South Carolina Task on Harmful Algae Group

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NOAA's HAB Analytical Response Team

Prior to the early 1990s, information about HABs and what caused them was lacking. There was no coordinated effort dedicated to understanding HABs until 1992 when NOAA sponsored a workshop to develop the U.S. National Plan for Marine Biotoxins and Harmful Algae. As a result of the workshop, the NOAA Marine Biotoxins Program was created. An immediate priority of the Program was to develop an Analytical Response Team (ART) to provide algal toxin analytical support for unusual mortality events and human illness associated with harmful algal blooms.

Today, the NOAA Marine Biotoxins Program employs internationally renowned taxonomists, chemists, molecular biologists, toxicologists, and outreach specialists, many of whom have worked together for over ten years. Located at the Center for Coastal Environmental Health and Biomolecular Research in Charleston, S.C., the Marine Biotoxins Program's ART pools the expertise of these individuals to promptly solve any unusual mortality event associated with HABs. "The Analytical Response Team is designed on the principles of a sense and respond unit," says Tod Leighfield, coordinator for the team. "Unusual mortality events, such as the California sea lion deaths caused by *Pseudo-nitzschia* spp. in 1998, are largely unpredictable, and require early event listeners, a multi-disciplinary team of event assessors, and a team leader responsible for designing an event-specific solution."

A management team directs every step of the sample analysis and communication process, and, for each unusual mortality or HAB event, generates a report to the agency or researcher who requested the analysis. The ART works with a variety of organizations, including the U.S. Food and Drug Administration, National Marine Fisheries Service, Mote Marine Laboratory, and, closer to home, SCDNR and SCDHEC. Recently, the Delaware Department of Natural Resources and Environmental Control came to the Marine Biotoxins Program for guidance on developing its own harmful algal toxin program.

The ART uses highly sophisticated instruments and techniques, rather than animal-based tests, to analyze toxins in minute quantities with absolute identification down to the most elemental chemical composition. High-tech tools used to analyze samples for the presence of algal toxins include cell-based sensors, receptor binding assays, antibody-based assays, liquid chromotography, mass spectrometry, and magnetic resonance. The lab also cultures algae to learn more about the taxonomy of harmful species. Detailed analyses are performed on samples ranging from marine mammals, birds, and fish, to humans and algae.

For more information, contact Tod Leighfield at (843) 762-8631.

Human Health Effects of HABs

Algae are at the base of the food chain for both marine and freshwater life. Many types of algae are beneficial in a variety of ways, such as food for human consumption, animal feed and fertilizer, and pharmaceuticals. Sunlight, water temperature changes, and nutrient levels are contributing factors for the formation of algal blooms, some of which have adverse effects on fish, animals, and humans.

The S.C. Task Group on Harmful Algae is at the forefront of scientific research, human health surveillance, and public education about HABs in South Carolina. Working together on the HAB issue are, among other institutions, the NOAA National Ocean Service Marine Biotoxin Program, S.C. Department of Natural Resources (SCDNR), S.C. Department of Health and Environmental Control (SCDHEC), and the Medical University of South Carolina (MUSC). There are strict standards regulating seafood safety and water quality, and the list below is not intended to alarm, but rather to educate citizens of South Carolina about the negative human health effects of some toxin-producing HABs. To report a bloom, contact SCDNR at (800) 922-5431 or SCDHEC at (888) 481-0125. For medical information or questions, contact the MUSC Health Connection at (843) 792-1414.

Amnesic Shellfish Poisoning (ASP):
A type of poisoning caused by domoic acid, which is produced by certain diatoms such as *Pseudo-nitzschia* spp. Organisms affected include cormorants, sea lions, mussels, and scallops. If contaminated organisms are consumed, people may experience gastrointestinal and neurological symptoms. ASP is found in North America, specifically in the Pacific Northwest and Atlantic Northeast.

Ciguatera Fish Poisoning (CFP):
A type of poisoning caused by eating fish that have fed on certain dinoflagellates which produce ciguatoxin. CFP human health effects include gastrointestinal disturbance in 2-6 hours and neurological symptoms within 18 hours. CFP, usually found in reef fish inhabiting tropical waters of the Pacific and Caribbean, is becoming more problematic as tropical fish are transported to U.S. markets.

Diarrhetic Shellfish Poisoning (DSP):
A type of poisoning caused by eating shellfish contaminated with okadaic acid, which is produced by dinoflagellates such as *Dinophysis* spp. Affected organisms are mussels, oysters, and scallops. People who eat contaminated shellfish may experience sever gastrointestinal disorders including nausea and abdominal pain. DSP is found worldwide, including provinces of Canada on the eastern seaboard.

Neurotoxic Shellfish Poisoning (NSP):
A type of poisoning caused by eating shellfish that contain brevetoxins derived from the dinoflagellate *Karenia brevis*. Bottlenose dolphins, oysters, clams, and fish are some of the organisms affected by NSP. Human health symptoms include tingling and numbness, throat irritation, and muscle aches. NSP is typically found in the Gulf of Mexico, but it can be carried around the base of Florida and northward by the Gulf Stream.

Paralytic Shellfish Poisoning (PSP):
A type of poisoning caused by eating shellfish that contain saxitoxin, a toxic chemical produced by dinoflagellates such as *Alexandrium* spp. Affected

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The S.C. Task Group on Harmful Algae publishes this newsletter three times a year to share knowledge about harmful algae and communicate activities of the task group. Interested constituents include elected and appointed officials, natural resource managers, public health organizations, and the general public. Comments regarding this or future issues are welcomed. Subscriptions are free upon request.

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organisms include oysters, mussels, marine mammals, birds, and herring. Human consumption of contaminated shellfish results in a rapid onset of symptoms, including tingling and numbness, drowsiness, and, in the case of high doses, respiratory paralysis. The most widespread of all the algal-derived shellfish poisonings, PSP is found worldwide; in North America, PSP cases are in the Pacific Northwest and Atlantic Northeast.

Possible Estuary-Associated Syndrome (PEAS):

A condition associated with exposure to toxins produced by the dinoflagellate *Pfiesteria piscicida*. *Pfiesteria* is implicated in some fish kills: fish come in contact with the toxin, become sluggish, develop open sores or lesions, and die. *Pfiesteria* may also affect shellfish in the same way, however, there have been no reported human illness cases attributed to *Pfiesteria* from eating shellfish. Research continues on the effects of this dinoflagellate on fish and shellfish. *Pfiesteria* may affect humans through direct water-to-skin contact or by breathing air above the water in which the toxin is present. PEAS is found along the Atlantic Coast from Delaware to the Gulf of Mexico.

Classes of Toxin-Producing Alga

Diatom:
- Single-celled algae with cell wall composed of silica
- Produces domoic acid, a toxic chemical compound associated with Amnesic Shellfish Poisoning (ASP)
- Harmful species include *Pseudo-nitzschia multiseries* and *Pseudo-nitzschia australis*

Dinoflagellate:
- Single-celled algae with two flagella, or long, thin organelles, extending from the surface of the organism. The flagella are used for locomotion.
- Produces okadaic acid, ciguatoxin, and several other toxins. Associated with Ciguatera Fish Poisoning (CFP), Diarrhetic Shellfish Poisoning (DSP), Neurotoxic Shellfish Poisoning (NSP), and Paralytic Shellfish Poisoning (PSP)
- Harmful species include *Gambierdiscus toxicus*, *Dinophysis* spp., *Karenia brevis*, and *Alexandrium* spp.

Cyanobacteria:
- Single-celled, blue-green algae that does not have a distinct nucleus
- Produces neurotoxins, poisonous protein complexes affecting the nervous system, and, more commonly, hepatotoxins, which cause injury to the liver. Impacts human and animal health through contaminated water.
- Harmful species include *Aphanizomenon flos-aquae*, *Anabaena circinalis*, and *Oscillatoria*. Typically found in fresh water, but has been identified in marine water.

SCPMN Nets Success

In a little over a year since its inception, the South Carolina Phytoplankton Monitoring Network (SCPMN) is off to a fantastic start. Led by algae taxonomist Steve Morton and coordinated by Kate Schaefer, both of the NOAA/NOS Center for Coastal Environmental Health and Biomolecular Research (CCEHBR), the SCPMN has grown from three participating schools in Charleston County to nineteen schools in the greater Charleston area, with citizen groups in Beaufort County becoming involved as well.

"Right now we are expanding along the South Carolina coast," says Schaefer. "We hope to move farther inland over the next few years to include freshwater sampling."

Training sessions are scheduled as needed. Interested groups learn how to sample and identify phytoplankton, and are given a manual containing general algae information, a species identification key, a plankton net, a refractometer, and data sheets for recording what was found. NOAA staff helps train groups, at the collection site and in the classroom, on species identification.

To date, the SCPMN has helped scientists at the CCEHBR identify five potentially toxic species not previously known to exist in South Carolina. These include representatives of the genera *Prorocentrum*, *Pseudo-nitzschia*, *Heterosigma*, and *Akashiwo*.

Get involved in this community outreach program by contacting Kate Schaefer or Steve Morton at (843) 762-8500, or visit http://www.chbr.noaa.gov/CoastalResearch/SCPMN/SCPMNmain.htm for more information.

Information and Resources

Web sites

Harmful Algal Blooms

NOAA's Marine Biotoxins Program: http://www.chbr.noaa.gov/CoastalResearch/Whols.htm

NOAA Coastal Services Center's Harmful Algal Bloom Forecasting Project: http://www.csc.noaa.gov/crs/habf

The National Office for Marine Biotoxins and Harmful Algal Blooms at Woods Hole Oceanographic Institution: http://www.redtide.whoi.edu/hab

10th International Conference on Harmful Algae: http://www.xhab2002.com

Water Quality

S.C. Department of Health and Environmental Control: http://www.scdhec.net/water

Nonpoint Education for Municipal Officials (NEMO): http://www.nemo.uconn.edu

Publications

Harmful Algae News. The Intergovernmental Oceanographic Commission (IOC) newsletter on toxic algae and algal blooms, Tim Wyatt, Editor: http://www.ioc.unesco.org/hab/news.htm

Journal of Phycology. Dr. Patricia Wheeler, Editor: http://www.blackwellscience.com/journals/phycology

Harmful Algae. Sandra Shumway and Theodore Smayda, Editors-in-Chief: http://www.elsevier.com/locate/hal Scheduled to be published in 2002.

Other

Nature Out of Balance video and educational guide. Covers types of HABs and their effects on water quality and human health. Order from N.C. Sea Grant at http://www.ncsu.edu/seagrant

International Directory of Experts in Harmful Algae, an IOC publication: http://ioc.unesco.org/hab/data.htm

Algae-L Listserve, Mike Guiry, Moderator: http://www.seaweed.ie

S.C. Task Group on Harmful Algae Web Site Now On-line at www.scseagrant.org/schab.htm

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