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## 2007 Great Bay Organic Nitrogen and Light Extinction Monitoring Program

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**2007 Great Bay  
Organic Nitrogen (PON & DON) and  
Light Extinction (PAR) Monitoring Program**

A Final Report to

The New Hampshire Estuaries Project

Submitted by

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## Table of Contents

|                                       |                   |
|---------------------------------------|-------------------|
| Introduction .....                    | 2                 |
| Project Goals and Objectives .....    | 2                 |
| Methods .....                         | 3                 |
| Results and Discussion .....          | 3                 |
| Conclusions and Recommendations ..... | 4                 |
| References .....                      | 4                 |
| Appendix 1 (Meta-Data) .....          | 5                 |
| Appendix 2 (Data CD) .....            | Inside Back Cover |

## Introduction

Nitrogen is most often considered to be the limiting nutrient for plant growth in marine waters. As a result, knowledge of nitrogen loading and ambient water-column concentrations are considered to be critical to understanding the response of aquatic ecosystems to nutrient over-enrichment—a process known as eutrophication when it results in the excess production of organic matter.

Plant production in many estuarine systems may also be limited by light availability as a result of high levels of turbidity in the water resulting from sediments, dissolved organic matter, and phytoplankton in the water column. Light limitation resulting from human-induced increases in turbidity is known to be particularly deleterious to seagrass production/distribution in some ecosystems and also play an important role in determining how phytoplankton respond to nutrient enrichment.

EPA is developing water quality criteria for estuaries that require knowledge of both total nitrogen and light availability (measured as photosynthetically active radiation, PAR). Through the National Estuarine Research Reserve (NERR) System-Wide Monitoring Program (SWMP), inorganic nutrient concentrations, chlorophyll-a concentration, and a number of hydrographic and water quality parameters are sampled on a monthly basis at 7 sites in the Great Bay system.

This project takes advantage of these existing monitoring activities to collect and analyze for particulate organic nitrogen (PON), dissolved organic nitrogen (DON) and photosynthetically active radiation (PAR) at existing sample sites in the New Hampshire seacoast region. When combined with existing dissolved inorganic nitrogen measurements, PON and DON allow the entire Total Nitrogen (TN) pool to be quantified. PAR measurements provide an estimate of the light availability in the system.

## Project Goals and Objectives

UNH completed this project under contract to the NH Estuaries Project (Project ID #05-M-9). The project goals and objectives per the contract were to:

- (1) Conduct PON, DON, and PAR monitoring for the April – December sampling season at the Lamprey River (LR), Squamscott River (SQ), Chapman’s Landing (CL), Oyster River (OR), Great Bay (GB) and Coastal Marine Lab (CML).

The goal was to provide 84 total measurements for PON and POC, 246 total measurements for DON and 99 total measurements of PAR during the sampling period. The final work product was agreed to be an Excel data file containing hydrographic, PON, DON and PAR data for all of these sites.

## Methods

The methods for this project followed the procedures specified in the approved QA Project Plan (Pennock and Trowbridge, 2003).

## Results and Discussion

Overall, as shown in the table below, we were able to obtain 116 discrete estimates for the attenuation coefficient (PAR), 83 measurements for particulate nitrogen (PN) and 83 measurements of particulate carbon (PC), 237 measurements of total dissolved nitrogen (TDN) and 237 measurements of dissolved organic nitrogen (DON). We performed replicate analyses on all parameters except for PAR (triplicate PAR analyses was performed at 9 stations during the 2007 sampling period.) Laboratory analyses fell within the accepted guidelines detailed in the approved QA Project Plan (Pennock and Trowbridge, 2003).

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| Parameter | Location | Stations | Analyses | Mean   |
|-----------|----------|----------|----------|--------|
| PAR       | All Data | 98       | 98       | -1.46  |
| PAR       | QA       | 9        | 27       | -1.36  |
| POC       | All Data | 42       | 83       | 0.6831 |
| PON       | All Data | 42       | 83       | 0.0913 |
| TDN       | All Data | 107      | 237      | 0.3592 |
| DON       | All Data | 107      | 237      | 0.1924 |

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The CD included with this report contains data files in an Excel format that is consistent with NERR SWMP CDMO requirements. Included are the following required parameters for this project: Record #; Sample Date; Site/Station Name; Tidal Stage; Bottom Depth; Temperature; Salinity; Oxygen Concentration; Oxygen Percent Saturation; pH; Total Dissolved Nitrogen (TDN); Dissolved Organic Nitrogen (DON); Particulate Organic Carbon (POC); Particulate Organic Nitrogen (PON); and Attenuation Coefficient ( $K_d$ ).

Please note that for analyses that were above zero and below the MDL, a value of one-half the MDL was inserted into the raw data file (0.01 for DON). Negative values were omitted from the data file and flagged with a "D". The attached CD contains an excel file with 4 worksheets: (1) Processed 2007 Data for relevant NHEP stations; (2) PAR QA/QC data; (3) Raw Complete Data Set for 2007; and (4) Raw nutrient results from analytical laboratory.

Differences between POC, PON and TDN replicate samples were compared to data quality objectives of 30% RPD and 0.5, 0.1 and 0.5 mg/L, respectively. Replicate samples that failed both tests should be rejected.

Data contained in this file are scheduled to be submitted to NERR CDMO by June 15<sup>th</sup>, 2008. It is subject to review and potential revision by the NERR CDMO.

### Conclusions and Recommendations

The PON, DON and PAR monthly monitoring program provides important data on nitrogen concentration and light availability in the Great Bay estuary. When combined with the NERRS SWMP program, these data provide comprehensive coverage of the Great Bay estuary and allow total nitrogen concentrations to be calculated for use in nutrient criteria measurements.

### References

Pennock and Trowbridge (2003) UNH Nutrient and Light Extinction Monitoring Program Quality Assurance Project Plan, Version 4, Final. University of New Hampshire and NH Estuaries Project, August 8, 2003.

## 2007 Organic Nitrogen (PON & DON) and Light Extinction (PAR) Monitoring Program Meta-Data (Appendix 1)

### Research Methods

Monthly monitoring is conducted during ice-free seasons (generally April through December) as part of the GB NERR System-Wide Monitoring Program and National Coastal Assessment at the following locations:

| Funding Source | Station Name                 | Station ID | Tide Stage | Lat Deg | Lat Minute | Long Deg | Long Minute |
|----------------|------------------------------|------------|------------|---------|------------|----------|-------------|
| NERR           | Adams Point                  | AP         | L&H        | 43      | 5.495      | 70       | 51.821      |
| NERR           | Great Bay                    | GB         | L          | 43      | 4.367      | 70       | 52.311      |
| NERR           | Lamprey River                | LR         | L&H        | 43      | 4.697      | 70       | 56.092      |
| NERR           | Oyster River                 | OR         | L&H        | 43      | 8.400      | 70       | 54.100      |
| NERR           | Squamscott Railroad Bridge   | SQ         | L          | 43      | 3.182      | 70       | 54.754      |
| NERR           | Squamscott Chapman's Landing | CL         | L&H        | 43      | 2.500      | 70       | 55.569      |
| NERR           | Coastal Marine Lab           | CML        | L&H        | 43      | 4.350      | 70       | 42.640      |

Samples are generally collected by small boat except for the Coastal Marine Lab site, which is accessed by vehicle. During certain periods of particularly stormy weather or when the channel markers are not present (generally early and late season), a subset of the normal stations may be sampled by vehicle; these cases are noted in the meta-data.

At each station, a hand-held YSI multi-probe is used to measure temperature, salinity, dissolved oxygen, and dissolved oxygen percent saturation in the surface water (~0.5m). Nutrient samples are collected in acid-washed and DI-water rinsed 1-liter HDPE bottles at ~0.5m depth, placed on ice in a cooler and processed upon return to the laboratory. Photosynthetically Active Radiation (PAR) profiles are made at as many stations as possible using a LiCor Quantum Irradiance Meter.

All nutrient processing and analysis methods and PAR profiling methods are detailed in the 2003 UNH Nutrient and Light Extinction Monitoring Program Quality Assurance Project Plan (Pennock & Trowbridge, 2003).

### Deviations in Sampling Procedures for 2007

#### January

- Icing Conditions; only AP samples collected (no PAR).

#### February

- Icing Conditions; only AP samples collected (no PAR).

#### March

- Icing Conditions; only AP samples collected (no PAR).

#### April

- NERR samples collected by vehicle due to the lack of channel markers.
- Limited PAR measurements taken as a result of vehicle-based sampling.

#### May

- Limited vehicle-based sampling due to extreme flooding conditions.

#### June

- No PAR taken at ORL; too shallow.

#### July

- Many missing PAR values due to LiCor instrument malfunction.

#### August

- Many missing PAR values due to LiCor instrument malfunction.

#### September

- No PAR taken at OR (low tide); too shallow.

#### October

- No PAR taken at ORL, CLL, CLH; too shallow (CL accessed by vehicle).

#### November

- Vehicle-based sampling; limited PAR measurements as a result of shallow water.

#### December

- No PAR taken, rough sampling conditions.