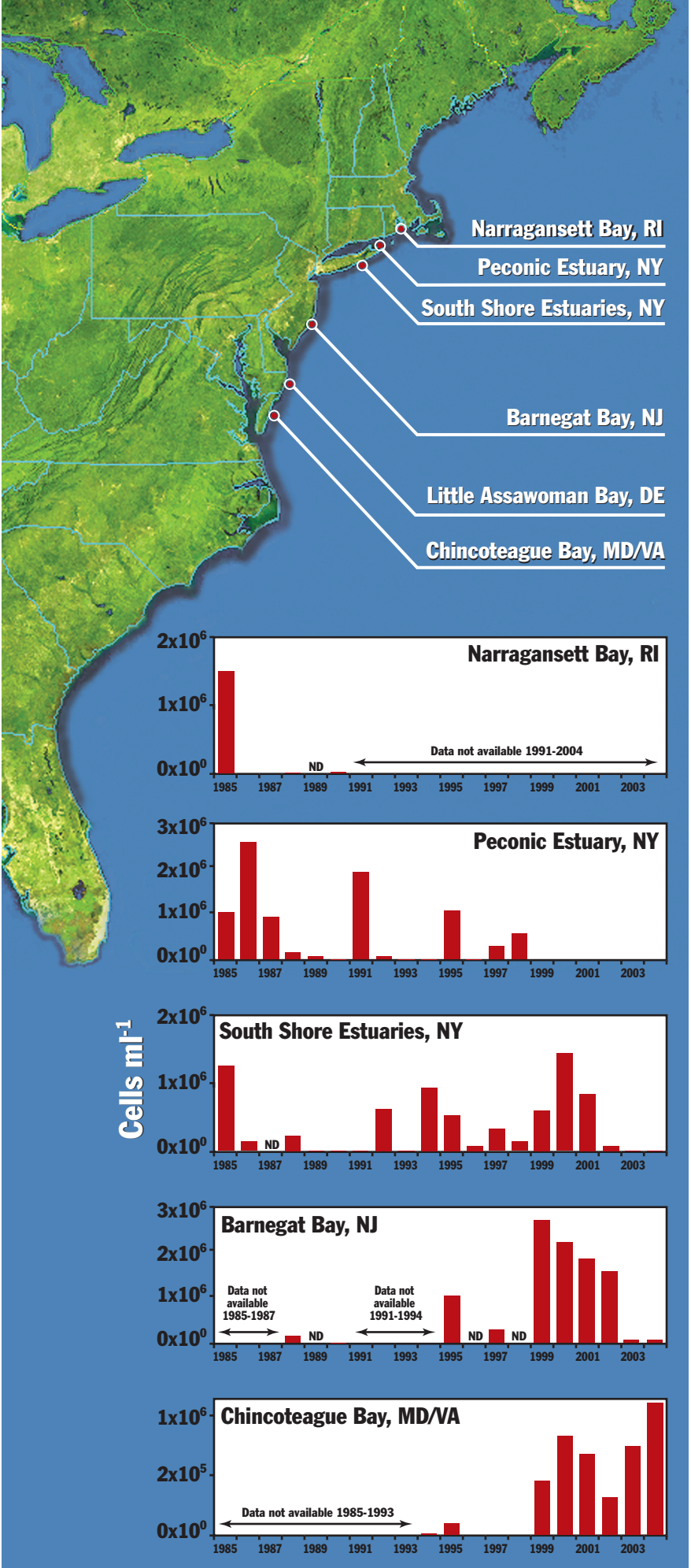
Brown Tide:

The Final Chapter



Twenty years ago, blooms of *Aureococcus anophagefferens* suddenly appeared in Long Island's Peconic Bay, Rhode Island's Narragansett Bay and possibly in New Jersey's Barnegat Bay. Blooms of this microscopic alga caused the waters to turn coffee brown, prompting the name "brown tide."

Since 1985, Long Island's south shore bays and other Atlantic coast estuaries have experienced intermittent brown tides. *A. anophagefferens* cells have been showing a geographic expansion with cells positively identified, at least at low levels, in the phytoplankton community from Maine to Florida and on the continental shelf off the northwest Atlantic Ocean (as illustrated by the brown shading along the eastern US seaboard in the map at left). They have even appeared across the Atlantic in Saldanha Bay, South Africa, where they bloomed between 1997 and 1999. Bays in New Jersey, Maryland, Delaware, and Virginia have also experienced brown tide blooms as shown in map and graphs at left.

BTRI: A Need Arises

Recognizing Sea Grant's broad capabilities for designing and coordinating research programs with links among academia, agencies and others on the federal, state and local levels, NOAA's Coastal Ocean Program (COP) collaborated with NYSG in 1996 to develop the Brown Tide Research Initiative (BTRI). BTRI became a 6-year, $3 million dollar program of coordinated research and outreach involving as many as 19 investigators and 12 institutions and agencies.

"The success of BTRI is, in large part, a result of the leadership and expertise of NYSG," says **Susan Banahan**, COP's Program Manager. "NYSG facilitated information exchange among investigators and assumed a major role in the synthesis of results. In addition, Sea Grant's BTRI outreach program paralleled the research efforts. The BTRI newsletter series, Web site, investigator workshops, and public symposia have provided a unique opportunity for the public to stay informed on research progress and communicate directly with BTRI scientists."

Under greatest magnification is an *Aureococcus anophagefferens* cell with a distinct cell wall. The photomicrograph shows a phytoplankton assemblage that includes the circular brown tide cells and elongated diatoms. For comparison's sake, 50 brown tide cells can fit across the width of an average human hair. Placed side-by-side, it would take about 2,500 hairs to cover an inch.
Photo composite by Anita Kusick
Photos by Robert Nuzzi and Robert Anderson

The overall objective of the Brown Tide Research Initiative was to determine the physical, chemical and biological factors that cause, sustain, and lead to the cessation of *Aureococcus* blooms. "Brown tide has been a significant and difficult puzzle," says NYSG's Assistant Director **Cornelia Schlenk**, "but steady progress has been made in past years toward understanding what makes it tick."

Cumulative BTRI results have advanced new research directions and influenced state and local policy by narrowing the field of likely causal factors. The inclusion of brown tide research in the comprehensive management plans for both the Peconic Estuary Program and the South Shore Estuary Reserve demonstrates BTRI's influence on state and local policy. Members of BTRI's ad hoc Steering Committee have provided valuable insight to NOAA's Coastal Ocean Program. BTRI's research priorities were incorporated into the Ecology and Oceanography of Harmful Algal Blooms (ECOHAB), a larger national program of harmful algal bloom research that continues to support brown tide studies.

"Consultation with BTRI's Steering Committee was key to helping NYSG and the COP determine the priorities for research and prepare outreach communications," says Banahan. "In addition to a much improved understanding of brown tide blooms, BTRI produced a 'next generation' of brown tide investigators critical to the further advancement of this line of research."

Effects of Brown Tide

Even though brown tide has no known impacts on human health, *A. anophagefferens* has negatively affected Long Island ecosystems, shellfisheries and economies. Sunlight can be blocked by the dense biomass of cells during an intense brown tide bloom, shading parts of the water column negatively impacting eel grass (*Zostera marina*). Eelgrass beds serve as a vital nursery for finfish and shellfish and a refuge for many other estuarine organisms.

The hardest hit shellfishery has been the bay scallops (*Argopecten irradians*) in Peconic and Gardiners Bays, with an estimated monetary loss of $3.3 million annually. This fishery has been unable to recover from the extensive recruitment failure after the loss of the 1985 bay scallop year-class. Other shellfish, including hard clams (*Mercenaria mercenaria*), have also been affected.

Recent field results show that juvenile hard clam growth was significantly lower during a brown tide in Maryland with cell abundances of 100,000 cells per milliliter (a milliliter is equivalent to about 7 to 8 drops of water). At these bloom abundances, most juvenile hard clams die. Those able to survive recover and resume growth after the bloom ends. *A. anophagefferens* also has a negative impact on the growth and egg production of zooplankton, a major food source for some fish. Some zooplankton can consume *A. anophagefferens*, though at lower rates compared to other phytoplankton in the community.

That's a Wrap

To help wrap-up the BTRI effort, three investigators–Stony Brook University's **Darcy Lonsdale** and **Christopher Gobler** and SUNY College of Environmental Science and Forestry's **Gregory Boyer**–recently completed a document that brings together and synthesizes results from BTRI and other brown tide research projects. This synthesis will be published in the scientific journal *Estuaries* by year's end.

"We strove to make the manuscript as comprehensive as possible by incorporating and synthesizing results from over 150 different peer reviewed articles," says Gobler. "We also wanted to be sure to include the perspectives of multiple BTRI investigators and other scientists. Toward that end, the paper was reviewed by eight scientists and the BTRI Steering Committee's seven members."

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Taking Stock of...
Storm Barrier Research

"Storm buster" Dr. Malcolm Bowman, Chair of the EarthStock 2005 organizing committee (kneeling), with NYSG's Susan Hamill and Paul Focazio at EarthStock 2005. Photo by George Carroll

"Respect for nature" is an Earth Day credo worth heeding. But containing nature–that is something else. Stony Brook Storm Surge Research Group collaborators **Malcolm Bowman**, **Frank Buonaiuto**, **Brian Colle**, **Roger Flood**, **Douglas Hill** and **Robert Wilson** and their marine science students are suggesting just that. The group's NYSG-funded project used storm surge models to determine the feasibility of using barriers positioned at strategic "choke" points around metropolitan NY to ward off nature's wrath and prevent storm surge flooding (see Spring '05 *Coastlines*). The combination of high tides and a storm surge during an intense storm would be devastating, given the vulnerability of lower Manhattan tenuously situated at just 10 feet above sea level. Storm barriers could effectively prevent potentially catastrophic flooding and loss of property and life in the event of a 100-year storm. "What gives urgency to the project is the acceleration of sea level rise associated with global climate change," says Bowman.

NYSG got the word out about this project on a brisk, bright, wind-swept day in April at EarthStock 2005, when it was among the 55 organizations and sponsors demonstrating ways to ensure a safe, healthy environment for the future. Over 3,500 attended the free open-air festivities hosted by Stony Brook University.

NYSG's colorful display included photos of what some downtown landmarks might look like under flood conditions. "Goddard Institute of Space Studies scientists in Manhattan predict up to a two-foot sea level rise by 2050. Thus a modest 5-year storm event in 2050 will do as much damage as a rare 100-year storm event would do today," says Bowman. The images brought many curious visitors to the booth, generating interest in the potential use of protective barriers as a way to counter storm surge destruction in our vital city.

"Celebrate, respect and protect mother Earth and her environment." That was the challenge and the theme that swelled in the hearts of all who enjoyed Earth Day at this year's EarthStock 2005. But protecting and maintaining a habitable environment for the future may take some cooperation with the forces of nature.

— Susan Hamill

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A laymen's version of the to-be-published *Estuaries* article will constitute the ninth and final issue of BTRI's report series, scheduled for publication by this October. Synthesis information will also be presented at the final informational public symposium, to be held later this fall. "We look forward to sharing the synthesis of the research results in a format that will be easily understandable for all," says Schlenk.

"All the BTRI investigators worked very well together to help put all the brown tide pieces in place," adds Patrick Dooley, NYSG's BTRI Outreach Specialist. "Our better understanding of brown tide is due to their insightful research and dedication. BTRI is a successful example of a coordinated research and outreach effort that can serve as a model to approach other environmental issues."

Adds Gobler, "While I believe we accomplished what we set out to do, brown tide research continues today, so the story is not truly over. Perhaps another synthesis paper will be needed in another 20 years."

For more information on brown tide and the future public symposium, visit the BTRI web site: **www.nyseagrant.org/BTRI**.

— Patrick Dooley and Paul C. Focazio