



Cabrillo
Marine
Aquarium

Virginia Reid Moore

Marine Research Library

@ the Cabrillo Marine Aquarium

LIBRARY PATHFINDER

THE VAST FRONTIER: TALES FROM THE DARKSIDE

The Earth's oceans cover about 70% of its surface. The average depth of the oceans is 2.7 miles deep. Many sea creatures live in these depths, including the amphipod *Phronima sedentaria*. Living in the deep sea, they endure freezing temperatures, darkness and intense underwater pressure.

The swiftest, largest, fastest-growing and most migratory fishes on Earth live in the open ocean. They range from tiny drift fish to plankton-straining whale sharks and to streamlined predators such as tuna and marlin.

All ocean animals are threatened by ocean acidification. Since the Industrial Revolution, concentrations of carbon dioxide (CO₂) in the atmosphere have increased primarily due to the burning of fossil fuels. The ocean absorbs about 30% of the CO₂ that is released into the air. As levels of atmospheric CO₂ increase, so do the CO₂ levels in the ocean, causing the seawater to become more acidic.

High acidic seawater increases hydrogen ions and reduces carbonate ions. Oysters, clams, coral and some plankton species need carbonate ions to build and maintain shells and calcium. Various fish are unable to detect predators in highly acidic waters. Ocean acidification can put the entire food web at risk on land as well as in the open ocean, as many populations of the world rely on seafood as their primary source of protein.

BOOKS

Creatures of the Deep / Erich Hoyt. 2nd ed, Updated and expanded.
Firefly Books, 2014. QL122 .H68 2014

Discoveries of the Census of Marine Life: Making Ocean Life Count / Paul V.R. Snelgrove. (*Chapter 8 : Into the Deep*, pp. 175-210, with bibliography). QH91.8 .B6 S64 2010

Fishes of the Open Ocean: A Natural History and Illustrated Guide / Julian Pepperell.
Univ. of Chicago Press, 2010. QL620 .P46 2010.

Marine Biodiversity, Climatic Variability and Global Change / Grelgory Beaugrand.
Routledge, 2015. QH91.8 .B6 B427 2015

World Ocean Census: A Global Survey of Marine Life / Darlene T. Crist.
Census of Marine Life, 2009. QH91.17 .C757 2009

Children's Books

Sea Monsters / Mary Pope Osborne. Fact Tracker, Nonfiction companion to **Magic Tree House**
#39. QL122.2 .O83 2011

Deep Sea Creatures / Kids Explore! QL122.2 .K42 DSC 2014

PERIODICAL / JOURNAL ARTICLES

“Deep-Sea Secrets” / Brian Switek. *Discover*, September 2013, pp. 58-59.

“Monsters of the Deep”. *Science Illustrated*, May/June 2009, pp. 30-37.

“Nocturnal Nautica”. / Ernie Mastroianni. *Discover*, November 2015, pp. 38-43.

“Observations on the Anatomy and Behavior of *Phronima sedentaria* (Forskål)
(Amphipoda: Hyperiidea). / Carol Diebel. *Journal of Crustacean Biology* 8(1), pp. 79-90, 1988.

“Rapid Progression of Ocean Acidification in the California Current System” /
Nicolas Gruber et al. *Science* 337, 220, (2012).

“Rising Acidity Brings an Ocean of Trouble” / Robert F. Service. *Science* 337, 146 (2012).

“Sea Butterflies’ are a Canary for Ocean Acidification” / Eli Kintisch. *Science* 344, 569 (2014).

FEATURED WEBSITES

Jellies Zone www.jellieszone.com

Beautiful website of all things Jelly, including Pacific Coast gelatinous zooplankton!
Jellies classification and identification, references, FAQs, links to additional jellies sites and a discussion
on photographing jellies are included on this site.

Jelly Watch www.jellywatch.org

Jelly Watch allows ‘jellywatchers’ to record and submit their jellies sightings. There are 2 free apps
offered, one Android and one iOS that enable users to take pictures of their sightings and send them to
Jelly Watch!

Ocean Portal – Census of Marine Life <http://ocean.si.edu/census-marine-life>

Magnificent photography and numerous links to the categories researched by the Census of Marine Life,
including the Census of Diversity of Abyssal Marine Life.

*Cabrillo Marine Aquarium is a facility of the City of Los Angeles, Recreation and Parks Department with
support from FRIENDS of CMA.*



Cabrillo Marine Aquarium

Virginia Reid Moore Marine Research Library

Library Pathfinder: Harmful Algal Blooms (HABs)

Harmful algal blooms (HAB) are a major environmental problem in all 50 states. Often known as red tides, harmful algal blooms may have severe impacts on human health, aquatic life and our economy.

Harmful algal blooms are population explosions of algae in water. HABs require plenty of sunlight, slow moving water and nutrients such as phosphorous and nitrogen. Nutrient pollution is a result of human industrial waste and agricultural runoff into the ocean and often provides excess nutrients for the harmful algae. HABs occur when water conditions foster explosive growth of a toxic algal species.

Harmful algal blooms can produce extremely dangerous toxins. These toxins bioaccumulate in the food web and can reach dangerous concentrations in the top predators. High levels of these toxins can sicken or kill people and/or animals. Domoic acid is a type of neurotoxin produced by HABs. Studies have shown how domoic acid can cause illness, seizures and death in humans and marine mammals, specifically in the California sea lion. Other HABs can raise the cost of the treatment of drinking water and put a strain on industries that depend on clean water.

Scientists predict that climate change will have many effects on freshwater and marine environments. These effects, along with nutrient pollution, might cause harmful algal blooms to occur more often, in more bodies of water and to be more intense. Several climate change factors may contribute to the growth of algal blooms. **Warmer temperatures** prevent water from mixing, allowing algae to grow faster. **Increases in salinity**, caused by droughts, can allow marine algae to invade freshwater ecosystems and kill freshwater fish. **Higher levels of carbon dioxide** can increase the growth of blue-green algae (a type of cyanobacteria HAB). **Changes in rainfall patterns** from droughts to intense storms can increase the nutrient pollution of water, which feeds the HABs. Climate change may also alter the timing and intensity of **coastal upwelling** along the west coast of the United States, bringing excess nutrients from the ocean floor which might lead to more algal blooms.

Using water and energy efficiently, using phosphate-free cleaning supplies, driving fuel efficient vehicles, washing your car on the lawn (to avoid runoff), fertilizing and watering gardens minimally, properly disposing of pet waste and planting native gardens are just a few of the many ways we can help reduce the nutrient pollution which nourishes harmful algae blooms.

BOOKS

Books for Adults

Ecology of Harmful Algae: 189 (Ecological Studies) E. Granéli (Author, Editor), Jefferson T. Turner (Author, Editor) B0017ZNVAI

Toxic Algae: How to Treat and Prevent Harmful Algal Blooms in Ponds, Lakes, Rivers and Reservoirs Paperback – December 22, 2014. 978-1505640052

Journal Articles

Anthropogenic nutrients and harmful algae in coastal waters. Keith Davidson et al. *Journal of Environmental Management*, 146: 206-216 (2014)

Form of epilepsy in sea lions similar to that in humans. Stanford University Medical Center. *Science Daily*, 18 March 2014. www.sciencedaily.com/releases/2014/03/140318113725.htm

Hippocampal neuropathology of domoic acid-induced epilepsy in California sea lions (*Zalophus californianus*). Paul S. Buckmaster, et al. *Journal of Comparative Neurology*, 2014 May 1: 552(7): 1961-1706

Ocean Climate Change, Phytoplankton Community Responses and Harmful Algal Blooms: A Formidable Predictive Challenge. Hallegraeff, Gustaaf. *Journal of Phycology*, April 2010: 46(2): 220-235.

Pathology of Domoic Acid Toxicity in California Sea Lions (*Zalophus californianus*). P. A. Silvagni et al., *Veterinary Pathology*, 42: 184-191 (2005)

Featured Websites

EPA / HABs, Climate Change
<http://www2.epa.gov/nutrientpollution/harmful-algal-blooms>

Climate Change
<http://www2.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms>

Harmful Algal Blooms Program
<http://hab.ioc-unesco.org/>

Marine Mammal Center / Domoic Acid
<http://www.marinemammalcenter.org/science/top-research-projects/domoic-acid-toxicity.html>

Marine Mammal Center / Domoic Acid
<http://www.marinemammalcenter.org/about-us/News-Room/2014-news-archives/domoic-acid-toxicity.html>

Predicting HABs
<http://oceantoday.noaa.gov/predictinghabs/>