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Introduction

SeagrassNet is a global monitoring program begun in 2001 and designed to scientifically detect and document seagrass habitat change (Short et al. 2006a, 2014). Monitoring of eelgrass (Zostera marina L.) in the Great Bay Estuary using SeagrassNet was conducted in Portsmouth Harbor between 2001 and 2009 (Short et al 2006b, Rivers and Short 2007), and is ongoing in Great Bay itself, from 2007 (Short 2009) to the present. In this report, July quadrat photos taken along the three Great Bay SeagrassNet transects from 2007 – 2014 are presented and discussed. They provide useful documentation of field percent cover measurements of eelgrass, and a record of conditions seen in the field on the day of SeagrassNet sampling.

Figure 1. SeagrassNet monitoring site Transects A, B and C in Great Bay, New Hampshire.
At the request of PREP (Piscataqua Region Estuaries Partnership), the July quadrat photographs from 2007 - 2014 have been compiled and displayed in a time series format, so changes in eelgrass over time can be tracked for an exact location in the estuary. The twelve repeat quadrat photos from each transect in each of seven Julys are presented. The photographs are categorized based on the amount of eelgrass in the quadrat (Appendix).

Following the standard SeagrassNet protocol, the SeagrassNet site in Great Bay was established in 2007 (Figure 1). For SeagrassNet, a “site” consists of three permanent, parallel, 50 m transects (referred to as A, B and C). At the Great Bay site, transect A is closest to shore and shallowest, and C is furthest from shore and deepest (Figure 2). Along each transect, twelve 0.25 m² quadrats, randomly selected when the protocol was established, are designated for intensive repeat sampling (Figure 3). Part of the protocol is photography of these quadrats at each sampling period. The result is that, on a quarterly basis, thirty-six quadrat photographs are taken at each site, documenting eelgrass condition and cover as well as seaweed presence and water clarity (Appendix).

Figure 2. SeagrassNet monitoring locations, using GPS data, for each end and the midpoint of Transects A, B and C in Great Bay, New Hampshire.
Figure 3. Location of the 12 SeagrassNet quadrats along the 50 m transects. Each square represents a quadrat. Numbers indicate the meter distance along each transect where the quadrats are positioned for sampling. The stars represent the midpoint of each transect.
Figure 4. Samples of eelgrass quadrat photographs at SeagrassNet site NH9.2 in Great Bay, representing the various eelgrass density designations and algal presence.

Sparse: <10% eelgrass
Patchy: 10 – 30% eelgrass
Half: 30 – 60% eelgrass
Majority: 60 – 90% eelgrass
Dense: >90% eelgrass
w/ algae: seaweeds visible
To help interpret the photographs, and in line with the determinations made in the field at the time of sampling, each quadrat photograph for each year is labeled with an eelgrass density category (Figure 4). Each category represents the range of percent cover of eelgrass seen in the photograph. The eelgrass density categories are named Zero, Sparse, Patchy, Half, Majority, Dense, and With algae, to represent amounts of eelgrass that are zero, less than 10% cover, between 10 and 30% cover, 30 – 60% cover, 60 – 90% cover, and over 90% cover, respectively. The “With algae” category indicates that seaweeds are present and visible in the photograph, along with varying amounts of eelgrass in the quadrat.

To make a comparison of quadrat results over the years, a value was assigned to each eelgrass density category, 0 – 5, with zero being no eelgrass present in a quadrat and 5 being dense eelgrass. Every quadrat in every year was assigned its correct value. For each year and transect, these numbers were then added and normalized by dividing by the number of quadrats per transect (usually 12, but there were some exceptions). The resulting figures were plotted on a graph of normalized quadrat count vs. year for each of the three SeagrassNet transects in Great Bay (Figure 5). Seaweed in the quadrats was noted as present or absent and the number of quadrats with seaweed was summed and plotted on the same graphs.

The photographs are a year-by-year, detailed representation of eelgrass and conditions in Great Bay, taken at the exact same locations over time. While some photographs are clear and the eelgrass is readily visible, in others the water clarity or light conditions limit the photographic record. Overall, eelgrass cover in the quadrats declined significantly over the years 2007 – 2014 (Figure 7). SeagrassNet monitoring was not started in Great Bay until after the recent major loss of eelgrass began in the bay (PREP 2013).

Presence of seaweed in the quadrats of all three SeagrassNet transects significantly increased (Figure 7). Seaweeds dominated Transect A in 2012 and 2014. At Transect B, seaweeds spiked in 2014 in (Figure 5). Transect C had somewhat less seaweed (Short 2017).
Figure 5. Eelgrass and seaweed (macroalgae) in the July SeagrassNet quadrat photos from Great Bay NH9.2 for 2007-2014, showing eelgrass percent cover, measured as normalized occurrence and seaweed presence in quadrats along Transects A, B, and C. Transect A photos for 2009 and 2013 are missing and the Transect B 2012 number is normalized based on six quadrats.
Figure 6. Eelgrass and seaweed (macroalgae) in the July SeagrassNet quadrat photos from Great Bay NH9.2 for 2007-2014, showing eelgrass percent cover measured as normalized occurrence and seaweed presence in quadrats along Transects A, B, and C combined.
Figure 7. Significant trends (2007-2014) of eelgrass and seaweed at the Great Bay SeagrassNet site, NH9.2. The eelgrass data for 2009 and 2013 were omitted because no photos were available for Transect A. Critical values for Pearson Correlations (r) indicate the significant linear trends of the data at $P \leq 0.05$. 

$\text{Normalized Quadrat Count for Eelgrass}$

$\text{Direct Quadrat Count for Seaweed}$

$r = 0.8237$

$r = 0.9147$
References


Appendix: Guide to SeagrassNet Quadrat Categories

Figure A1. SeagrassNet site NH9.2 photographs for July 2007-2014, Transect A, Quadrats 1-6.

### Transect A Quadrat 1
- **2007**: Sparse
- **2008**: Majority
- **2009**:零
- **2010**: Sparse w/algae
- **2011**: Patchy w/algae
- **2012**: Patchy w/algae
- **2013**: Patchy w/algae
- **2014**: Patchy w/algae

### Transect A Quadrat 2
- **2007**: Patchy
- **2008**: Dense
- **2009**: Patchy
- **2010**: Half w/algae
- **2011**: Sparse w/algae
- **2012**: Sparse w/algae
- **2013**: Sparse w/algae
- **2014**: Sparse w/algae

### Transect A Quadrat 3
- **2007**: Half
- **2008**: Majority
- **2009**: Patchy
- **2010**: Patchy
- **2011**: Sparse w/algae
- **2012**: Sparse w/algae
- **2013**: Sparse w/algae
- **2014**: Sparse w/algae

### Transect A Quadrat 4
- **2007**: Majority
- **2008**: Dense
- **2009**: Majority
- **2010**: Half
- **2011**: Sparse w/algae
- **2012**: Sparse w/algae
- **2013**: Sparse w/algae
- **2014**: Sparse w/algae

### Transect C Quadrat 5
- **2007**: Half
- **2008**: Half w/algae
- **2009**: Patchy w/algae
- **2010**: Half
- **2011**: Sparse w/algae
- **2012**: Sparse w/algae
- **2013**: Algae only
- **2014**: Algae only

### Transect C Quadrat 6
- **2007**: Majority
- **2008**: Majority
- **2009**: Sparse
- **2010**: Half
- **2011**: Patchy w/algae
- **2012**: Sparse w/algae
- **2013**: Sparse w/algae
- **2014**: Sparse w/algae
Figure A2. SeagrassNet site NH9.2 photographs for July 2007-2014, Transect A, Quadrats 7-12.
Figure A3. SeagrassNet site NH9.2 photographs for July 2007-2014, Transect B, Quadrats 1-6.
Figure A4. SeagrassNet site NH9.2 photographs for July 2007-2014, Transect B, Quadrats 7-12.
Figure A5. SeagrassNet site NH9.2 photographs for July 2007-2014, Transect C, Quadrats 1-6.
Figure A6. SeagrassNet site NH9.2 photographs for July 2007-2014, Transect C, Quadrats 7-12.