Currents

Sea Grant Scholar Stuart Waugh brings up a box corer full of sediment.

The Bottom is Tops:

Looking at nitrogen in Peconic sediments

Paddle out into Great Peconic Bay, and you can often see bottom. "The bottom's close to the top," **Dr. Robert Aller** from Stony Brook University's School of Marine and Atmospheric Sciences tells students. He explains that with light penetration allowing for photosynthesis deep into the water column and with worms, brittle stars and clams churning up the mud below, the shallow bay is a dynamic ecosystem driven by close coupling of the water column with the processes taking place in its bottom sediments. Aller and co-investigator **Dr. Christopher Gobler** are studying the role of sediments in nitrogen cycling and eutrophication in the Peconic Estuary, a system of bays on eastern Long Island. Over the last three decades, the bays have seen an increase in nuisance or harmful algal blooms— first brown tide and more recently, red tide. This may indicate that there are more nutrients in the water, perhaps caused by nitrogen-rich runoff and groundwater inputs which hasten the process of eutrophication and "feed" algal blooms.

As part of a two-year project funded by NYSG, the research team (including Sea Grant Scholars **Chuck Wall** and **Stuart Waugh**) is characterizing Great Peconic Bay and measuring remineralization and the amount of nitrogen gas produced in its bottom sediments. Nitrogen gas (N_2) is produced during important microbial processes known as denitrification and *anammox*—the latter short for **anaerobic ammonium oxidation**. After the first sampling season, the team found that microbes in the sediment are mainly converting the proteins that come from decaying marine plankton into N_2 rather than from organic matter from the land. This important finding indicates that the system is governed largely by chemical processes taking place in the water and not by an external supply of organic material in runoff from the land.

Preliminary research shows that most of the decomposition of organic material is initially through anaerobic pathways, that is, without oxygen. Then resulting products—ammonium and hydrogen sulfide (think rotten eggs)—are re-oxidized by the oxygen gas that penetrates the sediment. Says Aller, "The sediment is characterized by mud and sand riddled with tubes and worms creating a well-ventilated seabed. This makes for highly active benthic communities and efficient re-oxidation." The researchers found the highest penetration of oxygen into the sediment was in the fall and winter.

Data so far indicate that as decomposition of marine plankton takes place during spring and summer, ratios of nitrogen and carbon remain steady, but in the fall there is a possible depletion of nitrogen relative to carbon, suggesting a sedimentary "sink" for nitrogen. The lowered nitrogen production rate during the fall depends on remineralization of organic material that has settled to the bottom previously. At this same time, there is decreased productivity in the water column as you would expect with the change of season. Says Aller, "We see evidence that in the fall, the sediment system begins to switch from a state of net N_2 production (denitrification) to N_2 fixation. In our second year of study spearheaded by Stuart Waugh, we are trying to confirm this apparent seasonal pattern."

—Barbara A. Branca