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Eelgrass Distribution in the Great Bay Estuary for 2006

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A Final Report to

The New Hampshire Estuaries Project

Submitted by

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New Hampshire Estuaries Project

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Executive Summary

Eelgrass in Great Bay itself decreased substantially (43%) between 2005 and 2006, due to losses in both biomass and distribution. Little Bay and the Piscataqua River showed greater change (loss of 40%) between 2005 and 2006 than previously, with very low levels of eelgrass compared to historical distributions and the large beds of ruppia in the Bellamy, Oyster and upper Piscataqua Rivers also diminished. The Portsmouth Harbor – Little Harbor area experienced a decrease in eelgrass abundance (14%) between 2005 and 2006. All of the Great Bay Estuary has decreased eelgrass beds compared to historic distributions. In the decade from 1996 to 2006, the Great Bay Estuary has lost almost half its eelgrass.

Introduction

Eelgrass (*Zostera marina* L.) is an essential habitat for the Great Bay Estuary (GBE) because it provides food for ducks, geese and swans and food and shelter for juvenile fish and shellfish. Also, eelgrass is the basis of an estuarine food chain that supports many of the recreationally, commercially and ecologically important species in the estuary and beyond. Eelgrass filters estuarine waters, removing both nutrients and suspended sediments from the water column. Eelgrass in the Great Bay Estuary is the largest monoculture in the State of New Hampshire and is considered a vital resource to the State's marine environment. Eelgrass is a habitat that is essential to the health of the estuary. The present report describes and interprets the eelgrass distribution data collected in 2006 for the Great Bay Estuary.

Seagrasses are a good indicator of estuarine health (Orth et al. 2006). 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 the impacts the estuary is experiencing. 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) and declining biomass (Beem and Short, in press); increase in nitrogen (enrichment) through the NPI (Nutrient Pollution Indicator, Lee et al. 2004); and status and health through scientific monitoring of cover and biomass changes (SeagrassNet Monitoring Program, Short et al. 2006).

As of the 2005 mapping, a year before the mapping reported here, the Great Bay Estuary continued to experience an alarming decline in both eelgrass biomass and distribution that appeared to be related to the declining water clarity of the estuary. Eelgrass biomass in Great Bay itself (grams of eelgrass per meter square) declined steadily (Trowbridge 2006) over the period 1996 - 2005. Eelgrass distribution also declined, although the distribution was relatively constant in Great Bay for this period, at approximately 2,000 acres. In the Piscataqua River, declines in both natural and transplanted eelgrass beds were evident (Beem and Short, in press); these declines were a combination of both loss of eelgrass biomass and loss of eelgrass distribution. In Portsmouth Harbor and Little Harbor from 2002 - 2005, eelgrass receded at the deep edge of the meadows, creating an overall loss of distribution accompanied by losses in biomass (Rivers 2007).

Ruppia maritima (called here by its common name, ruppia) was observed in large beds in several of the tributaries of GBE in 2005, both in aerial photographs and ground truthing. Ruppia is considered a seagrass. In 2005, ruppia was added as an element of the seagrass distribution maps and is reported below for the 2006 mapping, as well. Ruppia has always been found in the GBE at low levels, particularly in association with salt marsh pannes and in the upper reaches of the estuary. Ruppia occurs as both an annual and perennial plant, and the distribution of these beds is highly variable due to the annual nature of many of the beds. Although ruppia is a seagrass and provides some of the functions of an eelgrass meadow, its low canopy height (less than 10 cm in these beds) creates different habitat conditions.

Almost 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 1996 after the beds had recovered from the wasting disease episode of the late 1980s and early 1990s. The decline in eelgrass biomass seen from 1996 – 2005 is not a result of wasting disease, and shows all the signs of being caused by anthropogenic impacts, namely increased nutrient loading and sedimentation. Nutrient loading and sedimentation are the main causes of seagrass loss worldwide (Orth et al. 2006).

The University of New Hampshire has created digitized eelgrass distribution information for the Great Bay Estuary for the years 1999-2005 and these are now in the NHEP database. Here, I report on the eelgrass distribution and cover class information for the year 2006 in the Great Bay Estuary, based on aerial photography and ground truthing.

Project Goals and Objectives

UNH has now completed the 2006 eelgrass mapping project under contract to the NH Estuaries Project. The project goals and objectives of the contract were to:

(1) map eelgrass distribution in GBE for 2006 based on aerial photography and ground truth;
(2) acquire aerial photography of the Great Bay Estuary in 2007;
(3) conduct eelgrass ground truth observations of the 2007 aerial imagery.

The final work product is ArcInfo files of eelgrass distribution throughout the Great Bay Estuary for 2006, including all necessary documentation/metadata for the ArcInfo files, and this final report describing the results.

Methods

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

Results and Discussion

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

Codes for cover classes:
- P = 10 to 30 % cover
- H = 30 to 60 % cover
- SB = 60 to 90 % cover
- D = 90 to 100 % cover
- R = Ruppia

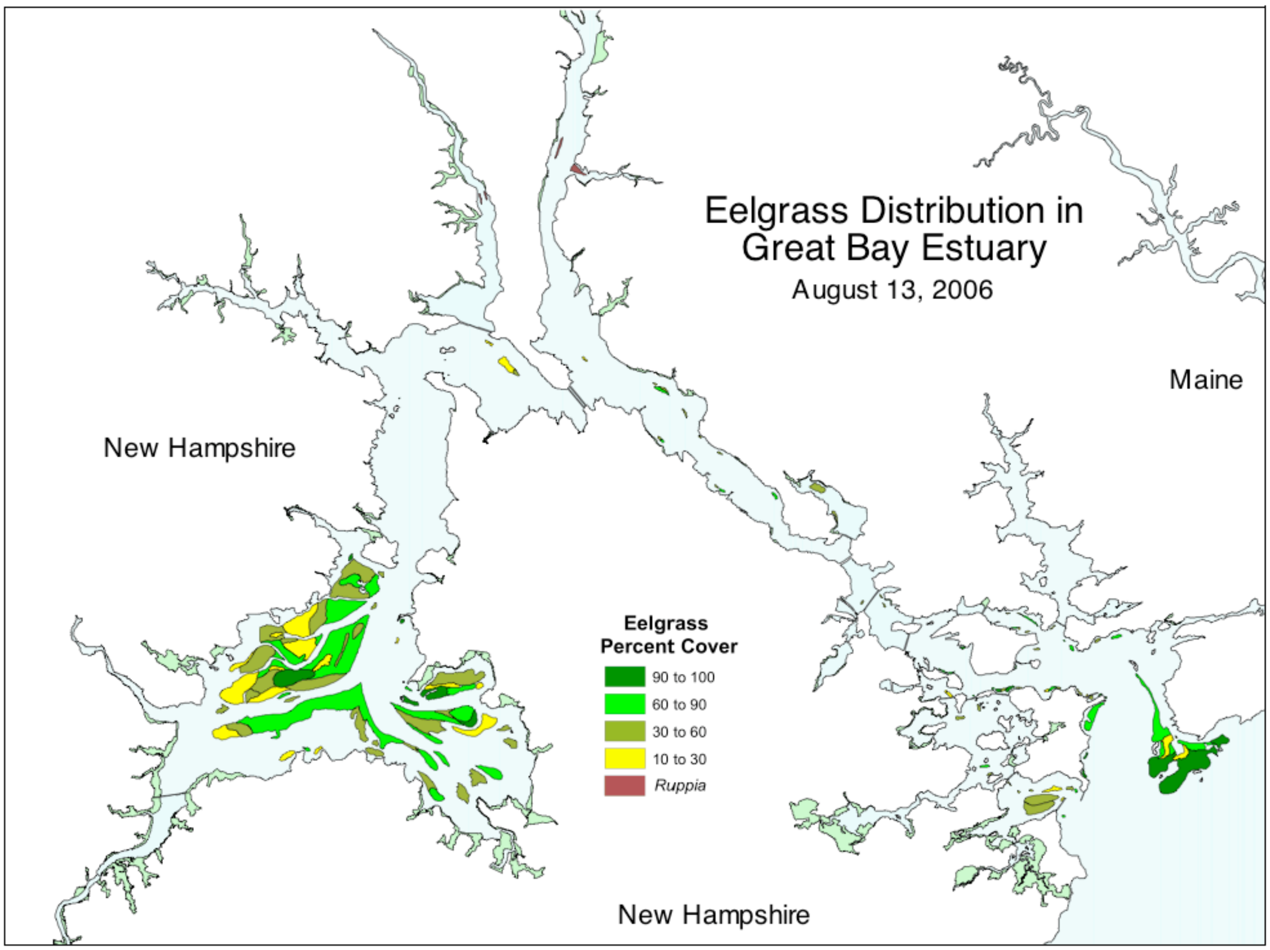
Eelgrass cover below 10% cannot be detected in the aerial photography.

In 2006, eelgrass (Figure 1) further decreased in the Great Bay Estuary. Eelgrass has disappeared throughout much of its historic range in the estuary: large areas of the estuary that historically supported eelgrass currently do not, including Little Bay and the Piscataqua River. The estuary has lost 47% of its eelgrass since 1996. The overall loss of eelgrass in the estuary is indicative of poor water quality conditions.

Specifically, eelgrass cover in ***Great Bay itself declined 43%*** from 2005 to 2006. Since the peak eelgrass year of 1996, eelgrass percent cover in Great Bay has declined 49%. Great Bay showed an overall decline in eelgrass biomass of 46%, due predominantly to an overall reduction in high eelgrass cover class (90-100%) areas. The central part of Great Bay showed little change in eelgrass distribution between 2005 and 2006, while biomass decreased overall. In the northwest part of the Bay, near Adams Point, there was a similar pattern, with a decrease in biomass and little change in distribution. On the western side of Great Bay, both biomass and distribution changed little between 2005 and 2006, although there were some new areas of low percent cover eelgrass. In the southern Bay, biomass and distribution both decreased as a result of the loss of the two lower cover classes (10 – 60%) near the shore; these areas have been taken over by macroalgae (*Ulva lactuaca* and *Gracilaria sp.*). The eelgrass bed along the eastern side of Great Bay near Thomas Point has nearly disappeared except for one patch adjacent to the point and one behind a rock outcrop. In Greenland Bay, much of the central area of eelgrass was lost from the low and moderate cover areas (10 – 60%).

In Little Bay and the Piscataqua River combined, there was a 40% loss of eelgrass cover from 2005 to 2006, down 71% from the peak year of 1996. In Little Bay between 2005 and 2006, there was a decrease in area and percent cover in the eelgrass beds off Dover Point. The small eelgrass bed at the mouth of Broad Cove disappeared. The ruppia seen in 2005 decreased in 2006 in the Bellamy River. There was no eelgrass or ruppia present in the Oyster River in 2006. There are still large areas of Little Bay and the Bellamy River which historically supported eelgrass that remain unvegetated. The only eelgrass present in the upper Bellamy River in 2006 was transplanted that same year, and does not show on the map (Figure 1). In the Piscataqua River, both the cover and biomass of eelgrass decreased from 2005 to 2006. Ruppia was again found in the upper Piscataqua River, but in only two low-density beds compared to the three large beds seen in 2005. On the New Hampshire side of the Piscataqua River, the predominant eelgrass beds remained those restored in the 1993 – 95 New Hampshire Port Mitigation Project, although these beds are diminished in both biomass and percent cover (Beem and Short, in press). On the Maine side of the Piscataqua River, several long-standing eelgrass beds decreased between 2005 and 2006.

In Portsmouth Harbor and Little Harbor, eelgrass beds were somewhat reduced in some areas from 2005 to 2006. Parts of upper Portsmouth Harbor, near the Mildred Long Bridge, lost eelgrass cover and biomass. The eelgrass meadows in lower Portsmouth Harbor and Little Harbor appear relatively stable. The former eelgrass meadow between Gerrish and Fishing Islands in Portsmouth Harbor remained severely impacted by continued grazing by Canada geese (Rivers and Short 2007) and is now below detection limits.



Conclusions and Recommendations

1. Increase efforts to lower nitrogen loading to the Great Bay Estuary with particular emphasis on the Piscataqua River, Little Bay, and Portsmouth Harbor.

2. Accelerate the implementation of sediment retention structures to reduce the direct sediment input to the estuary which leads to elevated turbidity.

3. Continue annual monitoring of eelgrass in the Great Bay Estuary to detect trends in eelgrass and estuarine health.

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

5. Restore eelgrass in Little Bay and the Oyster and Bellamy Rivers.

6. Conduct quantitative monitoring of the wasting disease in the Great Bay Estuary.

7. Institute best management practices in the Great Bay Estuary to reduce boating and mooring impacts to eelgrass.

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

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

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