

## **The System Wide Monitoring Program (SWMP or "Swamp") At the Narragansett Bay Research Reserve**

As one of 27 Reserves in the National Estuarine Research Reserve System's (NERRS), the Narragansett Bay Research Reserve participates in the System Wide Monitoring Program (SWMP). All 27 Reserves are participating in this effort to develop long-term data sets in the 27 estuaries, to track changes in water quality, plants and animals, and habitats over time. Initiated in 1995, SWMP is probably the only monitoring program in the country to have such a long-term monitoring program. All 27 Reserves follow the same protocols for data collection, lending the data excellent reliability and the ability to be compared from different areas around the country.

The first phase of SWMP is to track water quality, weather conditions, and amounts of chlorophyll and nutrients in the bay over time. Every day of the year, information about water quality is collected at **four sites** around Prudence Island **every 15 minutes**. This information is collected by water quality data loggers (also known as Sondes).

Water quality data collected at one of the four SWMP stations around NBNERR and from the Reserve's weather station data is used as part of the Integrated Ocean Observing Systems (IOOS) system. IOOS is a system created by Ocean.US, a federal interagency office supported by ten agencies including NOAA. The Integrated Ocean Observing Systems is described here: [http://www.ocean.us/what\\_is\\_ioos](http://www.ocean.us/what_is_ioos)



*T-Wharf SWMP Station*

All 27 Reserves contribute SWMP data to IOOS which is collected hourly and transmitted to the internet via satellite telemetry where it is available as first-draft data. You can see this near real-time weather and water quality data on the NERRS' Centralized Data Management Office's website: <http://cdmo.baruch.sc.edu/QueryPages/googlemap.cfm>. For researchers interested in accessing a more carefully quality assured dataset, please contact Daisy Durant, the Reserve's Marine Research Specialist at [daisy@nbnerr.org](mailto:daisy@nbnerr.org)

### **Water Quality Parameters**

When the dataloggers are in the water they collect information about a number of different factors, or parameters, including temperature and depth. Below is a list of some of the other water quality parameters and why they are being recorded.

**Dissolved Oxygen** – Oxygen concentrations in seawater display both daily and seasonal fluctuations. Daily variations are due to changes in the tides, in temperature, and in the photosynthetic activity of plants. Oxygen levels typically peak during the daylight hours as plants are photosynthesizing. At night oxygen levels decrease because plants stop photosynthesizing. Seasonal and monthly changes are reflected in the tides, day lengths, and temperatures. High levels of dissolved oxygen in seawater (supersaturation) can be harmful to fish, causing capillaries in fish gills to rupture or tear. Of greater concern in Narragansett Bay are low levels of dissolved oxygen known as **hypoxia**. Hypoxic conditions in the Bay may cause fish to suffocate and can harm the development of juvenile fish. Hypoxic areas also tend to support a lower diversity and abundance of organisms. Dissolved oxygen levels are therefore critical to the health of the Bay.

**Salinity** – Salinity refers to the amount of dissolved salts in seawater and is usually expressed in parts per thousands (PPT). Salinity levels in an estuary vary daily, seasonally, or with tidal cycles. Salinity levels can rise on hot sunny days when there is a lot of fresh water being evaporated which leaves behind the salt. The formation of sea ice will also raise salinity levels. On the other hand, salinity can be reduced by large amounts of rain or snow which increase the flow of freshwater entering the estuary from rivers and creeks. Salinity changes occur throughout an estuary, from the river to the open ocean. The species of plants and animals that inhabit an area are influenced by salinity.

**pH** – The pH of a solution specifies whether it is acidic (pH = 0 to < 7), neutral (pH = 7), or alkaline (pH = > 7 to 14). Daily and seasonal fluctuations in pH levels in estuaries are affected by photosynthesis of phytoplankton and by temperature. Aquatic organisms generally live within specific optimal pH ranges. If the pH level of the water changes then the distribution of these organisms will also change. Extreme fluctuations in pH may be toxic.

**Turbidity** – Turbidity is a reduction in the clarity of water due to the presence of particles suspended in the water column. Generally, sediments such as silt and clay which are transported into the estuary by river systems are responsible for high turbidity conditions, although organic material can also play a role. High turbidity limits the amount of light that can penetrate through the water and therefore influences the vertical distribution and productivity of phytoplankton, eelgrass, and large algae known as macroalgae.

**Chlorophyll** – Chlorophyll is a green-colored pigment that plants use to help make their own food from the sun and various nutrients. This process is known as photosynthesis. In the ocean and estuaries, microscopic plant plankton known as phytoplankton are suspended in the water column and use chlorophyll to photosynthesize. By measuring the amount of chlorophyll in the Bay, the Reserve is measuring the levels of photosynthetic activity in the water. This is generally seasonally dependent with chlorophyll levels being higher in the sunny summer months when phytoplankton are actively photosynthesizing. However, high chlorophyll levels can also indicate high levels of stormwater runoff pollution entering the Bay. After a heavy rain, polluted, nutrient loaded, runoff from roads, farms, building sites and poorly designed sewage treatment systems enters the Bay. All of these nutrients increase the rates of photosynthesis and can cause phytoplankton blooms. By measuring levels of chlorophyll in the water, the Reserve can detect these pollution related phytoplankton blooms.

## Nutrient Sampling

In addition to the parameters listed above which are measured by stationary data loggers, water samples are taken monthly at each of the four water quality sites around the Research Reserve.



Two different types of samples are taken. The first are called grab samples and are replicate samples taken by hand to look at nutrient differences between the four monitored sites. The second sample type is taken by an automated portable sampler over a 24 hour period at 2 hours and 15 minute intervals to look at nutrient changes throughout a tidal cycle. All the samples are analyzed for chlorophyll, nitrogen, phosphorous, and silicate content.

*At Left: Setting up the automated nutrient sampler*

## NBNERR Weather Station

Weather plays an important role in the natural processes of an estuary. To better understand this relationship, all Reserves in the National Estuarine Research Reserve System have weather stations that collect data on temperature, relative humidity, barometric pressure, rainfall, wind speed and direction, and photosynthetically active radiation (PAR).

Data for all of these weather parameters is collected every five seconds and is averaged as in the case of the temperature, barometric pressure, relative humidity, wind speed and direction, or tallied as in rainfall and PAR, every 15 minutes.

**PORTS on Prudence Island** – In addition to the NERRS SWMP weather data collection equipment stationed at the NBNERR Weather Station, the Reserve hosts one of six **PORTS** (Physical Oceanographic Real-Time System) radio transmitters around Narragansett Bay. PORTS is a program of NOAA's National Ocean Service that supports safe and cost-efficient navigation by providing ship masters and pilots with the accurate real-time information required to avoid groundings and collisions. PORTS is critical to environmental protection, since marine accidents can lead to hazardous material spills that can destroy the bay's ecosystem as well as tourism, fishing, and other industries that depend on a clean, healthy Narragansett Bay.