Sea Grant
New York

Brown Tide Research Initiative

Report #7 September 2002

RECENT BROWN TIDE ACTIVITY

Following are the current results of the Suffolk County Department of Health Services monitoring for the year 2002 on Long Island.

The Peconic Estuary has shown no indication of bloom conditions this year. *Aureococcus anophagefferens* cell numbers at stations analyzed have not exceeded 2,000 cells per milliliter.

Relatively high numbers (80,000 – 90,000 cells per milliliter) for January through early March 2002 at several Great South Bay (GSB) stations suggested the possibility that there would be an occurrence of a major brown tide event during the summer months. However, cell numbers decreased to less than 15,000 cells per milliliter by late March and have not exceeded 17,000 cells per milliliter to date. Special phytoplankton samples collected at a hatchery in GSB revealed that the poor shellfish growth noted there was not related to high numbers of *Aureococcus.*

A bloom occurred in Quantuck Bay beginning in early June. Cell numbers rose to 160,000 cells per milliliter, reached over 730,000 cells per milliliter in late June, and then declined to about 325,000 per milliliter in mid-July (the last date for which data are

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Figure 1: Hugh MacIntyre and Alison Coe set up a mesocosm containing a sediment core.
Photo by Todd Kana

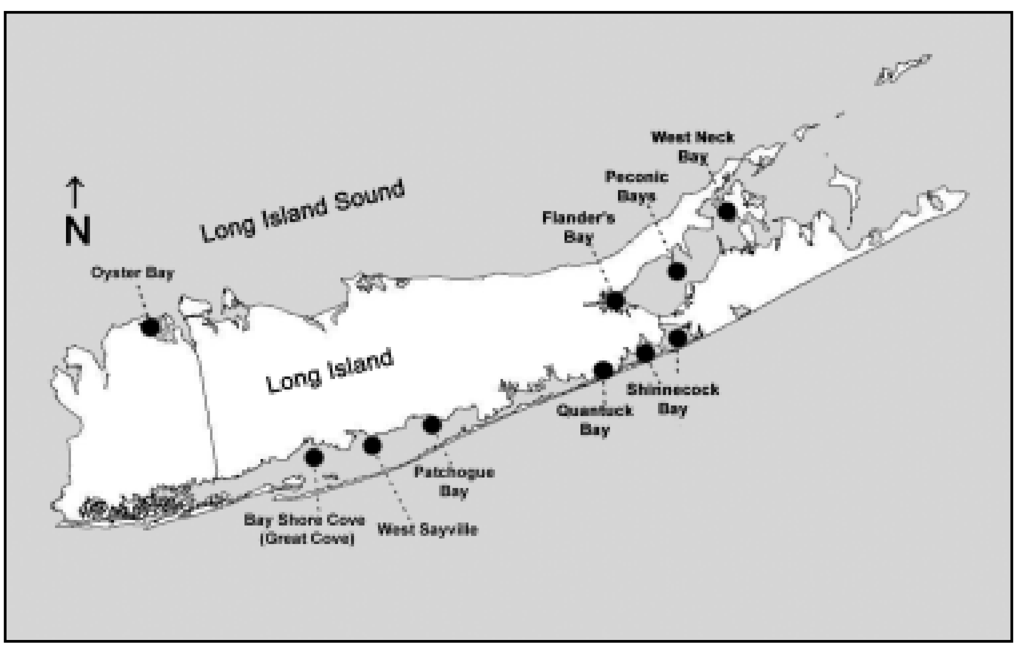

Figure 2: Map showing sampling sites across Long Island.

Brown Tide Research Initiative
Report #7

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Sea Grant New York

New York Sea Grant is part of a national network of universities meeting the challenging environmental and economic needs of the coastal ocean and Great Lakes regions. Unique among the 30 Sea Grant programs nationwide because it has both marine and Great Lakes shorelines, New York Sea Grant engages in research, education, and technology transfer to promote the understanding, sustainable development, utilization, and conservation of our diverse coastal resources. NYSG facilitates the transfer of research-based information to a great variety of coastal user groups which include businesses, federal, state and local government decision-makers and managers, the media, and the interested public.

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RECENT BROWN TIDE ACTIVITY

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presently available). Cell numbers in west-central Shinnecock Bay reached almost 200,000 cells per milliliter in June, declining to less than 30,000 per milliliter in July.

The State of New Jersey Department of Environmental Protection reported that Barnegat Bay and Little Egg Harbor Bay in New Jersey experienced brown tide in April and May 2002. *Aureococcus* concentrations ranged from 200,000 – to greater than 851,000 cells per milliliter causing a local hatchery to relocate juvenile seed clams to waters free of brown tide. Brown tide blooms have recurred in these bays since 1995 and have occurred every year since 1999 at specific locations.

To find out more about regional brown tide activity, please visit the Brown Tide Clearinghouse website at: http://www.seagrant.sunysb.edu/browntide.

Editor's Note: BTRI Report Number 7 builds on the preceding 6 BTRI Reports and follows a similar format as the previous issues for easy project tracking. **Boldfaced** terms are defined under *Key Terms* adding to those defined in the earlier reports.

What's Next

Synthesizing the results of the past five years of lab and fieldwork is the next priority for present and past BTRI and other brown tide researchers, New York Sea Grant and the BTRI Steering Committee. In the coming months, we will be spearheading efforts to synthesize all the new results and knowledge for presentation in a technical document and an executive summary report that will also include any possible brown tide mitigation recommendations.

Five years ago, the first set of eight BTRI projects began. Building on early results of these efforts, three BTRI projects were added in September 1999. While the first projects have been completed, the second set are still winding down and finishing data analyses. Accordingly, conclusions and possible mitigation recommendations are not presented in this report.

Photo by Todd Kana

BTRI Projects 1999-2001

Kana, MacIntyre, Cornwell & Lomas:
Benthic-Pelagic Coupling and Long Island Brown Tide

This research team continues its investigation into the control of brown tide by nutrients. A significant aspect of this project is the documentation of the importance of nutrient exchange between the sediments and water column and the interaction between benthic and pelagic processes. Quantuck and Flanders Bays were sampled to represent various Long Island embayments. During the 2000 field season, a single brief brown tide event occurred between field sampling periods in Quantuck Bay only. Accordingly, modifications were made during the 2001 field season to account for the possibility of another "non-brown tide year," or missed bloom event. The investigators included mesocosm experiments to directly test the effects of selected nitrogen nutrients and a sediment interface on biological processes in the water column. Four treatments of inorganic and organic nitrogen combinations plus a control were tested over the course of two ten-day mesocosm experiments (see Figures 1 and 3).

The first experiment encountered a natural fluctuation in available light. During the first 5 days of this experiment, the weather was overcast or rainy while the weather was sunny during the second 5 days. These weather conditions had the effect of lowering the entire mesocosm system's "metabolism" during the first half of the experiment, followed by a "grow-out" period in the second half.

The water column uptake rates of the various nitrogen forms (inorganic forms: nitrate & ammonium, organic forms: glutamic acid & urea) were measured in the mesocosm experiment. The uptake rates of the inorganic nitrogen forms did not change significantly over time in any of the treatments. The uptake rates of the organic nitrogen forms showed a more complex pattern. The organic nitrogen treatments showed significant increases in either glutamic acid or urea uptake. Of the total nitrogen uptake in the mesocosms (inorganic + organic), the organic nitrogen forms had a higher uptake relative to the inorganic nitrogen forms.

Figure 3: (Opposite page)
Kana's mesocosms were deployed off a floating dock at the Marine Science Station of Southampton College. Treatments included inorganic nitrogen, organic nitrogen, heat degraded green algae, sediment plus a control.

Associated with the nitrogen uptake differences, there were corresponding changes in *Aureococcus* densities. All treatments started with roughly the same *Aureococcus* densities (3,000 – 12,000 cells per milliliter), but by day 6, densities dropped to less than 1,000 cells per milliliter in all treatments most likely due to the overcast weather conditions. During the second half of the experiment when it was sunny (days 6-9), *Aureococcus* populations grew in all the organic nutrient treatments to greater than 10,000 cells per milliliter. There remained less than 1,000 cells per milliliter in the control (no added nutrients) and inorganic (nitrate) treatment. The increase in *Aureococcus* density during the second half of the experiment was concurrent with the increase in the relative uptake of organic nitrogen forms. These results support the hypothesis that *Aureococcus* growth is enhanced under organic rather than inorganic nitrogen conditions.

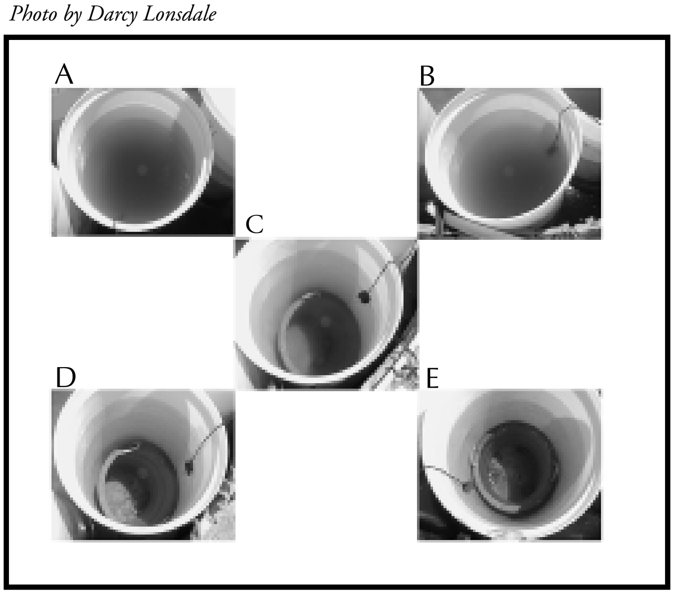
Field studies focused on the shallow Quantuck Bay (see Figure 2) for the benthic-pelagic coupling experiments detailing the flux of nutrients into or out of the bottom sediments. The rationale is that the nutrient exchange (or flux) across the sediment-water interface would be important in providing supportive nutrients to *Aureococcus* growth. Both inorganic and organic nitrogen forms can be released or taken up by the sediments. For 2000 and 2001, large temporal and spatial differences were seen in the flux of dissolved organic nitrogen (DON) across the sediment-water interface. On average DON was released from the sediment (3-4 μmol per liter per day: this is equivalent to approximately 10% of the DON standing stock per day). There were some high rates of DON uptake by the sediments, however, uptake rates varied across the bay (e.g., lower flux rates were observed in the center and southern sampling sites). So far the results suggest that the sediments appear to have had only a small impact on the water column DON concentration in Quantuck Bay. In terms of brown tide, except for a brief event in late June of 2000, Quantuck Bay had low DON concentrations which may have caused it to remain relatively free of a major brown tide bloom.

Lonsdale, Caron & Cerrato:
Causes and Prevention of Long Island Brown Tide

During the summer of 2001, this research team continued its mesocosm investigation into how hard clams (suspension-feeding bivalve *Mercenaria mercenaria*) impact brown tide and the structure of the rest of the plankton community.

Two eight-day mesocosm experiments were conducted to test the effects of varying concentrations of hard clams on brown tide bloom dynamics. The hard clam treatments were designed to approximate higher hard clam population densities in Great South Bay during the 1970's and lower present day concentrations. The clam treatments consisted of 2, 4, 8 and 16 clams per mesocosm. To encourage brown tide growth, nutrients were added to the mesocosms. These included urea, an organic nutrient source, and phosphate (PO_4) as a phosphorus source.

Figure 4:
Water color and transparency in mesocosms differing in the number of hard clams (about 20-60 millimeters long) in an experiment conducted during 2001. A = no clams, B = 2 clam-treatment, C = 4 clams, D = 8 clams, and E = 16 clams). *Aureococcus anophagefferens* reached an average concentration of 400,000 cells per milliliter in the 'A' no clam treatment.
Photo by Darcy Lonsdale



Brown tides developed in mesocosm tanks treated with pumps and nutrients, reaching maximum concentrations of 400,000 cells per milliliter in experiment #1 and approximately 600,000 cells per milliliter in experiment #2. Nutrients alone enhanced brown tide growth only until day 3 during experiment #1 whereas in experiment #2, concentrations peaked at 600,000 cells per milliliter by day 6 (see Figure 4).

Although plankton community structure samples from these experiments are still being enumerated, preliminary results suggest that hard clams in mesocosms have a significant impact on both brown tide and the entire planktonic food web structure. Previous experiments conducted in 1997 and 1998 showed that as hard clam clearance rates went up, copepod abundance decreased. However, the ciliate population increased in the presence of clams. It is plausible that without copepod predation pressure, the ciliate population increased in mesocosms with clams. Additionally, the ciliate population may have increased because brown tide abundance was also reduced. By the end of both mesocosm experiments, the hard clam clearance rate experiments showed that clams in the two-clam treatment were not feeding (Table 1). The high concentrations of brown tide (greater than 400,000 cells per milliliter for both experiments) in the tanks could have inhibited their feeding. The degree of brown tide control with four clams per mesocosm differed between experiments. After day 3 during experiment #1, *Aureococcus* declined to less than 10,000 cells per milliliter. By day 8, the clams were clearing the water at a mean rate of 0.55 liters per clam per hour or a water turnover rate of 19% per day. This water turnover rate is higher than that estimated for current hard clam populations in Great South Bay but lower than that estimated for the 1970's prior to the onset of brown tides. In contrast, after day 3 during experiment #2, the concentration of *Aureococcus* gradually increased in the four-clam treatments, reaching 179,000 cells per milliliter on day 8 and the clams had ceased feeding. Brown tides did not develop in

Table 1:
Hard clam mean clearance rates (liters per hour per clam) summarized for mesocosm experiments between 1997-2001. *Indicates treatments in which mesocosms developed an *Aureococcus anophagefferens* bloom.

mesocosms containing eight or sixteen clams during either experiment. For experiment #1, water turnover rates on day 8 were estimated as 66% and 95% per day for the eight- and sixteen-clam treatments, respectively, and for experiment #2, 27% and 74% per day (see Table 1).

A review of hard clam results from all the mesocosm experiments conducted between 1997 and 2001 (Table 1) strongly suggests that a water turnover rate by hard clams of approximately 30% per day is sufficient to prevent the formation of brown tide in controlled mesocosms even when the *Aureococcus* population is growing at near-maximum growth rates (1.0 population doubling per day). These results match the estimates of hard clam grazing impacts in the Great South Bay during the 1970's. This finding supports the hypothesis that the significantly reduced density of this benthic suspension feeder in Long Island embayments over the last 30 years may be an important factor contributing to the mid-80's appearance and continual reoccurrence of brown tide.

Sieracki & O'Kelly:
The Effects of Microbial Food Web Dynamics on the Initiation of Brown Tide Blooms

While examining growth and grazing of *Aureococcus* within the context of the microbial plankton community, this team's research includes studying picoplankton community dynamics such as bacteria and protozoan grazers. One focus under investigation is the '**picoalgae niche**' hypothesis (see BTRI Report #6).

Four bays were sampled in 2001 (4/2001-7/2001): Flanders, Quantuck, Shinnecock and West Neck Bays (see Figure 2). Only Quantuck Bay experienced a brown tide. This occurred in the beginning of July and peaked at greater than 800,000 cells per milliliter. The 2000 and 2001 field results for Quantuck Bay and West Neck Bay are consistent and demonstrate a picoalgae niche in the late spring. During the short 2001 brown tide bloom in Quantuck Bay, *Aureococcus* dominated the picoalgae size class. ***Synechococcus*** was present, but at reduced population numbers during the brown

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tide bloom. West Neck Bay's picoalgae niche was dominated by a short bloom of *Ostreococcus tauri* (greater than 500,000 cells per milliliter, June 2001), a species not previously identified in Long Island bays and the smallest **eukaryotic** organism known to science (see Figures 5 and 6).

This research team previously reported a positive correlation between *Aureococcus* and bacteria populations based upon samples taken during a brown tide bloom in its initiation phase (see BTRI Report #3, March 1999). This information led to the hypothesis that under bloom conditions *Aureococcus* could out compete the bacteria for DON. With new information and further analysis of past data, no strong correlation exists between *Aureococcus* and bacteria abundance, biomass or cell size. Large amounts of **mucopolysaccharide** produced at the bloom onset sustains a large bacterial population leading to the hypothesized brown tide – bacteria correlation. Data are now available for the entire bloom period and the relationship between brown tide and bacteria seems clearer. During the bloom initiation period, *Aureococcus* produces mucopolysaccharides that fuel bacteria populations. After a lag period, protozoa that feed on bacteria (called **bacterivores**) respond to the elevated bacteria populations and also increase. As the brown tide bloom progresses the combination of less mucopolysaccharide production and grazing by bacterivores cause these two populations to balance out and stabilize.

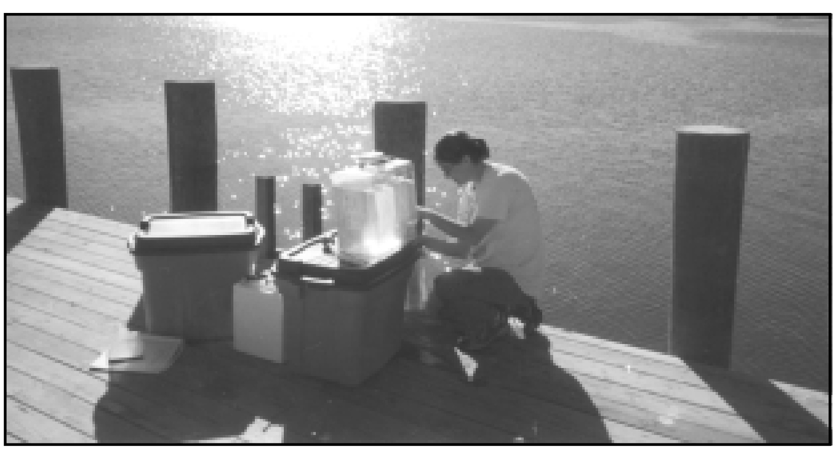

Figure 5:
Ilana Hobson, of Sieracki's research team, fills experiment incubation bottles at Quantuck Bay May 2001, Long Island, New York.
Photo by Mike Sieracki

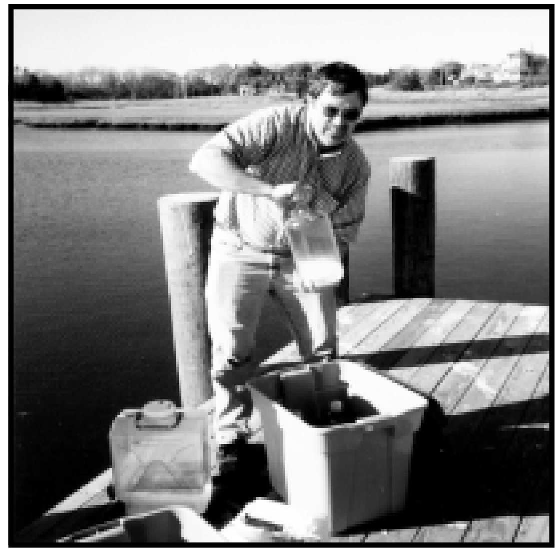

Figure 6:
Mike Sieracki fills experimental incubation bottles at Quantuck Bay May 2001, Long Island, New York.
Photo by Sieracki team member

Plankton community studies showed community-wide changes during the summer of 2000. The **microphytoplankton** populations shifted from low abundances dominated by **dinoflagellates** to high abundances dominated by **pennate diatoms**. For comparison, flagellates and the dinoflagellate *Prorocentrum* dominated West Neck Bay during June. **Heterotrophic** dinoflagellates (*Gyrodinium/Gymnodinium*) dominated the week prior to the brown tide bloom and may have effectively grazed competing phytoplankton. In West Neck Bay *Synechococcus* (similar in size to *Aureococcus*) bloomed the same week as the *Aureococcus* bloom in Quantuck Bay.

Although analysis is still underway, preliminary growth and grazing rates of total phytoplankton, nanoalgal and picoalgal cell populations indicate a tightly coupled system between micrograzers and algal prey during the brown tide initiation period (usually May). Very high growth rates (one doubling of the population per day) were commonly observed. Growth and grazing were closely balanced, with grazing removing virtually all phytoplankton production. Addition of organic nutrients changed the picoalgal cell populations, but did not stimulate any blooms of *Aureococcus*.

Other Brown Tide Projects

Greenfield: Ph.D. Dissertation: *The Influence of Variability in Plankton Community Composition on the Growth of Juvenile Hard Clams Mercenaria mercenaria (L.)*

Dianne Greenfield worked on her doctoral research with Dr. Lonsdale, addressing the influence of *Aureococcus anophagefferens* on the growth and feeding physiology of juvenile hard clams (*Mercenaria mercenaria*). Field studies conducted during 1999 and 2000 compared clam growth and plankton community composition between Oyster Bay, an embayment where *Aureococcus* has never bloomed, and West Sayville where brown tide frequently recurs (see Figure 2). Hard clams grew better at Oyster Bay than West Sayville regardless of *Aureococcus* levels at West Sayville. The phytoplankton community at Oyster Bay generally consisted of **centric diatoms** both years. West Sayville typically supported **pennate diatoms**, dinoflagellates, and small flagellates. A brown tide in 2000 caused 67% clam mortality at West Sayville, but survivors grew rapidly within weeks. During the brown tide at West Sayville, clams did not exhibit an increase in whole animal biomass. Then, after the brown tide subsided (7/17/00), clams that survived brown tide exhibited recovery and a rapid increase in biomass. After a 4-week rapid growth spurt, clam growth rates were equivalent to Oyster Bay, a site that had no bloom of *Aureococcus*. Clams that survive brown tide recover and may eventually grow at rates comparable to clams that never experienced a bloom of Aureococcus (see Figure 7.)

Since the field component involved raising two different clam stocks in their native embayments, a study was conducted to determine if genetics were responsible for growth differences between Oyster Bay and West Sayville. Though **Polymerase Chain Reaction** (PCR) amplification demonstrated genetic differences, common garden experiments revealed no significant growth differences between populations. Thus, clam growth was likely more heavily influenced by environmental factors than heritability.

To determine if hard clams are sensitive to *Aureococcus* when concentrations are too low for toxicity to inhibit feeding, carbon absorption rates and clam growth were compared between clams fed unialgal diets of phytoplankton common to Long Island embayments to diets mixed with brown tide. Flagellates and centric diatoms promoted the highest absorption rates and fastest growth. Pennate diatoms resulted in poor absorption rates and growth. Mixed diets generally caused a decrease in absorption rate and a minor negative influence on growth. Since centric diatoms were typical in Oyster Bay, the higher absorption rates possibly explained the rapid clam growth in the field. Conversely, the slower hard clam growth at West Sayville was probably associated with the abundance of

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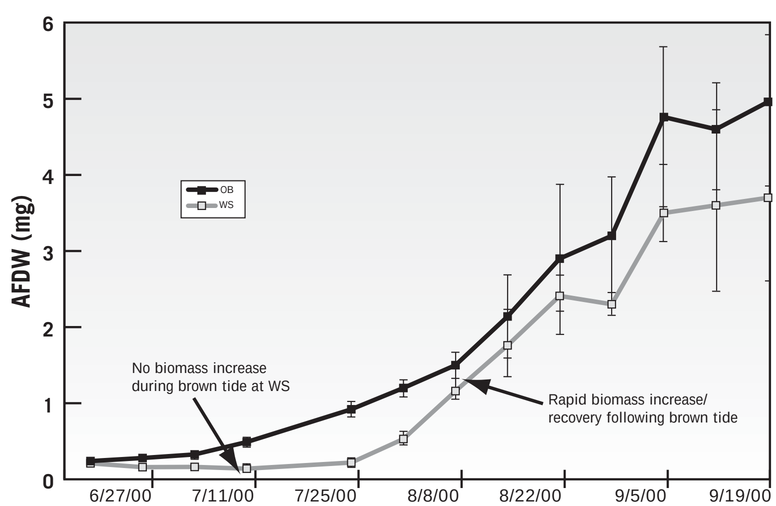

Figure 7:
Mean (n = 5 ± SE) ash-free dry weight or biomass of *Mercenaria mercenaria* at Oyster Bay and West Sayville during the 2000 growing season. Note that during the West Sayville brown tide (May through July ending on July 17th) hard clams did not grow but started growing again after brown tide subsided.

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pennate diatoms, a poor food source. These findings suggest that clams suffer subtle, chronic effects of brown tide at low levels, and in general, brown tide is not solely responsible for the poor hard clam growth in West Sayville. [Text written by Greenfield and modified by Dooley]

Gobler:

The Impact of Bottom-Up and Top-Down Processes on the Abundance of Aureococcus anophagefferens During the Summer 2000 Brown Tide Bloom in Great South Bay, NY, USA

During the summer of 2000, the most intense New York brown tide bloom (*Aureococcus anophagefferens*) in fifteen years occurred throughout Great South Bay. During the bloom, light and dissolved inorganic nitrogen (DIN) levels were low (1% light depth less than 1.5 meters, mean DIN = 0.6 µM), indicating that obtaining carbon and nitrogen by standard autrophic means was likely difficult for most phytoplankton species. However, dissolved organic carbon and nitrogen levels were high (mean = 600 µM and 45µM, respectively) in Great South Bay, potentially giving a nutritional advantage to the brown tide which can use organic nutrients. Although the growth of most phytoplankton in Great South Bay was limited by nitrogen during the summer of 2000, brown tide growth is frequently not limited by nutrients. Instead, the brown tide seemed to utilize the high levels of organic nutrients for growth, as DOC and DON concentrations in Great South Bay decreased as the brown tide grew. During the Great South Bay 2000 brown tide, microzooplankton, which consume phytoplankton, grazed *Aureococcus* cells at a slower rate than they grazed other phytoplankton in western Great South Bay (Bay Shore Cove). In contrast, **microzooplankton** consumed *Aureococcus* and the total phytoplankton community at nearly equivalent rates in eastern Great South Bay (Patchogue Bay). Since the brown tide ended more quickly in eastern Great South Bay, the results could indicate that microzooplankton grazing can play a key role in regulating blooms. In summary, the results indicate that both organic nutrients and lowered microzooplankton grazing rates can contribute toward the formation of brown tides in Long Island bays. [Text written by Gobler and modified by Dooley]

Mulholland:

Pathways of DON Mobilization by Aureococcus anophagefferens: Peptide Hydrolysis, Amino Acid Oxidation and Uptake

Dissolved organic nitrogen (DON) has been implicated as a causative agent in the formation of brown tides. It was determined that *Aureococcus* has several unique attributes that may allow it to out-compete co-occurring species in systems with high organic nutrient levels. A newly tested fluorescent compound was used to measure rates of **peptide hydrolysis**. Stable isotopes were also used to trace both carbon and nitrogen uptake from amino acids to test hypotheses regarding the ability of *Aureococcus* to recycle and use organic material to support their growth. Peptide hydrolysis was high during blooms of *Aureococcus* enabling it to rapidly break down and recycle proteins and peptides. If so, brown tide cells might not become nutrient deprived so long as there is high ***in situ*** production to supply reactive organic material. In addition to DON uptake, Mulholland directly determined that brown tide organisms subsidize photosynthetic carbon acquisition by using dissolved organic carbon to support net growth. The ability to take up organic material to provide cells with both nitrogen and carbon may give cells a competitive advantage in organically enriched environments where light levels may be low. Peptide hydrolysis can fuel both carbon and nitrogen acquisition because peptides are nitrogen-rich organic compounds. These studies are the first to employ dually labeled organic compounds to trace both carbon and nitrogen uptake from dissolved organic material and they are the first studies investigating seasonal changes in rates of organic material utilization and cycling. [Text written by Mulholland and modified by Dooley]

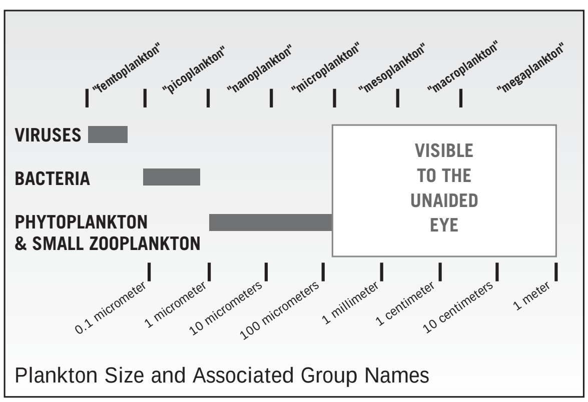

Figure 8:
Diagram depicts typical size ranges for some common marine groups (micrometer = micron = μm).
Figure from Bigelow Laboratory

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Published papers and graduate student theses from BTRI and other NYSG funded brown tide projects since BTRI #6 October 2001.
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KEY TERMS

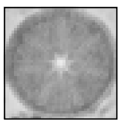
For a complete list of Key Terms, access http://www.seagrant.sunysb.edu/BTRI/btriterms.htm. See Figure 8 on page 9 for plankton size ranges.

bacterivores

Organisms such as protozoa that eat bacteria.

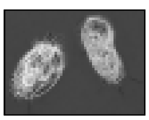
benthic-pelagic coupling

The interaction that links the benthos or bottom with the water column or the pelagic ecosystems. In particular, this term refers to how the dynamics in one ecosystem influence the dynamics of the other. In other words, how benthic systems affect pelagic systems, and how pelagic systems influence benthic systems.



centric diatoms

Round shaped cylindrical single-celled algae, mostly photosynthetic, that form silica cell walls and can be solitary or chain-forming, ranging in size from 2 microns to several millimeters. They are found in marine and aquatic systems, up in the water column or on/in the bottom sediments.

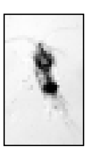


ciliate

Single-celled protozoa (1.0 microns in diameter and range up to about 250 microns) often found in plankton that move by beating hair-like structures called cilia. Ciliates are especially important trophic links in microbial food webs because they are the major consumers of bacteria, pico- and nano- plankton, diatoms, dinoflagellates, and amoebae, and they are eaten in turn by animals such as copepods in the zooplankton. Because of their “keystone” role in microbial food webs, they are important indicators of the conditions and health of the environment at the microbial level.

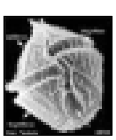
clearance rates

As used in this Report Series, the rate at which filter-feeders, such as shellfish, remove particles (including plankton) from water by passing the water through their systems.



copepod

A small crustacean that is important as a food source for higher trophic organisms such as fish (typically 1-2 millimeters in length; oceanic species can reach over 1 centimeter).

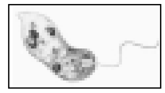


dinoflagellates

Unicellular protists, which exhibit a great diversity of form including photosynthetic (autotrophic), heterotrophic, or parasitic and range in size from up to about 250 microns). Many harmful algae blooms are caused by dinoflagellates.

eukaryotic

A cell with a distinct membrane-bound nucleus.



flagellate

Flagellates are single-celled protista with one or more flagella, a whip-like organelle often used for propulsion.

growth rate

Increase in the number of individuals in a population per unit time (e.g., population doubles once per day).

heterotrophic

Organisms that obtains nourishment from the ingestion and breakdown of organic matter such as plants and animals.

in situ

In the original location (e.g., water column or within the organism).

microflagellate

Small protists that can be photosynthetic or heterotrophic.

micrometer (µm) or micron

One millionth of a meter (1 inch = 25,400 µm).
1 millimeter = 1000 micron

microphytoplankton

Small, plant planktonic organisms in a size range 20 - 200 µm.

microzooplankton

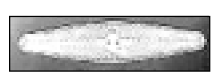
Small, animal planktonic organisms in a size range 20 - 200 µm.

mucopolysaccharide

Complex polysaccharides containing an amino group; occur chiefly as components of connective tissue. Mucopolysaccharides are quite similar structurally to the more well-known animal and plant polysaccharides such as glycogen and starch. Chitin is a particularly plentiful mucopolysaccharide and serves as a structural polysaccharide for many phyla of lower plants and animals such as lobsters, crayfish, crabs, insects, and many other invertebrate organisms.

nanoplankton

Small, single-celled planktonic organisms in a size range 2.0 - 20 microns. Can be animals – nanozooplankton or plants – nanophytoplankton.



pennate diatoms

Elongated single-celled algae, mostly photosynthetic, that form silica cell walls; can be solitary or chain-forming, range in size from 2 microns to several millimeters and are found in marine and aquatic systems, up in the water column or on/in the bottom sediments.

peptide

A compound of two or more amino acids joined by peptide bonds. Proteins are formed by the linkage of many peptides.

peptide hydrolysis

The splitting of a peptide compound molecule (protein or polypeptide) by the addition of water.

picoalgae

Very small, single-celled planktonic algae in a size range 0.2 – 2.0 µm.

picoalgae niche hypothesis

Between April and May, there is a succession from larger to smaller algal cells in Long Island bays. Typically, *Synechococcus* dominates the smaller picoalgae size class. If, however, *Synechococcus* is selectively removed or its density is reduced, the picoalgae niche opens for some other similar sized algae, such as *Aureococcus anophagefferens.*

picoplankton

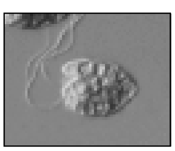
Very small, single-celled planktonic organisms (plants or animals) in a size range 0.2 - 2.0 µm.

Polymerase Chain Reaction (PCR)

PCR is used in classification to help show evolutionary relationships among organisms on the molecular level. It has the advantage of being useful even when only very small samples, such as tiny pieces of preserved tissue from extinct animals, are available.

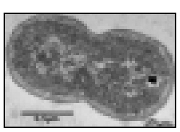
polysaccharide

Polysaccharides are carbohydrates, such as starch and cellulose, formed from many connected sugar units.



protist

A group of simple single celled eukaryotic organisms (e.g., protozoa and eukaryotic phytoplankton) not distinguished as animals or plants, though having some characteristics common to both.



Synechococcus

A group in the genus of cyanobacteria (also called blue-green algae) that contain chlorophyll; are coccoid in shape and are within the same size range as *Aureococcus*.

BACKGROUND

The Brown Tide Research Initiative (BTRI) is funded by the National Oceanic and Atmospheric Administration's Coastal Ocean Program and administered by New York Sea Grant. The first (1996-1999) three-year $1.5 million BTRI program was developed to increase knowledge concerning brown tide by identifying the factors and understanding the processes that stimulate and sustain brown tide blooms. Continued funding for BTRI (1999-2001), as a second $1.5 million three-year effort, comes once again from NOAA's COP. The COP, National Sea Grant Office, National Science Foundation, Environmental Protection Agency, Office of Naval Research, and National Aeronautics and Space Administration are jointly sponsoring research on Harmful Algal Blooms (HAB) ecology and oceanography in the interagency research program, Ecology and Oceanography of Harmful Algal Blooms (ECOHAB).

There were eight projects in the first three-year effort, then three projects in the next three-year effort. All BTRI projects were selected through national calls for proposals. The research projects chosen for BTRI funding were selected following peer review and evaluation by a technical review panel. To involve concerned parties and aid in decision-making, New York Sea Grant formed the BTRI Steering Committee as an advisory group of invited state, local and government agency representatives, and citizen's groups.

This Report Series will aid in the dissemination of general brown tide information. The results and conclusions of the projects will help determine the directions of potential management and future research.

BTRI researchers continue to work closely with the Suffolk County Department of Health Services which has provided brown tide and water quality data, and has collected samples for various investigators. Suffolk County has also provided funds to BTRI and other researchers studying the brown tide phenomenon including: Drs. Boyer, Lonsdale, Caron and Gobler (BTRI researchers), J. LaRoche (University of Kiel), D. Repeta (WHOI), G. Taylor, S. Sañudo-Wilhelmy (MSRC), and J. Giner (SUNY ES&F, Syracuse). The work from these and others has been integrated into the brown tide story, assisting in the efforts to understand this phenomenon. For a listing of BTRI Investigators, please see page 9.

INSIDE

Brown Tide Research Initiative

If you have any questions about brown tide, would like a copy of *Report #1, 2, 3, 4, 5 or 6,* or would like to be added to our mailing list, please contact Patrick Dooley at New York Sea Grant (patrick.dooley@stonybrook.edu or 631-632-9123) .

You may also read these reports by visiting our website: www.seagrant.sunysb.edu

This publication may be made available in an alternative format and is printed on recycled paper.

Sea Grant New York

Brown Tide Research Initiative

Bringing Science to the Shore

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