

## **ORD Contributions to *Pfiesteria*, and Other Harmful Algal Bloom Research**

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In addition to supporting the Office of Water in responding to short-term problems like the recent outbreaks of the algae *Pfiesteria* in the mid-Atlantic, EPA's Office of Research and Development (ORD) also conducts long-term research on other harmful algae that occur as blooms that affect ecological and human health. This research is conducted on a wide variety of organisms in an attempt to better understand the environmental and ecological factors which contribute to these outbreaks. This work is coordinated with other federal and state agencies that have been active in recent weeks in responding to outbreaks of *Pfiesteria*. Some of ORD's activities are summarized below:

### **Grant to Dr. Joanne Burkholder**

In the spring of 1997, ORD awarded Dr. Joanne Burkholder of North Carolina State University a \$500,000 grant to:

- (1) study factors determining the impact of nutrients on optimizing growth of the *Pfiesteria*.
- (2) develop specific gene probes to enable detection of *Pfiesteria* in environmental samples.
- (3) determine the effects that *Pfiesteria* has on valuable shellfish.

### **ECOHAB (Ecology and Oceanography of Harmful Algal Blooms)**

EPA's ORD, along with the National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSF), and the Office of Naval Research (ONR) are jointly funding over a three-year period the ECOHAB interagency research program. ECOHAB research efforts include not only studies of the potentially harmful dinoflagellate *Pfiesteria*, but also other harmful algae. Following the ECOHAB 1997 competition, ORD recommended funding several studies that will contribute to better understanding harmful algal blooms and their effects on human health.

- ▶ The role of nutrients (Si, N, P) on the growth of the diatom *Pseudonitzschia* and its production of toxins harmful to humans. The results of these studies will be useful in assisting resource managers in predicting where and when a toxic bloom of this organism may occur.
- ▶ The dinoflagellates, *Prorocentrum minimum* and *Gyrodinium aureolum*, thought to have harmful effects on humans will be studied for their effects on a variety of marine organisms which feed on them (including bay scallops). This information will help to determine what organisms, (those that inhabit the ocean floor or those found in the overlying water) will be most impacted by these two toxic algae, and could result in adverse human health effects.

- ▶ The focus of other ORD/ECOHAB research are blooms of cyanobacteria (blue green algae). These blooms are increasingly more common, and can produce secondary products that impact native coral reef and seagrass communities. These products are also thought to be harmful to humans. ORD has recommended funding research on the ecology of blue-green algae that will characterize their secondary products and the potential for these organisms to impact the reef fishes which feed on them.
- ▶ The toxic dinoflagellate *Gymnodinium breve* is of concern because blooms occur almost every year in the Gulf of Mexico and as far north as North Carolina. ORD has recommended support for a ECOHAB research effort to study the fate and transport of toxic products (brevetoxins) from *Gymnodinium breve*. The research will focus on toxin distribution both during and after a bloom, as well as the fate of the toxin in water, sediment, and in other organisms.
- ▶ In order to continue the scientific progress made during ECOHAB 1997, and to better understand harmful algal blooms, ORD, NOAA, ONR, and the NSF are considering re-issuing the ECOHAB Request for Applications (RFA) during FY 1998.

#### **The National Environmental Monitoring and Research Initiative**

In support of the Committee on Environment and Natural Resources (CENR), ORD is participating in an interagency, integrated environmental monitoring effort, the National Environmental Monitoring and Research Initiative.

- ▶ The National Environmental Monitoring and Research Initiative includes a pilot project in the Mid-Atlantic region, and the CENR has produced a three-year strategy designed to improve our understanding and integration of the linkages among air, land, water, biota, and people that will contribute to better environmental decision making across the Mid-Atlantic region. Understanding these linkages is critical to determining the degree to which human development and economic needs may be sustained and balanced with environmental health needs across the region.
- ▶ In addition, this CENR pilot will add to our understanding of cause and effect of algal blooms, and allow us to better document current nutrient levels in Mid-Atlantic estuaries; thus, resulting in better management of Mid-Atlantic region coastal marine resources. This knowledge is critical not only to our understanding of *Pfiesteria* in the Chesapeake Bay area, but also that of other harmful marine organisms.

### Mid-Atlantic Integrated Assessment (MAIA)

ORD's labs at Narragansett, Rhode Island, and Gulf Breeze, Florida, are cooperating with a number of Federal and State agencies in the Mid-Atlantic Integrated Assessment (MAIA). This is a joint effort with the Chesapeake Bay Program, NOAA, National Parks Service, Delaware Basin River Commission, and individual States in the region. The project is designed to monitor the ecological condition of the estuaries of the Mid-Atlantic coast, with over 150 stations sampled during the summer of 1997.

- ▶ Although no direct monitoring for *Pfiesteria* was conducted in this project, a variety of other chemical and biological parameters were addressed. These included benthic community assemblages, nutrient chemistry, water quality, and sediment quality, all of which are important in understanding factors contributing to outbreaks of *Pfiesteria* and other harmful algae in the Chesapeake Bay region.
- ▶ In 1998, MAIA will expand its sampling to include fish sampling protocols to obtain measures of fish health. Included during the summer sampling were six sites in the Pocomoke River and one site at the mouth of the Manokin River, both of which have experienced dinoflagellate blooms this summer, as well as selected sites within other small shallow estuaries.
- ▶ The data from the Pocomoke and Manokin rivers will be used to improve our understanding of, among other things, the roles of nutrients and sediments and their relative contributions to environmental problems in these small estuaries. One goal of this study is to identify other waters that are at risk of *Pfiesteria* outbreaks based on the characteristics of those systems.

### Human Health Research

Staff from ORD's lab at Research Triangle Park, North Carolina, have been involved in the human health aspects of *Pfiesteria*. Since the initially-recorded outbreaks of *Pfiesteria* in the Pamlico and Neuse River (North Carolina), the poisoning of North Carolina State (NCS) researchers Drs. Burkholder and Glasgow, and the resulting neurotoxicological effects on these and other NCS researchers, ORD staff have met with Dr. Burkholder and Duke University researchers to discuss *Pfiesteria*, research needs, and collaborative research.

- ▶ As a result of this collaboration, the results of preliminary research by Dr. Levin (Duke University) into the potential learning and memory deficits caused by *Pfiesteria* indicated that acute exposures of rats to crude cell extracts of *Pfiesteria* caused a learning deficit.
- ▶ In 1996, ORD funded Dr. Levin (\$25,000) to conduct additional research to systematically replicate the results of these initial experiments. This work is nearing completion and a final report is due November, 1997.

### **Fish Kill Research**

ORD's lab at Gulf Breeze, Florida, is currently working collaboratively with the U.S. Geological Survey (USGS) to investigate fish kills in the Pocomoke River that are believed the result of an outbreak of *Pfiesteria*.

- ▶ Because ORD has concerns about the effectiveness of procedures currently used to identify the causative agent in outbreaks of harmful algae, the USGS will be performing a series of immune function assays to assess any probable association with *Pfiesteria*. ORD is conducting histopathological examinations of seven species of fish from surrounding fish kill areas in an attempt to identify the causes, and to determine if *Pfiesteria* is present.

### **Harmful Algal Bloom Workshop**

In support of its role as ORD's representative to the Interagency Committee for Harmful Algal Blooms, ORD's lab at Gulf Breeze, Florida, in collaboration with ORD's lab at Research Triangle Park, North Carolina, are sponsoring a Harmful Algal Bloom Workshop which will address *Pfiesteria*, on October 6-7, 1997 in Pensacola Beach, Florida.

- ▶ While the immediate focus of concern is on the potentially harmful dinoflagellate *Pfiesteria*, there is a much larger context in which to view the *Pfiesteria* problem; harmful blooms of a number of other organisms. There are many different types of toxins potentially harmful to humans that are produced by a variety of other water-borne organisms.
- ▶ At this upcoming workshop, health and ecological scientists from federal agencies, universities, and state environmental departments will be assembled to identify research needs and information gaps. Based on input from this workshop, EPA's ORD will draft a long-term research strategy for Harmful Algal Blooms that will include the critical research needs identified, in part, during the workshop.