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Macroalgae and Eelgrass Mapping in Great Bay Estuary Using AISA Hyperspectral Imagery.

Shachak Pe'eri
University of New Hampshire, Durham, shachak.peeri@unh.edu

John RU Morrison
University of New Hampshire, Durham

Frederick T. Short
University of New Hampshire, Jackson Estuarine Laboratory

Arthur C. Mathieson
University of New Hampshire

Phil Trowbridge
New Hampshire Department of Environmental Services

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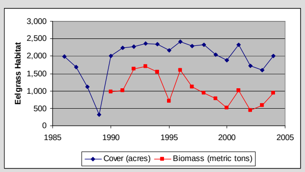
Shachak Pe'eri[1] (shachak@ccom.unh.edu), John R. Morrison[2], Frederick Short[3], Arthur Mathieson[3], Philip Trowbridge[4]

[1]Center for Coastal and Ocean Mapping, University of New Hampshire
[2]Ocean Process Analysis Laboratory, University of New Hampshire
[3]Jackson Estuary Laboratory, University of New Hampshire, Durham, NH 03824
[4]N.H. Dept. of Environmental Services, Concord, NH 03302

Abstract

Results Increases in nitrogen concentration and declining eelgrass beds in Great Bay Estuary have been observed in the last decades. These two parameters are clear indicators of the impending eutrophication for New Hampshire's estuaries. The NH Department of Environmental Services (DES) in collaboration with the Piscataqua Region Estuaries Partnership adopted the assumption that eelgrass survival can be used as the target for establishing numeric water quality criteria for nutrients in NH's estuaries. One of the hypotheses put forward regarding eelgrass decline is that an eutrophication response to nutrient increases in the Great Bay Estuary has been the proliferation of nuisance macroalgae, which has reduced eelgrass area in Great Bay Estuary. To determine the extent of this effect, mapping of eelgrass and nuisance macroalgae beds using hyperspectral imagery was suggested. A hyperspectral image was made by SpecTIR in August 2007 using an AISA Eagle sensor. The collected dataset was then used to map eelgrass and nuisance macroalgae throughout the Great Bay Estuary. Here we outline the procedure for mapping the macroalgae and eelgrass beds. Hyperspectral imagery was effective where known spectral signatures could be easily identified. Comprehensive eelgrass and macroalgae maps of the estuary could only be produced by combining hyperspectral imagery with ground-truth information and expert opinion. Macroalgae was predominantly located in areas where eelgrass formerly existed. Macroalgae mats have now replaced nearly 9% of the area formerly occupied by eelgrass in Great Bay.

Eelgrass in GBE

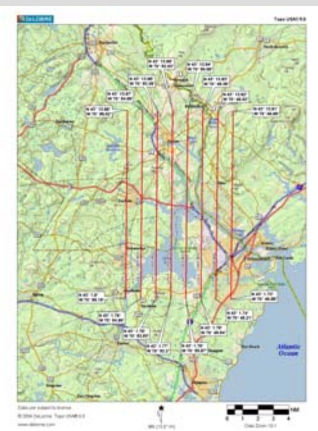


The eelgrass (*Zostera marina*) in GBE is an essential habitat because it provides food for wintering waterfowl and habitat for juvenile fish and shellfish. The eelgrass beds in Great Bay serve as sediment traps and help stabilize bottom sediments. Additionally, eelgrass filters estuarine waters, removing both nutrients and suspended sediments from the water column. Recent decline of eelgrass biomass in the intertidal portions of the estuary has also been linked to nitrogen enrichment and proliferation of nuisance macroalgae

GBE Hyperspectral Survey 2007

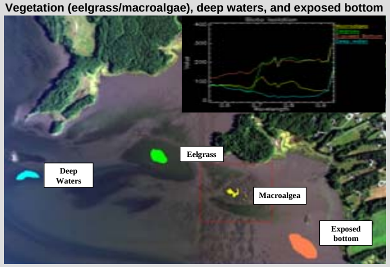
Ahyperspectral mission using a AISA Eagle sensor. The survey was conducted by SpecTIR and was flown on August 29 from 08:00 to 09:30 local time (12:00 to 13:30 GMT) over GBE.

Eight lines oriented approximately north-south with a 30% overlap were collected in each survey with a ground resolution of 2.5 m.

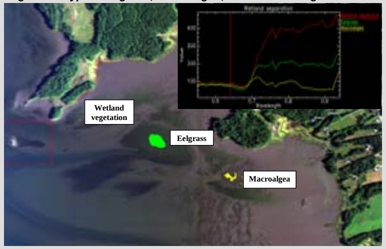


End-members

Vegetation (eelgrass/macroalgae), deep waters, and exposed bottom

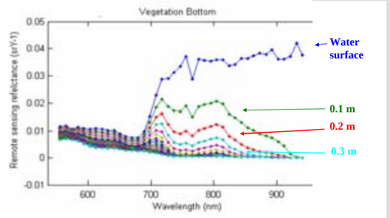


Vegetation types: eelgrass, macroalgae, and wetland vegetation



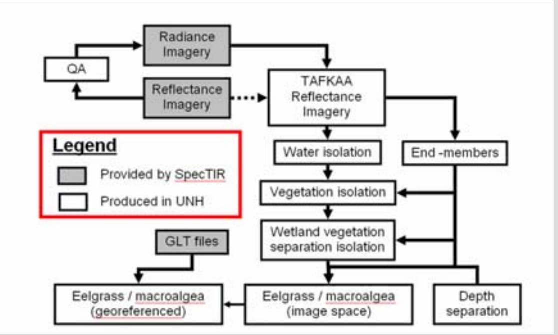
A spectra collected from a hyperspectral dataset that represents a spectrally "pure" feature is defined as a spectral end-member. Regions of Interest (ROI) containing similar underwater features were identified and spectral signature (spectral value as a function of wavelength) for each ROI.

Water attenuation



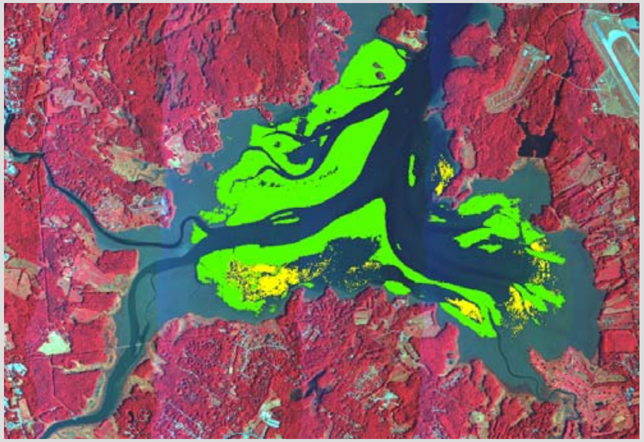
In natural environments the spectral signature from the seafloor is often complicated due to the water-column attenuation. Both the water column and bottom contribute to the water-leaving radiance with their relative contributions being modulated by water depth. The attenuation changes as a function of wavelength.

Flow Chart of the Mapping Procedure



Flow chart for eelgrass and macroalgea mapping using the AISA hyperspectral dataset.

Results



Eelgrass (green) and macroalgea (yellow) distribution overlaid on the survey project mosaic.

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