# SCIENCE REVIEW OF THE EASTERN NEWFOUNDLAND STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)

## Context

Since 2002, the C-NLOPB has been conducting Strategic Environmental Assessments (SEAs) of portions of the Newfoundland and Labrador Offshore Area that may have the potential for offshore oil and gas exploration activity. SEA is a broad-based approach to environmental assessment that examines the environmental effects which may be associated with a plan, program or policy proposal and that allows for the incorporation of environmental considerations at the earliest stages of program planning. SEA typically involves a broader-scale environmental assessment (EA) that considers the larger ecological setting, rather than a project-specific environmental assessment that focuses on site-specific issues with defined boundaries. Notably, the accuracy of information in a SEA is especially important as it sets the basis for future project-specific EA within its study area.

On March 5, 2014, The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) released the Draft Eastern Newfoundland Strategic Environmental Assessment (SEA) Report for public comment.

The Environmental Assessment and Major Projects (EAMP) Division of the DFO Ecosystems Management Branch in the Newfoundland and Labrador Region requested that DFO Science undertake a review of this document, and specifically the information put forward in the SEA on the (physical and biological) Environmental Setting: Section 4.1.4 (Oceanography); Section 4.1.5 (Ice conditions); Section 4.2.1 (Fish and Fish Habitat); Section 4.2.3 (Marine Mammals and Sea Turtles); Section 4.2.4 (Sensitive and Special Areas); as well as that on Environmental Interactions, Mitigation and Planning Considerations (i.e., the effects assessment): Section 5.1 (Fish and Fish Habitat); Section 5.3 (Marine Mammals and Sea Turtles); and Section 5.4 (Sensitive and Special Areas).

Given the short timeline to carry out a review, a DFO Science Response process was undertaken. Science expertise within Fisheries and Oceans, Newfoundland and Labrador Region was solicited to address this review – although the provision of feedback was limited to the areas of the report where expertise was available at the time of the review, including that from Ecological Sciences, Marine Mammals, Marine Fish Species at Risk and Pelagic Sections.

The review found that overall the quality of scientific information presented in the SEA varies across the sections. While the SEA document contains a large volume of information and valuable data, it is not complete in its current form. The SEA fails to incorporate many important and relevant data sources (e.g. non-Canadian surveys and analyses derived from them) and overlooks many important and basic considerations on ecosystem structure and function. It also does not adequately explore to the potential impacts on ecosystem functioning. Suggested changes/updates resulting from this review should be considered for incorporation into the final Eastern Newfoundland SEA before using it as a source of guidance for decision-making.

This Science Response Report results from the April 2014 Science Response Process for the review of the “Eastern Newfoundland Strategic Environmental Assessment (SEA) (AMEC November 2013).” The report is a summary of the comments provided by DFO Science Branch, Newfoundland and Labrador Region, to the Marine Habitat Protection Section on the above noted sections, as well as other parts of the document where knowledge was available.

# Analysis and Response

## General Comments

- As the *Eastern Newfoundland Strategic Environmental Assessment* is intended to identify and incorporate environmental considerations at the earliest stages of planning and decision making, it is expected to be broad in its scope, and relatively general in its description of potential impacts associated with oil and gas exploration and/or production in the region within the next decade. However, specific details still remain important in many regards as it is fundamental that the SEA provides a complete and comprehensive system-wide perspective in order to be useful for future project-specific EAs.
- Much of the information describing the existing environment is reasonably complete for the area of the SEA that falls inside the 200 mile limit. However, specific information for the offshore (>200 miles) portion of the study area, and in particular the Flemish Cap and Orphan Basin, is lacking. This is largely attributable to lack of consideration of fishing and research data from NAFO sources and is considered a major weakness in the accuracy of the assessment.
- The SEA is lacking a comprehensive overview on climate change in its description of the physical environment. Only a few statements regarding climate change exist throughout, with nothing substantive reported. Information taken from existing models and the most current projections should be presented for key physical indices where available.
- The SEA does not adequately capture the complexity of the biological environment of the study area. The report does not describe functional ecosystem units or attempt to analyze impacts on their structure and function; but rather simply provides a list of components and compiles potential effects on them, as opposed to on the system as a whole. While this type of description is useful, it is not complete, and carries the risk of promoting “tunnel vision” approaches to management issues.
- The SEA is lacking in its consideration of important aspects of the ecosystem such as trophic structure, ecoregion configuration, linkages between the Grand Bank and the northern Newfoundland shelf, and bottom up regulation of ecosystem productivity – all of which are key to understanding the existing environment and potential interactions.
- The SEA provides incomplete descriptions of Vulnerable Marine Ecosystems (VMEs), and is lacking adequate information for characterization of VME indicator species, including their distribution and the potential impacts of oil and gas exploration/production and spills on these.
- The SEA consideration of potential environmental effects is basic at best, failing to synthesize the current understanding of potential effects. This is also the case for the sections on interactions with other human activities including fishing and sensitive and special areas. The potential for cumulative effects is mentioned in the report, but is not developed.
- The SEA contains data sets that appear to be dated (e.g., DFO fish survey data up to 2009; Sea Ice Atlas to 2010; some tropical storm data to 2000; MSC50 wave/current data to 2011; etc.) While it is understandable that some data sets may not available after a certain date; it is, however, likely that some are available in an updated format (e.g., the most recent tropical storm data). As such, if a data set is ‘prematurely’ truncated or not being used for some reason – it should be stated within the report and clarification provided. Also, if there are additional data expected, it should be noted when they are likely to become available.

## Specific Comments

### Section 3.2 – Generic Description of Offshore Oil and Gas Activities

- Primary emissions from offshore production should explicitly list produced water since it is the largest waste stream from that activity.
- Spill data for NL offshore should be updated to include 2013. Spill discussion should also include that spills may be due to aging or leaky infrastructure.
- Oils spills scenarios under ice should be included in tables where available. Although they are mentioned as part of some of the studies, inclusion in the tables would prove useful.
- Table 3.4 – Numbers are not standardized per unit time or capacity; therefore, they are misleading. What are the "lifespans" of the wells in this table – i.e., how many of the 29,527 wells in the 1980's were also operational I the 1970's (and hence double counted)? The total number operating during each period may reduce the apparent blowout frequency by referencing existence in more than one of the time periods. The number of operating wells in 1971-80 plus the number of "new wells" minus the number of "decommissioned wells" would be a more meaningful number in this column in this comparison. The number or exploration vs. production wells would be very revealing also. It is suggested that revising the blowout instances per unit time of well operational life would be more informative than the numbers currently reported.
- Table 3.8 – Comments in the text related to the table suggests that 2% is some form of benchmark for oil spill dispersion rate. It is not clear what is the basis for reliance on such a number, what the reference authority for this number is, and whether it is an ecologically useful number.

### Section 4.1 – Physical Environment

It is notable that the description of the physical environment lacks a comprehensive overview on climate change. While there are a few statements regarding climate change, nothing substantive is reported. This should be included in the SEA. In this, the document should include general information on the most current projections relative to air and sea temperatures, currents, primary productivity and changes in frequency of extreme weather based on regional climate change models. This would include consideration of which models are considered best right now for the study area in question; and data gaps and key uncertainties. These projections should be also be integrated into subsequent areas of text throughout the SEA as required (e.g. the sections on ice and ice bergs as well as in the species accounts where information is available).

#### *Section 4.1.1 – Geology*

- Note that multiple references for Piper (pers. comm.) exist in this section. Since this is an area of active research, and since the SEA is a living document, this section should be updated on a priority basis as the research is published.
- The explicit risk of a landslide (1/500) is included in the SEA, yet the risks for other geohazards are not specified. This is also reported as a personal communication which may not be particularly useful for future planning. This section should be updated to include the anticipated report from Natural Resources Canada that contains slope failure risk maps. This would provide operators with useful information at the planning stages.
- A map of the features of the Orphan Basin described in this section should be included. They are not in Figure 4.3.

*Section 4.1.2 – Bathymetry*

- As knowledge of bathymetry is important to understanding many key aspects of the physical and biological environment, it would be helpful to include major bathymetric contours/features in a clear manner on all maps depicted within the report (e.g., Figure 1.1), similar to that in Figure 2.2. Otherwise, maps provide very little frame of reference.
- Figure 4.6 – The figure should indicate in title or legend that bathymetry is in 'm'.

*Section 4.1.3 – Climatology*

- Precipitation figures need a better explanation for the y-axis indicating whether the frequency of occurrence (%) refers to event duration per month or number of events per month or per day.
- The data for frequency of thunderstorms looks odd. Figure 4.26 shows a big spike in July while Figure 4.28 has a big dip in September. Could these be the result of calculation errors? Since this is a 63-year climatology it should not be related to sample size and interannual variability.

*Section 4.1.4 – Oceanography*

- The description on extreme wind and wave events partially captures the level of integration and comprehensiveness that is required to make all the information presented useful. However, it is problematic in that it lacks a climate change context.

## Section 4.2 –Biological Environment (4.2.1 Fish and Fish Habitat)

Overall, ecosystem structure within the study area is not adequately described within the SEA. The study area for the SEA essentially expands over at least four different functional ecosystem production units: 1) Grand Bank; 2) Newfoundland-Labrador Shelf (both parts of the Newfoundland-Labrador Shelves marine ecosystem); 3) Flemish Cap (considered a relatively closed marine ecosystem); and 4) oceanic waters beyond the continental shelf break. Furthermore, the study area includes the transition areas between these ecosystems, and given the large range in depths involved in SEA study area, it may be argued that it also spans bathypelagic and abyssal oceanic ecosystems. These very basic descriptions and their potential implications, currently absent in the SEA, need to be incorporated.

It should be highlighted that the basic ecoregion structure on the Grand Bank indicates that the Grand Bank and the Labrador-Newfoundland Shelf can be considered ecosystem sub-units, where the northern Grand Bank (NAFO Division 3L) acts as a transition zone between these subunits. It is also clear the existence of a distinct shelf-break ecoregion, which acts as a transition zone (ecotone) between shelf and oceanic realms (Pepin et al. 2010, NAFO 2010b, 2012a). The Flemish Cap also emerges as a distinct ecosystem production unit (Perez-Rodriguez et al. 2010, NAFO 2010b). Note that the Grand Bank and Flemish Cap are among the candidate ecosystem management units being considered for the development of an ecosystem approach to fisheries by NAFO (NAFO 2010b).

Although the Newfoundland-Labrador Shelves and Flemish Cap share many of their core species and both have experienced collapses of major groundfish components, the structure of these ecosystems is not identical. For example, the key forage species are sandlance and capelin in the [southern] Grand Bank, and shrimp and capelin in the [northern] Newfoundland-Labrador Shelf; while in the Flemish Cap redfish and shrimp have been key prey species for that ecosystem (NAFO 2010b, 2011, 2012, Perez-Rodriguez et al. 2011, 2012). Furthermore, there is evidence in the NL shelves of bottom-up regulation of capelin, its overall core forage fish species, with linkages between environmental drivers (e.g. ice dynamics), phytoplankton blooms, zooplankton abundance, and capelin dynamics (DFO 2012, Buren et al. 2014). Here, the dynamics of upper trophic levels (e.g. Atlantic cod) seem to have been driven by availability of food (capelin) and fishing (DFO 2012, Buren et al., submitted). However, the influence of ice dynamics on ecosystem trends is not observed in the Flemish Cap ecosystem (NAFO 2011). Besides the impact of fishing, environmental drivers seem to be influencing recruitment success, while predation by top predators appears to regulate the dynamics of juvenile and smaller fishes here (Perez-Rodriguez et al. 2013). Strong trophic interactions also link the core species (cod, redfish and shrimp) in the Flemish Cap ecosystem (NAFO 2011, 2012a).

The above highlights that while the basic ecosystem organization and dynamics that exists in the SEA study area is not described by the SEA document, there are analyses and information available to produce the strategic/broad base description that could provide managers/decision makers with a more functional and holistic perspective of the ecosystems that are potentially affected by oil and gas development.

***Section 4.2.1 – Fish and Fish Habitat***

- The report provides a comprehensive review of the biology, ecology, distribution and general aspects of the life history of several relevant fish species inhabiting the Grand Bank and southern Labrador shelf. In general the data shown in the Figures and Tables are accurate and informative, and the references cited in the report are generally up to date, with a few exceptions. An interesting aspect of this report is the integrated approach used to describe fish habitat and how it varied temporally and spatially, including the interrelationships of the various trophic/ecological components.
- The SEA contains only partial survey information and exhibits a lack of understanding of the limitations of the DFO trawl surveys. It is notable that the SEA only considers research survey information from DFO, but survey programs conducted by the European Union (EU), and/or some of its member states, exist. These research surveys, focused on the Flemish Cap, but also on the nose and tail of the Grand Bank, are routinely used by NAFO Scientific Council to assess fish stocks in the area, as well as ecosystem structure and interactions. Numerous NAFO documents and papers describe and analyze data from these surveys (e.g. NAFO 2010a; 2010b; 2011; 2012a; Perez-Rodriguez *et al.* 2011; 2012; Nogueira *et al.* 2013).
- While the SEA mentions the changes in areal coverage and gear of DFO surveys referenced (page 161), it also indicates that 4 invertebrate species passed its screening process – failing to recognize that only shrimp and crab have been consistently recorded in DFO surveys since the switch to the Campelen gear in 1995-1996. As such, it is actually impossible to establish if other invertebrates (e.g. brittle stars and/or sea urchins, among others) could have met or not the SEA screening criteria. It should be noted, however, that consistency in the recording of invertebrates in DFO surveys has been improved in recent years. Also, as part of the DFO Ecosystem Research Initiative (ERI) NEREUS Program during, a grab sampling program was implemented in soft bottoms of the Grand Bank over 2007-2010 (e.g. DFO 2012; Gilkinson 2012). These results should be included in the SEA.
- An incomplete description and characterization of Vulnerable Marine Ecosystem (VME) indicator species exists in the SEA. Over the last 5-7 years, there has been increased research effort devoted to the identification, characterization, and mapping of Vulnerable Marine Ecosystem (VME) indicator species within the SEA study area. Most of this work has been done under the umbrella of NAFO, and through the NAFO Scientific Council (SC) Working Group on Ecosystem Approaches to Fisheries Management (WGEAFM; recently been renamed SC Working Group on Ecosystem Science and Assessment (WGESA)). Most of this work is not included or mentioned in the current SEA. Furthermore, some recent and relevant studies like Baillon *et al.* (2012) and Beazley *et al.*

(2013) are referenced in the text, but absent in the references section, and some of their implications not included in the document. For example, Baillon's study documents the linkage between seapens (corals) and redfish larvae, and makes the case for seapen fields to be considered essential fish habitat for redfish. This potentially critical role of seapen fields for redfish is absent from Table 4.62 (overview of key groundfish species in the SEA area), and there is no mention of this linkage in Table 5.1. (fish and fish habitat potential environmental interactions).

- It should be noted that sponge grounds are among the more abundant VME indicator species in the SEA study area, but little attention is paid to these in Table 5.1., including the impacts of potential spills on these large grounds of filter-feeding, habitat forming species. Spill simulations described in SEA also seem to focus on either shoreline/surface impacts or highlights that spills will drift east (beyond 50°W). No attempt to assess the impact of these trajectories on VMEs exists in the current SEA, even though potentially damaging biogenic essential fish habitat could have serious long term impacts on ecosystem productivity.
- Although corals and sponges have been the initial focus in the study of VMEs, many other taxa have been identified as VME indicator species. These include tube-dwelling anemones, erect bryozoans, and crinoids. Several physiographic features (e.g. seamounts, canyons, the Southeast shoal) have also been identified as VME elements because they contain (or are likely to contain) VMEs (NAFO 2012). These other VME components are not discussed in any detail in the SEA, nor is an assessment of the potential impact of oil and gas exploration/production on them considered.
- Many of the NAFO reports from the Scientific Council meetings since 2008, and reports from the SC WGEAFM (and references within), summarize most of the available information on VMEs in the SEA study area. These reports should be used in the SEA not just to describe what is known on VMEs, but also to inform/construct scenarios for spill simulation studies.
- The upcoming NAFO SC WGESA report (to be released in May 2014) will contain an updated summary on VMEs, as well as an analysis of adequacy for current NAFO VME closures. This report will also contain recent findings that suggest that VME areas may be linked to higher fish densities, highlighting the potential importance of these areas for overall ecosystem production.
- Another important source of information that will be useful for preparation of the final version of the SEA is the report resulting from a Convention on Biological Diversity (CBD) Regional Workshop that took place in Montreal, on 24-28 March 2014 and was intended to facilitate the description of ecologically or biologically significant marine areas in the Northwest Atlantic. The international waters within the SEA study area were part of the area considered by this CBD workshop.

***Section 4.2.1.3 – Plankton***

- Plankton – The role of plankton in nitrogen and carbon cycling is not well explained. The term "biological pump" is misused. It does not refer to benthic pelagic coupling (which is an important process and should be explained) but rather to the sequestration of biogenic carbon in the deep ocean.
- The description of the causal mechanisms of the spring bloom is incomplete. Onset of stratification and the interaction with light availability are key factors. Incorrect use of the term "biological pump" occurs in this section.

***Section 4.2.1.4 – Plants and Microalgae***

- Several important aspects of macroalgal communities in the study area are missing from the SEA. Several types of macroalgae, in particular coralline algae, have depth distributions well in excess of 30 m. Urchin-kelp-coralline algae dynamics are an important determinant of hard substrate communities in our waters (Himmelman and Steele, 1971). The substrate of the Grand Banks has been greatly disturbed by trawling which may affect the distribution of macroalgae. Fishing exclusion zones and artificial reefs may change this and provide refuges for macroalgae. Seaweed zonation with light is an important determinant of distribution. Seaweed communities are vulnerable to oil spills. Therefore coastal seaweed communities and their structure and function should be included in this section.

***Section 4.2.1.5 – Benthic Communities***

- All Gilkinson and Edinger (2009) citations should be Gilkinson and Edinger (eds.) (2009).
- As different types of benthic communities are sensitive to different types of disturbance, this should be discussed and summarized in a table for easy reference and decision-making.
- Regarding the statement, *"…and DFO and NAFO RV surveys…"…visual assessments also poorly…"* What is meant by 'visual assessments' here?
- Regarding the statement, *"It is also important to note that characterizations of benthic communities are also inevitably biased according to sampling method. For example, visual assessments often poorly assess infaunal communities whereas grabs may have challenges sampling communities over harder substrates."* It should also be noted that bottom trawls typically sample only a small fraction of resident benthos, and most often larger epibenthos.
- The statement, *"Collectively, these studies confirm that benthic communities in the SEA Study Area are quite diverse compared to higher trophic levels, as well as being somewhat sensitive to anthropogenic effects…",* requires qualification. When speaking in terms of sand-dominated continental shelves, the global literature on fishing impacts in these habitats indicate that, in many cases, recovery can be relatively rapid (e.g. months). However, in deep-water slope environments inhabited by slow growing, long-lived corals and sponges, recovery could be measured in terms of decades in many cases, if not longer (Gilkinson and Edinger (eds.)(2009)).
- Further to the statement, *"Perhaps the most holistic sampling was done on the Grand Banks as part of a series of trawling impact studies (Prena et al. 1999; Kenchington et al. 2001)"*, it should be noted that these researchers used video and grabs (Kenchington et al 2001) and a benthic sled and trawl bycatch (Prena *et al.* 1999).
- Table 4.58 – Some non-shellfish species (e.g., sea urchins, polychaetes, sponges etc.) are included in this table summarizing shellfish species.
- Table 4.58 – Regarding the statement, *"Spat settle primarily between August and November at depths of 10-15 m."*, it should be noted that they also settle in deep offshore water – primarily gravel, on Grand Bank (Gilkinson and Gagnon, 1991).
- Table 4.58 – Information on 'Pale Sea urchin' should reference Gagnon and Gilkinson (1994).
- Table 4.58 – Information on 'surf clam' is incorrect. Surfclams (*Spisula solidissima*) are mostly confined to warmer waters, which on Grand Bank, is the Tail of the Bank and Southeast Shoal. The species that is harvested commercially north-east of this area is the Arctic surfclam (*Mactromeris polynyma*)*,* with only sporadic occurrences of *S. solidissima*.

- Table 4.58 – Information on Polychaete worms indicates that they occur on a variety of substrates. However, much of the Grand Bank is comprised of sandy sediments which support abundant and diverse populations (documented by Kenchington *et al.*, 2001).
- The statement, *“Studies to date indicate that, like fish, benthic assemblages respond to environmental variables such as depth, substrate and flow field (Houston and Haedrich 1984; Schneider et al. 1987).”*, requires addition of the following references related to Grand Banks benthos: Gilkinson and Gagnon, 1991; Gilkinson, 2013; Gale *et al.* (in press).
- Amphipod prey includes much more than just seaweed and phytoplankton. They have many diverse and ecologically important feeding modes. Many are scavengers and some are aggressive predators.
- Polychaete information is not comprehensive. The available literature should be used to provide data on diet and ecological roles of these important members of the benthos.
- The statement, *“Collectively, sea pens, soft corals, stony corals, and sponges are represented across the shelf, slopes and banks of the Study Area but are found at their highest densities along the slopes, i.e. depths > 200 m.”*, requires addition of references Wareham and Edinger (2007); Wareham (2010).
- The statement, *“Sponges, in contrast are more widely distributed and high densities can be found along the eastern slopes of the Grand Banks, around the Flemish Cap and along the northern slopes of the SEA Area”*, requires a reference.
- Regarding the statement, *“In response to the known sensitivity of coral and sponge grounds, many important coral and sponge areas have been designated as Vulnerable Marine Ecosystems (VMEs) (DFO 2012b) and are protected from damaging fishing activities in Canadian and NAFO waters..”,* it should be noted that with the exception of a portion of the southwest Grand Banks slope closure, these fishing closures occur in the NAFO regulatory area outside Canadian waters.
- Table 4.61 – The final column of this table is difficult to read. The number of digits after the decimal is inconsistent and the information is center justified, both of which are inappropriate formats for displaying such data. A right justified and constant number of digits after the decimal (suggested one digit past the decimal to be sufficient for "summary" statistics where precision is unwarranted) is more appropriate.
- Figures 4.70 and 4.71 – The time period covered by the coral and sponge RV records should be stated in the figure titles.

### *Section 4.2.1.6 – Marine Fish*

- Table 4.62 and 4.63 – Tables are listed alphabetically by species. The order of the species should be taxonomic to permit grouping of species into various logical ecological groups.
- Table 4.62 – There is a notable lack of the most recent publications describing feeding habits and distribution and abundance trends of the three wolffish species found in the study area. The following references should be included in the descriptions for Atlantic Wolffish, Northern Wolffish, and Spotted Wolffish: Simpson *et al.* (2013); Collins *et al.* (2014).
- Table 4.62 – Atlantic Wolffish Habitat and Distribution – Wolffish are found over a variety of substrates (not just “hard clay bottom”), and at depths less than 25 m, and in excess of 250 m.
- Table 4.62 – That Atlantic Wolffish can be retained under SARA, unlike the other two wolffish species, deserves mention, even if this species is not “commercially significant”.

- Table 4.62 – Include fish species as an important component of Cusk diet (Bowman *et al.* 2000). Also include that Cusk is monotypic species in the Northwest Atlantic.
- Table 4.62 – The statement, "*A number of research initiatives have also characterized benthic communities on the Grand Banks (Schneider et al. 1987; Kenchington et al. 2001)",* should include the following references Gilkinson, 2013; Gale *et al.* (in press). Gilkinson (2013) documents benthic communities over areas of the Grand Bank as part of the DFO NL NEREUS Ecosystem Research Initiative, which involved a 3-year grab sampling program during multispecies trawl surveys. Gale *et al.* (in press) describe seastar (Asteroidea) assemblages and habitat use over wide areas of the eastern Canadian continental shelf and slope based on DFO survey trawl bycatch records and ROV video.
- Northern Wolffish – The statement *"…occurs in Arctic seas on both sides of the North Atlantic Ocean"* should be rewritten. Northern Wolffish occurs in both Arctic and Atlantic Oceans, as do other wolffish species – though no mention of this is made. The fact that Northern Wolffish is more pelagic than the other two species should also be noted.
- The statement that Northern Wolffish is distributed as a 'widespread self-assemblage', is incorrect. Northern Wolffish are mostly found along the shelf edge, not on the shelf.
- It should be included that, in the past, redfish larvae dominated the ichthyoplankton in many parts of the SEA area (Serebryakov *et al.* 1987).
- The introduction of invasive species and changes to habitat and/or community structure should also be discussed in the context of cumulative effects.
- The statement, *"A total of four invertebrate taxa (snow crab, northern shrimp, pink striped shrimp, and shrimp Pandalus propinquis) were available from the Canadian Research Vessel surveys (Table 4.60)"*, requires clarification. These are the major commercial species; however many other non-commercial taxa have been processed using standardized protocols during RV surveys since 2005/2006. The point of availability is inaccurate.
- Roughhead Grenadier – The reference Lorance *et al.* (2008) is relevant to the Northeast Atlantic only. A publication by Edinger *et al.* (2007) contains information on Roughhead Grenadier in NL waters. Specifically, it reports that Roughhead Grenadier were found in association with deep-sea corals, such as gorgonians, antipatharians, and soft corals at depths of 200-1000 m.
- Roundnose Grenadier – The reference Lorance *et al.* (2008) is relevant to the Northeast Atlantic only. In the Northwest Atlantic, the species has been caught at depths less than 400 m. The data provided for NL comes from Parsons 1976. Newer information is available in Power and Maddock-Parsons (1998), and Kulka (2001). Most catches of this species occurred at depths of 900 m or more.
- Spotted Wolffish – Spawning in late autumn and early winter was suggested by Templeman 1966. A more recent publication (Templeman 1986) suggested mid to late summer spawning (July-August-Sept).
- White Hake – White Hake occur at depths much less than 200 m. On the western St. Pierre Bank, and southwest slope of the Grand Bank, they frequently occur at around 100 m (Han and Kulka 2007). Juvenile White Hake are commonly found inshore, and may even occupy estuaries. Reference to Longfin Hake (*U. chesteri*) is not appropriate.
- White Hake – Not all juvenile White Hake are pelagic. The juvenile stage of the life cycle is characterized by pelagic and (later) demersal components.

- Winter Skate – Kelly and Hanson (2013) estimated that 40-70 egg cases are deposited each year. Also, cephalopods (squid) are an important component of the diet.
- Herring – The occurrence for this species has been recorded up to 450 m depth in multispecies surveys.
- Capelin – Capelin are found in 3NLOPs in spring RV survey. Include 3K and 2J from fall RV survey. Besides the RV trawl surveys, capelin distribution information is available from annual DFO acoustic surveys.
- Capelin – The information related to 'subsequently spent adults…' is incorrectly stated and cited. Spent females move out to deeper water after spawning on beaches/bottom sites. Those that survive eventually migrate to offshore feeding areas and likely aggregate with capelin that will be maturing and spawning next year. The timing, the route, and mechanisms used to migrate from coastal waters to offshore feeding areas have not been knowingly documented.
- Include cephalopods as a major component of the Shortfin Mako diet.
- Include reproduction of White Sharks via internal fertilization, with development characterized by aplacental viviparity (also known as ovoviviparity) with embryonic oophagy. See Saïdi *et al.* 2005.
- Table 4.54 – Capelin spawning on Southeast Shoal takes place in June, July. Capelin also spawn on the bottom in coastal waters.
- Table 4.54 – Capelin spawning time (cumulatively) on beaches and coastal bottom sites and the Southeast Shoal encompasses May, June, July, August.
- Table 4.54 – No corresponding footnote reference exists for superscript #4 (Atlantic Cod).
- Table 4.54 – Sandlance spawning season is winter (December-March) not June–August as indicated in the table.
- Table 4.65 – There is much accompanying text around this table related to the inflated representation introduced by comparing numbers among various body sizes (e.g., cod versus sand lance). It is agreed this is important and suggested a companion table bed added which reports weight of catch by species rather than numbers to reflect the biomass of the various species in the SEA area.
- Sandlance – Table 4.65 states Sandlance constitute 6% of RV catch while the text states they constitute 30%.
- Sandlance – The report should include information regarding habitat usage of Sandlance, i.e., burrowing in substrate part of day; migrating vertically to feed; and no distance migrations as are closely associated with their habitat.
- Sandlance – It should be noted that inshore and offshore sandlance are two different species. The report should highlight which species is impacted by any proposed work.
- Atlantic Cod – Other than a line in one of the tables in this section of the report, there is no mention of Atlantic cod, despite the existence of a published Atlantic cod Recovery Potential Assessment in 2011 (DFO-CSAS).

### *Section 4.2.1.8 – Environmental Influence and Changes*

- The section on Environmental Influence and Changes does provide some useful information on climate change in regards to fish and invertebrates; however, the context needs to be improved with the addition of information of the role of the North Atlantic Oscillation (NAO) and more comprehensive text on climate change in general (either in the existing text or earlier in sections on the physical environmental setting).

***Section 4.2.1.9 – Aquatic Invasive Species***

- Table 4.67 – Green crab is also one of the few AIS which are known to destroy fish habitat (i.e., eelgrass), thereby affecting recruitment of some species (e.g., Morris et al 2010).

***Section 4.2.1.10 – Ecologically and Biologically Significant Species (EBSAs)***

- The recent identification and description of additional EBSAs in the NL Shelves area (DFO 2013) is mentioned, but has not been adequately incorporated into this report. The data layers for these EBSAs can be provided upon request. Notably, The Orphan Spur EBSA, and possibly the edge of the Notre Dame Channel EBSA, overlaps with the study area.
- Ecologically and Biologically Significant Areas (EBSAs) – *Southeast Shoal and Tail of the Banks* – It should also be noted here that the Southeast Shoal is an area with some of the highest (if not the highest) benthic biomasses recorded anywhere in the world due to the standing biomass of populations of the Arctic wedge clam, *Mesodesma sp*.
- Figure 4.89 – It is unnecessary for EBSAs outside the Eastern NL SEA boundaries to be included.

***Section 4.2.1.11 – Other Ecologically Important Areas***

- Figure 4.90 – Ecologically Important Areas Identified in the Orphan Basin SEA (2003). The color designation for the Orphan Basin area should be a darker shade to differentiate from the surrounding area.
- Legends provide a color scheme for abundance/biomass/species richness in Figures 4.91-4.93. It is not indicated how these were derived. No units are shown.

***Section 4.2.3 – Marine Mammals and Sea Turtles***

- Given the objectives of the SEA, the document is generally well written as it pertains to marine mammals. However, similar to other sections in the document, this text also lacks synthesis and integration of information from a trophic dynamics and changing marine environment perspective. Where possible this deficiency needs to be addressed (particularly in the case of threatened and endangered species).
- In either the Introductory paragraph on Mysticetes (4.2.3.1) or in the supporting tables (under Foraging Strategy and Food Sources), additional text is required to emphasize that these species migrate into our waters to feed for a limited amount of time on relatively specific prey species that are densely aggregated with variable distribution and abundance. As the information is presented now, these key ecological factors do not receive the attention required.
- There is no mention in any of the tables or Introductory paragraphs for either Mysticetes or Odontocetes that most of these species have complex social structures and communication systems. Although group size is mentioned in the tables, this doesn't adequately highlight these important behavioral traits.
- The information on Pinnepeds (Section 4.2.3.3) needs to be expanded so that harp seals, hood seals and grey seals are treated separately in the summary table (i.e. in the same manner key whale species were addressed). Although there are similarities in the ecology of harps and hoods, there are enough differences that lumping both species together results in a summary table with content that is too general to be useful. The timing and use of ice habitat for whelping needs to be a focus for each of these two species. There is also a climate change aspect that should be presented and discussed (there is published literature on this topic as well as new information becoming available pers. comm. Garry Stenson). Note that a recent publication on satellite movements of hooded seals indicates

that there is significant feeding along the shelf edge to the east of the ‘Northeast Shelf Slope’ EBSA (Anderson *et al.* 2012).

- Note that there are likely harbour seals present along the southern shore of the Avalon Peninsula for most of the year in addition to the Bays along the south coast.
- In March 2014 the Convention on Biological Diversity conducted a science advisory workshop to delineate EBSAs in the Northwest Atlantic Area, including areas beyond the 200mile limit. The shelf break area from the vicinity of Lilly/Carson Canyon extending northward to approximately 48’ N was identified as a potential EBSA and further emphasizes the biological importance of this slope habitat.

### Section 4.3 – Human Activities (4.3.4 Marine Fisheries)

An incomplete (and potentially misleading) description of fishing activities exists in the SEA. Virtually the entire section related to marine fisheries within the current SEA is constructed on the basis of Canadian fisheries, or foreign fisheries which land their catches in Canadian ports. This view of the fishing activities that take place in the SEA study area is limited and incomplete. The entire section related to this topic suggests a distribution of fishing activities that omits entirely the international fisheries operating outside the EEZ managed by NAFO, and therefore most of the maps could misled an uninformed reader to believe, for example, that there is essentially no fishing going on in the Flemish Cap, or that the Sackville Spur has no fishing whatsoever, when in reality this is one of the areas in the region that has the highest levels of fishing effort (e.g. NAFO 2012a).

Explicitly, it is not implied that that these omissions and shortcomings are intentional, but it is highlighted that they effectively render the entire analysis of marine fisheries useless. The SEA states, “*Although the DFO datasets are known not to be comprehensive, particularly with regard to important inshore fisheries, the information provides a useful regional picture of fishing activity in the area that is considered adequate and appropriate for the purposes of the SEA*”. However, this cannot be assumed true. Offshore, without integrating the information from Canadian and international fisheries it is impossible to assess if the picture provided is adequate and appropriate. As such, the entire section on marine fisheries should be redone to incorporate international fishing effort data. These data, in aggregated format, could be requested from the NAFO Secretariat. Note also that Campbell and Feridizon (2013) provide data for fishing vessel activity in the areas governed by NAFO for 2011 and 2012.

To permit a general visual comparison of fisheries activities in the study area with and without inclusion of NAFO data, see Figure 1; Appendix 1 that compares Figure 4.122 from the SEA report (commercial fishing locations in 2008-2012) and Figure 4.2.2.1.7 from NAFO (2012a) (common fishing effort areas derived from VMS data in 2008-2011). Such information should be combined with the fishing effort information from DFO to provide a complete picture of fishing in the SEA area.

### Section 5 – Environmental Interactions, Mitigation and Planning Considerations

In general, with regards to environmental interactions, mitigation and planning considerations, the report presents an overview of some of the possible interrelationships resulting from potential offshore oil and gas activities on the Grand Bank and adjacent areas (e.g., Table 5.1) by listing the major activities related to seismic surveys, exploration, drilling and production activities, and how these activities might potentially impact fish and fish habitat, while considering results from previous studies and other sources of available information. However, some areas remain vague in this regard, as do many of the environmental mitigation measures.

### *Section 5.1 – Fish and Fish habitat (effects assessment)*

- This section is a weak summary of other summaries. It is not comprehensive and will not serve as a useful reference. Our understanding has changed dramatically with the research following the Macondo blowout. This should be reflected in this summary.
- Table 5.1 – Information in the table is not adequate. The table is incomplete and often cites reviews of reviews. It is noted in the header that the table is a *"Summary of Some Known and Potential Environmental Effects Based on Available Information Sources"*. This implies that a thorough job of reviewing and summarizing the existing literature for this aspect of the report was not undertaken.
- Table 5.1 – It should be noted that accidental spills of oils or other substances onto the Southeast Shoal during the period capelin are spawning, eggs are incubating, and yolk sac larvae are in the sediment could have a negative impact on that year class and subsequent spawning biomass.
- The bullet, *"Changes in the presence, abundance, distribution and/or health of fish and invertebrates…"* is vague. Direct mortality of marine organisms (at various stages of development) resulting from exposure to oil spills should be stated explicitly instead.
- Produced water effects should include increased nutrient loading and the ecosystem consequences for benthic pelagic coupling and production (Rivkin *et al.* 2000).
- Tannen *et al.* ($2^{nd}$ line) is cited incorrectly. The effects found relate to increased oxygen demand not oxygen enrichment. Produced water effects in this section are related to discharge not flaring. Rye *et al.* (2003) is not in the list of references.
- Mitigations for ballast water introduction of invasive species are included, but not for fouling organisms on hulls, drilling rigs or equipment. Protocols for mitigation of these introduction vectors should also be included in this section.
- It is indicated that the Southeast Shoal is a nursery for yellowtail flounder. However, it should also be acknowledged that the Southeast Shoal is the only spawning site for the Southeast Shoal capelin stock.
- The report suggests '*avoiding species at risk where possible during the planning and conduction of oil and gas activities in the offshore'* as a mitigation procedure. However, since the three wolffish species are found throughout the study area, no practical avoidance exists. What should be a practical mitigation measure in the case of wolffish or white sharks?
- There are no considerations in the report regarding accidental oil spills vis-à-vis fish species at risk and their habitat. This study includes the spatial distribution of abundance indices for the three wolffish species; and potential spatial and temporal trajectories of oil spills have been modelled and/or simulated in previous studies (e.g. Net Environmental Benefit Analysis of Dispersant Use for Responding to Oil Spills from Oil and Gas Facilities on the Newfoundland Grand Banks, 2013); both sources of information could be used to assess the impact of oil spills on the wolffish populations components found in the study area and could also be used as a framework for identifying appropriate mitigation measures in the case of oil spills.

### *Section 5.3 – Marine Mammals and Sea Turtles (Effects Assessment)*

This section of the document is generally well written as it pertains to marine mammals given the objectives of the SEA. However, it is noted the sections on Important Areas and Times for each of the key VEC species groups (e.g. Marine Mammals and Sea Turtles - 5.3.3.2) have considerable repetition from earlier sections of text. While some of this is warranted, there should also be an effort to link this information with the appropriate mitigation measures presented in each of the preceding sections of text.

- The risk from ingestion of floating debris (i.e. plastic bags) for turtles should be discussed and garbage management and onshore disposal proposed as mitigations.

***Section 5.4 – Sensitive and Special Areas (Effects Assessment)***

- The effects of drilling wastes on sensitive and sessile benthic species such as corals and sponges are not well understood. However, since they are filter feeders and known to be sensitive to increased sedimentation, organic matter loading, and quality of suspended particulate material, it can be anticipated that they will be negatively affected. There is also very little information on the potential effects of seismic exploration on these organisms. These aspects should be highlighted as a critical information gap within this consideration of sensitive and special areas.
- The mitigation for cumulative effects is to reduce overlap of projects. This is not realistic. Overall this section is inadequate and does not summarize or address the potential for cumulative effects. It should include interactions between activities as well as thresholds for effects and consider climate, habitat and food web change as possible drivers.
- This section implies that only designated VMEs and Coral Areas will be considered in this section. Other coral and sponge populations are only briefly referred to in the ecosystem overview and generally ignored in the assessment of potential effects.

***Section 5.6 – Cumulative Environmental Effects***

This section is very superficial as presented. It is noted within the report that information on cumulative effects is undeveloped here because upcoming projects and their footprints are unknown. However, there is also no attempt to describe how cumulative effects are currently being assessed nor is there acknowledgment and discussion regarding the advancements in cumulative effects research in recent years. These issues need to be addressed.

Specifically regarding the issue of unknown projects and unknown project footprint sizes as an explanation for providing no relevant industry information, it is noted that it is indicated elsewhere in the current SEA and on the C-NLOPB website that up to ten Environmental Assessments for petroleum exploration/production activities are in progress. At the very least, an overview and time line of these activities should be presented here.

<u>*Note*</u>*: DFO conducted a National Science Advisory Process to develop a new framework for large project cumulative effects on marine mammals in March 2014 – contact J. Lawson for details on when this information will become available.*

***Section 5.7 Information Availability, Requirements and Opportunities***

Coral and sponge effects and sensitivity should be identified as a significant information gap.

# Conclusion

In conclusion, the quality of scientific content presented in the SEA varies across the sections. While the SEA document contains a large volume of information and valuable data, it is not complete in its current form. The SEA fails to incorporate many important and relevant data sources (e.g. non-Canadian surveys and analyses derived from them) and overlooks many important and basic considerations on ecosystem structure and function. It also does not adequately explore to the potential impacts on ecosystem functioning. Suggested changes/updates resulting from this review should be considered before the document can be considered a reliable source of guidance for policy and management decision-making.

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April 24, 2014

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This Science Response Report results from the Science Response Process of April 2014 for the Science Review of the Eastern Newfoundland Strategic Environmental Assessment (SEA).

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# Appendix 1: Figures

| Fishing Locations from SEA Report | Fishing effort from NAFO (2012a) |
|---|---|

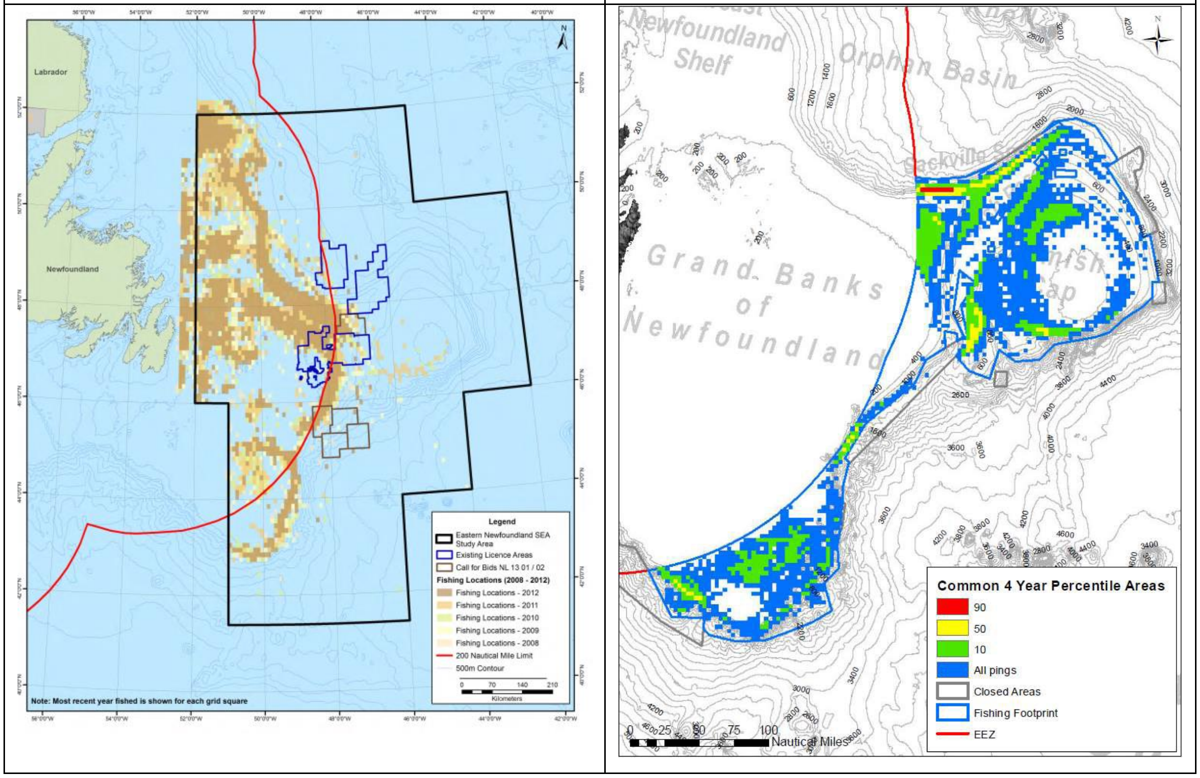


*Figure 1. Comparison of Fishing Locations mapping from the Eastern Newfoundland SEA (Figure 4.122 from the SEA report- commercial fishing locations in 2008-2012-) and common fishing effort areas in the NAFO Regulatory Area in 2008-2011derived from NAFO VMS data (Figure 4.2.2.1.7 from NAFO (2012a)).*

## This Report is Available from the

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