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Boom, Baby, Boom: The Environmental Impacts of Seismic Surveys

For offshore exploration, the oil and gas industry typically relies on arrays of airguns, which are towed behind ships and release intense impulses of compressed air into the water about once every 10 to 12 seconds. Although most of the energy from these acoustic “shots” is intended to search downward for evidence of oil and gas deep beneath the seafloor, a significant amount of the energy travels outwards and can be heard throughout vast areas of the ocean. The environmental problems created by these noise invasions are not fully understood, but we do know that these intense sounds threaten the habitats of endangered whales and commercial fisheries, and cannot remotely be confined to the waters off individual states that approve offshore production. Seismic surveys have been shown to disrupt essential behavior in endangered whales and cause catch rates of some commercial fish to plummet—in some cases over enormous areas of ocean. To mitigate these impacts, NRDC recommends that airguns be kept out of sensitive areas and that greener alternatives be promoted, some of which are already well into development and could be made commercially available within a few years.

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Airguns and Ocean Life

The ocean is an acoustic world. Unlike light, sound travels extremely efficiently in seawater, and marine mammals and many fish depend on sound for finding mates, foraging, avoiding predators, navigating, and communicating—in short, for virtually every vital life function. When we introduce loud sounds into the ocean, we degrade this essential part of the environment. Some biologists have likened the increasing levels of noise from human activities to a rising tide of “smog” that has urbanized and in some

areas industrialized major portions of the marine environment off our coasts. This “acoustic smog” is shrinking the sensory range of marine animals.¹ A substantial and growing body of research now indicates that ocean noise pollution negatively affects at least 55 marine species, including several endangered species of whales and 20 commercially valuable species of fish.^{2,3}

Seismic surveys have a staggering environmental footprint. A large seismic array can produce peak pressures of sound higher than those of virtually any other man-made source

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save explosives;⁴ and though its airguns are pointed downwards towards the sea floor, their sound travels outward so widely as to significantly raise noise levels literally thousands of miles away.⁵ The director of Cornell's Bioacoustics Research Program once described these surveys as possibly **"the most severe acoustic insult to the marine environment."** Unfortunately for the whales, airgun surveys last anywhere from weeks to many months and, in many coastal areas that represent vital feeding and breeding grounds, cause animals harm by depriving them access to their normal acoustic habitats.

Impacts on a Population Scale

The impacts of seismic surveys are felt on an extraordinarily wide geographic scale. For example, a single seismic survey can cause endangered fin and humpback whales to stop vocalizing—a behavior essential to breeding and foraging—over an area *at least* 100,000 *square nautical miles in size*.^{6,7} The few animals that persist in calling seem to abandon the entire area, which is larger than the state of New Mexico. Seismic surveys can also drown out mating and other calls of endangered whales over enormous distances. Beyond several miles, the periodic blasts of airguns can sound virtually continuous, making it impossible for species that use low-frequency sound—like the endangered great whales—to communicate, feed, and find mates.^{8,9}

Alarming, one of the species most vulnerable to these impacts, according to the latest research from NOAA and Cornell, is the critically endangered North Atlantic right whale, whose only known calving grounds occur off Florida and Georgia.^{10,11}

Given the scales involved, surveys taking place off the coast of Virginia could well affect endangered species off southern New England, and right whales could be disrupted throughout their east-coast migratory range.

Airguns have also been shown to affect a broad range of other marine mammal species beyond the endangered great whales. For example, sperm whale foraging appears to decline significantly on exposure to even moderate levels of airgun noise;¹² and harbor porpoises have been seen to engage in strong avoidance responses fifty miles from an array.¹³ Seismic surveys have been implicated in the long-term loss of marine mammal biodiversity off the coast of Brazil.¹⁴

Impacts on Fish and Fisheries

Airgun surveys also have serious consequences for the health of fisheries. For example, airguns have been shown to dramatically depress catch rates of various commercial species (by 40 to 80 percent) over thousands of square kilometers around a single array,^{15,16} leading fishermen in some parts of the world to seek industry compensation for their losses. These compensations are already occurring

The Seismic Footprint

Noise from a single seismic survey, operating in the direction of the upper right corner, saturates an area in the North Atlantic larger than the state of West Virginia (10,000 square nautical miles), masking low frequencies used by endangered baleen whales. Red signifies noise several orders of magnitude higher than the prevailing background noise in the region. In fact, biologists have found that airguns cause endangered fin and humpback whales to go silent over an area at least 10 times larger than this.



Image credit: Clark and Gagnon, 2006.

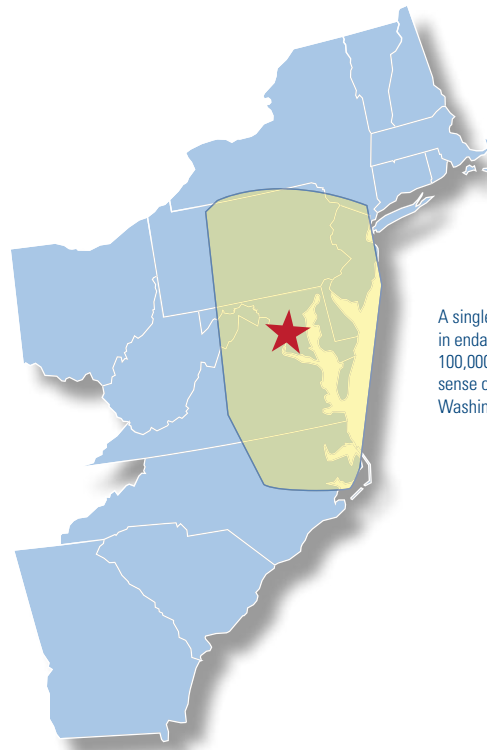
in Norway. Other impacts on commercially harvested fish include habitat abandonment—one possible explanation for the fallen catch rates—reduced reproductive performance, and hearing loss;¹⁷⁻¹⁹ and recent data suggest that loud, low-frequency sound also disrupts chorusing in black drum fish, a behavior essential to breeding in this commercial species.²⁰

What's in Store for the Atlantic

How much seismic surveying are we likely to see in the former moratorium areas? Within months after the Minerals Management Service (MMS) issued its scoping notice for the Atlantic region, Spectrum Geo proposed shooting 112,500 line miles of surveys from Massachusetts down to Florida, Western Geco another 54,900 miles between New Jersey and Georgia, and CGG Veritas more than 42,000 miles running southwards from Maine. In all, more than 285,000 line miles were proposed in the initial flurry of applications.²¹ Industry will conduct more surveys as areas are opened for leasing, and will send ships back time and again to certain areas of interest to see how geologic features there change over time. On top of this, some companies are making more and more use of “wide azimuth” surveys, in which up to four airgun arrays run side-by-side and fire in tandem.

The Way Forward

The mitigation measures typically prescribed by MMS require little more than visual monitoring for marine mammals within a small “safety zone” immediately around the seismic vessel. But that approach is completely inadequate to redress the large-scale environmental harm that science has identified.²² The only effective ways to mitigate these serious longer-range impacts are to keep airguns out of sensitive environmental areas (and the areas nearby), to cap the number of activities allowed each year by region, to bar redundant surveys, and to promote the use of greener alternatives—some of which are already well into development and could be made commercially available within a few years.



A single airgun array can disrupt vital behavior in endangered whales over an area at *least* 100,000 square nautical miles in size. For a sense of scale, here is that area centered over Washington, D.C.

NRDC makes the following recommendations:

- **Congress should not introduce new “seismic inventory” language into the pending climate and energy bills.**

A provision in the Senate’s energy bill would mandate that MMS conduct a seismic inventory of the OCS and authorize more than \$750 million for the purpose. In addition to unnecessarily subsidizing the industry, such a provision would result in significant environmental harm to marine mammal and fish habitat in regions, like the northeast and west coasts, that strongly oppose OCS development on environmental grounds and will certainly not figure in any government lease plan for at least 7 years.



Atlantic cod

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Haddock

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- **Congress should strengthen environmental review of seismic surveys on the Outer Continental Shelf.**

Allowing airgun surveys to proceed across ocean regions without even considering their harmful impacts, and how to mitigate them, is simply irresponsible and could result in needless harm to commercial fisheries and endangered species on a wide scale. Yet in some regions, like the Gulf of Mexico, neither MMS nor industry have obtained legally required permits under the Marine Mammal Protection Act or satisfied environmental review requirements of other laws. As one important step, Congress

Boom, Baby, Boom: The Environmental Impacts of Seismic Surveys

should amend the Outer Continental Shelf Lands Act to let the public seek judicial redress against companies that violate the Marine Mammal Protection Act.

- **Congress should authorize research and development funding for lower-impact exploration technologies and require MMS, in consultation with NOAA, to set 5- and 10-year benchmarks for their development and use.**

According to industry experts, airguns produce a great deal of “waste” sound and generate peak levels (which are thought to be one of the dangerous characteristics of airgun noise) substantially higher than those actually needed for exploration. Lower-impact technologies that would substantially shrink the environmental footprint of airguns in many areas could be available for commercial use within 3 to 5 years. Marine vibrators, for



North Atlantic right whale

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example, have the potential to reduce peak sound levels by 30 to 50 decibels, at least in shallow water, turning an extraordinarily powerful airgun array into the equivalent of a very large ship.²³ But increased funding and regulatory involvement are essential to realizing these lower-impact alternatives.²⁴

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