Eelgrass Distribution in the Great Bay Estuary for 2008

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 in 2008 was found only in the Great Bay itself and Portsmouth Harbor. In 2008 there was a continued loss of eelgrass biomass in the Estuary. Virtually all the eelgrass in Little Bay and the Piscataqua River has died. Eelgrass in Great Bay itself experienced an increase in distribution from 2007 to 2008, primarily from the re-seeding of bare areas that had been de-vegetated by nuisance algae in previous years. However, Great Bay showed a decrease in eelgrass biomass in 2008. Portsmouth and Little Harbors experienced a slight decrease in both distribution and cover in 2008 with the offshore beds in Portsmouth Harbor showing the greatest loss. Despite the slight increase in eelgrass distribution in Great Bay Estuary due to the increased seed recruitment in Great Bay, the loss of percent cover and biomass in Great Bay and in Portsmouth Harbor again this year (2007 – 2008) indicates the continuing adverse water quality conditions in the Estuary. Overall, the Estuary has lost 66% of its eelgrass biomass since 1996, a continuing and alarming trend of environmental decline.

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, as well as food, nursery habitat, and shelter for juvenile 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 of New Hampshire's marine environment, a habitat that is essential to the health of the estuary (Trowbridge 2006, Short 2007). The present report describes and interprets the eelgrass distribution data collected in 2008 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 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) and declining biomass (Beem and Short 2009); 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 2007 mapping, a year before the mapping of eelgrass distribution and cover reported here, eelgrass in the Great Bay Estuary remained at very low levels except in Great Bay itself. By 2007, eelgrass had almost totally disappeared from Little Bay and the Piscataqua River. The Great Bay Estuary as a whole, between 2006 and 2007, experienced an overall loss of 3% in eelgrass 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. The Portsmouth Harbor – Little Harbor area experienced an 11% decrease in eelgrass area between 2006 and 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 2007. The beds of ruppia in the Bellamy, Oyster and upper Piscataqua Rivers were gone in 2007 except for one large bed in the Bellamy River. Although ruppia is a seagrass and provides some of the functions of an eelgrass meadow, it is an annual plant, its distribution is highly variable from year to year, and its low canopy height (less than 10 cm in these beds) creates different habitat conditions than eelgrass.

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 1999-2007 and these are now in the PREP database. Here, I report on the eelgrass distribution and cover class information for the year 2008 in the Great Bay Estuary, based on aerial photography and ground truthing.

Project Goals and Objectives

UNH has now completed the 2008 eelgrass mapping project under contract to PREP. The project goal, and the objective of the contract, was to map eelgrass distribution in GBE for 2008 based on aerial photography and ground truth.

The final work product is ArcInfo files of eelgrass distribution throughout the Great Bay Estuary for 2008, 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 for 2008 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
H = 30 to 60 % cover
SB = 60 to 90 % cover
D = 90 to 100 % cover

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

Eelgrass cover in 2008 in the Great Bay Estuary remained diminished but largely unchanged, with no evidence of recovery from the declines of the last decade (Figure 1). In 2008, Little Bay and the Piscataqua River remained virtually devoid of eelgrass with no recovery evident. In Portsmouth and Little Harbors, eelgrass distribution remained decreased slightly with some decrease in percent cover. Eelgrass in Great Bay showed a slight increase in areal distribution from 2007 due to seedling recruitment in unvegetated areas, but an overall decrease in biomass. 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. ***Since 1996, the estuary has lost 45% of its eelgrass distribution and 66% of its eelgrass biomass.*** The overall loss of eelgrass in the estuary is indicative of poor water quality conditions.

In Great Bay itself, eelgrass cover increased somewhat from 2007 to 2008 while biomass decreased. The increase in cover was due mainly to re-vegetation via seedlings in bare areas of the bay. Eelgrass cover in Great Bay is at 42% of what it was in 1996, its peak year in recent times. Overall, there was a decrease in eelgrass biomass from 2007 to 2008 in Great Bay; some eelgrass beds in the bay increased in biomass, while others lost biomass. In the northwest part of the bay, near Adams Point, there was little change in distribution but eelgrass biomass decreased due to smothering from a massive macroalgal (*Ulva* sp.) bloom. On the western side of Great Bay, eelgrass distribution remained the same; some beds increased in biomass while others decreased. In the southern bay, the areas toward the shore continued in 2008 to be devoid of eelgrass and dominated by the algae *Ulva lactuca* and *Gracilaria* sp. The eelgrass beds off Sandy Point seen in 2007 became slightly more dense in 2008 but did not change substantially in distribution. Eelgrass seedlings revegetated a large area that was open in 2007 in the southwest part of Greenland Bay. In northern Greenland Bay, the beds shifted slightly from 2007 to 2008, but overall area remained the same with a slight increase in percent cover. Along the eastern side of Great Bay near Thomas Point, eelgrass distribution in 2008 remained the same as 2007 while biomass increased.

In Little Bay and the Piscataqua River there was virtually no eelgrass in 2008. Eelgrass cover in 2008 was down 99.9% from the peak year of 1996. No evidence of eelgrass or ruppia was seen from aerial surveys or photography. Ground truth efforts revealed <u>less than one square meter</u> of eelgrass in this entire section of the estuary except for the restored bed in the Bellamy River. All of the eelgrass transplanted for the NH Port Mitigation Project of 1993-95 has been lost (Beem and Short 2009). The loss of eelgrass in Little Bay and the Piscataqua River represents a decrease of 318 acres since the 1981 historical map, a severe loss of habitat and of the critical connecting corridor of

vegetation between Great Bay and Portsmouth Harbor. The only eelgrass present in the Bellamy River in 2008 was transplanted in 2006, and persists at cover too low to map. Small areas of ruppia were seen in the upper Bellamy River in 2008 in the vicinity of the eelgrass transplanting, but no ruppia remains in the Upper Piscataqua or Oyster Rivers.

In Portsmouth Harbor and Little Harbor, eelgrass distribution in 2008 decreased slightly, as did percent cover. The small eelgrass beds in upper Portsmouth Harbor seaward of the Memorial Bridge on both the New Hampshire and Maine sides, lost between 2006 and 2007, have not re-appeared. The eelgrass meadows in lower Portsmouth Harbor and Little Harbor decreased slightly in size from 2007 accompanied by some loss of biomass. The former eelgrass meadow between Gerrish and Fishing Islands in Portsmouth Harbor continued to be severely impacted by Canada goose grazing (Rivers and Short 2007) and remains below detection limits. The decreased percent cover in the most offshore beds (at the mouth of Portsmouth Harbor) is responsible for most of the reduced percent cover in this part of the estuary.

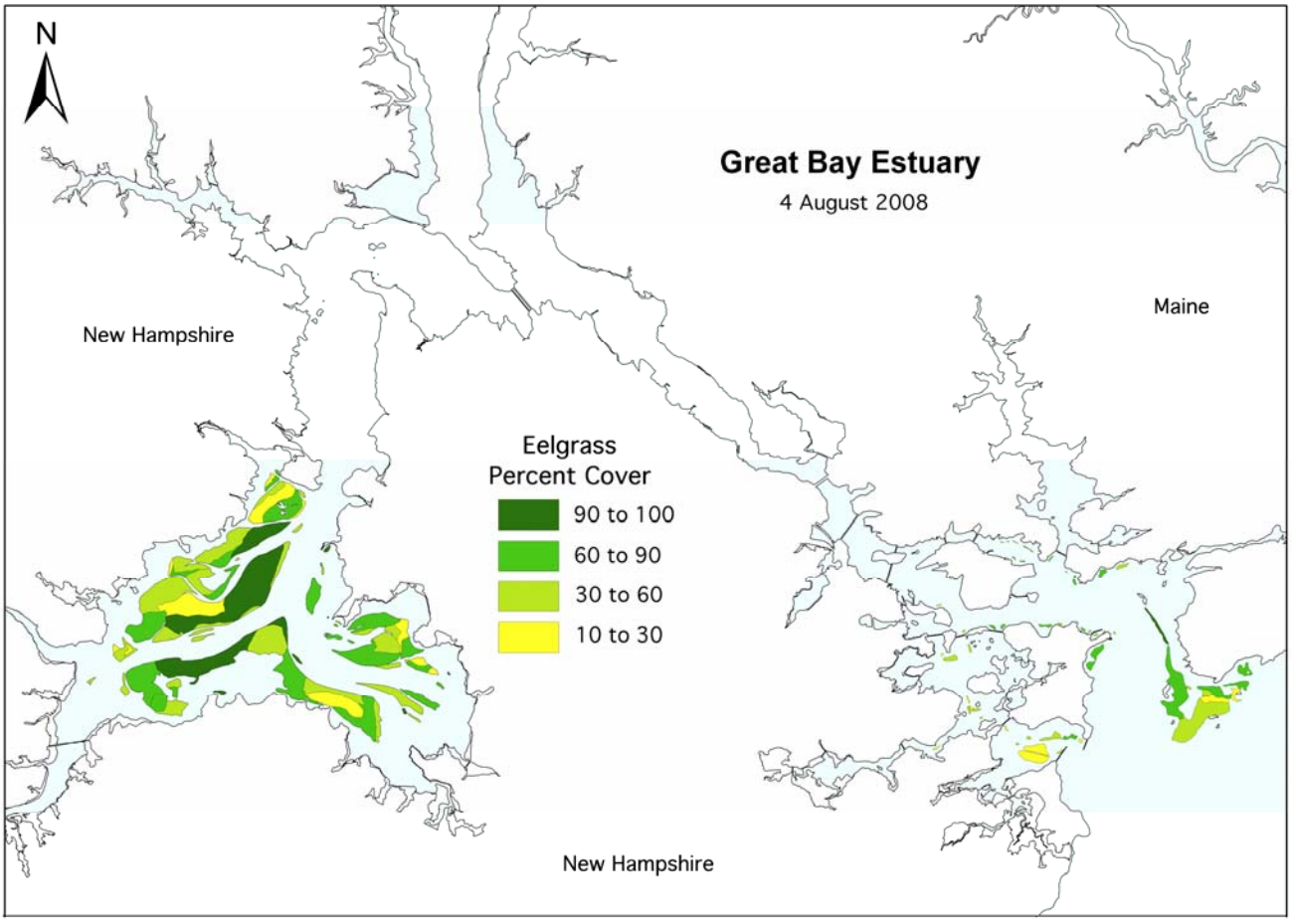

Figure 1. Eelgrass distribution for the Great Bay Estuary based on aerial photography from 4 August 2008.

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 itself 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 improved.

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

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