11-3-2008

Eelgrass Distribution in the Great Bay Estuary 2007

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A Final Report to

The New Hampshire Estuaries Project

Submitted by

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November 3, 2008

This report was funded by a grant from the New Hampshire Estuaries Project, as authorized by the U.S. Environmental Protection Agency pursuant to Section 320 of the Clean Water Act.

NewHampshire EstuariesProject

Table of Contents

Executive Summary

Eelgrass has now, in 2007, almost totally disappeared from Little Bay and the Piscataqua River. Despite these critical losses in mid-estuary, eelgrass distribution in the Great Bay Estuary (GBE) as a whole between 2006 and 2007 experienced an overall loss of 3% in area because of the areal dominance of Great Bay itself, where most of the eelgrass that remains in the GBE is found. Eelgrass area in Great Bay itself remained about the same between 2006 and 2007, with an increase in biomass due to some of the remaining beds becoming more dense. However, Little Bay and the Piscataqua River experienced the loss of most of their remaining eelgrass between 2006 and 2007 (99% loss); only a few very small beds survive. The beds of ruppia in the Bellamy, Oyster and upper Piscataqua Rivers, diminished from 2005 to 2006, were gone in 2007 except for one large bed in the Bellamy River. The Portsmouth Harbor – Little Harbor area experienced a decrease in eelgrass area (11%) between 2006 and 2007. All of the Great Bay Estuary has severely decreased eelgrass beds compared to historic distributions. The ongoing eelgrass decline in Little Bay and the Piscataqua River, now best characterized as a nearly complete loss of eelgrass, continues to be a major concern; total loss of eelgrass from an area greatly diminishes the potential for natural recovery of beds.

Introduction

Eelgrass (*Zostera marina* L.) is an essential habitat for the Great Bay Estuary (GBE) because it is the basis of an estuarine food chain 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 and food, shelter for juvenile fish and shellfish, and a nursery area for fish and shellfish. Eelgrass filters estuarine waters, removing both nutrients and suspended sediments from the water column. Eelgrass in the Great Bay Estuary is a vital resource to the State's marine environment, a habitat that is essential to the health of the estuary. The present report describes and interprets the eelgrass distribution data collected in 2007 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 2008); 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 2006 mapping, a year before the mapping reported here, the Great Bay Estuary continued to experience an alarming decline in both eelgrass distribution and biomass 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 decade 1996 - 2006. Eelgrass distribution also declined in Great Bay, particularly from 2005 - 2006. In the Piscataqua River through 2006, declines in both natural and transplanted eelgrass beds were evident (Beem and Short, 2008); these declines were a combination of both loss of eelgrass biomass and loss of eelgrass distribution, with the remaining beds in 2006 those that were transplanted in the 1993 – 95 New Hampshire Port Mitigation Project. In Portsmouth Harbor and Little Harbor from 2002 - 2006, 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, but declined in distribution from 2005 to 2006. 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 – 2006 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 1999-2006 and these are now in the NHEP database. Here, I report on the eelgrass distribution and cover class information for the year 2007 in the Great Bay Estuary, based on aerial photography and ground truthing.

Project Goals and Objectives

UNH has now completed the 2007 eelgrass mapping project under contract to the NH Estuaries Project. The project goal and the objective of the contract was to map eelgrass distribution in GBE for 2007 based on aerial photography and ground truth.

The final work product is ArcInfo files of eelgrass distribution throughout the Great Bay Estuary for 2007, 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). Data on the relative position of eelgrass meadows for 2007 were augmented using hyperspectral orthophotographic images of the Great Bay (Morrison unpubl.).

Results and Discussion

The shapefiles containing the eelgrass distribution data for 2007 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.

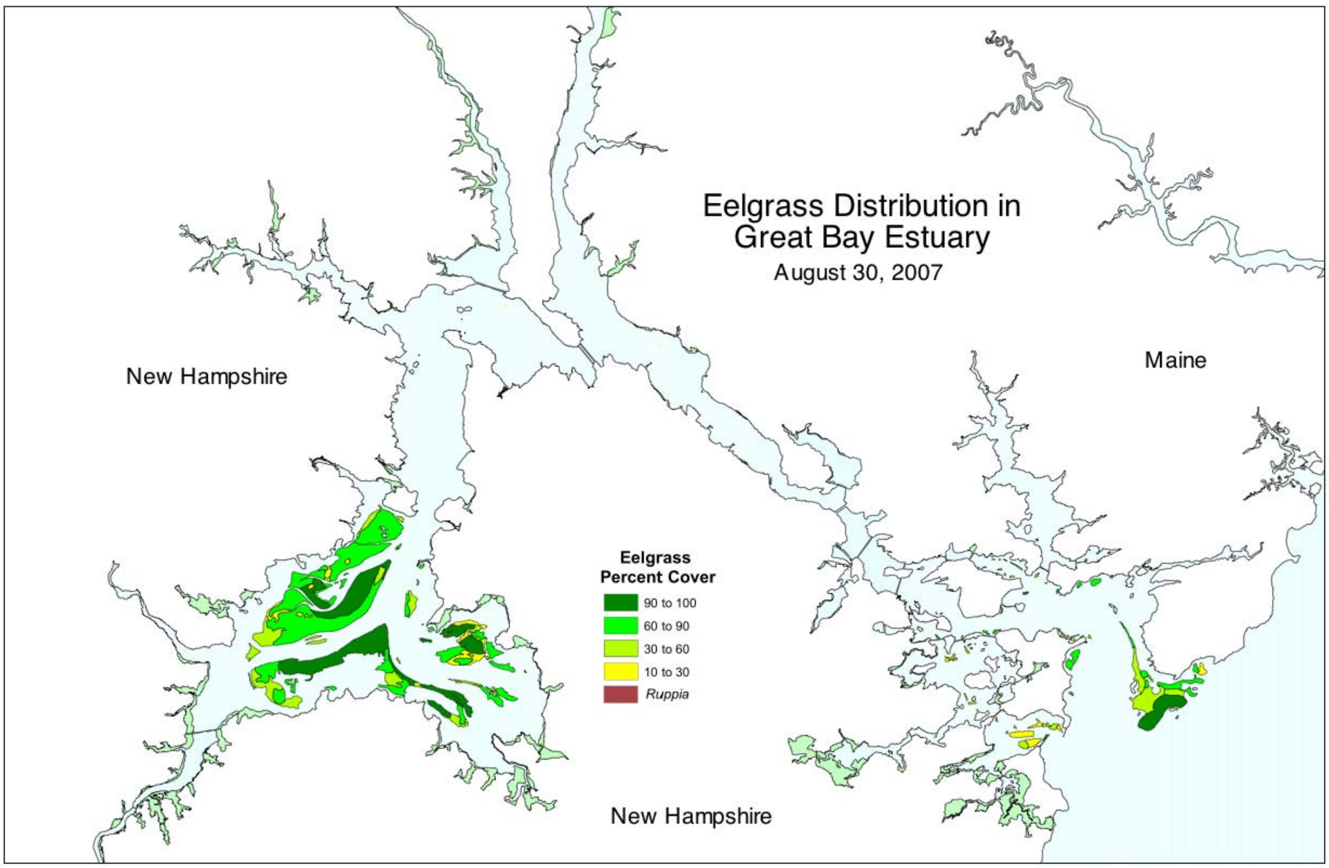
In 2007, the primary change in the Great Bay Estuary was the major loss of eelgrass in the mid-estuary region (Figure 1). There were losses of eelgrass area in Little Bay and the Piscataqua River (99% loss) and in Portsmouth and Little Harbors (11% loss). Eelgrass area in the Great Bay itself remained stable while biomass increased. Because of its large remaining intertidal eelgrass area, Great Bay dominates the areal findings for eelgrass in the estuary overall. 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 49% of its eelgrass since 1996. The overall loss of eelgrass in the estuary is indicative of poor water quality conditions, which impact deeper eelgrass beds more than intertidal beds.

Specifically, ***eelgrass cover in Great Bay itself showed little change from 2006 to 2007***. However, since the peak eelgrass year of 1996, eelgrass cover in Great Bay has declined 49%. From 2006 to 2007, some eelgrass beds in Great Bay itself increased in biomass, particularly the beds in the central bay and south bay. In the northwest part of the bay, near Adams Point, eelgrass biomass increased and there was little change in distribution. On the western side of Great Bay, biomass in nearly all cover classes increased with some loss of distribution. In the southern bay, the areas toward the shore continue to be devoid of eelgrass and dominated by the algae *Ulva lactuca* and *Gracilaria* sp. Some new eelgrass beds emerged off Sandy Point. The eastern side of Great Bay near Thomas Point had more eelgrass than in 2006, with the reestablishment of the offshore bed and expansion of the small patches near the point and the rock outcrop. In Greenland Bay, more of the central area of eelgrass was lost from the low and moderate cover areas, but eelgrass biomass increased in several of the northernmost beds.

In Little Bay and the Piscataqua River combined, there was a 99% loss of eelgrass cover from 2006 to 2007, down 99.8% from the peak year of 1996. In Little Bay between 2006 and 2007, there was a loss of all eelgrass except for one small bed off Dover Point. One of the ruppia beds seen in the Bellamy River in 2006 was lost by 2007; the other decreased. As in 2006, in 2007 there was no eelgrass or ruppia present in the Oyster River. 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 Bellamy River in 2007 was transplanted in 2006, and is too small an area to show on the map (Figure

1). In the Piscataqua River, both the cover and biomass of eelgrass decreased dramatically from 2006 to 2007, with only one eelgrass bed and one patch of eelgrass remaining on the Maine side of the river. On the New Hampshire side of the Piscataqua River, the eelgrass beds restored in the 1993 – 95 New Hampshire Port Mitigation Project are gone except for one patch of eelgrass (Beem and Short 2008). The ruppia seen in 2006 in the upper Piscataqua River was absent in 2007.

In Portsmouth Harbor and Little Harbor, there was an 11% decrease in eelgrass area from 2006 to 2007. Many of the small eelgrass beds in upper Portsmouth Harbor seaward of the Memorial Bridge, on both the New Hampshire and Maine sides, diminished or disappeared. The eelgrass meadows in lower Portsmouth Harbor and Little Harbor are all somewhat reduced in size. 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 remains below detection limits.



Conclusions and Recommendations

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

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

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

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

5. Restore eelgrass in Little Bay and the Piscataqua, 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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