

# BARNEGAT BAY



## Research to Develop Assessment Methods for Estuarine Narrative Nutrient Criteria



Recent changes to New Jersey's Surface Water Quality Standards include extending narrative nutrient criteria downstream to Barnegat Bay and other estuarine waters in the state. The narrative criteria incorporate descriptive conditions that, when present, impact aquatic life use. Examples include:

- ◆ Objectionable algal densities,
- ◆ Nuisance aquatic vegetation,
- ◆ Diurnal fluctuation in dissolved oxygen or pH indicative of excessive photosynthetic activity, and
- ◆ Detrimental changes in the composition of the aquatic ecosystem.

The Department seeks to define methods that will establish objective measures to assess attainment of the narrative criteria. One of the first actions was to identify all previous research efforts and create an on-line library with all available research on Barnegat Bay. The Department will develop these methods and explore the feasibility of developing numeric translators for the narrative criteria primarily through a comprehensive research plan and a comprehensive hydrodynamic and water quality monitoring and modeling effort. This work, undertaken in furtherance of Points 7 and 9 of the Barnegat Bay Plan, builds on previous and on-going research and is expected to inform development of objective assessment methods and numeric translators for the narrative nutrient criteria. This will be accomplished by using modeling and stressor-response analysis, consistent with USEPA recommendations regarding scientifically defensible empirical approaches for setting numeric criteria to address nitrogen/phosphorus pollution (USEPA 2010). Detailed information on each component of the comprehensive research plan can be found on the following website: <http://www.state.nj.us/dep/dsr/barnegat/research.htm>.

NJDEP has funded two projects that will use empirically collected biological data (i.e., benthic invertebrates and benthic algal diatoms) to develop stressor-response models linked to nutrients (nitrogen and phosphorus).

- ◆ **Benthic Invertebrate Community Monitoring and Indicator Development**  
Gary Taghon, Judy Grassle, Charlotte Fuller, Rosemarie Petrecca, Rutgers University, Institute of Marine and Coastal Sciences
- ◆ **Barnegat Bay Diatom Water-Quality Calibration**  
Mihaela Enache, Don Charles and Marina Potapova; Academy of Natural Sciences of Drexel University

Under the approach used in these projects, a conceptual model representing known relationships between nitrogen (N) and phosphorus (P) concentrations and biological responses must be developed. Based on the conceptual model, stressor-response relationships are estimated be-

tween N and P concentrations and the selected response variables – benthic macroinvertebrates and diatoms. The accuracy of estimated relationships is evaluated with regard to the possible influence of known confounding variables as identified by the conceptual model or by exploratory data analysis. If successful, stressor-response models may identify a threshold at which the biological community is considered impaired as a response to the presence of too much nitrogen and/or phosphorus. The hydrodynamic and water quality modeling work will link pollutant loading with water quality response, including primary productivity. Combining the findings of the inference models with this linkage may inform management decisions regarding the degree to which pollutants need to be reduced to attain a healthy level of primary productivity.

Several other research projects will assess the response of various components of the aquatic community:

- ♦ **Barnegat Bay - Phytoplankton and Harmful Algal Blooms** Ling Ren and Don Charles, Academy of Natural Sciences of Drexel University

This project will investigate the relationship between nutrient loads and phytoplankton and/or toxic/harmful algal blooms.

- ♦ **Benthic-Pelagic Coupling: Hard Clams as Indicators of Suspended Particulates in the Barnegat Bay** V. Monica Bricelj, John Kraeuter, and Gef Flimlin, Rutgers University

This project will assess if changes in food quality (phytoplankton) might be a major factor in the decline of hard clams and if nutrient load reductions might drive a positive trend with respect to the food supply.

- ♦ **Assessment of Fishes and Crabs Responses to Human Alteration of Barnegat Bay** Kenneth W. Able and Thomas Grothues (Rutgers University Marine Field Station) and Paul Jivoff (Rider University)

This project will assess how fish and crabs have responded to the stresses associated with watershed urbanization.

An additional project will build on research already completed by NJDEP (Velinsky et al., 2010), which demonstrated that salt marshes in Barnegat Bay sequester significant amounts of nutrients through sedimentation and accretion.

- ♦ **Wetland Studies of Ecological Function and Adaptation: Denitrification** Tracy Quirk and David Velinsky, Academy of Natural Sciences of Drexel University; Michael Piehler and Ashley Smyth, University of North Carolina

This research will investigate the biogeochemistry within these salt marshes to determine the efficiency of this removal process, and to see if significant denitrification occurs (conversion of nitrate to gaseous nitrogen and removal from the estuarine fluvial system). The marsh studies will core and measure nutrients in sediments going back in time to pre-anthropogenic conditions. This may provide insight into a "reference condition," albeit, one that may not account for the modifications in hydrology over time.

Each of these projects has started with field work scheduled in the spring of 2012 in accordance with an approved Quality Assurance Project Plan (QAPP). Participants

will be required to demonstrate proficiency to ensure that these projects generate useable high quality data. Each is anticipated to go for three years of data collection so as to guarantee enough seasonal and inter-annual data to decrease the uncertainties and develop the robust water-quality-based stressor-response models necessary for regulatory management decisions.

Prior to the Governor's 10 Point Plan, USEPA through the New England Interstate Water Pollution Control Commission provided funding to assist the Department in developing nutrient assessment tools and criteria for estuarine waters. Field data were collected in 2010 and 2011 with project completion estimated for 2012. This project helped identify additional research needs which are now being funded.

- ♦ **Assessment of Nutrient Loading and Eutrophication in Barnegat Bay-Little Egg Harbor, New Jersey in Support of Nutrient Management Planning.** Michael J. Kennish, Richard G. Lathrop Jr. and Benjamin Fertig, Rutgers University and Ronald J. Baker, Robert S. Nicholson and Christine Wieben; USGS

## References

USEPA. 2010. "Using Stressor-response Relationships to Derive Numeric Nutrient Criteria," EPA-820-S-10-001, Office of Science and Technology, Office of Water U.S. Environmental Protection Agency, Washington, DC

<http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/Using-Stressor-response-Relationships-to->



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