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Eelgrass Distribution in the Great Bay Estuary for 2011

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A Final Report to

The Piscataqua Region Estuaries Partnership

submitted by

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PISCATAQUA REGION Estuaries Partnership

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Executive Summary

Eelgrass in the Great Bay Estuary declined in both distribution and biomass between 2010 and 2011. In 2011, 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 itself decreased between 2010 and 2011 and experienced an alarming 26% loss of biomass in a single year. In Great Bay itself there has been a loss of 35% of eelgrass distribution since 1996. In 2011, despite recent consecutive excellent growing years in terms of weather, we saw a reverse of the trend of slight increases in 2009 and 2010. Nuisance macroalgae in Great Bay continued to proliferate in 2011 and impact eelgrass by smothering eelgrass shoots and reducing shoot density. For the fourth year in a row in the Piscataqua River, there was virtually no eelgrass. The eelgrass bed in Little Bay that first appeared in 2010 expanded greatly. Portsmouth Harbor also showed increased eelgrass distribution in the outer harbor. Overall, eelgrass distribution in Great Bay Estuary from 2010 to 2011 decreased 0.3%. There has been a 35% overall loss of eelgrass distribution in the Estuary since 1996. The 2011 gains seen in Portsmouth Harbor and Little Bay were largely a result of the plant reproductive response to stress and a good growing season, but could not compensate for overall losses, which created a downward trend. The long-term trend of eelgrass decline in the Great Bay Estuary continued in 2011.

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 2011 for the Great Bay Estuary.

Seagrasses are an indicator of estuarine 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 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 assessable at the plant population level or through 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)

- declining biomass (Beem and Short 2009)

- increases 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

- status and health of the estuary through scientific monitoring of eelgrass 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 area 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). More recently, the greatest extent of eelgrass in the GBE was observed in the year 1996 after the beds had recovered from the wasting disease episode of the late 1980s and early 1990s. 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 1996, a modern maximum for the Estuary. The trend shows losses of 33% in Portsmouth Harbor and complete loss of eelgrass in the Piscataqua River. The eelgrass bed in Little Bay represents a recovery from recent complete loss but represents only a fraction of what existed historically. 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 1999-2010 and these are now in the PREP database. *Ruppia maritima* was barely present in 2011 and is not reported here. Below, I report on the eelgrass distribution and cover class information for the year 2011in the Great Bay Estuary, based on aerial photography and ground truthing.

Project Goals and Objectives

UNH has now completed the 2011 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 2011 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 2011, including all necessary documentation/metadata for the ArcInfo files, and this final report describing the results of our 2011 findings.

Methods

The methods for this project followed the procedures specified in the approved QA Project Plan (Short and Trowbridge, 2003). As initiated in 2009, in 2011 the edges of some eelgrass beds were traced with a Garmin GPSmap 76C and the track was compared to the mapped eelgrass polygons as requested by PREP.

The present report describes and interprets the eelgrass distribution, percent cover and biomass data collected in 2011 for the Great Bay Estuary.

Results and Discussion

The shapefiles containing the eelgrass distribution data for 2011 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 2010 and 2011, there was an overall loss of eelgrass in the <u>Great Bay Estuary</u>. Additionally, eelgrass distribution and biomass in 2011 in the Great Bay Estuary remained low compared to historical data. Decreased distribution in Great Bay itself offset gains of distribution in Portsmouth Harbor and Little Bay (Figures 1 & 2). The Piscataqua River continued to be devoid of 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 greatest loss of eelgrass in the Estuary between 2010 and 2011 occurred in Great Bay. ***The Estuary has lost 35% of its eelgrass area since 1996. Great Bay itself has lost 68% of its eelgrass biomass since 1996.*** The overall loss of eelgrass in the Estuary and the downward trend are indicative of increased nitrogen pollution in the water, creating poor water quality conditions and excessive seaweed growth.

In <u>Great Bay</u> itself, eelgrass distribution decreased 6% from 2010 to 2011 and eelgrass biomass decreased by an alarming 26%. Eelgrass distribution in Great Bay is now at 65% of what it was in 1996, its peak year in recent times. The loss of 26% of eelgrass biomass in a single year represents a dramatic and alarming change that has occurred through higher density beds being replaced by low-density and patchy eelgrass. These losses are caused by greater abundance and distribution of nuisance seaweeds evident throughout Great Bay as well as decreases in water clarity.

The nuisance seaweeds largely comprised species of *Gracilaria* and *Ulva,* primarily growing within eelgrass beds and frequently noted during the ground truth assessments. Furthering the stress on eelgrass, in 2011 we noted an increased epiphyte load on the plants. Wasting disease was present in Great Bay at fairly low levels and did not strongly impact eelgrass in 2011.

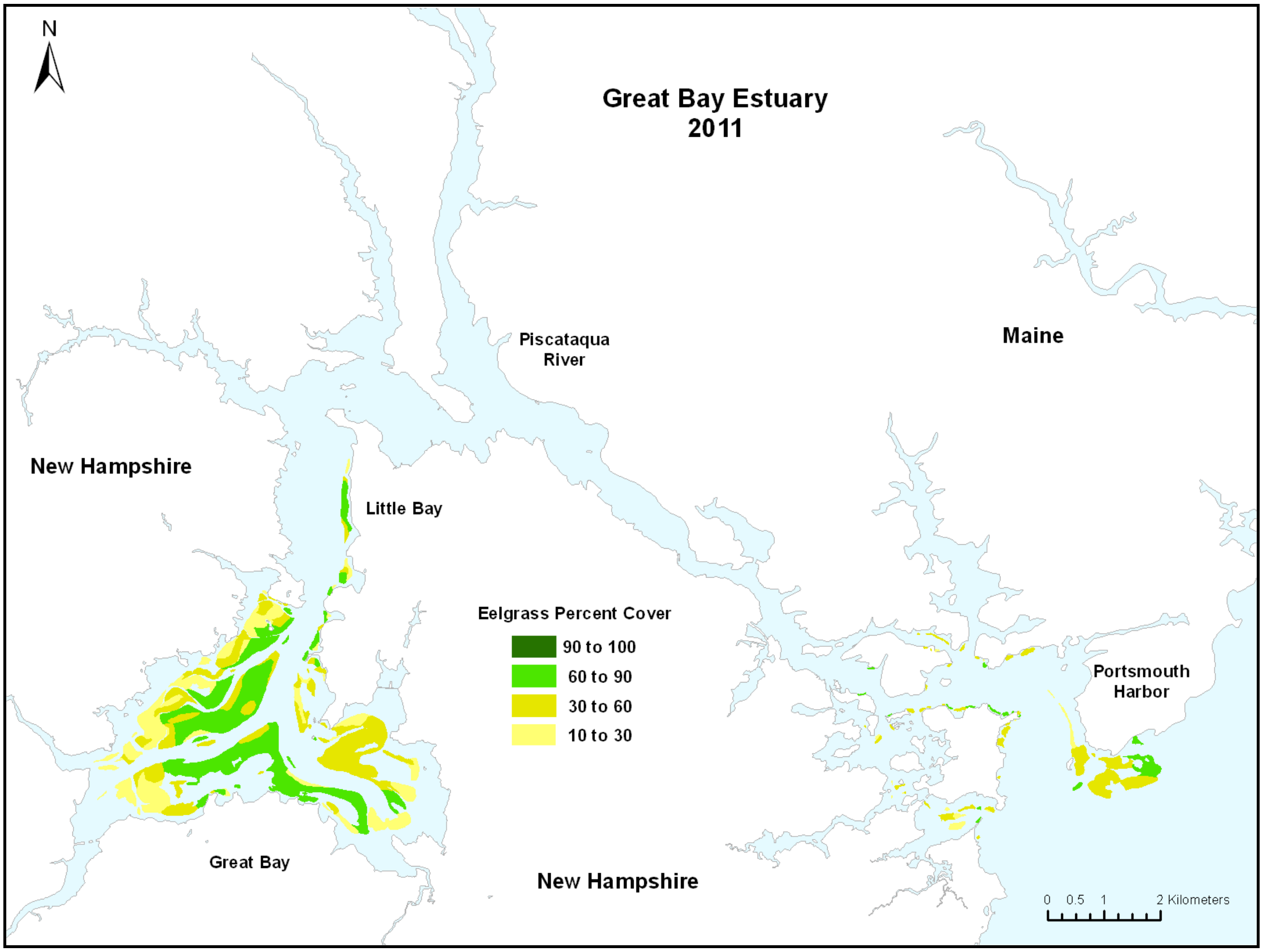

Figure 1. Eelgrass distribution for the Great Bay Estuary based on aerial photography from 1 September 2011 and ground truth surveys.

In the northwest part of Great Bay, near Adams Point and around the Footman Islands, eelgrass biomass decreased dramatically from 2010 to 2011, especially in the shallower areas. On the western side of Great Bay, eelgrass distribution was little changed but there was a substantial decrease in biomass, particularly of the shallower beds, due to nuisance algae in these areas. At the mouth of the Lamprey River, some increased eelgrass distribution occurred, with new beds reestablishing along the channel. In the southern Bay, some beds shifted their boundaries but there was little change in overall eelgrass area. Biomass decreased in the southern Bay eelgrass beds; the only high-cover (90 – 100% cover) eelgrass area remaining in Great Bay lost density. Greenland Bay lost both eelgrass area and biomass in 2011. Also in 2011, eelgrass distribution decreased along the eastern side of Great Bay; the new beds of seedlings that first appeared in 2010 increased in size in 2011 while losing density.

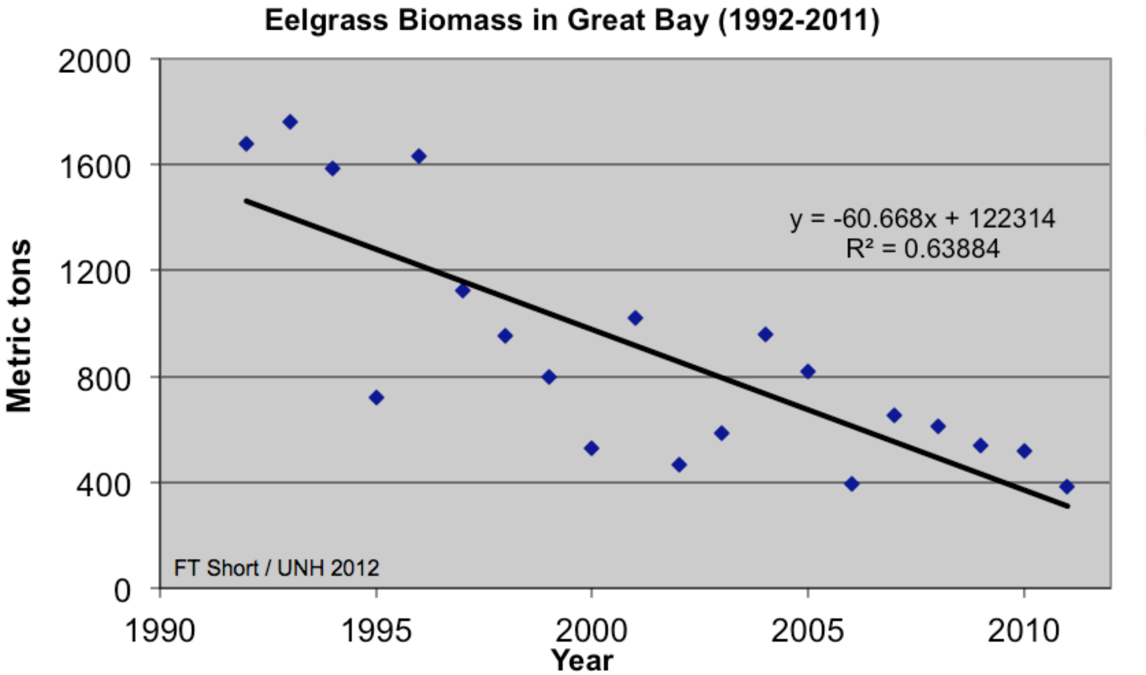

Figure 2. Downward trend in annual eelgrass biomass in Great Bay from 1992 through 2011. Eelgrass biomass is less than 1/3 of what it was in the early 1990s. The decline is accompanied by substantial increases in nuisance seaweeds. Some new eelgrass beds consisting of seedlings appear each year but rarely survive long term.

In Little Bay, the small patches of eelgrass seen in 2010 increased substantially in both distribution and density. The small patches of eelgrass seen in Little Bay in 2010 increased from 0.28 acres in size to 48 acres in 2011, representing a tremendous bed expansion. 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. The initial development and subsequent expansion of eelgrass into the eastern side of Little Bay north of Furber Strait resulted from two good growing seasons combined with clearer water in this part of the estuary, likely from the decreased nitrogen inputs to the Oyster River from the Durham WWTF. The Durham WWTF reduced its nitrogen loading since 2008 (Cedarholm, pers. comm.) and the result seems to be a clear, positive impact to eelgrass in this part of the estuary.

In the Piscataqua River there was virtually no eelgrass in 2011, similar to the previous two years. Ground truth efforts revealed a few small, scattered eelgrass patches at one site in the Piscataqua River near Adlington Creek. 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 increased by 25% from 2010 to 2011. The increases occurred primarily off Gerrish Island in the more open coastal area that receives Gulf of Maine water. Within the harbor itself, eelgrass distribution remained about the same and eelgrass density declined. The overall loss of eelgrass distribution in the Portsmouth Harbor region since 1996 is 109 acres, or 33%.

Recommendations

1. Increase efforts to lower nitrogen loading to the Great Bay Estuary (GBE) to improve water clarity and reduce nuisance seaweeds 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. Update the conversion of eelgrass percent cover to biomass through field surveys.

4. 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.

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

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, aquaculture leases, other habitat restoration activities, or boat moorings and docks in the estuary.

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