Sippewissett Association

Newsletter

Woodneck Beach Study

Nutrient Results

By Arthur G. Gaines and Elizabeth H. Gladfelter

Betsy Gladfelter and Courtney Bird of the Falmouth Conservation Commission initiated a study of Woodneck Beach in 2006. The main part of that study, on sand movement and flushing of the estuary, was completed by Applied Coastal Research and Engineering in late 2008. Ancillary studies by volunteers have been conducted to address remaining issues. This report gives some of the results of research we conducted in 2007 on nutrient exchange between the marsh complex and Buzzards Bay. Future reports will address other results.

The Woodneck tidal marsh complex, or system (Fig. 1), incorporates three brackish habitats: salt-marshes (intertidal flats dominated by grass plants); a network of marsh creeks (conveying tidal flow); and a brackish pond (characterized by standing water with a muddy bottom habitat). This marsh complex occupies a pre-existing glacial landform, now flooded by the rising sea. It is protected from offshore waves by a barrier beach and is connected to Buzzards Bay through a permanent tidal inlet that penetrates the beach.

Tidal water, flowing into and out of the marsh twice a day, amounts to about 400,000 cubic yards/day. Incorporated into this volume is about 7,400 (summer) to 11,000 (winter) cubic yards of fresh water entering the system as groundwater discharge around the margins of the marsh complex and in the creek beds. This is then discharged into Buzzards Bay with the ebb tide. There are no streams entering this marsh complex. During our study the salt content of the water varied from extremes of 29–32 o/oo (2.9 to 3.2 %).

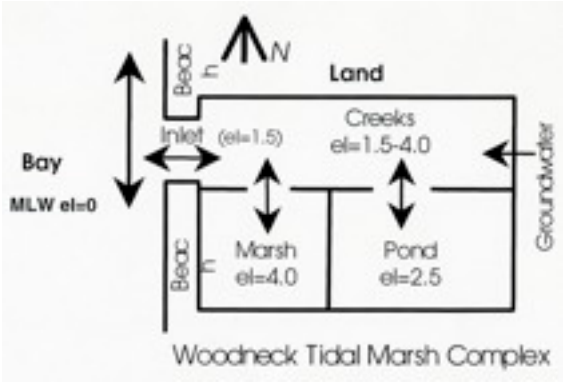

Figure 1. Woodneck Tidal Marsh Complex.

Dissolved materials in the groundwater and in the tidal water entering from Buzzards Bay are processed by biological and chemical actions that capture some dissolved materials and release others, both organic and inorganic materials. Some of the resulting products, living and nonliving, are retained within the system and some are exported to Buzzards Bay.

In addition, sand moving past the inlet can be driven into the estuary by flood currents and deposited within the creek and pond habitats. This process is expedited by the fact that flood currents are on average about 1 mph stronger than ebb currents. In addition, waves outside the

(*Continued on page 2)*

The mission of the Sippewissett Association is to: protect and foster the mutual benefit and interests of landowners of the Sippewissett region of the Town of Falmouth, Massachusetts; to promote and encourage cooperation among such landowners in order to ensure that the future development of said region shall be in keeping with its general residential zoning restrictions and to take whatever action or actions may be necessary to this end; and to protect and prevent the misuse of public and common areas in the Sippewissett region.

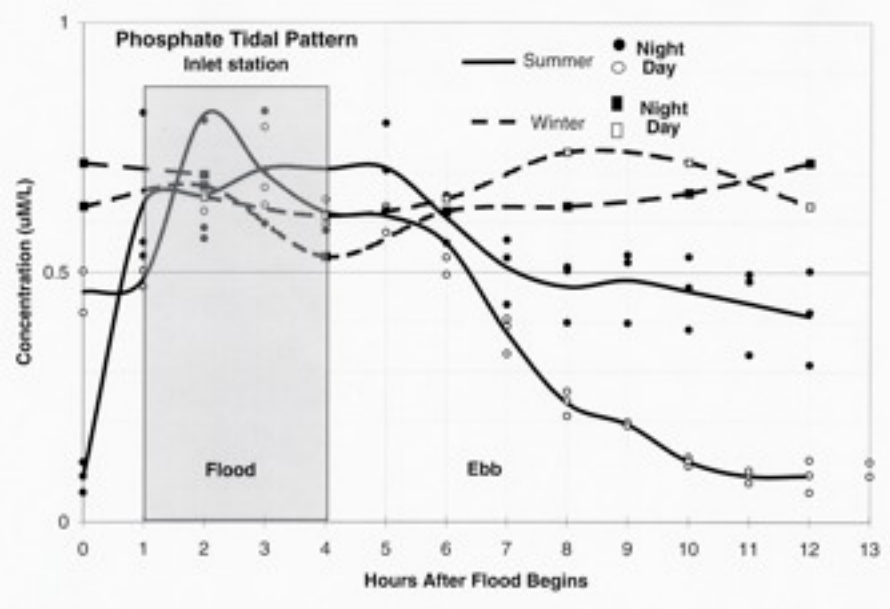

Figure 2. Phosphate Tidal Pattern.

estuary (which are absent inside the estuary) can mobilize beach sand, which is then deposited in the tranquil waters inside. Judging from aerial photographs, this process is particularly active when sand is artificially added to the beach.

The form of the tide wave entering the Woodneck marsh complex is distorted by the 3-D geometry of the embayment such that while flood in Buzzards Bay lasts 6.2 hours, flood at the inlet lasts only 4.1 hours and flood in the pond lasts 3.1 hours. This partly results from the fact that the inlet is perched behind a sill 1.5 feet above the mean low water level of Buzzards Bay and flood at the inlet doesn't begin until the bay tide has risen 1.5 feet. The pond resides behind a sill at an elevation of 2.5 feet, with a further delay in onset of flood. Finally, the marsh table lies over 4.0 feet elevation and floods for only a very short, but for marsh grasses, an environmentally crucial time.

Conversely, ebb from the pond lasts 9.3 hours and ebb at the inlet 8.3 hours. At full low tide in the bay the entire marsh system is draining (ebbing) and much of the creek network is nearly dry.

Our nutrient study was based on hourly water samples taken at two stations (at the inlet and in the pond) over three days during the summer, and again at two hourly intervals for one day in the winter. (The winter study was coordinated by Abby Gove for her high school science project). Thus, our results had a seasonal perspective.

The results show that in summer, phosphorus concentration was always higher in incoming water than ebbing water (Fig. 2). The net amount of phosphorus imported from Buzzards Bay from this imbalance amounted to 5.6 lbs/day (Table 1).

In contrast, in winter (dashed line) phosphorus was neither imported nor exported; phosphorus merely sloshed in and out with the tide at a more or less constant concentration, with no net flux.

These observations are consistent with the idea that biological activity in winter is low, so biota of the marsh complex was not taking up much phosphorus. During summer, however, plant activity and phosphorus uptake is strong. It is also consistent with the observation that phosphorus is not delivered to the marsh complex by groundwater discharge.

Table 1. Import (+) or export (-) of nutrient elements at the Woodneck Marsh Complex (lbs/day; S=summer, W=winter)

		Flux at Inlet	
		S	W
Phosphorus	Phosphate	+ 5.6	- 0.8
Nitrogen	Nitrate	+ 0.2	- 5.6
	Ammonia	- 6.1	- 1.6
	Total dissolved inorganic	- 5.7	- 7.2
	Dissolved organic	-57	
	Particulate organic	-25	
	Total organic	-82	
	Total nitrogen	-69/–88	
Silicon	Dissolved silica	-85	-215
Carbon	Particulate organic	-123	

Last Call for Wintering Birds

By Molly Cornell

Birds are on the move in Falmouth, now that the season has definitely swung from short winter days to longer daylight hours. The wintering shorebirds that we've seen on the beach (sanderlings, dunlins, turnstones), and the waterfowl in the bay (Brant geese, eider ducks, scoters and red-breasted mergansers) will be gone before you know it.

Replacing these and other winter visitors will be familiar birds returning from the south. First to come will be the male redwing blackbirds. Listen for them in the phragmites. Piping plovers are due as early as mid-March. Expect the osprey to return around St. Patrick's Day.

Warmer days are really here with the arrival of the first terns. Get out for a walk and enjoy the scene and sounds of spring!

A Ruddy Turnstone in breeding plumage.

Aquaculture Update

By Eric Matzen

For the oyster growers of Sippewissett, this winter has been a time for maintaining boats and making plans for the future. The few days we did spend on the water made us appreciate what a different place Buzzards Bay is during the winter—very little boat traffic, incredible seabird populations, and even icebergs for a while.

The oysters have fared well through the winter storms, and we believe that we have a good handle on the operations going into our second growing season. We are all looking forward to this planting season, which should begin in April.

As mentioned in the Summer 2010 Sippewissett Association newsletter, oyster growers of the town have established the Falmouth Shellfish Cooperative, and we are completing a brand-new temperature-controlled shellfish facility. The certified facility will ensure the oysters stay as fresh and clean as the second they left the water, and will allow us to provide the best possible product to our customers.

Last September, Coonamessett Farm hosted a Sea Chanty Buffet and Oyster Fest. Keeping to their "locally grown" theme, fresh oysters on the half shell grown by the Falmouth Shellfish Cooperative were featured. In my opinion, it would be very hard to find a similar event or menu—anywhere. Three shuckers worked for hours to keep up with the demand. By the end of the night we had received many compliments on our oysters, but the best compliment was being sold out.

You can contact your local grower by e-mail at Falmouth.Shellfish@gmail.com or through the Sippewissett Association.

Under ordinary conditions, phosphate compounds tend to be captured in sediments of the aquifer. Because phosphorus is an essential nutrient (and based on the average composition of organic matter in the sea), this summer uptake of phosphorus within the marsh complex could support a productivity of about 276 pounds of organic matter (dry weight) per day by algae and plants.

Another striking result was that phosphorus in water ebbing from the marsh complex during the day (open circles) was much lower in concentration than for water ebbing at night (filled circles). This result indicates, not surprisingly, that the uptake of phosphorus in the marsh system was a result of processes driven by photosynthesis such as by phytoplankton, grasses, and benthic algae.

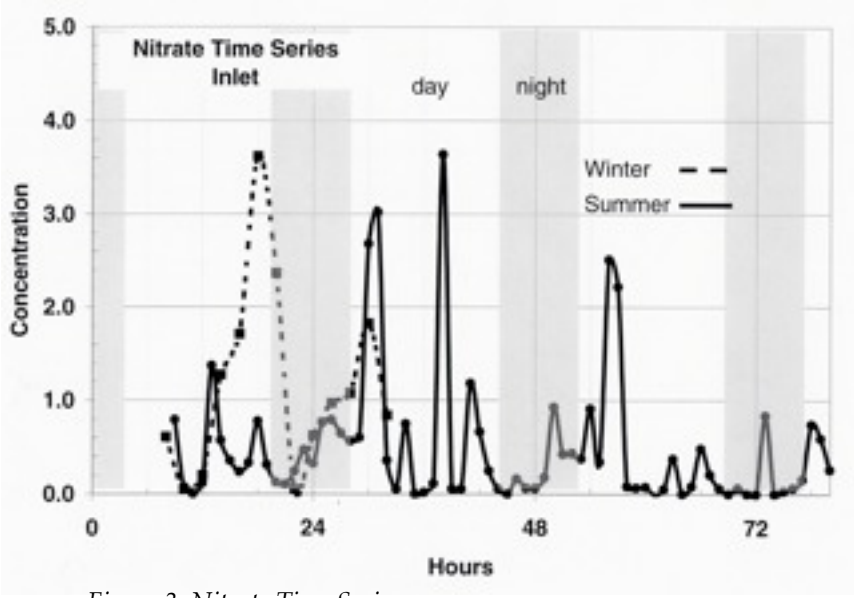

Figure 3. Nitrate Time Series.

Results for nitrogen, a second important nutrient, were far more complex. Unlike phosphorus, nitrogen is not captured within the aquifer and is commonly discharged as dissolved nitrate with groundwater. The pattern of nitrate concentration at the inlet varied with the dark–light cycle and with the tidal cycle. Its concentration typically showed four peaks per day and always ended the day at low levels (Fig. 3).

Our measurements during summer indicate nitrate entered Woodneck marsh with flood water from Buzzards Bay in equal amounts as lost during ebb with a net flux of zero (Fig. 4). During winter, however, the export of nitrate was significant, amounting to 5.6 lbs/day (Table 1), probably because nitrate entering the system was not utilized during the cold months.

A second important form of nitrogen, ammonia, behaved in exactly the opposite way—exported in summer and not in winter. Because ammonia is typically the product of active mineralization by living organisms, this pattern once again probably reflects the effect of colder temperatures in winter on slowing biological activity.

Much more important than either nitrate or ammonia was the summer flux of dissolved and particulate organic forms of nitrogen (winter measurements of these materials were not made), whose export to the bay amounted to more than 10 times the flux of ammonia–nitrogen. Although nitrate and ammonia are known to

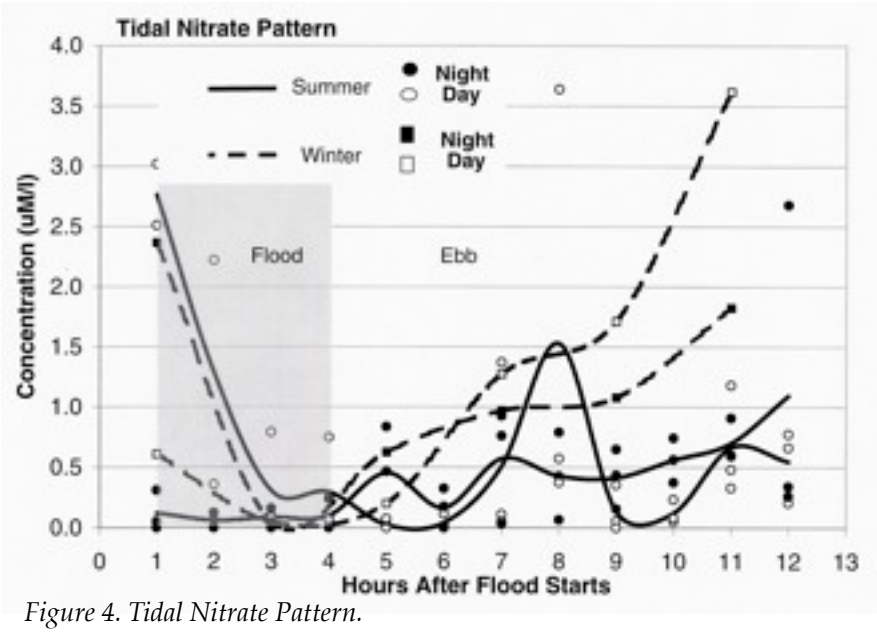

Figure 4. Tidal Nitrate Pattern.

serve readily as nutrients for plant growth, the role of organic nitrogen is not as clear. Some forms of organic nitrogen, such as urea, are known to support plant growth, but others in the complex mixture of compounds making up "organic nitrogen" are not as readily available to plants.

Silica, another nutrient important to some plant groups, is exported in large quantities from the marsh system. Dissolved silica is not a product of human activities. This nutrient supports growth of diatoms and silicoflagellates that can be important components of the plankton and aquatic food web. The excess export of silica during winter (215 lbs/day) over summer (85 lbs/day) suggests some silica is used within the marsh complex during the warm months.

Finally, particulate organic carbon, both living and dead, was exported in summer, amounting to 123 lbs/day. This material would serve as food for filter feeders in the bay, such as zooplankton, shellfish, and others residing on the bottom—even certain fish that can trap particles. This is equal to about one-half the organic matter formed within the marsh from imported phosphorus.

The picture emerging from this study may be typical of many marshes and estuaries. In open water, detrital food webs, the principal source of nutrients, is mineralization and recycling of nutrients from once-living material in the same habitat. Therefore, the balance of nutrients provided is the same as that needed for growth.

In the Woodneck Marsh system, however, different nutrients are derived from different sources (the land versus the sea) so their ratio is not usually in balance with that required for plant growth.

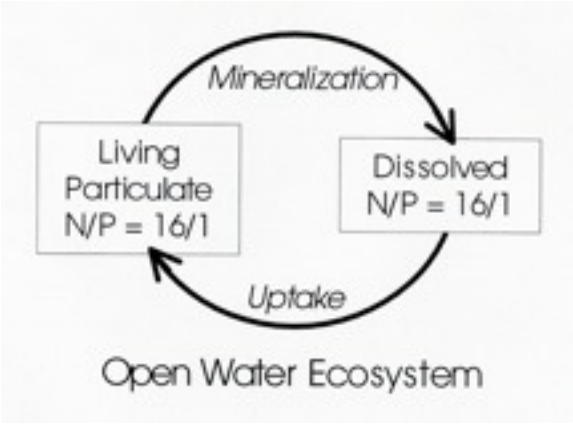

Figure 5. Open Water Ecosystem.

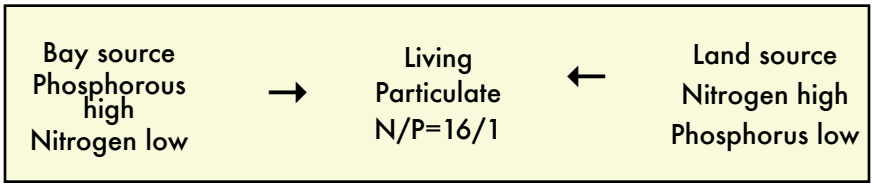

Figure 6. Woodneck Marsh System

Even in this small study it is clear that nitrogen takes many forms that can be interconverted. The results presented in this report do not address several possible fluxes of nutrient materials important to the marsh system. Exchanges of nitrogen with the atmosphere (such as denitrification and nitrification) and recycling of nutrients within the marsh system are just two examples. Fluxes of particles, as we have measured them, do not include large particles such as seaweeds or fish, both of which were seen moving in and out of the inlet.

We are very grateful to the many volunteers who stood watches around the clock to collect samples for this study.

In Remembrance

We are saddened to report that William B. Cooper, Jr., of Sippewissett, passed away on January 5, after a brief illness. He was 83. Bill leaves his wife of 63 years, Judith (Eldred) Cooper, who had been very active in the Sippewissett Association.

Although born in Brooklyn, New York, Bill always felt that Cape Cod was his home. When he first sailed into Quissett Harbor, in 1944, he found, in his words, "a little bit of Heaven."

While employed at the Woods Hole Oceanographic Institution, Bill sailed on the original research vessel *Atlantis*.

He was a renowned wooden boat builder, and in 1965, he started his own boat building and repair business

He served as a Falmouth Town Meeting member for many years. In 2000, he organized the Woods Hole Museum Small Boat Restoration Program and served as one of its instructors until his death.

Beat the Winter Blues

Join the Sippewissett Association for its
Winter Social, Sunday, March 27, 2:30–5 p.m.,
at the Quarterdeck Restaurant, 164 Main Street.
Light refreshments will be served.
Cash bar—after first round on the house!

The Sippewissett Association
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