msrc

BULLETIN UPDATE

January 1992

Special Edition

STONY BROOK
STATE UNIVERSITY OF NEW YORK

More recent theories stemming from the original bloom research address why the brown tide grows to such large numbers and what causes them to suddenly die off.

Brown Tide Update

After several years of relief from brown tide blooms, the nuisance algae (*Aureococcus anophagefferens*) reappeared this past year in Long Island's western (Peconics) bays and at least one south shore body of water (Quantuck), causing alarm in the shellfishing community and a new rash of media attention.

Again in 1991, cell counts reached 1 million cells per liter by the end of June in West Neck Bay and over 2 million cells per liter in Flanders Bay—as concentrated as the 1985-86 blooms. In August, the brown tide bloom crashed as suddenly as it had appeared.

The 1985 bloom in Great South Bay and New Jersey and Rhode Island bays was a first alert to scientists of the existence of this microscopic phytoplankton. It may have been "seeded" in the bays for some time, but, because of its small size, had gone undetected until it bloomed and turned the waters brown.

Scientists from all sectors began to study its physiology, life history, and the possible environmental causes for its sudden, explosive growth. Seven years of such studies have only grudgingly yielded the brown tide's secrets, given that it appears to have a very complex life history and lives in coastal environments with many variables, such as salinity, temperature, and nutrients.

A great deal was learned about the brown alga initially, but to date, the mystery of what triggers the blooms, what makes it so successful as to exclude all other species of phytoplankton, and what causes it to suddenly die off remains to be solved.

Many of the original theories gave enough promising clues to be validly pursued today. During the initial years of brown tide research, Marine Sciences Research Center biological oceanographer Elizabeth Cosper proposed that a sudden large delivery, or "spike," of storm runoff water may have carried a large pulse of micro-nutrients—those needed specifically by the brown tide alga to support rapid cell growth.

In 1985 the hypothetical micro-nutrient spike coincided with stormy weather patterns following an early drought in Great South Bay. In 1986, and again in 1987 and 1991, all years of large brown tide cell concentrations in some Long Island bays, the weather patterns were similar enough to the original event to warrant serious consideration of this theory. Cosper's laboratory results, which show increased growth of cultures given micro-nutrients iron and selenium, also support continuing these studies.

Other more recent theories stemming from the original bloom research address why the brown tide grows to such large numbers and what causes them to suddenly die off. One line of investigation being conducted by Cosper is whether a virus specific to the alga species is infecting it. Another line of investigation being conducted by biological oceanographer Darcy Lonsdale, along with Cosper, addresses what, if any, are the affects of the brown tide on the food web in these bays.

During blooms the brown tide virtually elbows out the usual array of green phytoplankton that dominate in non-tide conditions. It was discovered early on that bay scallops avoid consuming the brown tide alga species, and having no other phytoplankton species to eat, starve to death during brown tide blooms.

Do organisms that consume phytoplankton (called "grazers") such as zooplankton have an effect on brown tide crashes, and what role do the brown tide blooms have on the zooplankton community? Why at times, in the absence of any substantial amount of other phytoplankton species to graze on, do the larger, mesozooplankton seem to be able to fare well? Do they actually eat the brown tide? Or do they avoid the brown tide like the scallops, but manage to eat something else unknown to the scientists?

Lonsdale and Cosper are examining the grazer-phytoplankton community dynamics in these shallow bay systems, They are looking at which of several size classes of zooplankton are grazing on what phytoplankton species and size category, both before and after the brown tide bloom and comparing non-tide phytoplankton communities to those in tide-infected waters.

Their preliminary findings indicate that, like scallops, the mesozooplankton do not feed on, and can starve in the midst of, billions of brown tide cells. This was the case in West Neck Bay this summer. But plankton samplings showed that the mesozooplankton fared well in the presence of the brown tide bloom in 1985-86 in Great South Bay.

Assessments of the plankton community in nature and the results of laboratory experiments have led Lonsdale and Cosper to more closely examine previously unknown dynamics of the food web for the answers: the larger zooplankton are eating the smaller, microzooplankton, and it appears that microzooplankton, such as ciliates, may be feeding on the brown tide.

Working out the exact dynamics of the bays' natural food web, as well as this bloom-distorted version, will significantly aid future efforts in understanding, and perhaps managing, this and possibly other species' blooms. But besides the implications of a disruption of the natural food web in these bays with continuing brown tides, what are the implications for the scallop fishery?

By Spring 1991, spawning from a remnant natural population in the extreme eastern part of the system, as well as from at least one of several scallop transplant sites, led to a resurgence of the scallop population. At that time, prospects appeared good for a successful commercial harvest in the coming fall. But, after this summer's sudden bloom and severe infestation with a parasitic worm, those recovery estimates were too hopeful.

To save what they could of the existing population, state and local officials, working with local baymen, launched an emergency program to relocate adult scallops to non-affected waters. By mid-July, the brown tide had subsided and the adult scallops began to actively feed and put on weight. State officials then delayed the traditional opening of the scallop season by three weeks to allow the scallops to continue to grow and perhaps spawn. These measures have borne some fruit: harvestable numbers of scallops remain in the Peconics, with the promise of a modest commercial fishery in the 1991-92 season.

Of great concern still is to what extent the brown tide affected scallop reproduction. Baymen and scientists report spotting few "bug" scallops—newly settled thumbnail size and smaller larvae. Scallops that were spawned prior to and during the brown tide of 1991 have apparently suffered near-complete mortality. Thus, in another attempt at emergency rescue, MSRC's Living Marine Resources Institute, along with other groups, is exploring reinstitution of the transplant program.

Just as Sherlock Holmes often encourages his reactive companion, Watson, to be patient and not to jump to conclusions while solving mysteries, the brown tide studies also require such a patient, methodical approach. The puzzle is complex; the answers, therefore, will not come instantly. Yet, every year, more pieces of the puzzle are being fitted together by the persistence of the MSRC team.

SUGGESTED FIELD TRIPS AND ACTIVITIES

POSSIBLE FIELD TRIPS

1. Organize a class beach clean-up for a known length of seashore at a local beach. Be sure this is done cautiously with gloves. (Bring debris back to classroom for further activities outlined below).
2. Tour a local sewage treatment plant following classroom discussion comparing primary, secondary, and advanced treatment processes. Note the objects caught on the screening apparatus and compare with beach debris.
3. Tour a local landfill and approximate different percentages of refuse components (plastic, metal, paper, wood, rubber, cloth, and styrofoam). Discuss fate of the refuse.

CLASSROOM ACTIVITIES

1. The debris collected on beach clean-up days may be used in the following activities:

   a) Count and classify the number of items according to their composition and construct a bar graph. Note the differences in weight and volume.

   b) Try to identify where the beach debris might have come from. Look for clues: hospital names, state or country of origin.

   c) Calculate the percentages of composition of the different items and construct a pie chart.

   d) Weigh the items or determine their volumes by displacement and construct charts.

   e) Extrapolate the amount of refuse accumulated on the beach over both time (kilograms per week) and area (kilograms per meter).

   f) Construct posters on the results of the beach clean-ups and distribute around school.
2. Conduct studies on fouling organisms in local marine waters by observing growth over time on natural and man-made materials.
3. Conduct studies on resistance to biological, chemical, and physical degradation of different types of materials (plastics, paper, foods, leaves, etc.).

ACTIVITIES OUTSIDE THE CLASSROOM

1. Collect and weigh all non-recyclable and recyclable household wastes for a two-day or week-long period. Extrapolate the amount of waste produced per house per year and compare to published figures.
2. List all products on a store shelf using unnecesary packaging. Debate what is necessary and unnecessary, considering safety, freshness, etc. Compare different departments and companies. Write to companies with unnecessary packaging materials.
3. Survey non-recyclable items in the school environment and in the local community and start a recycling program in the school.
4. Write to local, state, and federal elected officials concerning recycling issues and waste reduction programs, after investigating their past voting records on environmental issues.

Compiled by Glynis Nau-Ritter, Earl L. Vandermeulen High School, Old Post Road, Port Jefferson, New York 11777