Supplementary Report

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Northeastern Canada 2D Seismic Exploration Survey

November 2012

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This report has been prepared in response to comments brought forward during community information sessions held in June and October, 2012. All sources referenced throughout the report will be available at the hamlet office, or provided by email, upon request.

This report provides a summary of information compiled from past research. It will not address unsubstantiated concerns expressed by some environmental organizations regarding development of natural resources in general.

Seismic Surveys

Marine seismic surveys are conducted to determine geologic features below the seafloor. The seismic survey process includes the following steps:

1. A piston (sound source) generates a sound when it quickly releases compressed air into the water. The sound source is towed by the research vessel 6-10 metres (18-30 feet) below the surface of the water.
2. The sound generated by the source travels through the water as a sound wave to the seafloor. Some of the sound will bounce off different layers (types) of sediments and rocks and return back to surface of the water.
3. The sound that returns to the surface of the water is detected by hydrophones. Hydrophones will be towed by the vessel on a cable that is 6-12 kilometres (18,000- 36,000 feet) long. The cable is also called a streamer.
4. The information collected is analyzed using computer programs that can produce an image of the different rock layers beneath the seafloor.

Marine Fish

Much of the research and knowledge of Arctic marine fish is restricted to Arctic cod due to its ecological importance and to Greenland halibut due to its economic importance. It is understood that there are two types of possible effects from high intensity sound on fish:

- Physical Effects: includes any changes in the fish itself, which may include death.
- Behavioural Effects: can result in changes in swimming direction and location.

There have been no documented cases of fish mortality upon exposure to sound from seismic air sources under field operating conditions (DFO, 2004) and airguns cause no physical damage to fish at distances greater than 12 metres (36 feet) (Gausland, 2000).

Behavioural effects on fish from seismic surveys are understood to be short term, with the duration of the effect less than the duration of the exposure (DFO, 2004). Behavioural effects on fish may affect commercial fisheries catch rates, however those rates are also dependent on many environmental factors. A Norwegian study observed a 132% increase in gillnet catches for Greenland Halibut, while long line catches decreased by 16% during the seismic survey

(Lokkeborg, Ona, Vold & Salthaug, 2012). To limit the potential effect of sound on commercial fisheries, mitigation measures provided by DFO (2010) will be followed.

The potential impact of a 3D seismic survey killing fish larvae and eggs in a fish population (0.18% per day) is below the naturally mortality (5-15% per day) observed in a fish population and, therefore is within the natural variability of fish and larvae mortality (Saetre & Ona, 1996 in LaPierre et al., 2011).

Whales and Seals

Information sources which inform management and policy decisions on seismic surveys with respect to marine mammals include the following:

- Captive Studies: have been used to measure auditory sensitivity, auditory function and the effects of noise exposure. However general behavioural changes in animals due to their captivity may affect natural responses to sound.
- Field Studies: opportunistic observations made by vessels on the behaviour of whales in the observable vicinity of a seismic survey vessel.
- Modelling: computer programs are used to predict the effect of sound on whales ears.
- Tracking devices: uses instruments attached to seals and whales to track individuals and document their underwater behaviour, physiological responses and obtain information on the environment.

Potential effects from seismic surveys on whales and seals include the following:

- Mortality and physical effects: stranding/mortality, hearing impairment and non-auditory effects (for example, ship strikes).
- Direct behavioural effects: displacement, migratory diversion, changes in dives and respiratory patterns, and changes in social behaviour and vocalization patterns.

There is very little information on the following effects of seismic surveys on whales and seals: functional consequences of physical and behavioural effects, chronic effects and indirect effects.

Physical Effect of Acoustic Sounds on Marine Mammals

There have been no documented cases of marine mammal mortality (whales, seals and walruses) upon exposure to oil and gas exploration seismic surveys (DFO, 2004; Abgrall, Moulton & Richardson, 2008).

Behavioural Effect of Acoustic Sounds on Marine Mammals

In field studies, behavioural responses to sounds[1] have been recorded for a few whale species in a limited range of conditions (Gordon et al. 2003; Weilgart, 2007; McCauly et al., 1998;

[1] sounds for this study include seismic surveys, drilling platforms and rigs, airplanes , sonar, commercial shipping, recreational boating

McDonald et al., 1995). Responses include startle and fright, avoidance, and changes in behaviour and vocalization patterns. However, behavioural observations are variable, some findings are contradictory, and the biological significance of these effects has not been measured.

The primary cause of physical and behavioural effects on marine mammals caused by seismic surveys is the intensity of sound, measured in decibels (dB), produced by the seismic source. Responses to noise can be highly variable, depending on species, individuals, age, sex, physical state, presence of offspring, prior experience, characteristics of the noise source, and other factors (Weilgart, 2007).

There are two categories to qualify the effect of sound on marine mammals hearing:

- Permanent Threshold Shift (PTS): permanent reduction in hearing sensitivity.
- Temporary Threshold Shift (TTS): temporary hearing loss (completely recoverable over time spans of minutes to hours).

The United States National Marine Fisheries Service and Department of Fisheries and Oceans have identified, that for high intensity sounds, whales and seals should not be exposed to impulsive sounds (such as those produced by seismic surveys) with levels greater than 180dB and 190dB respectively (Abgrall et al., 2008). This information has been incorporated into the "Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment" (DFO, 2010). For this project, the anticipated sound intensity at 500 metres (approximately 1500 feet) from the sound source is 180dB. Therefore, if a marine mammal is observed within the 500 metre safety zone, the seismic survey will stop operating.

To date, there has been no specific documentation that TTS or PTS occurs when marine mammals are exposed to sequences of airgun pulses under realistic field conditions (Gordon, 1998; DFO, 2004; Abgrall et al., 2008).

Whales and seals that may interact with the proposed seismic survey project include narwhal, beluga, bowhead, ringed seal, bearded seal, harp seal, and hooded seal.

Studies on the effects of sound on specific species are as follows:

- Narwhal
    - There are no known studies specifically on the effects of sound on narwhal. From conversations with hunters and elders, it was explained that narwhals are sensitive to sound. However, it is unknown what sound level would negatively affect narwhals.
- Beluga
    - Generally exhibited avoidance behaviour when swimming less than 1.5 km away from the sound source at a level of 163 dB (Awbrey and Stewart, 1983).

    - Observed to exhibit avoidance of seismic survey vessels of 10 to 20 km when sound levels reach 150 dB (Abgrall et al., 2008).
- Bowhead
    - Summering bowheads showed no detectable avoidance of seismic surveys, no change in general activities or call activities (Richardson et al., 2007 in Weilgart 2007).
    - Overt avoidance behaviour at ranges of 6-8km, swimming away from the vessels and air source (Gordon et al., 2003).
    - A pattern of shorter surfacing, shorter dives, few blows per surfacing, and longer intervals between blows when exposed to anthropogenic noise (Hildebrand, 2004).
    - Changes in call detection rates in response to airgun activity have been found for bowhead whales (Stone & Tasker, 2006).
- Ringed and Bearded Seals
    - A study observed the following behaviour of those seals sighted when the seismic airgun was operational (Harris et al., 2001):
        - 18% looked, 2% approached, 5% swam parallel to the boat's track, 36% dove, and 39% swam away
        - Seals might reduce exposure to the sounds by remaining at the surface
        - No seals were observed to leave the general area of operation during seismic activity
- Harp Seal
    - There are no known studies of the impact of seismic surveys on harp seals.
- Hooded Seal
    - There are no known studies of the impact of seismic surveys on hooded seals.

Mitigation Measures

The project proponent will implement the following mitigation measures:

Community Liaison Contact

The Community Liaison Officer will maintain communication with the project proponent to provided updates to the Hamlet Council, Hunters and Trappers Organization and community on the project. As well, they will work closely with the Hamlet on developing proposals, projects, and reports to advance economic development opportunities and build capacity within the community.

Fisheries Liaison Officer

The Fisheries Liaison Officer will maintain communication with all fishing vessels near the vicinity of the seismic survey. The officer is solely responsible for communicating with the fishing industry. The officer will update the survey vessel on known fishing activities in the area and will provide relevant information to DFO.

Marine Mammal Safety Zone

A safety zone of 500m (1500 feet) from the sound source has been established. If a whale, seal or walrus is identified within the safety zone, the seismic survey stops.

Marine Mammal Observer

Marine Mammal Observers (MMOs) are on the survey vessel looking for marine mammals. MMOs will keep a detailed log of what species are observed, and where and when they were observed. If a marine mammal is seen within the 500m-safety zone, the seismic survey stops. Once MMOs do not see a marine mammal within the 500m-safety zone for 30 minutes, the 20-minute ramp up procedure will begin.

Ramp Up Procedure

The ramp up procedure is when the survey vessel gradually increases the intensity of the air source (sound) over 20 minutes. This procedure is used to allow for fish and marine mammals to move away from the survey area. If a marine mammal enters the 500m-exclusion zone during this 20-minute 'ramp up' procedure, the airguns will be shut down. The ramp up procedure occurs each time the air source is turned on.

Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment

The project proponent is following the "Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment" in order to avoid or minimize the impacts on marine life. The Statement of Practice outlines the necessary and appropriate mitigation measures for seismic surveys.

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