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# BioScience

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## *Pfiesteria and the Chesapeake Bay*

**T**he restoration of the Chesapeake Bay is one of the world's most ambitious efforts to rehabilitate and manage a large ecosystem. Alarm over deteriorating environmental quality and declining resources during the 1970s led to identification of nutrient over-enrichment (eutrophication) and overexploitation of fisheries as the estuary's most pervasive problems. In 1983 the states of Maryland, Pennsylvania, and Virginia; the District of Columbia; and the federal government signed an agreement to arrest this deterioration and restore the bay. In 1987, these regional partners made a landmark commitment to reduce the controllable sources of nitrogen and phosphorus entering the bay by 40 percent by the year 2000. Many hundreds of millions of dollars have since been spent for treatment of sewage, subsidies, and other techniques aimed at improving agricultural management practices and restoring wetland and riparian habitats.

In 1997, as agencies, treatment plant operators, farmers, scientists, and citizens worked to meet the goal for 2000, the unexpected happened. Reports began to stream in about fish kills, fish with lesions, and health complaints from fishers and others in contact with the waters of the Pocomoke River and other tidal tributaries along the eastern shore of the Chesapeake. Concern soon focused on the possibility of toxic outbreaks of *Pfiesteria piscicida*, a dinoflagellate that had grabbed headlines in North Carolina earlier in the 1990s. *Pfiesteria* capable of killing fish had been reported from the Chesapeake a few years earlier, but had so far been blamed for large fish kills and harmful effects on human health only in North Carolina. The size of the incidents in the bay area was small, but because of the large public, political, and scientific commitment to the Chesapeake restoration, the impact on public policy was great.

Fortunately, because of the close working relationships among scientists and environmental managers developed through the Chesapeake Bay Program, the scientific advisory committees formed in response to the *Pfiesteria* threat were able to coordinate efforts and give valuable advice to political leaders. Medical researchers documented impairment of short-term memory in a few humans exposed to the putative *Pfiesteria* outbreaks. Scientists worked with the federal agencies and regional congressional delegation to develop new, competitive support for research on *Pfiesteria*. As a result, research is advancing along a broad front from molecular biology to ecology to epidemiology to agronomy. Unknowns and controversies remain, but scientists have developed new identification tools for *P. piscicida* and related organisms and significantly advanced understanding of the ecology of the dinoflagellate and its mode of toxic action.

Both in North Carolina and in the Chesapeake, high densities of *Pfiesteria* are found in shallow estuarine environments highly enriched by nutrients. The *Pfiesteria* incident brought to light the fact that, despite significant efforts to implement best management practices, nutrient inputs from the heavily agricultural watersheds of the Chesapeake's eastern shore had not declined. In particular, rapid growth of the poultry industry on the Delmarva Peninsula resulted in an overconcentration of poultry wastes. Inputs of nitrogen from surface and groundwater were high, and soil phosphorus concentrations had built up far beyond crop requirements. Hence in 1998 Maryland enacted the first law in the country to make agricultural nutrient management mandatory; Virginia and Delaware followed with their own statutes.

*Pfiesteria* and the realization that degraded water quality could endanger human health clearly raised the stakes in the struggle to restore the Chesapeake. Partners in the Chesapeake Bay Program—governments, scientists, managers, and concerned citizens—are working hard to meet the ante.

DONALD F. BOESCH

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(Editor's note: A special section of this issue of *BioScience*, beginning on page 827, is devoted to articles on *Pfiesteria*.)