seq) and qPCR analyses were used to identify and confirm expression levels of candidate molecular biomarkers associated with seismic sound exposure in field-collected snow crab hepatopancreas samples (Hall et al. 2021; Morris et al. 2021). The study identified nine transcripts with significantly higher expression after 2D seismic exposure, and 14 transcripts with significant differential expression between the test and control sites. These include transcripts with functional annotations related to oxidation-reduction, immunity, and metabolism. Changes in these transcripts were not observed in snow crab exposed to longer duration 3D seismic survey sound. The authors concluded transcript expression changes in snow crab can be detected in response to seismic survey sound; however, the candidate molecular biomarkers identified in one field season (2016) were not reliable indicators in the next year (2017) and that further study is warranted (Hall et al. 2021; Morris et al. 2021). Overall, Morris et al. (2021) concluded that "if seismic surveying impacts commercial snow crab, based on factors considered by our experiments, it is within the range of natural variability. Consistency among several independent measurement metrics used in this study, including measure of catch rate, movement, physiology and genomic response, adds considerable weight of- evidence support to this conclusion."

It has also been found that statocysts, the mechanosensory organs responsible for the detection of gravity, position, and movement that are common in marine invertebrates, have shown some sensitivities to underwater sound. Rock lobsters (*Jasus edwardsii*) were either collected from an area that had been previously subjected to high anthropogenic sound and or were collected from an area with little anthropogenic sound. Rock lobsters were caught and contained within lobster pots while exposed to an air gun array deployed by a vessel approximately 1 km from the test pots. The lobsters contained within the posts were exposed to maximum received cumulative sound exposure level of 198 dB re 1µPa^2.s Lobsters were then evaluated for righting reflex in the seawater bins for 0, 2, and 14-days post-exposure and statocysts were removed. The study concluded that lobsters were slower to right themselves after exposure in individuals collected from the noisy area compared to those collected from the remote area, and that lobsters from both areas showed damage to their statocysts following airgun exposure (Day et al. 2020). The study contends that crustaceans that are routinely exposed to high anthropogenic noise such as shipping traffic or marine construction can still be negatively impacted by airgun exposure on a physiological level.

Vazzana et al. (2020) conducted a laboratory study to determine the biochemical responses of the Black Sea urchin (*Arbacia lixula*) when exposed to high frequency (100–200 kHz) sound and measured protein concentration, enzyme activity, and cytotoxicity in the coelomic fluid. Sound pressure levels ranged between 145 and 160 dB re 1µPa in consecutive linear one-second sweeps generated from a single generator coupled with a projector within the experimental tank. After exposure to the acoustic stimulus, significant changes were found in enzyme activity, gene expression, and proteins compared to the control, which suggests high frequency sound exposure elicits a physiological stress response (Vazzana et al. 2020). While the species of focus in this study is typically found in coastal Mediterranean waters, the physiology of the sea urchin may be similar to that of urchins found in offshore Atlantic waters.

Adult and juvenile fish have been found to show vulnerability to acoustic stress due to the presence of a swim bladder, however few studies have shown the behavioural effect sound may have on juvenile individuals given that stress can negatively affect growth and impact survival. Mauro et al. (2020) studied the behavioural changes of juvenile gilthead seabream (*Sparus aurata*) when exposed to white noise filtered through third-octave bands at different frequencies. The bands were centered at 63, 125, 500, and 1000 Hz (sound pressure level 140–150 dB re 1 µPa) for 7 h in the laboratory. The study focused on behavioural changes in group dispersion, motility, and swimming height of fish where were analysed before and during sound exposure. When exposed to low frequency sound (63 and 125 Hz), fish dispersion reduced immediately and returned to the control condition after a period of 2 h, which was indicative of habituation. At 1 kHz, dispersion increased after 2 h with no signs of habituation. The motility of the juvenile fish significantly decreased at 63 Hz throughout the 7 h of experimental sound exposure, and the swimming height significantly decreased at all frequencies except at 125 Hz. The study concluded that noise exposure may have significant effects on juvenile fish behaviour which may subsequently affect fitness and survival (Mauro et al. 2020).

The effects of a commercial seismic survey on the movement behaviour of free-swimming Atlantic cod in the southern North Sea were investigated by van der Knaap et al. (2021). A total of 51 Atlantic cod were caught and tagged with acoustic transmitters and released in the southern North Sea where they were exposed to a towed airgun array 2.5 km from the tagged location over 3.5 days. The air gun array consisted of 36 airguns with a total volume of 2950 in^3 (48.3 L), which was activated every 10 s during operation in continuous loops, with parallel tracks of 25 km. The cumulative sound exposure level (SELcum, re 1 $mPa^2.s$) over the 3.5-day survey period at the receiver position was 186.3 dB in the 40–400 Hz band. During sound exposure, cod became less locally active (moving small distances, showing high body acceleration) and more inactive (moving small distances, showing low body acceleration) at dawn and dusk which interrupted their diurnal activity cycle. The authors concluded that seismic surveying has the potential to affect energy budgets for a commercial fish species, which may have population-level consequences (van der Knaap et al. 2021).

Another study exposed Atlantic cod in an aquaculture net pen to playback of airgun sounds to determine the effect on swimming patterns and behavioural states (Hubert et al. 2020). The fish were exposed to sound recordings of a downscaled airgun (10 in^3) and a pressure of 800 kPa. During the experimental trials fish were exposed to mean sound levels of 174, 169, and 152 dB re 1 µPa (0-pk) (100–600 Hz bandpass filter) with the speaker at 2, 7.8, and 20 m from the net pen, respectively (Hubert et al. 2020). Individual cod within the net pen did not immediately change their swimming patterns after sound exposure; however, several individuals did change the amount of time they spent in three different behavioural states (transit, locally active, inactive) during the 1 h exposure (Hubert et al. 2020).

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

6.3 Marine-Associated Birds

Recent publications relevant to the effects of vessel lighting and accidental release of hydrocarbons on marine-associated birds have become available since the original EA and 2019/2020 EA Update (LGL 2018a, 2019, 2020b); these studies are summarized below.

6.3.1 Vessel Lighting

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

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

The various colours emitted by different kinds of electrical lighting have differing effects on nocturnally active birds. In studies of passerines (songbirds and suboscine birds; Passeriformes) nocturnally migrating, continuous green, blue, or white light attracted significantly higher numbers of birds than continuous red light, but only when the sky was overcast (Rebke et al. 2019). A field experiment by Zhao et al. (2020) on nocturnally migrating birds showed similar results. Blue light attracted 7.8 times as many birds as red light, green light attracted 4.7 times as many birds as red, and yellow light attracted 3.5 times as many birds as red (Zhao et al. 2020). Fog resulted in 33 times as many birds attracted as clear weather, probably because the migrating birds were forced to fly at much lower altitudes (Zhao et al. 2020).

Atchoi et al. (2020) propose that the propensity for recently fledged young seabirds to strand as a result of artificial light may be due to their eyes not having achieved emmetropia. This is the ability of the eye to produce a well-focused image, which is attained after a period of visual stimulation. In burrow-nesting seabird species this visual stimulation does not occur until the young leave the dark burrow. Visual development has not been studied in seabirds, but in terrestrial species emmetropia is achieved after one to two weeks of visual exposure.

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.

The effects of marine oil spills on wildlife, including seabirds, are underreported. Among over 1700 spills in the time period from 1970 to 2018, only 18% were reported to have had effects on marine wildlife (Chilvers et al. 2021). The majority of reported casualties were seabirds (Chilvers et al. 2021). Most reports of wildlife impacts were associated with large spills from tankers and oil wells, probably due to their greater visibility, publicity, and coordinated oiled wildlife responses (Chilvers et al. 2021). As a result, the impacts of spills of intermediate and lighter fuel oils from cargo shipping are underreported. Data from these spills also supported previous research that suggests that wildlife impacts are not proportional to the volume of oil released (Chilvers et al. 2021).

Hunter et al. (2019) assessed overall avian mortality arising from the MV *Rena* spill in New Zealand in 2011. Like other spills, most of the carcasses recovered were found in the first week after the vessel grounded (Hunter et al. 2019). Necropsies found that the most frequent primary diagnosis was extensive oiling, which caused hypothermia, drowning, and starvation (Hunter et al. 2019). Another common diagnosis was dehydration/starvation, due directly to oiling that caused a reduced ability to forage, or indirectly due to oil effects on prey availability and distribution (Hunter et al. 2019). The cause of death for remainder of the carcasses could not be determined due to decomposition.

Barron et al. (2020) reviewed the long-term ecological impacts of the Exxon Valdez, Hebei Spirit, and Deepwater Horizon spills (Barron et al. 2020). The Exxon Valdez spill showed a total mortality of 250,000 seabirds and 250 Bald Eagles (Barron et al. 2020). Long-term studies have shown that the survival rate of Harlequin Ducks recovered after 14 years but that monitoring revealed that exposure to polycyclic hydrocarbons persisted for 22 years (Barron et al. 2020). Estimates of the number of seabirds affected by the Deepwater Horizon spill range from 10,000 to 0.5 million birds (Barron et al. 2020). This mortality is hypothesized to have caused an ecological cascade affecting prey fish and plankton in the Gulf of Mexico (Barron et al. 2020). However, the Heibei Spirit spill was not reported to have had significant effects on seabird populations. Before the Exxon Valdez spill, the impacts of spills were thought to be short-term and controlled by monoaromatic and less persistent components of oil (Barron et al. 2020). However, study of these spills and others have since shown that highly weathered oil contains substantial proportions of hydrocarbon and heterocyclic aromatics, and oxidized polycyclic aromatic hydrocarbons (Barron et al. 2020).

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 and 2020 Updates (LGL 2018a, 2019, 2020b) 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). 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).

Behavioural reactions of marine mammals to sound are difficult to predict in the absence of site- and context-specific data (Ellison et al. 2018), and numerous data gaps remain regarding the consequences of those responses (Elliott et al. 2019). As behavioural responses are not consistently associated with received levels, Tyack and Thomas (2019) along with other authors have made recommendations on different approaches to assess behavioural reactions.

Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Barkaszi and Kelly 2019). A summary of vessel-based monitoring data from the Gulf of Mexico during 2002–2015 showed that delphinids were seen significantly farther from the vessel during seismic than during non-seismic periods (Barkaszi and Kelly 2019). However, sightings of sperm whales were at similar average distances regardless of the airgun status (Barkaszi and Kelly 2019). Avoidance behaviour and/or decreases in echolocation signals during 3-D seismic operations were reported for harbour porpoise in the North Sea (Sarnocińska et al. 2020). Dunlop et al. (2020) found that humpback whales were significantly less likely to interact socially (e.g., joining a group) in the presence of a vessel, whether it was towing an active airgun array or not, at received sound levels lower than 160 dB re 1 $\mu Pa^2 \cdot s$.

Single or occasional occurrences of mild temporary threshold shift (TTS) are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS (e.g., Reichmuth et al. 2019). Based on studies that exposed harbour porpoises to one-sixth-octave noise bands ranging from 1 to 88.4 kHz, Kastelein et al. (2019b,c, 2020d,e) noted that susceptibility to TTS increases with an increase in frequencies below 6.5 kHz, but declines with an increase in frequency above 6.5 kHz.

Harbour seals appear to be equally susceptible to incurring TTS when exposed to sounds from 2.5 to 40 kHz (Kastelein et al. 2020a,b), but at frequencies of 2 kHz or lower, a higher SEL was required to elicit the same TTS (Kastelein et al. 2020c). No TTS was measured when a bearded seal was exposed to a single airgun pulse with an unweighted SEL of 185 dB and an SPL of 207 dB; however, TTS was elicited at 400 Hz when the seal was exposed to four to ten consecutive pulses with a cumulative unweighted SEL of 191–195 dB and a weighted SEL of 167–171 dB (Sills et al. 2020). 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. In addition, several studies have shown that some marine mammals (e.g., harbour porpoise, bottlenose dolphins) can decrease their hearing sensitivity or change orientation in order to mitigate the impacts of exposure to loud sounds (e.g., Finneran 2020; Kastelein et al. 2020f).

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

Although Hastie et al. (2019) noted that the impulsive nature of sound is range-dependent, becoming less harmful (and non-impulsive) for marine mammals with distance from the source, Martin et al. (2020) noted that sound retains its impulsive character at sound pressure levels (SPLs) above the effective quiet threshold. Additionally, as SPLs for impulsive sounds are generally lower just below the water surface, animals (e.g., seals) swimming near the surface are likely to be exposed to lower sound levels than when swimming at depth (Kastelein et al. 2018). However, the underwater sound hearing sensitivity for seals is the same near the surface and at depth (Kastelein et al. 2018).

Recent assessments and status reports for sei, fin, and Sowerby's beaked whales reported the threat from noise from seismic exploration as medium-low (COSEWIC 2019a,b,c). Anthropogenic noise was deemed to be a threat to the recovery of the Northwest Atlantic blue whale, North Atlantic right whale, and St. Lawrence Estuary beluga whale, and the Action Plans for those species call for measures to reduce the negative impact of noise (DFO 2020a,b,c). The Threat Assessment for leatherback sea turtle indicates that the threat risk of underwater noise is unknown (DFO 2020d). Nonetheless, in the Action Plan for Atlantic leatherback turtles, one of the measures listed therein was to "Reduce leatherback sea turtle exposure to potentially harmful levels of underwater noise…..and evaluate the use of the '*Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment*' with respect to leatherback sea turtles" (DFO 2020e). In recent review of the Statement of Canadian Practice (SOCP), numerous recommendations were made for changes to the SOCP in order to protect marine species, including sea turtles (Moulton et al. 2020). It appears that there is sufficient new information to warrant an update to the measures in the SOCP (DFO 2020f).

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 2021 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 2021. 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 2021 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 and 2020 EA Updates (LGL 2019, 2020b) and in the 3D survey areas considered in this EA Update, including the most recent commercial fisheries data (from 2017–2018) available. In 2021, it is anticipated that the commercial harvest species, and the timing and locations of commercial fisheries within the Study Area will be like 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 the EA Updates (LGL 2019. 2020b).

A Marine Traffic (2021) website was accessed and provided information on vessel density for 2018 and 2019 relative to the Project Area and 3D survey areas planned for 2021. 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 2018 and 2019, 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 2021). 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 2021.

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 2018 (Figure 6.1) and 2019 (Figure 6.2). There were relatively few vessel transits recorded in the northern portion of the Project Area, including the Orphan Basin and EL1149 3D survey areas. Overall, shipping traffic data from 2018 and 2019 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.

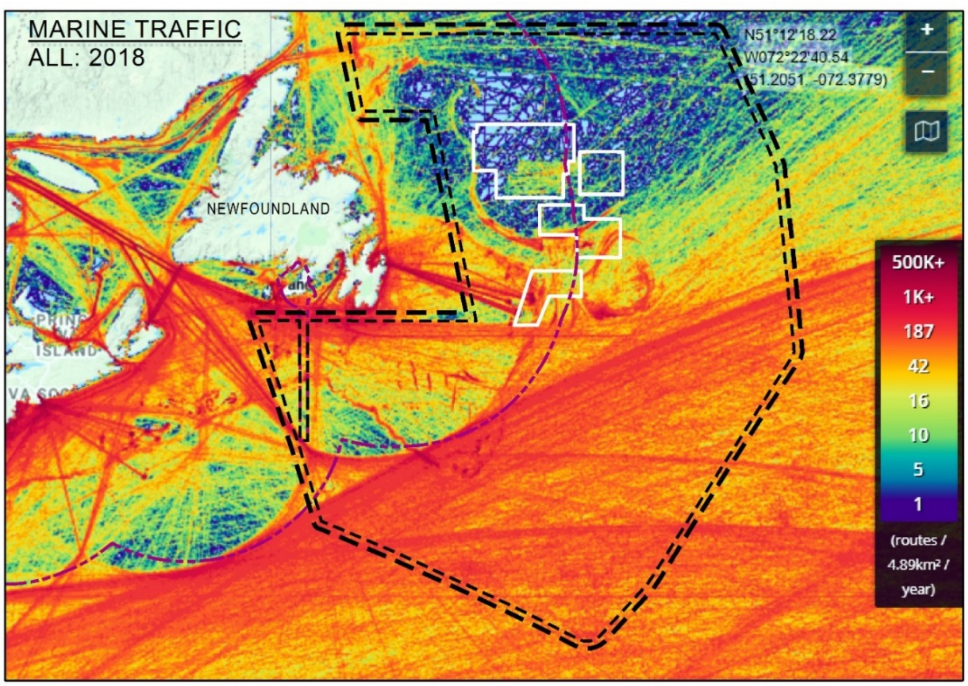


Figure 6.1. Marine shipping traffic density (routes per 4.89 km^2 grid cell) in 2018 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2021 3D Survey Areas.

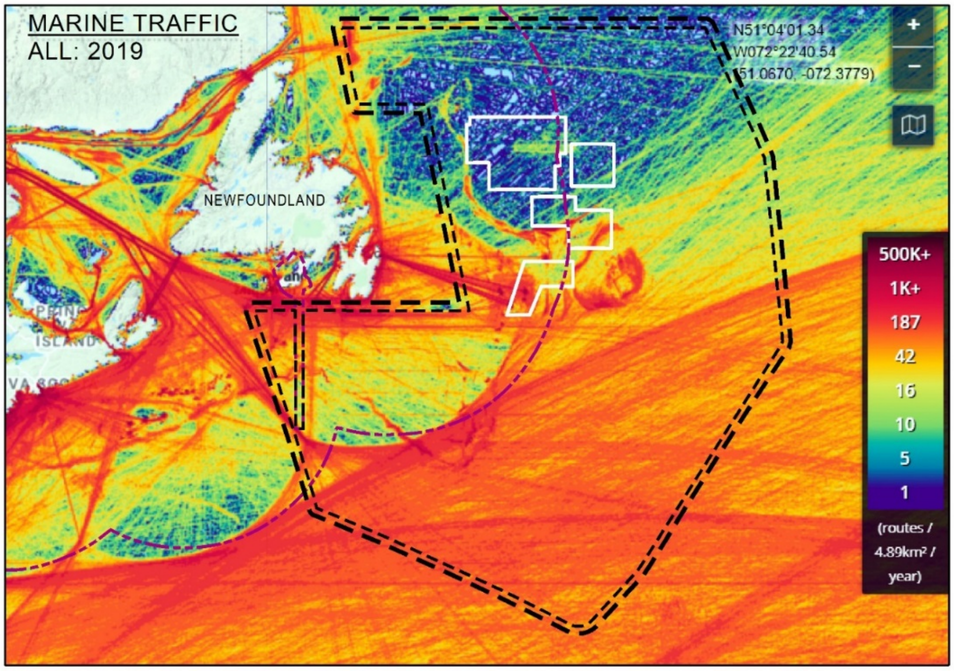


Figure 6.2. Marine shipping traffic density (routes per 4.89 km^2 grid cell) in 2019 in the MKI Project and Study Areas (depicted with small and large dashed lines, respectively) and the Planned 2021 3D Survey Areas.

6.5.1.3 Oil and Gas Activities

In 2021, MKI is planning to simultaneously conduct two 3D seismic surveys offshore Newfoundland during the late-May to early September period (Figure 6.3). The timing of the planned MKI surveys is shown in Table 2.1. MKI will not survey in Labrador in 2021. Note that it is unlikely that EL1158 survey area will be surveyed in 2021. If surveying does occur there, it will be conducted with the *Ramform Atlas*. At the start of surveying in 2021, the *Ramform Titan* will be surveying in the Cape Anguille (Orphan Basin) MC3D survey area while the *Ramform Atlas* will be surveying in the Cambriol MC3D survey area. Concurrent surveying within these two survey areas would occur for four weeks with a closest point of approach (CPA) of about 60 km. Following this, the *Atlas* will acquire data in EL 1149 MC3D survey area, where a minimum CPA of 30 km will be maintained with the *Titan* in the Cape Anguille (Orphan Basin) MC3D survey area. The *Atlas* will then transit farther south to survey in the Jeanne d'Arc HD3D Completion survey area for three weeks (the CPA to the Cape Anguille MC3D survey area is 171 km). Based on a review of the C-NLOPB website, there are currently no indications that other seismic surveys will occur in 2021. 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. Two developments fall within the Jeanne d'Arc HD3D survey area and one falls just outside of this survey area. Underwater sound generated from production installations and attending support vessels have lower source levels and are continuous in nature versus those produced during seismic surveys. CNOOC is currently drilling a single well with the *Stena Forth* in EL 1144 with the drilling authorization valid until 20 September 2021. MKI will avoid close approach to production developments and the CNOOC exploratory drilling activities which may occur in its planned survey areas (and other areas of the Project Area) unless appropriate SIMOPS plans are in place. MKI commits to communicating closely with production and exploratory drilling operators to ensure appropriate spatial separation of activities.

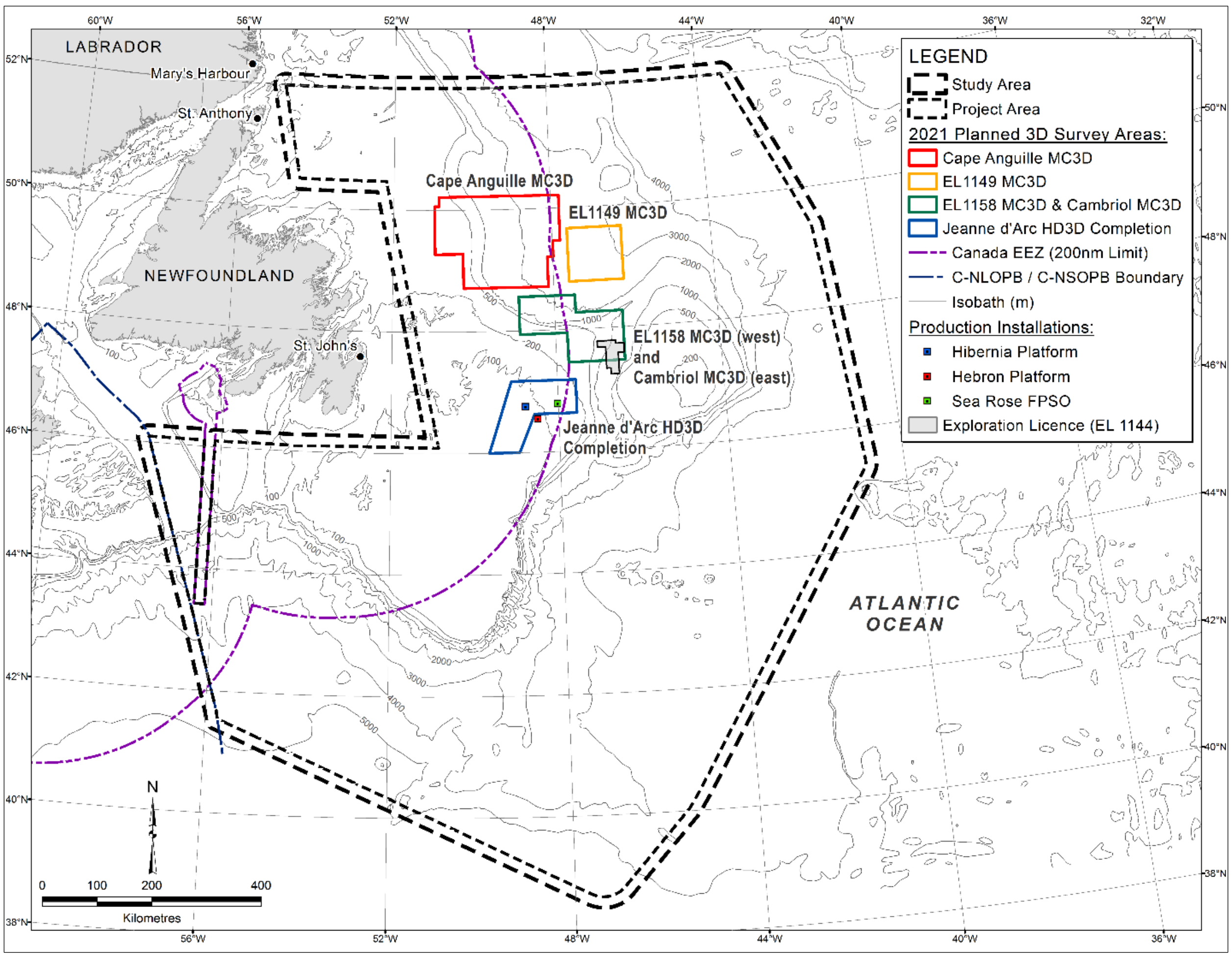


Figure 6.3. Locations of MKI's planned 3D seismic survey areas in 2021. Also shown are the production installations on the Grand Banks and EL 1148.

6.5.1.4 Consideration of Combined Activities

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

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

7.0 Concluding Statement

The 3D seismic survey activities proposed by MKI for 2021 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 2021 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.

8.0 References

Atchoi, E., M. Mitkus, and A. Rodríguez. 2020. Is seabird light-induced mortality explained by the visual system development? Conservation Science and Practice 2:csp2.195.

Barkaszi, M.J. and C.J. Kelly. 2018. Seismic survey mitigation measures and protected species observer reports: synthesis report. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. Contract No.: M17PD00004. OCS Study BOEM 2019-012. 220 p.

Barron, M.G., D.N. Vivian, R.A. Heintz, and U.H. Yim. 2020. Long-term ecological impacts from oil spills: comparison of Exxon Valdez, Hebei Spirit, and Deepwater Horizon. Environmental Science & Technology 54:6456-6467.

Bröker, K.C. 2019. An overview of potential impacts of hydrocarbon exploration and production on marine mammals and associated monitoring and mitigation measures. **Aquatic Mammals** 45(6): 576-611.

CBD (Convention on Biological Diversity). 2021. EBSAs. Available at https://www.cbd.int/ebsa/ebsas

Chilvers, B.L., K.J. Morgan, and B.J. White. 2021. Sources and reporting of oil spills and impacts on wildlife 1970-2018. Environmental Science and Pollution Research International 28:754-762.

Christiansen, F., S.M. Dawson, J.W. Durban, H. Fearnbach, C.A. Miller, L. Bejder, M. Uhart, M. Sironi, P. Corkeron, W. Rayment, E. Leunissen, E. Haria, R. Ward, H.A. Warick, I. Kerr, M.S. Lynn, H.M. Pettis, and J.J. Moore. 2020. Population comparison of right whale body condition reveals poor stat of the North Atlantic right whale. **Mar. Ecol. Prog. Ser.** 640:1-16.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2010. Southern Newfoundland strategic environmental assessment. LGL Rep. SA1037. Rep. by LGL Limited, Oceans Limited, Canning & Pitt Associates, Inc., and PAL Environmental Services, St. John's, NL for Canada-Newfoundland and Labrador Offshore Petroleum Board, St. John's, NL. 332 p. + appendix.

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

C-NLOPB. 2019. Geophysical, Geological, Environmental and Geotechnical Program Guidelines, June 2019. 43 p + appendices.

COSEWIC. 2019a. COSEWIC assessment and status report on the sei whale *Balaenoptera borealis*, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 48 p.

COSEWIC. 2019b. COSEWIC assessment and status report on the fin whale *Balaenoptera physalus*, Atlantic population and Pacific population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xv + 72 p.

COSEWIC. 2019c. COSEWIC assessment and status report on the Sowerby's beaked whale *Mesoplodon bidens* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 41 p.

Cote, C., C.J. Morris, P.M. Regular, and M.G. Persiak. 2020. Effects of 2D seismic on snow crab movement behaviour. **Fish. Res.** 230: 105661. Doi: 10.1016/j.fishres.2020.105661.

Cyr, F., S. Snook, C. Bishop, P.S. Galbraith, B. Pye, N. Chen, and G. Han. 2021. Physical Oceanographic Conditions on the Newfoundland and Labrador Shelf during 2019. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/017. iv + 52 p.

Davis, G.E., M.F. Baumgartner, P.J. Corkeron, J. Bell, C. Berchok, J.M. Bonnell, J.B. Thornton, S. Brault, G.A. Buchanan, D.M. Cholewiak, C.W. Clark, J. Delarue, L.T. Hatch, H. Klinck, S.D. Kraus, B. Martin, D.K. Mellinger, H. Moors-Murphy, S. Nieukirk, D.P. Nowacek, S.E. Parks, D. Parry, N. Pegg, A.J. Read, A.N. Rice, D. Risch, A. Scott, M.S. Soldevilla, K.M. Stafford, J.E. Stanistreet, E. Summers, S. Todd, and S.M. Van Parijs. 2020. Exploring movement patterns and changing distributions of baleen whales in the western North Atlantic using a decade of passive acoustic data. **Glob. Chang. Biol.** 26(9):4812-4840.

Day, R.D., Q.P. Fitzgibbon, R.D. McCauley, K. Hartmann, and J.M. Semmens. 2020. Lobsters with pre-existing damage to their mechanosensory statocyst organs do not incur further damage from exposure to seismic air gun signals. **Environ. Poll.** 267: 115478. Doi:10.1016/j.envpol.2020.115478

DFO. 2014. Offshore Ecologically and Biologically Significant Areas in the Scotian Shelf Bioregion. DFO Can. Sci. Advis. Sec. Sci Advis. Rep. 2014/041. 16 p. + appendix.

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

DFO. 2018. Identification of habitats important to the blue whale in the western North Atlantic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/003. 13 p. + appendix.

DFO. 2020a. 2020 offshore Arctic surf clam fishery – Banquereau and Grand Bank. Available at https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/fm-2020-gp/atl-01-eng.html.

DFO. 2020b. Stock Assessment of NAFO Subdivision 3Ps Cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/2018.

DFO. 2020c. Stock assessment of NAFO Subdivision 3Ps American Plaice in 2019. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/017.

DFO. 2020d. 2J3KLPs Capelin Management Plan 2019. Available at https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/fm-2019-gp/atl-20-eng.html.

DFO. 2020e. Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. Fisheries and Oceans Canada, Ottawa. vii + 81 p.

DFO. 2020f. Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada. *Species at Risk Act* Action Plan Series. Fisheries and Oceans Canada, Ottawa. v + 25 p.

DFO. 2020g. Fisheries management decisions. Fisheries and Oceans Canada, Government of Canada. Available at https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/index-eng.html.

DFO. 2020h. Assessment of the distribution, movements, and habitat use of northern bottlenose whales on the Scotian Shelf to support the identification of important habitat. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/008.

DFO. 2021a. Assessment of Newfoundland and Labrador (Divisions 2HJ3KLNOP4R) Snow Crab. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/009.

DFO. 2021b. Fisheries management decisions. Fisheries and Oceans Canada, Government of Canada. Available at https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/index-eng.html.

DFO. 2021c. An Assessment of Northern Shrimp (*Pandalus borealis*) in Shrimp Fishing Areas 4-6 in 2019. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/010.

DFO. 2021d. 2020 Stock Status Update for Northern Cod. DFO Can. Sci. Advis. Sec. Sci. Resp. 2021/004.

DFO. 2021e. Newfoundland and Labrador Angler's Guide 2020-2021. Fisheries and Oceans Canada, Communications branch, Newfoundland and Labrador Region. 52 p.

Dunlop, R.A., R.D. McCauley, and M.J. Noad. 2020. Ships and air guns reduce social interactions in humpback whales at greater ranges than other behavioral impacts. **Mar. Poll. Bull.** 154:111072. doi:10.1016/j.marpolbul.2020.111072.

Elliott, B.W., A.J. Read, B.J. Godley, S.E. Nelms, and D.P. Nowacek. 2019. Critical information gaps remain in understanding impacts of industrial seismic surveys on marine vertebrates. **Endang. Species Res.** 39: 247-254.

Ellison, W.T., B.L. Southall, A.S. Frankel, K. Vigness-Raposa, and C.W. Clark. 2018. An acoustic scene perspective on spatial, temporal, and spectral aspects of marine mammal behavioral responses to noise. **Aquat. Mamm.** 44(3): 239-243.

Erbe, C., M. Dähne, J. Gordon, H. Herata, D.S. Houser, S. Koschinski, R. Leaper et al. 2019. Managing the effects of noise from ship traffic, seismic surveying and construction on marine mammals in Antarctica. **Front. Mar. Sci.** 6:647.

Finneran, J.J. 2020. Conditional attenuation of dolphin monaural and binaural auditory evoked potentials after preferential stimulation of one ear. **J. Acoust. Soc. Am.** 147(4):2302-2313.

FLR (Fisheries and Land Resources). 2021. Aquaculture. Fisheries and Aquaculture, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador, Canada. Available at https://www.fishaq.gov.nl.ca/aquaculture/index.html.

Gomez, C., J. Lawson, A.-L. Kouwenberg, H. Moors-Murphy, A. Buren, C. Fuentes-Yaco, E. Marotte, Y.F. Wiersma, and T. Wimmer. 2017. Predicted distribution of whales at risk: identifying priority areas to enhance cetacean monitoring in the Northwest Atlantic Ocean. **Endang. Species. Res.** 32:437-458. Doi:10.3354/esr00823

Gomez C., C.M. Konrad, A. Vanderlaan, H. Moors-Murphy, E. Marotte, J. Lawson, A.-L. Kouwenberg, C. Fuentes-Yaco, and A. Bure. 2020. Identifying priority areas to enhance monitoring of cetaceans in the Northwest Atlantic Ocean. Can. Tech. Rep. Fish. Aquat. Sci. 3370:vi + 103 p.

Government of Canada. 2018. Guidelines to avoid disturbance to seabird and waterbird colonies in Canada. Available at:
https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/avoid-disturbance-seabird-waterbird-colonies-canada.html Accessed: 16 March 2020.

Gullage, L., R. Devillers, and E. Edinger. 2017. Predictive distribution modelling of cold-water corals in the Newfoundland and Labrador region. **Mar. Ecol. Prog. Ser**., 582: 57-77.

Hall, J.R., S.J. Lehnert, E. Gonzalez, S. Kumar, J.M. Hanlon, C.J. Morris, and M.L. Rise. 2021. Snow crab *(Chionoecetes opilio*) hepatopancreas transciptome: Identification and testing of candidate molecular biomarkers of seismic survey impact. **Fish. Res.** 234: 105794. Doi: 10.1016/j.fishres.2020.105794.

Harding, H.R., T.A.C. Gordon, E. Eastcott, S.D. Simpson, and A.N. Radford. 2019. Causes and consequences of intraspecific variation in animal responses to anthropogenic noise. **Behav. Ecol.** 30(6):1501-1511.

Hastie, G., N.D. Merchant, T. Götz, D.J. Russell, P. Thompson, and V.M. Janik. 2019. Effects of impulsive noise on marine mammals: investigating range-dependent risk. **Ecol. Appl.** 15: e01906.

Hubert, J., J.A. Campbell, and H. Slabbekorn. 2020. Effect of seismic airgun playbacks on swimming patterns and behavioural states of Atlantic cod in a net pen. **Mar. Poll. Bull.** 160: 111680.

Hunter, S.A., A.J.D. Tennyson, J.A. Bartle, C.M. Miskelly, S.M. Waugh, H.M. McConnell, K.J. Morgan, S.T. Finlayson, S.M. Baylis, B.L. Chilvers, and B.D. Gartrell. 2019. Assessing avian mortality during oil spills: a case study of the New Zealand MV "Rena" oil spill 2011.

Johnson, K.F. and G.K. Davoren. 2021. Distributional patterns of humpback whales (*Megaptera novaeangliae*) along the Newfoundland East Coast reflect their main prey, capelin (*Mallotus villosus*). **Mar. Mamm. Sci.** 37:80-97.

Kastelein, R.A., L. Helder-Hoek, and J.M. Terhune. 2018. Hearing thresholds, for underwater sounds, of harbor seals (*Phoca vitulina*) at the water surface. **J. Acoust. Soc. Am.** 143: 2554-2563.

Kastelein, R.A., L. Helder-Hoek, and R. Gransier. 2019a. Frequency of greatest temporary hearing threshold shift in harbor seals (*Phoca vitulina*) depends on fatiguing sound level. **J. Acoust. Soc. Am.** 145(3):1353-1362.

Kastelein, R.A., L. Helder-Hoek, R. van Kester, R. Huisman, and R. Gransier. 2019b. Temporary threshold shift in harbor porpoises (*Phocoena phocoena*) due to one-sixth octave noise band at 16 kHz. **Aquat. Mamm.** 45(3):280-292.

Kastelein, R.A., L. Helder-Hoek, S. Cornelisse, L.A.E. Huijser, and R. Gransier. 2019c. Temporary threshold shift in harbor porpoises (*Phocoena phocoena*) due to one-sixth octave noise band at 32 kHz. **Aquat. Mamm.** 45(5):549-562.

Kastelein, R.A., L. Helder-Hoek, C. Booth, N, Jennings, and M. Leopold. 2019d. High levels of food intake in harbor porpoises (*Phocoena phocoena*): insight into recovery from disturbance. **Aquat. Mamm.** 45(4):380-388.

Kastelein, R.A., L. Helder-Hoek, S.A. Cornelisse, L.A.E. Huijser, and J.M. Terhune. 2020a. Temporary hearing threshold shift in harbor seals (*Phoca vitulina*) due to a one-sixth-octave noise band centered at 32 kHz. **J. Acoust. Soc. Am.** 147(3):1885-1896.

Kastelein, R.A., C. Parlog., L. Helder-Hoek, S.A. Cornelisse, L.A.E. Huijser, and J.M. Terhune. 2020b. Temporary hearing threshold shift in harbor seals (*Phoca vitulina*) due to a one-sixth-octave noise band centered at 40 kHz. **J. Acoust. Soc. Am.** 147(3):1966-1976.

Kastelein, R.A., L. Helder-Hoek, S.A. Cornelisse, L.N. Defillet, L.A.E. Huijser, and J.M. Terhune. 2020c. Temporary hearing threshold shift in harbor seals (*Phoca vitulina*) due to a one-sixth-octave noise bands centered at 0.5, 1, and 2 kHz. **J. Acoust. Soc. Am.** 148(6):3873-3885.

Kastelein, R.A., L. Helder-Hoek, S.A. Cornelisse, L.N. Defillet, L.A.E. Huijser, and J.M. Terhune. 2020d. Temporary hearing threshold shift in harbor porpoises (*Phocoena phocoena*) due to one-sixth-octave noise bands centered at 63 kHz. **Aquat. Mamm.** 46(2):167-182.

Kastelein, R.A., L. Helder-Hoek, S.A. Cornelisse, L.A.E. Huijser, and J.M. Terhune. 2020e. Temporary hearing threshold shift at ecologically relevant frequencies in a harbor porpoise (*Phocoena phocoena*) due to exposure to a noise band centered at 88.4 kHz. **Aquat. Mamm.** 46(5):444-453.

Kastelein, R.A., L. Helder-Hoek, S.A. Cornelisse, A.M. von Benda-Beckmann, F.P.A. Lam, C.A.F. de Jong, and D.R. Ketten. 2020f. Lack of reproducibility of temporary hearing threshold shifts in a harbor porpoise after exposure to repeated airgun sounds. **J. Acoust. Soc. Am.** 148:556-565.

Kavanagh, A.S., M. Nykänen, W. Hunt, N. Richardson, and M.J. Jessopp. 2019. Seismic surveys reduce cetacean sightings across a large marine ecosystem. **Sci. Rep.** 9: 19164. Doi:10.1038/s41598-019-55500-4.

Kenchington, E., L. Beazley, C. Lirette, J. Murillo-Perez, J. Guijarro-Sabaniel, V. Wareham, K. Gilkinson, M. Koen-Alonso, H. Benoit, H. Bourdages, B. Sainte-Marie, M. Treble, and T. Siferd. 2018a. Delineation of coral and sponge significant benthic areas in eastern Canada using kernel density analyses and species distribution models. DOI: 10.17632/hnp4xr2sy3.1. Available at https://data.mendeley.com/datasets/hnp4xr2sy3/1.

Kenchington, E., C. Lirette, J. Murillo-Perez, L. Beazley, J. Guijarro-Sabaniel, V. Wareham, K. Gilkinson, M. Koen-Alonso, H. Benoit, H. Bourdages, B. Sainte-Marie, and M. Treble. 2018b. Kernal density analyses of coral and sponge catches form research vessel survey data for use in identification of significant benthic areas. DOI: 10.17632/dtk86rjm86.1. Available at https://data.mendeley.com/datasets/dtk86rjm86/1.

Krug, D.M, R. Frith, S.N.P. Wong, R.A. Ronconi, S.I. Wilhelm, N.J. O'Driscoll, and M.L. Mallory. 2021. Marine pollution in fledged Leach's storm-petrels (*Hydrobates leucorhous*) from Baccalieu Island, Newfoundland and Labrador, Canada. **Mar. Poll. Bull**. 162 (2021) 111842.

Kyhn, L.A., D.M. Wisniewska, K. Beedholm, J. Tougaard, M. Simon, A. Mosbech, and P.T. Madsen. 2019. Basin-wide contributions to the underwater soundscape by multiple seismic surveys with implications for marine mammals in Baffin Bay, Greenland. **Mar. Poll. Bull.** 138: 474-490.

Lefort, K.J., C.J.D. Matthews, J.W. Higdon, S.D. Petersen, K.H. Westdal, C.J. Garroway, and S.H. Ferguson. 2020. A review of Canadian Arctic killer whale (*Orcinus orca*) ecology. **Can. J. Zool.** 98(999):245-253.

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

LGL. 2015a. Environmental Assessment of WesternGeco's Southeastern Newfoundland Offshore Seismic Program, 2015-2024. LGL Rep. FA0034. Prepared by LGL Limited in association with Canning & Pitt Associates Inc., St. John's, NL for WesternGeco (Division of Schlumberger Canada Limited), Calgary, AB. 283 p. + appendices.

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

LGL. 2016. Environmental assessment update of the MKI Northeast Newfoundland Slope 2D Seismic Survey Programme, 2012–2017. LGL Rep. FA0075. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 32 p. + appendices.

LGL. 2018a. Environmental assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023. LGL Rep. FA0106A. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 233 p. + appendix.

LGL. 2018b. Addendum to the environmental assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023. LGL Rep. FA0106A-1. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 25 p. + appendix.

LGL. 2018c. Environmental Assessment Update (2018) of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023. LGL Rep. FA0106A-2. Prepared by LGL Limited, St. John's, Newfoundland and Labrador for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA.10 p. + appendices.

LGL. 2019. Environmental assessment update (2019) of Multiklient Invest Newfoundland Offshore Seismic Program, 2018−2023. LGL Rep. FA0179. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 100 p. + appendices.

LGL. 2020a. Amendment to Environmental Assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023. LGL Rep. FA0203. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 4 p.

LGL. 2020b. Environmental Assessment Update (2020) of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023. LGL Rep. FA0204-01. Prepared by LGL Limited, St. John's, Newfoundland and Labrador, for Multiklient Invest AS, Oslo. 86 p. + appendices.

LGL Limited. 2021. Amendment to Environmental Assessment of Multiklient Invest Newfoundland Offshore Seismic Program, 2018–2023. LGL Rep. FA0225. Rep. by LGL Limited, St. John's, NL for Multiklient Invest AS, Oslo, Norway, and TGS-NOPEC Geophysical Company ASA, Houston, Texas, USA. 8 p.

Lucke, K., S.B. Martin, and R. Racca. 2020. Evaluating the predictive strength of underwater noise exposure criteria for marine mammals. **J. Acoust. Soc. Am.** 147:3985. doi:10.1121/10.0001412.

Marine Traffic. 2021. Density maps. Available at https://www.marinetraffic.com/en/ais/home/centerx:-58.9/centery:56.1/zoom:5.

Martin, S.B., K. Lucke, and D.R. Barclay. 2020. Techniques for distinguishing between impulsive and non-impulsive sound in the context of regulating sound exposure for marine mammals. **J. Acoust. Soc. Am.** 147:2159-2176.

Matthews, M.R., D.S Ireland, D.G. Zeddies, R.H. Brune, and C.D. Pyć. A Modeling Comparison of the Potential Effects on Marine Mammals from Sounds Produced by Marine Vibroseis and Air Gun Seismic Sources. **J. Mar. Sci. Eng**. 2021, 9, 12. https://dx.doi.org/10.3390/jmse9010012

Mauro, M., I. Pérez-Arjona, E.J.B. Perez, M. Ceraulo, M. Bou-Cabo, T. Benson, V. Espinosa, F. Beltrae, S. Mazzola, M. Vazzana, and G. Buscaino. 2020. The effects of low frequency noise on the behaviour of juvenile *Sparus aurata*. **J. Acoust. Soc. Am.** 147: 3795. Doi: 10.1121/10.0001255.

MCI (Marine Conservation Institute). 2021. Atlas of marine protection. Available at http://www.mpatlas.org/map/mpas/.

Montevecchi, W.A., P.M. Regular, J.-F. Rail, K. Power, C. Mooney, K.J.N. D'Entremont, S. Garthe, L. Guzzwell, and S.I. Wilhelm. 2021. Ocean heat wave induces breeding failure at the southern breeding limit of the Northern Gannet *Morus bassanus*. **Mar. Ornithol.** 49: 71–78.

Morris, C.J., D. Cote, S.B. Martin, and D. Mullowney. 2020. Effects of 3D seismic surveying on snow crab fishery. **Fish. Res.** 232: 105719. Doi: 10.1016/j.fishres.2020.105719.

Morris, C.J., D. Cote, B. Martin, R. Saunders-Lee, M. Rise, J. Hanlon, J. Payne, P.M. Regular, D. Mullowney, J.C. Perez-Casanova, M.G. Persiak, J. Xu, V. Han, D. Kehler, J.R. Hall, S. Lehnert, E. Gonzalez, S. Kumar, I. Bradbury, and N. Paddy. 2021. As assessment of seismic surveys to affect Snow Crab resources. St. John's, NL. Environmental Research Fund Report No. 200. 92 p.

Moulton, V.D., A. d'Entremont, and J.R. Christian. 2020. Review of the 2008 Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/041. xi + 109 p.

NAFO (Northwest Atlantic Fisheries Organization). 2021. NAFO conservation and enforcement measures 2021. Serial No. N7153. NAFO/COM Doc. 21-01. 82 p. + annexes. Available at https://www.nafo.int/Fisheries/Conservation

NAMMCO (North Atlantic Marine Mammal Commission). 2018. Report of the workshop Cetacean abundance and distribution in the north Atlantic. 28 and 29 October 2017, Halifax, Nova Scotia, Canada.

Nordstrom, B., M.C. James, and B. Worm. 2020. Jellyfish distribution in space and time predicts leatherback sea turtle hot spots in the Northwest Atlantic. **PLoS ONE** 15(5):e0232628. doi:10.1371/journal.pone.0232628.

Nowak, B.V.R., W.D. Bowen, K. Whoriskey, D.D. Lidgard, J.E. Mills Flemming, and S.J. Iverson. 2020. Foraging behaviour of a continental shelf marine predator, the grey seal (*Halichoerus grypus*), is associated with in situ, subsurface oceanographic conditions. **Move. Ecol.** 8(41):1-14. doi:10.1186/s40462-020-00225-7.

OSPAR (Commission). 2021. OSPAR MPA database and webtool. Available at https://www.ospar.org/work-areas/bdc/marine-protected-areas/mpa-webtool.

Pace, R.M. III, R. Williams, S.D. Kraus, A.R. Knowlton, and H.M. Pettis. 2021. Cryptic mortality of North Atlantic right whales. **Conserv. Sci. Prac.** 3(2):e346. doi:10.1111/csp2.346.

Penney-Belbin, S.N. 2020a. Marine mammal, seabird, and passive acoustic monitoring of the Multiklient Invest Newfoundland Offshore Seismic Program, Blomidon 3D Survey Area (25 May−23 July 2020). LGL Rep. FA0207-02. Prepared by LGL Limited, St. John's, Newfoundland and Labrador, for Petroleum Geo-Services, Oslo, Norway. 29 p. + appendices.

Penney-Belbin, S.N. 2020b. Marine mammal, seabird, and passive acoustic monitoring of the Multiklient Invest Newfoundland Offshore Seismic Program, South Bank 3D Survey Area (29 June–11 August 2020). LGL Rep. FA0207-01. Prepared by LGL Limited, St. John's, Newfoundland and Labrador, for Petroleum Geo-Services, Oslo. 31 p. + appendices.

Perreault, A.M.J., L.J. Wheelend, M.J. Morgan, and N.G. Cadigan. 2020. A state-space stock assessment model for American plaice on the Grand Bank of Newfoundland. **J. Northw. Atl. Fish. Sci.** Vol. 51: 45-104.

Pettis, H.M., R.M. Pace III, and P.K. Hamilton. 2021. North Atlantic Right Whale Consortium 2020 Annual Report Card. Report to the North Atlantic Right Whale Consortium.

Popov, V.V., A.Y. Supin, A.P. Gvozdeva, D.I. Nechaev, M.B. Tarakanov, and E.V. Sysueva. 2020. Spatial release from masking in a bottlenose dolphin *Tursiops truncatus*. **J. Acoust. Soc. Am.** 147(3):1719-1726.

Protected Planet. 2021. World database on protected areas. Available at https://www.protectedplanet.net/ .

Rako-Gospić, N. and M. Picciulin. 2019. Underwater Noise: Sources and Effects on Marine Life. p. 367-389 *In:* C. Sheppard (ed.) World Seas: An Environmental Evaluation, Academic Press.

Rebke, M., V. Dierschke, C.N. Weiner, R. Aumüller, K. Hill, and R. Hill. 2019. Attraction of nocturnally migrating birds to artificial light: The influence of colour, intensity and blinking mode under different cloud cover conditions. **Biol. Conserv.** 233: 220-227.

Reichmuth, C., J.M. Sills, J. Mulsow, and A. Ghoul. 2019. Long-term evidence of noise-induced permanent threshold shift in a harbor seal (*Phoca vitulina*). **J. Acoust. Soc. Am.** 146(4):2552-2561.

Sarnocińska J., J. Teilmann, J.D. Balle, F.M. van Beest, M. Delefosse, and J. Tougaard. 2020. Harbor porpoise (*Phocoena phocoena*) reaction to a 3D seismic airgun survey in the North Sea. **Front. Mar. Sci.** 6:824. doi:10.3389/fmars.2019.00824

Sharp, S.M., W.A. McLellan, D.S. Rotstein, A.M. Costidis, S.G. Barco, K. Durham, T.D. Pitchford, K.A. Jackson, P.Y. Daoust, T. Wimmer, L. Couture, T. Bourque, T. Frasier, B. Frasier, D. Fauquier, T.K. Rowles, P.K. Hamilton, H.M. Pettis, and M.J. Moore. 2019. Gross and histopathologic diagnoses from North Atlantic right whale *Eubalaena glacialis* mortalities between 2003 and 2018. **Dis. Aquat. Organ.** 135(1): 1-31.

Sills, J.M., B. Ruscher, R. Nichols, B.L. Southall, and C. Reichmuth. 2020. Evaluating temporary threshold shift onset levels for impulsive noise in seals. **J. Acoust. Soc. Am.** 148)5):2973-2986.

Stenson, G.B., J.-F. Gosselin, J.W. Lawson, A. Buren, P. Goulet, S.L.C. Lang, K. Nilssen, and M.O. Hammill. 2020. Estimating pup production of Northwest Atlantic harp seals, *Pagophilus groenlandicus,* in 2017. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/056.

Syposz, M., F. Gonçalves, M. Carty, W. Hoppitt, and F. Manco. 2018. Factors influencing Manx Shearwater grounding on the west coast of Scotland. Ibis 160: 846-854.

Tyack, P.L. and L. Thomas. 2019. Using dose-response functions to improve calculations of the impact of anthropogenic noise. **Aquat. Conserv. Mar. Freshw. Ecosyst**. 29(S1): 242-253.

van der Knaap, I., J. Reubens, L. Thomas, M.A. Ainslie, H.V. Winter, J. Hubert, B. Martin, and H. Slabbekorn. 2021. Effects of a seismic survey on movement of free-ranging Atlantic cod. **Curr. Biol.** Doi:https://doi.org/10.1016/j.cub.2021.01.050.

Vazzana, M., M. Mauro, M. Ceraulo, M. Dioguardi, E. Papale, S. Mazzola, V. Arizza, F. Beltrame, L. Inguglia, and G. Buscaino. 2020. Underwater high frequency noise: Biological responses in sea urchin *Arbacia lixula* (Linneaus, 1758). **Comp. Biol. Physiol.** Part A. 242: 110650. Doi: 10.1016/j.cbpa.2020.110650.

Wilhelm, S.I., A. Hedd, G.J. Robertson, J. Mailhiot, P.M. Regular, P.C. Ryan, and R.D. Elliot. 2021. The world's largest breeding colony of Leach's Storm-petrel (*Hydrobates leucorhous*) has declined. Bird Conservation International, pp. 1-18.

Zhao, X., M. Zhang, X. Che, and F. Zou. 2020. Blue light attracts nocturnally migrating birds. The Condor – Ornithological Applications 122:duaa002.

Personal Communications

Keel, R.J.	Manager of Aquaculture Licensing and Administration, Department of Fisheries and Land Resources, Government of Newfoundland and Labrador. 19 April 2021.
Mello, L.	Stock Assessment Biologist, Marine Fish Species at Risk and Fisheries Sampling, Fisheries and Oceans Canada. 16 April 2021.
Morrow, G.	Senior Contract Manager, PGS. June 2017.
Murillo-Perez, J.	Research Scientist, DFO, Bedford Institute of Oceanography. 16 April 2021.
Roberts, A.	Data Archivist, DFO. 23 April 2021
Rowe, G.	Resource Management and Indigenous Fisheries, DFO. 26 April 2021.
Wells, N.	Biologist, Science Branch, DFO. 16 April 2021.

Appendix A – MKI Newsletter Distributed to Consultees

Multiklient Invest AS

Seismic Programs Offshore Newfoundland 2021 Update

Resumption of the Program in 2021

This news update is to inform stakeholders and other interested parties of the continuation of MKI's current seismic program, started in 2012, in waters offshore Newfoundland and Labrador. The Project Area is within the regulatory jurisdiction of the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and it is expected that the Ramform Atlas and Ramform Tethys will be acquiring data between late May and September 2021.

Figure 1: Seismic Vessels due to work in the province during 2021

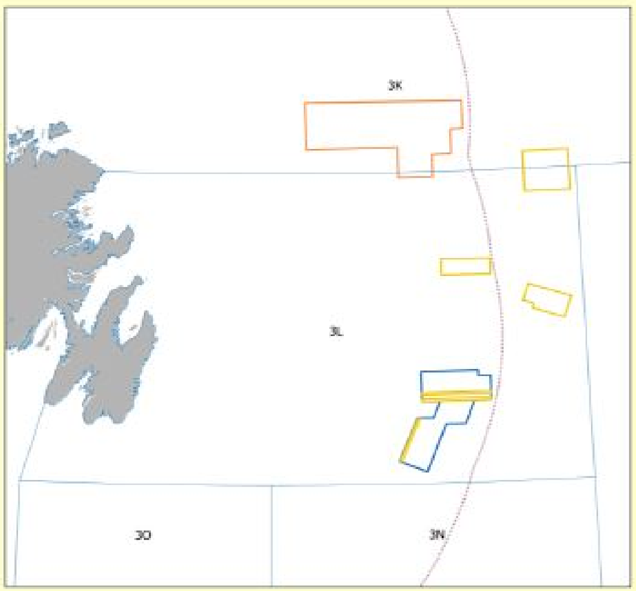


Figure 2: MKI Planned 2021 Seismic Activity Offshore Newfoundland

Ongoing Communication

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

Employment Opportunities

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

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 Assessment" link. Click on the "*Completed*" link. Once this page has opened, scroll down to the project titled *"Multiklient Invest AS Newfoundland Seismic Program 2018-2023"* and click on the link. Here you can find all environmental documents related to this project.

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

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

Contact Information

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

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

PGS

Appendix B – List of Consultees Contacted by MKI

Organization or Group Name	Email Address	Contact Name
Aquaforte		
Aquaforte Town Council	rhondaokeefe@aim.com	Rhonda O'Keefe
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	Stephanie Eddy, Clerk
Conne River		
Miaqpukek First Nation	thowse@mfngov.ca	Tracey Howse, Director, Training and Economic Development
Corner Brook		
Qalipu Mi'kmaq First Nation Band	reldridge@qalipu.ca	Ralph Eldridge, Manager of Community Economic Development
Ferryland		
Town of Ferryland	Town.ferryland@nf.aibn.com	Not available
M. & A. Fisheries Limited	Ma.fisheries@nf.aibn.com	Angus O'Connell
Fortune		
Town of Fortune	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
Southern Avalon Development Association	southernavalondev@nf.aibn.com	Anita Molloy, VP and Board Member
Witless Bay		
Town of Witless Bay	townofwitlessbay@nl.rogers.com	Geraldine Caul, Clerk