HARMFUL ALGAL BLOOMS PLAGUE LONG ISLAND WATERS

Streaks of red tide in Cutchogue Harbor run along the western side of Nassau Point on Long Island's north fork. Dr. Chris Gobler has observed the red tide *C. polykrikoides* since 2002 in the Peconic Estuary System.
Photo courtesy of Chris Pickerell

Harmful algal blooms (HABs) are a worldwide phenomenon posing a significant threat to fisheries, public health, and economies. HABs have increased in frequency, duration, and distribution in recent decades and New York waters have had their fair share. HABs come in a rainbow of colors, but at the end of this rainbow there's no pot of gold. In fact, it's just the opposite. During the 1950s there were green tide blooms in Long Island's (LI) south shore bays that negatively impacted the oyster fishery. In the mid-1980s, brown tides occurred in Great South Bay, Moriches and Shinnecock Bays on LI's south shore and in eastern LI's Peconic Estuary destroying eelgrass beds and shellfisheries. Since 2002, red tide blooms have occurred in Peconic Estuary and Shinnecock Bay and have caused shellfishery closures on LI Sound bays.

What's the difference among these recent blooms and what harm can they cause?

According to researchers funded via the Brown Tide Research Initiative (BTRI) and reported in the BTRI report series, brown tide blooms of the microscopic alga *Aureococcus anophagefferens,* can occur in such densities that the water turns dark brown. Long Island bays have experienced sporadic brown tide events since 1985. The tiny algae's appearance in quiet bays with little flushing brought on a steep decline in the Peconic Bay scallop population and its eelgrass habitat. Although scallops feed on algae, the organism's tiny size in great concentrations coupled with mild toxicity seem to gum up the works of the filter feeding mechanism, so that scallops starve to death. Likewise, hard clams do not thrive on a diet of brown tide, but rather become stunted. Such decimation to NY's bivalve populations cost millions in losses to these important commercial fisheries.

The last major brown tide bloom in the Peconic Estuary was in 1995, while the south shore estuaries on Long Island have experienced blooms in varying degrees through 2004. In the spring of 2008, a large bloom swept across LI's south shore bays for much of the spring, summer, and fall reaching farther west than in previous years. And this year, the alga was reported in the east end's Moriches, Quantuck and Shinnecock Bays during June and July.

Dr. Christopher Gobler of Stony Brook University's School of Marine and Atmospheric Science (SoMAS) has been examining the occurrence, biology, ecology and genetics of brown tide for over a decade. The recipient of numerous BTRI and other NYSG grants and author of related journal articles, Gobler is also currently a co-investigator on a new NYSG-funded two-year study of brown tide and its environment. "Due to the ecological impacts on economically important shellfisheries in Long Island from brown tide blooms, the importance of successful management and recovery plans hinges on adequate knowledge of bloom dynamics, ecology and physiology," says Gobler.

This study, which began in February 2009, will provide important information using traditional and molecular genetic techniques to characterize the entire plankton community – phytoplankton, bacteria, small zooplankton – during both bloom and non-bloom conditions. Gobler, along with **Dr. Jackie Collier** and their SoMAS team, will examine the incorporation of nitrogen from nitrate, ammonium, urea, and glutamate into the DNA of *A. anophagefferens* and other plankton.

"It's been hypothesized that *Aureococcus anophagefferens* forms brown tide blooms by relying on dissolved organic nitrogen sources, drawing nutrient concentrations down to such low levels that no competing phytoplankton can match its net growth rate," says Gobler. He and his fellow researchers on this NYSG-funded project will be the first to examine how the whole plankton community changes during brown tides and to measure the incorporation of specific nitrogen compounds by different individual species during these events. Knowing how these blooms acquire nitrogen will have important managerial implications.

Whereas the brown tide alga is a very small golden-brown algae along the size of bacteria, HABs are most commonly caused by dinoflagellates, other larger phytoplankton that have the ability to move with a whip-like flagellum or "tail." Dinoflagellates under bloom conditions can discolor effected waters red and thus have been dubbed "red tides." These organisms may synthesize potent biotoxins and can cause direct harm to or even kill marine animals. One such dinoflagellate, known for causing fish kills in southeast Asia, is *Cochlodinium polykrikoides*.

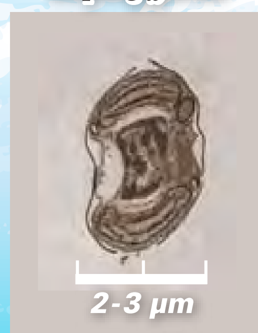
Gobler and his team reported the emergence of *C. polykrikoides* blooms in the Peconic Estuary and Shinnecock Bay during the late summers of 2002 through 2009 which may have caused shellfish and fish mortality events on eastern LI in recent years. Prior to 2002 the only North American occurrences of *C. polykrikoides* have been in Virginia and Barnegat Bay, NJ. Interestingly, the regions currently plagued with *C. polykrikoides* in LI and RI formerly hosted brown tides in the 1980s and 1990s.

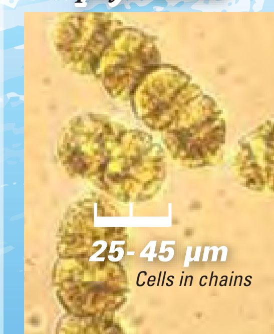
To judge the toxicity of this red tide species, Gobler's team showed that a 24-hour exposure to bloom waters killed 100% of multiple finfish species (both young and adult of some species) usually via impaired gill function. Juvenile bay scallops and American oysters experienced elevated mortality compared to control treatments. Concludes Gobler, "Our results indicate *C. polykrikoides* blooms have become annual events on eastern LI and that bloom waters are capable of causing rapid mortality in multiple species of finfish and shellfish."

Another species of red tide has also appeared in Long Island waters. The red tide organism *Alexandrium fundyense*, also a dinoflagellate, synthesizes a powerful toxin but one that is different from *C. polykrikoides*. This toxin can accumulate in shellfish and thus can be harmful to humans when they consume shellfish that have been feeding on high concentrations of the toxic red tide cells. Consumption of effected shellfish may bring on a condition known as Paralytic Shellfish Poisoning or PSP that can cause tingling, numbness of the mouth, convulsions and even death. "Fortunately, in 2009 on the east end and south shore of LI, *Alexandrium* red tide was found only in areas that were not open to shellfishing," says Gobler. However, some western LI Sound bays that are open to shellfishing, Northport and Huntington, were closed due to PSP in 2006, 2008, and 2009. These closures had a drastic financial impact on the area's shellfisheries.

In spring of 2009, Gobler began a new Long Island Sound Study/NYSG–funded project to study the development and dynamics of *Alexandrium* red tide. This research will give fisheries managers and local health departments the essential information they need to protect human health and sustain healthy ecosystems and local economies.

— Barbara A. Branca and Paul C. Focazio





	Aureococcus anophagefferens	*Cochlodinium polykrikoides*	*Alexandrium fundyense*
	Brown Tide	**Red Tide**	**Red Tide**
CLASS	Pelagophyte	Dinoflagellate	Dinoflagellate
ECOSYSTEM IMPACT	Harmful to shellfish, eelgrass	Lethal to fish, shellfish	**TOXIC** to humans (saxitoxin)
GLOBAL DISTRIBUTION	East coast US, South Africa	Northern hemisphere	Global for genus
BLOOMS IN NY	South shore bays (Great South, Moriches, Shinnecock)	East end bays (Peconic, Shinnecock)	North shore bays (Huntington, Northport, Mattituck)

How does red tide "measure up" to brown tide? The table compares some important characteristics of brown tide with those of the two species of red tide that have been found in Long Island waters. Red tide organisms are an order of magnitude larger than brown tide cells. Whereas 50 brown tide cells can fit across the width of a human hair, only two to four red tide cells can. Table by Anita Kusick