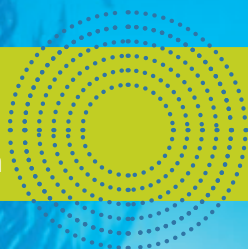




# **DROWNING IN SOUND**

It's Time for International Regulation of Ocean Noise Pollution



# Ocean Noise - A Growing Problem

Anthropogenic (human-generated) noise levels in the marine environment are increasing at an alarming rate. In some areas, noise levels have doubled every decade for the past 60 years. There is mounting concern that noise proliferation poses a significant threat to marine ecosystems and the survival of marine mammals, fish and other ocean wildlife.

Marine animals use sound to navigate, find food, locate mates, avoid predators and communicate. Flooding their world with intense sound interferes with these activities and results in serious consequences. A growing body of scientific research confirms anthropogenic noise can induce a range of adverse effects in fish, marine mammals and other ocean creatures, from disturbance to injury and death.

A review of the scientific literature revealed that at least fifty-five marine species have exhibited impacts from intense and moderate underwater noise. Noise can work cumulatively or synergistically with other environmental threats by masking the sounds necessary for animals to avoid ships or entanglement in fishing gear. Animals whose food sources have been stressed by overfishing may be unable to hear their prey because of anthropogenic noise.

## IMPACTS OF OCEAN NOISE ON FISHERIES

Three decades of controlled scientific studies indicate that intense ocean noise damages fish and, consequently, fisheries. Research so far indicates reactions to noise in 21 species of fish. Harmful effects include:

- Extensive damage to fish ears and hearing
- Reduced catch rates of 40-80 percent and fewer fish near seismic surveys reported for cod, haddock, rockfish, herring, sand eel and blue whiting
- Disruption in schooling structure, swimming behavior, and, possibly, migration in bluefin tuna
- Secretion of stress hormones in several fish species in the presence of shipping noise
- Alteration of gene expression in the brain of codfish following air gun exposure
- A significant increase in heart rate in embryonic clownfish with exposure to noise
- Negative impacts on sand eels from airguns
- Avoidance behavior in capelin and eels when exposed to noise

### Commercial Invertebrates

- A reduction in growth and reproduction in brown shrimp exposed to noise
- Bruised organs, abnormal ovaries, smaller larvae, delayed development and

- stress in snow crabs when exposed to seismic noise
  - Increased food consumption and histochemical changes in lobster after exposure to seismic noise
- Since anthropogenic ocean noise can travel hundreds of miles from its source, the potential impact to fisheries from domestically unregulated foreign noise activities is immense. This could have significant effect on national economies, commercial fisheries and local fishing communities.

## IMPACTS OF OCEAN NOISE ON MARINE MAMMALS AND OTHER MARINE ANIMALS

- At least 27 species of marine mammals have responded negatively to anthropogenic noise in scientific studies
- Mortality or serious injury caused by hemorrhaging around the brain, air cavities,

- lungs and other organs in marine mammals
- Mortality or serious injury caused by the formation of nitrogen bubbles in the bloodstream, leading to embolism in marine mammals
- Temporary or permanent loss of hearing, impairing an animal's ability to perform essential life functions, such as communication, avoiding predators, avoiding vessel traffic, finding mates and catching prey
- Stranding caused by the above factors
- Avoidance behavior, which can lead to abandonment of habitat or migratory pathways and disruption of mating, feeding or nursing
- Aggressive behavior, which can result in injury
- Masking of biologically meaningful sounds, such as the call of predators or potential mates
- Depletion of prey species

Dolphins / iStockphoto



*This Cuvier's beaked whale (Ziphius cavirostris) was a victim of the 2000 Bahamas stranding event, in which 17 individuals from several whale species stranded after naval exercises involving the use of active sonar.*



# What is the Source of the Noise?

Sources of anthropogenic ocean noise include the use of explosives, oceanographic experiments, geophysical research, underwater construction, ship traffic, military active sonar, and air guns used for oil and gas exploration, as well as oil drilling and shipping activities.

## EXPLOSIVES

Explosives are detonated in the ocean by the military, scientific researchers, and the oil and gas industry for destruction purposes, seismic exploration or testing equipment—such as ship-shock trials, whereby ships are deliberately struck with explosives to test their durability. Explosions are created by chemical devices; they cause extremely high noise levels in the wideband frequency range and are characterized by rapid rise times.

## SEISMIC AIRGUNS

Airgun arrays are used primarily for oil and gas exploration and research purposes. The airguns produce sound by introducing air into the water at high pressure, usually directed toward the sea floor, with up to 20 guns being fired in synchrony, while “streamers” of hydrophones listen for echoes. Seismic surveys with airguns can last for many weeks at a time. During the surveys, every airgun in the array produces a pulse of noise lasting 20 to 30 milliseconds which is repeated every 10 seconds, often for 24 hours a day.

## MILITARY SONAR

Active sonar is used by military vessels during exercises and routine activities to hunt for objects in the path of the vessel. These Mid-Frequency Active (MFA) and

Low-Frequency Active (LFA) sonar systems usually emit 100-second-long “pulses” of sound that can be deployed for hours and are designed to focus as much energy as possible in narrow ranges in a horizontal direction. LFA sonar is a type of long-range surveillance sonar that saturates thousands of cubic miles of ocean with sound. Frequencies commonly used by sonar systems range from around 0.1 to 10 kHz, with source levels in excess of 230 decibels.

## SHIP TRAFFIC

Ships produce noise that generally falls in the low frequency band, between 10 Hz and 1 kHz—capable of propagation over immense distances in all directions. These low frequencies coincide with the frequencies used, in particular, by baleen whales, fish, seals, sea lions and dolphins for communication and other biologically important activities. Ships generate sound primarily by propeller action, hull mounted machinery,



Photos: iStockphoto

*Large vessels are the primary source of the rapidly rising level of ocean noise that falls within the frequency range some marine mammals and fish use to communicate. This interferes with their ability to interact and conduct essential biological functions, including finding food and mates and avoiding predators.*

and hydrodynamic flow over the hull and the flexing of the hull. Over 90 percent of world trade is transported by ship, effectively producing an ever-present and rising aural “fog” that masks crucial natural sounds and is the most pervasive source of ocean noise today. It is generally accepted that there is a relationship between vessel speed and noise.

**“The evidence of sonar causation [of whale beaching] is, in our opinion, completely convincing and...there is a serious issue of how best to avoid/minimize future beaching events.”**

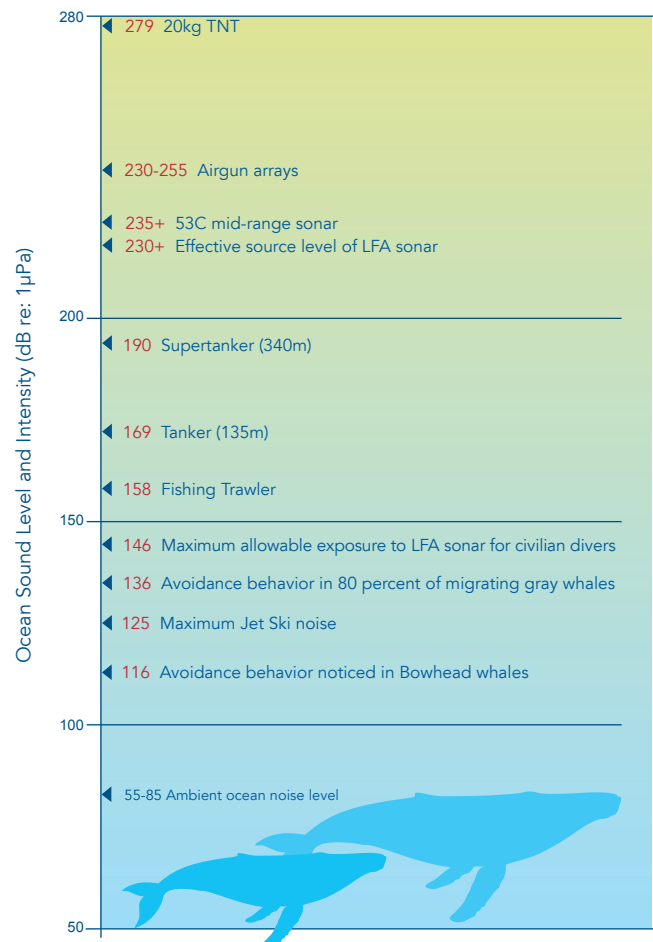
— Active Sonar Waveform, JSR-03-200, June 2004, under commission by the U.S. Office of Naval Research

## Anthropogenic Ocean Noise is Loud

Sound energy is measured in decibels (dB) relative to the threshold of human hearing. The decibel scale is logarithmic, which means 20dB is not twice as loud as 10dB, but

10 times more sound energy, and 30dB is 100 times more. In the table below, the supertanker produces over 100 times more sound energy than the tanker.

### Comparative Scale of Known Ocean Noises and their Noise Levels



## A Growing International Consensus on Regulating Ocean Noise

Although noise is a recognized form of pollution, sources of noise in the marine environment are not regulated at an international level. In the past few years, however, international institutions have begun to recognize the threat intense ocean noise poses to marine life. In response, there have been calls for precaution in the use of anthropogenic ocean noise.

The United Nations (UN) Convention on the Law of the Sea (UNCLOS) is the most far-reaching treaty governing the global marine environment, and it has been partially adopted into common law. UNCLOS already provides a solid basis for treating harmful, human-generated noise as a form of pollution that must be reduced and controlled. The agreement defines the term “pollution” as “the introduction by man, directly or indirectly, of substances or energy into the marine environment..., which results or is likely to result in such deleterious effects as harm to living resources...” (Art. 1(1) (4)).

### AUGUST 2003, DECEMBER 2006 AGREEMENT ON THE CONSERVATION OF SMALL CETACEANS OF THE BALTIC AND NORTH SEAS (ASCOBANS)

ASCOBANS recognized the dangers of underwater noise pollution in 1994 when its Conservation and Management Plan was implemented, setting forth mandatory conservation mea-

sures to be applied to cetaceans, including “the prevention of... significant disturbance, especially of an acoustic nature.” In 2003, ASCOBANS went further by passing a resolution requesting parties to take steps to reduce the impact of noise on cetaceans from seismic surveys, military activities, shipping vessels, acoustic harassment devices and other acoustic disturbances. In 2006, at its fifth meeting, ASCOBANS passed a second resolution on ocean noise, requesting that member states, *inter alia*, introduce guidelines on measures and procedures for seismic surveys, in order to “minimise risks to small cetaceans” and “develop...effective mitigation measures...to reduce disturbance of, and potential physical damage to, small cetaceans.”

### JUNE 2004 INTERNATIONAL WHALING COMMISSION (IWC)

The Scientific Committee of the IWC stated that there is now compelling evidence implicating anthropogenic sound as a potential threat to marine mammals, and that this threat is manifested at both regional and ocean-scale levels that could impact populations of animals. The report calls for multinational cooperation to monitor ocean noise, and to develop basin-scale and regional noise budgets.





#### **OCTOBER 2004**

##### **THE EUROPEAN PARLIAMENT**

The European Parliament voted overwhelmingly to adopt a resolution calling on member states to urgently restrict the use of high-intensity sonar in waters under their jurisdiction until a global assessment of their cumulative environmental impact on marine mammals, fish and other marine life has been completed. The European Parliament also called upon its member states to set up a Multinational Task Force to develop international agreements regulating noise levels in the world's oceans.

#### **NOVEMBER 2004**

##### **THE WORLD CONSERVATION UNION (IUCN)**

The IUCN adopted a resolution recognizing noise as a form of pollution and calling on member governments to apply the “pre-

cautionary principle” in assessing the impacts of noise generated by commercial, military and industrial activities. The resolution also entreated governments to avoid the use of powerful noise sources in habitats of vulnerable species and in areas where marine mammals or endangered species may be concentrated, as well as to work through the UN “to develop mechanisms for the control of undersea noise.”

#### **NOVEMBER 2004**

##### **AND OCTOBER 2007**

##### **AGREEMENT ON THE CONSERVATION OF CETACEANS OF THE BLACK SEA, MEDITERRANEAN SEA AND CONTIGUOUS ATLANTIC AREA (ACCOBAMS)**

The first resolution adopted by ACCOBAMS contracting parties recognized man-made ocean noise as a dangerous pollutant that can disturb, injure and kill whales and other marine species.

It called on member nations to avoid any use of anthropogenic noise in habitats of vulnerable species and in areas where marine mammals or endangered species may be concentrated; to intensify national and international research on the issue; to develop alternative technologies; and to require the use of best available control technologies and other mitigation measures, in order to reduce adverse impacts. A subsequent resolution adopted in 2007 urged parties to act in accordance with a set of principles to reduce noise impacts. It also established a Working Group to develop tools to assess the impact of anthropogenic noise on cetaceans and to elaborate measures to mitigate the impacts.

#### **JUNE 2005 ONWARDS**

##### **UNITED NATIONS**

Noise has been recognized as a growing threat by the UN since June 2005. At successive meetings discussing oceans and the law of the sea—including biodiversity, fisheries, ecosystem approaches and genetic marine resources—noise has been discussed as a threat to the marine environment. In his report to the General Assembly in July 2005, the UN Secretary General listed anthropogenic underwater noise as one of five “current major threats to some populations of whales and other cetaceans,” and also included noise as one of the 10 “main current and foreseeable impacts on marine biodiversity” on the high seas.

The General Assembly has responded by passing successive resolutions that encourage “further studies and consideration of the impacts of ocean noise on marine living resources” (2005, 2006 and 2007), and also “requesting the Division [DOALOS] to compile the peer-reviewed scientific studies it receives from Member States and to make them available on its website” (2006 and 2007).

#### **APRIL 2008**

##### **INTERNATIONAL MARITIME ORGANIZATION**

The IMO has recognized the harmful effects of ship-generated ocean noise and invited IMO governments to participate in the ongoing dialogue on potential adverse impacts associated with vessel noise and their potential mitigation (MEPC 57 (2008)).

#### **MAY 2008**

##### **EUROPEAN UNION**

The EU Marine Strategy Directive represents the first international legal instrument to explicitly include man-made underwater noise within the definition of pollution (Article 3(8)), which needs to be phased out in order to achieve the good environmental status (GES) of European marine waters by 2020 (Article 1). The Directive lists “the introduction of energy, including underwater noise, at levels that do not adversely affect the marine environment” among the criteria to achieve the GES (Annex I (11)) and sets out clear obligations for member states to address this form of pollution.

# Marine Mammal Strandings Connected with Noise Pollution



## EVENTS CORRELATED TO KNOWN SONIC ACTIVITY

### A) Hanalei Bay, Hawaii (2004)

- US Navy maneuvers
- 1 melon-headed whale
- Abnormal behavior by up to 200 melon-headed whales

### B) Baja California (2002)

- Seismic survey using airgun array
- 2 beaked whales

### C) Haro Strait, WA (2003)

- US Navy exercise
- 15 harbor porpoises
- Acoustic-induced avoidance by orcas

### D) Gulf of Alaska (2004)

- US Navy exercise
- 6 beaked whales

### E) Galapagos Islands (2000)

- Seismic research
- 3 beaked whales

### F) Outer Banks, NC (2005)

- US Navy exercise
- 34 pilot whales
- 1 minke whale
- 2 dwarf sperm whales

### G) Bahamas (2000)

- US Navy exercise
- 2 minke whales
- 15 beaked whales
- 1 spotted dolphin

### H) Bonaire, Lesser Antilles (1974)

- Naval explosion reported
- 4 beaked whales

### I) Virgin Islands, US (1999)

- Naval sonar reported
- 4 beaked whales

### J) Abrolhos Banks, Brazil (2002)

- Seismic Survey
- 8 humpback whales

### K) Canary Islands:

- Fuerteventura (1985)
- NATO naval maneuvers
- 13 beaked whales
- Fuerteventura (1988)
- NATO naval maneuvers
- 3 beaked whales
- 1 Northern Bottlenose whale
- Fuerteventura (1989)
- NATO naval maneuvers
- 24 beaked whales
- Fuerteventura (1991)
- Naval maneuvers
- 2 beaked whales
- Gran Canaria (2002)
- NATO Naval Exercise "Neo Tapon"
- 10 beaked whales
- Lanzarote, Fuerteventura (2004)
- NATO Naval Exercise "Majestic Eagle"
- 4 beaked whales

### L) Madeira (2000)

- Naval maneuvers
- 3 beaked whales

### M) Spain (2006)

- NATO exercise
- 4 beaked whales

### N) Corsica, France (1974)

- 3 beaked whales
- 1 Striped dolphin

### O) Gulf of Genoa, Italy (1963)

- Naval exercise
- 15 beaked whales

### P) Kyparissiakos Gulf, Greece (1996)

- NATO exercise testing
- LFA sonar, Warship reported
- 12 beaked whales

### Q) Greece (1997)

- Naval activity
- 9 beaked whales



ALINTAK/SEC/ILP/PGC

This Cuvier's beaked whale is one of four who stranded in an atypical mass stranding event in southern Spain in January 2006. The necropsy results of all four whales reported Gas and Fat Embolic Syndrome as the cause of their deaths and listed anthropogenic noise activities as the most likely cause of the mass stranding event.

## EVENTS IN THE VICINITY OF KNOWN SONIC ACTIVITY

### R) Saruga Bay, Japan

- (1978)
- 4 beaked whales
- (1987)
- 2 beaked whales
- (1990)
- 6 beaked whales

### (1967)

- 2 beaked whales
- (1978)
- 9 beaked whales
- (1979)
- 13 beaked whales
- (1989)
- 3 beaked whales

### S) Sagami Bay, Japan

- (1960)
- 2 beaked whales
- (1963)
- 8-10 beaked whales
- (1964)
- 2 beaked whales

-Sagami and Saruga Bays lie south and west of Yokosuka at the mouth of Tokyo Bay, the Command Base for the US Navy's Pacific Seventh Fleet.

It is likely that these mass mortalities are only indicators of a much larger problem. Many strandings go undiscovered, and the US National Marine Fisheries Service notes that most beaked whale mortalities from noise may go undocumented because of the small chance that injured animals will strand. There is also the danger that an entire population could disappear, as is thought to have occurred in the Bahamas stranding incident of 2000.

# Actions Needed

Because ocean noise is a form of pollution that knows no boundaries, nations must act together to protect marine living resources and ecosystems from its damaging effects. We call upon States, Intergovernmental Organizations and Non-governmental Organizations to work together to:

## **FURTHER RECOGNIZE THE PROBLEM OF ANTHROPOGENIC OCEAN NOISE WITHIN THE CONTEXT OF:**

- the United Nations General Assembly;
- Regional Seas Conventions;
- other multilateral environmental agreements and organizations; and
- national environmental policy making.

## **ASSESS THE IMPACTS OF OCEAN NOISE**

- by establishing or continuing relevant bodies such as the UN Expert Groups, to ensure that potentially harmful human activities, including anthropogenic ocean noise, are subject to Environmental Impact Assessments that address cumulative and synergistic effects on marine biodiversity; and
- on fisheries by requesting appropriate agencies, such as the FAO Fisheries and Aquaculture Department, conduct studies on the socioeconomic effects

of noise related impacts on commercial fisheries and local fishing communities.

## **WORK TOWARD ELIMINATING/REDUCING IMPACTS OF ANTHROPOGENIC OCEAN NOISE**

- by applying the Precautionary Approach to ensure that ocean noise levels are not harmful for marine life and humans;
- by developing effective guidelines to mitigate or eliminate intense noise producing activities in critical habitats including biosphere preserves, UNESCO Marine World Heritage Sites and Marine Protected Areas; and
- by considering and adopting all measures necessary to prevent, reduce and control ocean noise pollution in the marine environment.

This call for international regulation of ocean noise is expressed by over 140 NGOs across the globe represented by:

### **THE NORTH AMERICAN OCEAN NOISE COALITION (NAONC)**

Contact: Marsha L. Green, PhD  
tel. + 1-610-670-7386  
marshagreen@oceanmammalinst.org  
www.oceannoisecoalition.org

### **THE EUROPEAN COALITION FOR SILENT OCEANS (ECSO)**

Contact: Sigrid Lüber  
tel. + 41-79-475-26-87  
slueber@oceancaare.org  
www.oceancaare.org

### **THE LATIN AMERICAN OCEAN NOISE COALITION**

Contact: Dr. Yolanda Alaniz  
or Laura Rojas  
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For a complete list of coalition members and cited references, please visit: [www.oceannoisecoalition.org](http://www.oceannoisecoalition.org)



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