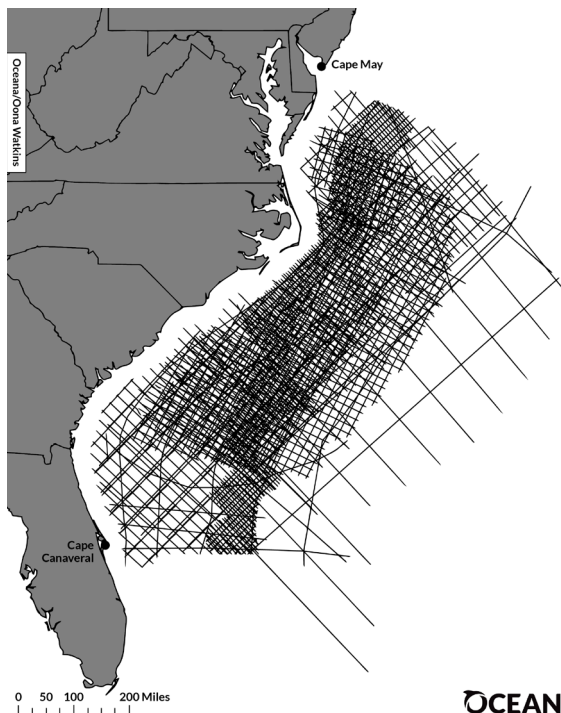


Exploration for Offshore Oil Drilling with Seismic Airguns Harms Marine Life

Seismic airgun blasting in search of offshore oil is shortsighted and dangerous. Seismic airgun arrays create one of the loudest manmade sounds in the ocean.¹ Noise from airguns can disturb, injure or kill marine animals from zooplankton, the base of the food web, to large whales.²⁻⁷ According to the government's own estimates, seismic airgun blasting in the Atlantic Ocean will injure and disturb marine mammals, like dolphins and whale, hundreds of thousands of times.⁸

Seismic Surveys in the Atlantic



Composite of proposed seismic survey tracklines

Seismic airgun blasting is the first step towards dirty and dangerous offshore drilling. In November 2018, the National Oceanic and Atmospheric Administration (NOAA) issued Incidental Harassment Authorizations (IHAs) for five companies to harm marine mammals while conducting large-scale seismic surveys for oil and gas in the Atlantic.⁸

Seismic airguns produce loud, repetitive sounds that can travel underwater up to 2,500 miles.⁹ Blasts are repeated as often as every 10 seconds for days, weeks or months at a time.^{8,9} These Atlantic authorizations allow nearly 850 combined days of around-the-clock activity, amounting to more than five million total seismic airgun blasts.⁸

The blast zone stretches from the mouth of Cape May, New Jersey to Cape Canaveral, Florida and contains at least thirty-four species of marine mammals.⁸ The area also includes the only known calving ground for the

critically endangered North Atlantic right whale. Endangered and threatened sea turtles live in the region's waters and nest on its beaches.¹⁰ The blast zone is also home to hundreds of species of fish and shellfish, many of which support important commercial and recreational fisheries.^{11,12}

Bad Deal for Coastal Communities

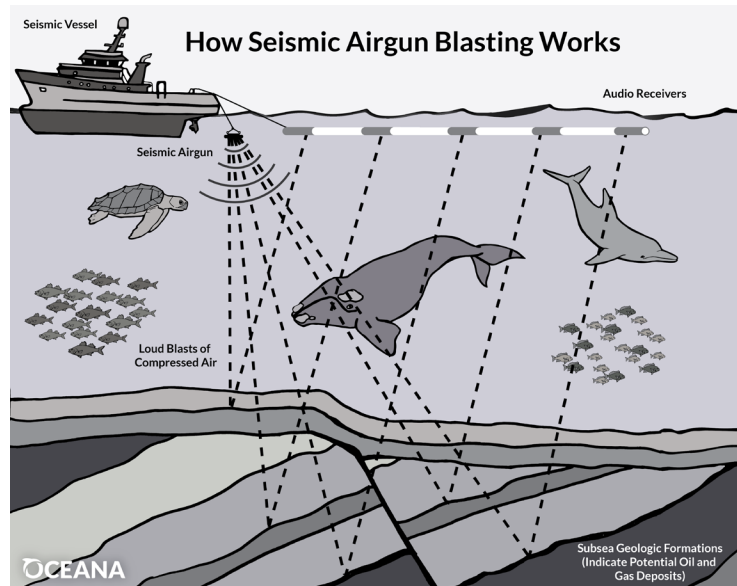
Seismic airgun blasting for oil and gas along the Atlantic coast threatens healthy marine resources that support over 1.5 million jobs and generate nearly \$108 billion in GDP through tourism, fishing and recreation.¹³ Risking the existing clean coast economy to *potentially* locate and extract very little oil and gas would be a



permanent mistake. In total, the Atlantic's economically-recoverable reserves would only meet domestic oil demand for seven months and gas demand for six months.¹³ The opposition to seismic airgun blasting is bipartisan and widespread, including more than 250 East Coast municipalities, over 1,600 elected officials, and an alliance representing over 43,000 businesses and 500,000 fishing families.¹⁴

Danger of Seismic Surveys

An extensive and growing body of research demonstrates the serious threat of seismic airgun blasting to marine animals.¹⁵ Airgun noise can reduce catch rates for fish¹⁶ and disrupt essential behaviors in marine mammals, like dolphins and whales.⁴ For marine animals, sound plays an essential role in feeding, mating, communicating and avoiding predators. The threats of underwater noise to marine life are well-documented, including stress, injury and disruption of important life functions, which lead to increased risk of death and lowered reproductive success.^{17–21} Keeping our ocean healthy and teeming with marine life is critical for tourism, fishing and recreation, important drivers of the coastal economy.



A review of the scientific literature demonstrates that seismic airgun blasting has substantial impacts on marine life:

Marine Mammals

- Seismic airgun noise disrupts feeding, predator avoidance, and social behavior – all of which can harm marine mammal populations.^{15,22,23}
- For whales, seismic surveys can interfere with finding food and lead to starvation, unsuccessful pregnancies or increased chance of death.^{3,24}
- Whales may move to avoid seismic airgun noise,^{4,23,25} potentially leaving important habitat for feeding, mating or raising young.
- Airgun noise can block or impair communication^{4,5,26,27} between mates or between mothers and calves.
- Some marine mammals spend extra energy on communication, making louder than normal sounds²⁷ that may never be heard because of airgun noise.
- Activities to find food are reduced in sperm whales²² and porpoises²⁸ after seismic surveys.



Fish

- Seismic airgun noise can injure fish hearing structures^{7,29} and cause hearing loss,³⁰ leaving fish unable to use sound for communicating, finding food or avoiding predators.
- In North Carolina, the number of active reef fish dropped over 75 percent during a seismic survey almost five miles away.³¹
- Seismic airgun noise causes behavioral changes in swimming and habitat use.^{29,31-34} Fish may move to avoid the noise, potentially leaving high quality habitat with abundant food or moving into places with more predators.
- Fish show alarm responses³⁵ and experience increased stress³⁶ with airgun noise, compromising the health of the fish and altering normal behavior.
- For some commercially and recreationally important fish species such as cod and haddock, catch rates can decrease by as much as 80 percent after seismic airgun blasts.^{16,37,38}

Sea Turtles

- Sea turtles swim erratically to avoid seismic airgun noise,^{29,39} spending energy on escape maneuvers.
- Sea turtles are at risk of hearing damage or loss from airgun noise, and displacement from high quality habitat.⁴⁰

Invertebrates (e.g. shellfish and zooplankton)

- A single seismic airgun can cause massive mortality in zooplankton – the base of the marine food web.²
- Seismic airgun noise causes increased mortality in scallops⁴¹ and can damage the immune system of lobsters.⁴²
- Airgun noise delays growth and causes body abnormalities in young scallops.⁶
- Squid show alarm near seismic airguns.^{29,33} Moving to avoid the noise means potentially wasting energy or leaving habitat that has abundant food and safety from predators.

Visit www.oceana.org/BlockTheBlast to join the fight to protect the Atlantic coast from the threat of seismic airgun blasting.



Sources:

- Hildebrand J (2009) Anthropogenic and natural sources of ambient noise in the ocean. *Marine Ecology Progress Series* 395: 5–20. doi: 10.3354/meps08353
- McCauley RD, Day RD, Swadlow KM, *et al.* (2017) Widely used marine seismic survey air gun operations negatively impact zooplankton. *Nature Ecology & Evolution* 1: 0195. doi: 10.1038/s41559-017-0195
- Farmer NA, Baker K, Zeddies DG, *et al.* (2018) Population consequences of disturbance by offshore oil and gas activity for endangered sperm whales (*Physeter macrocephalus*). *Biological Conservation* 227: 189–204. doi: 10.1016/j.biocon.2018.09.006
- Castellote M, Clark CW and Lammers MO (2012) Acoustic and behavioural changes by fin whales (*Balaenoptera physalus*) in response to shipping and airgun noise. *Biological Conservation* 147: 115–122. doi: 10.1016/j.biocon.2011.12.021
- Cerchio S, Strindberg S, Collins T, Bennett C and Rosenbaum H (2014) Seismic Surveys Negatively Affect Humpback Whale Singing Activity off Northern Angola. *PLoS ONE* 9: e86464. doi: 10.1371/journal.pone.0086464
- de Soto NA, Delorme N, Atkins J, *et al.* (2013) Anthropogenic noise causes body malformations and delays development in marine larvae. *Scientific Reports* 3 doi: 10.1038/srep02831
- McCauley RD, Fewtrell J and Popper AN (2003) High intensity anthropogenic sound damages fish ears. *The journal of the acoustical society of America* 113: 638–642.
- NOAA (2018) Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Geophysical Surveys in the Atlantic Ocean. *National Oceanic and Atmospheric Administration* : 83 FR 63268.
- Nieukirk SL, Mellinger DK, Moore SE, *et al.* (2012) Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999–2009. *The Journal of the Acoustical Society of America* 131: 1102–1112. doi: 10.1121/1.3672648
- NOAA (2018) Biological Opinion on the Bureau of Ocean Energy Management's Issuance of Five Oil and Gas Permits for Geological and Geophysical Seismic Surveys off the Atlantic Coast of the United States, and the National Marine Fisheries Services' Issuance of Associated Incidental Harassment Authorizations. *Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration* doi: 10.25923/t4qs-jc72
- NOAA (2019) 2019 Preliminary South Atlantic Commercial Landings | NOAA Fisheries. Available: /2019-preliminary-south-atlantic-commercial-landings. Accessed Feb 25, 2019.
- NOAA (2018) Environmental Assessment: Issuance of Five Incidental Harassment Authorizations to Take Marine Mammals Incidental to Geophysical Surveys in the Atlantic Ocean. Office of Protected Resources, National Oceanic and Atmospheric Administration.
- Oceana (2018) Clean Coast Economy. In: *Oceana USA*. Available: <https://usa.oceana.org/publications/reports/clean-coast-economy>. Accessed Feb 25, 2019.
- Oceana (2015) Grassroots Opposition to Offshore Drilling and Exploration in the Atlantic Ocean and off Florida's Gulf Coast. In: *Oceana USA*. Available: <https://usa.oceana.org/climate-and-energy/grassroots-opposition-offshore-drilling-and-exploration-atlantic-ocean-and>. Accessed Feb 25, 2019.
- Nowacek DP, Clark CW, Mann D, *et al.* (2015) Marine seismic surveys and ocean noise: time for coordinated and prudent planning. *Frontiers in Ecology and the Environment* 13: 378–386.
- Engås A, Løkkeborg S, Ona E and Soldal AV (1996) Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). *Canadian Journal of Fisheries and Aquatic Sciences* 53: 2238–2249. doi: 10.1139/cjfas-53-10-2238
- Rolland RM, Parks SE, Hunt KE, *et al.* (2012) Evidence that ship noise increases stress in right whales. *Proceedings of the Royal Society B: Biological Sciences* 279: 2363–2368. doi: 10.1098/rspb.2011.2429
- Forney K, Southall B, Slooten E, *et al.* (2017) Nowhere to go: noise impact assessments for marine mammal populations with high site fidelity. *Endangered Species Research* 32: 391–413. doi: 10.3354/esr00820
- Frantz A (1998) Does acoustic testing strand whales? *Nature* 392: 29–29. doi: 10.1038/32068
- Putland RL, Merchant ND, Farcas A and Radford CA (2018) Vessel noise cuts down communication space for vocalizing fish and marine mammals. *Global Change Biology* 24: 1708–1721. doi: 10.1111/gcb.13996
- Kight CR and Swaddle JP (2011) How and why environmental noise impacts animals: an



- integrative, mechanistic review. *Ecology Letters* 14: 1052–1061. doi: 10.1111/j.1461-0248.2011.01664.x
22. Miller PJO, Johnson MP, Madsen PT, *et al.* (2009) Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico. *Deep Sea Research Part I: Oceanographic Research Papers* 56: 1168–1181. doi: 10.1016/j.dsr.2009.02.008
23. Stone AJ and Tasker ML (2006) The effects of seismic airguns on cetaceans in UK waters. *Journal of Cetacean Research and Management* 8: 255–263.
24. New LF, Moretti DJ, Hooker SK, Costa DP and Simmons SE (2013) Using Energetic Models to Investigate the Survival and Reproduction of Beaked Whales (family Ziphiidae). *PLoS ONE* 8: e68725. doi: 10.1371/journal.pone.0068725
25. Richardson WJ, Miller GW and Greene CR (1999) Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *The Journal of the Acoustical Society of America* 106: 2281–2281. doi: 10.1121/1.427801
26. Blackwell SB, Nations CS, McDonald TL, *et al.* (2013) Effects of airgun sounds on bowhead whale calling rates in the Alaskan Beaufort Sea. *Marine Mammal Science* 29: E342–E365. doi: 10.1111/mms.12001
27. Blackwell SB, Nations CS, McDonald TL, *et al.* (2015) Effects of Airgun Sounds on Bowhead Whale Calling Rates: Evidence for Two Behavioral Thresholds. *PLoS ONE* 10: e0125720. doi: 10.1371/journal.pone.0125720
28. Pirotta E, Brookes KL, Graham IM and Thompson PM (2014) Variation in harbour porpoise activity in response to seismic survey noise. *Biology Letters* 10: 20131090. doi: 10.1098/rsbl.2013.1090
29. McCauley RD, Fewtrell J, Duncan AJ, *et al.* (2000) Marine seismic surveys—a study of environmental implications. *APPEA* 40: 692. doi: 10.1071/AJ99048
30. Popper AN, Smith ME, Cott PA, *et al.* (2005) Effects of exposure to seismic airgun use on hearing of three fish species. *The Journal of the Acoustical Society of America* 117: 3958–3971.
31. Paxton AB, Taylor JC, Nowacek DP, *et al.* (2017) Seismic survey noise disrupted fish use of a temperate reef. *Marine Policy* 78: 68–73. doi: 10.1016/j.marpol.2016.12.017
32. Fewtrell JL and McCauley RD (2012) Impact of air gun noise on the behaviour of marine fish and squid. *Marine Pollution Bulletin* 64: 984–993. doi: 10.1016/j.marpolbul.2012.02.009
33. Streever B, Raborn SW, Kim KH, Hawkins AD and Popper AN (2016) Changes in Fish Catch Rates in the Presence of Air Gun Sounds in Prudhoe Bay, Alaska. *ARCTIC* 69: 346. doi: 10.14430/arctic4596
34. Hassel A, Knutsen T, Dalen J, *et al.* (2004) Influence of seismic shooting on the lesser sandeel (*Ammonodytes marinus*). *ICES Journal of Marine Science* 61: 1165–1173. doi: 10.1016/j.icesjms.2004.07.008
35. Pearson WH, Skalski JR and Malme CI (1992) Effects of sounds from a geophysical survey device on behavior of captive rockfish (*Sebastes spp.*). *Canadian Journal of Fisheries and Aquatic Sciences* 49: 1343–1356.
36. Santulli A, Modica A, Messina C, *et al.* (1999) Biochemical responses of European sea bass (*Dicentrarchus labrax L.*) to the stress induced by off shore experimental seismic prospecting. *Marine Pollution Bulletin* 38: 1105–1114. doi: 10.1016/s0025-326x(99)00136-8
37. Løkkeborg S, Ona E, Vold A and Saltaug A (2012) Sounds from seismic air guns: gear- and species-specific effects on catch rates and fish distribution. *Canadian Journal of Fisheries and Aquatic Sciences* 69: 1278–1291. doi: 10.1139/f2012-059
38. Løkkeborg S and Soldal AV (1993) The influence of seismic exploration with airguns on cod (*Gadus morhua*) behaviour and catch rates. *ICES Mar Sci Symp* 196: 62–27.
39. DeRuiter S and Larbi Doukara K (2012) Loggerhead turtles dive in response to airgun sound exposure. *Endangered Species Research* 16: 55–63. doi: 10.3354/esr00396
40. Nelms SE, Piniak WE, Weir CR and Godley BJ (2016) Seismic surveys and marine turtles: An underestimated global threat? *Biological Conservation* 193: 49–65.
41. Day RD, McCauley RD, Fitzgibbon QP, Hartmann K and Semmens JM (2017) Exposure to seismic air gun signals causes physiological harm and alters behavior in the scallop *Pecten fumatus*. *Proceedings of the National Academy of Sciences* 114: E8537–E8546. doi: 10.1073/pnas.1700564114
42. Fitzgibbon QP, Day RD, McCauley RD, Simon CJ and Semmens JM (2017) The impact of seismic air gun exposure on the haemolymph physiology and nutritional condition of spiny lobster, *Jasus edwardsii*. *Marine Pollution Bulletin* 125: 146–156. doi: 10.1016/j.marpolbul.2017.08.004