



PSA-021-Marine Mammals and Air Guns

How do we save coral reefs?

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The ocean is a naturally noisy environment. From microscopic thermal noises, through local surface movements of wind and waves, to global geological processes and tectonic movements, natural processes create sound within the marine environment. However, in recent decades, the introduction of anthropogenic sounds into this environment has meant that these natural sounds are now just a small fraction of the noise found in our oceans and seas.

In just one century, we have seen the exponential development of medium and low frequency active



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sonar, diesel propulsion ships and international container transportation, and seismic exploration, all of which have introduced large amounts of noise into the ocean. Studies estimate that since the 1960s, underwater oceanic noise has increased at a rate of three decibels per decade, meaning that the world's oceans are now more than ten times noisier than they were just 50 years ago. In recent years, various governments around the globe have introduced legislation and encourage 'Best Practice' to be employed in order to protect marine wildlife from the physical and behavioral impacts of anthropogenic noise, in particular those resulting from seismic surveys.

Impact of Anthropogenic Sound

For marine mammals, sound is the primary sense, being used for communication, navigation, foraging and predator avoidance. Airguns used during seismic surveys introduce high amplitude, broadband noise into the survey area and it has been shown that seismic activity can be detected above background noise as far away as 3,000 km (Nieukirk et al. 2004).

Anthropogenic sound impacts marine mammals in various ways. Firstly, it can cause physiological damage to the auditory system. Research shows that seismic activity leads to temporary or permanent threshold shifts in marine mammal hearing, whereby the hair cells in the cochlea become damaged, rendering the animal's hearing less effective until the cells return to normal after a period of time or completely irreparable. Secondly, the overlap in the frequencies used by seismic airguns and marine mammals can mean that the animals' communication and navigation systems are rendered useless while the survey is being conducted. While there is not enough hard evidence to implicate seismic exploration as being a main cause of marine mammal strandings, it is possible that a sudden increase in anthropogenic underwater noise in a region could lead to animals becoming disorientated and unable to navigate normally. Finally, behavioral changes may also be demonstrated by marine mammals in the proximity of seismic surveys – the exact reactions are highly species-specific, but can include avoidance of the area being surveyed, attraction towards the seismic vessel, or a complete cessation of vocalization. Migration routes can thus be disrupted, or key feeding and breeding areas abandoned, all



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of which will have serious implications on local, and even global, populations of marine mammal species.

Mammals are not the only group affected by seismic noise – turtles are thought to be susceptible to physical damage, particularly at the embryonic stage, and both turtles and sharks often demonstrate negative responses to noise.

Best



Practice

Humpback whales, which rely on sound to survive, are a key species for mitigation in many areas, including Australia. Image: David Still

In an attempt to minimize the levels of acoustic disturbance and injury to marine animals, a number of countries have introduced 'Best Practice' mitigation guidelines to be used during seismic surveys. In



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1995, the UK's Joint Nature Conservation Committee was the first regulatory body to issue statutory marine mammal mitigation measures for use in their national waters. Australia's Department of the Environment, Water, Heritage and the Arts then followed in 2001 and since then a number of other countries have developed their own guidelines. While the details of these guidelines vary from country to country, the basic principles remain the same: seismic source vessels should carry trained Marine Mammal Observers (MMOs) who monitor a designated 'mitigation or exclusion zone' for the presence of marine mammals before and during seismic surveys, and advise on the mitigation requirements for the survey in real time.

It is the responsibility of the onboard MMOs to understand the relevant legislation within the survey area, which varies depending on country, season and type of seismic survey being conducted. The length and form of required pre-shooting watch, the radius of the mitigation or exclusion zone, and the species being mitigated for, all change from survey to survey. Within the UK, the mitigation requirements differ depending on water depth, volume of airguns being used, and sensitivity of the survey area with regard to marine mammal presence. For example, in one location a 30-minute pre-shooting visual watch conducted by a single MMO may be all that is needed; in another, a one-hour watch using two MMOs simultaneously as well as acoustic detection equipment is required. In UK waters, as in many other countries, the mitigation zone is designated as 500m from the source (i.e. the airguns). If marine mammals enter this zone prior to the start of firing, the survey operations must be delayed until the animals are clear of the zone, or have not been detected for more than 20 minutes within this zone. In other countries, this mitigation zone is extended to 1 km or even as far as 3 km depending on the type of survey and the animals detected, and the delay may also be extended to 30 minutes.

Once the airguns have commenced shooting, operations within UK waters may continue regardless of the presence of marine animals within the mitigation zone. However, the UK is alone in this respect. All other published guidelines require that the airguns are shut down under specified conditions. For example, in the Gulf of Mexico, shutdowns are required when any marine mammal or turtle enters the 500m mitigation zone. In Australia, the close proximity of any whale species and larger delphinid species means the airguns must be reduced to a low power, or fully shut down depending on the range of the animals. In New Zealand and Canada, shutdowns are only requested for listed 'species of



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concern'. Operations can be recommenced after a specified period of time since the last animal was detected. In an industry where vessels may cost in the order of hundreds of thousands of dollars each day, such delays to operations can have large financial repercussions, so it is crucial that the MMO is well trained and able to identify what animal is being detected, and its exact range from the source.

Not Always Popular

Marine mammal mitigation is a relatively new aspect of the exploration industry – and one that is not always popularly received. However, given the commitment of so many countries to the protection of cetaceans through various international agreements, it is an essential component of seismic surveys and one that is set to increase in significance. It is only through professional, dedicated mitigation and observation of marine wildlife during seismic surveys that the current guidelines can be revised and ameliorated so that exploration continues while still upholding a commitment to the conservation of our marine environment.

(see www.geoexpro.com: [Recent Advances in Technology](#) series for more information about the effect of sound on marine life)

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