

ALLIANCE OF MARINE MAMMAL PARKS AND AQUARIUMS

An international organization dedicated to conservation through public display, education, and research

Ocean Literacy and Marine Mammals: An Easy Reference Guide 2007



Education Committee

Alliance of Marine Mammal Parks and Aquariums

418 North Pitt Street

Alexandria, Virginia 22314

www.ammpa.org

This Ocean Literacy Reference Guide explains how some of the things we do, sometimes without knowing it, are harmful to whales, dolphins, and other marine mammals in our oceans, and includes a collection of important messages about what each of us can do to protect these animals we so love.

The more we know about oceans and the creatures that live in them, the better job we can do in making choices to take the best actions to protect them. The following messages are for anyone who cares about living in a healthy environment. Educators can use these messages to help reach students through classroom curriculum and other activities,

The fundamentals of these messages – the Essential Principles of Ocean Literacy - were developed by a consortium of some 100 ocean science professionals and educators during a workshop sponsored by the National Oceanic and Atmospheric Administration, the National Geographic Society's Ocean for Life Initiative, the National Marine Educators Association, and the Centers for Ocean Sciences Education Excellence.

Two of the seven essential principles - numbers five and six - emphasize the importance of marine life, its environment, and their interconnectedness with human activities. If you want to help the marine mammals that live in our oceans, this is where you can make a difference!

The marine life parks, aquariums, and zoos that make up the Alliance reach over 40 million people each year with conservation education messages. We create opportunities for visitors to see unique and fascinating marine mammals and these experiences instill an awareness of conservation issues and create a respect and caring for these animals and their environments.

Whether you are a parent, grandparent, friend, teacher or someone who just wants to help protect our oceans, you have the ability help inspire a stronger, active commitment to marine mammal conservation and an understanding that each and every person can make a difference.

We greatly appreciate all the educators who helped to make this document possible for others to learn more about the ocean and all of our roles in protecting it.

Sincerely,

Education Committee
Alliance of Marine Mammal Parks and Aquariums
Essential Principles of Ocean Literacy Campaign

Essential Principles of Ocean Literacy Campaign

1. The Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of the Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean makes Earth habitable.
- 5. *THE OCEAN SUPPORTS GREAT DIVERSITY OF LIFE AND ECOSYSTEMS.***
- 6. *THE OCEAN AND HUMANS ARE INEXTRICABLY INTERCONNECTED.***
7. The ocean is largely unexplored.

KEY MESSAGES

The Dangers of Human Interactions With Marine Mammals

Swimming with and feeding dolphins and whales in the wild, and approaching marine mammals closely with boats is harmful to the animals

Marine Debris Can Injure and Kill Marine Mammals

Marine debris is a growing problem around the world. Every year, marine debris injures and kills marine mammals and other animals. Marine debris can range from soda cans and plastic bags to derelict fishing gear and abandoned vessels that pollute our oceans and waterways.

Climate Change is Destroying Habitats Essential to Marine Mammals

Global climate change is of great concern. The future of many marine mammal species depends greatly on maintaining healthy environments for the animals. Humans affect the balance of environmental conditions in many ways and we all need to take appropriate action when serious threats arise.

How Marine Mammals Use and are Affected by Sound

Our oceans are naturally very noisy places. Marine animals use sound for many important functions, people make sounds both intentionally and inadvertently – even the weather can be noisy. Each of these sound types can have various effects on marine mammals, ranging from advantageous to benign to harmful. The type of sound produced, the background (or “ambient”) noise levels, the marine animals exposed, and the general context all determine the types of effect.

The Dangers of Human Interactions With Marine Mammals

Swimming with and Feeding Dolphins and Whales in the Wild, and Approaching Marine Mammals Closely with Boats is Harmful to the Animals

Human interactions are dangerous to marine mammals.

- Repeated exposure to humans and human activities has been correlated with placing these animals at greater risk of incidental interactions with boats, propellers, and fishing activities; being harmed by people; and ingesting inappropriate or contaminated food items.
- Feeding may impact the animals' ability or willingness to forage for food, which is of particular concern for young calves and pups that need to learn foraging skills.

Human interactions are dangerous because repeated exposure may lessen these animals' natural fear of humans. This can lead to:

- Depredation of catch/bait causing entanglement in fishing hooks and monofilament lines.
- Human retaliations - gunshot or knife wounds.
- Swimming too close to churning boat propellers and become fatally injured.

Marine mammals that are routinely fed may become dependent on human handouts.

- Bait, non-native fish species, and spoiled fish may harm their digestive systems.
- Human food may also lead to serious digestive problems.
- These animals may starve if not provided with the handouts they expect.

Harassing, feeding and swimming with wild marine mammals may disturb their natural behavior

- High boat traffic may separate mothers from calves, causing unnecessary stress to the pair.
- Calves will not survive if their mothers compete with them for handouts or do not teach them successful foraging strategies.
- Marine mammals may bite when they are angry, frustrated or afraid. Therefore, a recommended viewing distance of at least 50 yards should be observed at all times.

Marine Debris Can Injure and Kill Marine Mammals

Marine debris is a growing problem around the world. Every year, marine debris injures and kills marine mammals and other animals. Marine debris can range from soda cans and plastic bags to derelict fishing gear and abandoned vessels that pollute our oceans and waterways.

Key messages on how to decrease marine debris:

- Please dispose of all trash, including plastic lids, straws, plastic bags, cigarettes, and bottle caps in proper waste receptacles as they may pose a threat to marine animals.
- Participate in local beach, river, and lake clean-ups. Since all waterways lead to the ocean, you can help reduce amounts of debris by picking up trash along beaches, rivers, and lakes.
- Dispose of monofilament fishing line properly by using monofilament recycling containers at your local pier. If recycling containers are not available, place monofilament line into proper trash receptacles. If the monofilament gets caught on something, it is best not to cut the line but to free the line and dispose all of it properly.
- Find alternatives to balloon releases as balloons can travel great distances and be mistaken for food by marine animals. Dispose of plastic bags (both shopping and baggie) as they can also be mistaken for food. Use canvas bags instead of plastic shopping bags when fishing.
- Cut the rings of six-pack holders. If these plastic holders make it out to sea, marine mammals and other animals can become entangled in them.

Climate Change is Destroying Habitats Essential to Marine Mammals

Global climate change is of great concern. The future of many marine mammal species depends greatly on maintaining healthy environments for the animals. Humans affect the balance of environmental conditions in many ways and we all need to take appropriate action when serious threats arise.

Climate change has the potential to affect marine mammals by:

- Melting sea ice habitats in the polar regions essential to polar bears, whales, seals, and walrus.
- Increasing ocean temperatures and sea level which in turn
 - affects the relative abundance and type of prey available to marine mammals in their migratory ranges, and
 - disrupts the animals' migratory patterns, which can also impede successful breeding
- Contributing to ocean acidification and altering the ecosystems that provide food for marine mammals.

People can help slow or reduce the effect of global climate change – and save money - by:

- Reducing their use of fossil fuels, such as oil, gas, and coal.
- Using CFL bulbs instead of incandescent light – CFL bulbs use 75% less energy.
- Turning off energy-consuming equipment when not in use.
- Walking, riding a bike, using mass-transit, or carpooling when possible.
- Purchasing automobiles or appliances that are environment-friendly.
- Making home-improvements that use less fossil fuels.

A Primer on the Greenhouse Effect and Its Relationship to Climate Change

The “greenhouse effect” is the rise in temperature that the Earth experiences because certain gases in the atmosphere (water vapor, carbon dioxide, nitrous oxide, and methane for example) trap energy from the sun. Without these gases, heat would escape back into space and Earth’s average temperature would be about 60 degrees Fahrenheit colder. Because of how they warm our world, these gases are referred to as greenhouse gases. The name is derived from greenhouses, which are used to grow plants, especially in the winter. Greenhouses work by trapping heat from the sun. Scientists think that the things people do that send greenhouse gases into the air are making our planet warmer.

<http://www.epa.gov/climatechange/kids/change.html>

<http://www.ncdc.noaa.gov/oa/climate/globalwarming.html>

How Marine Animals Use and Are Affected by Sound

Our oceans are naturally very noisy places. Marine animals use sound for many important functions, people make sounds both intentionally and inadvertently – even the weather can be noisy. Each of these sound types can have various effects on marine mammals, ranging from advantageous to benign to harmful. The type of sound produced, the background (or “ambient”) noise levels, the marine animals exposed, and the general context all determine the types of effect.

- Most marine animals (including marine mammals) use sound for important life functions, including:
 - Finding food/prey
 - Attracting mates
 - Avoiding predators
 - Orienting within their environments and/or navigating long distances
 - Communicating with members of the same species

- Although some sounds can be benign, certain noises can harm marine mammals by:
 - Altering their natural behavior in ways that affect their feeding, breeding, or survival
 - Interfering with hearing important sounds like the approach of a predator (masking)
 - Causing hearing loss (temporary or permanent) or tissue damage
 - Frightening and/or disorienting them, which could cause them to strand on a beach

- Natural sounds come from:
 - Waves
 - Earthquakes
 - Lightning – it strikes the ocean 25 million times each year
 - Precipitation (rain and hail) and cracking sea ice
 - Even marine life – shrimp, fish, whales

- Humans create sound in the oceans as well.
 - Vessels of all sizes and other forms of transportation
 - Research and exploration
 - Oil and gas exploration and production
 - Military activity (sonars, explosions)
 - Construction and dredging

Most marine animals (including marine mammals) use sound for important life functions

Most marine animals, including marine mammals, use sound for important life functions. In fact, hearing is often the primary sensory system for many marine animals rather than sight. This is

especially true because it is very dark and murky in deep waters. While light may be limited underwater, sound travels much farther and faster in the ocean environment than it does in air. Consequently, vision is generally more restricted as a sense than hearing, essentially due to the physics of water.

Some of the ways in which marine animals use sound are:

- Finding food
 - Many toothed whales and dolphins will echolocate (send sound waves out into the water and listen to the echoes that return) to find prey. This is similar to the way humans use sonar.
 - Conversely, some cetaceans listen for sounds made by their prey, and remain silent in order to hear, locate and catch their meals. This technique is termed “passive listening.” Some marine mammals that do not use specialized echolocation systems to find food (like pinnipeds) likely use passive listening as one way of detecting prey.
- Finding and attracting mates
 - Many marine animals will produce sounds in order to attract a mate or interact with competitors in breeding areas.
 - Many species have specific sounds that are associated with reproductive activities
- Avoiding predators
 - If a predator makes any sounds at all (from swimming or for their own communication), their prey can often hear them coming long before they can see them.
- Navigating/Orienting
 - Sound is one of the most important tools for orienting and navigating through an environment that may be completely dark. Many marine mammals migrate great distances to breed, find food, mate, and give birth. Scientists think that listening to environmental sounds (like waves from distant shore) may be an important part of these complex migrations.
- Communicating
 - Just like people, marine mammals communicate using sound, which is important to their social dynamics.
 - All marine mammals that have been studied use sounds to some extent in order for mothers to maintain or re-establish contact with their young, sometimes in very crowded conditions like on pinniped rookeries.

Although some sounds can be benign, certain noises can harm marine mammals by:

- Altering their natural behavior
 - Some man-made sound may not cause any observable responses from marine mammals, while other sounds may cause subtle changes in diving, surfacing, or

vocalization patterns. Changes in behavior as a result of noise can have serious consequences for populations if it causes significant disruption of migration, feeding, breeding, or other critical activities.

- Preventing them from hearing important sounds like the approach of a predator (masking)
 - Masking: Loud sounds may prevent an animal from hearing important sounds like the approach of a predator, communication calls made by and used to locate their mates/partners/offspring, or even hearing and locating prey items. Marine mammals that use echolocation for a variety of things including navigation may not be able to hear the returning echoes if they are masked by human sounds that are of similar frequency (pitch).
- Causing hearing loss (temporary or permanent) or tissue damage in marine animals
 - Hearing Loss (temporary or permanent): Depending on how loud a sound is, how close the source is, and its frequency range, sounds can have short- or long-term effects on the animal's ability to hear. The relationship between temporary and permanent hearing loss is not well known in mammals, even in people.
 - Tissue Damage: Some very loud noises can actually cause physical damage to the anatomy of marine animals, including in tissues other than hearing organs. This tissue damage may even result in the death of an animal. This is one of the newest and least well-understood areas of the adverse effects of noise.
- Disorienting them, which could cause them to strand on a beach
 - Because of many animals' dependence on sound for navigation and orientation, man-made noise in the sea can actually disorient an animal and limit its ability to navigate. This may cause animals to enter habitats that are too shallow or even to strand on a beach.

Natural sounds in the ocean are made by waves, earthquakes, lightning, precipitation, cracking sea ice, and even marine life – shrimp, fish, whales

Click on the following links to hear what it sounds like underwater:

- Waves
 - **Listen Here:** <http://www.dosits.org/gallery/othrnr1/5.htm>
 - **Fun Fact:** The noise from a wave is actually produced by the bursting of many bubbles!
- Earthquakes
 - **Listen Here:** <http://www.dosits.org/gallery/othrnr1/3.htm>
 - **Fun Fact:** Sounds from an underwater earthquake can be heard thousands of miles away!
- Rain
 - **Listen Here:** <http://www.dosits.org/gallery/othrnr1/2.htm>
 - **Fun Fact:** Smaller raindrops produce louder noises than larger rain drops!
- Lightening
 - **Listen Here:** <http://www.dosits.org/gallery/othrnr1/4.htm>
 - **Fun Fact:** Lightning strikes the ocean 25 million times each year!
- Marine Life
 - Shrimp
 - **Listen Here:** <http://www.dosits.org/gallery/inverts/2.htm>
 - **Fun Fact:** A snapping shrimp produces its “snap” as a way to stun its prey, deter predators, and communicate with others!
 - Fish
 - **Listen Here:** <http://www.dosits.org/gallery/fishnbay/9.htm>
 - **Fun Fact:** Croakers will “croak” as a courtship display or when threatened!
 - Whales
 - **Listen Here:** <http://www.dosits.org/gallery/marinemm/2.htm>
 - **Fun Fact:** The songs of the humpback whale are exclusively produced by the males!
 - Dolphins
 - **Listen Here:** <http://www.dosits.org/gallery/marinemm/6.htm>
 - **Fun Fact:** Each dolphin creates a “signature whistle” that uniquely identifies it to other dolphins!

Humans create sound in the oceans as well

Human-generated sounds are called “anthropogenic sounds.” Because they are caused by human activities and not considered to be natural sounds, but they can contribute to (significantly in some cases) the underwater acoustic environment in which marine mammals live.

Some of the causes of man-made, anthropogenic sounds are:

Ships

Listen Here: <http://www.dosits.org/gallery/anthro/1.htm>

Fact: Large ships are one of the primary and most chronic sources of underwater anthropogenic sound. They emit primarily low frequency sound (“bass” sounds like the left side of a piano) that overlap with and mask frequencies many marine mammals (especially large whales, many pinnipeds, and most fish) produce and use to successfully survive the ocean.

Research and Exploration

Listen Here: <http://www.dosits.org/gallery/anthro/3.htm>

Fact: During offshore exploration, powerful underwater air guns release sounds that travel through the water column and penetrate the ocean floor. Sound energy is reflected back to the sea surface. Hydrophones record these sound reflections, and with the help of computers, create a three-dimensional picture of the sea floor and sub-surface layers miles beneath it. This information is used to locate oil and gas deposits and to study features of the Earth’s crust.

Outboard Motors

Listen Here: <http://www.dosits.org/gallery/anthro/6.htm>

Fact: One of the ways to minimize this source of noise pollution is to change gears more quickly because it is the prolonged changing of the gears that produces the most noise!

Torpedos

Listen Here: <http://www.dosits.org/gallery/anthro/5.htm>

Fact: The further a torpedo is from its destination, the longer the sound will be that it produces!

To hear more natural and anthropogenic sounds in the ocean, please go to:

<http://www.dosits.org/gallery/intro.htm>

END NOTES:

Learning about Sound “Frequencies”

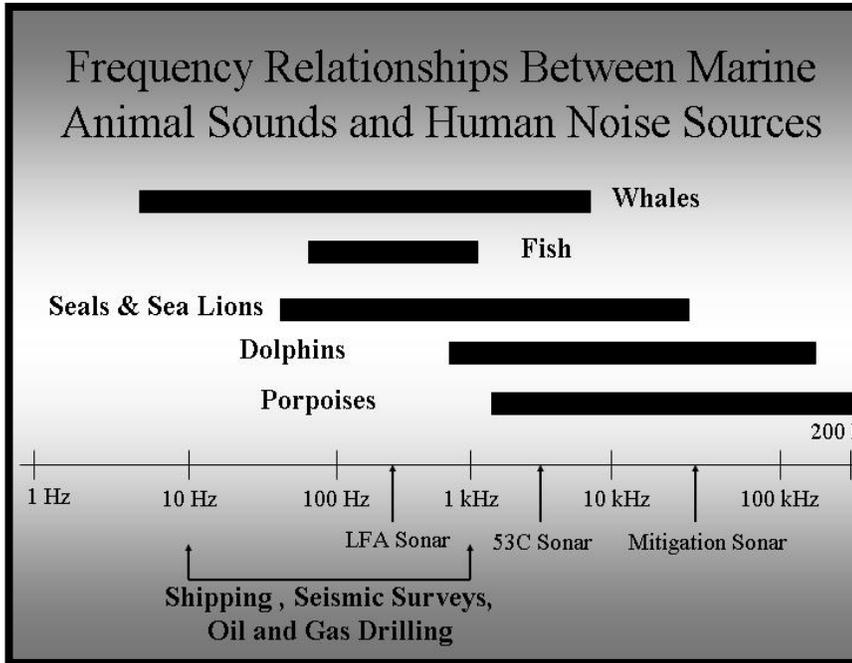
Sounds can be made by vibrating an object. We know that sound waves move through any medium (solid, gas, or liquid – anything but a vacuum) by bouncing particles into one another. How fast do sound waves move? Sound moves about 1500 meters per second in seawater. That's approximately 15 football fields end-to-end in one second!!

The frequency of a sound is also known as its pitch. The higher the frequency, the higher the pitch (think moving to the right on a piano keyboard) and the shorter its wavelength (that is, the closer the waves are together). Humans and animals hear or detect different ranges of frequencies, which is why dog whistles work but you can't hear them.

The frequency of sounds emitted into our oceans is important because of the effects on sounds on marine mammals are in large part determined by the extent to which sounds match the frequencies of those the animals use themselves. The range of hearing of marine mammals is incredibly diverse. Baleen whales hear and produce low frequency sounds. Some of these low frequency sounds can travel for thousands of miles and may allow large whales to communicate over vast distances. Dolphins on the other hand hear and produce sounds over a very wide frequency range, including the extremely high frequencies used in their sonar systems. High frequencies travel much shorter distances, but provide much greater detail (or “resolution”) about the surrounding environment. Many large shipping vessels produce noise in low frequency ranges, which may affect migrating whales, but may “seem” much quieter by dolphins due to difference in their hearing systems. Conversely, anthropogenic noise falling in higher ranges may inhibit a dolphin from navigating or finding prey, but may go completely unnoticed by a great whale.

Sound is a Complex Issue

The effect of sound on marine life is a very complex issue. Some sounds may affect some animals greatly, and others not at all. Some sounds may only affect a small fraction of a population of animals, such as those who were very close to the point of origin of the sound. Some sounds only have short term effects on marine life and then diminish over time (called “habituation”). Some sounds may affect all animals greatly, and yet the source of that sound is an important and integral part of our industrialized society. Currently there have not been enough scientific studies conducted to understand the full effects of any type of man-made sound on marine animals to determine which sounds are clearly detrimental to their feeding, reproduction, and survival and under which conditions. Continued scientific study is ongoing and will continue to investigate this issue in order to maintain the safety and protection of marine animals and their environment.



For more information on this very important topic, please visit [Discovery of Sound in the Sea at www.dosits.org](http://www.dosits.org).

Grateful appreciation to Dr. Brandon Southall, of the National Oceanographic and Atmospheric Administration's Ocean Acoustics Program (<http://www.nmfs.noaa.gov/pr/acoustics/>) and to the University of Rhode Island's Office of Marine Programs.