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Eelgrass Distribution in the Great Bay Estuary for 2012

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A Final Report to

The Piscataqua Region Estuaries Partnership

submitted by

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Executive Summary

Eelgrass in the Great Bay Estuary declined in both distribution and biomass between 2011 and 2012, continuing the long-term trend of eelgrass loss. In 2012, eelgrass was once again mainly present in the Great Bay itself with limited distribution in Portsmouth Harbor and Little Bay. Eelgrass distribution in Great Bay decreased 1.5% between 2011 and 2012 with no change in biomass. In Great Bay, eelgrass distribution has declined 36% since 1996 and biomass is a quarter of what it was in the early 1990s. Nuisance macroalgae in Great Bay continued to proliferate in 2012 and to impact eelgrass by smothering eelgrass shoots and reducing shoot density. In the Piscataqua River, a new, small bed of eelgrass was present in 2012. The eelgrass bed in Little Bay that first appeared in 2010 retracted by 28% between 2011 and 2012 and had very low percent cover in 2012. In 2012, no significant change in eelgrass distribution or biomass was seen in the Portsmouth Harbor and Little Harbor area of the estuary. Overall, eelgrass distribution in the Estuary from 2011 to 2012 decreased 3.9%. The long-term trend of eelgrass decline in the Great Bay Estuary continued in 2012, with a loss of eelgrass distribution of 37% 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. Also, 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. 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 2012 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 can be read 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, with change 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 declining biomass (Beem and Short 2009); increase in nitrogen (N enrichment) through the 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, Short et al. 2006).

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 not a result of wasting disease, and show every sign of being caused by anthropogenic impacts, namely a combination of increased nitrogen loading and 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 3.9% loss of distribution from 2011 to 2012 and a 37% loss overall since 1996. The trend shows losses of 44% in Portsmouth Harbor and nearly complete loss of eelgrass in the Piscataqua River. The eelgrass beds in Little Bay and the patches in the Piscataqua River represent a recovery from complete loss but are only a fraction of what existed historically in these locations. There are numerous signs, many of them eelgrass-related, of increased nitrogen impacts in Great Bay itself. We ignore these at the peril of the long-term health 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 1999-2011 and these are now in the PREP database. *Ruppia maritima* was barely present in 2012 and is not reported here. Below, I report on the eelgrass distribution and cover class information for the year 2012 in the Great Bay Estuary, based on aerial photography and ground truthing.

Project Goals and Objectives

UNH has now completed the 2012 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 2012 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 2012, including all necessary documentation/metadata for the ArcInfo files, and this final report describing the results of our 2012 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 2012 for the Great Bay Estuary.

Results and Discussion

The shapefiles containing the eelgrass distribution data for 2012 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 2011 and 2012, there was an overall loss of eelgrass in the <u>Great Bay Estuary</u>. Eelgrass distribution and biomass in 2012 in the Great Bay Estuary remained low compared to historical levels. Great Bay itself showed a small loss of eelgrass distribution, with a retraction of the recently established eelgrass bed in Little Bay and no change in Portsmouth Harbor (Figures 1 & 2). The Piscataqua River saw the reestablishment of eelgrass with 1.6 acres of patchy eelgrass.

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 at all.. ***The Estuary has lost 37% of its eelgrass area since 1996. As of 2012, Great Bay itself has lost 76% 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 excessive nuisance seaweed growth and greater epiphyte loads on eelgrass leaves.

In <u>Great Bay</u> itself, eelgrass distribution decreased 1.5% from 2011 to 2012, while eelgrass biomass was unchanged. The shallow eelgrass beds in several parts of the Bay lost distribution. Eelgrass distribution in Great Bay is now at 36% of what it was in 1996, its peak year in recent times. Eelgrass biomass remained at low levels from 2011 - 2012 but did not change. Nuisance seaweeds, largely comprised of species of *Gracilaria* (one native and one invasive species) and *Ulva*, continued to proliferate. In 2012 we noted an increased epiphyte load on the eelgrass leaves. 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 at fairly low levels and did not strongly impact eelgrass during the year.

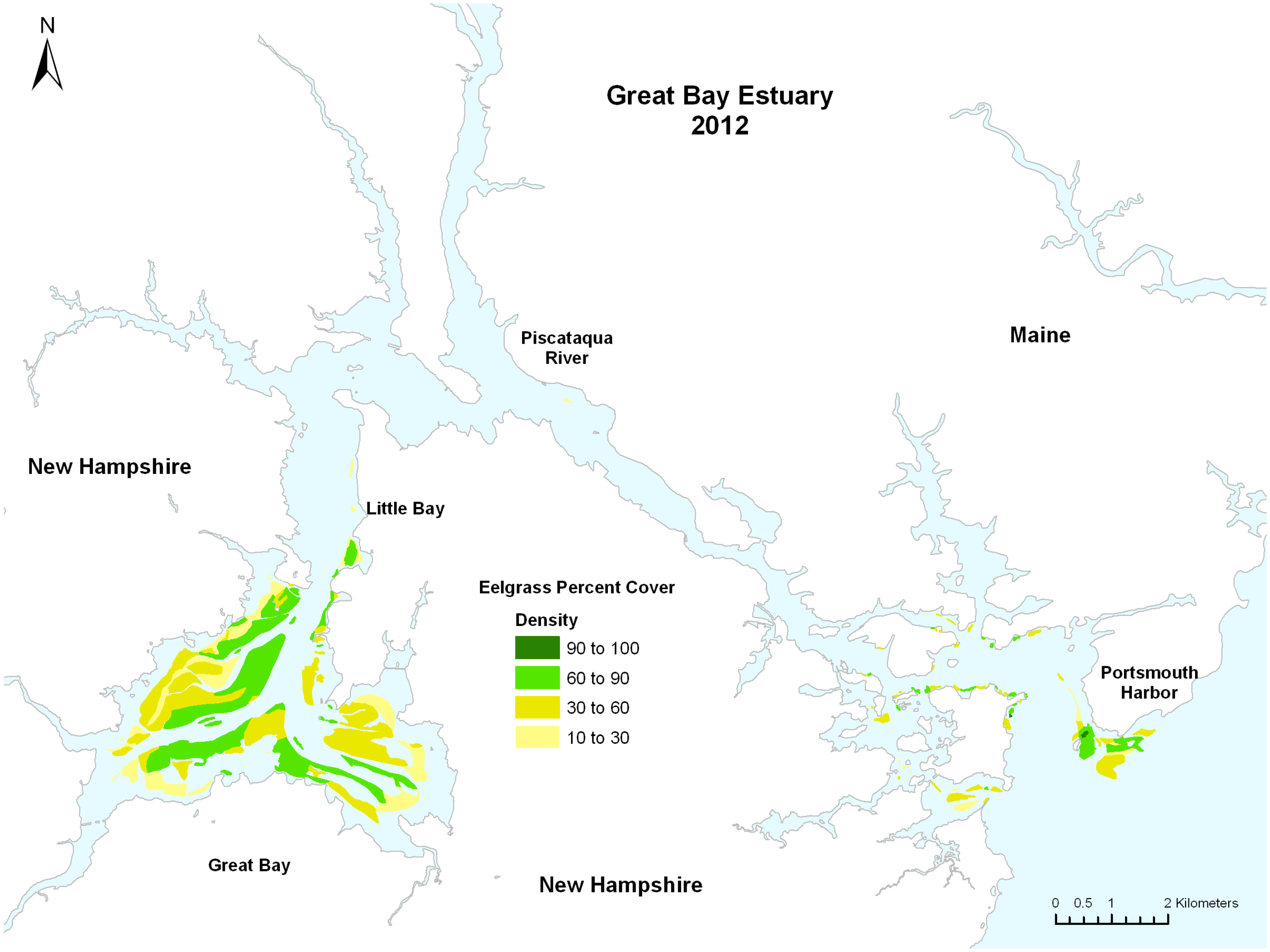

Figure 1. Eelgrass distribution for the Great Bay Estuary based on aerial photography from August 18, 2012 and ground truth surveys.

In the northwest part of Great Bay, near Adams Point and around the Footman Islands, eelgrass biomass increased from 2011 to 2012. On the western side of Great Bay, eelgrass biomass increased slightly in both shallow and deep areas with persistent nuisance seaweeds, while in a central bed in this area, biomass decreased. At the mouth of the Lamprey River, eelgrass increased in distribution and biomass. In the southern Bay, eelgrass bed boundaries remained about the same but the area toward the mouth of the Squamscott increased in biomass while in the central part of the bed, biomass decreased. Between 2011 and 2012, Greenland Bay showed some shifting of eelgrass beds but very little change in biomass. Along the eastern side of Great Bay the eelgrass beds increased slightly in both distribution and biomass from 2011 to 2012.

In Little Bay, the areas of eelgrass along the eastern shore of the upper bay decreased dramatically by 28%, as well as decreasing in percent cover and biomass. This bed first appeared as seedlings which developed into patches of reproductive plants in 2010. By 2011, the patches had expanded into beds through both vegetative growth and new seedling production. By

2012, most of the vegetative plants were gone and what remained were reproductive shoots, a sign of plant stress, likely from reduced water clarity.

In the Piscataqua River a new eelgrass bed of 1.6 acres appeared in the 2012, located off Adlington Creek on the Maine side of the river. The bed is sparse and patchy and represents and expansion of the 2011 seedlings into a series of small patches. All of the eelgrass transplanted for the New Hampshire Port Mitigation Project of 1993-95, as well as the naturally-occurring eelgrass beds that served as reference sites for this project, has been lost (Beem and Short 2009).

In Portsmouth Harbor (including Little Harbor and Back Channel), eelgrass distribution from 2011 to 2012 did not change substantially, although there were some small increases in biomass. The biomass increases occurred primarily off Gerrish Island in the more open coastal area that receives Gulf of Maine water. The overall loss of eelgrass distribution in the Portsmouth Harbor region since 1996 is 44%.

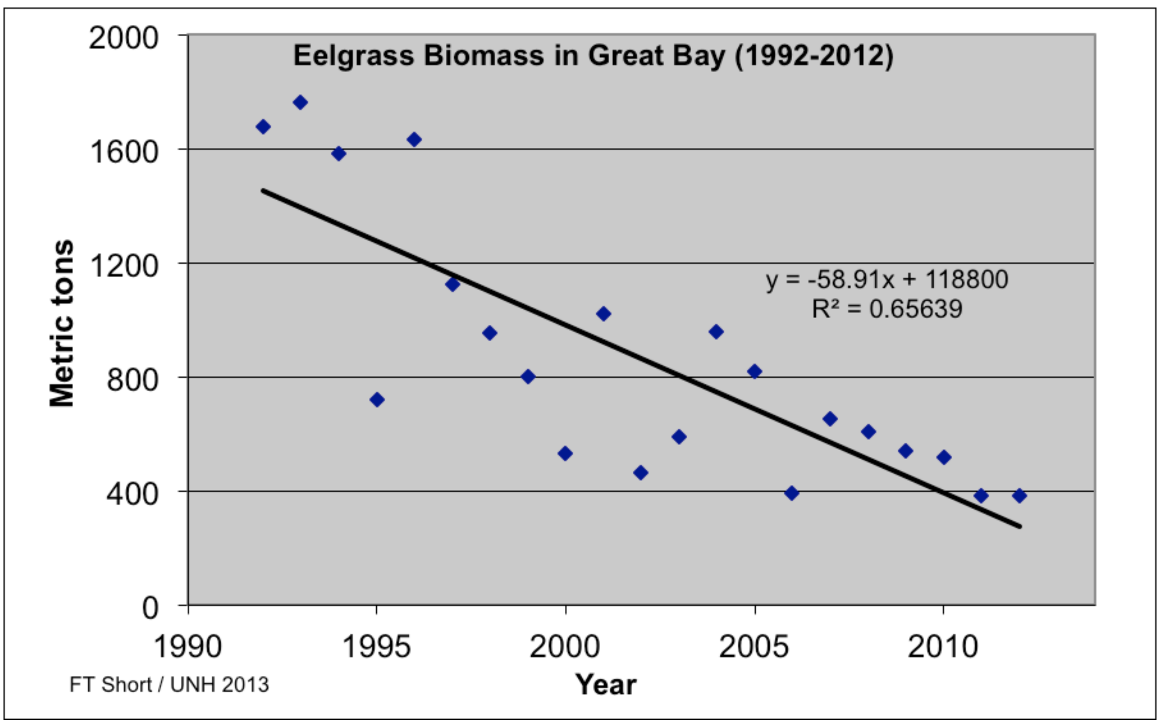

Figure 2. Downward trend in annual eelgrass biomass in Great Bay from 1992 through 2012. Eelgrass biomass is less than 1/4 of what it was in the early 1990s. The decline is accompanied by substantial increases in nuisance seaweeds.

Recommendations

1. Increase efforts to lower nitrogen loading to the Great Bay Estuary (GBE) to improve water clarity and reduce nuisance seaweeds and epiphytes 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. Secure funding for eelgrass research in GBE including investigations of the deep edge, Nutrient Pollution Indicator, and N isotope studies in order to examine trends and current status.

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

5. Update the conversion of eelgrass percent cover to biomass through field surveys.

6. Restore eelgrass in Little Bay and the Piscataqua, Oyster and Bellamy Rivers.

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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