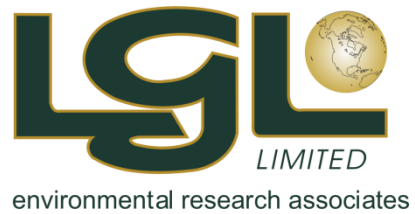


# **Environmental Assessment Update of the EMGS East Canada CSEM Survey, 2014–2018**

**Prepared by:**



**Prepared for:**



**16 March 2016  
LGL Project No. FA0078-1**



# **Environmental Assessment Update of the EMGS East Canada CSEM Survey, 2014–2018**

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## 1.0 Introduction

This document is an Update of the Environmental Assessment (EA) of the Electromagnetic Geoservices Canada Inc. (EMGS) East Canada Controlled Source Electromagnetic (CSEM) Survey, 2014–2018 (LGL 2014a), and the associated Addendum (LGL 2014b), two Amendments (LGL 2014c, 2015a), and 2015 EA Update (LGL 2015b). This document addresses the validity of the EA and its associated documents (Table 1.1) as it pertains to EMGS's proposed 2016 CSEM survey. The EA Update is intended to assist the C-NLOPB in its regulatory review process by demonstrating that both the scope of the assessment and the mitigation measures to which EMGS previously committed and implemented in 2014, remain technically valid for proposed CSEM survey operations in 2016.

**Table 1.1 Active Environmental Assessment Documents for the EMGS East Canada CSEM Survey, 2014-2018.**

Screening Determination Reference	Temporal Scope	EA Document Title
C-NLOPB File No. 56006-020-001	1 May to 30 November, 2014-2018	Environmental Assessment East Canada CSEM Survey, 2014-2018 (LGL 2014a,b) <sup>a</sup>
	1 May to 31 December, 2014	Environmental Assessment East Canada CSEM Survey, 2014-2018 Amendment (LGL 2014c) <sup>b</sup>
	1 May to 31 December, 2015-2018	Environmental Assessment East Canada CSEM Survey, 2014-2018 Amendment No. 2 (LGL 2015a) <sup>c</sup>
	1 May to 31 December, 2015	Environmental Assessment Update of the EMGS East Canada CSEM Survey, 2014-2018 (LGL 2015b) <sup>d</sup>

<sup>a</sup> The C-NLOPB made a positive determination on this EA document on 22 July 2014.

<sup>b</sup> The C-NLOPB made a positive determination on this EA Amendment document on 28 November 2014.

<sup>c</sup> The C-NLOPB made a positive determination on this EA Amendment document on 24 June 2015.

<sup>d</sup> The C-NLOPB posted the EA Update document on 25 May 2015.

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 CSEM survey activities within the defined Project Area (see Figure 2.1 later) on the following Valued Environmental Components (VECs): Fish and Fish Habitat; Fisheries; Seabirds; Marine Mammals and Sea Turtles; Species at Risk; and Sensitive Areas. This Update also includes new relevant information not included in the EA and its associated documents.

## **2.0 Project Description**

### **2.1 Vessels and Equipment**

The CSEM survey equipment, including the CSEM source, streamer and receiver packages, is described in Section 2.0 of the EA (LGL 2014a). The same equipment will be used during 2016 operations.

As described and assessed in the most recent Amendment of the EMGS EA (LGL 2015a), there is potential for two CSEM survey vessels to operate concurrently in 2016-2018, although only one vessel is currently planned for 2016. Two scenarios are possible with respect to two CSEM vessels working concurrently.

1. The two vessels work together in that one deploys and recovers the receiver packages, while the other tows the source and acquires data; and
2. Each of the two vessels will operate autonomously in different parts of the Project Area.

For the second scenario, the two vessels will have sufficient separation to ensure that the source signal from one does not affect the data being collected by the other vessel. In addition to the CSEM survey vessel(s), one support vessel will also be required during operations. It will be a supply vessel responsible for re-supply, refuelling and personnel transfer.

### **2.2 Spatial Scope**

The Project and Study areas defined in the EA (LGL 2014a) remain unchanged (Figure 2.1). All CSEM survey activities will occur within the Project Area. The Phase I Area of Interest (AOI) for 2016 (Figure 2.1) is the same area where EMGS proposed to acquire CSEM data in 2015 (LGL 2015b). The Phase II AOI for 2016 (Figure 2.1) is the same area where CSEM survey operations occurred in 2014.

### **2.3 Temporal Scope**

The temporal scope indicated in the EA was defined by a 1 May to 30 November period during each year of the 2014 to 2018 period (LGL 2014a). The first Amendment to the EA (LGL 2014c) extended the temporal scope to 31 December in 2014 only. The second Amendment (LGL 2015a) extended the temporal scope to 31 December for the four remaining years (i.e., 2015-2018) of the Project.

### **2.4 Geophysical Activities Planned for 2016**

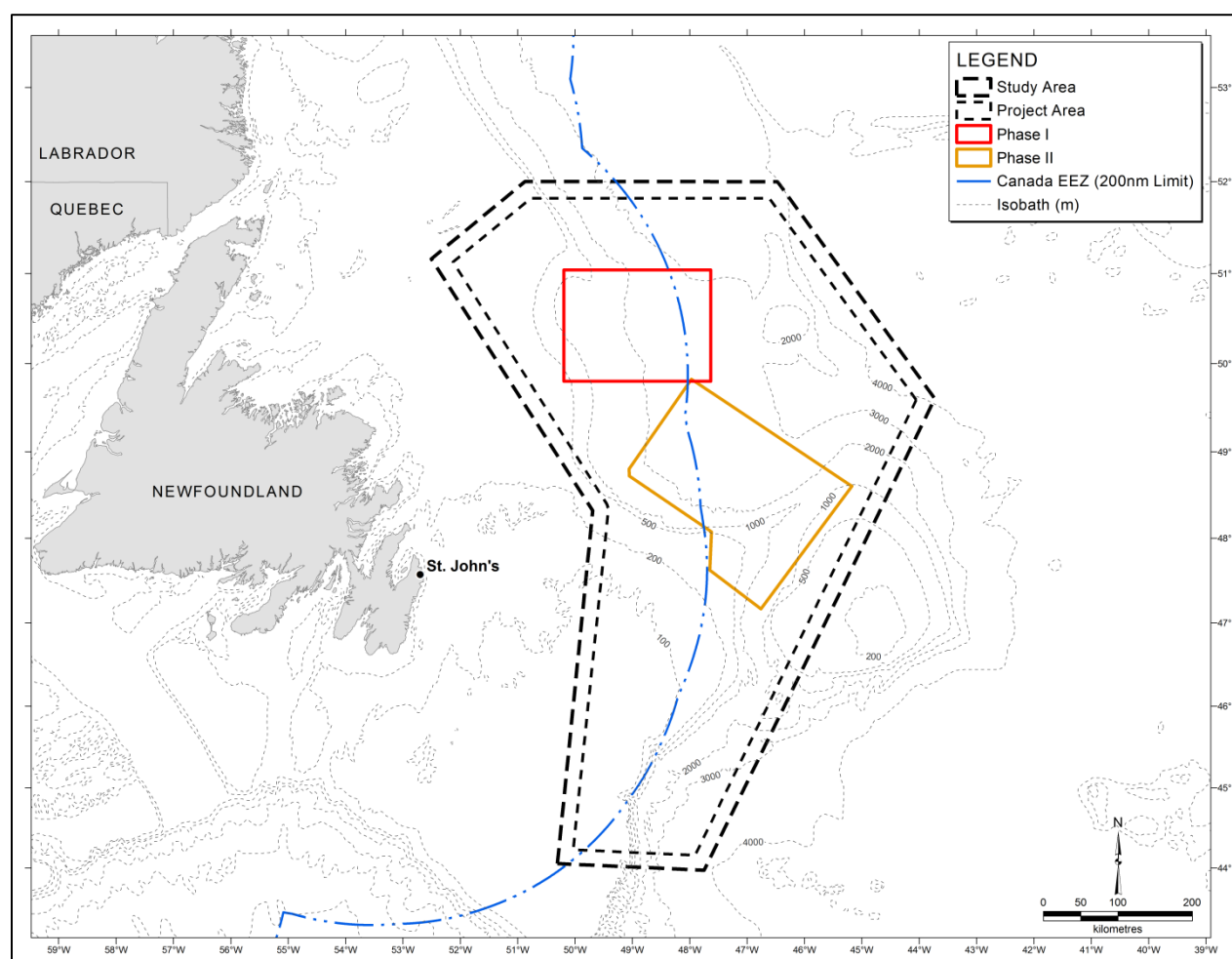
In 2016, EMGS is planning to survey the Phase I AOI (Figure 2.1), and to complete the CSEM survey begun in the Phase II AOI in 2014 (Figure 2.1).

EMGS plans to begin operations in the northern portion of the Project Area (Phase I) in early May and then continue operations farther south (Phase II) upon completion of Phase I. The expected duration of the 2016 operations is approximately 40 days. The intended area of survey coverage in 2016 is

approximately 2,934 km<sup>2</sup> in the Phase I AOI. The survey coverage area of the Phase II AOI is undetermined at this time and is currently dependent upon client interest. About 239 receivers will be deployed during the survey in the Phase I AOI.

As already indicated, as many as two CSEM survey vessels may operate concurrently, although only one vessel is currently planned for 2016. As indicated in the 2015 EA Update (LGL 2015b), examples of possible CSEM survey vessels for the 2016 exploration activities include the MV *Atlantic Guardian* and the MV *EM Leader*. The CSEM surveying will commence immediately after the proposed 2016 activities receive authorization.

All other project details presented in Section 2.0 of the original EA (LGL 2014a) apply to EMGS CSEM survey activities in 2016.



**Figure 2.1** Locations of the Project Area, Study Area, 2016 Areas of Interest (Phase I & Phase II) for the EMGS East Canada CSEM Survey, 2014 to 2018.

## **2.5 Mitigations**

Mitigation measures that will be implemented during CSEM surveys have been described in prior documents associated with this program (LGL 2014a,b, 2015a). Examples of mitigation measures include ramp-up (i.e., soft start) of the CSEM source, the use of qualified, dedicated Marine Mammal Observer(s) (MMOs) to monitor marine mammals and sea turtles and implement shut downs of the surveys when appropriate, and the use of a Fisheries Liaison Officer (FLO) and communication procedures to avoid conflicts with fisheries. Seabird observations will also be conducted by qualified personnel.

## **3.0 Physical Environment**

A summary of the physical environment was provided in Section 3.0 of the EA (LGL 2014a). There is no new and relevant information available on the physical environment in the Study Area.

## **4.0 Biological Environment**

Newly available background information not included in the previous documents associated with this program is included in this section.

### **4.1 Fish and Fish Habitat**

This section presents new information describing the Fish and Fish Habitat VEC that was not included in Section 4.2 of the EMGS EA (LGL 2014a), the associated Addendum (LGL 2014b), and the 2015 EA Update (LGL 2015b). Additional information is related to the relationship between planktonic communities and oceanic conditions inclusive of the Study Area. The new information presented in this section does not change the effects predictions made in the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a).

#### **4.1.1 Plankton**

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

- Copepod abundance throughout much of the Atlantic zone has increased consistently relative to levels observed in 2013, with the exception of the northeast Newfoundland Shelf (NAFO areas 2J3K) where a notable decline has occurred.
- In 2014, the annual-mean transport index for the Labrador Current was near normal over the Labrador and northeastern Newfoundland Slope.

- For the past decade, ice volumes on the Newfoundland and Labrador Shelf have generally been lower than normal.
- Chlorophyll anomalies have been below normal on the Newfoundland and Labrador Shelf since 2010 and have demonstrated interannual variability on the Grand Banks in recent years.
- Non-copepod taxa (e.g., larval stages of benthic invertebrates that feed on other zooplankton) demonstrated a considerable increase in abundance on the Grand Banks which appears to be the continuation of a trend which began in 2004.
- The abundance levels of zooplankton species (e.g., *Calanus finmarchicus*) has been declining steadily over the past five years.

#### **4.1.2 Snow Crab (*Chionoecetes opilio*)**

Offshore landings of snow crab in Northwest Atlantic Fisheries Organization (NAFO) Division 3K declined by 50% from 2008 to 2011 and are currently at an all-time low level. Also, offshore landings in NAFO Div. 3LNO have remained near their highest level, at about 26,000 mt, in the past three years (DFO 2015b).

#### **4.1.3 Northern Shrimp (*Pandalus borealis*)**

The northern shrimp fishable biomass index declined in Shrimp Fishing Area (SFA) 6 (NAFO Divisions 2J3K) from 421,000 t in 2011 to 216,000 t in 2013, and increased slightly to 233,000 t in 2014 (DFO 2015c). Meanwhile, in NAFO Division 3M, analyses of stratified random bottom trawl surveys completed on the Flemish Cap in 2015 show that total biomass and female biomass indexes increased with respect to 2014 (70% and 117%, respectively), but still remain at very low levels. The total and female biomasses estimated in 2015 were 1,527 and 1,057 mt, respectively (Casas 2015).

#### **4.1.4 Atlantic Cod (*Gadus morhua*)**

Recent assessments indicate that cod stocks in Divisions 3LMNO remain at very low levels. A cod fishery on the Flemish Cap (Division 3M) was re-opened in 2010 after having been under a moratorium for a decade. Cod moratoria still exist for Divisions 3NO and 3L (NAFO 2014a). The highest values in estimated cod biomass have been observed at shallow depths, in a range of 93 to 274 m (Román et al. 2015).

#### **4.1.5 Capelin (*Mallotus villosus*)**

Preliminary landings in 2013 and 2014 were 23,755 mt and 23,173 mt, respectively, against a Total Allowable Catch (TAC) in Divisions 2J3KL of 22,771 mt. The offshore fishery for capelin has been closed in Division 3L since 1979 and in Divisions 2J3K since 1992 (DFO 2015d).

## 4.2 Fisheries

This section includes updates to the description of the Fisheries VEC in Section 4.3 of the EMGS EA (LGL 2014a), the associated Addendum (LGL 2014b), and the 2015 EA Update (LGL 2015b). The new information presented in this section does not change the effects predictions made in the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a).

### 4.2.1 Commercial Fisheries

#### 4.2.1.1 Study Area Catch Analysis, 2014

As in previous years (see Table 4.2 in LGL 2014a), snow crab (26% of total catch in the Study Area in terms of total catch weight quartile code counts), Greenland halibut (*Reinhardtius hippoglossoides*) (20%) and northern shrimp (11%) were the most important commercial species in the Study and Project areas in 2014, followed by American plaice (*Hippoglossoides platessoides*) (8%), Atlantic halibut (*Hippoglossus hippoglossus*) (8%), yellowtail flounder (*Pleuronectes ferruginea*) (8%), redfish (*Sebastes mentella*) (6%) and Atlantic cod (5%) (Table 4.1). As in 2013, there were no reported catches of cockles (*Serripes groenlandicus*) in the Study Area in 2014, while there were reported harvests of Icelandic scallops (*Chlamys islandica*), witch flounder (*Glyptocephalus cynoglossus*), Atlantic (striped) wolffish (*Anarhichas lupus*) and capelin (see Table 4.2 in LGL 2014a and Table 4.1 in LGL 2015b). Species harvested during 2014 in the Project Area and Phase I and II AOIs are presented in Tables 4.2 to 4.4, respectively. Greenland halibut and snow crab were the most important commercial species in the Phase I AOI, accounting for 86% of the total catch in terms of total catch weight quartile code counts. Northern shrimp accounted for the majority (82%) of the 2014 harvest in the Phase II AOI.

#### 4.2.1.2 Commercial Harvest Locations in the Study Area

Figure 4.1 shows the distribution of harvest locations for all species, May–December, 2014. Analyses of the 2014 commercial fisheries landings data did not indicate any major differences in distribution of harvest locations for May–December 2014 compared to the distributions for May–November 2005–2012 (see Figure 4.5 in LGL 2014a) and May–December 2013 (see Figure 4.1 in LGL 2015b). The majority of harvesting occurred between the 100 m and 1,000 m depth contours. Relatively few grid cells within the Phase I and II AOIs had reported harvesting in 2014.

#### 4.2.1.3 Principal Species in the Study Area

##### Snow Crab

During May–December 2014, the general distribution of harvest locations for snow crab in the Study Area was consistent with that observed during May–November 2005 to 2012 (see Figure 4.2 below and Figures 4.8 and 4.9 in LGL 2014a) and May–December 2013 (see Figure 4.2 in LGL 2015b). Snow crab catches were reported in a few grid cells in the southwestern portions of both Phase I and II AOIs in 2014. The TAC for snow crab in NAFO Divisions 3K and 3LNO has remained somewhat consistent

since 2011, although there is a decreasing trend in 3K (from 12,053 mt in 2011 to 7,980 mt in 2014 and 7,294 mt in 2015) and increasing trend in 3LNO (from 33,222 mt in 2011 to 35,193 mt in 2014 and 35,698 mt in 2015; DFO 2015e).

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

Species	Catch Weight Quartile Code Counts <sup>a</sup>				Catch Value Quartile Code Counts <sup>b</sup>				Total Counts <sup>c</sup>	Month Caught	Gear Type	
	1	2	3	4	1	2	3	4			Fixed	Mobile
Snow Crab	45	108	155	75	35	86	127	135	383	May–Aug	Pot	-
Greenland Halibut	41	95	112	36	55	98	92	39	284	May–Sep; Dec	Gillnet; Longline	Trawl
Northern Shrimp	59	60	37	4	80	52	27	1	160	May–Oct	-	Trawl
American Plaice	18	40	43	19	38	45	33	4	120	May–Jul; Nov–Dec	Gillnet	Trawl
Atlantic Halibut	18	28	38	32	22	29	36	29	116	May–Dec	Gillnet; Longline	Trawl
Yellowtail Flounder	19	37	40	19	40	40	31	4	115	May–Jul; Nov–Dec	-	Trawl
Redfish	17	23	26	24	23	26	22	19	90	May–Sep; Dec	Gillnet; Longline	Trawl
Atlantic Cod	11	17	23	26	9	30	30	8	77	May–Sep; Nov–Dec	Gillnet; Longline	Trawl
Roughhead Grenadier	2	12	10	8	2	15	11	4	32	Jun–Aug	Gillnet	Trawl
Witch Flounder	2	5	8	13	3	3	8	14	28	Jun–Sep; Dec	Gillnet	Trawl
Argentine	2	9	4	4	3	11	4	1	19	Aug	-	Trawl
Atlantic (striped) Wolffish	1	1	5	5	1	5	4	2	12	May–Jun	-	Trawl
Atlantic Haddock	0	0	2	4	0	1	2	3	6	May–Jul	Longline	Trawl
Skate sp.	2	1	1	2	1	1	2	2	6	Jun–Jul	Gillnet; Longline	-
Icelandic Scallops	1	0	0	0	1	0	0	0	1	Aug	-	Dredge
Mackerel	0	0	1	0	0	1	0	0	1	Oct	-	Seine
<b>Total</b>	<b>238</b>	<b>436</b>	<b>505</b>	<b>271</b>	<b>313</b>	<b>443</b>	<b>429</b>	<b>265</b>	<b>1,450</b>	<b>-</b>	<b>-</b>	<b>-</b>

Source: DFO commercial landings database, 2014.

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

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

<sup>c</sup> Total counts of the number of catch records per species; the total quartile code counts for catch weight and catch value are equal.

**Table 4.2 Commercial Catch Weights and Values in the Project Area, May–December, 2014**  
(Values indicate the frequency of catch weight quartile codes [i.e., 1–4] attributed to each species. Gear types and months of effort are also indicated).

Species	Catch Weight Quartile Code Counts <sup>a</sup>				Catch Value Quartile Code Counts <sup>b</sup>				Total Counts <sup>c</sup>	Month Caught	Gear Type	
	1	2	3	4	1	2	3	4			Fixed	Mobile
Snow Crab	29	99	142	71	23	75	114	129	341	May–Aug	Pot	-
Greenland Halibut	35	90	108	36	49	92	89	39	269	Jun–Sep; Dec	Gillnet; Longline	Trawl
Northern Shrimp	54	41	29	4	73	34	20	1	128	May–Oct	-	Trawl
Redfish	15	22	24	24	21	24	21	19	85	May–Sep; Dec	Gillnet; Longline	Trawl
Atlantic Halibut	12	19	27	27	14	20	24	27	85	May–Sep; Nov–Dec	Gillnet; Longline	Trawl
American Plaice	10	29	32	9	25	31	23	1	80	May–Jul; Nov–Dec	Gillnet	Trawl
Yellowtail Flounder	9	25	29	9	24	26	21	1	72	May–Jul; Nov–Dec	-	Trawl
Atlantic Cod	7	10	14	16	5	19	18	5	47	May–Sep; Nov–Dec	Gillnet; Longline	Trawl
Roughhead Grenadier	1	11	8	8	1	13	10	4	28	Jun–Aug	Gillnet	Trawl
Witch Flounder	0	4	7	13	1	2	7	14	24	Jun–Sep; Dec	Gillnet	Trawl
Argentine	2	9	3	4	3	10	4	1	18	Aug	-	Trawl
Skate sp.	2	1	0	2	1	1	1	2	5	Jun–Jul	Gillnet; Longline	-
Atlantic (striped) Wolffish	0	1	2	1	0	3	1	0	4	May	-	Trawl
Atlantic Haddock	0	0	1	0	0	1	0	0	1	May	-	Trawl
Mackerel	0	0	1	0	0	1	0	0	1	Oct	-	Seine
<b>Total</b>	<b>176</b>	<b>361</b>	<b>427</b>	<b>224</b>	<b>240</b>	<b>352</b>	<b>353</b>	<b>243</b>	<b>1,188</b>	<b>-</b>	<b>-</b>	<b>-</b>

Source: DFO commercial landings database, 2014.

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

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

<sup>c</sup> Total counts of the number of catch records per species; the total quartile code counts for catch weight and catch value are equal.



**Table 4.3 Commercial Catch Weights and Values in the Phase I AOI, May-December, 2014**  
(Values indicate the frequency of catch weight quartile codes [i.e., 1–4] attributed to each species. Gear types and months of effort are also indicated).

Species	Catch Weight Quartile Code Counts <sup>a</sup>				Catch Value Quartile Code Counts <sup>b</sup>				Total Counts <sup>c</sup>	Month Caught	Gear Type	
	1	2	3	4	1	2	3	4			Fixed	Mobile
Greenland Halibut	4	3	9	0	4	3	6	3	16	Jun–Aug	Gillnet	Trawl
Snow Crab	0	2	1	0	0	2	1	0	3	May–Jun	Pot	-
Northern Shrimp	1	0	0	0	1	0	0	0	1	Jul	-	Trawl
Witch Flounder	0	0	1	0	0	0	1	0	1	Jun	-	Trawl
Atlantic Halibut	0	0	1	0	0	0	0	1	1	Jun	-	Trawl
<b>Total</b>	<b>5</b>	<b>5</b>	<b>12</b>	<b>0</b>	<b>5</b>	<b>5</b>	<b>8</b>	<b>4</b>	<b>22</b>	<b>-</b>	<b>-</b>	<b>-</b>

Source: DFO commercial landings database, 2014.

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

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

<sup>c</sup> Total counts of the number of catch records per species; the total quartile code counts for catch weight and catch value are equal.

**Table 4.4 Commercial Catch Weights and Values in the Phase II AOI, May-December, 2014**  
(Values indicate the frequency of catch weight quartile codes [i.e., 1–4] attributed to each species. Gear types and months of effort are also indicated).

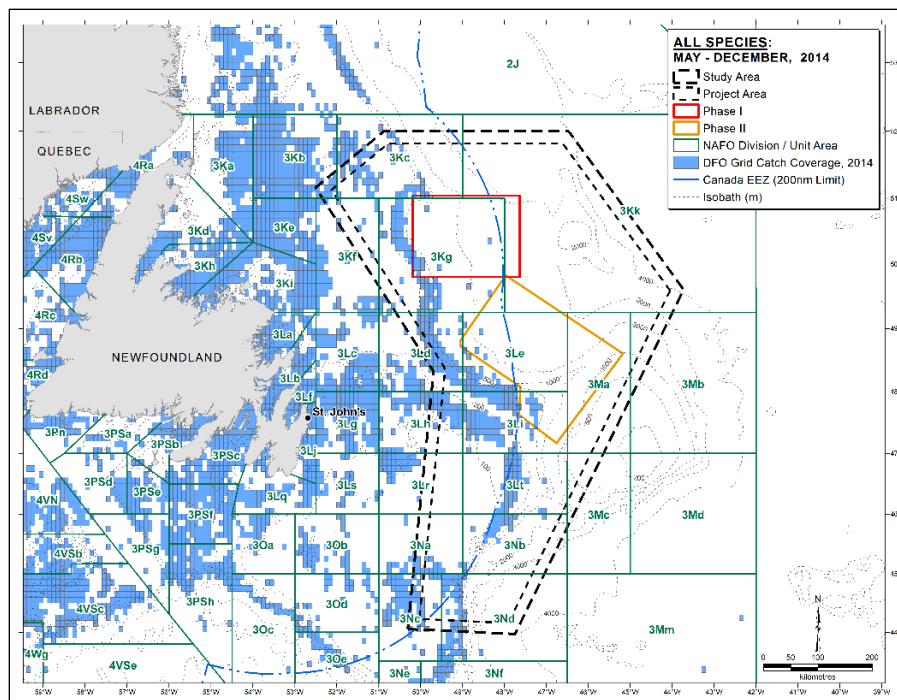
Species	Catch Weight Quartile Code Counts <sup>a</sup>				Catch Value Quartile Code Counts <sup>b</sup>				Total Counts <sup>c</sup>	Month Caught	Gear Type	
	1	2	3	4	1	2	3	4			Fixed	Mobile
Northern Shrimp	9	5	0	0	9	5	0	0	14	Jun–Sep	-	Trawl
Greenland Halibut	0	1	0	0	0	1	0	0	1	Jul	Gillnet	-
Atlantic Cod	1	0	0	0	1	0	0	0	1	Aug	Gillnet	-
Redfish	0	1	0	0	0	1	0	0	1	Sep	-	Trawl
<b>Total</b>	<b>10</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>-</b>	<b>-</b>	<b>-</b>

Source: DFO commercial landings database, 2014.

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

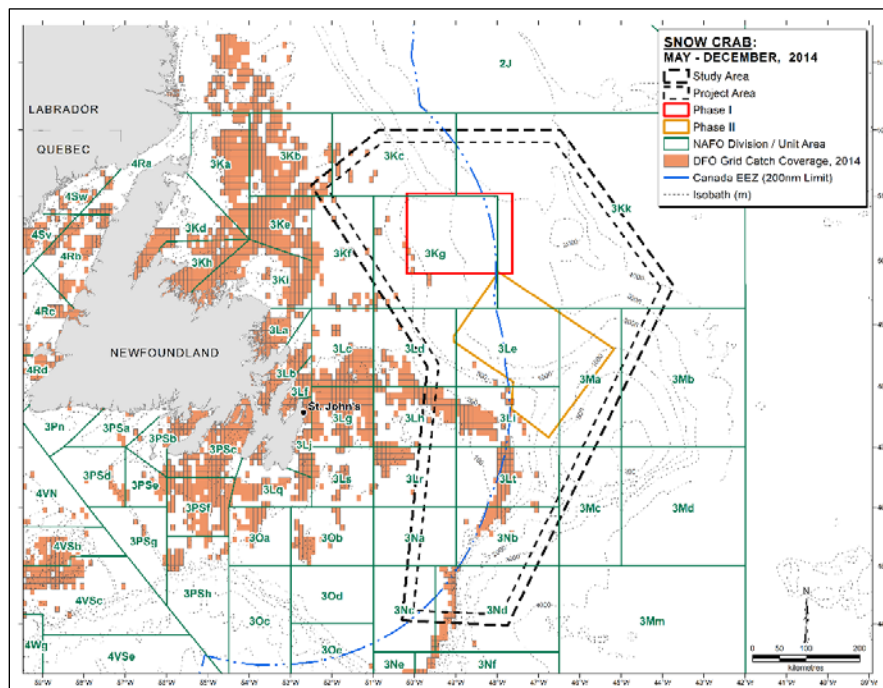
<sup>b</sup> Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch values in a given year, all species combined). 2014 quartile ranges: 1 = \$0 – \$8,851, 2 = \$8,852 – \$38,076, 3 = \$38,077 – \$140,695, 4 = ≥ \$140,696.

<sup>c</sup> Total counts of the number of catch records per species; the total quartile code counts for catch weight and catch value are equal.



Source: DFO commercial landings database, 2014.

**Figure 4.1 Distribution of Commercial Fishery Harvest Locations, All Species, May-December, 2014.**

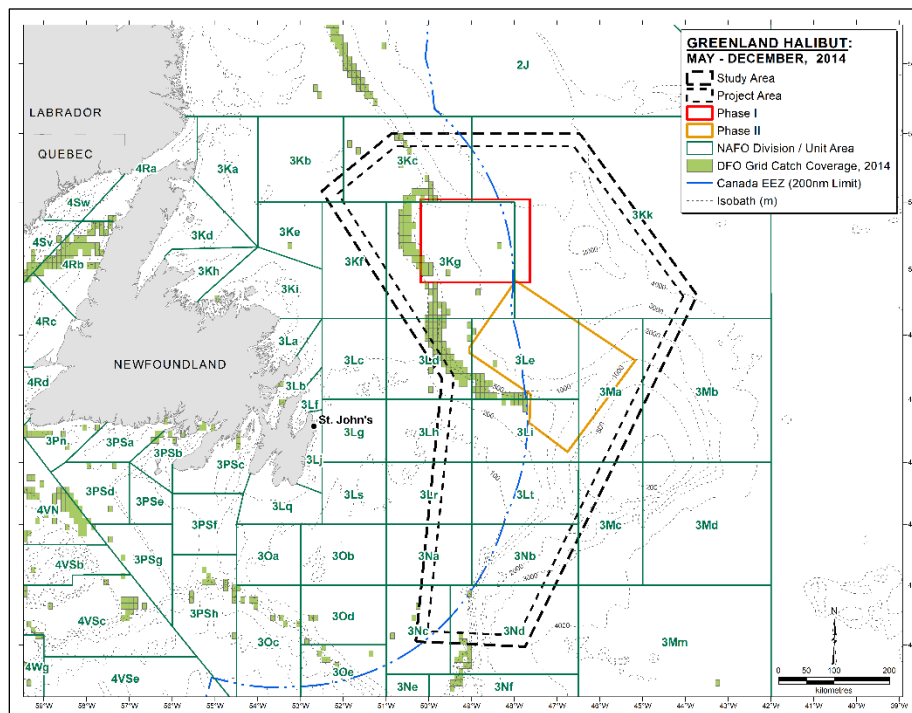


Source: DFO commercial landings database, 2014.

**Figure 4.2 Distribution of Commercial Fishery Harvest Locations, Snow Crab, May-December, 2014.**

## **Greenland Halibut**

During May–December 2014, the distribution of harvest locations for Greenland halibut in the Study Area was consistent with that observed during May–November 2005–2010 (see Figure 4.3 below and Figure 4.10 in LGL 2014a) and May–December 2013 (see Figure 4.4 in LGL 2015b), with the exception that there were more catch locations within the Study Area in 2014 than 2013, and the harvest locations did not extend as far east in 2014 as in 2013. The majority of catches occurred between the 500 m and 1,000 m isobaths. While there were several grid cells with reported harvesting in the Phase I AOI, none occurred within the Phase II AOI in 2014. NAFO and DFO manage the harvest for Greenland halibut in NAFO Divisions 3LMNO and 4RST, respectively (DFO 2015e; NAFO 2016). Between 2011 and 2013, the TAC for Greenland halibut in NAFO Divisions 3LMNO decreased, remained relatively constant at ~11,500 mt until 2015 (e.g., 11,543 mt in 2015), and decreased again to 10,966 mt in 2016 (NAFO 2016).



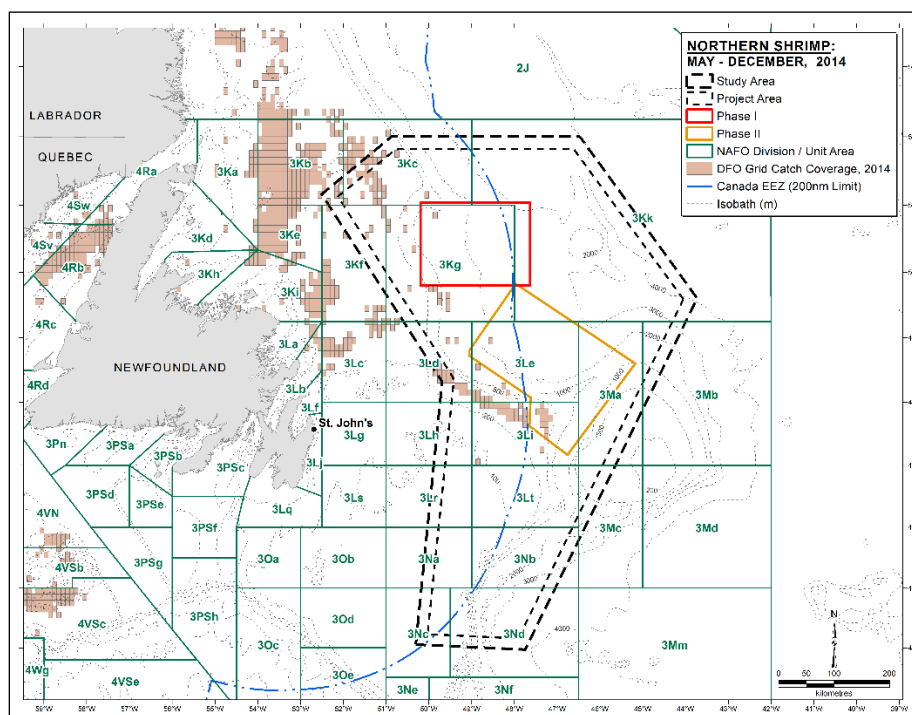
Source: DFO commercial landings database, 2014.

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

## **Northern Shrimp**

During May–December 2014, the overall distribution of harvest locations for northern shrimp in the Study Area was consistent with that observed during May–November 2005 to 2012 (see Figure 4.4 below and Figures 4.6 and 4.7 in LGL 2014a) and May–December 2013 (see Figure 4.3 in LGL 2015b), with fewer catch locations in either 2013 or 2014 than 2005–2012. During May–December 2014, there was a single grid cell with reported harvesting in the Phase I AOI but none in 2013. As in 2013, there

were several grid cells with reported harvesting in the Phase II AOI in 2014, primarily in the southwest. As noted in the 2015 EA Update (see Section 4.2.1 in LGL 2015b), northern shrimp stocks in the region have continued to decline in recent years. The 2010 moratorium on the shrimp fishery in Division 3M remains in effect (NAFO 2014b) and, as in 2015, there will be no shrimp fishery permitted within Division 3L in 2016 (NAFO 2015a). From 2011 to 2014, the TAC set by DFO for northern shrimp in SFA 6 showed a generally decreasing trend, from 52,387 mt in 2011 to 48,196 mt in 2014. The TAC remained at the 2014 level in 2015 (DFO 2015e).



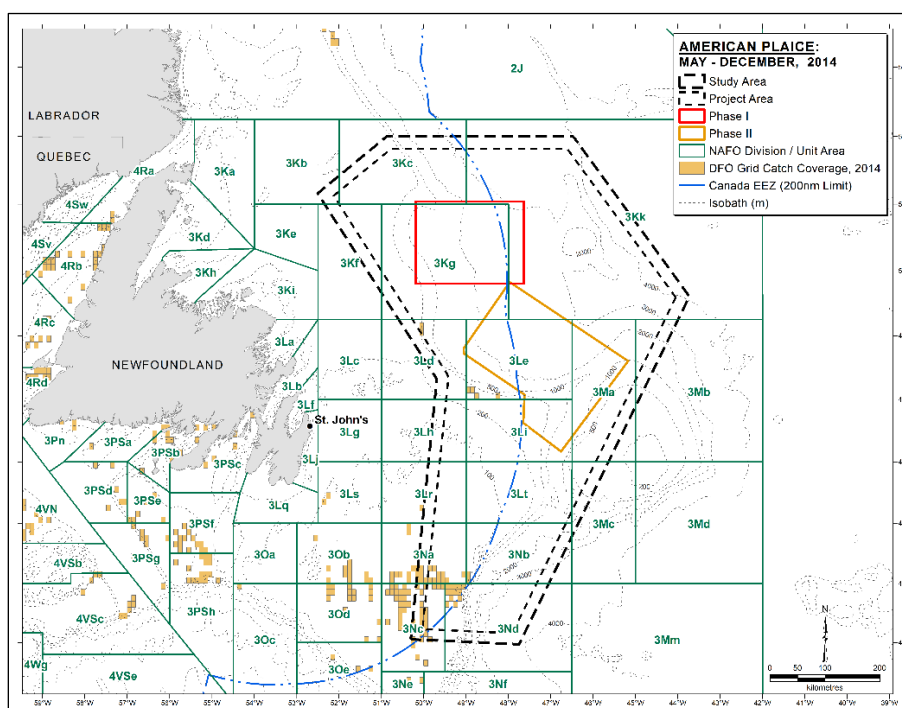
Source: DFO commercial landings database, 2014.

**Figure 4.4 Distribution of Commercial Fishery Harvest Locations, Northern Shrimp, May-December, 2014.**

### **Other Notable Species: American Plaice, Atlantic Halibut, Redfishes, Atlantic Cod and Yellowtail Flounder**

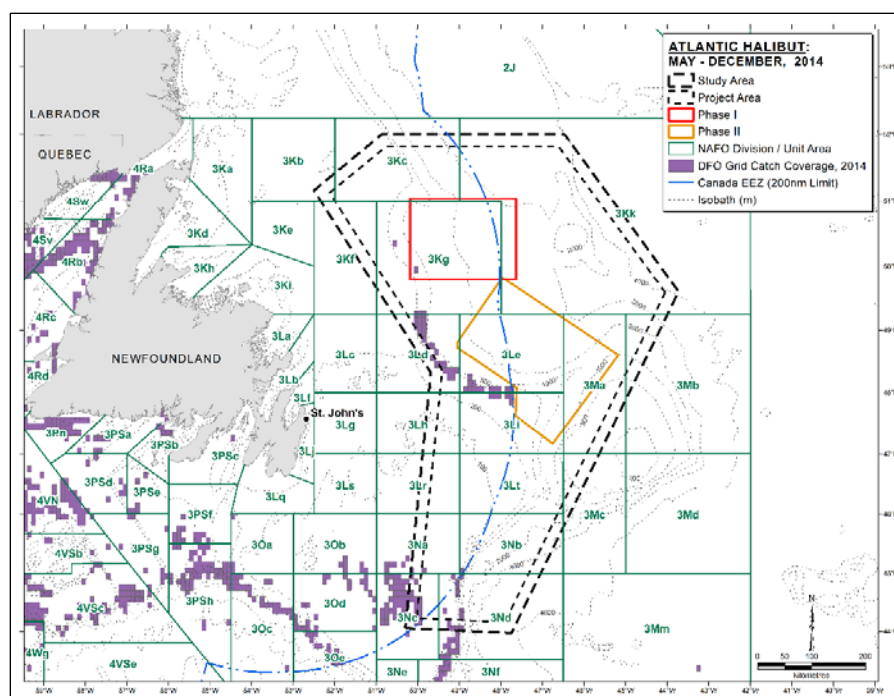
In addition to the three species already discussed, American plaice, Atlantic halibut, redfishes, Atlantic cod, and yellowtail flounder have also been identified as important commercial species within the Study Area (see Table 4.1, Table 4.2 in LGL 2014a and Table 4.1 in LGL 2015b). The 2014 harvest locations for these species are shown in Figures 4.5–4.9 (see also Figure 4.12 in LGL 2014a for harvest locations of yellowtail flounder). These species were predominantly captured in the southwestern and central portions of the Study Area, in areas where water depth was <500 m. There were few grid cells with reported harvesting of these species in the Phase I and II AOIs in 2014. In the Phase I AOI, there was one grid cell with Atlantic halibut, and in the Phase II AOI, there was one grid cell with Atlantic cod and one grid cell with redfishes.

The Atlantic halibut fishery is managed by DFO, while NAFO sets annual TAC values for the remaining four species. The 2015 TAC levels for Atlantic halibut in NAFO Divisions 3NOPs4VWX+5 increased from 2,563 mt in 2015 to 2,738 mt in 2016 (DFO 2015e). With relatively high recruitment levels since the mid-2000s, the Atlantic cod and redfish stocks on the Flemish Cap in NAFO Division 3M are currently in a healthy state, and are projected to be able to support an increase in catches in 2016 and 2017 (NAFO 2015a,b). The TAC for Atlantic cod in 3M increased from 13,795 mt in 2015 to 13,931 mt in 2016, while the TAC for redfishes remained constant at 10,400 mt in 2015 and 2016 in 3LN, increased from 6,700 mt in 2015 to 7,000 mt in 2016 in 3M, and remained at 20,000 mt in 2015 and 2016 in 3O (NAFO 2016). Fishing bans are in place in Divisions 3LN for Atlantic cod and American plaice, with American plaice also banned in Division 3M (NAFO 2015a). The TAC for yellowtail flounder remained steady at 17,000 mt in 2015 and 2016 in 3LNO (NAFO 2016).



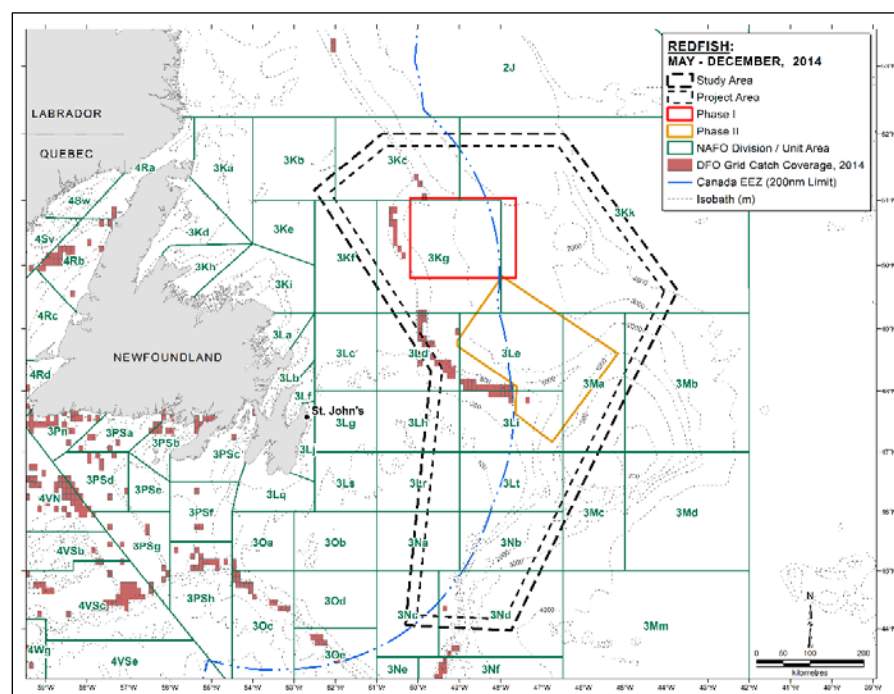
Source: DFO commercial landings database, 2014.

**Figure 4.5 Distribution of Commercial Fishery Harvest Locations, American Plaice, May-December, 2014.**



Source: DFO commercial landings database, 2014.

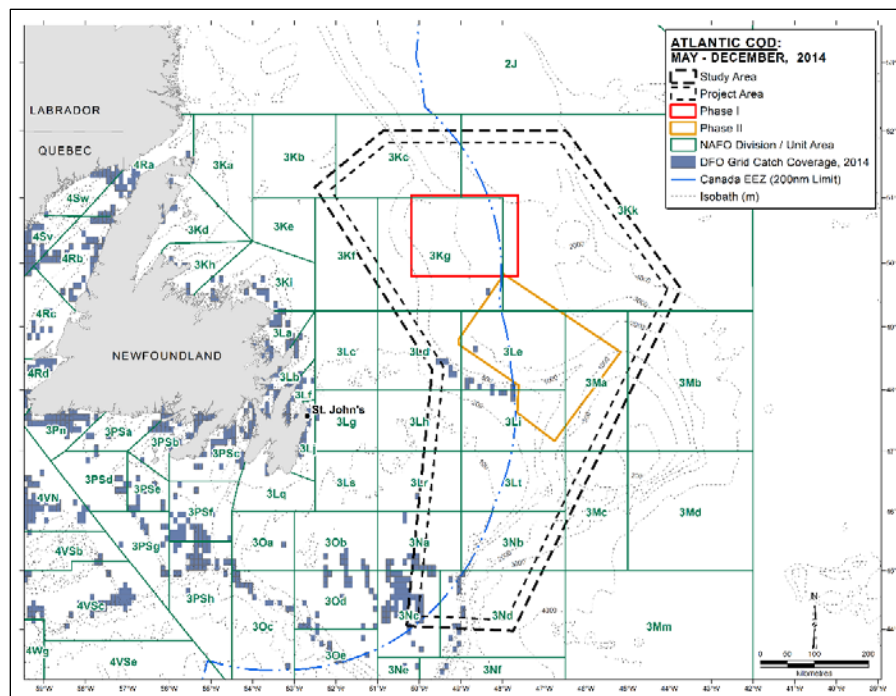
**Figure 4.6 Distribution of Commercial Fishery Harvest Locations, Atlantic Halibut, May-December, 2014.**



Source: DFO commercial landings database, 2014.

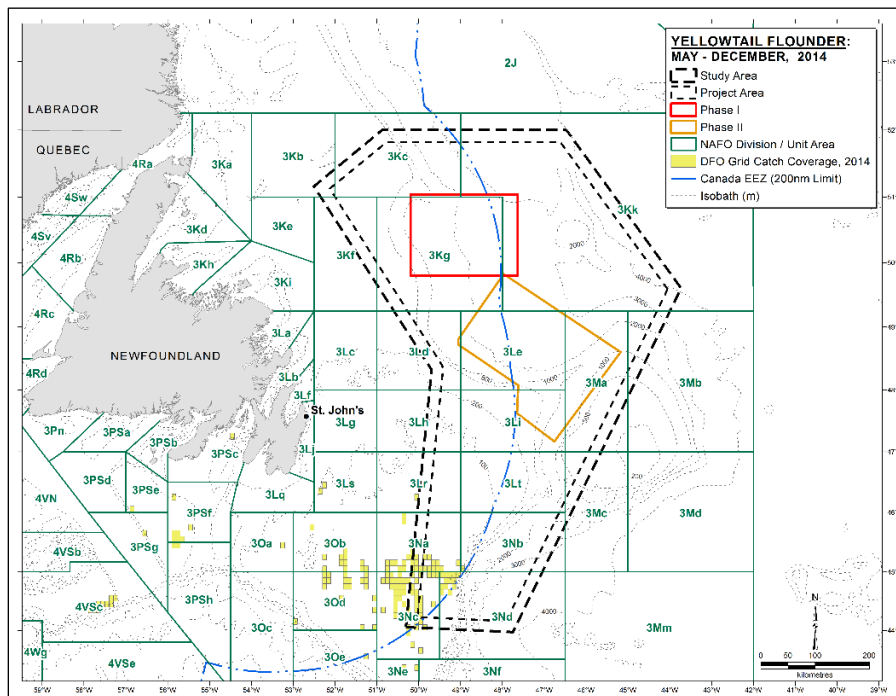
**Figure 4.7 Distribution of Commercial Fishery Harvest Locations, Redfish, May-December, 2014.**





Source: DFO commercial landings database, 2014.

**Figure 4.8 Distribution of Commercial Fishery Harvest Locations, Atlantic Cod, May-December, 2014.**



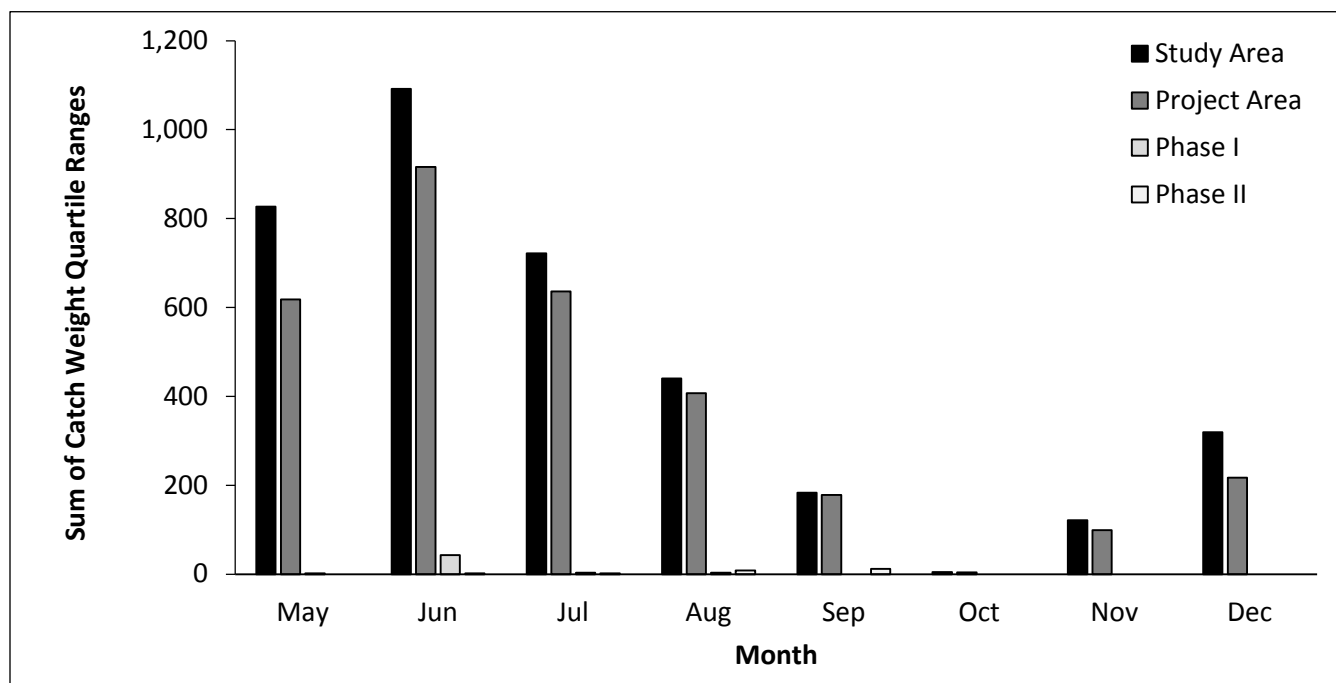
Source: DFO commercial landings database, 2014.

**Figure 4.9 Distribution of Commercial Fishery Harvest Locations, Yellowtail Flounder, May-December, 2014.**

#### 4.2.1.4 Harvest Timing and Fishing Gear Used in the Study Area

Similar to previous years, the majority of the 2014 harvest within the Study Area occurred during the May to July/August period, with less harvesting during the fall (see Figure 4.10 below, Figure 4.16 in LGL 2014a, and Figure 4.5 in LGL 2015b). In 2014, harvesting in the Phase I and II AOIs occurred exclusively during June–August and June–September, respectively.

Gear types used in the 2014 harvest were typical of those used in recent years (see Tables 4.1–4.4 and Section 4.3.3.6 in LGL 2014a). Harvest locations in 2014 using fixed and mobile gears are shown in Figure 4.11. The majority of harvesting within the Phase I and II AOIs was conducted using mobile gear.

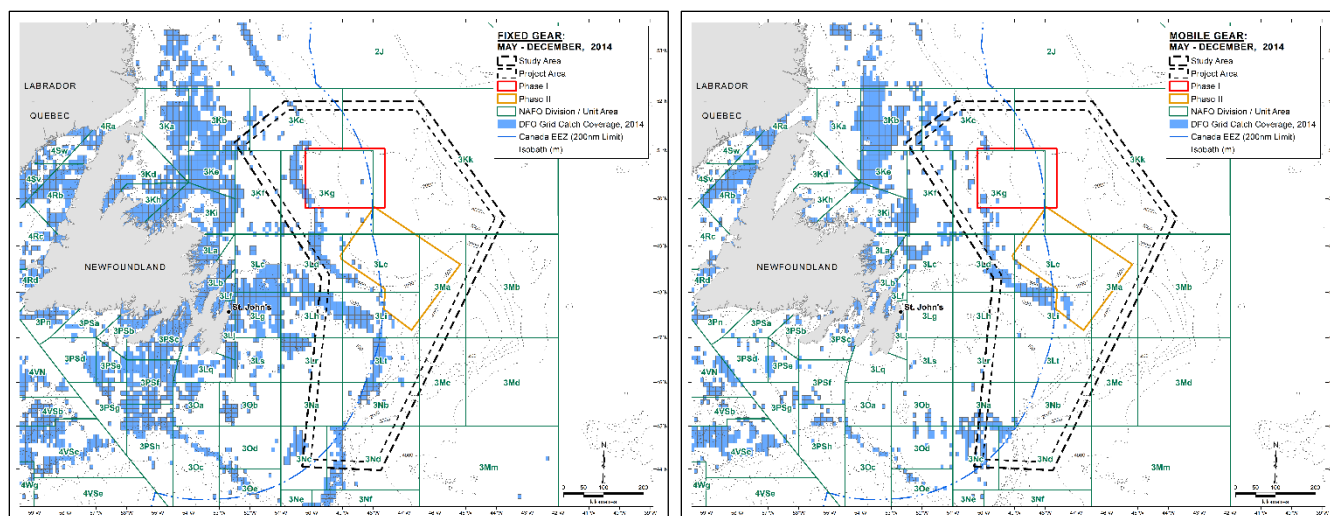


Source: DFO commercial landings database, 2014.

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

**Figure 4.10 Monthly Sums of Catch Weight Quartile Codes in the Study Area, Project Area and Phase I and II AOIs, All Species, May–December, 2014.**





Source: DFO commercial landings database, 2014.

**Figure 4.11 Harvest Locations using Fixed (left) and Mobile (Right) Gears in the Study Area, Project Area and Phase I and II AOIs, All Species, May–December, 2014.**

## 4.2.2 Traditional and Aboriginal Fisheries

Several communal commercial fisheries licences (CCFL) are held by Aboriginal groups for NAFO Divisions within the Study Area. The Qalipu First Nation Band holds CCFLs for snow crab and groundfish with allocations within Division 3K, and for shrimp in SFA 6 (D. Ball, DFO, Resource Management and Aboriginal Affairs, pers. comm. 3 December 2015; D. Tobin, DFO, Resource Management and Aboriginal Affairs, pers. comm. 3 December 2015). The Innu Nation of Labrador holds a CCFL for fixed gear groundfish fishing activity within NAFO Divisions 3Ps and 3LMNO (3Ps and 3O are located outside of and to the west of the Study Area). This licence also permits access to shrimp in SFA 6 and SFA 7 (i.e., NAFO Division 3L) (D. Ball and D. Tobin, DFO, Resource Management and Aboriginal Affairs, pers. comm. 3 December 2015). The potential exists for the Mi'kmaq Alsumk Mowimsikik Koqoey Association (MAMKA) to expand from the inshore into 3KL, depending on future management measures for northern cod (D. Ball and D. Tobin, DFO, Resource Management and Aboriginal Affairs, pers. comm. 3 December 2015).

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

## 4.2.3 Recreational Fisheries

Recreational fisheries in Newfoundland and Labrador are described in Section 4.3.5 of the EA (LGL 2014a), Section 4.3.4.4 of the Eastern Newfoundland SEA (C-NLOPB 2014), and Section 4.2.3 of the 2015 EA Update (LGL 2015b). In 2015, the recreational groundfish fishery was set to occur in all NAFO areas around Newfoundland and Labrador, including NAFO Divisions 2GH, 2J3KL, 3Ps, 3Pn and 4R, with the exception of the Eastport (northeast Newfoundland) and Gilbert Bay (southeast Labrador) Marine Protected Areas (MPAs) (DFO 2015e). Of these NAFO Divisions, portions of 3K

and 3L are within the Study Area. This fishery is largely conducted in coastal and inshore waters (C-NLOPB 2014), and was open for three weeks in the summer beginning on 18 July 2015, and for nine days in the fall beginning on 19 September 2015 (dates are subject to change; DFO 2015e). Information for the 2016 recreational fishery season was not yet available on the DFO website as of the writing of this document; however, the start and end dates for the summer and fall seasons are relatively consistent between years.

As per Section 4.2.3 *in* LGL 2015b, given the distance from shore it remains highly unlikely that any recreational fisheries will be conducted within the Study Area.

#### **4.2.4 Aquaculture**

As indicated in the Eastern Newfoundland SEA (see Section 4.3.4.3 *in* C-NLOPB 2014), and EMGS's 2015 EA Update (see Section 4.2.4 *in* LGL 2015b), there are currently no approved aquaculture sites within the Study Area. All approved aquaculture sites in Newfoundland and Labrador are coastally-based, and occur west of the Study Area (see Section 4.3.4.3 and Figure 4.150 *in* C-NLOPB 2014; DFA 2015).

#### **4.2.5 DFO and Industry Science Surveys**

DFO Research Vessel (RV) data collected during annual multi-species trawl surveys between 2007-2011 were presented in the EA (see Section 4.3.4 *in* LGL 2014a), and were analyzed for 2012 in the 2015 EA Update (LGL 2015b). Analysis of the 2013 dataset for spring (May–June) and fall (September–December) RV surveys in the Study Area did not indicate any major differences in either the predominant species caught or the harvest locations compared to previous survey years (see Table 4.5 and Figure 4.19 *in* LGL 2014a). As in 2012 but contrary to prior survey years, there were no RV survey data collected within the Study Area during March or July in 2013.

Fisheries research surveys conducted by DFO and the fishing industry were described in Section 4.3.6 of the EA (LGL 2014a). The tentative schedule of the 2016 DFO multispecies science surveys (RV surveys) is presented below (Table 4.5) (G. Sheppard, DFO, Technician, pers. comm. 27 January 2016). Spring RV surveys are currently set to begin at the end of March and continue into early-June, with surveys potentially occurring within the Study Area from early-May to early-June. DFO fall RV surveys will begin in mid-September and end in early-December, and may occur in the Study Area between late-September to early-December.

As indicated in the EA (see Section 4.3.6 *in* LGL 2014a), several DFO-Industry collaborative post-season snow crab trap survey stations are located in the western and south-central portions of the Study Area (see Figure 4.35 *in* LGL 2014a). It is anticipated that sampling at these stations will occur annually during the September to November period throughout the remainder of the Project (i.e., 2016-2018).

**Table 4.5 Tentative Schedule of DFO RV Surveys in 2016.**

NAFO Division	Start Date	End Date	Vessel
3P	29 Mar	12 Apr	<i>Needler</i>
3L	05 Apr	26 Apr	<i>Teleost</i>
3P	12 Apr	26 Apr	<i>Needler</i>
3L	26 Apr	02 May	<i>Vladykov</i> <sup>a</sup>
3P + 3KLMNO	27 Apr	02 May	<i>Teleost</i>
3P + 3O	27 Apr	10 May	<i>Needler</i>
3KL	03 May	21 May	<i>Teleost</i>
3O + 3N	10 May	21 May	<i>Needler</i>
3L + 3N	24 May	10 Jun	<i>Needler</i>
3K	06 Jul	18 Jul	<i>Vladykov</i>
3K	20 Jul	24 Jul	<i>Vladykov</i>
3L	15 Aug	21 Aug	<i>Vladykov</i>
3K	23 Aug	25 Aug	<i>Vladykov</i>
3O	14 Sep	27 Sep	<i>Needler</i>
3L	17 Sep	24 Sep	<i>Vladykov</i>
3O + 3N	27 Sep	08 Oct	<i>Needler</i>
2H	04 Oct	08 Oct	<i>Teleost</i>
3N + 3L	11 Oct	25 Oct	<i>Needler</i>
2H + 2J	11 Oct	25 Oct	<i>Teleost</i>
3L	17 Oct	26 Oct	<i>Vladykov</i>
3L	25 Oct	08 Nov	<i>Needler</i>
2J + 3K	25 Oct	08 Nov	<i>Teleost</i>
3K + 3L	09 Nov	19 Nov	<i>Needler</i>
3K	09 Nov	22 Nov	<i>Teleost</i>
3K + 3L Deep	22 Nov	06 Dec	<i>Teleost</i>

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

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

## 4.3 Seabirds

This section includes updates to the description of the Seabird VEC in Section 4.5 of the EMGS EA (LGL 2014a), the associated Addendum (LGL 2014b), and in Section 4.3 of the 2015 EA Update (LGL 2015b). The new information presented in this section does not change the effects predictions made in the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a).

### 4.3.1 Update to EA Section 4.5.3: Breeding Seabirds in Eastern Newfoundland

Just over 3.7 million pairs of seabirds nest on the southeast and east coast of Newfoundland. This includes 2.5 million pairs of Leach's Storm-Petrels (*Oceanodroma leucorhoa*) and 758,000 pairs of Common Murres (*Uria aalge*) (Table 4.6). The seabird breeding colonies on Funk Island, Baccalieu Island, the Witless Bay Islands and Cape St. Mary's are among the largest in Atlantic Canada. More than 3.6 million seabird pairs nest at these four locations alone (Table 4.6). This includes the largest Atlantic Canada colonies of Leach's Storm-petrel (2,022,000 pairs on Baccalieu Island), Common Murre (470,000 pairs on Funk Island), Black-legged Kittiwake (*Rissa tridactyla*) (13,879 pairs on Witless Bay Islands), Thick-billed Murre (*Uria lomvia*) (1,000 pairs at Cape St. Mary's), and Atlantic

Puffin (*Fratercula arctica*) (302,300 pairs on Witless Bay Islands). These breeding birds may use the western edge of the Study Area during the breeding season. After the nesting season and breeding seabirds disperse over a large area of the Newfoundland and Labrador offshore area including the Study Area.

#### **4.3.2 Update to EA Section 4.5.4.2: Hydrobatidae (Storm-petrels)**

##### **4.3.2.1 Leach's Storm-Petrel**

Leach's Storm-Petrel is common and widespread in offshore waters of Newfoundland from April to early November. More than two million pairs of Leach's Storm-Petrel nest on the Avalon Peninsula (Table 4.6). Accumulating evidence suggests the population of Newfoundland Leach's Storm-Petrels is experiencing a significant decline. Preliminary results from a 2013 survey of nesting Leach's Storm-Petrel on Baccalieu Island, the largest breeding colony of Leach's Storm-Petrels in the world, give an estimate of just over 2 million pairs. This represents a 40% decline from the previous survey in 1984 (EC-CWS, unpublished data). The results of surveys of nesting Leach's Storm-Petrels on Gull Island in the Witless Bay Ecological Reserve indicated a 51% decline in breeding pairs from 352,000 in 2001 to 180,000 pairs in 2012 (EC-CWS, unpublished data).

Leach's Storm-Petrels carrying geolocators were shown to travel up to 1,015 km ( $\pm 238$  km) during foraging trips from nesting colonies in Nova Scotia (Pollet et al. 2014a). Newfoundland breeders can be expected to travel a similar distance from the breeding colonies, if required, bringing the Study Area within reach. A bird outfitted with a geolocator in the Gull Island, Newfoundland colony migrated to Cape Verde Islands off the west coast of Africa in early December, averaging 420 km/day over 12 days of migration. It remained in this area five weeks until the transmitter stopped working (Pollet et al. 2014b).

#### **4.4 Marine Mammals and Sea Turtles**

This section includes updates to the description of the Marine Mammal and Sea Turtle VEC in Section 4.4 of the EMGS EA (LGL 2014a), the associated Addendum (LGL 2014b), and in Section 4.4 of the 2015 EA Update (LGL 2015b). The new information presented in this section does not change the effects predictions made in the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a).

**Table 4.6 Numbers of Pairs of Marine Birds Nesting at Marine Bird Colonies in Eastern Newfoundland.**

Species	Wadham Islands	Funk Island	Cape Freels and Cabot Island	Baccalieu Island	Witless Bay Islands	Mistaken Point	Cape St. Mary's	Middle Lawn Island	Corbin Island	Green Island
Northern Fulmar <i>Fulmarus glacialis</i>	-	13 <sup>a</sup>	-	-	13 <sup>a</sup>	-	Present <sup>a</sup>	-	-	-
Manx Shearwater <i>Puffinus puffinus</i>	-	-	-	-	-	-	-	7 <sup>c</sup>	-	-
Leach's Storm-Petrel	6,000 <sup>a</sup>	-	250 <sup>b</sup>	2,022,000 <sup>a</sup>	314,020 <sup>a</sup>	-	-	13,879 <sup>d</sup>	100,000 <sup>b</sup>	103,833 <sup>b</sup>
Northern Gannet <i>Morus bassanus</i>		6,075 <sup>a</sup>		2,564 <sup>a</sup>	-	-	14,789 <sup>a</sup>	-	-	-
Herring Gull <i>Larus argentatus</i>	-	150 <sup>a</sup>	-	46 <sup>a</sup>	2,045 <sup>a</sup>	-	Present <sup>b</sup>	20 <sup>b</sup>	5,000 <sup>b</sup>	Present <sup>b</sup>
Great Black-backed Gull <i>Larus marinus</i>	Present <sup>b</sup>	75 <sup>a</sup>	-	2 <sup>a</sup>	15 <sup>e</sup>	-	Present <sup>b</sup>	6 <sup>b</sup>	25 <sup>b</sup>	-
Black-legged Kittiwake	-	100 <sup>a</sup>	-	5,096 <sup>a</sup>	13,950 <sup>a</sup>	4,750 <sup>g</sup>	10,000 <sup>b</sup>	-	50 <sup>b</sup>	-
Arctic and Common Terns <i>Sterna paradisaea</i> , <i>Sterna hirundo</i>	376 <sup>b</sup>	-	250 <sup>b</sup>	-	-	-	-	-	-	Present <sup>b</sup>
Common Murre	-	470,000 <sup>a</sup>	2,600 <sup>b</sup>	1,440 <sup>a</sup>	268,500 <sup>a</sup>	100 <sup>g</sup>	15,484 <sup>a</sup>	-	-	-
Thick-billed Murre		250 <sup>a</sup>	-	73 <sup>a</sup>	240 <sup>a</sup>		1,000 <sup>b</sup>	-	-	-
Razorbill <i>Alca torda</i>	30 <sup>a</sup>	200 <sup>a</sup>	25 <sup>b</sup>	406 <sup>a</sup>	846 <sup>a</sup>	Present <sup>b</sup>	100 <sup>b</sup>	-	-	-
Black Guillemot <i>Cephus grylle</i>	25 <sup>a</sup>	1 <sup>b</sup>	-	113 <sup>a</sup>	20 <sup>a</sup>	Present <sup>b</sup>	Present <sup>b</sup>	-	-	-
Atlantic Puffin	7,140 <sup>a</sup>	2,000 <sup>a</sup>	20 <sup>b</sup>	45,300 <sup>a</sup>	324,650 <sup>a</sup>	50	-	-	-	-
TOTALS	13,571	478,864	3,145	2,077,040	924,299	4,900	41,373	13,912	105,075	103,833
Sources: <sup>a</sup> EC-CWS, unpubl.data; <sup>b</sup> Cairns et al. (1989); <sup>c</sup> Fraser et al. (2013); <sup>d</sup> Robertson et al. (2002).										

#### 4.4.1 Updated COSEWIC Designations

The following are updated COSEWIC designations (COSEWIC 2016) for marine mammals included in Table 4.8 of the original EA (LGL 2014a) and described in the EA Update (LGL 2015b). These changes in designation do not affect the effects assessment or requirement for mitigation measures.

- Cuvier's beaked whale (*Ziphius cavirostris*) – changed from *mid-priority candidate* species to *high-priority candidate* species; and
- Harp seal (*Pagophilus groenlandicus*) (Atlantic) – changed from *mid-priority candidate* species in the EA (LGL 2014a) to *high-priority candidate* species in the 2015 EA Update (LGL 2015b), and is currently considered *low-priority candidate* species.
- Hooded seal (*Cystophora cristata*) (Atlantic) – changed from *mid-priority candidate* species in the EA (LGL 2014a) to *high-priority candidate* species in the 2015 EA Update (LGL 2015b), and is currently considered *mid-priority candidate* species again.

#### 4.4.2 Updated Population/Abundance Estimates

Some of the marine mammal and sea turtle population/abundance estimates included in the original EA (LGL 2014a) and 2015 EA Update (LGL 2015b) are updated below.

- Fin whale (*Balaenoptera physalus*) – the current estimate for the western North Atlantic stock is 1,618 individuals (CV = 0.33; Waring et al. 2015).
- Cuvier's beaked whale – the best abundance estimate for Cuvier's beaked whales is 6,532 (CV = 0.32). This estimate is based upon shipboard surveys conducted from June to August 2011 between central Florida and the lower Bay of Fundy. Because beaked whales prefer deep-water habitats and the fact that no dive-time correction was used, the population estimate is considered negatively biased and an underestimate of the actual abundance (Waring et al. 2014).
- Bottlenose dolphin (*Tursiops truncatus*) – the best available estimate for the offshore stock of bottlenose dolphins in the western North Atlantic is 77,532 (CV = 0.40). This estimate is based on 2011 summer surveys covering waters from central Florida to the lower Bay of Fundy. A trend analysis has not been conducted for the western North Atlantic offshore stock of bottlenose dolphins; the statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey intervals (Waring et al. 2014).
- Grey seal (*Halichoerus grypus*) – population estimates for 2014 were 394,000 (95% CI 238,000-546,000), 13,800 (95% CI = 9,300–27,300), and 98,000 (95% CI = 54,000-179,000) for the Sable Island, coastal Nova Scotia, and Gulf of St. Lawrence herds, respectively (Hammill et al. 2014).

## 4.5 Species at Risk

This section includes updates to the description of the Species at Risk VEC in Section 4.6 of the EMGS EA (LGL 2014a), the associated Addendum (LGL 2014b), and in Section 4.5 of the 2015 EA Update (LGL 2015b). The new information presented in this section does not change the effects predictions made in the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a).

A report published by DFO in 2013 on the progress of the implementation of the 2007 recovery strategy and management plan for wolffishes was described in Section 4.5 of the 2015 EA Update (LGL 2015b); the recovery strategy and management plan have not yet been updated. Additionally, no other recovery strategies or management plans have been finalized or amended for species that may occur within the Study Area.

Table 4.7 summarizes species at risk that could potentially occur in the Study Area, based on available information as of February 2016 from the websites for SARA and COSEWIC. Changes in species designations since the 2015 EA Update was prepared are noted in red font and light grey shading in Table 4.7 and detailed below:

- Winter skate (*Leucoraja ocellata*) (Eastern Scotian Shelf – Newfoundland population) has been added; it was assessed as endangered by COSEWIC in May 2015; and
- Leatherback sea turtle (*Dermochelys coriacea*) was split into two entries in order to better reflect the listing as it appears on the SARA website; the listing without a specific population was assessed as endangered on Schedule 1 of SARA but without a COSEWIC designation, and the Atlantic population was assessed as endangered by COSEWIC but without a SARA designation.

As of February 2016, no species of special status that could potentially occur within the Study Area have been added to Schedule 1 of SARA.

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

**Table 4.7 SARA-Listed and COSEWIC-Assessed Marine Species that Potentially Occur in the Study Area.**

SPECIES		SARA <sup>a</sup>			COSEWIC <sup>b</sup>		
Common Name	Scientific Name	Endangered	Threatened	Special Concern	Endangered	Threatened	Special Concern
<b>Marine Mammals</b>							
Blue whale (Atlantic population)	<i>Balaenoptera musculus</i>	Schedule 1			X		
North Atlantic right whale	<i>Eubalaena glacialis</i>	Schedule 1			X		
Northern bottlenose whale (Scotian Shelf population)	<i>Hyperoodon ampullatus</i>	Schedule 1			X		
Fin whale (Atlantic population)	<i>Balaenoptera physalus</i>			Schedule 1			X
Sowerby's beaked whale	<i>Mesoplodon bidens</i>			Schedule 1			X
Harbour porpoise (Northwest Atlantic population)	<i>Phocoena phocoena</i>		Schedule 2				X
Humpback whale (Western North Atlantic population)	<i>Megaptera novaeangliae</i>			Schedule 3			
Killer whale (Northwest Atlantic/ Eastern Arctic population)	<i>Orcinus orca</i>						X
Northern bottlenose whale (Davis Strait-Baffin Bay-Labrador Sea population)	<i>Hyperoodon ampullatus</i>						X
<b>Sea Turtles</b>							
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Schedule 1					
Leatherback sea turtle (Atlantic population)	<i>Dermochelys coriacea</i>				X		
Loggerhead sea turtle	<i>Caretta caretta</i>				X		
<b>Fishes</b>							
White shark (Atlantic and Northern Gulf of St. Lawrence population)	<i>Carcharodon carcharias</i>	Schedule 1			X		
Northern wolffish	<i>Anarhichas denticulatus</i>		Schedule 1			X	
Spotted wolffish	<i>Anarhichas minor</i>		Schedule 1			X	
Atlantic wolffish	<i>Anarhichas lupus</i>			Schedule 1			X
Atlantic cod	<i>Gadus morhua</i>			Schedule 3			
Atlantic cod (Newfoundland and Labrador population)	<i>Gadus morhua</i>				X		
Atlantic bluefin tuna	<i>Thunnus thynnus</i>				X		



SPECIES		SARA <sup>a</sup>			COSEWIC <sup>b</sup>		
Common Name	Scientific Name	Endangered	Threatened	Special Concern	Endangered	Threatened	Special Concern
Porbeagle shark	<i>Lamna nasus</i>				X		
Roundnose grenadier	<i>Coryphaenoides rupestris</i>				X		
Cusk	<i>Brosme brosme</i>				X		
Smooth skate (Funk Island Deep population)	<i>Malacoraja senta</i>				X		
Winter Skate (Eastern Scotian Shelf – Newfoundland population)	<i>Leucoraja ocellata</i>				X		
American eel	<i>Anguilla rostrata</i>					X	
Shortfin mako shark (Atlantic population)	<i>Isurus oxyrinchus</i>					X	
American plaice (Newfoundland and Labrador population)	<i>Hippoglossoides platessoides</i>					X	
Atlantic salmon (South Newfoundland population)	<i>Salmo salar</i>					X	
Acadian redfish (Atlantic population)	<i>Sebastes fasciatus</i>					X	
Deepwater redfish (Northern population)	<i>Sebastes mentella</i>					X	
White hake (Atlantic population)	<i>Urophycis tenuis</i>					X	
Blue shark (Atlantic population)	<i>Prionace glauca</i>						X
Basking shark (Atlantic population)	<i>Cetorhinus maximus</i>						X
Spiny dogfish (Atlantic population)	<i>Squalus acanthias</i>						X
Roughhead grenadier	<i>Macrourus berglax</i>						X
Thorny skate	<i>Amblyraja radiata</i>						X
<b>Birds</b>							
Ivory Gull	<i>Pagophila eburnea</i>	Schedule 1			X		

Sources: <sup>a</sup> SARA website ([http://www.sararegistry.gc.ca/species/default\\_e.cfm](http://www.sararegistry.gc.ca/species/default_e.cfm)), accessed February 2016; <sup>b</sup> COSEWIC website (<http://www.cosewic.gc.ca/index.htm>); accessed February 2016. COSEWIC candidate species not included.

## 4.6 Sensitive Areas

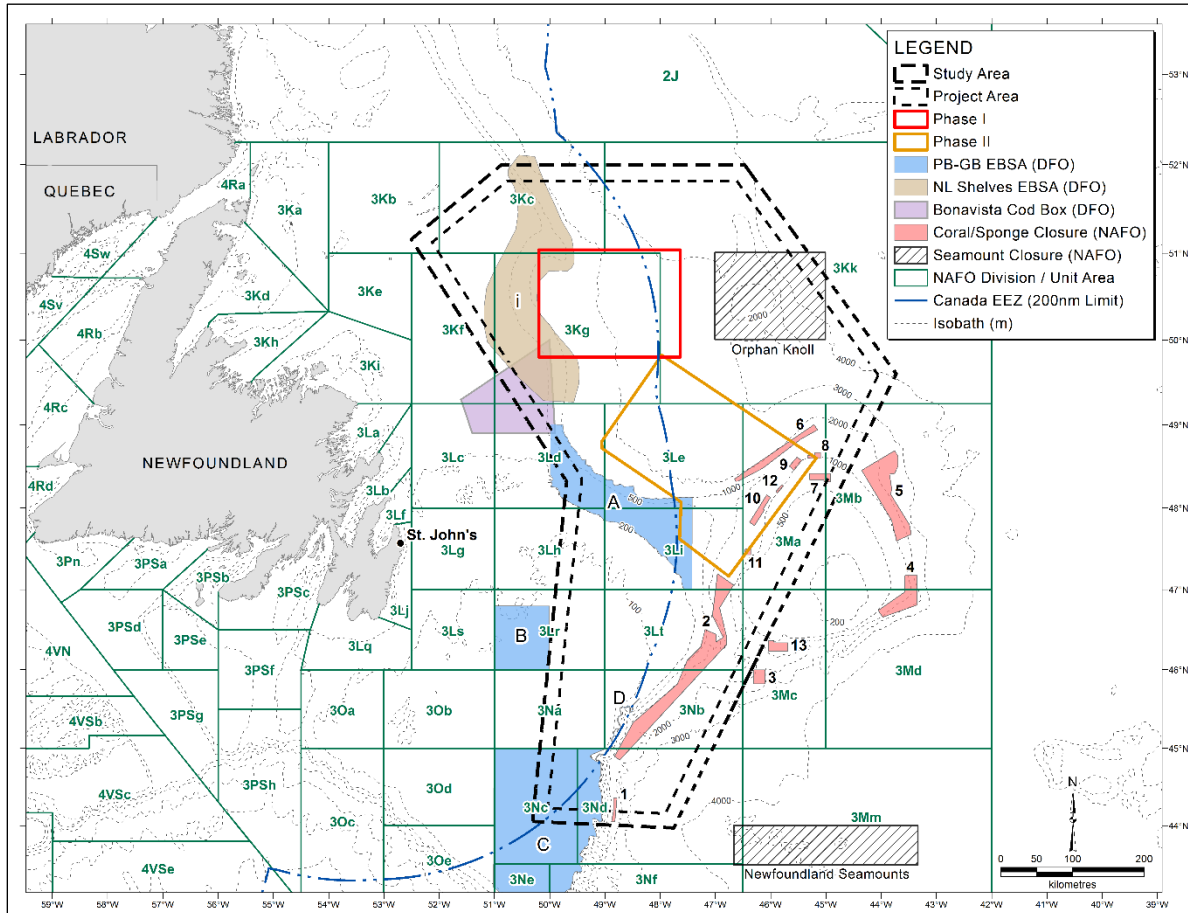
This section includes updates to the description of the Sensitive Areas VEC in Section 4.7 of the EMGS EA (LGL 2014a), the associated Addendum (LGL 2014b), and Section 4.6 of the 2015 EA Update (LGL 2015b). The new information presented in this section does not change the effects predictions made in the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a).

There have been no new designations or modifications of Coral/Sponge Closure Areas by the NAFO Scientific Council since the 2015 EA Update (see Figure 4.6 and Section 4.6 of LGL 2015b; NAFO 2015c). As shown in Figure 4.12 (below) and Figure 4.6 of the 2015 EA Update (LGL 2015b), nine of the total 13 Coral/Sponge Closure Areas are within the Study Area, with an additional three areas proximate to the eastern portion of the Study Area. Four Closure Areas are entirely or partially within the Phase II AOI; there are no Closure Areas within the Phase I AOI. These Coral/Sponge Closure Areas are closed to all bottom fishing activities until at least 31 December 2020 (NAFO 2015c). A recent Terms of Reference released by DFO detailed an upcoming national peer review in March 2016 in Halifax, NS, to address the needs of DFO Ecosystems and Fisheries Management in seeking scientific advice to develop clear guidance on how to use location data of coral and sponge concentrations in Canadian waters in order to aid the delineation of EBSAs for these species, and to relate these concentrations to the NAFO fishing footprint of bottom contact fisheries (DFO 2016a).

No additional Ecologically and Biologically Significant Areas (EBSAs) have been designated in association with the Placentia Bay – Grand Banks Large Ocean Management Area (PG-BG LOMA) and the Newfoundland and Labrador (NL) Shelves Bioregion since the 2015 EA Update (see Section 4.6 of LGL 2015b). The four PB-GB LOMA EBSAs (Northwest Shelf and Slope; Virgin Rocks; Southeast Shoal and Tail of the Banks; and Lilly Canyon – Carson Canyon) and single NL Shelves Bioregion EBSA (Orphan Spur) that overlap or are proximate to the Study Area are shown in Figure 4.12 (below) and Figure 4.6 of the 2015 EA Update (LGL 2015b). The key attributes of these EBSAs were presented in Table 4.8 of LGL (2015b). A small portion of the Northwest Shelf and Slope EBSA is within the Phase II AOI, and the Orphan Spur EBSA is partially within the Phase I AOI. A Terms of Reference was released by DFO for 29 January 2016 in relation to Canada's agreement to the Convention on Biological Diversity Aichi Target 11, which includes the goal of conserving 10% of coastal and marine areas by 2020 (DFO 2016b). Specifically, the Oceans Program aims to identify and/or clarify particular sub areas for each EBSA in the NL Bioregion; to this end, DFO Oceans has requested that DFO Science provide detailed descriptions of sub-components of the EBSAs designated in the PB-GB LOMA, and geospatially-referenced data layers for sub-components of the PB-GB LOMA and NL Shelves Bioregion EBSAs (DFO 2016b).

No NAFO Conservation and Enforcement Areas, including Seamount Closure Areas, have been newly designated or modified since the 2015 EA Update (see Figure 4.6 and Section 4.6 of LGL 2015b, and Figure 4.36 of LGL 2014a; NAFO 2015c). The single Seamount Closure Area which occurs within the Study Area, Orphan Knoll, is presented in Figure 4.12 (below) and briefly described in Section 4.6 of LGL (2015b). There are no Seamount Closure Areas within either the Phase I or II AOIs.

The Bonavista Cod Box, described in Section 4.7.3 of LGL (2014a), is an important area for cod spawning and juvenile cod, and was recommended by the *Fisheries Resource Conservation Council* (FRCC) to be protected from commercial fisheries (excluding snow crab trapping) and other invasive activities, including seismic exploration. A small portion of the Bonavista Cod Box is within the southwestern corner of the Phase I AOI (Figure 4.12).



Notes: NL Shelves Bioregion EBSA: (i) Orphan Spur; and PB-GB LOMA EBSAs: (A) Northwest Shelf and Slope, (B) Virgin Rocks, (C) Southeast Shoal and Tail of the Banks, and (D) Lilly Canyon-Carson Canyon.

**Figure 4.12 Sensitive Areas Overlapping or Proximate to the Study Area.**

## **5.0 Consultations**

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

The following stakeholders/agencies were contacted by EMGS on 20 January 2016 and provided information related to planned 2016 CSEM survey activities.

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

As of 16 March 2016, none of the consultees had responded to EMGS.

## **6.0 Environmental Assessment**

### **6.1 Mitigation Measures**

The mitigation measures described in the EA (see Sections 5.0 and 6.0 in LGL 2014a) and the associated Addendum (LGL 2014b) remain applicable to the CSEM survey activities planned for 2016.

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

### **6.2 Validity of Significance Determinations**

Based on careful consideration of newly available information presented in Section 4.0 and consultations with stakeholders, the determinations of significance of the residual effects of CSEM

survey activities on VECs presented in the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a) remain valid for the 2016 CSEM survey activities planned by EMGS.

## 7.0 Concluding Statement

The CSEM survey activities that EMGS plans to conduct in 2016 have been reviewed and determined to be within the scope of the EA (LGL 2014a) and its associated documents (LGL 2014b,c, 2015a,b) (see Table 1.1).

The environmental effects predicted in the EA and its associated documents remain valid. EMGS reaffirms its commitment to implement the mitigation measures proposed in these assessment documents and in the Screening Decisions made by the C-NLOPB.

## 8.0 Literature Cited

- Casas, J.M. 2015. Northern Shrimp (*Pandalus borealis*) on Flemish Cap Surveys 2015. NAFO SCR Doc. 15/047.
- Cairns, D.K., W.A. Montevecchi, and W. Threlfall. 1989. Researcher's guide to Newfoundland seabird colonies. Second edition. Memorial University of Newfoundland Occasional Papers in Biology, No. 14. 43 p.
- C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2010. Southern Newfoundland strategic environmental assessment. LGL Rep. SA1037. Rep. by LGL Limited, St. John's, NL, Oceans Limited, St. John's, NL, Canning & Pitt Associates, Inc., St. John's, NL, and PAL Environmental Services, St. John's, NL, for Canada-Newfoundland and Labrador Offshore Petroleum Board, St. John's, NL. 333 p. + appendices.
- C-NLOPB. 2014. Eastern Newfoundland strategic environmental assessment. Rep. by AMEC Environment & Infrastructure, St. John's, NL, for the C-NLOPB, St. John's, NL. 527 p. + appendices.
- COSEWIC. 2016. Candidate Wildlife Species. Accessed at [http://www.cosewic.gc.ca/eng/sct3/index\\_e.cfm](http://www.cosewic.gc.ca/eng/sct3/index_e.cfm) on 16 February 2016.
- DFA (Department of Fisheries and Aquaculture). 2015. Seafood industry year in review 2014. Fisheries and Aquaculture, Government of Newfoundland and Labrador. 38 p. Accessed at <http://www.fishaq.gov.nl.ca/> on 16 February 2016.
- DFO (Fisheries and Oceans Canada). 2015a. Oceanographic conditions in the Atlantic zone in 2014. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/030.
- DFO. 2015b. Assessment of Newfoundland and Labrador Snow Crab. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/029.
- DFO. 2015c. Assessment of Northern Shrimp (*Pandalus borealis*) in Shrimp Fishing Areas 4-6 (NAFO Divisions 2G-3K) and of Striped Shrimp (*Pandalus montagui*) in Shrimp Fishing Area 4 (NAFO Division 2G). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/018.
- DFO. 2015d. Assessment of Capelin in Subarea 2 and Divisions 3KL in 2015. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/036.

- DFO. 2015e. Decisions for Atlantic Canada, Quebec and the Arctic – 2015. Government of Canada. Accessed at <http://www.dfo-mpo.gc.ca/decisions/fm-2015-gp/index-atl-eng.htm> on 16 February 2016.
- DFO. 2016a. Terms of Reference. Delineation of significant areas of coldwater corals and sponge-dominated communities in Canada's Atlantic and Eastern Arctic marine waters. National Peer Review – National Capital Region. March 8-10, 2016, Halifax, NS. Accessed at [http://www.dfo-mpo.gc.ca/csas-sccs/Schedule-Horraire/2016/03\\_08-10-eng.html](http://www.dfo-mpo.gc.ca/csas-sccs/Schedule-Horraire/2016/03_08-10-eng.html) on 16 February 2016.
- DFO. 2016b. Terms of Reference. Refinement of information relating to Ecologically and Biologically Significant Areas (EBSAs) identified in the Newfoundland and Labrador (NL) Bioregion. Regional Science Response Process – Newfoundland and Labrador Region. January 29, 2016, St. John's, NL. Accessed at [http://www.dfo-mpo.gc.ca/csas-sccs/Schedule-Horraire/2016/01\\_29b-eng.html](http://www.dfo-mpo.gc.ca/csas-sccs/Schedule-Horraire/2016/01_29b-eng.html) on 16 February 2016.
- Fraser, G.S., J. Russell, G.J. Robertson, R. Bryant and D.A. Fifield. 2013. Prospects for the Manx Shearwater colony on Middle Island, Newfoundland, Canada. *Marine Ornithology* 41: 137-140.
- Hammill, M.O., C.E. den Heyer, and W.D. Bowen. 2014. Grey Seal Population Trends in Canadian Waters, 1960-2014. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/037. iv + 44 p.
- LGL (LGL Limited). 2014a. Environmental Assessment East Canada CSEM Survey, 2014-2018. LGL Rep. SA1248. Rep. by LGL Limited, St. John's, NL for Electromagnetic Geoservices Canada (Operator) (EMGS), Vancouver, BC. 192 p. + appendices.
- LGL. 2014b. Environmental Assessment EMGS East Canada CSEM Survey, 2014–2018 Addendum. LGL Rep. SA1248. Rep. by LGL Limited, St. John's, NL, for Electromagnetic Geoservices Americas Inc., Vancouver, BC. 26 p. + appendices.
- LGL. 2014c. Environmental Assessment EMGS East Canada CSEM Survey, 2014–2018 Amendment. LGL Rep. SA1248. Rep. by LGL Limited, St. John's, NL, for Electromagnetic Geoservices Americas Inc., Vancouver, BC. 1 p.
- LGL. 2015a. Environmental Assessment EMGS East Canada CSEM Survey, 2014–2018 Amendment. LGL Rep. SA1248. Rep. by LGL Limited, St. John's, NL, for Electromagnetic Geoservices Americas Inc., Vancouver, BC. 9 p.
- LGL. 2015b. Environmental Assessment Update of the EMGS East Canada CSEM Survey, 2014-2018. LGL Rep. FA0047. Rep. by LGL Limited, St. John's, NL for Electromagnetic Geoservices Canada Inc., Vancouver, BC. 30 p.
- NAFO (Northwest Atlantic Fisheries Organization). 2014a. Report of Scientific Council Meeting, 31 May -12 June 2014.
- NAFO. 2014b. Conservation and enforcement measures 2013. Northwest Atlantic NAFO high seas shrimp fisheries. FIRMS Reports In Fisheries and Resources Monitoring System (FIRMS) [online]. Rome. Available at <http://firms.fao.org/firms/fishery/664/en> on 16 February 2016.
- NAFO. 2015a. NAFO making waves: Bans on bottom fishing. Press Release. Available at <http://www.nafo.int/fisheries/frames/fishery.html> on 16 February 2016.
- NAFO. 2015b. NAFO regulated stocks. Available at <http://www.nafo.int/science/nafo-stocks.html> on 16 February 2016.

- NAFO. 2015c. Northwest Atlantic Fisheries Organization conservation and enforcement measures. NAFO/FC Doc. 15/01. Serial No. N6409.
- NAFO. 2016. Annex I – Fisheries Management. Annex I.A – Annual Quota Table. Available at <http://www.nafo.int/fisheries/frames/fishery.html> on 16 February 2016.
- One Ocean. 2013a. One Ocean Protocol for Consultation Meetings: Recommendations for the Fishing and Petroleum Industries in Newfoundland and Labrador. 7 p + appendix.
- One Ocean. 2013b. Protocol for seismic survey programs in Newfoundland and Labrador. One Ocean, St. John's, NL. 23 p.
- Pollet, I.L., R.A. Ronconi, I.D. Jonsen, M.L. Leonard, P.D. Taylor and D. Shutler. 2014a. Foraging movements of Leach's storm-petrels *Oceanodroma leucorhoa* during incubation. *Journal of Avian Biology* 45: 1-10.
- Pollet, I.L., A. Hedd, P.D. Taylor, W.A. Montevecchi and D. Shutler. 2014b. Migratory movements and wintering areas of Leach's Storm-Petrels tracked using geolocators. *Journal of Field Ornithology* 85:321-328, 2014.
- Robertson, G.J., J. Russell, and D. Fifield. 2002. Breeding population estimates for three Leach's Storm-Petrel colonies in southeastern Newfoundland, 2001. Canadian Wildlife Service, Atlantic Region Technical, Report Series No. 380.
- Román, E., Á. Armesto and D. González-Troncoso. 2015. Results for the Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish of the Spanish Survey in the NAFO Div. 3L for the period 2003-2014. NAFO SCR Doc. 15/020.
- Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rozel (eds.). 2014. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2013. NOAA Tech Memo NMFS NE 228: 464 p.
- Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2015. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2014. NOAA Tech Memo NMFS NE 231: 361 p. doi: 10.7289/V5TQ5ZH0.

#### **Personal Communications:**

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