Sea Grant
National Sea Grant College Program

Studies Unravels Mystery Of Public Health Threat

Toxic or harmful algal blooms, commonly called "red tides," are a serious economic and public health problem throughout the United States and the world.

In the New England region, the most serious problem is paralytic shellfish poisoning (PSP), a potentially fatal human neurological disorder caused by ingesting shellfish that have accumulated toxins as they feed on dinoflagellates of the genus *Alexandrium*. These toxins also can affect marine organisms and animals throughout the food chain, and they have been linked to massive die-offs of fish and humpback whales.

For more than 10 years, the Sea Grant Program at Woods Hole Oceanographic Institution (WHOI) has provided support for a series of studies on the regional red tide phenomenon. Led by biologist Don Anderson, WHOI Sea Grant researchers have published more than 45 papers on this subject, providing a wealth of physiological, genetic and ecological information for those confronting similar problems elsewhere in the United States or the world. The WHOI program is cited by many as a model for red tide investigations.

First Findings

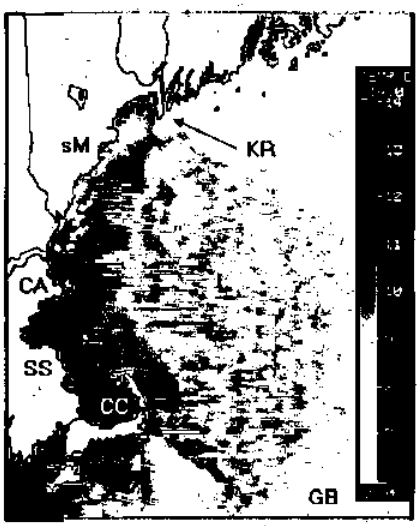
Shortly after PSP first was reported in Massachusetts in the early 1970s, Sea Grant supported Anderson and his co-workers to study *Alexandrium* ecology in Cape Cod salt ponds. The experience and information gained from these small-scale studies then led to larger, more ambitious field investigations of the widespread coastal algal-bloom phenomena responsible for PSP outbreaks in the southwestern Gulf of Maine.

With Sea Grant support, researchers at WHOI were the first to describe the dormant cyst of *Alexandrium*, a life cycle stage that allows the alga to initiate new blooms and disperse to new regions after overwintering in sediment.

These researchers also were the first to map cyst distributions throughout the region, discovering *Alexandrium* cysts in Connecticut and Long Island, N.Y., where PSP had never occurred.

Subsequent to these discoveries, researchers monitored shellfish in those areas and detected PSP at levels that could have caused serious illness and death in human consumers if quarantine notices had not been posted.

Anderson's group also identified a key hydrographic feature underlying PSP outbreaks in the coastal waters of the region. They discovered a buoyant coastal current, originating in the rivers of southern Maine. The current travels southward, carrying populations of *Alexandrium* hundreds of miles in a few weeks. The location of the plume and its associated toxic cells vary in a predictable manner with rainfall and wind, and this understanding now provides the cornerstone of a predictive capability that someday will allow regulatory officials not only to monitor the movement of the water mass using remote sensing techniques, but to predict where and when PSP outbreaks are likely to occur. This knowledge of *Alexandrium* transport and



NOAA Coastwatch sea surface temperature image, May 23, 1992, at 0300 hours local time. A warmer (darker) coastal current or plume formed principally from spring runoff from the Kennebec River (KR) in southern Maine (sM) and the Merrimack River near Cape Ann (CA) in Massachusetts is detectable. *Alexandrium* sp. has been shown to be associated with the less-saline, warmer surface waters of the plume, which may extend several hundred kilometers along the coast from the Kennebec River in Maine to the east of Cape Cod (CC) and may impact shellfish resources on Georges Bank (GB) as it travels south and further offshore.

bloom dynamics proved especially important in the public controversy surrounding a proposed new Boston Harbor sewage outfall that would alter the nutrient loading into Massachusetts Bay.

Many opposed to the project cited the possibility for increased red tides as an adverse impact, with potentially drastic effects on the northern right whale, an endangered species. In the many symposia and public discussions that took place, Anderson's group frequently was called upon to provide insight based on the legacy of Sea Grant-funded red tide research.

This issue highlighted the conflict between scientific uncertainty and the public's need for predictions and advice, and revealed many areas where information still was lacking. These areas now are the subject of ongoing Sea Grant investigations, co-sponsored by a Massachusetts state agency.

National Plan Prepared

At the national level, sustained Sea Grant research funding at WHOI has had a significant impact on the nature of harmful algal bloom (HAB) research throughout the United States. Anderson now is working closely with several federal agencies to mount a coordinated, national attack on the diverse HAB phenomena that affect our coastal states.

A national plan has been prepared to guide research and monitoring programs on all aspects of the HAB problem, from toxin detection to resource management to bloom ecology. Separate initiatives now are emerging from this plan, such as a joint NSF- and NOAA-sponsored workshop to establish a science plan on the oceanography and ecology of HABs.

Sea Grant support of research on red tides at WHOI thus has established a center of excellence for regional problems, and the knowledge and experience gained has been instrumental in formulating and implementing a national attack on this problem.

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