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The Environmental Impacts of Offshore Exploration

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Introduction: The Problem of Ocean Noise

In the darkness of the sea, many species of fish and marine mammals have evolved to rely on sound for navigating, finding food, locating mates, avoiding predators, and communicating. As we continue to develop and industrialize our coasts, we are substantially altering the acoustic environment vital to ocean life.

Over the last ten years, a broad body of research indicates that ocean noise impacts at least fifty-five marine species, including invertebrates, marine mammals and twenty commercially valuable species of fish such as pink snapper, cod, haddock, rockfish, herring, tuna and mackerel. These impacts include mass mortalities, injuries, and strandings of marine mammals (e.g., Fernandez et al. 2005; Parsons et al. 2008); temporary and permanent hearing loss, which compromise an animal's ability to survive (e.g., Lucke et al. 2009); disruptions in foraging, breeding, and other vital activities (e.g., Miller et al. 2009; Nowacek et al. 2004); habitat abandonment and loss of biodiversity (e.g., Parente et al. 2007); chronic stress (e.g., Wright et al. 2007); and the masking of biologically important sounds. Impacts on commercially harvested fish include habitat abandonment, reduced reproductive performance, and hearing loss (e.g., Bart et al. 2001; McCauley et al. 2000, 2003; Scholik and Yan 2002).

Some biologists have compared the increasing levels of background noise in many coastal regions to a continuous fog that is shrinking the sensory range of marine animals (Bode et al. 2009). Unfortunately, with increasing development, the problem will only grow more severe in the coming century. One of the most disturbing trends is the expansion of airgun surveys conducted by the oil-and-gas industry, which already occur in substantial numbers in some ocean regions (U.S. Marine Mammal Commission 2007), into pristine waters like the Arctic and into habitat close to shore.

"The Most Intrusive Form of Man-Made Undersea Noise Short of Naval Warfare"

To map the ocean floor, the oil and gas industry typically relies on airguns, which are towed behind boats in long arrays, firing shots of compressed air into the water about every ten seconds. The intense pulses that they produce travel down through the water column, penetrate the seafloor, and rebound to the surface where they can be analyzed.

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Unfortunately, the airguns used by industry generate serious environmental problems over large biological scales. A large seismic array can produce peak pressures of sound that are higher than those of virtually any other man-made source save explosives (NRC 2003); and although airguns are vertically oriented within the water column, horizontal propagation is so significant as to make airguns, even under present use, one of the leading contributors to ambient ocean noise even thousands of miles from any given survey (Nieukirk et al. 2004). Dr. Christopher Clark, the director of Cornell's Bioacoustics Research Program, has called these surveys, which can take weeks or in some cases months to complete, the most intrusive form of man-made undersea noise short of naval warfare.

It is well established that the high-intensity pulses produced by airguns can cause a range of impacts on marine mammals, fish, and other marine life, including broad habitat displacement, disruption of vital behaviors essential to foraging and breeding, loss of biological diversity, and strandings and mortalities (e.g., Clark and Gagnon 2006; Clark et al. 2009; Engås et al. 2006; Hildebrand 2005; McCauley et al. 2003; Miller et al. 2009).

For example, using passive acoustic monitoring, Clark and Gagnon (2006) demonstrated that a single seismic survey off the northeast U.S. coast caused endangered fin whales to cease vocalizing – a behavior essential to the breeding and foraging of this ESA-listed species – over an area larger than New Mexico (100,000 square nautical miles) and potentially an area larger than Alaska (800,000 square nautical miles), for the duration of the survey. Further, recent advances in modeling indicate that several endangered baleen whale species, including fin whales and the North Atlantic right whale, are highly susceptible to masking effects from seismic surveys, over extremely large spatial scales, severely inhibiting communications essential to foraging, finding mates, and avoiding predators (Clark et al. 2009). Other marine mammal species known to be affected by airgun arrays include (among others) sperm whales, whose foraging rates in the northern Gulf of Mexico appear to have declined in response to relatively moderate levels of airgun exposure (Miller et al. 2009); bowhead whales, which have been shown to avoid survey vessels to a distance of more than twenty kilometers while migrating off the Alaskan coast (Richardson 1999); and harbor porpoises, which have been seen to engage in strong avoidance responses at tens of miles from an array (Bain and Williams 2006).

Airgun surveys also have important consequences for the health of fisheries. For example, airguns have been shown to dramatically depress catch rates of various commercial species over thousands of square kilometers (Engås et al. 1996; see also Skalski et al. 1992), leading fishermen in some parts of the world to seek industry compensation for their losses. In fact, this is occurring in Norway at the present time.

Unfortunately, the environmental analyses conducted to date by the Minerals Management Service make no attempt to account for the impacts of airgun surveys on foraging rates and other essential behaviors in any marine mammal species, let alone endangered ones. Nor do they attempt to calculate the social cost to fishing communities from the wide-scale effects that seismic surveys have on catch rates in commercial fisheries. Finally, the mitigation measures typically prescribed by the Service are completely inadequate to redress the environmental harms that the science has identified, and cannot remotely be relied upon (see Parsons et al. 2009).

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