Print

Woods Hole Sea Grant: 1998-2000 Projects

Dynamics of the Toxic Dinoflagellate, Alexandrium, in the Gulf of Maine: Source Populations and Downstream Impacts

Donald M. Anderson, Woods Hole Oceanographic Institution, and Jefferson T. Turner, University of Massachusetts at Dartmouth

Toxic algal blooms or "red tides" can cause serious health and economic problems, including Paralytic Shellfish Poisoning (PSP), which occurs when shellfish, zooplankton, and other marine animals accumulate toxins while feeding on dinoflagellates of the genus Alexandrium. For humans, impacts of Alexandrium blooms range from the quarantine of shellfish beds to sickness or even death if the contaminated shellfish are eaten. For marine ecosystems, the impacts can be equally devastating, with mortalities or incapacitation occurring at multiple levels of the food web as toxins are passed from consumer to consumer. With evidence that toxic Alexandrium cells may be transported into Massachusetts coastal waters from the southwestern Gulf of Maine, researchers are investigating bloom dynamics before and after a sewage outfall pipe begins to re-route waste from Boston Harbor to a site nine miles offshore into Massachusetts Bay. During the first year of the multi-year project, investigators conducted three cruises in Massachusetts Bay and found Alexandrium to be present only in very low levels, similar to observations from the previous three years. Shellfish toxicity was detected in Casco Bay, Maine, in 1997, and intensive field efforts will be conducted there in 1998. In 1999 sampling efforts will again be focused on Massachusetts Bay, just months after the outfall will have begun discharging primary treated effluent into the bay. This research will undoubtedly assist in future management decisions relating to the controversial outfall project. (R/B-140)

Impacts of Accelerated Sea Level Rise in Storm-Induced Sedimentation on Southern New England Coastal Wetlands

Thompson Webb III and Jeffrey P. Donnelly, Brown University

To manage and restore coastal wetlands effectively, the processes that induce changes in the species distribution in salt marsh communities must be understood. Many global warming scenarios are predicting further increases in the rate of sea level rise as well as increases in the frequency of intense storms in the coming decades. Therefore, it is important to understand the effects of these factors on the structure and function of coastal wetland communities. This project will explore the regional consequences of accelerated sea level rise and the frequency of storm-induced sedimentation on the community structure of existing and prehistoric coastal wetlands. Field sampling and laboratory analysis will be used to test four hypotheses:

- (1) the coastal wetlands of Cape Cod, which are experiencing the greatest subsidence in the region, have been the first to be impacted by accelerations in the rate of sea level rise;
- (2) the response of both modern and ancient coastal wetlands to relative sea level rise rates greater than approximately 2.5 mm/year is a landward shift in community structure favoring stunted Spartina alterniflora and Salicornia-dominated communities;
- (3) the impacts of accelerated sea level rise have been diminished in portions of coastal wetlands subject to periodic storm-induced sedimentation; and
- (4) the timing of recent changes in wetland structure associated with an acceleration in the rate of sea level rise is coincident with increased emission of "greenhouse" gases associated with the onset of the industrial revolution. (R/G-25)

Multiple Tidal Inlet Stability

David G. Aubrey, Woods Hole Oceanographic Institution

A significant portion of the coastlines worldwide are comprised of estuaries or lagoonal systems, which often serve as habitat for diverse species and are increasingly used for human settlement. Many of these systems are connected to the open ocean by one or more inlets, through which most of the water circulation occurs due to buoyancy-driven, tidal, and wind-driven motions. A precise understanding of tidal inlet stability is fundamental for issues such as water quality, navigability, and beach and barrier stability. For long embayments, the existence and stability of multiple inlets can be important for a more efficient water exchange between the embayment and the ocean. The understanding of inlet interaction is important since changes in the physical characteristics of one inlet may affect the stability of adjacent inlets. This project will develop a model to identify the processes important for stability in multiple tidal inlet systems and will conduct a field experiment to test the model. (R/G-27)

Assessing the Potential for Increased Paralytic Shellfish Poisoning in Massachusetts and Cape Cod Bays due to the Outfall Effluents

Donald M. Anderson and Andrew R. Solow, Woods Hole Oceanographic Institution

Harmful algal blooms (HABs) are a serious economic and public health threat throughout the world. Toxins from dinoflagellates can lead to Paralytic Shellfish Poisoning (PSP), known to cause shellfish quarantines, mortality of birds, larval and adult fish, and marine mammals, and illness or even death in humans. In the Northeastern U.S. and Canada, organisms responsible for PSP are two dinoflagellates in the genus Alexandrium. This project is designed to enhance ongoing research efforts examining the occurrence of toxic Alexandrium blooms in the Massachusetts and Cape Cod Bays. A new sewage outfall that will discharge primary treated effluent into Massachusetts Bay is set to go on-line late in 1998. Opponents to the project believe that there could be an increase of harmful or toxic algal species due to nutrients from the outfall effluent. Before this can be proven or disproven, the variability of Alexandrium population abundance within the bays must be established, along with thresholds that are indicative of significant change. Investigators will compile 25 years of state-gathered shellfish toxicity data for the bays and nearby locations. From the data, they will develop a statistical model of pre-outfall variability in shellfish toxicity. Once that is complete, investigators hope to propose "caution" and "warning" levels that are indicative of significant change from historical means. And, once the outfall begins operation, the researchers will test the utility of these criteria using actual PSP data. (R/B-149)

Controls on Nitrogen Fluxes from Estuarine Sediments: The Importance of Salinity

Anne E. Giblin and Charles S. Hopkinson, The Ecosystems Center, Marine Biological Laboratory, and Gary T. Banta, Roskilde University (Denmark)
It is widely known and accepted that coastal ecosystems can be altered by nutrient inputs and that there is a direct relationship between human population in a watershed and the amount of nitrate-nitrogen that comes out of the watershed and into coastal waters. While many studies have looked at the relationship between nitrogen loading, nutrient recycling in the benthos, and the role of nitrogen in primary productivity, fewer have considered the effect of human-induced freshwater runoff (deforestation, agriculture, urbanization, river channeling, and damming, for example) on estuarine systems. Freshwater input strongly influences estuarine circulation, salinity distribution, primary production, plant and animal distributions, and nutrient dynamics. This project will focus on the interaction between freshwater flow and nutrient dynamics by:

- (a) determining the effect of salinity on nitrogen storage and release from sediments;
- (b) determining the effect of porewater (the water that is present in bottom sediment) salinity on rates of sediment nitrification and denitrification; and
- (c) modeling the implications of salinity control of benthic nutrient dynamics on temporal and spatial patterns of estuarine metabolism.

Results from this study will be used to improve the understanding of the controls on estuarine primary and secondary productivity, and to refine an existing model of estuarine primary productivity. This model, which includes a hydrologic component, could be adapted for any estuary and could be used to assess the impact of water withdrawal (in drought conditions) or addition (floods or storms) to a watershed. It could also be used as a management tool for estuaries where there is some control over the freshwater inputs on a seasonal basis, to minimize eutrophication problems. (R/M-41)

Last updated: January 14, 2015