

Oceans of Discovery

How the study of oceans and lakes can improve people's health

Oceans and lakes are more than a place to play — people depend on them for food, drinking water, and even clean air. Human health can be harmed when these waters become contaminated with toxin-producing algae or chemical pollutants.

The National Institute of Environmental Health Sciences (NIEHS), one of the National Institutes of Health (NIH), supports research to understand how people's health is affected by conditions in oceans and lakes.

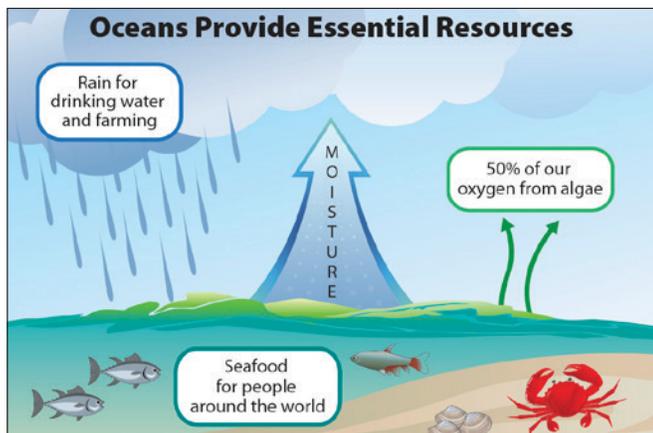
As part of this effort, NIEHS partners with the National Science Foundation (NSF) to fund two Centers for Oceans and Human Health — the Scripps Center for Oceans and Human Health in Southern California, and the Woods Hole Center for Oceans and Human Health in Massachusetts.

Harmful Algal Blooms (HABs)

Sometimes agricultural runoff, weather, and other environmental conditions in fresh and salt water promote excessive growth, or blooms, of algae. If the algae release toxins into the water or air, they are called harmful algal blooms (HABs).

People can get exposed to the toxins from HABs through fish they catch and eat, by swimming in or drinking the water, or from breathing the air near blooms.¹ People rarely get sick from HAB toxins in commercial seafood, because fisheries are closely monitored by state health officials and closed during blooms. Importantly, cooking contaminated seafood may not destroy the toxins.

HABs may become more wide-ranging, frequent, and severe due to climate change.¹ Blooms are encouraged by warmer water temperatures and heavier rains that wash excess nutrients into waterways.



Health effects of HABs

The health effects from some HAB toxins can be immediate. Eating seafood contaminated by toxins from the algae *Alexandrium* may lead to paralytic shellfish poisoning, which can cause paralysis and even death. The algae *Pseudo-nitzschia* produces domoic acid, a toxin that can cause vomiting, diarrhea, confusion, seizures, permanent short-term memory loss, or death when consumed at high levels.¹

NIEHS-funded scientists are currently studying potential long-term health effects of HABs, such as whether consuming trace amounts of domoic acid, over time, may affect brain function, especially among children or the elderly.²

Improving HAB detection

Accurate detection of HABs can help health officials protect the public while minimizing economic impacts to fisheries and recreational areas. The Woods Hole Center designed a robotic system called the Environmental Sample Processor, to remotely test seawater samples for HABs as they begin to bloom. Other NIEHS-supported researchers are developing instrumentation to detect HABs by counting individual algal cells in water samples³ or by using satellite images to monitor HABs from afar.⁴

Also, scientists are working with water treatment plants to improve HAB detection in drinking water supplies.



Most algal blooms are not harmful, but some produce toxins and can have serious health effects.

Forecasting HABs

With the frequency and severity of HABs increasing worldwide, improved prediction enables public health officials to be one step ahead of blooms. Researchers from the Woods Hole Center found that in deep waters the algae *Alexandrium fundyense* may bloom based on an internal clock, whereas in shallow waters conditions such as temperature may trigger blooms. The researchers have also found that the number of dormant cysts that form after a summer bloom can predict the extent of the next year's bloom.⁵

A promising cystic fibrosis treatment

HABs caused by the microorganism *Karenia brevis* are called red tides, because they turn the water red. Red tides can produce airborne toxins that cause respiratory irritation, especially among asthmatics.¹ Yet, sometimes during a HAB, the toxic effects suddenly go away. This observation led to the discovery of brevenal, a compound produced by *Karenia brevis* that counteracts its own toxins.⁶

Brevenal can also help clear mucus out of the lungs, and may help the treatment of cystic fibrosis. Efforts are underway to make synthetic brevenal for use as a therapeutic drug.⁷

Polluted waters

Pollution in oceans and lakes may also affect human health. Chemicals called persistent organic pollutants (POPs), which include some pesticides, flame retardants, and polychlorinated biphenyls (PCBs), are especially concerning because they don't break down in the environment and can accumulate in the food chain. NIEHS-funded scientists have found that POPs consumed in seafood can interfere with a mechanism cells use to clear foreign toxins.⁸ This may allow POPs to linger and cause damage in the body.

Also, researchers have found that in warmer conditions, such as those caused by climate change, more mercury accumulates in seafood.⁹ Mercury typically settles into water from air pollution and may interfere with brain development.

Oil spills

Oil spills can be extremely harmful to the environment and can threaten human health. After the 2010 Deepwater Horizon oil spill in the Gulf of Mexico, the NIEHS Worker Training Program ensured that approximately 150,000 workers had safety training to protect their own health as they cleaned up the spill.

NIEHS then led the five-year Deepwater Horizon Research Consortium, which formed partnerships between four universities and 45 community organizations to study whether the oil spill affected mental health, reproductive health, community resilience, and the safety of seafood for consumption. The research showed that after the spill residents in the Gulf region had more mental health problems, especially anxiety and depression.¹⁰ However, local seafood consistently had little or no oil spill-related contamination.¹¹

Also, the GuLF STUDY (Gulf Long-term Follow-up Study) was launched by NIEHS, on behalf of NIH, to track the health of workers involved in oil spill response or cleanup activities. From 2011 to 2013, nearly 33,000 individuals joined the study, making it the largest study ever conducted on the health effects of an oil spill. Scientists looked for immediate health effects in the workers, and will also evaluate their health for years to come, in case long-term health problems develop.

For more information on the National Institute of Environmental Health Sciences, go to www.niehs.nih.gov.

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