NIEHS
National Institute of Environmental Health Sciences

OCEANS OF DISCOVERY

HOW THE STUDY OF OCEANS CAN IMPROVE HUMAN HEALTH

You would think that the place to learn about our health and how it relates to the environment would be where people live – on dry land. Then it might surprise you to know that the oceans also provide important living laboratories where scientists can develop new medicines, protect people from toxic substances, and gain a better understanding of the health consequences of exposure to environmental agents. Like humans, fish and wildlife are suffering from both man-made pollutants like lead, mercury and arsenic, and natural toxins like red tide.

In order to address these health threats, and to take advantage of the medicinal benefits that the oceans may provide, the National Institute of Environmental Health Sciences (NIEHS) is conducting and funding research to explore the impact of our oceans on human health. The centerpiece of this effort is four Centers for Oceans and Human Health, jointly funded by the NIEHS and the National Science Foundation (NSF). The Centers will bring together experts in biomedical and oceanographic sciences to study the effects of harmful algal blooms, marine pathogens, and the oceans' vast potential for drug discovery.

NIEHS-NSF Centers for Oceans and Human Health:

- **University of Washington, Seattle**
- **University of Hawaii at Manoa**
- **Woods Hole Oceanographic Institution in Massachusetts**
- **University of Miami**

Cystic Fibrosis and Red Tide[1]

In the past year, NIEHS-funded scientists at the University of Miami and the University of North Carolina at Wilmington made a series of groundbreaking discoveries in their research with Florida red tide. As the name suggests, red tide is characterized by an explosive growth of microscopic plant-like cells along the Florida coast that often turns the water a reddish-brown color. These tiny cells produce a potent chemical toxin that causes fish kills, contaminates shellfish, and creates severe respiratory irritation in people.

After identifying the most potent of the red tide toxins, the UNC Wilmington researchers discovered two anti-toxins – a man-made compound called

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ß-Naphthoyl-brevetoxin, and brevenal, a natural compound produced by the organism itself – that can block the effects of the red tide toxin on the respiratory system. Additional research on these compounds shows that they may be useful in treating the mucus build-up associated with cystic fibrosis and similar lung diseases.

Tainted Shellfish in Puget Sound

At the University of Washington, researchers are studying the toxicity of domoic acid, a naturally occurring toxin produced by marine algae that is responsible for poisoning among Puget Sound residents who consume tainted shellfish. The researchers will explore the ways in which this toxin affects human health, especially in sensitive populations such as children.

Cancer, Infectious Diseases and Tropical Microorganisms

Scientists at the University of Hawaii are developing new methods for detecting ciguatoxin, a potent marine toxin produced by microscopic algae, in fish and humans. University researchers also are studying extracts from tropical microorganisms, and their potential application in the treatment of cancer and infectious diseases.

Toxic Plankton and Seafood Poisoning

At the Woods Hole Oceanographic Institution, scientists are studying the genetic makeup of the toxic plankton Alexandrium, microscopic organisms that are responsible for recent outbreaks of paralytic shellfish poisoning in the Gulf of Maine and other coastal waters of the northeastern United States.

Toxins in Recreational Waters

Researchers at the University of Miami are conducting experiments with harmful algal blooms in subtropical ecosystems in order to identify new species and toxins that might be a threat to human health. Center investigators also are studying microbes in coastal areas, and the health effects in waters heavily used for recreational purposes.

NIEHS Marine and Freshwater Biomedical Sciences Centers:

- **University of Wisconsin, Milwaukee**
- **University of Miami, Coral Gables**
- **Oregon State University, Corvallis, Oregon**
- **Mount Desert Island Biological Laboratory, New Haven, Connecticut**

NIEHS Research on Marine Toxins

In order to address the future needs of a population that is increasingly affected by marine pollutants, the NIEHS also funds four Marine and Freshwater Biomedical Sciences Centers. There, marine scientists are using aquatic organisms to test the effects of marine toxins on human health and well-being.

Cancer Treatment and Marine Algae

At Oregon State University, scientists identified some natural products from marine algae with potent anti-cancer and anti-inflammatory properties.[2] The ultimate goal of these studies is the development of new therapies for the prevention and treatment of cancer and other human diseases.

Lead, Toxin Sensitivity and Zebrafish

Researchers at the University of Wisconsin are using zebrafish, a common home aquarium species, to identify specific genes that influence a person's sensitivity to environmental chemicals.[3] Investigators also have used fathead minnows and rainbow trout to test the effectiveness of DMSA as a treatment for children with lead poisoning.[4]

Human Disease and Algal Blooms

Scientists at the University of Miami are studying the effects of harmful algal blooms, the most notorious marine hazard to humans and animals alike. Algal blooms are characterized by rapid growth of algae in oceans, lakes and streams. Algal blooms produce toxins that can cause diseases including neurotoxic disorders from fish and shellfish consumption, and chronic liver disease.[5]

For more information on environmental factors that impact health, go to our website at: **http://www.niehs.nih.gov/**

[1] *Abraham et al. (2005) Airway Responses to Aerosolized Brevetoxins in an Animal Model of Asthma. American Journal of Respiratory and Critical Care Medicine 171:26-34.*

[2] *Marquez et al. (2002) Structure and Absolute Stereochemistry of Hectochlorin, a Potent Stimulator of Actin Assembly. Journal of Natural Products 65:866-871.*

[3] *Loucks et al. (2004) Strain-Dependent Effects of Developmental Ethanol Exposure in Zebrafish. Neurotoxicology and Teratology 26:745-55.*

[4] *Weber et al. (1997) Alterations in Neurobehavioral Responses in Fishes Exposed to Lead and Lead-Chelating Agents. American Zoology 37:354-362.*

[5] *Fleming et al. (2002) The Epidemiology of Human Illnesses Associated with Harmful Algal Blooms. Neurotoxicology Handbook, Humana Press Inc., vol. 1:363-381.*