



## Impacts of Seismic Surveys on Marine Mammals and Fish

### What are seismic surveys?

Seismic surveys are used by the offshore oil and gas industry to help determine the location of oil and gas deposits beneath the seafloor. These surveys utilize large, specialized ships which tow an array of powerful air guns that generate sound waves by firing off explosive blasts of air. The sound waves are reflected off the seafloor and create a picture of underwater geological formations.

A typical seismic survey lasts 2-3 weeks and covers a range of about 300-600 miles. The intensity of sound waves produced by the firing of seismic air guns can reach up to 250 decibels (dB) near the source and can be as high as 117 dB over 20 miles away. The sound intensity produced by a jackhammer is around 120 dB, which can damage human ears in as little as 15 seconds.

### What impacts can seismic surveys have on marine mammals?

Unlike humans and other terrestrial animals, marine mammals rely on sound instead of sight as their primary sense. Dolphins, whales and seals utilize their sense of hearing to locate prey, avoid predators, choose migration routes, and to communicate across long distances. The noise associated with seismic surveys can affect the ability of these animals to detect natural underwater sounds, thereby disrupting these critical activities.

Numerous scientific studies have solidified what Eskimo subsistence hunters have known for years: that whales avoid expansive areas where seismic surveys are being conducted. One recent study showed that fall-migrating bowhead whales in the Beaufort Sea were displaced from an area within 12 miles of the seismic source and began to show avoidance behavior up to 21 miles away. Researchers have also observed signs of physical stress such as startle responses in humpback whales while seismic surveys were being conducted many miles away (see Figure 1 below).

Scientists believe that pods of whales that include calves are at serious risk from seismic activities due to their need to utilize critical habitats for feeding and resting. If seismic surveys continually displace whales from these important areas, population-level consequences may result. Dr. Barret-Lennard, Senior Marine Mammal Researcher at the Vancouver Marine Science Center, has asserted that seismic exploration is one of the two greatest threats to whales and dolphins.<sup>1</sup>

### What impacts can seismic surveys have on fish?

The powerful sound waves generated by seismic surveys can have a variety of harmful effects on fish. Within close range, seismic surveys have been found to kill adult fish as well as larvae and fish eggs. Scientific studies have also shown that air gun blasts can cause a variety of sublethal impacts on fish such as damaging orientation systems and reducing their ability to find food. Researchers have noted disturbances in the migration routes of salmon and other anadromous species as a result of seismic operations.

Seismic surveys can cause physical damage to fish ears and other tissues and organs such as swim bladders. Although such effects may not kill fish immediately, they may lead to reduced fitness, which increases their susceptibility to predation and decreases their ability to carry out important life processes. Furthermore, if important prey species in the food web such as squid and zooplankton are harmed by seismic testing, the fish dependent on these creatures may also be negatively affected.

Proponents of offshore oil and gas production often argue that overall impacts of seismic surveys on fish are negligible. However, Stanislav Patin, an international expert on the environmental impacts of offshore oil and gas development, has warned that "...there seems to be no reason for the optimism that is sometimes expressed regarding the ecological safety of seismic surveys and their harmlessness to fish resources."<sup>2</sup>

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## How do seismic surveys impact fishing efforts?

Seismic surveys not only threaten commercial and subsistence fishing by harming fish resources, but also by interfering with fishing operations and dramatically affecting catch rates. Seismic ships tow streamers that can be miles long. These can get tangled up with crab pots, set nets and trawl nets causing damage and decreasing crucial fishing time. The best time to conduct seismic surveys in Arctic environments is during the summer, which is also prime season for many Alaskan fisheries. As a result, seismic survey operations can end up competing with fishing for time and space on the water.

Even if these kinds of conflicts can be avoided, several studies have shown that seismic operations have greatly reduced catches of fish around areas where air guns were being fired. These studies have demonstrated reduced catches over 20 miles away from the source with catch reductions continuing five days after the testing was complete (See Table 1 below). Researchers believe these catch reductions are a result of altered fish behavior due to seismic operations which cause them to be less likely to take hooks and/or to move down and away from the seismic firing.

**Table 1: Reductions in fish catch rates as a result of seismic survey activity**

Species	Gear type	Noise level of seismic testing	Catch reduction	Source
Atlantic cod ( <i>Gadus morhua</i> )	Trawl	250 decibels (dB)	46-69% lasting at least 5 days	Engas et al. 1993
Atlantic cod ( <i>Gadus morhua</i> )	Longline	250 dB	17-45% lasting at least 5 days	Engas et al. 1993
Atlantic cod ( <i>Gadus morhua</i> )	Longline	Undetermined, 9.32 miles from source	55-79 % lasting at least 24 hours	Lokkeborg and Soldal, 1993
Haddock ( <i>Melanogrammus aeglefinus</i> )	Trawl	250 dB	70-72% lasting at least 5 days	Engas et al. 1993
Haddock ( <i>Melanogrammus aeglefinus</i> )	Longline	250 dB	49-73% lasting at least 5 days	Engas et al. 1993
Rockfish ( <i>Sebastes</i> spp.)	Longline	223 dB	52%- effect period not determined	Skalski et al., 1992

### Sources:

CEF Consultants Ltd. *Exploring for Offshore Oil and Gas* (Nov. 1998). No. 2 of Paper Series on Energy and the Offshore. Halifax, NS. Accessed May 18, 2005 at: <http://www.cefconsultants.ns.ca/2explore.pdf>

Engas et al. (1993) Effects of Seismic Shooting on catch and catch-availability of cod and haddock. *Fisken og Havet*, nr. 9, 99. 117.

Hirst, A.G. and Rodhouse, P.G. (2000) Impacts of geophysical seismic surveying on fishing success *Reviews of Fish Biology and Fisheries* Vol. 10, pp. 113-118.

Lokkeborg, S. and Soldal, A.V. (1993) The influence of seismic exploration with airguns on cod (*Gadus morhua*) behavior and catch rates. *ICES Marine Science Symposium*. 196, pp. 62-67.

McCauley, R., Fewtrell, J., and Popper, A. (2002) High Intensity Anthropogenic Sound Damages Fish Ears. *Journal of the Acoustical Society of America*. Vol. 113 (1) pp. 638- 642.

McCauley et al. (2000) Marine Seismic Surveys- A Study of Environmental Implications. *Australian Petroleum Production and Exploration Association Journal* pp. 692-708

<sup>1</sup>Pambris, Xanthe. "Sonar and Seismic Exploration: A Major Headache for Whales." September 13, 2004. *Vancouver Aquarium Aqua News*. Accessed June 23, 2005 at: <http://www.vanaqua.org/aquanews/features/sonar.html>

<sup>2</sup>Patin, Stanislav (1999). *Environmental Impact of the Offshore Oil and Gas Industry*. East Northport, NY: EcoMonitor Publishing.

Skalski et al. (1992) Effects of sound from geophysical surveys device on catch-per-unit-effort in a hook-an-line fishery for rockfish (*Sebastes* spp.). *Canadian Journal of Fisheries and Aquatic Sciences* Vol. 49, pp. 1357-1365.

Wardle et al. (2001) Effects of seismic air guns on marine fish. *Continental Shelf Research* Vol. 21 pp. 1005-1027.

Vancouver Aquarium Marine Science Center. November 3, 2004. "Canada: Seismic Surveys a Danger to Marine Life, Report Warns." *Vancouver Aquarium Aqua News*. Accessed June 23, 2005 at: <http://www.vanaqua.org/aquanew/fullnews.php?id=1722>

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