



University of New Hampshire  
University of New Hampshire Scholars'  
Repository

PREP Reports & Publications

Institute for the Study of Earth, Oceans, and Space  
(EOS)

7-13-2010

# UNH Eelgrass (*Zostera marina*) Monitoring Program for 2010-2014: Quality Assurance Project Plan

Frederick T. Short

*University of New Hampshire, Jackson Estuarine Laboratory, fred.short@unh.edu*

Phil Trowbridge

*NH Department of Environmental Services*

Follow this and additional works at: <https://scholars.unh.edu/prep>

 Part of the [Environmental Sciences Commons](#)

## Recommended Citation

Short, Frederick T. and Trowbridge, Phil, "UNH Eelgrass (*Zostera marina*) Monitoring Program for 2010-2014: Quality Assurance Project Plan" (2010). *PREP Reports & Publications*. 350.  
<https://scholars.unh.edu/prep/350>

This Report is brought to you for free and open access by the Institute for the Study of Earth, Oceans, and Space (EOS) at University of New Hampshire Scholars' Repository. It has been accepted for inclusion in PREP Reports & Publications by an authorized administrator of University of New Hampshire Scholars' Repository. For more information, please contact [nicole.hentz@unh.edu](mailto:nicole.hentz@unh.edu).

**UNH Eelgrass (*Zostera marina*) Monitoring Program for 2010-2014  
Quality Assurance Project Plan**

July 13, 2010  
FINAL

*Prepared by:*

**Fred Short, Ph.D.**  
**Jackson Estuarine Laboratory**  
**University of New Hampshire**  
**Durham, NH**

**Phil Trowbridge**  
**PREP Coastal Scientist**  
**Department of Environmental Services**  
**Concord, NH**

---

Program Manager:

\_\_\_\_\_  
Signature / Date  
Fred Short, Ph.D., UNH

Project QA Officer:

\_\_\_\_\_  
Signature / Date  
Nicole Sarrette, UNH

NHDES Quality Assurance Manager:

\_\_\_\_\_  
Signature / Date  
Vincent Perelli, NHDES

PREP/NHDES Project Officer:

\_\_\_\_\_  
Signature / Date  
Phil Trowbridge, PREP/NHDES

PREP Director:

\_\_\_\_\_  
Signature / Date  
Rachel Rouillard, PREP

USEPA Project Officer:

\_\_\_\_\_  
Signature / Date  
Jean Brochi, US EPA Region I

USEPA QA Manager:

\_\_\_\_\_  
Signature / Date  
Steve DiMattei, US EPA Region I

**A2 – Table of Contents**

A2 – Table of Contents ..... 2  
 List of Tables ..... 2  
 List of Figures ..... 2  
 A3 – Distribution List ..... 3  
 A4 – Project/Task Organization ..... 3  
 A5 – Problem Definition/Background ..... 5  
 A6 – Project/Task Description ..... 6  
 A7 – Quality Objectives and Criteria ..... 7  
 A8 – Special Training/Certification ..... 7  
 A9 – Documents and Records ..... 7  
 B1 – Sampling Process Design ..... 8  
 B2 – Sampling Methods ..... 8  
 B3 – Sample Handling and Custody ..... 8  
 B4 – Analytical Methods ..... 8  
 B5 – Quality Control ..... 9  
 B6 – Instrument/Equipment Testing, Inspection, Maintenance ..... 9  
 B7 – Instrument/Equipment Calibration and Frequency ..... 9  
 B8 – Inspection/Acceptance Requirements for Supplies and Consumables ..... 9  
 B9 – Non-direct Measurements ..... 9  
 B10 – Data Management ..... 9  
 C1 – Assessments and Response Actions ..... 9  
 C2 – Reports to Management ..... 10  
 D1 – Data Review, Verification and Validation ..... 10  
 D2 – Verification and Validation Procedures ..... 10  
 D3 – Reconciliation with User Requirements ..... 11  
 References ..... 11

**List of Tables**

Table 1. QAPP Distribution List ..... 3  
 Table 2. Project Schedule Timeline ..... 6  
 Table 3. Special Personnel Training Requirements ..... 7

**List of Figures**

Figure 1. Project organizational chart ..... 4

### A3 – Distribution List

Table 1 presents a list of people who will receive the approved QAPP, the QAPP revisions, and any amendments.

**Table 1. QAPP Distribution List**

QAPP Recipient Name	Project Role	Organization	Telephone number and Email address
Fred Short	Program Manager	UNH Jackson Estuarine Laboratory	603-862-5134 <a href="mailto:fred.short@unh.edu">fred.short@unh.edu</a>
Nicole Sarrette	Project QA Officer and GIS staff	UNH / JEL	603-862-5121 <a href="mailto:nsarrette@hotmail.com">nsarrette@hotmail.com</a>
Phil Trowbridge	PREP/NHDES Project Officer	NHDES Watershed Management Bureau	603-271-8872 <a href="mailto:Philip.Trowbridge@des.nh.gov">Philip.Trowbridge@des.nh.gov</a>
Vincent Perelli	NHDES Quality Assurance Manager	NHDES Office of the Commissioner	603-271-8989 <a href="mailto:vincent.perelli@des.nh.gov">vincent.perelli@des.nh.gov</a>
Jean Brochi	USEPA Project Manager	USEPA New England	617-918-1536 <a href="mailto:brochi.jean@epa.gov">brochi.jean@epa.gov</a>
Steve DiMattei	USEPA Quality Assurance Officer	USEPA New England	617-918-8369 <a href="mailto:DiMattei.Steve@epa.gov">DiMattei.Steve@epa.gov</a>
Rachel Rouillard	PREP Director	Piscataqua Region Estuaries Partnership (PREP)	603-862-3948 <a href="mailto:rachel.rouillard@unh.edu">rachel.rouillard@unh.edu</a>

Based on EPA-NE Worksheet #3

### A4 – Project/Task Organization

The project will be completed by the UNH Jackson Estuarine Laboratory, Seagrass Ecology Lab. Fred Short is the Program Manager for UNH and is the primary contact for UNH. Fred Short will be responsible for coordinating all program activities. This work is being done under contract for PREP so the Program Manager will be accountable to the PREP Coastal Scientist (Phil Trowbridge) and the PREP Director (Rachel Rouillard). The U.S. Environmental Protection Agency provides funding to the Piscataqua Region Estuaries Partnership. Jean Brochi is the project manager for EPA.

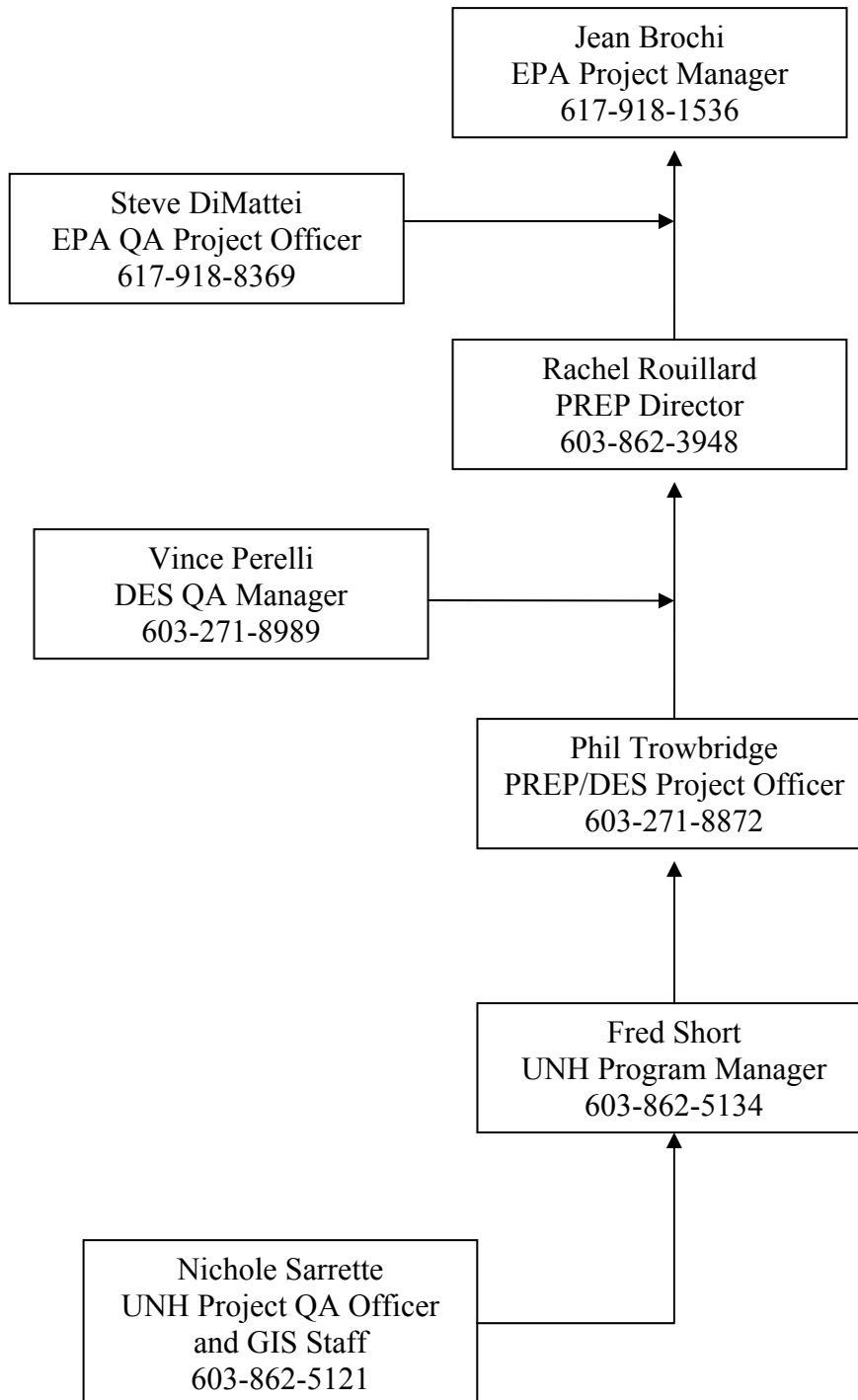
Daily operations of the project will be managed by the Program Manager. The Program Manager will manage all field staff, be responsible for “stop/go” decisions in the field, coordinate data analysis and will be responsible for all final products. The Seagrass Ecology Lab retains intellectual property rights to the data from the project and may use these

The Project QA Officer will be Nicole Sarrette. The QA Officer will be responsible for a memorandum to the Program Manager summarizing any deviations from the procedures in the QA Project Plan, the results of the QA/QC tests, and whether the reported data meets the data quality objectives of the project. This memorandum should clearly state whether any data should be rejected because they did not pass QA tests. The Program Manager will be responsible for resolving any logistical problems.

The principal users of the data from this project will be the PREP staff and NHDES. The Program Manager will submit a report to the PREP/NHDES Coastal Scientist and the PREP Director at the end of the project with all the data and the QA Officer’s summary report.

Figure 1 shows an organizational chart for this project.

**Figure 1. Project organizational chart**



## A5 – Problem Definition/Background

Eelgrass (*Zostera marina*) is essential to estuarine ecology because it filters nutrients and suspended particles from water, stabilizes sediments, provides food for wintering waterfowl, and provides habitat for juvenile fish and shellfish, as well as being the basis of an important estuarine food web. Healthy eelgrass both depends on and contributes to good water quality.

The UNH Seagrass Ecology Lab, has mapped the distribution of eelgrass every year from 1986 through 2009 in the Great Bay. The entire Great Bay Estuary (Great Bay, Little Bay, tidal tributaries, Piscataqua River, Little Harbor, and Portsmouth Harbor) was mapped by these researchers in 1996 and from 1999 through 2009. In 1989, there was a dramatic crash of the eelgrass beds in the Great Bay itself down to 300 acres (15% of normal levels). The cause of this crash was an infestation of a slime mold, *Labryrinthula zosterae*, commonly called “wasting disease” (Muehlstein et al., 1991). The eelgrass beds recovered following the infestation but have experienced a slow, steady decline since their initial recovery. Between 1990 and 2008, the eelgrass acreage in Great Bay and Little Bay has declined by 37 and 87 percent, respectively. In 2007 and 2008, no eelgrass was found in Little Bay and the Piscataqua River; in Portsmouth Harbor, eelgrass cover has also been declining. All of the eelgrass in the Winnicut River was lost between 1990 and 2008. Eelgrass seedlings and young plants have been occasionally detected at low levels in the other tributaries to Great Bay and Little Bay. However, historical maps indicate that eelgrass formerly existed in these rivers (DES, 2008).

The Piscataqua Region Estuaries Partnership (PREP) coordinates environmental monitoring in the Great Bay Estuary and Hampton-Seabrook Harbor. Maps of eelgrass distribution in the Great Bay Estuary provide useful information on water quality and critical habitats within the estuary and the environmental quality of the system. The PREP has developed a series of environmental indicators to track trends and to evaluate progress toward management goals. Eelgrass distribution is part of the PREP Monitoring Plan to gather data on these indicators (PREP, 2008). PREP intends to contract with UNH-JEL to continue this monitoring program in 2010 through 2014 to ensure that the record of annual eelgrass assessments will be unbroken.

The methods used in this study do not include georectified imagery due to cost constraints. PREP intends to collect georectified imagery approximately every 10 years. Eelgrass was mapped using georectified imagery in 1996 and 2007. After this QAPP expires, PREP intends to establish a new contract with UNH-JEL to collect georectified imagery in 2015 using the protocols from NOAA C-CAP (NOAA, 1995) or its successor guidance.

Maps of eelgrass in the estuary will be used by PREP, the NH Department of Environmental Services, UNH, and other coastal resource managers to evaluate trends in eelgrass populations over time.

## A6 – Project/Task Description

This project has six main tasks:

### 1. Prepare QA Project Plan

A QA Project Plan for eelgrass mapping will be produced by UNH. This plan must be approved by the PREP Coastal Scientist, the DES QA Manager, and EPA Region I before field work on this project begins. The QA Project Plan will be valid for sampling in 2010 through 2014.

### 2. Train Project Staff

Each year, the Program Manager will organize and implement a training session for field and analysis staff. The training session will cover SOPs for field instruments, laboratory instruments, and field data sheets. The training will be based on the QA Project Plan document. Field and laboratory staff will sign an attendance sheet for the training. The training will be completed before sampling begins.

### 3. Acquire Aerial Imagery of the Estuary

Each year, the Program Manager will organize an aerial over-flight in late August or early September to collect aerial imagery of the eelgrass distribution in the estuary at low tide.

### 4. Ground-Truth Aerial Imagery

Each year, the Project Manager will organize field crews to ground-truth the aerial imagery.

### 5. Generate Maps of Eelgrass Distribution

Each year, using aerial imagery and ground-truthing data, the Project Manager will coordinate the analysis and development of eelgrass distribution maps of cover classes (see Section B4).

### 6. Prepare Final Report

Each year, the final work product will be GIS shapefiles of eelgrass distribution throughout the Great Bay Estuary, all necessary documentation/metadata for the shapefiles, and a final report describing the results. See Section C2 for reporting requirements.

**Table 2. Project Schedule Timeline**

Activity	Dates (MM/DD/YYYY)		Product	Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
QAPP Preparation	6/1/10	7/31/10	QAPP Document	8/31/10
Field Team Training	August 1	August 15	Training Documentation	Annual task
Acquire aerial imagery and ground truth imagery	August 16	September 30	Raw aerial imagery, ground-truth observations	Annual task
Final project report preparation	October 1	March 31	Final report	Annual task

Based on EPA-NE Worksheet #10.

## A7 – Quality Objectives and Criteria

This study is primarily acquisition and interpretation of aerial imagery with quality control ground-truthing data. No laboratory measurements will be made.

Precision: +/- 5 m for eelgrass bed boundaries

Accuracy: +/- 5 m for eelgrass bed boundaries

Representativeness: The entire estuarine system will be mapped so the results will be representative of the whole system.

Comparability: The method is compatible with scientific practice and has been described in previously published papers (Short and Burdick, 1996). The method will generally follow the standardized NOAA C-CAP protocol for mapping submerged aquatic vegetation (NOAA, 1995) or its successor documents to remain consistent with scientific practice.

Sensitivity: Aerial imagery should be collected under conditions that are suitable to clearly delineate submerged eelgrass beds.

Completeness: The entire Great Bay Estuary, including tributaries, will be mapped annually.

## A8 – Special Training/Certification

The Program Manager will organize and implement a training session for project staff. The training will be based on the QA Project Plan document. Project staff will sign an attendance sheet for the training, which will be retained by the Program Manager and included in the final report. The training will be completed before sampling begins.

**Table 3. Special Personnel Training Requirements**

Project function	Description of Training	Training Provided by	Training Provided to	Location of Training Records
Eelgrass ground truthing methods	Field method SOPs, and field data sheets. This training will be conducted once at the beginning of the field season.	Program Manager	All project staff.	With Program Manager and included in final report to PREP.

Based on EPA-NE Worksheet #7.

## A9 – Documents and Records

### QA Project Plan

The Program Manager will be responsible for maintaining the approved QA Project Plan and for distributing the latest version to all parties on the distribution list in section A3. A copy of the approved plan will be on file at the PREP offices in Durham, NH and on the PREP website.



### Reports to Management

The Program Manager will provide a final report to the PREP Coastal Scientist. The final work product will be GIS shapefiles of eelgrass distribution throughout the Great Bay Estuary, all necessary documentation/metadata for the shapefiles, and a final report describing the results.

### Archiving

The QA Project Plan and final report will be kept on file with PREP (both in hard-copy and posted on website) for a minimum of 10 years after the publication date of the final report.

## **B1 – Sampling Process Design**

Images will be acquired with a 60% overlap. Typically 300 images are needed to cover the entire Great Bay Estuary. Ground-truthing requirements are discussed in Sections B2 and B5.

## **B2 – Sampling Methods**

Aerial photographs are taken at 3000 feet at low spring tide with roughly 60% overlap on a calm day without preceding rain events and when the sun is at a low angle to minimize reflection (between 7 am and 10 am). Digital photographs are taken in late summer, usually late August or early September, depending on tides and weather, to reflect the maximum eelgrass annual biomass. The orientation of the photographs is near-vertical. The use of near-vertical images, instead of truly vertical images, is a deviation from the C-CAP protocol (NOAA, 1995), but follows a published method (Short and Burdick, 1996).

Ground-truthing observations are made from a small boat within a month of the date of the overflight. The Project Manager navigates to areas in the estuary and checks for the presence of eelgrass and its approximate cover. The presence of macroalgae in these areas is also noted. Observations are recorded in a field notebook. Specific locations are recorded with a hand held GPS unit. The observations are used to identify eelgrass beds from the aerial imagery.

In 10 locations in the estuary, the Project Manager delineates the boundary of an eelgrass bed using a hand-held GPS and a small boat. At least 50 meters of boundary are mapped in each of these locations. These boundaries are compared to boundaries mapped from the aerial imagery to determine the accuracy of the photo interpretation methods.

## **B3 – Sample Handling and Custody**

Not applicable. No water quality or biological samples will be collected.

## **B4 – Analytical Methods**

No laboratory analytical method will be used. Aerial photographs will be interpreted using methods from Short and Burdick (1996) and NOAA (1995) to delineate the boundaries of eelgrass beds. The boundaries of eelgrass beds are then digitized by creating polygons using ArcView or ArcMap GIS software. Each polygon is assigned a percent cover value from the following list: “d” (90-100% cover), “sb” (60-90%), “h” (30-60%), or “p” (10-30%). Code for percent coverage: d = dense; sb = some bottom;

h = half; p = patchy (or sparse). The maps are then adjusted and verified using ground-truthing data (discussed in Section B5).

### **B5 – Quality Control**

The quality of the photo-interpreted eelgrass bed boundaries is checked using ground-truth observations. The 10 bed boundaries mapped using a hand-held GPS (see section B2) are mapped on top of the eelgrass polygons using GIS software. For each of the 10 bed boundaries, the distance between each GPS point and the photo interpreted boundary is calculated. The average distance for all the GPS points in each boundary is then compared to the data quality objectives for precision and accuracy of +/- 5 m.

The ground-truth observations of eelgrass and macroalgae presence in different locations are used to check the photo-interpreted maps for accuracy.

### **B6 – Instrument/Equipment Testing, Inspection, Maintenance**

Not applicable.

### **B7 – Instrument/Equipment Calibration and Frequency**

Not applicable.

### **B8 – Inspection/Acceptance Requirements for Supplies and Consumables**

Not applicable.

### **B9 – Non-direct Measurements**

Not applicable.

### **B10 – Data Management**

GIS files of eelgrass in the estuary will be processed by the PREP Coastal Scientist and then provided with appropriate metadata to NH GRANIT for public distribution. The final report from the UNH Program Manager will be archived on the PREP website.

### **C1 – Assessments and Response Actions**

Review and assessment of all aspects of this project is the responsibility of the Program Manager. The Program Manager will be involved with all aspects of this project. If problems occur, appropriate adjustments will be made. All such changes will be recorded and reported to the PREP Project Manager immediately.

The Project Manager is specifically responsible for assessing that the data quality objectives from section A7 have been met. The precision and accuracy objectives are assessed using the methods from Section B5. The representativeness and completeness objectives are assessed based on whether complete maps of the entire estuary were generated. The comparability and sensitivity methods are assessed based on whether the methods from the QAPP were followed or if there were non-conformances. The results from all of these assessments will be summarized in the final report (see reporting requirements in section C2).

## **C2 – Reports to Management**

The Program Manager will provide the following electronic reports to the PREP, DES, and EPA:

- Interim Report (due by October 31 each year): A one page update on all activities between June 1 and October 31 of that year.
- Final Report (due by March 31 of each year): The final work product will consist of:
  - A final report containing the following sections: Executive Summary, Introduction, Project Goals and Objectives, Methods, Results and Discussion, and Conclusions and Recommendations. The PREP report format (<http://www.prep.unh.edu/programs/grant-guidelines.htm>) will be used. The final report should also include:
    - Quality assurance assessments from section C2.
    - Flight information, specifically the date, start time, end time, weather conditions, tide stage, approximate altitude, photographer, and camera details,
  - A GIS shapefile of the eelgrass distribution throughout the Great Bay Estuary, including a metadata file.
  - Copies (or scans) of notebook pages containing ground-truthing observations and of hand-held GPS coordinates.
  - Raw aerial imagery (digital photographs).

## **D1 – Data Review, Verification and Validation**

The Project QA Officer will review the methods used to acquire, process, and interpret data on eelgrass distributions in the Great Bay Estuary to verify that the methods follow the procedures outlined in this QA Project Plan (Sections A7, B1, B2, B3, B4, and B5). The Project QA Officer will be responsible for a memorandum to the Program Manager summarizing any deviations from the procedures in the QA Project Plan, the results of the QA/QC tests.

## **D2 – Verification and Validation Procedures**

The Program Manager reviews the memorandum from the QA Officer to see if there have been deviations from the QA Project Plan. Any decisions made regarding the usability of the data will be left to the Program Manager; however, the Program Manager may consult with project personnel, the PREP Project Officer, or with personnel from EPA-NE, if necessary.

### D3 – Reconciliation with User Requirements

The Program Manager will be responsible for reconciling the results from this study with the requirements of the study (the ultimate use of the data). Results that are qualified by the Project QA Officer may still be used if the limitations of the data are clearly reported to decision-makers. Data for this project are being collected as part of a long-term monitoring program. It is not possible to repeat sampling events without disrupting the time series. Therefore, the Program Manager will:

1. Review data with respect to sampling design.
2. Review the Data Verification and Validation reports from the Project QA Officer.
3. If the project objectives from Section A7 are met, the user requirements have been met. If the project objectives have not been met, corrective action as discussed in D2 will be established by the Program Manager prior to the next monitoring event.
4. Draw conclusions from the data.

### References

- DES (2008) New Hampshire 2008 Section 305b and 303d Surface Water Quality Report: Appendix 5 (Eelgrass Assessment Methodology). New Hampshire Department of Environmental Services, Water Division, Concord, NH. Published online:  
<http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/index.htm>.
- Muehlstein LK, Porter D, Short FT (1991) *Labyrinthula zosterae* sp. Nov, the causative agent of wasting disease of eelgrass, *Zostera marina*. *Mycologia* **83**: 180-191.
- NOAA (1995) Coastal Change Analysis Program (C-CAP): Guidance for Regional Implementation. NOAA Technical Report NMFS 123. U.S. Department of Commerce, Washington, DC. Published online: <http://spo.nwr.noaa.gov/tr123opt.pdf>.
- PREP (2008) PREP Monitoring Plan. Piscataqua Region Estuaries Partnership, University of New Hampshire, Durham, NH. Published online:  
[http://prep.unh.edu/resources/pdf/nhep\\_monitoring\\_plan-nhep-08.pdf](http://prep.unh.edu/resources/pdf/nhep_monitoring_plan-nhep-08.pdf).
- Short FT and Burdick DM (1996) Quantifying eelgrass habitat loss in relation to housing development and nitrogen loading in Waquoit Bay, Massachusetts. *Estuaries*, **19**:730-739.