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Eelgrass Distribution in the Great Bay Estuary 2005

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A Final Report to

The New Hampshire Estuaries Project

Submitted by

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NewHampshire EstuariesProject

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Introduction

Eelgrass (*Zostera marina*) is an essential habitat for the Great Bay Estuary (GBE) because it provides food for wintering waterfowl and habitat for juvenile fish and shellfish. Eelgrass is the basis of an estuarine food chain that supports many of the recreationally, commercially and ecologically important species in the estuary. Additionally, 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. The present report describes and interprets the eelgrass distribution data collected in 2005 for the Great Bay Estuary.

The Great Bay Estuary is experiencing an alarming decline in both eelgrass biomass and distribution that appears to be related to the declining water clarity of the estuary. Eelgrass biomass in Great Bay itself (grams of eelgrass per meter square) has declined steadily (Trowbridge 2006) over the past decade, although the distribution has been relatively constant in Great Bay for the past 10 years at approximately 2,000 acres. In the Piscataqua River, recent declines in both natural and transplanted eelgrass beds are now evident (Short and Beem, in prep) and are a combination of both loss of biomass and loss of distribution. In Portsmouth Harbor in the past 3 years, eelgrass has receded at the deep edge of the meadows, creating an overall loss of distribution which has been accompanied by losses in biomass (Rivers 2007).

In this study, we refer to eelgrass biomass as measured by percent cover, i.e., the percent of the bottom which is vegetated with eelgrass. Biomass is determined through a regression of field-measured biomass and field-measured percent cover. The percent cover map from the aerial distribution can then be converted to biomass (g dry weight eelgrass m^{-2}).

For the first time, *Ruppia maritima* (called here by its common name, ruppia) was observed in large beds in several of the tributaries of GBE, both in aerial photographs and while ground truthing. Therefore, ruppia has been added as an element of the seagrass distribution maps. 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. It is mapped in 2005 for the first time because it appeared in large beds in parts of the tributaries where eelgrass could be expected. Ruppia occurs as both an annual and perennial plant, and the persistence of these beds is impossible to predict. 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". More recently, the greatest extent of eelgrass in the GBE was observed in 1996 after the beds had recovered from the wasting disease episode. The decline in eelgrass biomass seen over the past decade (1996 – 2006) is not a result of wasting disease, and shows all the signs of being caused by anthropogenic impacts, namely nutrient loading and sedimentation.

The University of New Hampshire provided digitized eelgrass distribution information in Great Bay Estuary for the years 1999-2001 to the NHEP database. Additionally, the 2002, 2003 and 2004 eelgrass coverages are now in the NHEP database.

In 2006, the NHEP funded annual monitoring for eelgrass in GBE. We collected aerial photography of eelgrass coverage for 2006 and mapped eelgrass distribution for 2005 from the information gathered in the summer of 2005 (aerial photography and ground truthing). Here, I report on the eelgrass distribution and cover class information for 2005 in the Great Bay Estuary.

Project Goals and Objectives

UNH has now completed the 2005 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 2005 based on aerial photography and ground truth;
(2) acquire aerial photography of the Great Bay Estuary in 2006;
(3) conduct eelgrass ground truth observations of the 2006 aerial imagery.

The final work product is ArcInfo files of eelgrass distribution throughout the Great Bay Estuary in 2005, including all necessary documentation/metadata for the ArcInfo files, and this final report describing the results and any deviations from the protocols established in the QA Project Plan.

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 and ruppia distribution data were 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
G [or SB] = 60 to 90 % cover
D = 90 to 100 % cover
R = Ruppia

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

In 2005, eelgrass biomass (shown as percent cover on Figure 1) decreased in the Great Bay Estuary while eelgrass distribution increased slightly. Eelgrass was present throughout much of its expected range in the estuary, although there are still large areas of the estuary that historically supported eelgrass and currently do not, including Little Bay, the Piscataqua River, and parts of Portsmouth Harbor and Little Harbor. Despite a few increases in low biomass eelgrass bed distribution in the upper estuary, the continued decrease in eelgrass biomass in the estuary overall is indicative of poor water quality conditions.

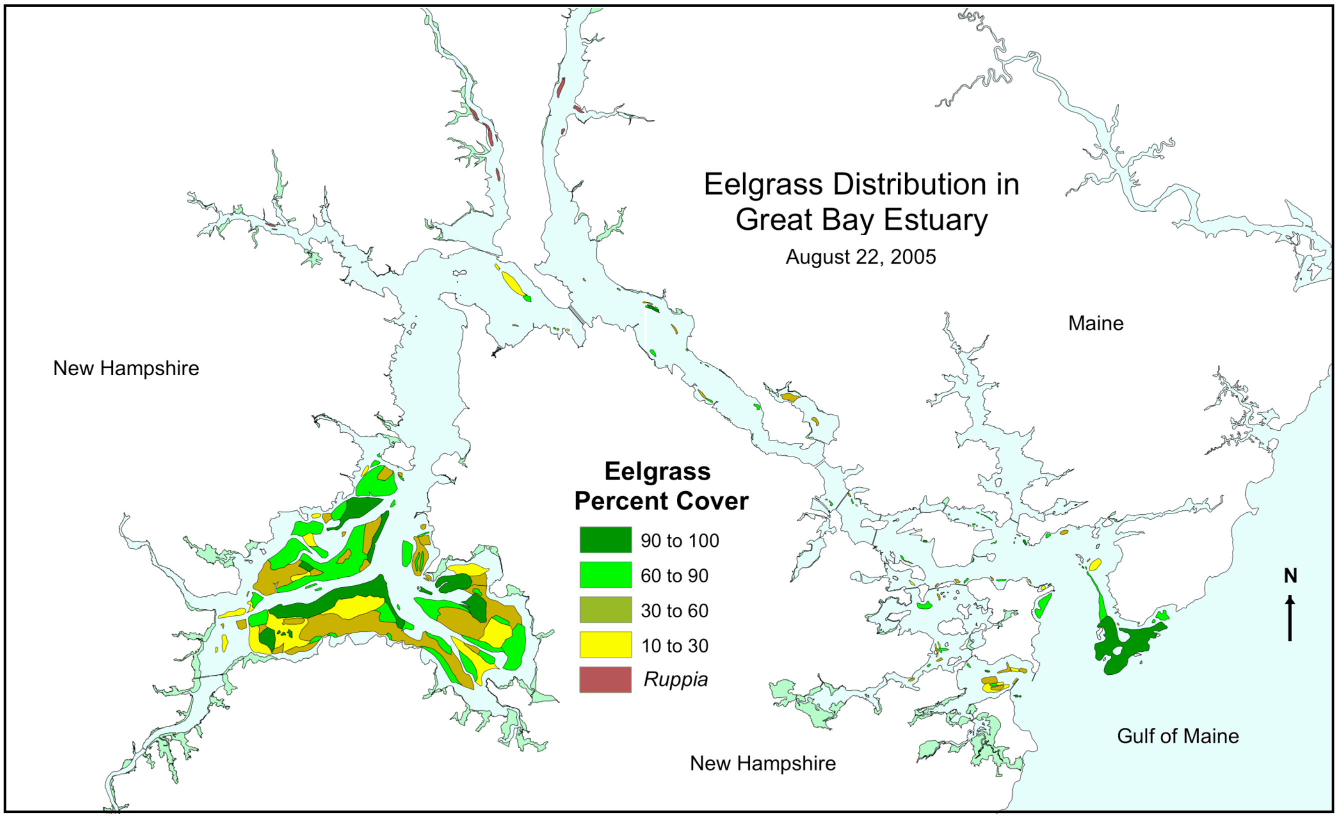
Eelgrass in the central part of Great Bay showed little change in distribution between 2004 and 2005, while biomass decreased overall. In the northwest part of the Bay, near Adams Point, there was a similar pattern, with a decrease in biomass and little change in distribution. On the western side of Great Bay, both biomass and distribution changed little between 2004 and 2005. In the southern Bay, biomass and distribution are little changed overall. The eelgrass bed along the eastern side of Great Bay near Thomas Point lost area but increased in biomass, while in Greenland Bay, eelgrass area increased and biomass remained the same or increased slightly. Most likely, the increase seen in Greenland Bay was present in 2004 as low-density seedlings which were not detectable until 2005 when they were mature plants.

In Little Bay between 2004 and 2005, there was a shift in the eelgrass beds off Dover Point, with an increase of patchy eelgrass and formation of a new bed along the channel. Overall, Little Bay showed some increases in eelgrass biomass or total distribution. There were patches of ruppia in both the Oyster and Bellamy Rivers; these were large, fairly low-biomass patches. There was no eelgrass 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 single patchy eelgrass bed in the upper Bellamy River present in 2004 was not present in 2005.

In the upper Piscataqua River, both the cover and biomass of eelgrass decreased from 2004 to 2005. The two new eelgrass beds seen in 2003 on the Maine side of the river across from the General Sullivan Bridge disappeared in 2005. Ruppia was found in the upper Piscataqua in three large, low-density beds. 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. These restored eelgrass beds remained roughly the same from 2004 to 2005 in area, although biomass further decreased.

In Portsmouth Harbor and Little Harbor, some eelgrass beds increased in biomass while others decreased. Overall, there was a loss of eelgrass biomass while area increased slightly. Some losses of biomass and distribution were evident around the Coast Guard station. The eelgrass meadow between Gerrish and Fishing Islands in Portsmouth Harbor remained severely impacted by continued grazing by Canada geese (Rivers and Short 2007). The offshore eelgrass bed southwest of Gerrish Island decreased in biomass while remaining approximately the same size.

For all the areas surveyed in 2005, only Great Bay itself retained eelgrass distributions similar to historic levels, although eelgrass biomass in Great Bay was much lower than seen historically. Eelgrass in Great Bay decreased somewhat between 2004 and 2005, due to losses in biomass, even with gains in distribution. Little Bay showed little change (some increase in area but steady biomass) between 2004 and 2005, with very low levels of eelgrass compared to historical distributions but appearance of large beds of ruppia in the Bellamy River. In the Piscataqua River, an overall decrease was apparent in 2005. The Portsmouth Harbor area experienced a slight increase in eelgrass biomass. Overall, eelgrass in 2005 in the Great Bay Estuary was slightly decreased in biomass and slightly increased in extent, although not consistently throughout the estuary. All of the Great Bay Estuary has decreased eelgrass beds compared to historic distributions (especially in Little Bay and the Piscataqua River), with average biomass levels lower than seen historically.


Eelgrass Distribution in
Great Bay Estuary
August 22, 2005
New Hampshire
Maine
Eelgrass
Percent Cover
90 to 100
60 to 90
30 to 60
10 to 30
Ruppia
N
New Hampshire
Gulf of Maine

Conclusions and Recommendations

1. Increase efforts to lower nitrogen loading to the Great Bay Estuary with particular emphasis on Portsmouth Harbor and the Piscataqua River.
2. Accelerate the implementation of sediment retention structures to reduce the direct sediment input which leads to elevated turbidity in the estuary.
3. Continue annual monitoring of eelgrass in the Great Bay Estuary.
4. Determine the cause of long-term loss of eelgrass percent cover in Great Bay itself and throughout the Estuary.
5. Update the conversion of eelgrass percent cover to biomass through field surveys.
6. Restore eelgrass in Little Bay and the Oyster and Bellamy Rivers.
7. Conduct quantitative monitoring of the wasting disease in the Great Bay Estuary.
8. Institute best management practices in the Great Bay Estuary to reduce boating and mooring impacts to eelgrass.
9. Create an improved map of potential eelgrass habitat for the Great Bay Estuary.
10. Avoid both actual and potential eelgrass habitat when siting other restoration activities or boat moorings and docks in the estuary.

References

Rivers, D.O. 2007. Assessing the suitability of the eelgrass (*Zostera marina* L.) deep edge as an indicator for light reduction in estuarine systems. MS thesis, UNH. 166p.

Rivers, D.O. and F.T. Short. 2007. Impact of grazing by Canada geese (*Branta canadensis*) on an eelgrass (*Zostera marina* L.) meadow, New Hampshire, USA. Marine Ecology Progress Series. 333: 271–279.

Short, F. and N. Beem. unpublished. Eelgrass in the Great Bay Estuary: recent declines of concern, JEL, UNH. May 2007

Short, F. and P. Trowbridge. 2003. UNH Eelgrass Monitoring Program, Quality Assurance Project Plan, Version 1, Final. University of New Hampshire and NH Estuaries Project, June 30, 2003.

Trowbridge, P. 2006. State of the Estuaries. New Hampshire Estuaries Program, Durham, NH. 32p.