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Eelgrass Distribution in the Great Bay Estuary for 2013

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A Final Report to

The Piscataqua Region Estuaries Partnership

submitted by

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Executive Summary

***Headlines*:**

- **Great Bay lost 21% of its eelgrass from 2012 to 2013.**

- **As of 2013, the Great Bay Estuary has lost 50% of its eelgrass since 1996.**

Once again, eelgrass in the Great Bay Estuary declined in both distribution and biomass between 2012 and 2013, continuing the long-term trend of eelgrass loss. In 2013, Great Bay itself lost over 20% of its eelgrass (333 acres) and biomass decreased, amounting to about 400 tons, down from 1600 tons in 1996. These eelgrass losses are alarming and not sustainable. In Great Bay, eelgrass distribution has declined 49% since 1996. Nuisance macroalgae in Great Bay continued to proliferate in 2013 and to impact eelgrass at the shallow edges of the beds, of concern since eelgrass is also disappearing at the deep edges from poor water clarity. The eelgrass bed in Little Bay that first appeared in 2010 has now disappeared, with no eelgrass present in Little Bay in 2013. In the Piscataqua River, the small eelgrass bed that originated in 2011 continued to expand, increasing by 5 acres. In 2013, there was a slight decrease (4%) in eelgrass distribution in Portsmouth and Little Harbors. Overall, eelgrass distribution in the Estuary from 2012 to 2013 decreased 20%. The long-term trend of eelgrass decline in the Great Bay Estuary continued in 2013, with a 50% loss of eelgrass distribution estuary-wide since 1996.

Introduction

Eelgrass (*Zostera marina* L.) is an essential habitat for the Great Bay Estuary (GBE) because it is the basis of an estuarine food web that supports many of the recreationally, commercially and ecologically important species in the estuary and beyond. Eelgrass provides food for ducks, geese and swans, as well as food, nursery habitat, and shelter for juvenile fish and shellfish. Eelgrass filters estuarine waters and improves water clarity, removing both nutrients and suspended sediments from the water column; its roots and rhizomes bind and hold sediments in place, thereby reducing turbidity. Historically, eelgrass has been the primary habitat in the Great Bay Estuary, for many decades covering the most area of any of the three major habitats: eelgrass, salt marsh, and mud flat. Eelgrass in the Great Bay Estuary is a vital resource to the State of New Hampshire's marine environment, and eelgrass habitat is essential to the health of the estuary (Trowbridge 2006, Short 2009). The present report describes and interprets the eelgrass distribution, percent cover and biomass data collected in 2013 for the Great Bay Estuary.

Seagrasses are an indicator of estuarine and coastal health worldwide (Orth et al. 2006, Waycott et al. 2009). Rooted in place, eelgrass integrates the influences of environmental conditions that it experiences within an estuarine system and therefore its health status acts as a barometer of impacts and changes to the estuary. Eelgrass beds alter their distribution and biomass in response to changing water quality, nutrient inputs, and light levels. Eelgrass change can be measured at the plant population level or by examining differences in plant physiology and chemistry. Using eelgrass as an indicator, one can detect:

- reduction in water clarity through reduced areal coverage (distribution) in subtidal beds, particularly at the deep edge of eelgrass beds (Rivers 2006, Ochieng et al. 2010) and through declining biomass (Beem and Short 2009);
- increase in nitrogen (N enrichment) through the eelgrass-based NPI (Nutrient Pollution Indicator, Lee et al. 2004) as well as through increased nuisance seaweeds (Nettleton et al. 2011) and epiphyte cover on eelgrass blades;
- and status and health of the estuary through scientific monitoring of eelgrass distribution, percent cover, and biomass changes (SeagrassNet Monitoring Program, as described in Short et al. 2006, 2014).

Over two decades ago, in 1989, there was a dramatic decline in eelgrass distribution in Great Bay itself to only 300 acres (15% of normal levels). The cause of this crash was an outbreak of a slime mold, *Labryrinthula zosterae*, commonly called "wasting disease" (Muelhstein et al. 1991). Since the partial recovery from that crash in 1989, the greatest extent of eelgrass in the GBE was observed in the year 1996. The declines in eelgrass biomass seen since 1996 are <u>not</u> a result of wasting disease, and show every sign of being caused by anthropogenic impacts, namely a combination of increased nitrogen loading and increased sedimentation which are the main causes of seagrass loss worldwide (Orth et al. 2006).

A downward trend continues, showing losses of eelgrass distribution and biomass in the Great Bay itself and Estuary-wide since the modern maximum of 1996 with a 20% loss of distribution from 2012 to 2013 and a 50% loss overall since 1996. Eelgrass biomass, representative of eelgrass habitat functions and values, is down 80% in Great Bay since 1996. We ignore these strong signals of lost estuarine health at the peril of a crucial New Hampshire estuarine ecosystem.

The University of New Hampshire has created digitized eelgrass distribution information for the Great Bay Estuary for the years 1999-2012 and these are now in the PREP database. *Ruppia maritima* was barely present in 2013 and is not reported here. Below, I report on the eelgrass distribution and cover class information for the year 2013 in the Great Bay Estuary, based on aerial photography and subsequent ground truthing carried out in August 2013.

Project Goals and Objectives

UNH has now completed the 2013 eelgrass mapping project under contract to PREP. The project goal, and the objective of the contract, was to map eelgrass distribution by cover class in the Great Bay Estuary for 2013 based on aerial photography and ground truth, as well as to report on eelgrass biomass.

The final work product is ArcInfo files of eelgrass distribution throughout the Great Bay Estuary for 2013, including all necessary documentation/metadata for the ArcInfo files, and this final report describing the results of our 2013 findings.

Methods

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

The present report describes and interprets the eelgrass distribution, percent cover and biomass data collected in 2013 for the Great Bay Estuary.

Results and Discussion

The shapefiles containing the eelgrass distribution data for 2013 have been provided to the PREP Coastal Scientist by email. Metadata for the shapefiles is as follows:

Codes for cover classes:
- P = 10 to 30% cover (Patchy)
- H = 30 to 60% cover (Half)
- SB = 60 to 90% cover (Some Bottom)
- D = 90 to 100% cover (Dense)

Eelgrass cover below 10% cannot be detected in the aerial photography.

Between 2012 and 2013, there was, once again, an overall loss of eelgrass in the <u>Great Bay Estuary</u>, a 20% loss of distribution in a single year. Eelgrass distribution and biomass in 2013 in the Great Bay Estuary remained low compared to historical levels. Great Bay itself showed an alarming loss of eelgrass distribution, down 21% since 2012 -- a loss of 333 acres. Eelgrass biomass in Great Bay, declining steadily since 2007, decreased 16% between 2012 and 2013. The eelgrass bed in Little Bay, appearing in 2011 and declining by 2012, completely disappeared in 2013. The Piscataqua River saw an increase from 1.6 acres of patchy eelgrass to 7 acres. Between 2012 and 2013, there was a 4% loss of eelgrass in Portsmouth Harbor (Figures 1, 2, and Appendix).

Eelgrass has disappeared throughout much of its historic range in the Estuary: large areas of the Estuary that historically supported eelgrass no longer have any eelgrass. ***The Estuary has lost 50% of its eelgrass area since 1996. As of 2013, Great Bay itself lost 80% of its eelgrass biomass since 1996.*** The overall loss of eelgrass in the Estuary and the continuing downward trend of this resource indicate increased nitrogen pollution in the water, creating poor water quality conditions for eelgrass growth along with observed excessive nuisance seaweed growth and greater epiphyte loads on eelgrass leaves.

In <u>Great Bay</u> itself, eelgrass distribution decreased 21% from 2012 to 2013, while eelgrass biomass declined 16%. Note that more than ONE FIFTH of the eelgrass in Great Bay disappeared in a single year, from 2012 to 2013. The shallow eelgrass beds in several parts of the Bay lost both distribution and biomass. The eelgrass acreage in Great Bay itself is now 49% of the acreage in 1996, the peak year of recent times. Eelgrass biomass declined substantially from 2012 – 2013, 16%. There is now only one remaining area in Great Bay with high eelgrass density (90 – 100% cover). Nuisance seaweeds, largely comprised of the invasive species, *Gracilaria vermiculophylla*, as well as *Ulva lactuca*, continued to proliferate. In 2012 we noted an increased epiphyte load on eelgrass leaves which continued in 2013. Epiphyte loading further stresses eelgrass by shading the leaves and by causing accumulation of sediment on the eelgrass leaf surface. Wasting disease was present in Great Bay in 2013 at fairly low levels and did not strongly impact eelgrass during the year.

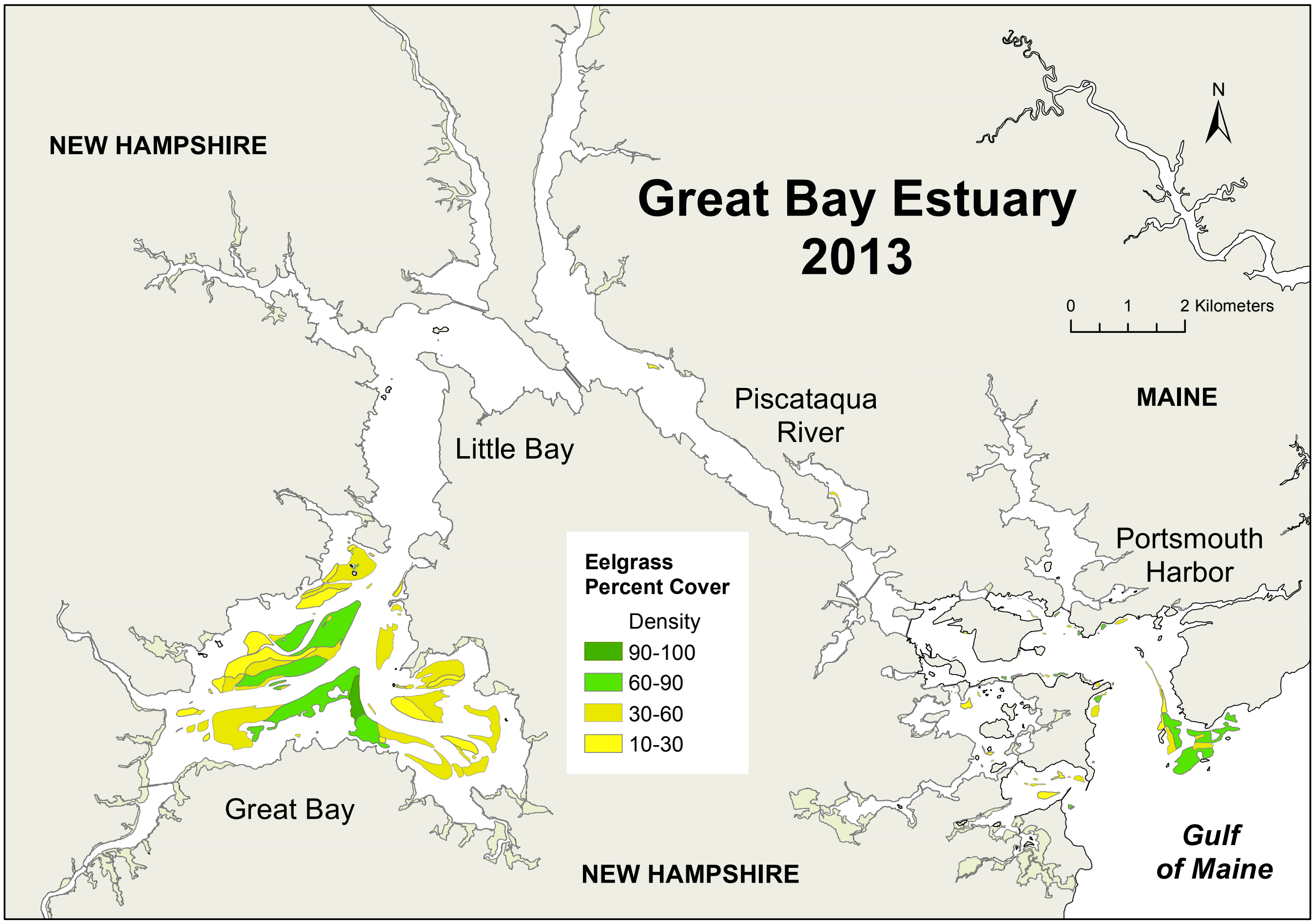

Figure 1. Eelgrass distribution for the Great Bay Estuary based on aerial photography from August 23, 2013 and ground truth surveys.

In the northwest part of Great Bay, near Adams Point, the eelgrass bed west of Seal Rock was much smaller than in 2012 and the fringing beds along the Adams Point shoreline were completely gone. The distribution of eelgrass on the flat surround the Footman Islands was nearly unchanged but eelgrass biomass was reduced. On the western side of Great Bay, eelgrass was lost on both the shallow and deep edges of the bed. The main loss occurred in the shallow areas extending from the Footman Island flat south to the Lamprey River. The entire western side of Great Bay had patches of *Ulva* without eelgrass. Eelgrass biomass increased slightly in both shallow and deep areas with persistent nuisance seaweeds, while in the central bed in this area, biomass decreased. At the mouth of the Lamprey River, eelgrass was greatly reduced compared to 2012 with only a small patch remaining. In the southern Bay, eelgrass lost biomass and distribution at the Squamscott River bed, again with loss of eelgrass at the shallow edge. Between 2012 and 2013, Greenland Bay lost a large area of eelgrass in the central bay, replaced by seaweed. In areas where eelgrass remained, it was intermixed with *Gracilaria*. Along the eastern side of Great Bay the eelgrass beds were largely unchanged in both distribution and biomass from 2012 to 2013. North of Thomas Point, eelgrass beds lost both distribution and biomass.

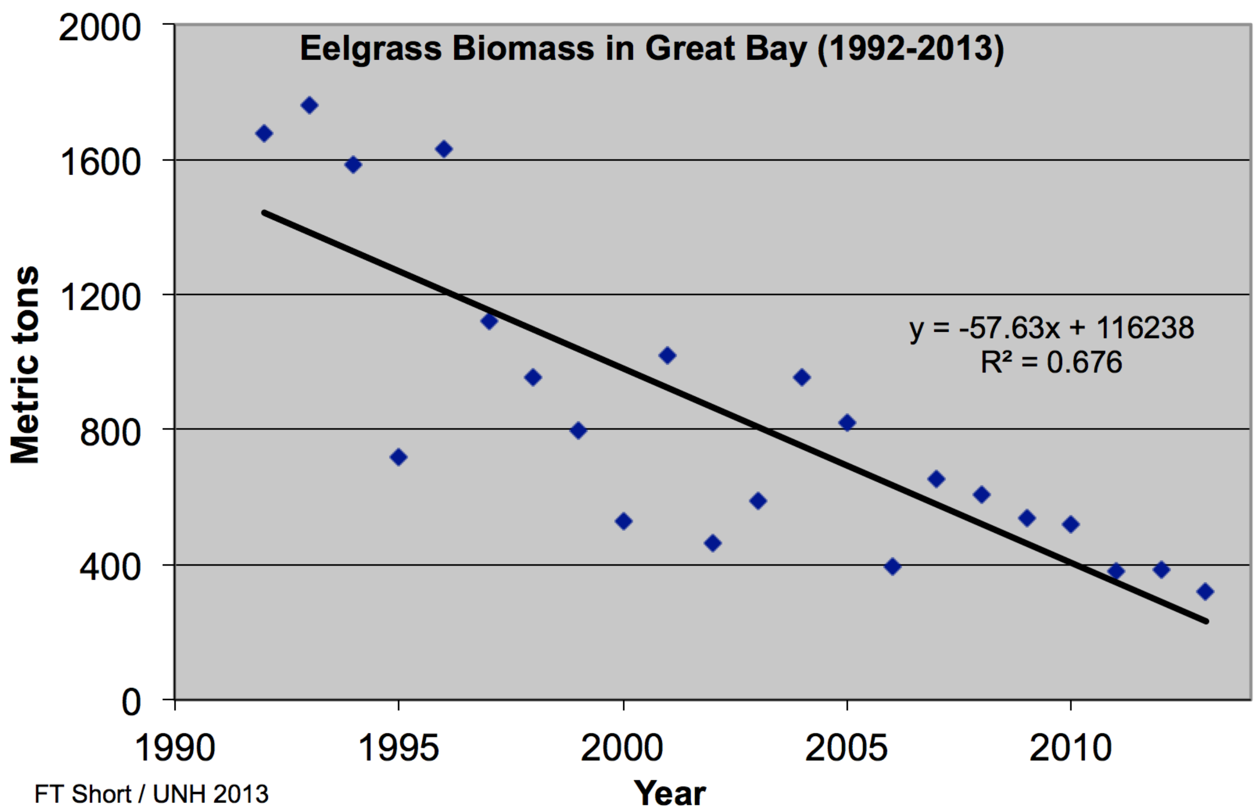

Figure 2. Downward trend in annual eelgrass biomass in Great Bay from 1992 through 2013.

In Little Bay, the eelgrass beds along the eastern shoreline and in Welch Cove completely disappeared between 2012 and 2013. There was no eelgrass in Little Bay in 2013.

In the Piscataqua River, the patchy bed adjacent to Adlington Creek, Maine, expanded from 1.6 to 7 acres, with additional patches of eelgrass. The eelgrass patches first noted in 2011 continue to grow in size and to increase in cover.

In Portsmouth Harbor (including Little Harbor and Back Channel), eelgrass distribution from 2011 to 2012 decreased 4%, with some decrease in biomass along the eastern side of Gerrish Island. There was a substantial loss in eelgrass distribution and cover in Little Harbor. The overall loss of eelgrass distribution in the Portsmouth Harbor region since 1996 is 46%.

***The changes seen in the Great Bay Estuary in 2013 are more alarming than in recent times* because of the large increase in eelgrass loss seen in this year alone (2012 to 2013) and the continued overall declining trends in the estuary. Efforts to reduce point source nitrogen inputs are encouraging, but for the Great Bay Estuary, time is now a critical issue. Making changes to reverse the losses in eelgrass and the functional health of Great Bay Estuary are more immediate than ever.**

Recommendations

1. Continue the efforts to lower nitrogen loading to the Great Bay Estuary (GBE) to improve water clarity and reduce nuisance seaweed and epiphyte growth throughout the estuary.

2. Throughout the GBE watershed, accelerate the implementation of sediment retention structures to reduce the direct sediment input to the estuary that contributes to elevated turbidity.

3. Continue annual monitoring of eelgrass in the GBE to detect trends in eelgrass itself and as an indicator of estuarine health.

4. Secure funding for eelgrass research in GBE including investigations of the deep edge, Nutrient Pollution Indicator, and N isotope studies to better understand the health status of the estuary.

5. Carry out the scientific study needed in order to update eelgrass biomass measurements.

6. Restore eelgrass in Portsmouth Harbor and Little Harbor, the two locations in the estuary where water clarity is presently adequate for eelgrass growth.

7. Conduct quantitative monitoring of the wasting disease in the GBE.

8. Institute best management practices in the GBE to reduce boating and mooring impacts to eelgrass.

9. Create an improved map of potential eelgrass habitat for the GBE and use it in planning estuarine development to avoid impacts to areas where eelgrass could grow if water clarity were improved.

10. Avoid both actual and potential eelgrass habitat when siting construction projects, other habitat restoration activities, or boat moorings and docks in the estuary.

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Appendix

Great Bay eelgrass areas mapped from aerial photography with field verification GPS points obtained in Great Bay on 19 August 2013. GPS points and eelgrass condition data (eelgrass percent cover) were collected from a small boat at low spring tide to determine the edge of the eelgrass beds for comparison to the eelgrass polygons mapped from aerial photographs. On the base map, salt marshes around the margins of Great Bay are indicated in light sage color.