



GEOFORCE GROUP LIMITED

Protocols for Mitigating Impact to Marine Mammals
during High Resolution Geophysical Surveys

The Geoforce sub-bottom profiling systems, with boomer and sparker acoustic sources, are categorized as high resolution geophysical (HRG) sound sources, which are known to operate in discrete frequency bands and for shorter durations than seismic airgun surveys.

While the boomer and sparker acoustic sources are known to be detectable by marine mammals, HRG surveys put out less energy than seismic airguns and operate in smaller areas. Therefore, the size of the area impacted by sound is much smaller, though they can impact marine animals at close ranges, mostly within 200 meters.

No injury to marine mammals or sea turtles is expected from these sound sources, as sound has been shown to diminish rapidly with distance from the sound source.

(<https://www.boem.gov/sites/default/files/about-boem/BOEM-Regions/Atlantic-Region/GandG-Overview.pdf>)

This Canada Department of Fisheries and Oceans report (<https://waves-vagues.dfo-mpo.gc.ca/Library/363476.pdf>) states:

“A multitude of studies on a variety of species and for a variety of noise sources have attempted to address the issue of noise levels capable of causing behavioural responses in marine mammals. Based on the data available in 1999, the U.S. government identified 160 dB re 1 μ Pa (RMS) as the threshold beyond which negative behavioural responses were expected in marine mammals exposed to pulsed noise sources, such as sparkers and boomers. This criterion is still in effect and has been applied in assessing some projects in Canada (e.g. DFO 2012a; 2014a).

All the existing literature indicates, however, that behavioural responses vary greatly between studies (reviews: Southall et al. 2007; Nowacek et al. 2007). This suggests that biological, operational and environmental factors play a role in determining the likelihood and severity of the response, particularly when noises are of relatively low intensity, that is, beneath the 160 dB re 1 μ Pa (RMS) threshold used in cases of pulsed sources (Southall et al. 2007; Ellison et al. 2012).



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As a result, there is a growing consensus that the likelihood of behavioural impacts should not be determined strictly based on the received level of noise and a dose-response concept (Richardson et al. 1995) without taking into consideration the context of exposure, motivations, the populations' naïveté about the noise source and their habituation (Southall et al. 2007; Ellison et al. 2012). This same analysis indicates that the noise emitted by a boomer in the Gros-Cacouna area should fall beneath the disturbance thresholds of 160 and 140 dBrms at distances of 400 m and 6 km from the source, respectively."

To mitigate its impact to marine mammals during HRG surveys, Geoforce has established the following guidelines:

Planning of seismic surveys

- As a precautionary measure and to minimize the unnecessary introduction of sound into the marine environment, Geoforce's HRG surveys are designed to use the minimum energy needed to obtain the information sought, to reduce or baffle the horizontal spread of sound and reduce the generation of unnecessary high frequency sounds.
- To further reduce the potential impacts of a HRG surveys, Geoforce designs programs which avoid areas where it is known that there are aggregations of marine mammals and marine fish at critical times in their life cycle and during critical biological functions such as spawning, breeding, feeding, nursing and migration times.

Establishment and monitoring of a safety zone

- Geoforce sub-bottom profiling systems use boomer and sparker acoustic sources, which could potentially harm marine mammals within a 200-meter range from these acoustic sources.
- As such, Geoforce Group has established a 200-meter safety zone for monitoring the presence of marine mammals during its surveys.



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Survey start-up protocol

- It has been observed that most marine species will likely avoid a vessel while survey activities are underway. Geoforce uses a start up technique whereby activation of the boomer and sparker acoustic sources begins with a gradual increase of the intensity of the sound until it reaches the required intensity.
- This procedure provides the time and the incentive for marine mammals and fish to leave the immediate area.

Survey shut-down protocol

Once our HRG survey activity is ongoing, if a marine mammal or a turtle enters the safety zone:

- Our survey personnel will assume the marine mammal or turtle is endangered
- We will shut down and wait for the marine mammal to leave the safety zone

Procedures when active surveying ceases

- As a precautionary measure and to reduce the amount of unnecessary sound released into the marine environment, when active surveying ceases, Geoforce generally shutdowns the boomer and sparker acoustic sources completely. However, leaving one sound source active is known to deter whales, dolphins, porpoises or turtles from entering the safety zone.

Prescribed marine mammal observation and detection measures

- When Geoforce conducts company sea trials or HRG surveys for internal research and development purposes, we will station an observer on board the vessel to monitor marine mammal activity within a 200-meter safety zone from the acoustic sources.
- The observer will verify the safety zone is clear of marine mammals or turtles for at least 30 minutes before the Geoforce boomer and sparker acoustic sources will be activated.
- Our observer will maintain a regular watch during the entire duration of the time the acoustic sources are active and as long as the safety zone is visible.
- If our observer identifies marine mammals within the 200-meter safety zone, Geoforce will shut down its survey activities for a minimum of 30 minutes.