

**Addendum to the  
Environmental Assessment of Statoil's  
Geophysical Program for the Jeanne d'Arc and Central  
Ridge/ Flemish Pass Basins,  
2011-2019**

**Prepared by**



**for**



**June 2011  
LGL Project No. SA1121-1**

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Environmental Assessment of Statoil's  
Geophysical Program for the Jeanne d'Arc and Central Ridge/  
Flemish Pass Basins,  
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**Prepared by**

**LGL Limited  
environmental research associates**  
388 Kenmount Road, Box 13248, Stn. A.  
St. John's, NL A1B 4A5  
Tel: 709-754-1992  
rbuchanan@lgl.com  
www.lgl.com

**In Association With**

**Canning & Pitt Associates, Inc.**  
Box 21461, St. John's, NL A1A 5G2  
Tel: 709-738-0133  
www.canpitt.ca

and

**Oceans Limited**  
65A LeMarchant Road  
St. John's, NL A1C 2G9  
Tel: 709-753-5788

**Prepared for**

**Statoil Canada Ltd.**  
Level II, Cormack Building  
2 Steer's Cove  
St. John's, NL A1C 6J5

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## **Preface**

This addendum contains Statoil's responses to reviewer comments on the "Environmental Assessment of Statoil's Geophysical Program for the Jeanne d'Arc and Central Ridge/Flemish Pass Basins, 2011-2019". Comments and responses are organized by the regulatory agency and groups that submitted comments. Comments are provided in italic font and responses in normal font.

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## Fisheries and Oceans Canada (DFO)

**General Comment:** Please be advised that DFO recommends that Statoil adhere to the "Statement of Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment" (SOCP) when conducting seismic programs. The SOCP specifies the mitigation requirements that must be met during the Planning Seismic Surveys, Safety Zone and Start-up, Shut-down of Air Source Array(s), Line Changes and Maintenance Shut-downs, Operations in Low Visibility and Additional Mitigative Measures and Modifications in order to minimize impacts on life in the oceans. These requirements are set out as minimum standards, which will apply in all non-ice covered marine waters in Canada. Sensitive Areas should include areas that are considered vulnerable, specifically areas that are known to have coral and/or sponge. Please consider incorporating aspects of the following documents:

- "Status Report on Coral and Sponge Conservation in Canada" for context of coral/sponge conservation in NL waters. <http://www.dfompo.gc.ca/library/340259E.pdf> Sections: 3.2.2, 4.5, 7.2.1 as well as Figures: 1, 6, 7)
- Canadian Science Advisory Secretariat Science Advisory Report 2010/041 "Occurrence, Sensitivity to Fishing, and Ecological Function of Corals, Sponges, and Hydrothermal Vents in Canadian Waters" [http://www.dfo-mpo.gc.ca/CSAS/Csas/publications/saras/2010/2010\\_041\\_e.pdf](http://www.dfo-mpo.gc.ca/CSAS/Csas/publications/saras/2010/2010_041_e.pdf)
- NAFO Conservation and Enforcement Measures 2011 Article 16 "Coral and Sponge Protection Zones" <http://www.nafo.int/fisheries/frames/regulations.html>

*It is noted in the EA that electromagnetic surveys are not specifically assessed, but may be a part of the geophysical program. However the potential impacts of the electromagnetic survey, mitigations, significance, residual impacts, have not been addressed in this EA Report.*

### Response:

#### Re: corals and sponges

Change the title of Section 4.2.4 to "Deep-water Corals and Sponges" and add the following text and figure to Section 4.2.4:

Sponges also provide significant deep-sea habitat, enhance species richness and diversity, and exert clear ecological effects on other local fauna. Sponge grounds and reefs support increased biodiversity compared to structurally-complex abiotic habitats or habitats that do not contain these organisms (DFO 2010).

Morphological forms such as thick encrustations, mounds, and branched, barrel- or fan-like shapes influence near-bottom currents and sedimentation patterns. They provide substrate for other species and offer shelter for associated fauna through the provision of holes, crevices, and spaces. Siliceous hexactinellid sponges can form reefs as their glass spicules fuse together such that when the sponge dies the skeleton remains. This skeleton provides settlement surfaces for other sponges, which in turn form a network that is subsequently filled with sediment (DFO 2010).

Although some of the siliceous spicules of non-reef-forming species dissolve quickly, there is some accumulation of shed spicules forming a thick sediment-stabilizing mat, which constitutes a special bottom type supporting a rich diversity of species. Organisms commonly associated with sponges and sponge grounds include species of marine worms and bryozoans, as well as higher fauna. Live glass

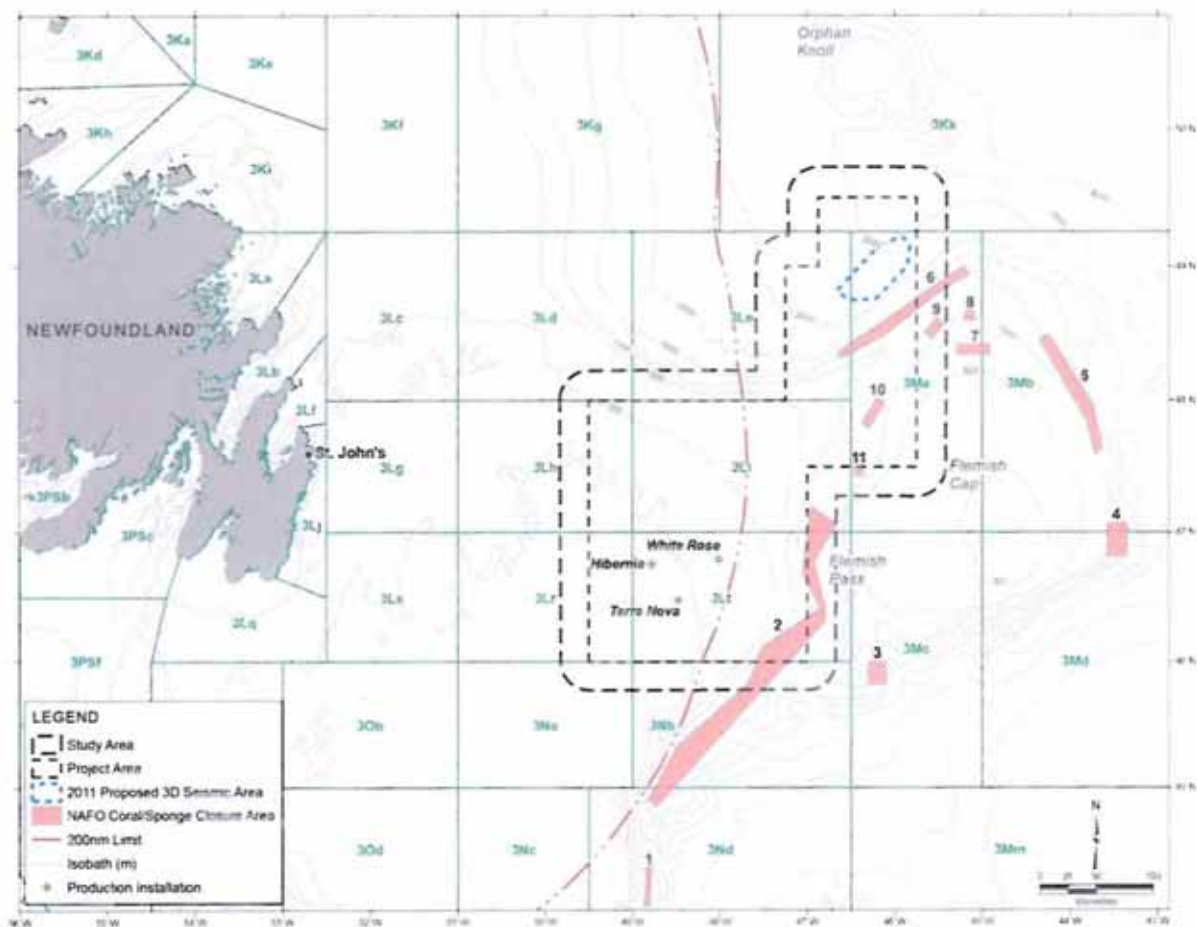


sponge reefs have been shown to provide nursery habitat for juvenile rockfish and high-complexity reefs are associated with higher species richness and abundance (DFO 2010).

In 2008 and 2009, the NAFO Scientific Council identified areas of significant coral and sponge concentrations within the NAFO Regulatory Area. Based on these identifications, areas for closure to fishing with bottom contact gear were delineated. Figure 1 shows the locations of 11 of these areas, five of which occur either entirely or partially within the proposed Statoil Study Area. None occur within the proposed 2011 3D seismic area. Implementation date of the closures started on 1 January 2010 (NAFO website: <http://www.nafo.int/about/annrep/ar09/fc-index.html>). Given the nature of seismic and geohazard surveys, survey equipment is not expected to come in contact with the seafloor and deep-water corals and sponges.

#### Reference:

DFO (Fisheries and Oceans Canada). 2010. Occurrence, susceptibility to fishing, and ecological function of corals, sponges, and hydrothermal vents in Canadian waters. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/041.



**Figure 1. Locations of NAFO Coral/Sponge Closure Areas relative to the Statoil Study Area, Project Area, and 2011 Proposed 3D Seismic Area.**

Also add the following subsection to Section 4.7 on "Potentially Sensitive Areas".

#### 4.7.3 Coral/Sponge Closure Areas

In 2008 and 2009, the NAFO Scientific Council identified areas of significant coral and sponge concentrations within the NAFO Regulatory Area. Based on these identifications, areas for closure to fishing with bottom contact gear were delineated (see revised Section 4.2.4 and Figure 1 above).

Reference:

DFO (Fisheries and Oceans Canada). 2010. Occurrence, susceptibility to fishing, and ecological function of corals, sponges, and hydrothermal vents in Canadian waters. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/041.

#### Re: electromagnetic surveys

See response to a similar comment posed by the C-NLOPB on [pages 21-28](#) of this document.

**Comment (Section 4.1, pg 31):** Please insert as follows: "This EA focuses on components of the ecosystem such as selected species....that are important economically, socially, and ecologically with potential to interact with the project".

**Response:** Change the sentence referenced above to: "This EA focuses on components of the ecosystem such as selected species and stages of fish, seabirds and marine mammals that are important ecologically, economically and/or socially, with potential to interact with the Project."

**Comment (Section 4.2.1, pg 31):** Please insert as follows: "The physical and chemical nature of the water column and bottom substrate is a critical factor affecting the characterization....."

**Response:** Insert "water column" as indicated above.

**Comment (Section 4.2.2, pg 31):** While the assessment is comprehensive and well done there is an exception with the section describing the pelagic ecosystem and the plankton of the study area. The linear foodweb described is overly simplistic and does not represent our current understanding of planktonic foodwebs. Diatoms and copepods are an important component of the planktonic ecosystem at certain times of year in this region, but they are not always dominant and do not always represent the principal pathways of energy flow or carbon cycling. The timing of the spring bloom and the release of fish larvae into the upper water column have been shown to be important determinants of larval survival. This is particularly relevant for species such as redfish which have episodic recruitment. Specific information on the composition and dynamics of the pelagic communities of the study area should be documented, as should the importance of sedimentation for carbon supply of benthic foodwebs.



**Response:** It is understood that Section 4.2.2 on "Plankton" is presented in a simplistic and highly generalized manner but a comprehensive discussion of NW Atlantic plankton is not warranted for a seismic program of limited scale and duration relative to the oceanic processes that govern plankton populations. Section 4.2.2 refers to other EAs which present more information on plankton in the area, and points out that the wide distribution and abundance of plankton makes this ecosystem component essentially insensitive to measureable or meaningful effects as a result of the proposed seismic program.

**Comment (Section 4.2.5.2, pg 40, 2nd sentence):** *Feeding is most intense in fall and spring (not late winter) and diet is primarily copepods with some amphipods and euphausiids.*

**Response:** Change the questionable text in Section 4.2.5.2 to the following:

Capelin prey consists of planktonic organisms comprised primarily of copepods with some amphipods and euphausiids. Capelin feeding is seasonal with the most intense feeding during the fall and spring. Feeding recommences several weeks after cessation of spawning in late spring/early summer (Scott and Scott 1988).

**Comment (Section 4.2.5.2, pg 40):** *It is not clear which dataset is being referenced here and therefore this section requires some clarification. The reference may be to the capelin by-catch in the shrimp fishery, which is not an exhaustive descriptor of their distribution as the shrimp fishery is located over a rather limited area. If this is the case then it would need to be stated. Another possibility is that the reference may be to the multi-species surveys, which are not part of a fishery. There is no offshore commercial capelin fishery.*

**Response:** The first sentence of the last paragraph in the subsection on capelin refers to the capelin by-catch in the shrimp fishery conducted within the Study Area. The second sentence in this same paragraph refers to DFO RV survey data.

**Comment (Section 4.3.3.1, pg 50, 2nd sentence):** *Northern shrimp and snow crab are described as "underutilized". There were northern shrimp and snow crab fisheries prior to the collapse of the groundfish fishery. There is no evidence that the northern shrimp stock and snow crab stock was underutilized. It is suggested to replace the term "underutilized species" with "other".*

**Response:** There is no reference on page 50 to northern shrimp and snow crab as being underutilized species. This particular reference actually appears on page 53 (in the first paragraph of Section 4.3.3.1). The same DFO comment is noted and dealt with in the following comment/response below.

**Comment (Section 4.3.3.1, pg 53, 1st paragraph):** *It is suggested to replace the term "formally underutilized species" with "other", as "formally underutilized species" implies that they were present, but not fished. It may be that they were not there previously.*

**Response:** On p 53, replace "formerly underutilized species" with "other species" as DFO suggests.

**Comment (Section 4.3.4.2, pg 58, 2nd sentence):** *It is stated that the "study area overlaps with parts of SFA 6". However SFA 6 ends at the 200 mile limit. Please clarify whether the study area does or does not overlap with SFA 6.*

**Response:** The Study Area does not overlap with Shrimp Fishing Area (SFA) 6. The sentence should be amended to read as follows: "The Study Area overlaps with parts of Shrimp Fishing Area (SFA) 7 and 3M (Figure 4.16)."

**Comment (Section 4.3.4.2, g 68, 2nd paragraph):** *It is suggested that the word "Landed" be placed before the word "Prices" to distinguish between prices paid to harvesters and final project market prices.*

**Response:** Insert the word "landed" as suggested.

**Comment (Section 4.3.4.2, pg 58, 2nd sentence):** *This sentence is confusing and should be rewritten.*

**Response:** The sentence the DFO reviewer is referring to is actually on the top of page 74 (not page 58) in the Statoil ERA document and reads as follows: "Shrimp harvesting uses mobile shrimp trawls. These are modified stern otter trawls, for both inshore and offshore vessels, though some use beam trawls. Over the past several years in offshore Newfoundland and Labrador, shrimp vessels and survey ships, with good communications, typically avoid each other without interference to either industry, as has been noted by industry participants during previous consultations."

This sentence is indeed a bit confusing and should be reworded (see below).

However, this sentence (which now appears on page 74) belongs to short section on fishing gear which has been left out of the EA document. This missing section is 4.3.5 Fishing Gear and should start on page 70 (just after the last paragraph in existing Section 4.3.4.3, Greenland Halibut).

The missing section – 4.3.5 Fishing Gear – including the amended text of the confusing sentence (indicated above in quotation marks) should be inserted into the revised EA document.

This missing section should read as follows:

#### 4.3.5 Fishing Gear

The commercial fisheries within the Study and Project Areas are conducted using both mobile gear (shrimp trawls) and fixed gear (crab pots and gillnets), although only a minority of the overall catch is harvested using gillnets. In general, fixed gear poses a much greater potential for conflicts with towed survey gear since it is often hard to detect when there is no fishing vessel nearby, and it may be set out over long distances in the water. In particular, crab pots pose a significant potential for conflict if a seismic survey vessel encounters them. Crab pots are set on the seabed in strings buoyed at the



surface. Crab gear generally has a highflyer (radar reflector) at one end and a large buoy at the other. Some fishers use highflyers at both ends. Depending on weather, they may be left unattended several days at a time. Fishers typically try to leave about 20 fathoms (36.5 m or 120 feet) on the seabed between each pot. Thus, allowing slack for the anchor ropes on either end of the string to extend upwards at an angle, the distance between the typical highflyer and end-buoy of, for example, a 50 to 60 pot string of crab gear would be 6,000 feet to 7,500 feet, or approximately 1.8 km to 2.3 km. The 2011 seismic survey is planned to occur well removed from crab fishing efforts, thus no interaction is anticipated.

Although they only account for about 0.1% of the harvest by quantity, Greenland halibut gillnets (e.g., 200 nets per boat) are also fixed gear and may pose a potential to conflict with seismic gear if in the same area at the same time.

Shrimp are harvested with shrimp trawls, a mobile fishing gear which is essentially a modified stern otter trawl. As industry participants have noted in previous consultations, with good communications at sea, shrimp vessels and survey ships have usually managed to avoid each other without interference to either industry.

Because of the potential for conflict between shrimp trawls and fixed gears, the two fisheries generally stay apart, as discussed above.

**Comment (Section 4.3.5, pg 74):** *In addition to the multi-species bottom trawl surveys listed, there is an annual Spring 3L Capelin acoustic survey which may be impacted.*

**Response:** Statoil notes that an annual Spring 3L Capelin acoustic survey may occur in the Study Area. The DFO RV managers will be contacted prior to the start of the survey to determine if an RV vessel might be operating in the vicinity of the seismic vessel during the survey timeframe. If so, an avoidance plan will then be worked out.

**Comment (Section 4.5.1.2, pg 88):** *DFO has population estimates for many cetacean and pinniped species in Atlantic Canada. These are based on systematic surveys such as those detailed in Lawson and Gosselin (2009) and Stenson et al. (2011). These figures could be quoted in place of the NOAA estimates unless the latter includes species for which the DFO surveys did not have enough sighting events to generate an acceptable estimate.*

**Response:** For most marine mammal species, the NOAA Stock Assessment estimates include the data reported in Lawson and Gosselin (2009). For cetacean species where the NOAA Stock Assessments were not appropriate to use (e.g., humpback whales), abundance estimates provided in Lawson and Gosselin (2009) were provided or other sources of information were cited (e.g., COSEWIC status reports). Stenson et al. (2011) report that total harp seal pup production in 2008 was estimated to be 1.63 million (SE=110,400). They note that this is significantly higher than estimated previously and is inconsistent with previous predictions obtained from the harp seal population model.

References:

Lawson, J.W. and J.F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey – A component of the 2007 TNASS. DFOCan. Sci. Advis. Sec. Res. Doc. 2009/031. 28 p.

Stenson, G.B., M.O. Hammill and J.W. Lawson. 2011. How many harp seal pups are there? Additional results from the 2008 surveys. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/137. iv + 19 p.

**Comment (Section 4.5.1.3, pg 92, 1st paragraph):** *Based on aerial searches and acoustic recordings, the south eastern edge of the Grand Banks remains an area populated by cetaceans during the winter. Therefore, the statement "although some individual baleen whales may be present in offshore waters of NL..." is not necessarily accurate (Stenson et al 2011).*

**Response:** DFO has placed autonomous acoustic recorders at the east and southeast edges of the Grand Banks and have recorded mysticete and odontocete calls throughout the winter (J. Lawson, Research Scientist, DFO, pers. comm.). PAL surveillance imagery, records, and observations by DFO staff have also shown there to be quite a few humpbacks and other large whales out in this area through the winter. Based on these observations, change the sentence referenced above to "Some baleen whales are present in offshore waters of Newfoundland year-round but most species presumably migrate to lower latitudes during winter months."

**Comment (Section 4.5.1.3, pg 94):** *It is noted through DFO review that Sperm Whales are regularly sighted in shallow coastal waters, therefore may also be encountered in the Flemish Basin.*

**Response:** Change the following sentence: "Sperm whales appear to prefer deep waters off the continental shelf, particularly areas with high secondary productivity, steep slopes, and canyons that may concentrate their primary prey of large-bodied squid (Jaquet and Whitehead 1996; Waring et al. 2001)."

to

"Sperm whales appear to prefer deep waters off the continental shelf, particularly areas with high secondary productivity, steep slopes, and canyons that may concentrate their primary prey of large-bodied squid (Jaquet and Whitehead 1996; Waring et al. 2001); however, they are regularly sighted in shallow coastal waters and therefore, may be encountered in the Flemish Basin (DFO, unpubl. data).

**Comment (Section 4.5.1.5, pg 97):** *More information should be provided on the importance of the area for feeding Harp and Hooded Seals. The area of the NE Grand Banks, slope and Flemish Pass is critical for seals during the spring when they need to replenish their energy reserves. Satellite telemetry studies have shown that this area is used extensively by Hooded Seals in May. By late May they have left the area for the moulting ice although harps are still present through June. Harp Seals tend to remain on the continental shelf while Hooded Seals dive in the deep shelf waters.*

**Response:** The Statoil EA referred the reader to LGL (2008) for a more detailed review of the biological background information on marine mammals, including seals. There have been no new publications describing the results of the satellite tag study referenced above since that time (B. Sjare,



Research Scientist, DFO, pers. comm.). The following text for hooded and harp seals is taken from Sections 4.6.1.21 and 4.6.1.22 of LGL (2008), respectively:

#### Hooded Seals

"Data collected from satellite transmitters deployed on hooded seals in the Gulf of St. Lawrence indicate that some females feed near the Flemish Cap after breeding while migrating to Greenland waters (G.B. Stenson, unpubl. data). Tagged males migrating to Greenland in early summer were recorded along the Grand Banks shelf edge near the Flemish Pass. It appears that males spend little time foraging in this area (G.B. Stenson, unpubl. data). Little is known regarding their winter distribution, although it is believed that the majority of seals remain offshore; they have been seen feeding off the Grand Banks in February. Surveys in the early 1990s suggested that the offshore waters on the northern edge of the Grand Banks might be an important over-wintering area for hooded seals (Stenson and Kavanagh 1994)."

#### Harp Seals

"Surveys conducted during the early 1990s suggested that offshore waters on the northern edge of the Grand Banks in NAFO fishing area 3L were an important over-wintering area for these animals during those years (Stenson and Kavanagh 1994). ...Similarly, data from satellite transmitters deployed on harp seals suggest that the Grand Banks is an important wintering area for some seals (Stenson and Sjare 1997)."

#### References:

LGL. 2008. Environmental assessment of StatoilHydro's Jeanne d'Arc Basin area seismic and geohazard program, 2008-2016. LGL Rep. SA947. Rep. by LGL Limited, Canning and Pitt Associates Inc., and Oceans Ltd., St. John's, NL for StatoilHydro Canada Ltd., St. John's, NL. 174 p + appendices.

Stenson, G.B. and D.J. Kavanagh. 1994. Distribution of Harp and Hooded Seals in offshore waters of Newfoundland. Northwest Atlantic Fisheries Organization, Scientific Council Studies 21:121-142.

Stenson, G.B. and B. Sjare. 1997. Seasonal distribution of Harp Seals, *Phoca groenlandica*, in the Northwest Atlantic. ICES. C.M. 1997/10 p.

**Comment (Section 4.5.1.5, pg 97):** *The report estimates harp seal population at 6.85 million. Hammill and Stenson (2010) state the population is ~ 8 million.*

**Response:** The 6.85 million population estimate for harp seals was provided based on the information in Hammill and Stenson (2010). Hammill and Stenson (2010) do provide a second population estimate of ~8 million but they acknowledge that the model fit for this estimate is poor. To more accurately reflect the information in the DFO report, change the sentence in question to "The total NW Atlantic population is estimated at 6.85 million or 8.24 million seals in 2009 depending on which estimate of pup production is used in the population model (Hammill and Stenson 2010)."

#### Reference:

Hammill, M. O. and G. B. Stenson. 2010. Abundance of Northwest Atlantic harp seals (1952-2010). DFO Can. Sci. Advis. Sec. Res. Doc. 2009/114. iv + 12 p.



**Comment (Section 4.5.1.5, pg 97):** *Lavigne and Kovacs (1988) is not necessarily the best choice of reference for locations of pupping harp seals. There are a large number of papers in the primary literature indicating that the proportion pupping is not a „small remainder“. In fact the proportion accounts for 25-30% of total pupping, which can be over 400,000 pups (Stenson et al 1993, 2002, 2003, 2009, 2010).*

**Response:** Change the sentence referenced above to "Harp seals are common during spring off northeast Newfoundland and southern Labrador where they congregate to breed and pup on the pack ice; the majority of the NW Atlantic population uses this region while the remainder uses the Gulf of St. Lawrence (Lavigne and Kovacs 1988; Stenson et al. 2010)."

Reference:

Stenson, G.B., M.O. Hammill, and J.W. Lawson. 2010. Estimating pup production of Northwest Atlantic Harp Seals, *Pagophilus groenlandicus*: Results of the 2008 surveys. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/103. iv + 39 p.

**Comment (Section 4.6, pg 99):** *The word "designated" should be replaced with "listed" throughout these sections when referring to SARA listed species. The term "designated" would be more appropriate when referring to species that have been assessed by COSEWIC, but not listed on SARA.*

**Response:** Replace "designated" with "listed" when referring to SARA-listed species. Also, use "designated" versus "listed" when referring to species that have been assessed by COSEWIC.

**Comment (Section 4.6, pg 99, 3rd paragraph):** *There is also a final recovery strategy posted on the SARA Registry for the North Atlantic Right Whale.*

**Response:** On p. 99, add North Atlantic right whale to the list of endangered or threatened species with final recovery strategies in place.

**Comment (Section 4.6, pg 100, Table 4.12):** *It should be noted that for the Atlantic Salmon designatable units (DU) occurring in NL, only the South Newfoundland DU was assessed as threatened by COSEWIC.*

**Response:** It is noted that the only Atlantic salmon DU linked to NL that has COSEWIC designation (i.e., threatened) is the South Newfoundland population. However, other Atlantic Canadian populations may also use the Study Area during migratory movements.

**Comment (Section 4.6, pg 100, Table 4.12):** *For the Deepwater Redfish, it is the Northern DU which was assessed by COSEWIC as threatened.*

**Response:** It is noted that only the Northern DU of Deepwater Redfish is designated by COSEWIC as threatened.

**Comment (Section 4.7, Pg 105):** *This section of the EA notes that "there are a variety of regulatory frameworks that deal directly or indirectly with sensitive areas...", and lists them, but does not mention the Oceans Act (it is highlighted on pg 2 as relevant to environmental aspects of the EA but occurs nowhere else in the document). Oceans Act Marine Protected Areas are established by Fisheries and Oceans Canada to protect and conserve important fish and marine mammal habitats, endangered marine species, unique features and areas of high biological productivity or biodiversity.*

**Response:** The Oceans Act should be added to the list of examples of regulatory frameworks in Section 4.7. In addition, the following text should also be added to this section:

"The Oceans Act Marine Protected Areas (MPA) are established by the Fisheries and Oceans Canada to protect and conserve important fish and marine mammal habitats, endangered marine species, unique features and areas of high biological productivity or biodiversity."

**Comment (Section 4.7.1, pg 105):** *In referring to the Placentia Bay/Grand Banks Large Ocean Management Area correctly refers to the existence of the Ecologically and biologically Significant Area (i.e. the Northeast Shelf and Slope) within the study area as a potential Area of Interest (i.e. AOI). However, it should also be noted within the EA Report that the Oceans Act provides the Minister of Fisheries and Oceans with a leadership role for coordinating the development and implementation of a federal network of Marine Protected Areas (MPA), of which can include areas within and outside of the Integrated Management (IM) area that has yet to be developed specifically within the Region to date. Therefore, there is the potential for subsequent identification of EBSAs, AOI, MPAs and other sensitive areas in the study area within the future.*

**Response:** The following text should be added to Section 4.7.1.

"The Oceans Act provides the Minister of Fisheries and Oceans with a leadership role for coordinating the development and implementation of a federal network of MPAs, which can include areas within and outside of the Integrated Management (IM) area that have yet to be developed within the Region. Therefore, there remains potential for further identification of EBSAs, AOI, MPAs and other sensitive areas within the Study Area."

**Comment (Section 5.1.1.1, pg 108):** *DFO suggests that the consultation section be expanded to include more information on the discussion between DFO and Statoil's consultant which included the importance of current and relevant information on SARA species and commercial fisheries. There was also additional correspondence in which DFO indicated that "DFO guidance on Seismic programs is based upon the "Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment" (SOCP) to protect fish (including marine mammals), SARA species and fisheries. Mitigations from the SOCP should be incorporated into the EA Report, as well as updated fisheries and SARA information." (refer to email exchange of March 4 - 8, 2011 of S. Canning and J. Kelly titled: Statoil Canada Ltd. Geophysical Program for Jeanne d'Arc Basin and Central Ridge / Flemish Pass Basin, 2011 - 2019).*

**Response:** As DFO suggests, the following sentences should be added to the Consultations section:



"During consultations with departmental managers it was also noted that DFO's guidance on seismic programs is based upon the *"Statement of Practice with respect to the Mitigation of Seismic Sound in the Marine Environment"* (SOCP), and is designed to protect fish (including marine mammals), SARA species and fisheries. It was suggested that relevant mitigations from the SOCP should be incorporated into the EA Report, as well as updated fisheries and SARA information."

**Comment (Section 5.2, pg 110):** *Under section 5.2 valued ecosystem components, the first of 6 VECs is titled "Commercial fish". However in each of the tables that follow pertaining to that VEC, it is referred to as "the fish and fish habitat VEC". It might be more appropriate to re-name that VEC in section (5.2), from "commercial fish" to "fish and fish habitat". The paragraph should then proceed to explain why only a few commercial species are considered under that VEC. Cod is one species mentioned under the existing commercial fish VEC, but little mention is made of spawning aggregations (i.e. breeding habitat) or mitigations to avoid breeding areas or breeding periods, should they be identified. A brief description of cod spawning characteristics might improve the EA. Although there maybe few large breeding aggregations of cod and other groundfish known to exist in the proposed study area (compared to historical accounts), the study duration is sufficiently long (-2019) allowing for significant changes to develop in offshore fish populations. An appropriate mitigation measure to reduce potential harm to VECs (such as breeding aggregations) is the avoidance of known breeding fish aggregations, either spatially or temporally.*

**Response:** The name of the first VEC identified in Section 5.2 should be changed from "Commercial Fish" to "Fish and Fish Habitat". The text of the associated paragraph for this VEC remains entirely relevant despite the name change. As explained in the paragraph, the identified commercial invertebrate and fish species provide representation of the variety of macro invertebrates and fishes that could be exposed to the seismic sound during the proposed program. Three of the four species have also been used as subjects in studies of the effects of exposure to seismic sound.

The assessment does consider the potential behavioural effects of exposure to seismic sound, including effect on reproductive behavior. While detailed description of cod spawning behavior is not provided, the assessment does discuss the idea of underwater sound causing interruption of spawning behavior in general. As for mitigations, the assessment does note the potential application of 'spatial and temporal avoidance' of known unique areas where spawning or some other type of important life history behaviour occurs (e.g., feeding).

**Comment (Section 5.6.1.2, pg 125):** *A report on Lobster catch rates and seismic activity in Australia is noted. It is suggested to add something similar to the following statement "However, the study noted that due to natural variability and fishing pressure, a large effect on lobster would be required to link any effect to seismic".*

**Response:** The following text should be added to the paragraph discussing the work of Parry and Gason (2006).

"Parry and Gason (2006) noted that due to natural variability and fishing pressure, a large effect on lobster would be required to make any link to effect of seismic".

**Comment (Section 5.6.5, pg 193):** *The word "designated" should be replaced with "listed" throughout these sections when referring to SARA listed species. The term "designated" would be more appropriate when referring to species that have been assessed by COSEWIC, but not listed on SARA.*

**Response:** Replace "designated" with "listed" when referring to SARA-listed species. Also, use "designated" versus "listed" when referring to species that have been assessed by COSEWIC.

**Comment (Section 5.8, pg 199, Table 5.18):** *The proponent will employ multiple trained MMO"s in addition to the FLO. This will enhance the efficiency of this type of mitigation, although the EA could benefit from more detailed descriptions of the MMO activities to ensure the reviewers that the best possible methods will be employed.*

**Response:** The primary role of the MMO (sometimes referred to as the Environmental Observer or EO) is to implement mitigation measures outlined in the SOCP and included in the C-NLOPB (2011) "Geophysical, Geological, Environmental and Geotechnical Program Guidelines". MMOs are specifically tasked with:

- detecting blue whales, North Atlantic right whales and leatherback sea turtles (i.e., species listed as Endangered on Schedule 1 of SARA; there are no marine mammals or sea turtles listed as Threatened in the Study Area) within, or about to enter, the safety zone and initiating immediate shutdown of the airgun arrays; delaying ramp-ups when a marine mammal (or sea turtle) is sighted within the safety zone; ensuring that airgun ramp-up procedures are followed, and
- documenting the reactions of marine mammals (and sea turtles) to seismic operations and documenting locations and abundance of marine mammals (and sea turtles).

MMOs monitor for marine mammals and sea turtles during all daylight hours the airgun(s) are operational, during the 30-minute period before ramp up, and during most other daylight hours. Monitoring is typically conducted from the bridge and/or bridge wings of the seismic vessel and reticle binoculars are used to aid the MMO in distance estimates. MMOs typically conduct 2-3 hour watches followed by a 2 hour break; this is repeated about three times per day depending on the hours of daylight. Data collection protocols closely follow those outlined in Moulton and Mactavish (2004) and recommended for use by C-NLOPB (2011).

Biologists that perform MMO duties also conduct systematic seabird surveys periodically each day when weather conditions permit and search the vessel for stranded birds. Stranded birds are handled and released in accordance with appropriate protocols (Williams and Chardine, n.d.).

#### References:

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2011. Canada-Newfoundland and Labrador Offshore Petroleum Board. Geophysical, Geological, Environmental and Geotechnical Program Guidelines, February 2011.

Moulton, V.D., and B.D. Mactavish. 2004. Recommended seabird and marine mammal observational protocols for Atlantic Canada. LGL Rep. SA775-1. Rep. from LGL Ltd., St. John's, NL, for Environmental Studies Research Funds, Calgary, AB. 71 p.



Williams, U. and J. Chardine, n.d. The Leach's Storm-Petrel: General information and handling instructions.

**Comment:** *The information provided in the report is well presented and up to date. However additional information related to international waters would help to improve the report. For instance, information on fish surveys and fisheries could be improved with regards to international waters. Data from the NAFO is mostly restricted to the landings database STATLANT 21A. However, there is more NAFO-linked information that could be presented in this assessment.*

*NAFO data on fishing locations can also be improved within this report. Portions of the project area squarely fall within the NAFO fisheries footprint. Furthermore, NAFO collects vessel monitoring system (VMS) data that may be available upon request to the NAFO secretariat.*

*This information would enhance the Report. For example, both Kenchington et al. (2010 DFO ResDoc10/40) and Cogswell et al. (2010, NAFO SCR 10/71) make use of this type of data for specific analyses and both reports provide maps of fishing location and fishing effort in NAFO waters.*

*Aggregate VMS data from NAFO will provide a better perspective of fisheries activities in the project area. Equally important is to incorporate information contained in NAFO documents related to VME areas and closed areas for corals and sponges. This information is readily available from the NAFO website ([www.nafo.int](http://www.nafo.int)). Some key meeting reports from NAFO documents include:*

NAFO 2008 SCS 08/10  
NAFO 2008 SCS 08/19  
NAFO 2008 SCS 08/24  
NAFO 2009 SCS 09/06  
NAFO 2009 SCS 09/26  
NAFO 2010 SCS 10/18  
NAFO 2010 SCS 10/19  
NAFO 2010 FC Doc 09/06  
NAFO 2010 FC Doc 10/04

*This list is not intended to be exhaustive, but provides a reasonable starting point.*

**Response:** Relevant NAFO documents are used in the EA. It is our understanding that the vast majority of NAFO data are not georeferenced and thus, are of limited use in discriminating specific locations of fishing vessels. The few NAFO data that are georeferenced are available to us. As such, there appears to be little value in adding this material to the EA. It will not add any location information or expand our level of understanding of the existing environment. In addition, the additional NAFO documents will not change the mitigations, predictions or the conclusions provided in the EA.

We know there are foreign vessels in the offshore area outside 200 miles. These are large vessels, which can easily be detected on radar and visually if they are operating in the vicinity of the survey vessel. Further, these foreign vessels are using primarily mobile gear and can thus be easily avoided by seismic vessels (and vice versa).

With one exception, seismic survey vessel personnel and FLOs operating in Newfoundland waters have never reported/experienced any problems dealing with foreign fishing ships operating in their vicinity. We are aware of only one instance in the past 10-12 years when foreign vessels came in close contact with a seismic survey vessel: that incident involved a "rogue" fishing vessel (probably North Korean) that refused to answer a hail from the seismic vessel bridge and which had its vessel name



and id number covered with plywood. [In that case, the survey vessel's SPOC contacted DFO and the department quickly dispatched an over flight to check out the illegal fishing.]

**Comment:** *In terms of corals, sponges, and vulnerable marine ecosystems (VME), the assessment mainly reports studies from Canadian sources such as DFO documents. These documents provide good information, but typically do not include information from outside the EEZ. Information from outside the EEZ should be included to provide a balanced picture of the ecosystem being affected by this proposed project. For example, in 2008, the NAFO Working Group on Ecosystem Approaches to Fisheries Management identified a number of candidate VME areas and based on subsequent requests by the NAFO Scientific Council and NAFO Fisheries Commission, more tightly defined areas with high concentrations of corals and sponges were later identified. Many of these areas, including most seamounts, have been closed to bottom trawl fishing by NAFO. None of the maps in this report actually show all these areas (candidate VME's and areas of high concentration of corals and sponges). Some of these identified areas are within the target area for this project, thus should be included in the report.*

**Response:** See response to previous comment related to the inclusion of sponges in Section 4.2.3 on "Benthos" and mapping of the NAFO coral/sponge closure areas.

**Comment:** *It is suggested that some statements within the report require supporting material. An example in Section 4.2.2 is the statement that plankton is "so ubiquitous and abundant" is not necessarily supported by research. This statement should be clearly framed and justified. For example, there is evidence that primary production appears to be a general limiting factor for fisheries productivity in marine systems (see Chassot et al. 2010 Ecology Letters 13: 495-505) and hence, any factor affecting its abundance has the potential for affecting fisheries yields.*

**Response:** It is understood that primary production is likely a general limiting factor for marine fisheries productivity. The EA predicts that the proposed seismic program would have negligible effect on the health of plankton. There is evidence to support the idea that some of the plankton occurring within 3-5 m of a discharging airgun would be damaged (Payne 2004). However, the number of plankton that would be directly affected by exposure to seismic sound relative to the total number of plankton in the area would be negligible and indistinguishable from the numbers of plankton damaged or killed under natural conditions.

As for other "statements within the report requiring supporting material", the reviewer did not specify what they are or where they occur in the EA.

Reference:

Payne, J.F. 2004. Potential effect of seismic surveys on fish eggs, larvae and zooplankton. DFO Can. Sci. Adv. Sec. Res. Doc. 2004/125.

**Comment:** *A description of the role of ice in the regulation of the phytoplankton bloom should be included (e.g. see Wu et al 2007 J. Plankton Research 29:509-514). Ice plays a role in defining the environmental conditions required for the bloom to occur.*

**Response:** These authors related the timing of the spring plankton bloom off NE Newfoundland to the retreat of sea ice in the spring. The seismic survey will occur in the summer and the seismic survey is predicted to damage little phytoplankton relative to regional populations.



## Department of National Defence

**Comment:** *It was observed that the information provided to the C-NLOPB by the Department of National Defence (DND), through the Federal Coordination Regulations process, has not been included in the report. That information was:*

*"DND is likely to be operating in the vicinity of the study area in a non-interference manner during the April to October 2011 to 2019 timeframe. Unexploded Ordinate (sic) (UXO) data is available for the study area and a search of the records was conducted to determine the possible presence of UXO within the Statoil Project Description survey area. DND records indicate no wrecks are present within the survey area. However, as depicted in the attached graphic, one site is approximately 8 km from the western boundary of the study area. According to the database, it is a U- 520 German IXC Type U-Boat which was sunk by depth charges from a Canadian Digby aircraft on 30 October 1942. The exact location of the wreck is uncertain due to the limitation of the positional location technology of the time (the site was plotted with information reported at the time of the sinking). Given our understanding of the survey activities to be conducted, the associated UXO risk is assessed as negligible. Nonetheless, due to the inherent dangers associated with UXO and the fact that the Atlantic Ocean was exposed to many naval engagements during WWII, should any suspected UXO be encountered during the course of Statoil's operations, it should not be disturbed/manipulated. Statoil should mark the location and immediately inform the Coast Guard. Additional information is available in the 2010 Annual Edition - Notices to Mariners, Section F, No.37. In the event of activities which may have contact with the seabed (such as drilling or mooring), it is strongly advised that operational aids, such as remote operated vehicles, be used to conduct seabed survey in order to prevent unintentional contact with harmful UXO items that may have gone unreported or undetected. Further UXO general information is available at our website at [www.uxocanada.forces.gc.ca](http://www.uxocanada.forces.gc.ca) "*

*Particular attention should be made to the following:*

*"... should any suspected UXO be encountered during the course of Statoil's operations, it should not be disturbed/manipulated. Statoil should mark the location and immediately inform the Coast Guard. Additional information is available in the 2010 Annual Edition – Notices to Mariners, Section F, No.37."*

*The assessment of the possible presence of this wrecked submarine and the potential for the presence of unexploded ordnates (UXO) is extremely important. DND and the C-NLOPB requests that Statoil Canada Limited include the information provided to the C-NLOPB by the DND, through the Federal Coordination Regulations process, and provided to Statoil Canada Limited, via the Draft Scoping Document Review Comments, by the C-NLOPB on February 24, 2011 in the assessment report for the proposed project.*

**Response:** During the preparation of the EA, the information provided by DND concerning the possible presence of a wrecked submarine and unexploded ordnance was considered. Given the nature of seismic and geohazard surveys, survey equipment is not expected to come in contact with wrecks and/or UXO on the seafloor. Also, the location of the recorded wreck is outside of the Project Area. As recommended by DND, in the highly unlikely event that suspected UXO are encountered during the course of seismic and geohazard operations, Statoil and its subcontractors will not disturb or manipulate UXO, will mark the location, and immediately inform the Coast Guard.

Some geophysical survey techniques (e.g., CSEM surveys) may utilize small dissolvable anchors. DND will be consulted prior to any deployment of bottom mounted equipment and adjustments made to study design, if necessary.

## Environment Canada (EC)

**Comment (Seabird Data Collection):** *This survey provides a good opportunity to collect additional seabird data from the area. CWS has developed a pelagic seabird monitoring protocol that we are recommending for all offshore projects. This protocol is a work in progress and we would appreciate feedback from the observers using it in the field. A guide sheet to the pelagic seabirds of Atlantic Canada is available through CWS in Mount Pearl.*

*In an effort to expedite the process of data exchange, the Canadian Wildlife Service would appreciate that the data (as it relate to migratory birds or species at risk) collected from these surveys be forwarded in digital format to our office following completion of the study. These data will be centralized for our internal use to help ensure that the best possible natural resource management decisions are made for these species in Newfoundland and Labrador. Metadata will be retained to identify source of data and will not be used for the purpose of publication. The Canadian Wildlife Service will not copy, distribute, loan, lease, sell, or use of this data as part of a value added product or otherwise make the DATA available to any other party without the prior express written consent.*

**Response:** A seabird data collection program will be undertaken aboard the survey vessel by experienced biologists. Survey methods will closely follow the Eastern Canada Seabirds at Sea (ECSAS) Standardized Protocol for Pelagic Seabird Surveys from Moving and Stationary Platforms (Gjerdrum et al. 2011). The seabird data will be provided to CWS in digital format for the purposes of natural resource management. It is understood that CWS "will not copy, distribute, loan, lease, sell, or use of this data as part of a value added product or otherwise make the DATA available to any other party without the prior express written consent". In addition, a seabird (and marine mammal) monitoring report will be submitted to the C-NLOPB in accordance with their "Geophysical, Geological, Environmental and Geotechnical Program Guidelines" (C-NLOPB 2011).

### Reference:

Gjerdrum, C., D.A. Fifield and S.I. Wilhelm. 2011. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 36 p.



## **Fish, Food and Allied Workers (FFAW)**

**General Comment:** *To clarify a point made in the document (page 199), fishing gear may only be retrieved from the water by the gear owner (i.e. fish license owner). This includes buoys, radar reflectors, rope, nets, pots, etc. associated with fishing gear and/or activity. If gear contact is made during seismic operations it should not be retrieved or retained by the seismic vessel. There are conditions that may warrant gear being retrieved or retained if it becomes entangled with seismic gear, however, further clarification on rules and regulations regarding fishing gear should be directed to the Conservation and Protection Division of Fisheries and Oceans Canada (NL Region).*

*Also, to clarify, it is unreasonable for Statoil to encourage or ask a fish harvester to shift or set his gear away from the project area, see pg C-1, such that the seismic ship can pass through without incident. Setting gear in an area outside of normal fishing grounds may result in loss of catch, increased expenses, and therefore, decreased revenue for the harvester. Exploration activities should not be to the detriment of the harvester."*

*Another point in the document requires clarification. The Newfoundland and Labrador population of Atlantic Cod is not currently designated under COSEWIC (pg 43). It may be recommended for this designation, but the Government of Canada has not made this decision on this.*

*The quota in 2010 for the 3M cod fishery was 44 tonnes. The quota in 2011 was increased to 10,000 tonnes (pg 109). In 2011, Canada acquired a greater percentage of the quota (0.8% in 2010, 3.3% in 2011). The company should be aware that there may be international fishing vessels operating in the 3M area that may or may not be familiar with communication practices that have been established for oil and gas exploration activities in Newfoundland and Labrador waters.*

*It is important for Statoil [to] maintain regular communication with the FFAW to keep apprised of ongoing developments with fisheries in the large project area. A number of surveys and programs are proposed over the nine years. Harvesters are spread out over a wide geographic area and communication is vital to the safety of all involved.*

*The unknown long term effects of seismic activities continue to concern harvesters. There have been reports from harvesters that fish behaviour has been affected following seismic blasts and shellfish have disappeared from areas following seismic work being undertaken. There have also been reports from vessel captains that ground fish catches have been impacted when oil and gas activities have been ongoing. While the research has not determined any direct mortality of fish or shellfish attributable to seismic activity there may be behavioural changes that could affect migration and/or reproductive spawning activities as well as movement of the exploitable biomass in an area. This, in turn, can impact catch rates in years to come. There is need for further research on impacts on seismic activity on important commercial species including shrimp, crab, turbot and Atlantic cod to address data gaps.*

*The commercial fishery will be actively prosecuted at the time that Statoil is proposing to conduct its program in 2011 and beyond. While historical fishing patterns have been detailed in the document, fishing activity can change from year to year and during the season as well. While there has not been recent fishing activity recorded in the area of the 2011 proposed program, other areas of the project area are heavily fished by the inshore fleet. The offshore fleet and other international vessels may also be fishing in the area.*



*In addition to the deployment of a Fisheries Liaison Officer onboard the seismic vessel to mitigate potential conflicts with fishing vessels and fishing gear (both towed and fixed gear) in heavily fished areas of the project area, the FFAW recommends that the company also consider the deployment of a Fisheries Guide Vessel when they work in this heavily fished area. The loss of fishing time, catch and/or gear that may be associated with gear entanglement in this area may be significant during this prime period so all avenues to mitigate conflicts should be considered. The deployment of a Fisheries Guide Vessel may also be beneficial during the route analysis and/or transit of the seismic ship from St. John's to the Flemish Pass in 2011.*

**Response:**

**Re: Clarification of gear handling procedures**

In response to a statement on page 199 of the EA which noted that the survey vessel would retrieve and retain any floating debris from contact with fishing gear if it was safe to do so, the FFAW said this statement needed to be clarified as follows:

"... fishing gear may only be retrieved from the water by the gear owner (i.e. fishing license owner). This includes buoys, radar reflectors, rope, nets, pots, etc. associated with fishing gear and/or activity. If gear contact is made during seismic operations it should not be retrieved or retained by the seismic vessel. There are conditions that may warrant gear being retrieved or retained if it becomes entangled with seismic gear, however, further clarification on rules and regulations regarding fishing gear should be directed to the Conservation and Protection Division of Fisheries and Oceans Canada (NL Region)".

Statoil agrees fully with this statement of clarification. Add the above text to the statement made on p. 199 of the EA.

**Re: Potential costs incurred by fishers who might be requested to shift their fishing gear away from a survey line**

With respect to the point mentioned on page C-1 of the EA, the FFAW notes that "it is unreasonable for Statoil to encourage or ask a fish harvester to shift or set his gear away from the project area such that the seismic ship can pass through without incident. Setting gear in an area outside normal fishing grounds may result in loss of catch, increased expenses and therefore decreased revenue for the harvester. Exploration activities should not be to the detriment of the harvester."

The FFAW's manager is referring to Appendix C of the EA Report. This Appendix describes the responsibilities of participants involved in providing Single Point of Contact (SPOC) Services to the Newfoundland & Labrador Offshore Sector. The FFAW's comment refers to a paragraph in the "Operational Responsibilities, Protocols and Communications" (i.e. Protocols) section of the SPOC document.

Among other items, the SPOC document explains the procedures to be followed by the onboard Fisheries Liaison Officer (FLO), the seismic operator - and the SPOC onshore -when fishing gear is present in the vicinity of survey operations.

The Protocols section notes: " The main threat of conflict with exploration activities is usually from fixed fishing gear ... .. [However] fishers are not required to move fishing gear from the exploration work area. All gear in the path of the petroleum exploration work must be avoided [by the seismic vessel] and other clear areas pursued instead, if encountered". (Emphasis added)

The FFAW's comment is directed specifically to the wording of the last sentence of the following paragraph which reads:

"If obstructing fishing gear is located by the exploration or scout vessel, the exact positions and name or CFV number on the gear would be recorded and relayed to the FLO and the SPOC. At sea the FLO, and on land the SPOC, will try to contact the gear owners (based on the name or CFV information). The FLO and SPOC will attempt to determine the plans / schedule of the gear owner with respect to that gear, and will encourage the owner to communicate with the exploration vessel / FLO at sea, and to shift the gear in question into a different area the next time it is hauled, though this may not result in any significant change of location".

The FFAW's interpretation of the last sentence is that the survey vessel operator will, and also has the right to, ask the fisher to move his gear. In its response, the FFAW objects to this action noting that " it is unreasonable for Statoil to encourage or ask a fish harvester to shift or set his gear away from the project area such that the seismic ship can pass through without incident".

The FFAW goes on to say - correctly - that such an action could "result in loss of catch, increased expenses and therefore decreased revenue for the harvester".

We agree with the above statement: a fisher could suffer economic consequences if he opts to shift his gear to another location at the request of a seismic vessel. However, the Protocols do not state that the fisher is required to move his gear if asked to do so by the seismic vessel operator. All they say is that the FLO (or in some cases the SPOC) may reasonably ask the fisher to "shift the gear in question into a different area the next time it is hauled". The decision is entirely with the harvester in question; he can decide to stay where he is, or he might voluntarily comply with the request to shift his gear the next time he hauls it at the location in question.

We are not aware of any cases in the offshore where a fisher was forced to move his gear out of the path of a survey line. There are a couple of cases (e.g. during the 1990s in Bay St. George) in which inshore crab fishers agreed to move their gear off planned seismic lines as part of an overall compensation program worked out in advance with these fishers. There is also at least one instance where an offshore seismic vessel waited for several days after the close of the (offshore) crab season for fishers to remove their gear from the path of a survey line.

#### **Re: Comment on the current status of cod under COSEWIC**

According to the COSEWIC website ([www.cosewic.gc.ca](http://www.cosewic.gc.ca)), the NL population of Atlantic cod is designated as 'endangered' (as of October 2010).

#### **Re: 2011 3M cod fishery**

Statoil is aware that international fishing vessels may be harvesting cod (and other species) in the general vicinity of the proposed 2011 survey area.

#### **Re: Ongoing concerns of harvesters regarding potential unknown/long term effects of seismic activities**



Statoil acknowledges that many fishers, and the FFAW, continue to remain concerned about the potential effects of seismic survey operations on their harvesting activities and on various key species that they exploit in the marine environment.

**Re: (a) Need for regular communications with the FFAW and harvesters during the life of the program and (b) Potential for year to year variations in historical fishing patterns**

Statoil acknowledges that fishing activity patterns, industry-based survey areas and the geographic location of some species harvesting grounds may change and vary over the next nine years. Statoil agrees that it is important to maintain regular communications with the FFAW and fishers in order to keep apprised of ongoing developments in the project area fisheries.

**Re: Suggestion for the deployment of a Fisheries "Guide" Vessel**

Statoil acknowledges the FFAW's views regarding the potential benefits of using a fisheries guide vessel to assist seismic surveys. Statoil is also aware of the FFAW's capability to provide these 'guide' vessels to surveys which Statoil plans to undertake during the project timeframe. Statoil does not foresee a requirement for such a vessel during its geophysical surveys. The FLO and picket vessel are tasked with minimizing the potential of interactions between geophysical operations and fishing activities. In addition, Statoil is committed to ensuring open and frequent communications with the FFAW before and during the 2011 survey (and those in 2012-2019).

## Canada-Newfoundland and Labrador Offshore Petroleum Board

**General Comment:** Section 3 of the Scoping Document identifies the components of the project to be assessed. Although "electromagnetic surveys" are discussed in various upfront sections of the EA (e.g. pgd 1, 3, 9, 10), they are not included in the assessment of the project. Statoil should fully assess all components of the project (including electromagnetic surveys) that were identified in the Scoping Document.

### **Response:**

Please apply the following changes in regard to CSEM to the EA sections listed below.

#### **1.0 Introduction**

*Remove the last two sentences under 1.0 and add:*

"If a drilling target is identified, electromagnetic surveys, a type of geophysical survey, may be conducted to aid in assessing the potential for petroleum hydrocarbons. These potentially could be conducted anywhere within the Project Area as defined here and the technology that would be used is assessed in this EA. Project details such as specific locations and times, and numbers of receivers and a more detailed assessment will be provided in a supplement to the EA if and when an electromagnetic survey is planned and designed."

#### **2.3 Project Overview**

*Insert as second last paragraph:*

"Controlled source electromagnetic (CSEM) surveys may be conducted prior to drilling if likely targets are identified by seismic. These types of surveys analyze the resistivity of the seabed substrata in order to aid in discriminating between pockets of water versus hydrocarbons. At present, there are no such specific targets but they could potentially occur at locations of relatively limited areal extent anywhere within the Project Area (Figure 1.1). CSEM surveys do not utilize strong sound sources and thus may not require the same mitigations as seismic surveys. Nonetheless, the several programs in Newfoundland and Labrador waters that have been conducted to date have applied typical seismic survey mitigations (see following paragraph)."

##### **2.3.1 Objectives and Rationale**

*Add as last paragraph:*

"As noted above, CSEM surveys analyze the resistivity of the seabed substrata in order to aid in discriminating between pockets of water versus hydrocarbons thus potentially increasing exploration drilling success rates. Increased drilling success has the overall effect of reducing effects on the environment by reducing the total number of wells."

##### **2.3.3 Project Scheduling**

*Add as last paragraph:*

"Given the scarcity of CSEM survey sources and vessels, typical duration of surveys (40-80 days), and the need for good weather conditions, a maximum of one or two CSEM surveys could occur per year."

#### **2.3.4 Site Plans**

*Add as last paragraph:*

"Specific site plans will be provided if and when CSEM surveys are planned. Typically a season's survey might cover on the order of 1,200 km<sup>2</sup>. There could be as many as about 200 bottom-mounted receivers employed in a grid pattern several kilometres apart."

#### **2.3.5 Personnel**

*Add the following sentence:*

"A typical CSEM survey vessel accommodates about 30-40 technical and ship's crew."

*Add a new subsection:*

##### **2.3.9a CSEM Vessel and Equipment**

The total duration of a season's program is anticipated to be 75 days. This includes time to complete reconnaissance by echo sounder along all proposed source lines, deployment of receivers, sourcing of all source lines, recovering of receivers, overhead (transits, crew changes, etc), and downtime (weather or technical). In general, the CSEM survey technique described in Sections 3.3 and 3.4 of Buchanan et al. (2006) will be employed in 2011-2019. The electrical source would be towed approximately 30 m above the sea bottom. Current (about 1,200 Amperes) will be alternating and very low frequency (on the order of 0.25 Hz and will be determined on site after initial testing). A typical CSEM survey vessel is the M/V *Siem Mollie* owned by *emgs* the same vessel used during the 2009 CSEM survey in Orphan Basin.

Dipole receivers (i.e., antennae) are normally mounted on the sea bed in a grid pattern using anchors designed to dissolve within one year or so. The receivers are retrieved using acoustic releases. Specific details will be provided in a supplement if and when a CSEM program is being designed. These details are not presently available because specific targets have not yet been defined, and hence the surveys have not been designed and specific contractors and equipment have not been retained.

#### **5.5 Effects of the Environment on the Project**

*Add a new paragraph:*

"Similar to seismic and geohazard survey operations, CSEM vessels suspend operations once wind and wave conditions reach a certain level."

#### **5.6 Effects of the Project on the Environment**

*Add as last paragraph:*

CSEM surveys as envisaged here only tow a single electric source just off the bottom in deep water. They tow gear at a slower speed than does a seismic vessel (e.g., 2 kts vs 4 kts). CSEM surveys also differ from seismic and geohazard surveys in that they do not emit strong underwater sound and do not



tow streamers. Because of this the main pathways for effects on the environment lie with the electromagnetic fields emitted or induced and bottom-mounted receivers (if used) plus those generally associated with all offshore vessels (e.g., propulsion noise and light attraction). The former pathways are described in detail in Buchanan et al. (2006) and associated updates. Noise and light issues are discussed in the following sections as they relate to seismic and geohazard vessels and apply as well to CSEM vessels.

### 5.6.1 Fish and Fish Habitat VEC

*Add a new section:*

#### " 5.6.1.4a Effects of EM Emissions

Potential effects of EM emissions are reviewed and assessed in detail in Buchanan et al. (2006) and associated updates (e.g., LGL 2007, 2009). In summary, the extremely low frequency (ELF) emissions of the EM source are non-ionizing radiation, exposure times are short and thus CSEM surveys are predicted to have no effect on the health of marine organisms (see also WHO 2007 in regard to potential health effects from ELF).

A wide variety of invertebrates and vertebrates are known to orient to the Earth's magnetic field and some animals such as juvenile sea turtles are known use these fields to navigate. Although the literature is somewhat contradictory, magnetic fields have also been implicated to varying degrees in some species of salmon, eel, sharks, and cetaceans. It has been theorized that sharks use their electroreceptive capabilities to aid navigation. While it is unknown exactly what, if any effects, anthropogenic CSEM emissions (an alternating current, AC source) may have on marine animals that use the Earth's magnetic field (a direct current, DC source), it is reasonable to predict that there would be negligible effects on navigation from brief exposures in the open ocean on the order of minutes. In addition, it is known that animals (as with humans) cannot and do not rely on a single source of navigational information.

If there are effects from CSEM emissions, the most likely group affected would be the elasmobranchs. This group of cartilaginous fishes (e.g., sharks and rays) is electroreceptive through organs known as ampullae of Lorenzini which are extremely sensitive to AC current (i.e., AC receptors) but also can likely detect DC fields by moving back and forth through them. It is well documented that ampullae of Lorenzini in marine species are capable of detecting weak electric currents in seawater. Kalmijn (1966) showed that swimming sharks and rays exhibited avoidance responses when subjected to voltage gradients of  $1\text{--}10\ \mu\text{V cm}^{-1}$ . Sedate sharks and rays visibly responded to a square wave field of 5 Hz with a voltage gradient of  $0.1\ \mu\text{V cm}^{-1}$ . Changes in the heart rate of a ray were detected down to a voltage gradient of  $0.01\ \mu\text{V cm}^{-1}$ . The dogfish displayed behavioral responses to gradients as low as  $5\ \text{nV cm}^{-1}$  (Kalmijn 1982). The blacktip reef shark and whitetail stingray both showed threshold responses at about  $4\ \text{nV cm}^{-1}$  (Haine et al. 2001).

At least some elasmobranchs use their electroreceptive sense to detect non-visible prey at very close range (matter of centimeters). Based upon the interaction of multiple electric fields, Haine et al. (2001) calculated that the distance at which the source potential dropped below the detection level of the shark and ray was 250 cm.

The above information on elasmobranch sensitivities to electric fields notwithstanding, they are not predicted to be significantly affected by the electromagnetic fields generated by CSEM mainly because of attenuation, short exposure times, and the fact they regularly encounter natural electric fields stronger than those generated by CSEM.

Modeling by the ExxonMobil Upstream Research Company showed that the largest magnetic field is at the source (Buchanan et al. 2006). This is less than 10% of the earth's magnetic field strength and has a polarity reversal of seconds to one minute duration. Intensity drops to background fluctuation levels (100 nT) within about 400 m of the source (given a 500 A source). An exposure time for a stationary point is on the order of 20 minutes for an exposure level of  $\geq 100$  nT.

Similarly, modeling of the electric field showed the largest field strength at the source. The maximum mid-dipole strength was 3  $\mu\text{V}/\text{cm}$  with a temporal polarity reversal of seconds to one minute. Intensity drops rapidly with distance from source (about 1.0  $\mu\text{V}/\text{cm}$  at about 500 m and about 0.1  $\mu\text{V}/\text{cm}$  at about 1,000 m (about 1,200 m for a 1,000 A source). Source level exposure times were calculated as 25 minutes at  $\geq 1.0$   $\mu\text{V}/\text{cm}$  to 45 minutes at  $\geq 0.1$   $\mu\text{V}/\text{cm}$ .

Strong water currents in the Atlantic are capable of generating induced electric fields as strong as 500  $\mu\text{V}/\text{cm}$  (von Arx 1962 in Kalmijn 1971). Elasmobranchs must be routinely exposed to these naturally occurring fields without any known effect.

In summary, it is predicted that because the EM fields generated by CSEM attenuate with distance ( $< 1$  km) and exposure times are brief ( $< 1$  month) that any effects will be of low magnitude and hence *not significant* (Table 5.2)."

Add two new lines to Table 5.2:

<b>EM Emissions</b>	Disturbance (N)	N/A	0-1	1	1	1	R	2
<b>Receiver Anchors</b>	Disturbance (N)	Dissolving	0-1	1	1	2	R	2

Add two new lines to Table 5.3:

<b>EM Emissions</b>	NS	2-3	-	-
<b>Receiver Anchors</b>	NS	2-3	-	-

#### 5.6.1.5 Other Project Activities

Add the following subsection:

##### Receiver Anchors

CSEM receivers (dipole antennae) are mounted on the bottom using dissolvable anchors. Receivers are retrieved using acoustic releases once the survey is complete. Each anchor measures about 10-15 cm in thickness and 1 m x 1 m in area. Techniques are presently being developed where the receivers are towed on a streamer behind the source vessel which would eliminate the need for the temporary anchors.



There could be some interaction with UXOs if they are present in the area where anchors are deployed. There are no known UXO areas in the Project Area but Statoil will communicate with DND prior to deployment of any bottom-mounted equipment.

The anchors will affect small areas of benthic communities by altering small amounts of soft substrate (in most cases) to temporary hard substrates. Any effects of this temporary change are predicted to be low and thus *not significant* (Tables 5.2 and 5.3).

#### **5.6.1.6 Cumulative Effects**

*Add this paragraph:*

Given the scarcity of CSEM survey vessels, the potential for interference with each other, and the relatively specialized need and use of them, it is deemed unlikely that more than one CSEM vessel would be operating on or near the Grand Banks within the time frame assessed. Thus, there will be no cumulative effects from other CSEM surveys.

#### **5.6.2 Effects on Commercial Fisheries VEC**

*In Tables 5.4 to 5.6 under "Presence of Vessels" change "Seismic Vessel" to "Survey Vessel".*

#### **5.6.2.3 Vessel Presence**

*Add as last paragraph:*

The CSEM survey vessel has less potential to conflict with fishing gear or fishing vessels because it operates at lower speeds and does not tow long sets of streamers. The anchor grids could potentially conflict with fishing gear although any one mooring represents a very small area. Any EM emissions should not affect catches because they will attenuate before reaching gear. Mitigations will be the same as for a seismic survey and any effects will be *not significant*.

#### **5.6.3 Seabirds**

*Change "Seismic Vessel" in Tables 5.7 to 5.9 to "Survey Vessel."*

#### **5.6.3.4 Other Project Activities**

*Add the following as the last paragraph:*

##### **CSEM Surveys**

The CSEM surveys will not affect marine birds in any way differently than the other survey vessels and the same mitigations will be utilized. As a result, any effects for CSEM are predicted to be the same as for seismic or geohazard vessels and *not significant*.

#### **5.6.4 Marine Mammals and Sea Turtles**

*In Tables 5.10 to 1.12, change "Seismic Vessel" to "Survey Vessel" under "Presence of Vessels."*

*Add a new section at the end:*

##### **5.6.4.9 Effects of CSEM Activities**



It has been theorized that some species of cetaceans may use geomagnetic cues to assist their migrations. This theory is based on several studies that have related whale strandings to geomagnetic anomalies (Klinowska 1985,1986; Kirschvink 1990; Walker et al. 1992). However, this phenomenon appears to be site-specific because other studies (Brabyn and Frew 1994; Mazzuca et al. 1999) with the same methods and species in other areas were unable to find this relationship. Juvenile sea turtles but not adults are known to use geomagnetic cues in what is likely a suite of navigational capabilities (Avins and Lohmann 2003,2004). To the best of our knowledge, juvenile sea turtles have not been reported in the Project Area.

Given that these animals likely use a variety of navigational cues and that any exposure to CSEM emissions will be brief, likely on the order of minutes, any effect on their navigation is predicted to be *negligible*. With the obvious exception of those stemming from the sound source or streamers, any other potential effects on marine mammals and sea turtles would be similar to the seismic or geohazard surveys.

#### **5.6.5 Effects of the Project on Species at Risk**

*In Tables 5.15 to 5.17, change "Seismic Vessel" to "Survey Vessel" under "Presence of Vessels."  
Add a second to last paragraph in this sub-section:*

As stated in previous sections, any effects on fish, birds, sea turtles or marine mammals from CSEM surveys will not differ from those originating from seismic or geohazard surveys with the exception of those related to the energy sources. Wolffish are not electroreceptive and have not been reported to use geomagnetic cues for navigation. The CSEM dissolvable anchors could have some very small interactions with wolffish if they occur at the depths of the surveys but would be very unlikely to interfere with their dens which are in small caves and rock crevices. Ivory gulls, if present in the area, would not likely be affected by any emissions. Blue and right whales and leatherback sea turtles are not known to use geomagnetic cues for navigation but if they do, they likely use a variety of other cues as well. Thus, considering the above coupled with the attenuation of very low frequency electromagnetic emissions and brief exposure periods (minutes), it is predicted that any effects on SARA species will be transitory and *negligible*.

#### **5.7 Cumulative Effects**

*Add paragraph at the end of this section:*

It is unlikely that there would be more than one CSEM survey on or near the Grand Banks in any one season. This is due to the highly specialized nature of these surveys and the shortage of CSEM contractors worldwide. Thus, there would be no cumulative effects from electromagnetic emissions. In addition, any potential effects on marine animals have all been predicted to be either *negligible* or *low* in magnitude. Any other potential effects would be similar to those generated by any survey vessel transiting at low speed. CSEM activities, if they occur, are also predicted to produce *no significant residual effects or cumulative effects*.

#### **5.8 Mitigations and Follow-up**

*Add a paragraph to this section:*

Except for the bird stranding protocols, it is unclear if seismic-type mitigations are warranted for CSEM surveys. Nonetheless, following the precautionary principle, Statoil proposes to use the same mitigations as those used for seismic.

## 5.9 Residual Effects of the Project

Add the following to Table 5.19:

"CSEM Vessel after "Geohazard" under "Sound" and under "Presence of Vessels".

Add two new lines to Table 5.19:

<b>EM Emissions</b>	NS	2-3	-	-
<b>Receiver Anchors</b>	NS	2-3	-	-

## 6.0 Literature Cited

Add the following references:

Avins, L., and K.J. Lohmann. 2003. Use of multiple orientation cues by juvenile loggerhead sea turtles *Caretta caretta*. The Journal of Experimental Biology 206:4317-4325.

Avins, L., and K.J. Lohmann. 2004. Navigation and seasonal migratory orientation in juvenile sea turtles. The Journal of Experimental Biology 206:1771-1778.

Brabyn, M., and R. Frew. 1994. New Zealand herd stranding sites do not relate to geomagnetic topography. Marine Mammal Science 10:195-207.

Buchanan, R.A., R. Fechhelm, J. Christian, V.D. Moulton, B.D. Mactavish, R. Pitt and S. Canning. 2006. Orphan Basin controlled source electromagnetic survey program environmental assessment. LGL Rep. SA899. Rep. by LGL Limited and Canning & Pitt Associates Inc., St. John's, NL, for ExxonMobil Canada Ltd., St. John's, NL. 128 p. + appendices.

Haine, O.S., P.V. Ridd and R.J. Rowe. 2001. Range of electrosensory detection of prey by *Carcharhinus melanopterus* and *Himantura granulate*. Marine and Freshwater Research. 52: 291-296.

Kalmijn, A.J. 1966. Electro-perception in sharks and rays. Nature (London). 212: 1232-1233.

Kalmijn, A.J. 1971. The electric sense of sharks and rays. Journal of Experimental Biology 55:371-383.

Kalmijn, A.J. 1982. Electric and magnetic field detection in elasmobranch fishes. Science 218:916-918.

Kirschvink, J.L. 1990. Geomagnetic sensitivity in cetaceans: an update with live stranding records in the United States. Pages 639-649 in J.A. Thomas and R.A. Kastelein, editors. Sensory Abilities of Cetaceans: Laboratory and Field Evidence. Plenum Press, New York.

Klinowska, M. 1985. Cetacean live stranding sites relate to geomagnetic topography. Aquatic Mammals 1:27-32.

Klinowska, M. 1986. Cetacean live stranding dates relate to geomagnetic disturbances. Aquatic Mammals 11.3:109-199.



LGL Limited. 2007. Supplement to: Orphan Basin controlled source electromagnetic survey program environmental assessment. LGL Rep. SA937. Rep. by LGL Limited in association with Canning & Pitt Associates Inc., St. John's, NL, for ExxonMobil Canada Ltd., St. John's, NL. 15 p. + appendix.

LGL Limited. 2009. Orphan Basin controlled source electromagnetic survey program environmental assessment: Supplement 2009. LGL Rep. SA1038. Rep. by LGL Limited, St. John's, NL, for ExxonMobil Canada Ltd., St. John's, NL. 19 p. + appendices.

Mazzuca, L., S. Atkinson, B. Keating, and E. Nitta. 1999. Cetacean mass strandings in the Hawaii Archipelago, 1957-1998. *Aquatic Mammals* 25:105-114.

Walker, M.M., J.L. Kirschvink, G. Ahmed, and A.E. Diction. 1992. Evidence that fin whales respond to the geomagnetic field during migration. *Journal of Experimental Biology* 171:67-78.

WHO (World Health Organization). 2007. Environmental Health Criteria 238. Extremely Low Frequency Fields. World Health Organization. Geneva. 445 p.

**General Comment:** *Legends in some of the Figures are confusing. For example, Figure 1.1's legend should start with Study Area, not Project area as it is the larger area. There are several instances of this.*

**Response:** The different colours and lengths of the dashed lines used in the map Legends accurately represent the Project and Study areas depicted on the maps in the EA. For future submissions, Statoil will endeavour to present the standard areas used in its offshore EAs (i.e., Project and Study areas) in decreasing order of size in map Legends.

**Comment (Section 1.0, pg 1, line 8):** *"original 2008 seismic area". Figure 1.1 identifies it as the "2007 EA Project Area". Please be consistent throughout the EA report.*

**Response:** Add in parentheses ("2007 EA Project Area" in Figure 1.1) after "original 2008 seismic area".

**Comment (Section 1.1.1, pg 3, para. 1, line 8):** *Insert "describing project activities and" after "C-NLOPB".*

**Response:** The suggested change noted above is acceptable. Documentation describing future work will be provided to the C-NLOPB.

**Comment (Section 1.1.1, pg 3, 2nd para., line 2):** *Delete "to determine the need for submission of an update to the EA". The action that results from changes to the project activities will be determined at that time.*

**Response:** The suggested change noted above is acceptable.

**Comment (Section 2.1, pg 7, para. 2, last sentence):** *the reference to highlighted licences should be more appropriately read, "see licences in bold in Table 2.1". Also, there are only "29" significant discovery licences in Table 2.1.*

**Response:** Change text to "see licences in bold in Table 2.1". Change text from 30 significant discovery licences to 29.

**Comment (Section 2.2, pg 8):** *Please identify the total size of the "Project Area" and the "Study Area".*

**Response:** Project Area and Study Area are 64,370 km<sup>2</sup> and 99,520 km<sup>2</sup>, respectively.

**Comment (Section 2.2, pg 9, line 1):** *"includes space". What exactly is the buffer included in the "Project Area" for vessel turning.*

**Response:** A 10-km buffer was used as the buffer for vessel turning.

**Comment (Section 2.2, pg 9, para. 2, last sentence):** *What exactly is meant by "The option of carrying out ...in the EA to follow." Please identify where in the EA report this was done. It states in Section 5.3 "Temporal" that "geohazard surveys may be conducted at any time of the year." This inconsistency is confusing and the actual temporal boundary for geohazard surveys that was assessed and is proposed during the 2012 to 2019 timeframe should be stated.*

**Response:** Geohazard surveys could be conducted at any time of the year but would most likely occur during the April through November time frame. Change the last sentence in paragraph noted above to "Geohazard surveys may be conducted at any time of the year".

**Comment (Section 2.3, pg 9):** *It is mentioned in the EA report that the seismic vessel may deploy streamers enroute to the Project Area. Please provide details of this activity. Is it the intent to have active airguns during transit? If so, this would be outside the Project Area.*

**Response:** Airguns would not be operated outside of the Project Area. If streamers are deployed enroute to the Project Area a separate route analysis will be prepared and discussions with fishing interests undertaken before the transits, to avoid fixed gear fishing activities. The route analysis would be submitted to the C-NLOPB.

**Comment (Section 2.3, pg 9, para. 1, line 2):** *What is meant by "Ocean bottom seismic"?*



**Response:** An Ocean Bottom Seismic (OBS) program involves placing small-diameter nodes or hydrophone cables on the seafloor to record seismic data from a seismic source vessel; rather than using a conventional seismic vessel with streamers towed in the water column.

**Comment (Section 2.3, pg 9, last para., last sentence):** *Please identify where in the "following EA" this has been addressed.*

**Response:** Change the sentence referenced above to "The need for dedicated MMOs and FLOs for the more limited temporal and geographically scope geohazard surveys will be determined in consultation with the C-NLOPB prior to the start of geohazard surveys".

**Comment (Section 2.3.3, pg 11, last 2 sentences):** *"one geohazard survey may occur in 2011" and "As many as five geohazard surveys per year may occur in 2011- 2019". Which is it?*

**Response:** Change the sentence to "2012 to 2019".

**Comment (Section 2.3.10.1, pg 15, line 1):** *"may be". Will the seismic vessel be accompanied by a picket vessel or not.*

**Response:** Change "may be" to "will be".

**Comment (Section 2.3.10.3, pg 15, last sentence):** *Please identify the "relevant authorities".*

**Response:** The relevant authorities include Transport Canada and C-NLOPB.

**Comment (Section 3.3.1, pg 26, para. 3, line 3):** *"...large annual variation in the steric height over...". Steric – of or relating to the spatial arrangement of atoms in a molecule. Is this what the author intended? If not, then please address.*

**Response:** In oceanography, steric height is a sea level change due to changes in temperature and salinity and hence, density of the seawater.

**Comment (Section 5.1.1.1, pg 108):** *This section provides a summary of the discussions held with the various stakeholders. Some of the stakeholders asked specific questions (e.g. NHS – "Over what range will the noise generated...background levels?). Please identify where in the EA report these questions were addressed and hopefully answered.*

**Response:** During the consultation process, specific questions were asked by Bruce Chapman of GEAC and Len Zedel of the NHS; see Section 5.1.1.1 of the EA. Mr. Chapman noted general concerns about the effect of seismic operations "on various marine species, especially in the egg/larval stage, and also in relation to short-term effects on catch rates". He also asked what mitigative measures or 'operational adjustments', other than "providing communications about (seismic) vessel plans," might be implemented to address these potential effects and concerns within the industry. Dr. Zedel asked "Over what range will the noise generated by the seismic vessel exceed normally occurring background levels?"

**Re: effects of seismic operations on marine species and additional mitigation measures**

With regard to the susceptibility of eggs and larvae to seismic sound, there are a number of research studies that have examined the possible impacts on fish eggs and larvae. Some have concluded that there can be some physical effect on eggs and larvae but only if they are within a few metres of an airgun. Considering the large numbers of eggs and/or larvae in the upper water column at any particular time, only a very small proportion would likely be affected by airgun sound. Previous EAs have indicated temporal and spatial avoidance as a possible mitigation for effects of seismic sound on eggs and larvae. This mitigation would only be implemented if a particular location at a particular time was identified as 'unique' in terms of macro-invertebrate and/or fish spawning. Currently, no such 'unique' locations within the Study Area have been identified. Spawning by the various macro-invertebrates and fishes within the Study Area is relatively widespread. However, if a 'unique' location was identified, the temporal and spatial avoidance mitigation would be applied.

With respect to the potential effects of seismic sound on catch rates for northern shrimp and Greenland halibut, for example, existing studies have indicated changes in catch rates for some commercial species (Lokkeborg et al. 2010 [various demersal fishes]; Engås et al. 1996 [cod, haddock]) but not in others (Andriguetto-Filho et al. 2005 [shrimp]; Parry and Gason 2006 [lobster]; these studies were forwarded to Mr. Chapman). The catch rates that appear to be affected typically return to normal in a short time. There has been a fair amount of research on the potential interactions between seismic noise and catch rates. A technical workshop addressing ways to measure the potential effects of seismic sound on fish 'catchability' will be held during the last week in March 2011.

Previous EAs have included other mitigation measures such as communication at sea between seismic and fishing vessels to ensure that seismic vessels conduct operations as far away as possible from active fishing operations and/or establish a temporal buffer between the two operations. Another mitigation measure is the presence of a Fisheries Liaison officer (FLO) provided by the FFAW on board the seismic vessel to liaise between the seismic ship and fishers in the area. For example, the Husky Energy Sydney Basin 2D seismic survey in 2010 included such measures. These measures were established after considerable consultation between the operator and OCI fleet personnel. (The same geo-spatial and temporal buffers are now part of the established protocol between DFO RV survey vessels and seismic survey ships).

**Re: range that seismic survey noise will exceed background levels**

Background levels of wind and wave noise with no shipping noise have been measured over extended periods in the Arctic by Greeneridge Inc. (C. Greene, Acoustician, pers. comm.). From 10 Hz upward to 1,000 Hz or even higher (not much is added by noise at higher frequencies because the spectrum levels are decreasing), Greeneridge found a nominal range of levels from 80 to 120 dB re 1  $\mu$ Pa (rms). This noise is continuous, unlike airgun sounds which are pulsed, and these are rms (root-mean-square) measurement levels.



Ignoring other sounds, the question then becomes "At what distance would the pulse sounds of an airgun array decrease to 120 dB? This will depend on the array size and depth, and the propagation loss will depend on the water depth, the sound speed profile with depth, and the bottom geoacoustic properties.

In "Marine Mammals and Noise", Chapter 6, the source level of a 3100 in<sup>3</sup> airgun array is given as 252 dB re 1  $\mu$ Pa @ 1 m (0-peak) (Richardson et al. 1995). Other arrays have source levels said to be from 239 to 259 dB re 1  $\mu$ Pa @ 1 m (0-peak). Statoil's seismic energy source has been estimated at about 255 dB re 1  $\mu$ Pa @ 1 m (0-peak). The rms level corresponding to a 0-peak level may be about 10 dB less. A depth of 6 m or more will result in significant lateral transmission of the pulsed sounds. Using the Statoil source, pulsed sounds with a source level of 245 dB re 1  $\mu$ Pa @ 1 m (rms) would have to lose about 125 dB to be at the continuous level of the background during periods of high wind and waves (i.e., 120 dB). Assuming spherical spreading loss,  $20 \cdot \log(\text{Distance})$ , and no absorption or scattering losses, the pulsed sounds would have to travel about 1,780 km to be received at 120 dB re 1  $\mu$ Pa (rms). Such a potential distance is supported by reports of seismic surveys off Nigeria and Brazil being heard across the ocean.

However, the ocean can be a noisy place from both natural and anthropogenic sounds. For example, natural sounds in the ocean could range on the order of 70-130 dB re  $\mu$ Pa (rms) (wind and wave) (C. Greene, Acoustician, pers. comm.) to 171-236 dB re 1  $\mu$ Pa @ 1 m (biological sources such as snapping shrimp and marine mammals) to 248-269 dB re  $\mu$ Pa @ 1 m (rms) (physical sources such as lightning and earthquakes) (IAGC n.d.). All of these increase the background levels above those from wind and waves alone. In addition, there are a variety of anthropogenic sounds such as shipping. All of these variables add to background sound levels and would lessen the distance that the airgun sounds will travel before they reach "background levels."

#### References:

Andriguetto-Filho, J.M., A. Ostrensky, M.R. Pie, U.A. Silva, and W.A. Boeger. 2005. Evaluating the impact of seismic prospecting on artisanal shrimp fisheries. *Cont. Shelf Res.* 25:1720-1727.

Engås, A, S. Løkkeborg, E. Ona, and A.V. Soldal. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*G. morhua*) and haddock (*M. aeglefinus*). *Can. J. Fish. Aquat. Sci.* 53(10):2238-2249.

IAGC n.d. Seismic surveys and marine mammals. Joint OGP/IAGC Position Paper. Produced by the International Association of Oil & Gas Producers (London) and the International Association of Geophysical Contractors (Houston). 11 p.

Løkkeborg, S., E. Ona, A. Vold, H. Pena, A. Salthaug, B. Totland, J.T. Øvredal, J. Dalen, and N.O. Handegard. 2010. Effekter av seismiske undersøkelser på fiskefordeling og fangstrater for garn og line i Vesterålen sommeren 2009. [Effects of seismic surveys on fish distribution and catch rates of gillnets and longlines in Vesterålen in summer 2009]. *Fisken og Havet 2-2010*. 74 p. (in Norwegian with English summary).

Parry, G.D. and A. Gason. 2006. The effect of seismic surveys on catch rates of rock lobsters in western Victoria, Australia. *Fisheries Research*. 79: 272-284.

Richardson, W.J., C.R.J. Greene, C.I. Malme and D.H. Thomson. 1995. *Marine mammals and noise*. Academic Press, San Diego, CA. 576 p.

#### Personal Communications:

Dr. Charles Greene, Acoustician, Greeneridge, Inc.

**Comment (Section 5.4.2, pg 112, last line):** *"(CEA Agency 1994)". Please provide the full reference in Section 6.0 Literature Cited.*

**Response:** Change the citation in Section 6.0 to "CEA Agency (Canadian Environmental Assessment Agency). 1994. Environmental Assessment Guidelines Canadian Environmental Assessment Agency, Ottawa."

**Comment (Section 5.5, pg 116, 2nd para., line 10):** *"reach certain levels". What are they?*

**Response:** When wind speeds are greater than 20-25 knots and wave/swell conditions are greater than 4 m, Statoil typically looks at suspending data acquisition operations.

**Comment (Section 5.6.2.3, pg 142, Avoidance, para. 3):** *Gear damage should be reported to the C-NLOPB.*

**Response:** In Appendix C: SPOC (and FLO) Protocols, Procedures and Reporting Forms, a section titled "Reporting an Incident" describes the procedures which the seismic vessel operator and the SPOC are required to follow when there is a gear damage incident, including notifying the C-NLOPB of any gear damage incident or physical contact with fishing gear.

**Comment (Section 5.6.2.3, pg 142, Avoidance, para. 4, line 2):** *It states what was done in "2002". Is this presently being done?*

**Response:** The procedures (i.e., "protocols") which seismic vessels are asked to follow in order to avoid interference with any DFO RV vessel that may be operating in the vicinity of the seismic survey vessel were worked out in consultation with relevant DFO science branch personnel in 2002. These protocols have been implemented with good success on several occasions during offshore surveys since they were established in 2002. The usual practice is for the seismic vessel operator and/or the SPOC to contact DFO RV managers prior to the start of the survey to determine if an RV vessel might be operating in the vicinity of the seismic vessel during the survey timeframe. If so, an avoidance plan will then be worked out.

**Comment (Section 5.7, pg 198):** *Please ensure the list of projects is complete.*

**Response:** The C-NLOPB public registry was reviewed as late as possible during preparation of the EA to ensure that the cumulative effects section included the most up-to-date listing of potential oil and gas industry projects. Statoil will consult the C-NLOPB public registry as well as contact the C-NLOPB directly prior to the start of their seismic operations to obtain the most recent information on other



operators in and near the Statoil Project Area. In addition, the public registry will be reviewed during the preparation of future amendments to the EA.

**Comment (Section 5.8, pg 199, Table 5.18):** *Please ensure that all mitigation measures identified throughout the EA report are included (e.g. monitoring for seabirds).*

**Response:** Table 5.18, Summary of Mitigation Measures is complete. The conduct of systematic seabird counts is not considered a mitigation measure; it is a means to collect scientific data.